Standard Treatment Guidelines and Essential Medicines List for South Africa

PAEDIATRIC HOSPITAL LEVEL
2023 EDITION

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- https://knowledgehub.health.gov.za/content/standard-treatment-guidelines-and-essential-medicines-list

Additionally, the updated Paediatric Standard Treatment Guidelines and Essential Medicines List can be access from the "EMGuidance mobile application. This mobile application can be downloaded on android, IOS and windows operating systems, from the relevant app stores.

Note:
The information presented in these guidelines conforms to the current medical, nursing and pharmaceutical practice. Contributors and editors cannot be held responsible for errors, individual responses to drugs and other consequences.

Produced by: The National Department of Health, Pretoria, South Africa

FOREWORD

"Investing in children is one of the most important things a society can do to build a better future" – World Health Organization

The children of South Africa are our future, they will be driving the success of the country as they become adults. Good healthcare in childhood is the foundation on which a healthy life is developed, fundamental for the mental, social, emotional and physical development of children as they grow into functional adults. Children form a distinctive population, with unique treatment and patient care requirements. This vulnerable population group should be considered differently to adults in order to appropriately meet needs.

The National Department of Health has brought together the country's leading experts in paediatric healthcare to develop treatment guidelines reflective of the ever-changing needs of our children. The Paediatric Hospital Level Standard Treatment Guidelines (STGs) and Essential Medicines List (EML) aim to provide equitable access to good quality healthcare for all children, a vital element of universal healthcare that South Africa is striving for through the implementation of National Health Insurance.

I am proud to present the 5th version of the Paediatric Hospital Level STGs. This latest edition of the Paediatric Hospital Level STGs and EML is a culmination of many efforts from a broad range of experts, and we are thankful to all those who participated in the review process. The review of the STGs and EML is a dynamic process. We thus encourage the continued engagement, feedback, and collaboration from all healthcare stakeholders to ensure continued quality care for our children.

It is our hope that healthcare workers will continue to make use of the STGs and EML in their endeavors in providing quality care to the children of South Africa.

DR MJ PHAAHLA, MP

MINISTER OF HEALTH

DATE: 20 July 2023

INTRODUCTION

The COVID-19 pandemic had a profound impact on health systems across the world. Access and availability of health services were limited and care to children, one of the most vulnerable populations, was negatively impacted. The latest emerging evidence on the treatment and care of children with COVID-19 was evaluated and a section dedicated to management of COVID-19 was added to the Infectious Diseases Chapter of the Paediatric Standard Treatment Guidelines.

The National Department of Health would like to thank the wide range of experts that provided inputs into these guidelines as part of the Paediatric Hospital Level Expert Review Committee. The dedication of these individuals through the COVID-19 pandemic, when virtual meetings between increased clinical responsibilities became the norm, is highly appreciated. In addition, we would like to thank the members of the National Essential Medicines List Committee and all external stakeholders who provided feedback.

The fifth version of the Paediatric Hospital Level Standard Treatment Guidelines and Essential Medicines List has been enhanced through the improvement in methodology and rigor of decision-making. Expansion of chapters such as those addressing Palliative Care and Intensive Care was enabled through consultation with key experts in these areas.

It is my pleasure to present to you the fifth edition of the Paediatric Hospital Level Standard Treatment Guidelines and Essential Medicines List.

DR SSS BUTHELEZI

DIRECTOR-GENERAL: HEALTH

DATE: 12 July 2023

ACKNOWLEDGEMENTS

Without the continued dedication of the members of the Paediatric Expert Review Committee for the Hospital Level Essential Medicines List, this edition of the Standard Treatment Guidelines and Essential Medicines List would not have been possible. The quality of this edition was further enhanced by the contribution of many doctors, pharmacists, professional societies and other health care professionals. We are humbled by the willingness to participate in the consultative peer review process. We hope that, with renewed enthusiasm, future editions will benefit from your contributions.

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THE ESSENTIAL MEDICINES CONCEPT

The World Health Organization (WHO) describes essential medicines as those that satisfy the priority health care needs of the population. Essential medicines are intended to be available within the context of functioning health systems at all times in adequate quantities, in the appropriate dosage forms, with assured quality and adequate information, and at a price the individual and the community can afford.

The concept of essential medicines is forward-looking. It incorporates the need to regularly update medicines selections to:

» reflect new therapeutic options and changing therapeutic needs;
» the need to ensure medicine quality; and
» the need for continued development of better medicines, medicines for emerging diseases, and meet changing resistance patterns.

Effective health care requires a judicious balance between preventive and curative services. A crucial and often deficient element in curative services is an adequate supply of appropriate medicines. In the health objectives of the National Drug Policy, the government of South Africa clearly outlines its commitment to ensuring availability and accessibility of medicines for all people. These are as follows:

» To ensure the availability and accessibility of essential medicines to all citizens.
» To ensure the safety, efficacy and quality of drugs.
» To ensure good prescribing and dispensing practices.
» To promote the rational use of drugs by prescribers, dispensers and patients through provision of the necessary training, education and information.
» To promote the concept of individual responsibility for health, preventive care and informed decision-making.

Achieving these objectives requires a comprehensive strategy that not only includes improved supply and distribution, but also appropriate and extensive human resource development.

The Essential Drugs Programme (EDP) forms an integral part of this strategy. Essential medicines are selected with due regard to disease prevalence, evidence on efficacy and safety, and comparative cost.

The implementation of the concept of essential medicines is intended to be flexible and adaptable to different and changing situations.

HOW TO USE THIS BOOK

Principles

The National Drug Policy makes provision for an Essential Drugs Programme (EDP), which is a key component in promoting rational medicines use.

Each treatment guideline in the Paediatric Hospital Level Standard Treatment Guidelines (STGs) and Essential Medicines List (EML) has been designed as a progression in care from the current Primary Health Care (PHC) STGs and EML. In addition, where a referral is recommended, the relevant medicines have either been reviewed and included in the tertiary level EML, or are in the process of being reviewed.

The STGs serve as a standard for practice, but do not replace sound clinical judgment. It is important to remember that the recommended treatments provided in this book are guidelines only, and are based on the assumption that prescribers are competent to handle patients with the relevant conditions presenting to their facilities.

All reasonable steps have been taken to align the STGs with Department of Health guidelines that were available at the time of review. A medicine is included or removed from the list using an evidence based medicine review of safety and effectiveness, followed by consideration of cost and other relevant practice factors.

The EML has been developed down to generic or International Non-propriety Name (INN) level. It is anticipated that each Province will review the EML and prevailing tenders to compile a formulary which:

» lists formulations and pack sizes that will facilitate care in alignment with the STG;
» selects the preferred member of the therapeutic class based on cost;
» Implements formulary restrictions consistent with the local environment; and
» provides information regarding the prices of medicines.

Therapeutic classes are designated in the "Medicine treatment" section of the STGs which provides a class of medicines followed by example such as, topical retinoid e.g. tretinoin. These therapeutic classes have been designated where none of the members of the class offers a significant benefit over the other registered members of the class. It is anticipated that by limiting the listing to a class there is increased competition and hence an improved chance of obtaining the best possible price in the tender process. In circumstances where you encounter such a class always, consult the local formulary to identify the example that has been approved for use in your facility.

The perspective adopted is that of a competent medical officer practicing in a public sector hospital. As such, the STGs serve as a standard for practice but do not replace sound clinical judgment.

Navigating the book

It is important that you become familiar with the contents and layout of the book in order to use the STGs effectively.

Where relevant this book is consistent with the Standard Treatment Guidelines for Primary Health Care, Integrated Management of Childhood Illness Strategy (IMCI) guidelines and other National Programme Guidelines.

The ICD-10 number, included with the conditions, refers to an international classification method used when describing certain diseases and conditions. A brief description and diagnostic criteria are included to assist the medical officer to make a diagnosis. These guidelines also make provision for referral of patients with more complex and uncommon conditions to facilities with the resources for further investigation and management. The dosing regimens provide the recommended doses used in usual circumstances however, the final dose should take into consideration capacity to eliminate the medicine, interactions and comorbid states.

It is important to remember that the recommended treatments provided in this book are guidelines only and are based on the assumption that prescribers are competent to handle patients' health conditions presented at their facilities.

The STGs are arranged into chapters according to the organ systems of the body. Conditions and medicines are cross-referenced in two separate indexes of the book. In some therapeutic areas that are not easily amenable to the

development of a STG, the section is limited to a list of medicines.

The Paediatric Hospital Level STGs and EML provides additional information regarding Patient Adherence in Chronic Conditions, Measuring Medication Level and Prescription Writing. The section on Patient Education in Chronic Conditions aims to assist health workers to improve patient adherence and health, generally.

Furthermore, to promote transparency, in this fourth edition, revisions are accompanied by the level of evidence that is cited and hyperlinked accordingly. All evidence is graded according to the Strength of Recommendation Taxonomy (SORT) (a patient-centered approach to grading evidence in the medical literature).

Finally, the guidelines make provision for referral of patients with more complex and uncommon conditions to facilities with the resources for further investigation and management.

Medicines Safety

Provincial and local Pharmaceutical and Therapeutics Committees (PTCs) should develop medicines safety systems to obtain information regarding medication errors, prevalence and importance of adverse medicine events, interactions and medicines quality. These systems should not only support the regulatory pharmacovigilance plan but should also provide pharmacoepidemiology data that will be required to inform future essential medicines decisions as well as local interventions that may be required to improve safety.

In accordance with the South African Health Products Regulatory Authority's (SAHPRA) guidance on reporting adverse drug reactions in South Africa, all healthcare professionals, including doctors, dentists, pharmacists, nurses and other healthcare professionals, patients, caregivers and representatives of the patient (e.g., lawyer) are encouraged to report all suspected adverse reactions to medicines. (see page xl: Guidelines for adverse drug reaction reporting.

Feedback

Comments that aim to improve these treatment guidelines will be appreciated. The submission form and guidelines for completing the form are included in the book. Motivations will only be accepted from the Provincial PTC.

MEASURING MEDICATION LEVELS

Potentially toxic medicines, medicines with narrow therapeutic indices and those with variable pharmacokinetics should be monitored to optimise dosing, obtain maximum therapeutic effect, limit toxicity and assess compliance.

Routine measurement is rarely warranted, but rather should be tailored to answering a specific clinical question, and is of most value in medicines with a narrow therapeutic index or where there is considerable individual variation in pharmacokinetics.

Aminoglycosides

Peak levels will be adequate if dosing is adequate. Trough levels taken immediately before the next dose are valuable in identifying potential toxicity before it manifests as deafness or renal impairment. Aminoglycosides are contraindicated in renal impairment.

Anti-epileptics

Levels may be helpful to confirm poor adherence or to confirm a clinical suspicion of toxicity. Routine measurement in patients with well controlled seizures and no clinical evidence of toxicity is not appropriate. Individual levels may be difficult to interpret - if in doubt, seek assistance from a clinical pharmacokineticist.

Therapeutic Drug Level Monitoring

Guidance on therapeutic drug level monitoring has been added to this edition of the Paediatric Hospital Level STGs and EML in certain indications requiring vancomycin and gentamycin.

PRESCRIPTION WRITING

Medicines should be prescribed only when they are necessary for treatments following clear diagnosis. Not all patients or conditions need prescriptions for medicine. In certain conditions simple advice and general and supportive measures may be more suitable. In all cases, carefully consider the expected benefit of a prescribed medication against potential risks.

All prescriptions should:

- be written legibly in ink by the prescriber with the full name and
- address of the patient, and signed with the date on the prescription form;
- specify the age and, in the case of children, weight of the patient;
- signature of prescriber and practice/prescriber number;

» have contact details of the prescriber e.g.name and telephone number.

In all **prescription writing the following should be noted:**

» The name of the medicine or preparation should be written in full using the generic name.
» No abbreviations should be used, due to the risk of misinterpretation.
» Avoid the Greek mu (μ): write mcg as an abbreviation for micrograms.
» Avoid unnecessary use of decimal points and only use where decimal points are unavoidable. A zero should be written in front of the decimal point where there is no other figure, e.g. 2 mg not 2.0 mg or 0.5 mL and not .5 mL.
» Frequency: Avoid Greek and Roman frequency abbreviations that cause considerable confusion (qid, qod, tds, tid, etc.). Instead, either state the frequency in terms of hours (e.g. 8 hourly) or times per day in numerals (e.g. 3 times daily).
» State the treatment regimen in full:
  - medicine name and strength,
  - route,
  - dose or dosage,
  - dose frequency,
  - duration of treatment,

  e.g., amoxicillin, oral, 250 mg 8 hourly for 5 days.
» In the case of 'as required', a minimum dose interval should be specified, e.g. every 4 hours as required.
» Most monthly outpatient scripts for chronic medication are for 28 days; check that the patient will be able to access a repeat before the 28 days are completed.
» After writing a script, check that the dose, dose units, route, frequency, and duration for each item is stated. Consider whether the number of items is too great to be practical for the patient, and check that there are no redundant items or potentially important drug interactions. Check that the script is dated and that the patient's name and folder number are on the prescription form. Only then sign the script, and provide some other way for the pharmacy staff to identify you if there are problems (print your name, use a stamp, or use your institution issued prescriber number).

A GUIDE TO PATIENT ADHERENCE IN CHRONIC CONDITIONS

Achieving health goals for chronic conditions such as asthma, diabetes, HIV and AIDS, epilepsy, hypertension, mental health disorders and TB requires attention to:

» Adherence to long term pharmacotherapy-incomplete or non-adherence can lead to failure of an otherwise sound pharmacotherapeutic regimen.
» Organisation of health care services, which includes consideration of access to medicines and continuity of care.

Patient Adherence

Adherence is the extent to which a person's behavior-taking medication, following a diet and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider.

Poor adherence results in less than optimal management and control of the illness and is often the primary reason for suboptimal clinical benefit. It can result in medical and psychosocial complications of disease, reduced quality of life of patients, and wasted health care resources.

Poor adherence can fall into one of the following patterns where the patient:

» takes the medication very rarely (once a week or once a month);
» alternates between long periods of taking and not taking their medication e.g. after a seizure or BP reading:
» skips entire days of medication;
» skips doses of the medication;
» skips one type of medication:
» takes the medication several hours late:
» does not stick to the eating or drinking requirements of the medication:
» adheres to a purposely modified regimen; and
» adheres to an unknowingly incorrect regimen.

Adherence should be assessed on a regular basis. Although there is no gold standard, the current consensus is that a multi method approach that includes self-report be adopted such as that below.

Barriers that contribute toward poor adherence.

BARRIER	RECOMMENDED SUPPORT
Life style	
» It is often difficult to take multiple medications.	» Create a treatment plan with information on how and when to take the medications.
» A busy schedule makes it difficult to remember to take the medication.	» Use reminders such as cues that form part of the daily routine.
Attitudes and beliefs	
» The condition is misunderstood or denied.	» Remind patients that they have a long-term illness that requires their involvement.
» Treatment may not seem to be necessary.	» Use change techniques such as motivational interviewing.
» May have low expectations about treatment.	» Identify goals to demonstrate improvement/stabilisation.
Social and economic	
» May lack support at home or in the community	» Encourage participation in treatment support programs.
» May not have the economic resources to attend appointments.	» Consider down referral or reschedule appointment to fit in with other commitments.
Healthcare team related	
» Little or no time during the visit to provide information.	» Encourage patient to ask questions.
» Information may be provided in a way that is not understood.	» Use patient literacy materials in the patient's language of choice.
» Relationship with the patient may not promote understanding and self-management.	» Engage active listening.
Treatment related	
» Complex medication regimens (multiple medications and doses) can be hard to follow.	» If possible, reduce treatment complexity.
» May be discouraged if they do not feel better right away.	» Help the patient understand the condition and the role of their medication.
» May be concerned about adverse effects.	» Discus treatment goals in relation to potential adverse effects.

Although many of these recommendations require longer consultation time, this investment is rewarded many times over during the subsequent years of management.

For a patient to consistently adhere to long term pharmacotherapy requires integration of the regimen into his or her daily life style. The successful integration of the regimen is informed by the extent to which the regimen differs from his or her established daily routine. Where the pharmacological proprieties of the medication permits it, the pharmacotherapy dosing regimen should be adapted to the patient's daily routine. For example, a shift worker may need to take a sedating medicine in the morning when working night shifts, and at night, when working day shifts. If the intrusion into life style is too great, alternative agents should be considered if they are available. This would include situations such as a lunchtime dose in a school-going child who remains at school for extramural activity and is unlikely to adhere to a three times a regimen but may very well succeed with a twice-daily regimen.

Towards concordance when prescribing

Establish the patient's:

» occupation,
» daily routine,
» recreational activities,
» past experiences with other medicines, and
» expectations of therapeutic outcome.

Balance these against the therapeutic alternatives identified based on clinical findings. Any clashes between the established routine and life style with the chosen therapy should be discussed with the patient in such a manner that the patient will be motivated to a change their lifestyle.

Note:

Education that focuses on these identified problems is more likely to be successful than a generic approach toward the condition/medicine.

Education points to consider

» Focus on the positive aspects of therapy whilst being encouraging regarding the impact of the negative aspects and offer support to deal with them if they occur.
» Provide realistic expectations regarding:
    - normal progression of the Illness - especially important in those diseases where therapy merely controls the progression and those that are asymptomatic;

- the improvement that therapy and non-drug treatment can add to the quality of life.

» Establish therapeutic goals and discuss them openly with the patient.
» Any action to be taken with loss of control or when side effects develop.
» In conditions that are asymptomatic or where symptoms have been controlled, reassure the patient that this reflects therapeutic success, and not that the condition has resolved.
» Where a patient raises concern regarding anticipated side effects, attempt to place this in the correct context with respect to incidence, the risks vs. the benefits, and whether or not the side effects will disappear after continued use.

Note:
Some patient's lifestyles make certain adverse responses acceptable which others may find intolerable. Sedation is unlikely to be acceptable to a student but an older patient with insomnia may welcome this side effect. This is where concordance plays a vital role.

Notes on prescribing in chronic conditions.

» Do not change doses without good reason.
» Never blame anyone or anything for non-adherence before fully investigating the cause.
» If the clinical outcome is unsatisfactory- investigate adherence (remember side effects may be a problem here).
» Always think about side effects and screen for them from time to time.
» When prescribing a new medicine for an additional health related problem ask yourself whether this medicine is being used to manage a side effect.
» Adherence with a once daily dose is best. Twice daily regimens show agreeable adherence. However once the intervals decreased to 3 times a day there is a sharp drop in adherence with poor adherence to 4 times a day regimens.
» Keep the total number of tablets to an absolute minimum as too many may lead to medication dosing errors and may influence adherence

Improving Continuity of Therapy

» Make clear and concise records.
» Involvement the patient in the care plan.
» Every patient on chronic therapy should know:
  - his/her diagnosis,
  - the name of every medicine,
  - the dose and interval of the regimen,
  - his/her BP or other readings.

Note: The prescriber should reinforce this only once management of the condition has been established.

» When the patient seeks medical attention for any other complaints such as a cold or headache, he/she must inform that person about any other condition/disease and its management.

» If a patient indicates that he/she is unable to comply with a prescribed regimen, consider an alternative - not to treat might be one option, but be aware of the consequences e.g. ethical.

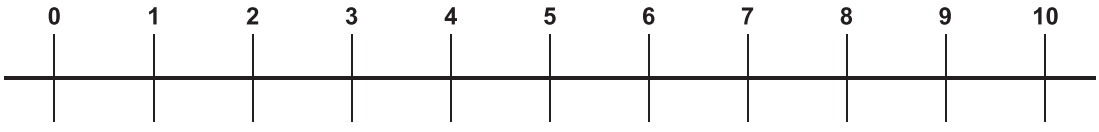
Patient Adherence Record

Folder No.	Date (dd/mm/yyyy) / /

Self-Reporting

Question	Yes	No
Do you sometimes find it difficult to remember to take your medicine?		
When you feel better, do you sometimes stop taking your medication?		
Thinking back over the past four days, have you missed any of your doses?		
Sometimes if you feel worse when you take the medicine, do you stop taking it?		

Visual Analogue Scale (VAS)



Score ____%

Pill Identification Test (PIT)

Medication	Knows the name (Y/N)	Knows the number of pills per dose (Y/N)	Time the medication is taken			Knows any additional instruction
			Morning (hour)	Evening (hour)	Considered Acceptable (Y/N)	

Pill Count

Did the client return the medication containers? Yes* No

If yes, check that the client only used medication from this container since the date of their last visit. If leftover medication had been used or an emergency prescription obtained, then the calculation will be invalid – skip to adherence assessment.

$$\text{\% Adherence} = \frac{\text{Dispensed} - \text{Returned}}{\text{Expected to be taken}} \times 100 = \frac{\square - \square}{\square} \times 100 = \square\ \%$$

Adherence Assessment

Self-reporting	Answered 'No' to all questions	Answered 'Yes' to 1 question	Answered 'Yes' to 2 or more questions
VAS	> 95%	75–94%	Less than 75%
PIT—*Client knows the…*	Dose, Time, and Instructions	Dose and Time	Dose only or confused
Pill count	> 95%	75–94%	Less than 75%
Overall Adherence	High	Moderate	Low

CHAPTER 1

EMERGENCIES AND TRAUMA

1.1 PAEDIATRIC EMERGENCIES

Certain emergencies are dealt with in the chapters on respiratory, cardiac and nervous system. This section deals only with the approach to the severely ill child and selected conditions (cardiorespiratory arrest, anaphylaxis, shock, foreign body inhalation and burns). All doctors should ensure that they can provide basic (and preferably advanced) life support to children.

> The most experienced clinician present should take control of the resuscitation.

1.1.1 TRIAGE

Early recognition of life-threatening emergencies and rapid provision of appropriate care can prevent childhood deaths and reduce associated morbidity.

Triage aims to identify those children most in need of resuscitation and emergency care. It involves the rapid examination of all sick children when they first arrive in hospital to prioritise their care. They should be reassessed regularly while awaiting definitive care.

Categories

1. Emergencies: Conditions that cannot wait and require immediate treatment.
2. Priority signs (place ahead of the normal queue).
3. Non-urgent (join the queue).

Emergencies:
Conditions that cannot wait and require immediate treatment.
If any emergency sign is present: give emergency treatment, call for help, and perform relevant emergency laboratory investigations.

(A&B) Airway and Breathing

» Not breathing

or

» Airway obstructed

or

» Central cyanosis

or

» Severe respiratory distress

(C) Circulation

» Cold hands

and

» Capillary refill ≥ 3 seconds

and

» Weak and fast pulse

(C) Coma/Convulsing

» Coma

or

» Convulsing (at the time of evaluation)

(D) Severe dehydration

Fluid loss plus any two of the following:

» Lethargy
» Sunken eyes
» Very slow skin pinch (the fold is visible for more than 2 seconds)

Priority signs (place ahead of the normal queue):

These children need prompt assessment and treatment:

» young infant (< 3 months),
» temperature very high (> 38 ºC) or very low (< 36.4 ºC),
» trauma or other urgent surgical condition,
» severe pallor,
» history of poisoning,
» severe pain,
» respiratory distress,
» restless, continuously irritable, or lethargic,
» urgent referral from another health professional,
» malnutrition: visible severe wasting,
» oedema of both feet,
» burns (major).

Non-urgent (queue):

Proceed with assessment and further treatment according to the child's priority.

A number of different triage processes exist and the above is based on the South African Emergency Triage Assessment and Treatment (ETAT).

In addition, the use of clinical markers such as respiratory rate, blood pressure and pulse rate add precision to triage.

Other important conditions may be added to the ETAT guidelines based on local circumstances, such as identifying infectious diseases that need immediate isolation, dehydration (not severe), facial or inhalational burns, evidence of meningococcal septicaemia, and inconsolable crying.

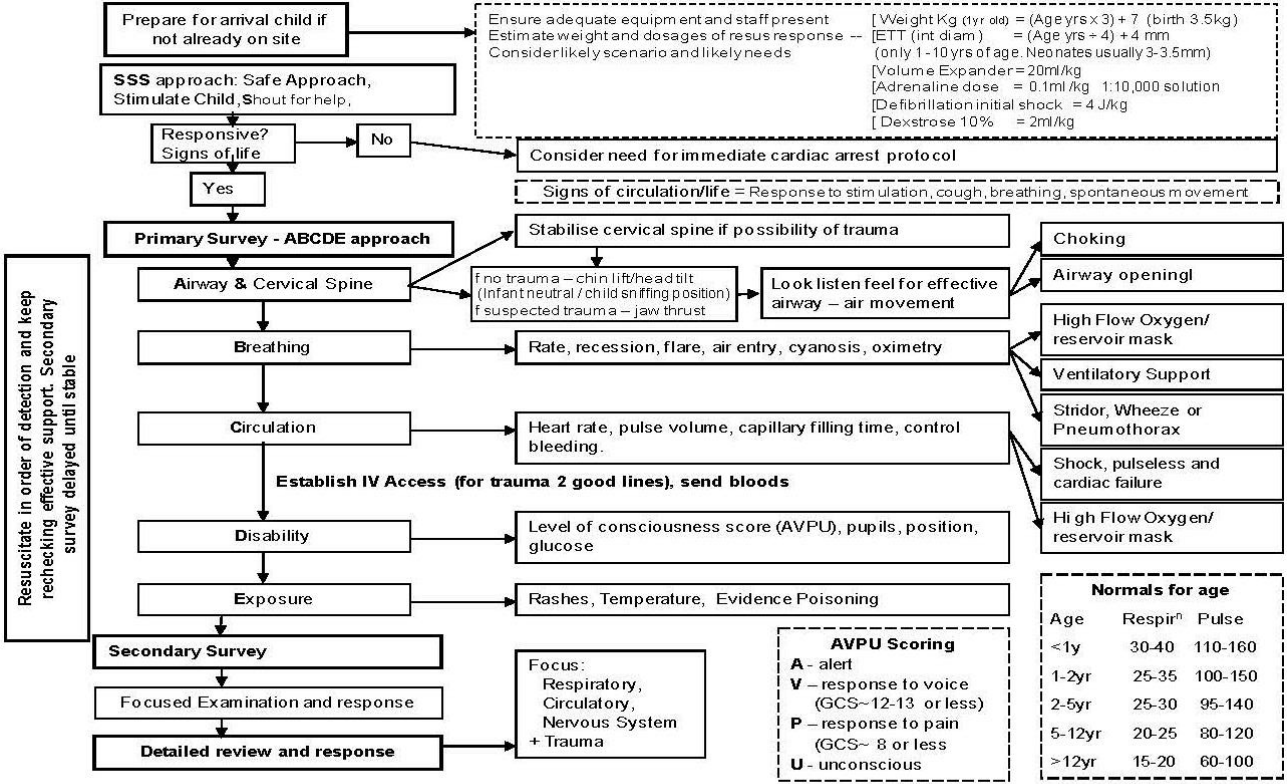
The ETAT triage presented above should be a minimum standard of triage in community health centres, district or regional hospitals in South Africa.

1.1.2 RESUSCITATION OF THE CHILD

A structured approach to the seriously ill or injured child can rapidly optimise their outcome.

Estimation of weight in children is inaccurate and they should be weighed as soon as stabilised. The PAWPER tape allows for consideration of body habitus when estimating weight and can be used as an alternative to the formulae provided (in the diagram below).

The following is a diagrammatic overview derived from an approach to advanced paediatric life support.



A brief summary of the approach and primary survey adapted from paediatric life support documentation – for comprehensive competence an advanced paediatric life support course should be attended.

To optimise oxygen delivery:

- Oxygen, high flow, 15 L/minute via facemask with reservoir bag **or** 6–10 L/minute.
  - If oxygen saturation < 92% or P_aO_2 < 80 mmHg despite maximal oxygen supply, consider providing additional respiratory support.

1.1.3 ANAPHYLAXIS/ANAPHYLACTIC REACTIONS

T78.2

DESCRIPTION

An acute, potentially life-threatening hypersensitivity reaction starting within seconds to minutes after administration of, or exposure to, a substance to which the individual is sensitised. Clinical manifestations include at least one of the following: upper airway obstruction, bronchospasm, hypotension, or shock.

The reaction can be short-lived, protracted or biphasic, i.e. acute with recurrence several hours later. Immediate reactions are usually the most severe.

DIAGNOSTIC CRITERIA

Clinical

» **Acute onset** of signs and symptoms.
» Dizziness, paraesthesia, syncope, sweating, flushing, dysrhythmias.
» Swelling of eyes, lips and tongue (angioedema).
» Upper airway obstruction with stridor.
» Hypotension and shock.
» Bronchospasm, wheezing, dyspnoea, chest tightness.
» Gastrointestinal symptoms such as nausea, vomiting, diarrhoea.

A life-threatening anaphylactic reaction requires **immediate** treatment. Facilities to initiate treatment must be available at all health centres.

GENERAL AND SUPPORTIVE MEASURES

» Place hypotensive or shocked patient in the horizontal position. Do not place in a sitting position.
» Assess and secure airway. If necessary, bag via mask or intubate.

MEDICINE TREATMENT

- Adrenaline (epinephrine) 1:1000 (undiluted), IM, 0.01 mL/kg. (i.e. 10 mcg/kg).
  - Can be repeated every 5 minutes, if necessary.
  - Maximum per dose: 0.5 mL.

Do not administer IV unless there is failure to respond to several doses of IM.

If no response, use IV:

- Adrenaline (epinephrine) 1:1000 (undiluted), IV infusion at 0.02 mcg/kg/minute (mix 0.06 mg/kg adrenaline in 50 mL 5% dextrose, 1 mL/hour = 0.02 mcg/kg/minute).

To maintain arterial oxygen saturation ≥ 95%:

- Oxygen, at least 1–2 L/minute by nasal prong.

In severe anaphylaxis, nasal oxygen is unlikely to be adequate:

- Oxygen, 15 L/minute by face mask with a reservoir bag.

Crystalloid solutions, e.g.:

- Sodium chloride 0.9% OR Ringers Lactate, IV, 20 mL/kg rapidly.
  - Repeat if necessary until circulation, tissue perfusion and blood pressure improves (up to 60 mL/kg).

LoE I[1]

- Hydrocortisone, IV, 5 mg/kg, 4–6 hourly for 12–24 hours.
  - **Note**: Steroids are adjunctive therapy, are not part of first line treatment, and should never be the sole treatment of anaphylaxis.

- Promethazine, IV/IM, 0.25–0.5 mg/kg/dose. Contra-indicated in children < 2 years old.

Continue with:

- Chlorphenamine, oral, 0.1 mg/kg/dose 6 hourly for 24–48 hours, if necessary.

If associated bronchospasm:

- Salbutamol, nebulised, 1 mL salbutamol respirator solution in 3 mL sodium chloride 0.9%.
  - Nebulise at 20-minute intervals.

If associated stridor:

- Adrenaline (epinephrine), 1:1000, nebulise with oxygen, every 15–30 minutes until expiratory obstruction is abolished.
  - 1 mL adrenaline (epinephrine) 1:1000 diluted in 1 mL sodium chloride 0.9%.

Observe for 24 hours, in particular for recurrent symptoms as part of a 'biphasic' reaction.

PREVENTATIVE MEASURES AND HOME BASED TREATMENT

» Obtain a history of allergies/anaphylaxis on all patients before administering medication/immunisation.
» Identify offending agent and avoid further exposure.

» Ensure patient wears allergy identification disc/bracelet.
» Train patients to self-administer adrenaline (epinephrine) pre-filled auto injecting device. Specialist initiated for patients who have anaphylactic reactions.
» Educate patient and parent/caregiver on allergy and anaphylaxis.

REFERRAL

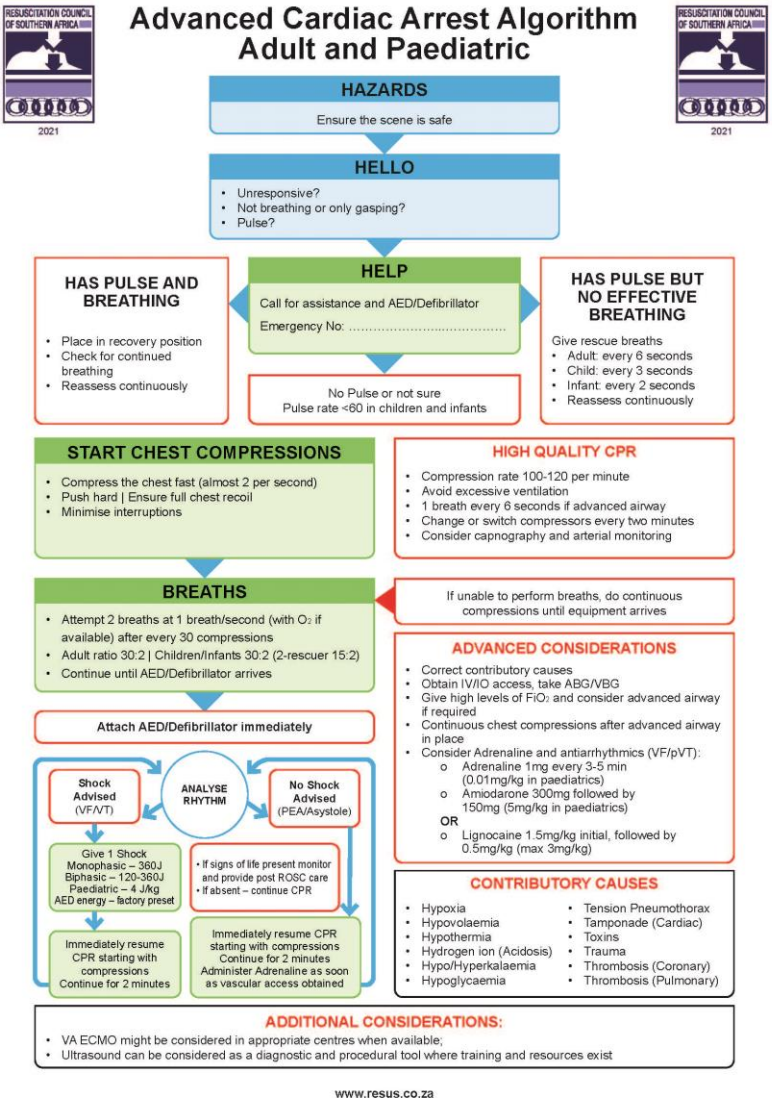
Caution

- **Do not refer the patient during the acute phase.**
- **Transfer can only be done once the patient is stable.**
- **Patients supplied with self-administered adrenaline (epinephrine) must be informed of the shelf life of adrenaline (epinephrine) and when they must come in to get a replacement.**

» Bee sting anaphylaxis for desensitisation.

1.1.4 CARDIORESPIRATORY ARREST

I46.9



DESCRIPTION

Cardiorespiratory arrest in children usually follows a period of circulatory or respiratory insufficiency and less commonly is precipitated by a sudden cardiac event. It is, therefore, important to pre-empt cardiorespiratory arrest in children by recognising and urgently treating respiratory or circulatory compromise.

Cardiorespiratory arrest is diagnosed clinically in the unresponsive child who has no respiratory effort and/or in whom there is no palpable pulse and no signs of life, i.e. cough or spontaneous movement.

GENERAL AND SUPPORTIVE MEASURES

Always call for help immediately.

Ensure an open airway (position head in a neutral position for toddlers or sniffing position for older children with head-tilt, chin-lift manoeuvre or jaw-thrust in trauma cases).

If there is still no respiration, then commence with artificial breathing using a self-inflating bag, with a reservoir and an appropriate mask. Connect the bag to a high flow oxygen source (15 L/minute). Squeeze the bag with enough air to cause the chest to rise, do not overinflate the child's lungs with too much tidal volume.

If there is inadequate chest movement with bag-valve-mask ventilation, re-assess airway patency and adjust, re-positioning the airway with a naso or oropharyngeal tube/airway. If necessary, place an appropriately sized endotracheal tube. In the event of an unexpected arrest or an arrest where there are no witnesses, consider foreign body obstruction. See section 1.1.7: Inhalation, foreign body.

Checklist:

1. Reassess head position to keep airway open.
2. Reassess for an adequate seal when performing bag-mask ventilation.
3. Ensure an adequate size bag is used according to the size of the patient.
4. Ensure no leaks in bag.
5. Exclude a pneumothorax.

Once effective breathing has been established, provide chest compressions at a rate of 100–120/minute for all children excluding neonates. Provide artificial breaths at a ratio of 30 compressions to 2 breaths (30:2) if alone and 15 compressions to 2 breaths (15:2) if two rescuers are present.
Attach a cardiac monitor to the child and secure vascular access. If unable to insert an IV line, obtain intra-osseous access. See section 1.1.10: Intra-osseous infusion in emergencies.

MEDICINE TREATMENT

Asystole or pulseless electrical activity (i.e. no palpable pulse even if normal electrical pattern (PEA)):

- Adrenaline (epinephrine) 1:10 000 (diluted), IV/intra-osseous, 0.1 mL/kg. (Follow each dose with a small bolus of sodium chloride 0.9%)

- 0.1 mL of 1:10 000 solution = 10 mcg.
- Dilute a 1 mL ampoule of adrenaline (epinephrine) 1:1000 in 9 mL of sodium chloride 0.9% or sterile water to make a 1:10 000 solution.

ETT adrenaline is no longer recommended as absorption is unpredictable. It is faster to get an IO line than intubating the child – rather go for IO adrenaline.

Repeat the dose of adrenaline (epinephrine) every 4 minutes if asystole/PEA persists while CPR continues.
When an ECG sinus rhythm trace is present, continue CPR until an effective pulse and circulation is present.

If the arrest was preceded by circulatory shock:

- Sodium chloride 0.9% OR Ringers Lactate, IV, 20 mL/kg as a bolus.

LoE I[1]

During the resuscitation consider if any of the following correctable conditions are present (and if present correct them):

» Hypoxia
» Hypovolaemia
» Hyperkalaemia, hypokalaemia, hypocalcaemia.
» Hypothermia
» Tension pneumothorax.
» Tamponade (cardiac).
» Toxins (e.g. tricyclic antidepressants).
» Thrombo-embolic event.

Note:
There is no evidence to support the **routine** use of any of the following in cardiac arrest:

» sodium bicarbonate,
» calcium,
» high dose IV adrenaline (epinephrine) (100 mcg/kg/dose).

Ventricular fibrillation or pulseless ventricular tachycardia
Consider the following and if present, correct:

» Hypoxia
» Hypovolaemia
» Hyperkalaemia, hypokalaemia, hypocalcaemia.
» Hypothermia
» Tension pneumothorax.
» Tamponade (cardiac).
» Toxins (e.g. tricyclic antidepressants).
» Thrombo-embolic event.

Proceed to immediate defibrillation, but during this process cardiorespiratory resuscitation (compressions and ventilation) must continue, except during the actual administration of each shock. Continue until adequate circulation can be demonstrated.
For pulseless ventricular tachycardia and ventricular fibrillation, the defibrillator should be set to asynchronous mode and 4 J/kg shocks administered.

Do not increase voltage; give 4 J/kg repeatedly, if needed.

After each shock continue CPR immediately for 2 minutes and only re-assess the ECG rhythm thereafter.

If ventricular tachycardia/fibrillation has reverted to sinus rhythm, stop shock cycle, but continue CPR until good stable circulation and adequate spontaneous breathing is evident.

If fibrillation/ventricular tachycardia is still present, give further shocks for 3 x 2-minute cycles of shocks every 4 minutes.

Thereafter, if necessary, the 2-minute shock cycles should continue but, in addition, give the following after the 3rd shock:

- Adrenaline (epinephrine) 1:10 000 (diluted), IV, 0.1 mL/kg and then repeat after every 2nd shock, i.e. every 4 minutes. (Follow each dose with a small bolus of sodium chloride 0.9%.)
  - 0.1 mL of 1:10 000 solution = 10 mcg.
  - Dilute a 1 mL ampoule of adrenaline (epinephrine) 1:1000 in 9 mL of sodium chloride 0.9% or sterile water to make a 1:10 000 solution.

Allow one minute of cardiopulmonary resuscitation between the administration of any medicine and a repeat cycle of shocks.

REFERRAL

» To an intensive care unit after recovery from an arrest.

1.1.5 POST RESUSCITATION CARE

Once children have been successfully resuscitated and emergency treatment provided, they remain at high risk for death or disability.

In order to optimise outcomes, the following principles of care apply:

1. Admit or refer to a ward with appropriate monitoring facilities, e.g. a high care or intensive care unit as soon as possible.
2. Identify and manage underlying pathology.
3. Maintain normoxia (avoid both hyperoxia and hypoxia).
4. Avoid hypo- and hypercapnia.

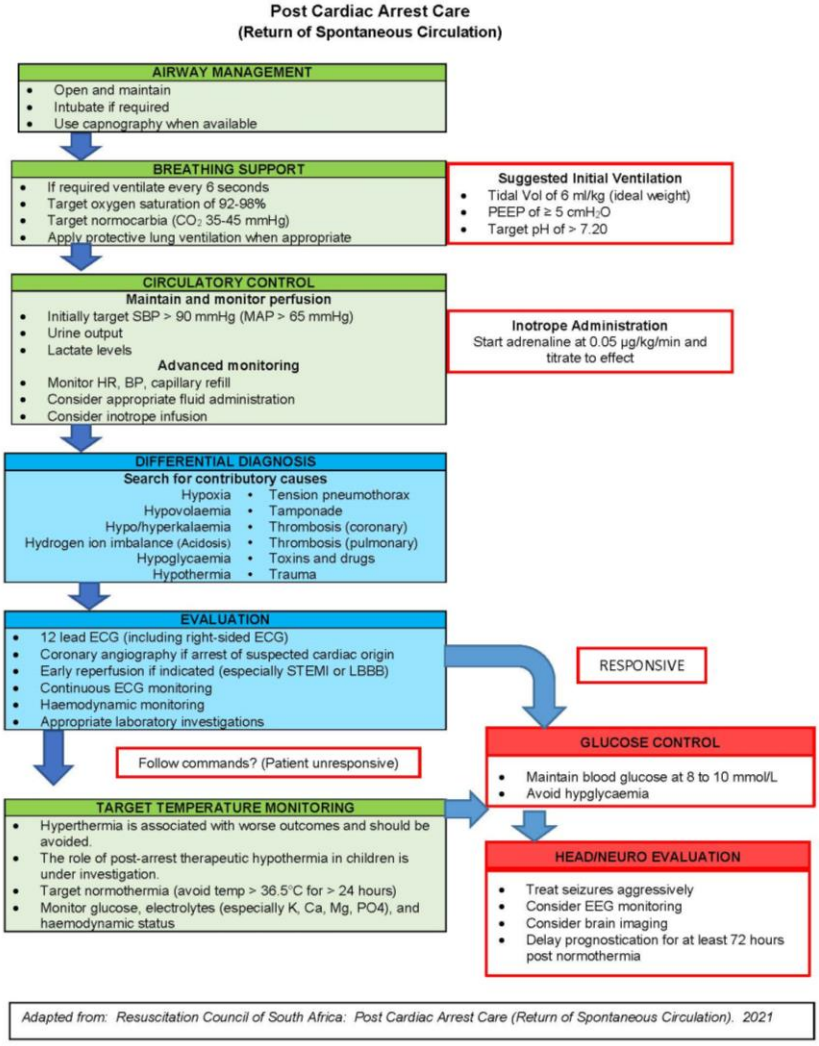
5. Maintain systolic BP ≥ 5th percentile for age (refer to Chapter 4: Cardiovascular System, section 4.11: Hypertension); this may require intravascular fluids and/or inotropes.
6. Avoid hyperthermia and treat fever aggressively.
7. Provide adequate nutrition.
8. Monitor and correct glucose and electrolyte abnormalities.
9. Provide appropriate analgesia.
10. Consider rehabilitation requirements.

1.1.5.1 TERMINATION OF RESUSCITATION

» The decision to stop CPR attempts depends on the specifics of the individual patient and should be based on clinical judgement.
» Consider stopping resuscitation attempts and pronouncing death if there is incurable underlying disease, or if asystole > 20 minutes.

Consider carrying on for longer especially with:
» hypothermia and drowning,
» poisoning or medicine overdose,
» neurotoxic envenomation (e.g. black and green mamba or Cape cobra snakebite) – see section 18.2.3: Snakebite.

This decision should take into consideration the potential risk that CPR poses to the rescuer, e.g. infectious diseases.



1.1.6 CONVULSIONS, NOT FEBRILE CONVULSIONS

See section 13.1: Seizures.

1.1.7 INHALATION, FOREIGN BODY

T17.9

DESCRIPTION

Accidental inhalation of a solid object that may obstruct the airway at any level.

DIAGNOSTIC CRITERIA

Ask specifically about a possible choking episode if there is any suspicion of a foreign body aspiration.

» Initial symptom is frequently sudden onset of choking followed by persistent unilateral wheeze (may be bilateral), chronic cough, or stridor.
» Segmental or lobar pneumonia failing to respond to standard therapy.
» Mediastinal shift.
» Chest X-ray on full expiration and full inspiration may show hyperinflation and/or collapse or sometimes, a radio-opaque foreign body.

GENERAL AND SUPPORTIVE MEASURES

ACUTE EPISODE

» If coughing effectively and breathing adequately, provide oxygen and refer urgently for airway visualisation. Carry out transfer with a person who is able to manage the foreign body process accompanying the child.
» If the child is still breathing but unable to cough or breathe adequately, attempt to dislodge the foreign body by cycles of 5 back slaps followed by 5 chest compressions (infants), or 5 Heimlich manoeuvres (child) repeatedly.
» If the child is unresponsive, carry out standard cardiorespiratory resuscitation, i.e. cardiac compressions and ventilation (provide artificial breaths at a ratio of 30 compressions to 2 breaths (30:2) if alone and 15 compressions to 2 breaths (15:2) if two rescuers are present).

Caution

Blind finger sweeps are dangerous and contra-indicated.
Foreign bodies may be removed under direct vision.
All cases should have airway visualisation or be referred for airway visualisation.

REFERRAL

» All cases for the removal of retained foreign bodies.
» Unresolved respiratory complications.

1.1.8 SHOCK

R57.9

DESCRIPTION

An acute syndrome that reflects the inability of the pulmonary and circulatory system to provide adequate perfusion, oxygen and nutrients to meet physiological and metabolic demands.

Compensation is achieved by increased pulse rate, and peripheral vascular constriction. The blood pressure may be relatively well maintained but the patient still requires urgent resuscitation. Hypotension is a late and ominous sign.

Shock can be further characterised:

» **Hypovolaemic shock:** e.g. dehydration, haemorrhage or fluid shifts.
» **Distributive shock:** e.g. septicaemia and anaphylaxis.
» **Cardiogenic shock:** e.g. cardiac dysfunction.
» **Dissociative shock:** e.g. profound anaemia and carbon monoxide poisoning.
» **Obstructive shock:** e.g. pneumothorax and cardiac tamponade.
» **Septic shock:** many mechanisms are operative in septic shock.
» **Neurogenic shock:** e.g. spinal cord trauma.

Complications of shock include multi-organ dysfunction and/or failure. A patient may have more than one type of shock present, e.g. a trauma patient with spinal cord injury, pneumothorax and haemorrhagic shock.

DIAGNOSTIC CRITERIA

Evidence of compensated shock includes:

» cold peripheries,
» weak pulse pressure especially peripheral pulse weaker than central pulses,
» prolonged capillary filling, i.e. ≥ 3 seconds,
» agitation/confusion/decreased level of consciousness,
» skin pallor,
» increased heart rate,
» signs and symptoms of underlying conditions.

In uncompensated shock, falling BP and failure to act urgently will result in irreversible shock and death.

Facilities to start treatment of shock must be available at all health centres.

GENERAL AND SUPPORTIVE MEASURES

» Follow the ABCDE algorithm. See section 1.1.1: Triage.
» Identify and treat the underlying cause.
» Ensure good intravenous or intra-osseous access. In trauma, two large bore lines for access are important. See section 1.1.10: Intra-osseous infusion in emergencies.

» Perform relevant investigations.
» Monitor:
  > Vital signs and maintain within normal limits.
  > Metabolic parameters and correct as needed.
  > Urinary output – aim for at least 1 mL/kg/hour.

MEDICINE TREATMENT

To optimise oxygen delivery to the tissue, administer:

- Oxygen, high flow, 15 L/minute via facemask with reservoir bag or 6–10 L/minute.

If oxygen saturation < 92% or P_aO_2 < 80 mmHg, consider the need to intubate and continue respiratory support.

1. Hypovolaemic shock

Response to each step of management must be reviewed every 15 minutes.
If after administration of a total of 40 mL/kg of sodium chloride 0.9% fluid, shock has not resolved, consider other causes and the need for inotropes.

For fluid deficit (vs. blood loss):
IV fluids to correct the intravascular fluid deficit and improve circulation:

- Sodium chloride 0.9% OR Ringers Lactate, IV, 20 mL/kg rapidly.
  - Review after each bolus to see if shock has resolved.

LoE I[1]

In children with **severe malnutrition**:

- Sodium chloride 0.9%, IV, 10 mL/kg administered over 20 minutes.
  - Review after each bolus to see if shock has resolved.

With each re-assessment, if:
» Shock has resolved (capillary filling time < 3 seconds, good pulse, normal blood pressure, urine output, skin perfusion and level of consciousness improved), do not repeat the fluid bolus.
» Shock is better but still present, repeat bolus (up to 40 mL/kg). After this further care should be in an ICU setting. Consider initiation of inotropes/vasopressors.
» Monitor for persistence of shock, i.e.:
  > Non-responding or decreasing BP.
  > Non-responding or increasing pulse rate/decreasing volume.
  > Non-responding or increasing capillary filling time.
» Monitor for fluid or circulatory overload, i.e.:
  > Increasing respiratory rate.
  > Increasing basal crepitations.
  > Increasing pulse rate.
  > Increasing liver size/tenderness.
  > Increasing JVP.
  > Increasing oxygen requirement.

After circulatory stabilisation, continue with appropriate maintenance fluid.

For blood loss:
- Packed red cells **or** whole blood, 10–20 mL/kg, repeat if required.
  - Stop once haemodynamic stability reached.

While awaiting blood products to arrive, proceed with volume resuscitation.
See section 1.1.9: Massive blood loss.

2. Cardiogenic shock

Ideally, children receiving treatment for cardiogenic shock should be in a high care or ICU.

Inotropic support:
When perfusion is poor and blood pressure response is unsatisfactory, despite adequate fluid replacement.

- Dobutamine, IV, 5–15 mcg/kg/minute.
  - Initiate slowly and with caution as dobutamine can potentially drop BP due to unopposed β-2 adrenergic vasodilation properties.

Chronotropic/inotropic plus vascular tone support:
If tissue perfusion and blood pressure do not improve satisfactorily on adequate fluid volume replacement and inotropic support, consider:
- Adrenaline (epinephrine), IV infusion, 0.05–1 mcg/kg/minute.

If poor ventricular contractility and increased afterload are considered as the primary problem, do not give adrenaline (epinephrine) but consider adding an afterload reducing agent to the dobutamine infusion but only with specialist advice.

3. Septic shock

Treatment for septic shock should be initiated urgently and then patients should preferably be transferred to an ICU.

Response to each step of management must be reviewed every 15 minutes.

IV fluids:
- Sodium chloride 0.9% **OR** Ringers Lactate, IV, 10 mL/kg rapidly.
  - Review after each bolus to see if shock has resolved.

LoE I[1]

In children with **severe malnutrition**:
- Sodium chloride 0.9%, IV, 10 mL/kg administered over 20 minutes.
  - Review after each bolus to see if shock has resolved.

With each reassessment, if:
» Shock has not resolved after 40 mL/kg of sodium chloride 0.9% fluid, consider inotropes.

» Shock has resolved (capillary filling time < 3 seconds, good pulse, normal blood pressure), do not repeat bolus. Proceed to other care.
» Shock is better but still present, repeat bolus (up to 40 mL/kg). After this, further care should be in an ICU setting.
» Monitor for persistence of shock, i.e.:
  > Non-responding or decreasing BP.
  > Non-responding or increasing pulse rate/decreasing volume.
  > Non-responding or increasing capillary filling time.
» Monitor for fluid or circulatory overload, i.e.:
  > Increasing respiratory rate.
  > Increasing basal crepitations.
  > Increasing pulse rate.
  > Increasing liver size/tenderness.
  > Increasing JVP.

Chronotropic/Inotropic plus vascular tone support:
If tissue perfusion and blood pressure do not improve satisfactorily on adequate fluid volume replacement: titrate inotropes against the response and add an additional agent if poor response.

- Adrenaline (epinephrine), IV infusion, 0.05–1 mcg/kg/minute.

If inadequate response:
ADD
- Dobutamine, IV, 5–15 mcg/kg/minute.

Septicaemic shock unresponsive to inotropes:
- Hydrocortisone, IV, 1–2 mg/kg/dose, 6 hourly until shock has resolved.

Antibiotic therapy
» Start empiric antibiotics early.
» Aim to get source control: all pus should be drained; all necrotic tissue should be removed/debrided.

Before initiating antibiotic therapy, take blood and urine specimens, if appropriate, for culture and sensitivity testing.

Consider whether community or hospital acquired and treat based on anticipated susceptibility. Ensure immediate administration.

Reconsider antibiotic and/or antifungal therapy when culture and sensitivity results become available.

Caution **Patients must be resuscitated and stabilised before referral.**

1.1.9 MASSIVE HAEMORRHAGE WITH MASSIVE TRANSFUSION OF BLOOD

DEFINITION

Massive blood loss in children is recognised when a child requires a blood transfusion to replace 50% of total blood volume in 3–4 hours (40 mL/kg) or > 100% of total blood volume in 24 hours or receives replacement of 10% of total blood volume/minute. The rapid recognition is important to maintain tissue oxygenation by restoration of blood volume and haemoglobin.

Common causes:
» Trauma (especially blunt injuries).
» Ruptured aortic aneurysm.
» Liver surgery.
» Gastrointestinal bleeding.
» Invasive tumour.

Presentation: Hypotension, prolonged capillary fill time, tachycardia, urinary output decreases, oxygen saturation reduced, hypothermia.

DIAGNOSTIC CRITERIA

Investigations
» ABG, Thromboelastogam (TEG), haemoglobin, PT/PTT, platelets, INR, clotting factors, DIC screening.
» Haemoglobin must be done initially and repeated every 60 minutes.

MEDICINE TREATMENT

Massive transfusion protocol (MTP) activation must be prompt as every minute from activation to product arrival increases odds of mortality by 5%.

Facilities without access to a blood bank:
- Lyophilised plasma, IV.
  - 1 unit for each unit of emergency blood transfused.

Arrange urgent transfer to a centre with blood bank and specialist services.
Facilities with access to a blood bank:
» Ensure that the blood bank receives an appropriate specimen as soon as the possible need for transfusion is identified.
» Notify the blood bank as soon as possible of the need for a massive transfusion and request a massive transfusion pack.

A massive transfusion pack will typically consist of:
- Red blood cells (RBCs).

AND
- Lyophilised plasma, IV.
  - 1 unit for each unit of emergency blood transfused.

OR

- FFP – thawed when requested.

AND

- Platelets
  - Aim to transfuse the above products in a 1:1:1 ratio, or as guided by laboratory parameters.
  - Send specimens for FBC and INR and continue to monitor.

Watch for complications:

» Electrolyte abnormalities:
  > Hyperkalaemia
  > Hypocalcaemia
» Transfusion:
  > Induced coagulopathy.
» Immunologic reactions:
  > ABO incompatibility.
  > Transfusion-related acute lung injury.
  > Transfusion-associated circulatory overload.
  > Alloimmunization

REFERRAL

» All
» MTP deactivation must be stopped timeously to decrease wastage and adverse effects.

1.1.10 INTRA-OSSEOUS INFUSION IN EMERGENCIES

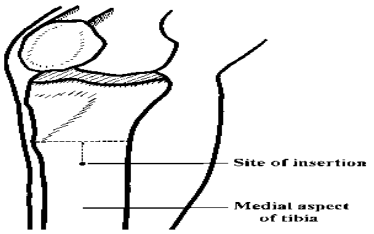
During resuscitation and when managing a critically ill child, if intravenous access is not established within 5 minutes, obtain intra-osseous (IO) access.

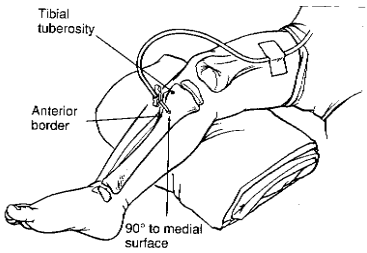
1. Use an intra-osseous needle or if not available, a FG18 x 1.5 cm (or less ideally FG20 x 1.5 cm) or lumbar puncture needle.
2. Grasp the thigh and knee above and lateral to the insertion site with the palm of the left hand (if right-handed). Wrap the fingers around the knee to stabilise the proximal tibia. Do not allow any portion of your hand to rest behind the insertion site.
3. Find the site of insertion, i.e. feel the tibial tuberosity. The site of insertion is about 2 cm below this tuberosity on the broad flat medial surface of the tibia.
4. Careful surgical preparation of the injection site as for lumbar punctures.
5. Insert the needle through the skin over the flat surface of the tibia.
6. Holding the needle low down near the skin, advance the needle through the bony cortex of the tibia, directing the needle perpendicular, i.e. 90° to the long axis, using a gentle but firm twisting or drilling motion.
7. Stop advancing the needle when a sudden decrease in resistance to forward motion of the needle is felt.
8. Remove the stylet from the needle.

9. Slowly inject a small amount of sodium chloride 0.9% through the needle. Check for any signs of increased resistance to injection, increased circumference of the soft tissues of the calf, or increased firmness of the tissue.
10. If the test injection is successful, disconnect the syringe and join an infusion set to the needle. Secure the needle and tubing with tape and support it with a bulky dressing.
11. If the test injection is unsuccessful, i.e. infiltration of the sodium chloride 0.9% into the leg tissue is observed, remove the needle and try again on the other leg.
12. The flow rate should rapidly increase after flushing through. If flow is poor, consider the use of a 3-way tap and syringe.
13. Secure the IO needle to the skin by using forceps/spatula/cord-clamp, clamping the IO needle perpendicular to the leg and place two-plaster straps over the forceps/cord-clamp/spatula. Do not cover the leg with a circumferential dressing, as you need to watch the calf for signs of compartment syndrome.

Signs of successful insertion:

» Sudden decrease in resistance to insertion as the needle passes through the bony cortex.
» The needle remains upright without support.
» Fluid flows freely through the needle without evidence of subcutaneous infiltration.





Automated hand-held intra-osseous access devices are increasingly available and their use allows for the rapid attainment of vascular access in almost all children – when available, their use is strongly encouraged and should be consistent with the manufacturer's instructions. The same landmarks are used as for manual insertion and the procedure is less painful. For older children (> 40 kg) the proximal humerus can be used as an access site.

Aspiration and rapid infusion may be painful; lignocaine 0.5 mg/kg can be slowly infused as analgesia.

1.1.11 EXPOSURE TO POISONOUS SUBSTANCES

See Chapter 18: Poisoning, section 18.1: Poisoning.

1.1.12 INSECT BITES AND STINGS

See Chapter 18: Poisoning, section 18.2: Envenomation.

1.2 TRAUMA

1.2.1 BURNS

T30.0

DESCRIPTION

Burns lead to skin and soft tissue injury and may be caused by:

» heat, e.g. open flame, hot liquids, hot steam,
» chemical compounds,
» physical agents, e.g. electrical/lightning, and
» radiation.

GENERAL AND SUPPORTIVE MEASURES

Emergency treatment

» Remove smouldering or hot clothing.
» Remove constrictive clothing/rings.
» To limit the extent of the burn, soak the affected area generously in cold water for not more than 20 minutes.
» In all burns, > 10% or where carbon monoxide poisoning is possible (enclosed fire, decreased level of consciousness, disorientation) administer high flow oxygen by face mask with reservoir bag (15 L/minute).
» Examine carefully to determine the extent and depth of the burn wounds.
» Respiratory obstruction due to thermal injury or soot inhalation, production of black coloured sputum, shortness of breath, hoarse voice and stridor are serious signals and may rapidly proceed to respiratory compromise. Consider early endotracheal airway placement.

Further assessment and care

Assessment:

The extent and depth may vary from superficial (epidermis) to full-thickness burns of the skin and underlying tissues.

Since burns are usually sterile, empiric antibiotics are not initially indicated.

Depth of burn wound	Surface/Colour	Pain sensation/Healing
Superficial or epidermal	Dry, minor blisters, erythema.	» Painful » Heals within 7 days.

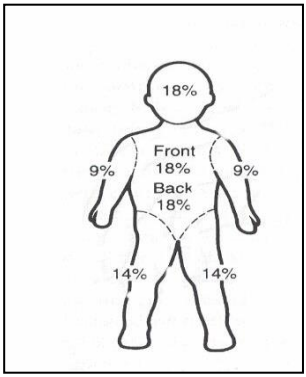
Depth of burn wound	Surface/Colour	Pain sensation/Healing
Superficial partial thickness or superficial dermal	Blisters, moist.	» Painful » Heals within 10–14 days.
Deep partial thickness or deep dermal	Moist white or yellow slough, red mottled.	» Less painful. » Heals within a month or more. » Generally needs surgical debridement and skin graft.
Full thickness (complete loss of dermis)	Dry, charred whitish, brown or black.	» Painless, firm to touch. » Healing by contraction of the margins (generally needs surgical debridement and skin graft).

Burns are classified as minor or major burns.

Major burns:
» Partial thickness burns (superficial or deep) of > 10% body surface area.
» Full thickness burn of > 3% body surface area.
» Any burn involving the head and face, hands, feet and perineum.
» Inhalation injuries.
» Circumferential burns.
» Electrical burn injuries.
» Burns in neonates.
» Burns in patients with serious pre-existing or concomitant injuries.

Minor burns:
» Partial thickness burns of < 10% body surface area in a child > 1 year of age.

Estimation of total body surface area (TBSA) involved in burn injury:



Published with kind permission from SAMJ. South African Burn Society burn stabilisation protocol. JS Karpelowsky, L Wallis, A Maderee and H Rode. 2007. SAMJ Vol 9, No. 8. Page 574–7.

The figure above is used to calculate body surface area percentage, and indicates percentages for the whole leg/arm/head, (and neck in adults) not the front or back.

» In children, the palm of the hand is 1%.
» The following adjustments are made in children up to the age of 8 years old after which adult percentages are used for the head, neck and each lower limb.
» **Less than 1 year**:
  > Head and neck are 18% of TBSA.
  > Each leg is 14% of TBSA.
» **After 1 year**:
  For each year of life:
  > Head and neck decrease by 1% of TBSA until 9% (adult value).
  > Leg gains 1/2% of TBSA until 18% (adult value).

Age (Years)	Head + neck Front + back	Torso Front	Torso Back	Lower limb Front + back	Upper limb Front + back
< 1 year	18%	18%	18%	14%	9%
1 to < 2 years	17%	18%	18%	14.5%	9%
2 to < 3 years	16%	18%	18%	15%	9%
3 to < 4 years	15%	18%	18%	15.5%	9%
4 to < 5 years	14%	18%	18%	16%	9%
5 to < 6 years	13%	18%	18%	16.5%	9%
6 to < 7 years	12%	18%	18%	17%	9%
7 to < 8 years	11%	18%	18%	17.5%	9%
8 to < 9 years	10%	18%	18%	18%	9%
≥ 9 years *(plus 1% perineum)*	9%	18%	18%	18%	9%

Care:

Inhalation injury

In addition to other treatment, the degree of inhalation injury may warrant:
» monitoring of blood gases,
» warm humidified oxygen and/or intubation,
» positive pressure ventilation.

Ensure adequate airway in the presence of inhalational burns.
Children with burns may present with delayed onset of airway obstruction. Consider early intubation.

Suspect carbon monoxide poisoning in all fire victims.
» Obtain carboxyhaemoglobin level.
» Treat by administering 100% oxygen (15 L/min by facemask with reservoir bag).

Prevent heat loss

Nurse all major burns in a warm room (26 °C).

Nasogastric drainage
Use a nasogastric tube on free drainage in all burns > 10% (especially during transfer).
Within the 1st 24 hours, commence nasogastric feeds in children with > 15% TBSA where ileus is not suspected.

Nutritional support
Consult a dietician as children with burns require a higher than usual intake of nutrients (due to a hypermetabolic state).
Start enteral feeds within 6 hours in all children unless there are contraindications.

Estimate daily energy and protein needs using the formulae:

Energy (kJ):	250 kJ/kg body mass + (150 kJ x % burned TBSA)
Protein (g):	3 g/kg body mass + (1 g x % burned TBSA)
Maximum % burn area used for calculation should not exceed 50%.	

Give iron and vitamins routinely until burn wounds are healed and/or skin grafting has successfully been completed.

Note:
Do not supplement with iron during sepsis or infection.
In addition, provide:
» psychological support,
» physiotherapy,
» occupational therapy,
» waterbeds and cradles,
» distraction therapy: music, video games, etc. for dressing changes.

MEDICINE TREATMENT
Fluid replacement

Burns < 10% of total body surface area:
- Oral fluids.

Burns > 10% of total body surface area:
- IV fluid for resuscitation.

If in shock, first treat shock. See section 1.1.8: Shock.

As in all fluid administration in sick children, volumes are estimates, response must be constantly re-evaluated, and rates adjusted appropriately.

CALCULATION OF INITIAL FLUID REPLACEMENT (AFTER SHOCK HAS BEEN TREATED)
First 24 hours:
Replacement fluids for burns
- Sodium chloride 0.9%, IV OR Ringers lactate.
  - Calculate total fluid requirement in 24 hours:

[Total % burn ____x weight (kg) ___x 4 mL] as sodium chloride 0.9%.
Give half of this volume in the 1st 8 hours from the time of the burn.
Administer remaining fluid volume in the next 16 hours.

LoE I[1]

Note:
If urine output not adequate (adequate urine output = 1–2 mL/kg/hour), increase fluids for the next hour by 50% (continue at higher rate until urine output is adequate then resume normal calculated rate).

PLUS
Maintenance fluids in children
In children, give oral or intravenous maintenance fluid in addition to the above calculated volume.

Child maintenance fluid requirement volumes	
≤ 1 year	120 mL/kg/24 hours
All children > 1 year – the sum of the following:	
» For each kg of body weight up to 10 kg	100 mL/kg/24 hours
» For each additional kg of body weight more than 10 kg	50 mL/kg/24 hours
» For each additional kg of body weight more than 20 kg	20 mL/kg/24 hours

Example: 24 kg child with 10% burns	
1st 24 hours:	
» Replacement for expected losses: 4 mL/kg x 24 kg x 10%	 **= 960 mL**
» Maintenance: First 10 kg = 10 kg x 100 mL/kg/24 hours Second 10 kg = 10 kg x 50 mL/kg/24 hours Remaining 4 kg = 4 kg x 20 mL/kg/24 hours Total maintenance:	 = 1000 mL + = 500 mL + = 80 mL **= 1580 mL**
Thus	
1st 8 hours: = ½ resuscitation fluids + ⅓ maintenance fluids	480 mL sodium chloride 0.9% + 527 mL sodium chloride 0.9%/dextrose 5%
Next 16 hours: = ½ resuscitation fluids + ⅔ maintenance fluids	480 mL sodium chloride 0.9% + 1053 mL sodium chloride 0.9%/dextrose 5%

The above are guidelines. Regular review is needed to maintain urine output 1–2 mL/kg/hour.

Avoid circumferential taping when securing infusion lines as oedema under the eschar may decrease the venous return.

If urine output > 1–2 mL/kg/hour or base excess (BE) better than minus 4, stop resuscitation fluids. Too much fluid is almost as harmful as too little fluid.

Second 24 hours:
If urine output is adequate, continue resuscitation:
- Sodium chloride 0.9%, IV, 1.5 mL/kg/% burn/24 hours.

PLUS

Maintenance:
- Sodium chloride 0.9%/dextrose 5% (dextrose saline), as per maintenance requirement above.

Part of this volume may be replaced by enteral feeds.

Thereafter, progressively decrease IV fluids and increase enteral fluids according to response over time. Aim for full enteral feeds as soon as possible.

Anaemia
If haemoglobin < 7 g/dL:
- Packed red cells, 10 mL/kg over 3 hours.

Hypoalbuminaemia
If indicated by symptomatic hypoalbuminaemia:
- Albumin 20%, IV, 2 g/kg/day. (2 g = 100 mL.)

For pain

Pain associated with burn injury is often severe and requires active and continuous management. Procedural pain management measures need to be taken during dressing changes.

See Chapter 20, section 20.1.1: Management of pain.

For pruritus
Antihistamines
- Chlorphenamine, oral, 0.1 mg/kg/dose as a single dose at night.
  - Maximum: 4 mg.

For children 2 years and older, second-generation antihistamines can be considered:
- Cetirizine, oral, as a single dose.
  - Children 2–6 years: 5 mg.
  - Children 6–12 years: 10 mg.

Topical
- Aqueous cream.

If not controlled:
- Ondansetron, oral, 0.1–0.2 mg/kg 12 hourly.

If oral route cannot be used:
- Ondansetron, IV, 0.1 mg/kg immediately.
  - Maximum: 4 mg/day.

Refractory pruritus: Refer for consideration of gabapentinoids.

Change of dressing
Provide analgesic cover at each dressing change (Chapter 20: Pain Control).
In major burns, change dressings under procedural sedation or general anaesthesia.

Gastric erosions
Preventative medication treatment is not given. Effective early resuscitation and early feeding decrease the incidence of gastric erosion.

If gastric erosion is suspected due to haematemesis or brownish gastric aspirates.

Proton pump inhibitor, e.g.
- Omeprazole, oral, 0.4–0.8 mg/kg/dose 12 hourly. Specialist initiated.
  - Maximum dose: 20–40 mg/dose.
  - If 1 month–2 years: 2.5 mg 12 hourly.
  - If > 2–6 years: 5 mg 12 hourly.
  - If > 7–12 years: 10 mg 12 hourly.

If unable to take orally:
- Proton pump inhibitor, e.g.
  - Pantoprazole, IV, 0.5 mg/kg/dose 12 hourly.

OR
- Ranitidine, IV, 1 mg/kg 6 hourly.

Local treatment of burns
Gently clean the wounds with running water, utilising appropriate pain and sedation, see Chapter 20, section 20.1.1: Management of pain.
Remove loose skin and debride dead tissue and dress with topical antiseptic cream and non-adherent dressing.
Thereafter, daily rinse with running water and dress with topical antiseptic cream and non-adherent dressing.

In < 20% body surface area burns:
- Povidone-iodine 0.5%, with occlusive dressings.

In > 20% body surface area burns:
- Silver-sulphadiazine 1%, on non-adhesive dressings.
  - Cover with paraffin gauze and crepe bandages.

- Change dressings daily.

Excise and graft all full thickness or deep dermal burns as soon as the patient is stable.
Consider skin grafting in wounds not healed in three weeks.

Antibiotics
Consider if signs of infection are present as these may be subtle:
» pyrexia/hypothermia,
» shock (compensated or not compensated),
» rising pulse or respiratory rate,
» petechiae,
» leucocytosis/thrombocytopenia,
» looks ill/toxic/altered level of consciousness,
» local inflammatory changes,
» vomiting.

The choice of antibiotics is based on the culture and sensitivity results of wound, urine and blood cultures once available.
Positive wound cultures alone do not indicate systemic infections requiring antibiotic treatment.
» Start empiric antibiotics early.
» Aim to get source control: all pus should be drained; all necrotic tissue should be removed/debrided.

Before initiating antibiotic therapy, take blood and urine specimens, if appropriate, for culture and sensitivity testing.

Consider whether community or hospital acquired and treat based on anticipated susceptibility. Ensure immediate administration.

Reconsider antibiotic and/or antifungal therapy when culture and sensitivity results become available.

Tetanus prevention
Patients with no previous immunisation in the last 5 years:
- Tetanus toxoid, IM, 0.5 mL.
  - Complete course in previously unvaccinated patients.

Where deep necrotic lesions are part of the burn and if the immunisation status is not known:
- Tetanus immunoglobulin, IM, 500 IU.

Prior to transport/referral
» Commence resuscitative measures, if necessary.
» Administer 100% humidified oxygen by facemask for inhalation injuries, if necessary.

» Cover wounds with clean dressings after hot or smouldering clothing have been removed.

REFERRAL
» Major burn injuries.

1.2.2 TRAUMATIC BRAIN INJURY
S06.2

See Chapter 23: ICU, section 23.7: Traumatic Brain Injury (TBI) and neuro-protection in the ICU, for full management details.

DESCRIPTION
Types:
» Concussion (minor), e.g. shaken baby.
» Contusion
» Penetrative
» Anoxic – commonest, e.g. falls, vehicle collusion, violence, sport injuries.

DIAGNOSTIC CRITERIA
Symptoms:
» Headache
» Eating/nursing habits.
» Unusual or easy irritability.
» Persistent crying & inability to console.
» Change in sleeping habits.
» Seizure
» Mood
» Drowsiness
» Loss of interest in toys.

Signs of raised intracranial pressure (> 20 mmHg):
» Cushing response (hypertension and bradycardia).
» Crackpot sign.
» Features on fundoscopy.

Imaging:
» CTS – done within 0–6 hours.
» Transcranial doppler: Cerebral perfusion pressure > 40 mmHg.

GENERAL AND SUPPORTIVE MEASURES
» Rest/Trendelenburg position.
» Tight glucose and calcium control.

REFERRAL
» Refer all patients.

References

[1] Kartha GB, Rameshkumar R, Mahadevan S. Randomized Double-blind Trial or Ringers Lactate versus Normal Saline in Pediatric Acute Severe Diarrheal Dehydration. Journal of Pediatric Gastroenterology and Nutrition. 2017, (6):621-626.

CHAPTER 2
ALIMENTARY TRACT

2.1 DENTAL AND ORAL DISORDERS

2.1.1 GINGIVITIS, UNCOMPLICATED
K05.1

DESCRIPTION
Inflammation of the gum margin causing the gums to separate from the teeth.
Pockets form between the gums and the teeth where pus and bacteria can collect, eventually causing periodontitis, a disease in the tissue that surrounds and supports the teeth – see section 2.1.2: Periodontitis.

Characteristics of uncomplicated gingivitis:
» change in the normal gum contour,
» redness,
» watery exudate/bleeding,
» may be recurrent.
» may be painful,
» swollen gums,
» gum recession may occur,

GENERAL AND SUPPORTIVE MEASURES
Oral hygiene is usually adequate to prevent superficial mouth and gum infection:
» Oral hygiene after each meal to remove plaque and food debris.
» Frequent thorough brushing of teeth, at least twice daily.
» Dental flossing at least once a day.
» Homemade warm saline rinse. Dissolve ½ teaspoon of table salt (sodium chloride) in ~ 200 mL warm water. Rinse mouth for one minute twice daily but do not swallow.

MEDICINE TREATMENT
- Paracetamol, oral, 15 mg/kg/dose 6 hourly when required to a maximum of 4 doses per 24 hours.
- Chlorhexidine 0.2%, 15 mL as a mouthwash, 2–4 times daily for 5 days; use after brushing and flossing.

2.1.2 PERIODONTITIS
K05.4

DESCRIPTION
Progressive gingivitis to the point where the underlying bone is eroded, is characterised by teeth becoming loose in their sockets.
It is a cause of tooth loss in adults.

GENERAL AND SUPPORTIVE MEASURES

» Advice on improving and maintaining oral hygiene. See section 2.1.1: Gingivitis, uncomplicated. General and supportive measures.

MEDICINE TREATMENT

- Chlorhexidine 0.2%, 15 mL as a mouthwash, 2–4 times daily for 5 days.

REFERRAL

» All cases to a dentist.

2.1.3 NECROTISING PERIODONTITIS

K05.6

DESCRIPTION

An acute very painful infection of the gingival margin characterised by:

» foul smelling breath,
» loss of gingiva and supporting bone around teeth, and
» presence of underlying disease, e.g. HIV.

May lead to loss of surrounding lips and cheeks if not adequately treated.

GENERAL AND SUPPORTIVE MEASURES

» Advice on improving and maintaining oral hygiene. See section 2.1.1: Gingivitis, uncomplicated. General and supportive measures.

MEDICINE TREATMENT

- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose of the amoxicillin component 12 hourly for 5 days. (See annexure 1: Amoxicillin/Clavulanic weight band dosing table)
- Chlorhexidine 0.2%, 15 mL as a mouthwash, 2–4 times daily 30 minutes after brushing and flossing.
  - Continue for 5 days.

For pain:

- Paracetamol, oral, 15 mg/kg/dose 6 hourly when required, to a maximum of 4 doses per 24 hours.

REFERRAL

For dental treatment:

» No improvement within 5 days.

2.1.4 CANDIDIASIS, ORAL

B37.0

See section 8.6: Candidiasis, systemic and other.

2.1.5 APHTHOUS ULCERS

K12.0

DESCRIPTION

Painful ulcers in the oropharynx. Minor ulcers (< 1 cm diameter) usually heal within 2 weeks. Major ulcers (> 1 cm diameter) are very painful, often very deep and persist.

GENERAL AND SUPPORTIVE MEASURES

» Maintain adequate nutrition and hydration by encouraging fluid and food intake – use bland foods and fluids as they cause less pain.
» For minor aphthous ulcers, use homemade warm saline rinse. Dissolve ½ teaspoon of table salt (sodium chloride) in ~ 200 mL warm water. Rinse mouth but do not swallow.

MEDICINE TREATMENT

For pain:

- Paracetamol, oral, 15 mg/kg/dose 6 hourly when required to a maximum of 4 doses per 24 hours.

REFERRAL

» Major aphthous ulcers for further diagnostic evaluation.
» Aphthous ulcers not resolving in 3 weeks for further evaluation.

2.1.6 HERPES GINGIVOSTOMATITIS

B00.2

DESCRIPTION

Inflammation of the mouth structures with ulcers (which may be of various numbers and sizes), caused by *Herpes simplex* virus infection. The normal course of the disease is 7–10 days.

DIAGNOSTIC CRITERIA

Clinical

» General inflammation of the mouth with multiple small ulcers on the buccal mucosa, palate, anterior tonsillar pillars, tongue, inner lips and gingival margins.
» Fever, malaise and dysphagia.
» Tender, enlarged cervical lymph nodes.

GENERAL AND SUPPORTIVE MEASURES

» Maintain adequate nutrition and hydration by encouraging fluid and food intake – use bland foods and fluids as they cause less pain.
» If oral nutrition cannot be maintained use oral/nasogastric and/or IV fluids, if necessary.

MEDICINE TREATMENT

- Chlorhexidine 0.2%, 10 mL as a mouthwash or gargle, 12 hourly.
  - Do not swallow.

For pain:

- Paracetamol, oral, 15 mg/kg/dose 6 hourly.

OR

- Ibuprofen, oral, 5–10 mg/kg/dose 6 hourly after meals.

If more than minor fever blisters:

- Aciclovir, oral, 250 mg/m2/dose 6 hourly for 7 days (or per kg dose equivalent below):
  - If > 1 month to 1 year old: 12.5 mg/kg/dose.
  - If > 1 year to 6 years old: 10 mg/kg/dose.
  - If > 6 years to 12 years old: 6 mg/kg/dose.

LoE III[1]

If very severe infection, consider:

- Aciclovir, IV, 250 mg/m^2/dose 8 hourly for 7 days (per kg dose equivalent below):
  - If > 1 month to 1 year old: 12.5 mg/kg/dose.
  - If > 1 year to 6 years old: 10 mg/kg/dose.
  - If > 6 years to 12 years old: 6 mg/kg/dose.
  - Change to oral as soon as possible.

For very painful oral herpes in children > 2 years:

- Lidocaine (lignocaine) 2% gel applied every 3–4 hours.
  - Apply a thin layer on the affected areas only.
  - Do not exceed 3 mg/kg dose, i.e. maximum 0.15 mL/kg of 2% gel.

REFERRAL

» Herpes gingivostomatitis not responding to therapy.
» Disseminating disease, especially if associated with encephalopathy or increasing liver span.

2.2 GASTROINTESTINAL DISORDERS

2.2.1 CHOLERA

A00.9
*****Notifiable condition.

DEFINITION

An acute diarrhoeal disease caused by *V. cholerae*.

DIAGNOSTIC CRITERIA

Clinical

» Sudden onset of severe, watery diarrhoea, i.e. 'rice water' diarrhoea.
» Low-grade or no fever.
» Persistent vomiting not associated with nausea.
» Rapid fluid and electrolyte losses with dehydration, acidosis and hypovolaemic shock with/without renal failure.
» History of contact with a cholera case or the presence of cholera in the community.

Investigations

» Positive stool culture.
» Agglutinating or toxin-neutralising antibodies in the serum.

GENERAL AND SUPPORTIVE MEASURES

» Isolate patient and institute barrier nursing.
» Ensure adequate hydration and nutrition.
» Check blood glucose in patients with decreased level of consciousness.

The management of the fluid requirements is the most critical element of treating a patient with cholera.

MEDICINE TREATMENT

First treat shock.
Once shock has resolved, manage as acute diarrhoea. See section 2.2.4: Diarrhoea, acute.

For the management of shock during recognised cholera outbreaks, there may be benefit to replace sodium chloride 0.9% with:

- Ringers Lactate, IV.

Antibiotic treatment

Recommended antibiotics may vary according to susceptibilities of organisms in current epidemics. Consult the NICD for the latest recommendations.
Current recommendations for severe dehydration are:

- Ciprofloxacin, oral, 20 mg/kg as a single dose (maximum 750 mg).

OR

- Azithromycin, oral, 20 mg/kg as a single dose.

LoE III[2]

In all children who are able to take oral medication:

- Zinc (elemental), oral, 10 mg/day for 14 days:

REFERRAL

» Cholera with complications, e.g. persistent shock, renal failure and severe electrolyte disturbances.

2.2.2 CONSTIPATION/FAECAL LOADING

K59.0

DESCRIPTION

Constipation: The infrequent passage of hard stools. This is often due to behavioural retention following previous painful episodes of defaecation (functional constipation), but may also be due to organic causes (metabolic, endocrine, neurogenic, lower bowel abnormalities and medication side effects).

Constipation-associated faecal incontinence: The involuntary leakage of small amounts of soft or watery stools secondary to faecal loading.

DIAGNOSTIC CRITERIA

Rome IV Criteria:

Infants up to 4 years of age should have at least two symptoms for 1 month prior to diagnosis and those over developmental age 4 years should have at least two symptoms present for the previous 2 months:

» Two or fewer defaecations per week.
» At least 1 episode of faecal incontinence per week.
» Retentive posturing or stool retention.
» Painful or hard bowel movements.
» Presence of a large faecal mass in the rectum.
» Large diameter stools that may obstruct the toilet.

LoE III[3,4]

GENERAL AND SUPPORTIVE MEASURES

» Determine and treat the underlying cause.
» Treatment involves 3 steps:
  > initial clearance of stools,
  > prevent re-accumulation of hardened retained stool, and
  > retraining of the gut to achieve regular toilet habits.
» Management is long-term and requires the active involvement of the parents.

MEDICINE TREATMENT

Initial therapy

(Disimpaction if indicated):

- Phosphate-containing enema (sodium phosphate 6 g, sodium biphosphate 16 g/100 mL).
  - Age 2–5 years: 32 mL.
  - Age 5–11 years: 64 mL.
  - Repeat once, if necessary.

OR

- Polyethylene glycol 59 g/L solution with sodium sulphate and electrolytes, oral/ nasogastric tube, 10–25 mL/kg/hour until clear fluid is passed rectally.

Note: No additional ingredient should be added to the solution, e.g.

flavourings or sugar containing cold drinks.

Maintenance therapy
The child and parents should be counselled and educated about behaviour modification (regarding toilet habits) and diet changes (additional natural fibre from fruit, vegetables and bran).

(a) Osmotic laxative:
- Lactulose, oral, 0.5–1 mL/kg/dose once or twice daily.

AND/OR
(b) Stool softener:
- Liquid paraffin, oral, 1–3 mL/kg/day. Single or divided dosage.
- Do not use in children under 1 year or those with neurological conditions or swallowing disorders.

AND/OR
(c) Bulk-forming agent:
- Ispaghula husk, oral, 1.75–3.5 g, stirred in water with breakfast.

If faecal loading was present, maintenance therapy should be continued for months to years.

REFERRAL
» Suspected organic cause, e.g. constipation from birth in a breastfed baby.
» Inadequate response to therapy.

2.2.3 CYSTIC FIBROSIS
E84.9

DESCRIPTION
An autosomal recessive disorder of exocrine glands, mainly affecting the gut, pancreas and lungs.

DIAGNOSTIC CRITERIA
Clinical
» Recurrent infections of the respiratory tract with later bronchiectasis, respiratory failure and cor pulmonale.
» Bulky, greasy and foul-smelling stools.
» Occasionally presents with constipation.
» Malabsorption with weight loss and failure to thrive.
» Meconium ileus.
» Positive family history is uncommon unless cystic fibrosis is present in a sibling.

Investigations

» Sweat test:
  > Quantitative analysis of sodium and chloride concentrations in sweat collected after stimulation by pilocarpine iontophoresis with chloride > 60 mmol/L.
  > Sweat conductivity tests are more readily available but not as reliable as sweat electrolyte testing. Positive range for conductivity is 90 mmol/L and above.
» DNA analysis. Negative mutation analysis does not exclude cystic fibrosis.
» Stool elastase will be low in cystic fibrosis patients with pancreatic insufficiency.

GENERAL AND SUPPORTIVE MEASURES

» Nutritional support.
» Physiotherapy and postural drainage.
» Psychosocial support.
» Genetic counselling.

MEDICINE TREATMENT

Medicinal treatment is specialised and individualised and should be under the supervision of a subspecialist.

- Pancreatic enzymes (lipase/amylase/protease), with meals according to clinical response.

REFERRAL

» All to a recognised cystic fibrosis centre and/or specialist health facility for confirmation of diagnosis and initiation of treatment.
» Management of exacerbations.

2.2.4 DIARRHOEA, ACUTE

A09.0

DESCRIPTION

Diarrhoea is a serious common childhood illness evidenced by the passing of frequent profuse loose watery stools. Vomiting may or may not be present.

Diarrhoeal disease is often caused by viral infection but may be due to bacterial infection, dietary or other causes.
Dehydration and metabolic disturbances are common if treatment is not instituted early and may result in severe disease, irreversible organ damage and death in children.

Malnutrition is a serious co-morbidity and/or result of diarrhoeal disease and must be managed correctly, employing ongoing feeding. Feeding, minerals, micronutrients and vitamins are continued except during ileus or shock. See section 2.4: Malnutrition.
In severe malnutrition or in the young infant (< 2 months of age) bacterial co-infection is common.

DIAGNOSTIC CRITERIA

Clinical

The assessment of shock and dehydration in children is not always simple. A good initial assessment and frequent reassessments (4 hourly if dehydration is present) are required. In the presence of shock, continuous reassessments with appropriate adjustment of care are vital in the care of these children.

Shock is shown by one or more of the following:
Compensated shock:
» delayed capillary refilling time (CRT) (> 3 seconds),
» rapid, weak pulse rate,
» cool peripheries.

Late (pre-terminal):
» decreased level of consciousness,
» decreased blood pressure,
» decreased pulse volume.

Dehydration **is treated after shock is dealt with:**

Severe dehydration	Some dehydration
Sunken eyes. Very slow skin pinch (≥ 2 seconds). Drinking poorly.	Sunken eyes. Slow skin pinch (< 2 seconds). Drinks eagerly. Irritable/restless.

Other indicators of dehydration may be sought but do not add substantially to assessment, e.g. depressed fontanelle, absent tears, decreased passage of urine.

Also assess for signs of metabolic, nutritional and other co-morbidities:
» severe malnutrition,
» decreased level of consciousness,
» abnormal tone or floppiness,
» abdominal distension,
» decreased bowel sounds,
» increased respiratory rate and chest indrawing,
» persistent or bile stained vomiting,
» urine for leucocytes or nitrites.

Investigations
» After resuscitation, in children with severe dehydration, shock or other signs of metabolic, nutritional or other co-morbidities:
  > sodium, potassium, urea, creatinine, blood acid-base assessment.

» Stool culture if suspected dysentery, typhoid, cholera.
» Urine test strip on fresh/clean urine specimen for leucocytes, nitrites and blood.
» Ascertain HIV status with consent in every child.

GENERAL AND SUPPORTIVE MEASURES

» Adequate initial assessment and frequent reassessment, including weight, is vital.
» Reassess the patient continuously while shock persists.
» If dehydration is present, reassess the patient 4 hourly and immediately correct shock or deterioration.
» Monitor and maintain:
  > hydration and circulation,
  > blood pressure,
  > acid-base status.
  > normal blood glucose,
  > blood electrolytes,
» Monitor urine output, should be at least 1 mL/kg/hour. This may be difficult in small children with diarrhoea, especially in female infants.
» Monitor body mass regularly. Weigh daily, or 6 hourly if unsure of hydration status and child is very ill or small. This can be used to indicate response of hydration.
» Continue oral feeds during period of diarrhoea:
  > if the child is breastfed, continue breastfeeds and encourage the child to feed longer at each feed;
  > if the child is exclusively breastfed, give oral rehydration solution (ORS) in addition to each feed;
  > if the child is not exclusively breastfed, give ORS and other appropriate feeds, e.g. breast milk substitutes or food based fluids;
  > if the child is severely dehydrated or shocked, withhold feeding until stable, usually a few hours only.

MEDICINE TREATMENT

There is no place for antidiarrhoeal medications, i.e. kaolin and pectin, atropine and diphenoxylate, loperamide, or antiemetics in the routine management of acute diarrhoea.

OUTLINE OF PRACTICAL FLUID THERAPY OF DEHYDRATING WATERY DIARRHOEA

With severe malnutrition, the assessment of dehydration is more difficult. Avoid intravenous infusions, if possible.
Treatment of dehydration requires more care/more frequent assessments.

1. First treat shock, if present (if no shock, proceed to section 2 below).

If an IV infusion cannot be set up within 5 minutes, use an intra-osseous infusion. See section 1.1.10: Intra-osseous infusion in emergencies. During treatment of shock and administer oxygen.

- Sodium chloride 0.9%, IV, 10 mL/kg given as a bolus over 20 minutes.
  - After each bolus, reassess for persistence of shock, or evidence of circulatory overload.
  - Repeat the fluid bolus up to 6 times if shock still persists, provided that evidence of circulatory overload is not present.
  - If after the forth bolus, i.e. total of 40 mL/kg has been given and the response is inadequate, a fifth bolus can be started. Move the patient to ICU for CVP monitoring and inotropic support.

Treatment of shock in severe malnutrition

Shock treatment should be more cautious in patients with severe malnutrition due to poor cardiac reserve and high prevalence of gram-negative septicaemia.

- Sodium chloride 0.9%, IV, 10 mL/kg administered over 20 minutes.
  - Up to 4 boluses may be given.
  - Deterioration may be due to fluid overload and shock may be due to septicaemia, not always hypovolaemia.
  - After 4 boluses (40 mL/kg) further treatment should be in a high care unit.
  - Reassess frequently during treatment of shock. Patient's response should guide further fluid therapy.

If pulse and respiratory rate increases, increasing liver span and gallop rhythm are found, suspect fluid overload/cardiac dysfunction and manage appropriately. See section 1.1.8: Shock.

When shock has been treated, proceed to the management of dehydration.

2. Severe dehydration or some dehydration.

2a. If the child has not failed oral rehydration and was not in shock:

- Oral rehydration solution (ORS), oral, 80 mL/kg over 4 hours using frequent small sips (i.e. 5 mL/kg every 15 minutes for 4 hours).
  - Give more if the child wants more.
  - Show the caregiver how to give ORS with a cup and spoon.
  - If child vomits, wait 10 minutes and then continue more slowly.

Nasogastric tube (NGT) rehydration 20 mL/kg/hour over 4 hours can be used as an alternative.

PLUS

» Encourage caregiver to continue feeding the child, especially breastfeeding.
» Oral feeds should be given at normal volumes and times if:
  > the level of consciousness is normal,
  > the child is not in severe distress,
  > not shocked and,
  > has no surgical abdomen.
» Review after 4 hours:
  > general condition,
  > capillary filling time,
  > level of consciousness,
  > skin turgor,
  > sunken eyes.
  > respiratory rate,
  > abdomen (liver span),
  > if passing urine,
  > number/quality of stools,

See *Figure 1: Summary flow chart for correction of dehydration in diarrhoeal disease.*

» Assess response 4 hourly.

2b. If the above treatment (oral/NGT treatment) fails, and patient was in shock or has already failed at primary health care level, then:

Oral rehydration solution

- Oral rehydration solution (ORS), oral, 80 mL/kg over 4 hours using frequent small sips (i.e. 5 mL/kg every 15 minutes for 4 hours) or NGT rehydration 20 mL/kg/hour over 4 hours.

PLUS

Oral feeds at normal feed volumes and times if:
» the level of consciousness is normal,
» the child is not in severe distress,
» is not shocked and,
» has no surgical abdomen.

PLUS

IV fluid*

- Sodium chloride 0.9%/dextrose 5%, IV, 10 mL/kg/hour administered for 4 hours, then reassess.
  - Alternative isotonic fluids can be used, e.g. sodium chloride 0.9% or ringers lactate.

**(This rate is in line with current safety evidence but the need for regular reassessment 4 hourly remains.)*

» Review after 4 hours:
  > general condition,
  > capillary refilling time,
  > respiratory rate,
  > abdomen (liver span),

- level of consciousness,
- skin turgor,
- sunken eyes.
- urine output,
- number/quality of stools,

See Figure 1: Summary flow chart for correction of dehydration in diarrhoeal disease.

3. No visible signs of dehydration on presentation or a child stable with no dehydration after treatment of dehydration.

Show the caregiver how to give ORS with a cup and spoon using frequent small sips.

Encourage caregiver to give 10 mL/kg after each diarrhoeal stool until diarrhoea stops.

Instruct the caregiver on how to make and use ORS/sugar salt solution (SSS) at home.

Homemade sugar and salt solution may be used if oral rehydration formula is not available.

HOMEMADE SUGAR AND SALT SOLUTION (SSS)

½ level medicine measure of table salt
PLUS
8 level medicine measures of sugar
dissolved in 1 litre of boiled (if possible) then cooled water
(1 level medicine measure = approximately 1 level 5 mL teaspoon).

Encourage the caregiver to continue feeding the child, especially breastfeeding.

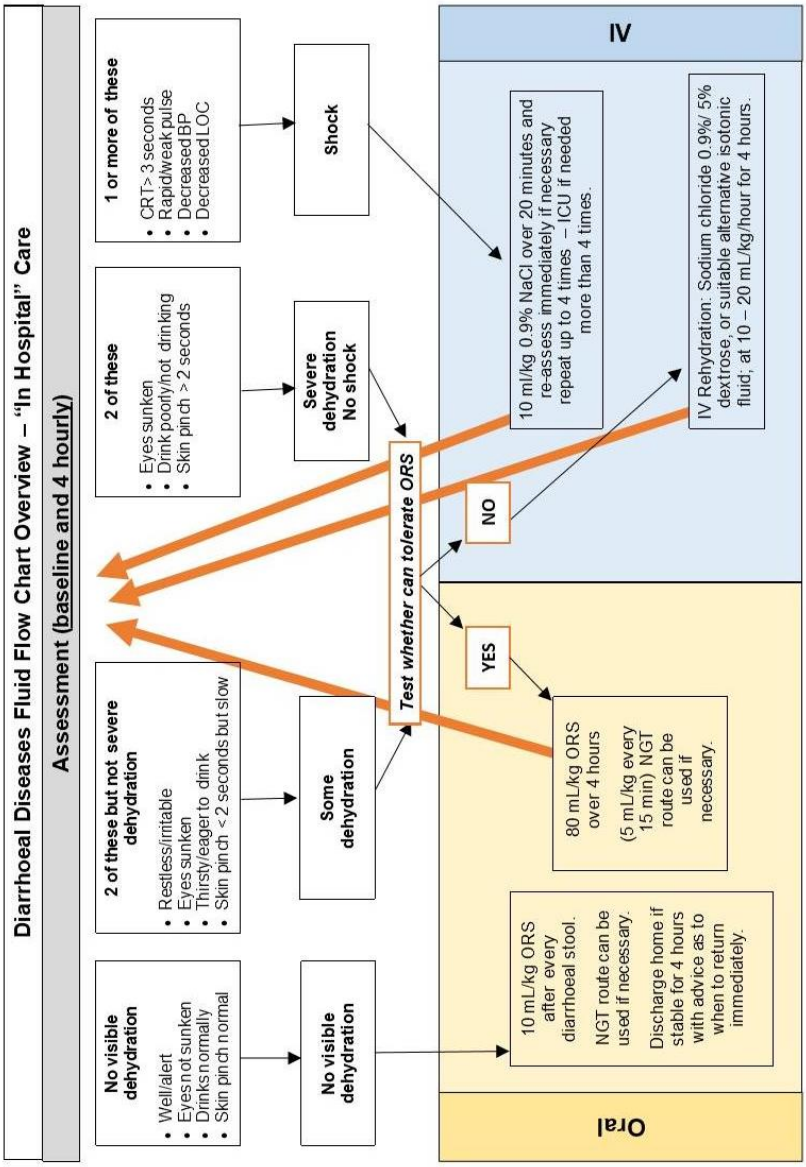
Instruct the caregiver to give the child extra feeds after the diarrhoea has stopped to make up for the period of inadequate intake.

Child should return to hospital immediately if:

- no improvement,
- condition deteriorates,
- poor drinking or feeding,
- slow skin pinch.
- blood in stool,
- fever develops,
- sunken eyes,

Educate caregivers about hygiene, oral rehydration solution and danger signs of diarrhoea.

Figure 1: Summary flow chart for correction of dehydration in diarrhoeal disease.



CRT: Capillary Refilling Time

Metabolic disturbances

Acidosis

Metabolic acidosis will correct with appropriate fluid therapy and does not require additional treatment unless severe, i.e. pH < 7.1, or if the body is unable to correct the deficit, e.g. salicylate poisoning or renal failure.
Additional treatment should only be considered with expert supervision.
Correcting the renal circulation and shock will lead to self-correction in almost all cases.
If correction is necessary: volume of sodium bicarbonate 4.2% required is:

- Sodium bicarbonate 4.2% as a bolus.
    - Dose in mL to be given = 0.3 x base deficit x weight in kg.
    - Review response to assess the need for further correction.

Hypokalaemia

Note: Potassium levels are affected by the degree of acidosis.

If potassium is 2.5 mmol/L to 3.5 mmol/L:

- Potassium chloride, oral, 25–50 mg/kg/dose 8 hourly.

If potassium is < 2.5 mmol/L:

- Potassium IV replacement:

IV potassium only to be used where appropriate monitoring is available which must include continuous ECG and bedside serum potassium/blood gas analysis.
Ensure slow administration, over 4 hours.

    - The maximum concentration of potassium in a litre of fluid is 40 mmol and should not exceed 0.5–1 mmol/kg/hour. For sodium chloride 0.9%/dextrose 5%, the maximum volume of 15% potassium chloride in 1 L is 20 mL. (1 mL 15% potassium chloride has 2 mmol potassium.)
    - Mix well before administration.
    - Run at normal rehydration rate (as above).

Note: In stable patients with severe hypokalaemia, correction with oral potassium supplementation can be considered.

Oral potassium may also be given during this period:

- Potassium chloride, oral, 25–50 mg/kg/dose 8 hourly.

Monitor serum potassium 8–12 hourly. Once above 3.0 mmol/L, stop IV potassium and continue with oral.

Hypernatraemia (> 150 mmol/L)

Severe symptoms usually only develop when the serum sodium is > 160 mmol/L. Symptoms tend to be more severe with acute hypernatraemia (i.e. over a period of hours) while chronic hypernatraemia is often better tolerated because of cerebral compensation.

The true degree of dehydration is often underestimated because the intravascular volume is preserved; signs of intracellular dehydration include lethargy, irritability, 'doughy skin', high-pitched cry, hyperreflexia and seizures.

Too rapid reduction of the serum sodium in hypernatraemia can cause cerebral oedema, convulsions and permanent brain injury. More frequent serum sodium monitoring is needed where hypotonic solutions are used.

Moderate hypernatraemic dehydration (Na 150–169 mmol/L):

» If shock is present resuscitate with boluses of 20 mL/kg of 0.9% sodium chloride (see above: step 1 – treat shock).
» Aim to lower the serum sodium slowly with no more than 0.5 mmol/L/hour (10–12 mmol/L) over 24 hours.
» Fall of sodium levels more than 1 mmol/L/hour on average means the rehydration rate should be reduced.
» Oral rehydration (10 mL/kg/hour) is preferable to IV rehydration.
» If oral rehydration is tolerated, feeding should be continued.
» Because of longer duration of dehydration, continuous nasogastric tube administration is preferable.
» Fluid is calculated as replacement of deficit (50–70 mL/kg) plus maintenance (over 2 days) over 48 hours.

Calculation of maintenance fluid (mL):

≤ 1 year:	120 mL/kg/24 hours
> 1 year = sum of the following: » First 10 kg body weight » Second 10 kg body weight » Additional weight > 20 kg body weight	 100 mL/kg/24 hours 50 mL/kg/24 hours 20 mL/kg/24 hours

If oral/NGT rehydration fails, rehydrate using IV with sodium chloride 0.9%/dextrose 5% over 48 hours.

IV fluid rate

Rate:

> If 2–10 kg: 6 mL/kg/hour
> If > 10–20 kg: 5 mL/kg/hour
> If > 20–40 kg: 4 mL/kg/hour

» Oral rehydration can be continued for ongoing losses (such as profuse diarrhoea).
» Fluid status, ongoing losses and neurological status should be monitored 2 hourly.

Severe hypernatraemic dehydration (sodium > 170 mmol/L (discuss with specialist paediatrician):

This is a medical emergency and referral to an intensive or high care unit should be considered.

» Sodium chloride 0.9%/dextrose 5% plus potassium chloride (see below) is used to correct clinical dehydration for the first 48 hours. Sodium chloride 0.9%/dextrose 5% plus potassium chloride (to 20 mmol/L), IV.
» To every litre 0.9% sodium chloride add 100 mL 50% dextrose and 10 mL 15% KCl [20 mmol potassium]). Infusion rate as above.
» Repeat serum sodium every 8–12 hours to monitor progress.
» Failure to decrease sodium levels usually means the rehydration rate is too slow.
» Frequent clinical reassessment is the key to the safe management of this situation. Serum sodium levels may be done more frequently where this is possible. Adjust the drip rate according to response.
» If convulsions are considered likely, (decreased level of consciousness, hyper-irritable child), in the setting of high serum sodium, consider the use of prophylactic anticonvulsants:
  - Phenobarbitone, IV, 20 mg/kg as a single dose.

  OR

  If IV phenobarbitone not available:
  - Phenobarbitone, oral, 20–30 mg/kg as a single dose.

Hyponatraemia

The correction of hyponatraemia is usually only necessary where the serum sodium is significantly decreased (i.e. < 120 mmol/L), or if the patient is symptomatic.

Use sodium chloride 0.9% and add potassium chloride and dextrose as indicated below.

Give at the rate indicated for dehydration and expect correction to have occurred after the following estimated volume:

Volume of sodium chloride 0.9% (mL) = (130 - Na) x body weight in kg x 4.

- Administer sodium chloride 0.9%, 200 mL plus potassium chloride 15%, 2 mL plus dextrose 50%, 20 mL into the fluid bag.
  - Mix well before administration.
- Oral rehydration solution (ORS), oral, at the required rate.

Antibiotic therapy

Note:

» Antibiotics are not routinely used for diarrhoeal disease.
» During diarrhoea, absorption of antibiotics may be impaired due to intestinal hurry. Give antibiotics orally if administered for intra-luminal effect.
» Other antibiotics for systemic action are best administered parenterally.
» Consider a urinary tract infection, or septicaemia in children with severe malnutrition, the immunocompromised and infants < 2 months old.

Dysentery

Treat initially as Shigella dysentery:

- Ceftriaxone, IV, 100 mg/kg as a single daily dose for 5 days.

OR

- Ciprofloxacin, oral, 15 mg/kg/dose 12 hourly for 3 days.

For *Entamoeba histolytica* (if demonstrated on stool microscopy, or strongly suspected – this is now a relatively uncommon condition in children in South Africa).

- Metronidazole, oral, 15 mg/kg/dose 8 hourly for 7 days.
  - Severe disease: treat for 10 days.

Cholera

Treat according to susceptibilities of organisms in current epidemics.
See section 2.2.1: Cholera.

Typhoid

- Ceftriaxone, IV, 100 mg/kg once daily for 10–14 days.

Severe malnutrition

See section 2.4.1: Malnutrition, severe acute.

- Ampicillin, IV, 50 mg/kg/dose 6 hourly for 5 days.

PLUS

- Gentamicin, IV, 6 mg/kg as a single daily dose for 5 days.
  - Confirm normal renal function before second dose.

Very young infants < 2 months

- Ampicillin, IV, 25–50 mg/kg/dose 6 hourly for 5 days.

PLUS

- Gentamicin, IV, 6 mg/kg as a single daily dose for 5 days.
  - Confirm normal renal function before second dose.

Mineral and micronutrient supplementation

All children with diarrhoea.

- Zinc (elemental), oral, 10 mg/day for 14 days.

- Potassium chloride, oral, 8 hourly.
  - If < 6 months: 125 mg.
  - If > 6 months: 250 mg.
  - Do not give if patient is hyperkalaemic or anuric.

REFERRAL

» Inability to correct/treat shock/dehydration.
» Metabolic complications: non-responsive acidosis, severe hypernatraemia (> 170 mmol/L) and symptomatic hypokalaemia.

2.2.5 PERSISTENT DIARRHOEA

DESCRIPTION

Persistent diarrhoea is a diarrhoeal episode of presumed infectious aetiology that begins acutely but has a prolonged duration lasting more than 14 days.

GENERAL AND SUPPORTIVE MEASURES

Treatment strategy includes a stepwise approach with modification of the diet, which are not mutually exclusive and are applied according to local resources.

» Monitor hydration, stools, nutritional status, weight gain, growth and other nutritional parameters such as serum proteins.
» Nutritional support:
  > Aim to provide at least 460 kJ/kg/day orally within 3 days to protect the nutritional state.

STEP-WISE EMPIRIC PROTOCOL FOR MANAGEMENT OF DIARRHOEA

Commence management at the most appropriate step according to previous management – many infants with persistent diarrhoea will already have failed the 'day 1–2' stage and will commence management on 'day 3–7'.

Day 0 (presentation at Health Care Facility with acute diarrhoea):

» Rehydration according to figure above. Recommence breast or formula feeds within 4–6 hours, and additional oral rehydration solution (ORS) to maintain hydration.

Day 1–2:

» Continue full-strength feeds with additional ORS as required.

Day 3–7:

» Change to lactose-free feeds if not breastfed.
» Continue additional oral rehydration as required.
» If diarrhoea resolves, discharge, but continue with lactose-free feeds for 2 weeks.

Day 8–13:

» Semi-elemental formula: sucrose- and lactose-free, protein hydrolysate, medium chain triglyceride.
» Continue additional ORS as required.
» If diarrhoea resolves, discharge if possible on semi-elemental feeds for at least 2 weeks. If this is not possible, a trial of lactose-free feeds before discharge should be given and if successful, the child should be discharged on this feed.

If Giardia is not excluded:

- Metronidazole, oral, 7.5 mg/kg/dose 8 hourly for 5 days.

In HIV-infected children: *Cystoisospora belli* and *Cyclospora cayetanensis*:

- Co-trimoxazole, oral, 5 mg/kg/dose of trimethoprim 12 hourly for 10 days.

If diarrhoea persists, the child should be referred for further investigations and/or intravenous alimentation.

> Where the stepwise approach is not possible:
Under 4 months:
Encourage exclusive breastfeeding if lactose intolerance is not severe.
If not exclusive breastfeeding, use breast milk substitutes that are low in lactose, e.g. yoghurt or amasi or specialised formulae or lactose-free milk formula.

Children aged 4 months and older:
Feeding should be restarted as soon as the child can eat, with small meals 6 times a day.

> Nasogastric feeding may be required in children who eat poorly.
> If the response is good, give additional fruit and well-cooked vegetables to children who are responding well.
> After 7 days of treatment with an effective diet, resume an appropriate diet for age, including milk, which provides at least 460 kJ/kg/day.
> Follow up regularly to ensure recovery from diarrhoea, continued weight gain and adherence to feeding advice.

MEDICINE TREATMENT

CAUTION
Antidiarrhoeal and anti-emetic agents are NOT recommended.

Antibiotic therapy
Antibiotics are only indicated when specific infections are suspected or where they are used in the Step-Wise Based Empiric Protocol for Management of Diarrhoea.

All persistent diarrhoea with blood in stool should be treated as dysentery. See section 2.2.7: Dysentery.

For *Campylobacter*:
- Azithromycin, oral, 10 mg/kg/day for 3 days.

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For *G. lamblia*:
- Metronidazole, oral, 7.5 mg/kg/dose 8 hourly for 5–7 days.

For *Y. enterocolitica*:
- Ceftriaxone, IV, 100 mg/kg/dose once daily.

OR
- Cefotaxime, IV, 50 mg/kg/dose 6 hourly.

For *Cryptosporidium*:
- No effective treatment available in the presence of HIV-related immunosuppression.

For *Cystoisospora belli*:
- Co-trimoxazole, oral, 5 mg/kg/dose of trimethoprim component 12 hourly for 10 days.

For *Cyclospora cayetanensis*:
- Co-trimoxazole, oral, 5 mg/kg/dose of the trimethoprim component 6 hourly for 5 days.

For *Microsporidia*:
- Albendazole, oral, 7.5 mg/kg/dose 12 hourly. (Specialist supervision.)

LoE III[6]

After success as indicated by weight gain, return of appetite and decrease of diarrhoea, less elemental diets can be judiciously and slowly re-introduced.

Mineral and micronutrient deficiencies
- Zinc (elemental), oral, 10 mg/day.

Provide nutritional support.

2.2.6 DIARRHOEA, CHRONIC OTHER THAN POST INFECTIOUS

K52.9

DESCRIPTION

Chronic diarrhoea: diarrhoea for longer than two weeks.

Chronic diarrhoea results in significant morbidity and mortality associated with poor nutrition.

Chronic diarrhoea is most frequently due to:

» Temporary loss of disaccharidase activity in the intestinal microvillous brush border, e.g. lactase loss; or luminal infection/infestation, which may be non-specific bacterial overgrowth.
» Rare causes include food allergies, cystic fibrosis and coeliac disease.

DIAGNOSTIC CRITERIA

Clinical

» Chronic diarrhoea without weight loss or dehydration – consider toddler's diarrhoea.
» Chronic diarrhoea with weight loss and dehydration – consider small bowel mucosal injury with multiple pathophysiological mechanisms, e.g. lactose intolerance, small bowel bacterial overgrowth and immunosuppression.
» Chronic diarrhoea with weight loss but no dehydration – consider a malabsorption syndrome, e.g. coeliac disease, allergic enteropathy, cystic fibrosis, etc.
» Consider the possibility of HIV infection.
» In the presence of abdominal pain, bloody stools, weight loss, perianal disease or extraintestinal features such as arthritis or uveitis, consider inflammatory bowel disease and refer to an appropriate specialist.

Investigations

Where weight gain falters, dehydration recurs, the child is ill or the diarrhoea continues:

» Full blood count.
» Serum proteins.
» Urine and stool microscopy, culture and sensitivity tests (MCS).
» Positive stool-reducing substances if on a lactose-containing diet. Stool pH < 5.5 also suggests carbohydrate malabsorption.
» Faecal elastase.

REFERRAL

» Inability to maintain hydration (persisting watery diarrhoea even when fasting).
» Lack of local resources to support the stepwise protocol at any step.

» All cases not responding by day 12–13 of the stepwise protocol.
» If cystic fibrosis, allergic enteropathy or coeliac disease is suspected, but difficult to diagnose due to lack of local resources.

2.2.7 DYSENTERY

A03.9

DESCRIPTION

Passage of blood and mucus in the stools.
Shigella infection is the most common serious cause in children in South Africa.
Complications include:

» dehydration,
» shock,
» acidosis,
» renal failure, and
» convulsions,
» toxic megacolon,
» rectal prolapse,
» haemolytic uraemic syndrome.

DIAGNOSTIC CRITERIA

Clinical

» Sudden onset.
» Abdominal cramps, peritonism, urgency, fever and diarrhoea with blood and mucus in the stools.
» Meningismus and convulsions may occur.
» Exclude intussusception. Evidence of intussusception includes:
  > pain or abdominal tenderness,
  > bile-stained vomitus,
  > red currant jelly-like mucus in stool,
  > appearance of the intussusceptum through the anus.

Investigations

» Stool culture to confirm diagnosis of Shigellosis.
» Polymorphs and blood on stool microscopy.
» Immediate microscopy of warm stool to diagnose amoebic dysentery.

GENERAL AND SUPPORTIVE MEASURES

» Monitor fluid and electrolyte balance.
» Ensure adequate nutrition and hydration.

MEDICINE TREATMENT

Fluid and electrolyte replacement

See section 2.2.4: Diarrhoea, acute.

Antibiotic therapy
Treat as Shigella during an epidemic of Shigellosis, or if the child is febrile, 'toxic'-looking, has seizures or if Shigella is cultured from the stool and the child is still ill.

- Ciprofloxacin, oral, 15 mg/kg/dose 12 hourly for 3 days.

Where oral medication cannot be used:
- Ceftriaxone, IV, 100 mg/kg as a single daily dose for 5 days.

For *Entamoeba histolytica* (only if demonstrated on stool microscopy, or strongly suspected):
- Metronidazole, oral, 15 mg/kg/dose 8 hourly for 7 days.

REFERRAL
» Dysentery with complications, e.g. persistent shock, haemolytic uraemic syndrome and toxic megacolon.

2.2.8 GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD)
K21

DESCRIPTION
Gastro-oesophageal reflux is repetitive regurgitation/reflux of gastric contents into the oesophagus.

It is termed 'Complicated GOR' or 'GORD' if associated with the diagnostic criteria below.

It should be differentiated from 'Uncomplicated GOR' if the only symptom is frequent small vomits, in which case no further investigation or treatment is needed. Parents should be reassured that regurgitation improves spontaneously during the first year of life.

DIAGNOSTIC CRITERIA
» GORD should be suspected if there is recurrent vomiting or regurgitation and any of the following:
  > respiratory symptoms, i.e. recurrent wheeze or cough, chronic obstructive airway disease, recurrent aspiration/pneumonia, stridor, apnoea and an apparent life-threatening event;
  > faltering of growth; and
  > abnormal posturing or opisthotonus (Sandifer syndrome).

Consider other causes of vomiting and faltering of growth, such as pyloric stenosis or cow's milk allergy.

Investigations

Note: Routine investigations are seldom indicated. Discuss with a specialist prior to performing investigations.

GENERAL AND SUPPORTIVE MEASURES

» Postural treatment: lying on the left side is currently recommended.
» Dietary measures such as feed thickeners. If not breastfeeding, frequent small volume feeds or specialised anti-reflux infant formula.

MEDICINE TREATMENT

Note: Evidence in support of the following recommendations is weak.

Specialist initiated:

- Omeprazole, oral, 0.7–1.4 mg/kg/day once daily, on an empty stomach for 4 weeks, then stop therapy. If symptoms re-occur and persist for 3–4 days after stopping, consider reinitiating.
  - Maximum dose: 20–40 mg/dose.
    If 1 month–2 years: 5 mg once daily.
    If > 2–6 years: 10 mg once daily.
    If > 7–12 years: 20 mg once daily.

REFERRAL

» For diagnostic investigations, if not available locally.
» GORD not responding to treatment.

2.2.9 PEPTIC ULCER DISEASE

K27

DESCRIPTION

Varying degrees of gastritis or frank ulceration of the stomach or duodenum due to acid and pepsin-laden stomach contents on the gastric and duodenal mucosa in the face of inability of mucosal defence mechanisms to prevent these effects.
Peptic ulcers may be primary (e.g. *Helicobacter pylori* related) or secondary, (e.g. stress related or associated with NSAID use).

DIAGNOSTIC CRITERIA

Clinical

» Haematemesis or melaena is a relatively common presentation in children (up to 50%).
» Epigastric pain. Pain is often poorly localised in children, described as dull and aching and frequently does not respond to antacids.

Investigations

» Endoscopy to confirm diagnosis.

GENERAL AND SUPPORTIVE MEASURES

» Manage circulation and anaemia, as required.
» Stop all non-steroidal anti-inflammatory agents.
» Remove all stressors identified.

MEDICINE TREATMENT

- Proton pump inhibitor, e.g.:
  - Omeprazole, oral, 0.7–1.4 mg/kg/day once daily. Specialist initiated.
    - Maximum dose: 20–40 mg/dose.
      If 1 month–2 years: 5 mg once daily.
      If > 2–6 years: 10 mg once daily.
      If > 7–12 years: 20 mg once daily.

LoE III [7]

PLUS

If *Helicobacter pylori* positive: (Not routinely.)

- Metronidazole, oral, 7.5 mg/kg/dose 12 hourly for 14 days.

PLUS

- Amoxicillin, oral, 25–30 mg/kg/dose 12 hourly for 14 days.

LoE III [7]

Penicillin allergy

In case of severe penicillin allergy, replace amoxicillin with:

- Azithromycin, oral, 10 mg/kg daily for 5 days.

REFERRAL

» Poor response to treatment.
» Suspicion of underlying cause.

2.3 HEPATIC DISORDERS

2.3.1 CIRRHOSIS

K74.6

DESCRIPTION

The end result of irreversible damage to the liver tissue, causing a widespread, diffuse process of fibrosis with regenerating nodule formation. The fibrosis and abnormal portosystemic vascular connections that result cause ongoing damage. The progression rate is variable, but ultimately results in liver failure.

Causes are divided into biliary cirrhosis due to bile duct obstruction and post necrotic cirrhosis where the lesion is hepatocellular.

Complications include:
» fat malabsorption,
» liver failure,
» portal hypertension, and
» ascites secondary to portal hypertension.

DIAGNOSTIC CRITERIA

Clinical

» Clubbing may be present.
» Jaundice
» Hepatomegaly and/or splenomegaly and/or ascites.
» Signs and symptoms of complications.

Investigations

» Liver enzymes may be normal.
» FBC may show signs of hypersplenism with reduced circulating red cells, white cells and platelets.
» Prolonged prothrombin time/INR.
» Hypo-albuminaemia.
» Ultrasound of the liver and spleen may be abnormal.
» Liver biopsy confirms cirrhosis.

GENERAL AND SUPPORTIVE MEASURES

» Ensure adequate nutrition:
  > Consult dietician, if available.
» If not encephalopathic:
  > High protein diet, i.e. 3 g/kg/day and medium chain triglyceride supplementation (if cholestatic jaundice).
  > High carbohydrate diet, supplement with glucose polymers.
  > If high serum cholesterol or if xanthelasma: low cholesterol diet.

MEDICINE TREATMENT

- Multivitamin, oral, 5 mL as a single daily dose.

If INR is abnormal, consider a trial of vitamin K and if no response, stop.

- Vitamin K1 (phytomenadione), oral, 2–5 mg three times weekly.
  - Monitor INR and titrate dose accordingly.
  - In the presence of cholestatic jaundice vitamin K should be given parenterally.

REFERRAL

» All children with suspected cirrhosis should be referred to determine a possible cause.

2.3.2 CHRONIC CHOLESTASIS

DESCRIPTION

Impairment of bile formation and/or bile flow, which may present with pruritis and/or jaundice. It is classified as intrahepatic (e.g. chronic hepatitis, paucity of bile ducts) or extrahepatic (e.g. biliary atresia).

GENERAL AND SUPPORTIVE MEASURES

Diet supplemented with medium-chain triglycerides.

MEDICINE TREATMENT

For pruritus of cholestasis:

- Colestyramine, oral, 240 mg/kg/day in 3 divided doses with meals.
  - Mix with water or other fluids.
  - Other medications should be given 1 hour before or 4–6 hours after colestyramine use.

For sedation:

- Chlorphenamine, oral, 0.1 mg/kg/dose up to 6 hourly.

2.3.3 PORTAL HYPERTENSION

K76.6

DESCRIPTION

Increased portal venous pressure above vena cava pressure. Most commonly secondary to cirrhosis, but causes without cirrhosis may be divided into prehepatic portal vein obstruction, intra-hepatic (pre-or post-sinusoidal) and post-hepatic causes.

DIAGNOSTIC CRITERIA

Clinical

» Splenomegaly with ascites, variceal haemorrhage or hypersplenism.

Investigations

» FBC may show hypersplenism.
» Doppler assisted ultrasound and angiography.
» Investigations as listed under cirrhosis.

GENERAL AND SUPPORTIVE MEASURES

» Determine and manage underlying cause.

REFERRAL

» All children with portal hypertension should be referred.

2.3.3.1 BLEEDING OESOPHAGEAL VARICES

I85.0

DESCRIPTION

Presentation with haematemesis (fresh blood) or melaena in a patient who has a spontaneous bleed from varices at the oesophageal-gastric junction. The patient may or may not have been known to have chronic liver disease and portal hypertension. This bleeding may be hard to control and be life threatening.

GENERAL AND SUPPORTIVE MEASURES

» Resuscitation and blood transfusion as required.
» For local control of acute bleeds that are not controlled with medicine treatment: Sengstaken tube.
» For secondary prophylaxis after a bleed: refer for endoscopic injection sclerotherapy or variceal banding every 2 weeks until eradicated.
» If either or both treatments fail: surgical over-sewing.

MEDICINE TREATMENT

- Octreotide, IV, bolus, 1–2 mcg/kg immediately, then 1–5 mcg/kg/hour by infusion. Specialist initiated.

LoE III[8]

Post bleed prophylactic management

- Proton pump inhibitor, e.g.:
  - Omeprazole, oral, 0.7–1.4 mg/kg/day once daily. Specialist initiated.
    - Maximum dose: 20–40 mg/dose.
      If 1 month to < 2 years: 5 mg once daily.
      If 2 to < 7 years: 10 mg once daily.
      If 7 to12 years: 20 mg once daily.

LoE III [7]

AND

- Propranolol, oral, 2 mg/kg daily in 3 divided doses.
  - If needed, increase dose to 8 mg/kg/24 hours.
  - Aim to reduce the resting pulse rate by 25%.

REFERRAL

» All, to establish diagnosis and initiate treatment.
» Bleeding varices: only after commencement of resuscitation and octreotide, if available.

2.3.3.2 ASCITES, DUE TO PORTAL HYPERTENSION

R18

GENERAL AND SUPPORTIVE MEASURES

» Restrict sodium intake, 1–2 mmol/kg/24 hours.
» Restrict fluids if serum sodium < 130 mmol/L.

MEDICINE TREATMENT

- Spironolactone, oral, 1–3 mg/kg as a single daily dose. Can increase dosage slowly to 4–6 mg/kg/day.
  - Continue for as long as needed to control ascites.
  - Monitor serum potassium.

If insufficient response, add:

- Furosemide, oral, 1–3 mg/kg as a single daily dose.

Note: Spironolactone to furosemide ratio should be 2.5:1.

OR (do not give furosemide and hydrochlorothiazide together)

- Hydrochlorothiazide, oral, 1 mg/kg/dose 12–24 hourly.
  - Maximum dose: 25 mg daily.

Therapeutic paracentesis may be performed to relieve the cardiorespiratory and gastrointestinal manifestations of tense ascites. The upper abdomen, surgical scars, the bladder and collateral vessels should be avoided when inserting the paracentesis needle. 50 mL/kg ascites can be tapped over an hour with IV albumin 1 g/kg to prevent circulatory dysfunction.

LoE III[9]

REFERRAL

» **Urgent:** Refractory ascites interfering with respiration.
» For determination of the underlying cause of the cirrhosis, portal hypertension and initiation of treatment.
» Cirrhosis, portal hypertension and/or liver failure not responding to adequate therapy.
» Hepatic encephalopathy.

2.3.4 HEPATITIS, VIRAL, ACUTE

B17.9
*Notifiable condition

DESCRIPTION

Acute inflammation of the liver with varying degrees of hepatocellular necrosis caused by Hepatitis A, B and less commonly C, and E viruses.

DIAGNOSTIC CRITERIA

Clinical

» Prodromal phase:

- nausea,
- vomiting,
- fever, and
- malaise,
- anorexia,
- right upper quadrant abdominal pain.

» Jaundice, tender hepatomegaly and dark urine.

Investigations

» Raised transaminases and bilirubin.
» Serological evidence of hepatitis virus infection. See section 2.3.5: Hepatitis B, chronic, for Hepatitis B interpretation chart.

GENERAL AND SUPPORTIVE MEASURES

» Isolate patient if Hepatitis A for 7–10 days after the onset of jaundice.
» Inform patient of infectivity risk if Hepatitis B, or C.
» Bed rest does not alter the course of the disease.
» Hepatitis B is vaccine preventable, see Primary Health Care STGs and EML, Chapter 13: Immunisation.

MEDICINE TREATMENT

» If Hepatitis B treatment is being considered, discuss with a specialist.
» See section below for chronic Hepatitis B.

REFERRAL

» Acute hepatitis with bleeding tendency and altered level of consciousness – isolation recommended.
» Prolonged jaundice or raised transaminases.
» Chronic hepatitis with/without cirrhosis.

2.3.5 HEPATITIS B, CHRONIC

B18.1

DESCRIPTION

Persistently elevated transaminases after Hepatitis B infection.

DIAGNOSTIC CRITERIA

» Transaminases are double upper limit of normal.
» Liver biopsy is characteristic.
» Hepatitis B serology positive.

Interpretation of Hepatitis B Serological Test Results

- Susceptible:

HBsAg	negative
Anti-HBc	negative
anti-HBs	negative
IgM anti-HBc	negative

- Immune due to vaccination:

HBsAg	negative
Anti-HBc	negative

anti-HBs positive > 10 milli-units/mL

- Immune from natural infection:
  - HBsAg negative
  - Anti-HBc positive
  - anti-HBs positive
- Acute infection:
  - HBsAg positive
  - Anti-HBc positive
  - anti-HBs negative
  - IgM anti-HBc positive
- Chronic infection:
  - HBsAg positive
  - Anti-HBc positive
  - anti-HBs negative
  - IgM anti-HBc negative

Four possible interpretations:

1. Recovering from acute HBV infection.
2. Distantly immune anti-HBs level too low to detect.
3. Susceptible with false positive anti-HBc.
4. Chronic infection with HBsAg levels too low to detect.
   - HBsAg negative
   - Anti-HBc positive
   - anti-HBs negative

REFERRAL

» For confirmation of diagnosis and initiation of treatment.

2.3.6 HEPATITIS C, CHRONIC

B17.1

DESCRIPTION

A chronic inflammation of the liver caused by vertical (perinatal) transmission of Hepatitis C virus from an infected mother. The disease is mostly mild in childhood and in up to 25% the virus can be spontaneously cleared from age 2 up to 7 years.

DIAGNOSTIC CRITERIA

» Anti-HCV ELISA which detects IgG antibodies. Transplacental maternal IgG antibodies may persist up to age 18 months.
» HCV RNA (quantitative).
» HCV genotyping is only done if treatment is considered.

REFERRAL

All children with positive HCV RNA.

2.3.7 HEPATITIS, TOXIN INDUCED, ACUTE

K71.6

DESCRIPTION

Liver damage attributed to a toxin or medicine. The most common herbal toxin in South Africa is atractyloside (*Impila)*, which causes a Reye's-like syndrome, with liver failure. *Senecio* ingestion is also seen but this causes endothelial damage in hepatic veins, resulting in hepatic sinusoidal obstruction syndrome with secondary cirrhosis and portal hypertension.

There are many medicines that are hepatotoxic. The commonest are:

- » anticonvulsants,
- » cytotoxics,
- » analgesics,
- » antiretrovirals.
- » immunosuppressants,
- » anti-inflammatories,
- » antituberculous medication,

DIAGNOSTIC CRITERIA

- » Depends on the toxin, but the history is usually diagnostic.
- » *Impila* poisoning, given orally or rectally, may result in anicteric hepatic encephalopathy.
- » Presents with onset of severe vomiting, followed by anuria and then rapid depression of level of consciousness, progressing to seizures and/or coma within a day.

GENERAL AND SUPPORTIVE MEASURES

- » Stop all potentially hepatotoxic medication, including paracetamol.
- » Education regarding herbal toxins, if appropriate.

MEDICINE TREATMENT

For paracetamol poisoning:
See section 18.1.11: Paracetamol poisoning.

Acute liver failure/Hepatic encephalopathy:
See section 2.3.9: Liver failure, acute.

REFERRAL

- » All cases of hepatic encephalopathy due to toxin ingestion.
- » All cases in which re-challenge of medication is considered.

2.3.8 HEPATITIS, CHRONIC, AUTOIMMUNE

K75.4

DESCRIPTION

Autoimmune induced hepatitis.

DIAGNOSTIC CRITERIA

Clinical

» Jaundice.
» Hepatosplenomegaly.
» Cutaneous features of chronic liver disease.
» Extrahepatic manifestations of the autoimmune process.

Investigations

» Elevated bilirubin and transaminases.
» Hypoalbuminaemia and prolonged prothrombin time/INR.
» Auto-immune marker screen.
» Total serum globulin or gammaglobulin or IgG greater than 1.5 times upper normal limit.
» Diagnosis confirmed on liver biopsy.

MEDICINE TREATMENT

Induction therapy:

- Corticosteroids. Specialist initiated.

Maintenance therapy:

- Azathioprine. Specialist initiated.

REFERRAL

» All for confirmation of diagnosis and initiation of treatment.

2.3.9 LIVER FAILURE, ACUTE

K72.0

DESCRIPTION

Acute liver failure is a devastating clinical syndrome, which has a high mortality. It results from massive necrosis of liver cells leading to the development of hepatic encephalopathy. The clinical appearance can be deceptive and it is easy to underestimate how critically ill these patients are. Refer patients early to a secondary or tertiary hospital. Paediatric acute liver failure is said to be present once the INR is greater than 2 (not correctable with vitamin K), or greater than 1.5 in the presence of encephalopathy.

The following complications can occur:

» coagulopathy,
» cerebral oedema,
» encephalopathy,
» metabolic acidosis, and
» hypoglycaemia,
» renal failure,
» cardiorespiratory failure,
» sepsis.

DIAGNOSTIC CRITERIA

Clinical

Appears deceptively well in the early stages. Progressive features include:

- malaise,
- stupor,
- encephalopathy,
- bleeding tendency,
- jaundice.
- vomiting,
- anorexia,
- foetor hepaticus,
- ascites, and

The absence of jaundice suggests another process, such as Reye syndrome, which also leads to hepatic encephalopathy.

Investigations

- Raised or low liver enzymes, low serum albumin, raised bilirubin, raised blood ammonia, hypoglycaemia.
- Prolonged prothrombin time/INR.
- Low fibrinogen.

GENERAL AND SUPPORTIVE MEASURES

- Admit to a high care or intensive care unit.
- Monitor:
  - blood pressure,
  - heart rate,
  - respiration,
  - haematocrit,
  - acid-base status,
  - urine output,
  - neurological state,
  - gastro-intestinal bleeding,
  - blood glucose – 3 hourly if comatosed,
  - liver and renal functions,
  - coagulation competence (INR),
  - electrolytes: sodium, potassium, calcium and phosphate, magnesium.
- Maintain hydration.
- With encephalopathy, aim to reduce ammonia production by the gut and optimise renal excretion.
- Withdraw protein intake completely initially followed by restricted intake if level of consciousness improves, i.e. 0.5–1 g/kg/24 hours.
- Stop sedatives, diuretics and hepatotoxic medicines, if possible.

MEDICINE TREATMENT

To reduce intestinal protein absorption:

- Lactulose, oral, 1 g/kg/dose (1.5 mL/kg/dose) 4–8 hourly via nasogastric tube, then adjust dose to produce 2–3 soft stools daily.

OR

- Polyethylene glycol 59 g/L solution with sodium sulphate and electrolytes, oral/ nasogastric tube, 10–25 mL/kg/hour until clear fluid is passed rectally (about 4–6 hours).
  - No additional ingredient should be added to the solution, e.g. flavourings or sugar containing cold drinks.
  - Follow with regular lactulose to keep stool loose.

- Gentamicin, oral, 12.5 mg/kg/dose 6 hourly for 5 days.
  - The intravenous formulation can be given orally.

Cerebral oedema:
For management of cerebral oedema, see section 13.3: Status epilepticus (convulsive).
For pre-operative use or with active bleeding:

- Fresh frozen plasma, IV, 20 mL/kg administered over 2 hours.

OR

- Lyophilised plasma (fresh dried plasma), IV, 20 mL/kg administered over 2 hours.

- Vitamin K_1 (phytomenodione), IV, 2.5–10 mg daily.
  - Monitor response to vitamin K_1 with INR and PTT.

If platelet count < 10 x 10^9/L or if < 50 x 10^9/L and with active bleeding:

- Platelet transfusion.

For gastrointestinal bleeding:

- Omeprazole, oral, 0.7–1.4 mg/kg/day once daily. Specialist initiated.
  - Maximum dose: 20–40 mg/dose.
    If 1 month to < 2 years: 5 mg once daily.
    If 2 to < 7 years: 10 mg once daily.
    If 7 to12 years: 20 mg once daily.

LoE III [7]

For hypoglycaemia:

- Dextrose 10%, IV bolus, 5 mL/kg.
  - Administer maintenance as below.

Maintenance of fluids until enteral feeding resumed:

- Sodium chloride 0.9%/dextrose 5%, IV, 60–80 mL/kg/day.
  - Ensure a minimum of 3–6 mmol/kg/day of potassium.
  - Avoid diuretics.

For anaemia:

- Packed red cells, 10 mL/kg over 3 hours if haemoglobin < 7 g/dL.

For shock:
See section 1.1.8: Shock.

For sedation, if essential:

- Midazolam, IV, 0.1 mg/kg.
  - Benzodiazepines are poorly metabolised in liver failure and may result in prolonged sedation.
  - Do not repeat without clinical indication.

Seizures are often subclinical or subtle. For seizures:

- Diazepam, IV, 0.2 mg/kg.
  - Repeat dose if not controlled in 5 minutes.
  - Benzodiazepines are poorly metabolised in liver failure and may result in prolonged sedation.
  - Do not repeat without clinical indication.

Antibiotic therapy

Where sepsis is suspected, prevent and treat aggressively with intravenous broad spectrum antibiotics. Empiric antibiotic therapy until culture results known.

- Ampicillin, IV, 50 mg/kg/dose, 6 hourly.

PLUS

- Cefotaxime, IV, 50 mg/kg/dose, 6 hourly.

REFERRAL

» All for determination of the underlying cause after initiation of treatment.
» Combined hepato-renal failure.
» Failure to contain bleeding.

2.4 MALNUTRITION

E40–E46

2.4.1 MALNUTRITION, SEVERE ACUTE

E40–E43

Z-scores

» For practical purposes a 'z-score' is the number of standard deviations (SD) below or above the mean.
» 2 SD or 2 z-scores above the mean (+2) equates fairly closely to the 97th percentile and 2 SD or 2 z-scores below the mean (-2) equates fairly closely to the 3rd percentile.
» 3 SD or 3 z-scores above or below the mean would be regarded as severe deviation from normal.
» In deviation below normal, consider if a reasonable explanation exists, e.g. severe low birth weight with adequate growth profile subsequently.

Admit all cases with complicated severe acute malnutrition.

Uncomplicated cases may be managed with 'ready to use therapeutic food' (RUTF) in ambulatory settings where this service is established.

DESCRIPTION

Severe Acute Malnutrition (SAM)

A multi-deficiency state of severe undernutrition of essential nutrients exacerbated by acute/chronic infection and metabolic disturbances. Severe Acute Malnutrition (SAM) includes but is not restricted to the clinical entities of bilateral pitting oedema or severe wasting. It is associated with a high but significantly modifiable mortality.

Criteria for ambulatory treatment of severe acute malnutrition

All of the following must apply:

» Children over the age of 6 months with no pitting oedema.

PLUS

» Alert and feeding well.

PLUS

» None of the IMCI danger signs/nor those listed below.

PLUS

» Exclusion of other morbidity, TB and HIV infection.

DIAGNOSTIC CRITERIA

SAM in children aged 6–60 months:

Indicator	Measure	Cut-off
Severe wasting	Weight-for-height	z–score less than -3
	Mid upper arm circumference (MUAC)	Less than 11.5 cm
Bilateral pedal oedema	Clinical sign	

Where a suitable measuring device is not available, the following less sensitive findings would also indicate the need to manage as severe acute malnutrition:

» **Severe underweight:**
  > weight for age z-score less than -3 (usually clinically reflective of marasmus) where no other reasonable explanation is present, and/or
  > clinically visible severe wasting (usually clinically reflective of marasmus – thin arms, thin legs, 'old man' appearance, baggy pants folds around buttocks, wasted buttocks).

» **Nutritional oedema** (usually clinically reflective of kwashiorkor – bilateral pedal oedema usually supported by findings of skin changes, fine pale sparse hair, enlarged smooth soft liver, moon face).

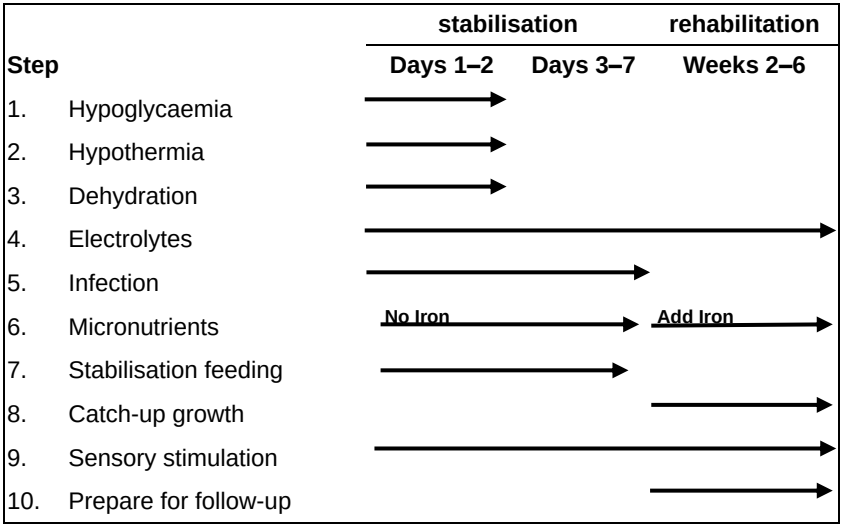
Danger signs:

» Lethargy
» Shock
» Refusing feeds.
» Hypoglycaemia
» Jaundice
» Dehydration

- » Weeping skin lesions.
- » Hypothermia
- » Convulsions
- » Respiratory distress.
- » Bleeding
- » Vomiting everything.

Note: Any of these danger signs indicate the need for more intensive inpatient management.

Time-frame for inpatient management of severe acute malnutrition



The general approach to the inpatient management of severe acute malnutrition is encapsulated in the 10-step approach illustrated above.
Within this approach, the first days are involved in achieving metabolic and physical stability and this phase usually moves to the rehabilitation phase somewhere between the 3rd and 7th day of admission.

Stabilisation phase:

- » feeding,
- » preventing/treating hypoglycaemia,
- » preventing/treating hypothermia,
- » treating infections,
- » giving minerals, vitamins and trace elements, and
- » preventing/treating dehydration.
- » Dietician referral.

Rehabilitation phase:

- » continued feeding,
- » catch up growth,
- » management of chronic infections/infestations,

» continued administration of minerals and vitamins (including commencing iron),
» play and love; stimulation, and
» preparation for discharge.
» Dietician and occupational therapy referral.

Step 1: Hypoglycaemia (Blood glucose < 3 mmol/L)

Prevention

Feed child with severe acute malnutrition immediately (within 30 minutes of presentation) and then ensure every feed is given by day and at night. See step 7: Stabilisation feeding.
Keep the child warm. See step 2: Hypothermia.

Detection and treatment

Test blood glucose level 3 hourly in severely ill child for first 24 hours and until stable (longer if the child is very ill).

Asymptomatic hypoglycaemia:
If blood glucose < 3 mmol/L in asymptomatic child, give immediately (oral bolus):

- Stabilisation/F75 formula, oral, 15 mL/kg.

OR

- Dextrose, 10%, oral, 10 mL/kg.
  - Dextrose 10% = Dextrose 50%, 2 mL/kg with water for injection 8 mL/kg.

OR

- Sugar solution, oral, 10 mL/kg.
  - 1 rounded teaspoon of sugar in 50 mL or 3½ tablespoons of water.

Check blood glucose after 30 minutes and maintain it above 3 mmol/L. Continue feeds.

If symptomatic or persistent hypoglycaemia:

- Dextrose, 10%, IV, 5 mL/kg.

Continue feeds once responsive.

- Change feeds to 2 hourly if hypoglycaemia has occurred. See step 7: Stabilisation feeds.

These children have poor cardiac reserves and are easily volume overloaded. Do not start or maintain IV infusions unless absolutely necessary.

Step 2: Hypothermia (Axillary temperature < 35 ºC)

Prevent hypothermia

Care for the child in a warm area, i.e. 25–30 ºC room temperature.
Ensure the child's body, especially the head, is covered at all times, particularly at night.
Avoid drafts and change wet napkins/clothing.
Avoid exposure, e.g. bathing.
Feed immediately and 2–3 hourly as this provides energy to generate heat.
Allow the child to sleep with mother/carer at night for warmth.

Treat hypothermia

Check axillary (underarm) temperature, 3 hourly.
Axillary temperature < 36 ºC indicates an urgent need to warm child.
Allow the child to sleep with mother/carer at night for warmth. Use mother-child skin-skin contact, i.e. Kangaroo care, to keep child warm and wrap both with blankets.
Place heater nearby. If a radiant heater is used for warming, check temperature at least every ½ hour.
If severely hypothermic and not improving, use other heating measures but do not apply direct heat to the skin as this may burn the child.
Check temperature 2 hourly until > 36.5 ºC.
Consider and treat for infection and sepsis. See step 5: Infection.

Step 3: Dehydration

See section 2.2.4: Diarrhoea, acute.
Continue feeds and other care of severe malnutrition.

Step 4: Electrolytes (hypokalaemia, hypomagnesaemia, hypophosphataemia and hypernatraemia)

All severely malnourished children have excess body sodium even though the plasma sodium may be low. Oedema is partly due to these imbalances, not fluid overload.

Giving high sodium load fluids is dangerous.
Do **NOT** treat oedema with a diuretic.

Potassium

Serum potassium does not indicate total body potassium status. Potassium supplementation is required unless frank hyperkalaemia exists.
Feeds made with combined mineral and vitamin complex contains potassium. When this is used, do not add further potassium.

If the formula is made without combined mineral and vitamin complex**, add** potassium:

- Potassium chloride solution, 25–50 mg/kg/dose, oral, 8 hourly until oedema subsides:
  - If < 10 kg: 250 mg.
  - If > 10 kg: 500 mg.

Magnesium

Feeds made with combined mineral and vitamin complex or trace element mix contains magnesium. If formula is made without either of these additives, **add** magnesium:

- Trace element mix, oral, daily.
  - If < 10 kg: 2.5 mL.
  - If > 10 kg: 5 mL.

OR

- Magnesium sulphate 50%, oral, 0.2 mL/kg as a once daily dose for at least 2 weeks. The IV preparation can be given orally.

Refeeding syndrome may occur at any stage during the stabilisation phase. Regular phosphate level monitoring is advisable and cautious feeding with slow feed advancement is encouraged.

Phosphate (enema administered orally)

Serum phosphate levels	Recommended dosage	Oral dose for Lenolax® phosphate enema	Oral dose for Fosenema® phosphate enema
0.73-0.96mmol/L	0.32mmol/kg in divided doses orally.	0.25mL/kg in divided doses orally.	0.18mL/kg in divided doses orally.
0.51-0.72mmol/L	0.64mmol/kg in divided doses orally.	0.5mL/kg in divided doses orally.	0.37mL/kg in divided doses orally.
< 0.5mmol/L	1.0mmol/kg in divided doses orally.	0.75mL/kg in divided doses orally.	0.57 mL/kg in divided doses orally.

Step 5: Infection

Antibiotics

Start antibiotics on the first day, at admission.

If the child has no danger signs, is alert and feeding well:

- Amoxicillin, oral, 45 mg/kg/dose 12 hourly for 5 days.

All other children:

- Ampicillin, IV/IM, 50 mg/kg/dose 6 hourly for 7 days.
  - Avoid IV infusions, if possible. Use a 'heparin lock' to avoid fluid overload because of poor cardiac reserves.

PLUS

- Gentamicin, IV, 6 mg/kg once daily for 7 days.

As soon as there is a response and patient can tolerate oral medication change ampicillin to amoxicillin and continue with gentamicin:

- Amoxicillin, oral, 30 mg/kg/dose 8 hourly for a further 5 days.

PLUS

- Gentamicin, IV/IM, 6 mg/kg once daily for 7 days.

If the child is severely ill or fails to improve after 48 hours:

- Third generation cephalosporin, e.g.:
  - Ceftriaxone, IV/IM, 100 mg/kg/dose once daily.
    - If meningitis suspected: use 80 mg/kg/dose.

If child does not improve after 5 days, or deteriorates:
Refer to a higher level of care.

Intestinal worm infestation

Treat after the acute phase:
Children 1–2 years of age:

- Mebendazole, oral, 100 mg 12 hourly for 3 days.

Children > 2 years:

- Mebendazole, oral, 500 mg as a single dose immediately.

HIV and TB

In children with HIV and TB, good recovery from malnutrition is possible but may take longer. Treatment failure of malnutrition may be more common.

» Actively investigate for TB and HIV as soon as possible. TB is difficult to diagnose and confirm.
» Ask about contacts, symptoms, do a tuberculin skin test (TST) and chest X-ray. If TST negative, repeat just before discharge.
» If TB is clinically likely, presumptive TB treatment is often reasonable, but once begun, should be completed. See Chapter 10: Tuberculosis, section 10.2: Tuberculosis, pulmonary.

HIV is relatively simple to diagnose and confirm:

» Children < 18 months: HIV PCR and confirm with a second HIV PCR test; children 18–24 months: rapid antibody test/ELISA, if positive confirm with an HIV PCR test.
» Children > 24 months: rapid antibody test/ELISA, if positive confirm with different rapid antibody test/ELISA.

Once the child enters the rehabilitative phase, commence antiretroviral therapy without delay if HIV-infected. See Chapter 9: Human Immunodeficiency Virus Infection, section 9.1: Human immunodeficiency virus infections.

Step 6: Micronutrients

Vitamins

- Vitamin A, oral, as a single dose:

Age	Dose	No. of capsules
Infants < 6 months:	50 000 IU	1 capsule
Infants 6–11 months:	100 000 IU	1 capsule
Children 12 months to 5 years:	200 000 IU	1 capsule

Record doses in the Road-to-Health booklet.

All children with clinical signs of severe vitamin A deficiency (eye changes: xerophthalmia, corneal ulceration, Bitot's spots, corneal clouding) **and** severe measles:

- Vitamin A, oral, 3 doses.
  - First dose, immediately; second dose on day 2 and third dose after 14 days.
  - Record the dose given in prescription and the Road-to-Health booklet.

If on feeds with combined mineral and vitamin complex:

- Folic acid, oral, 2.5 mg as a single dose.

If not on feeds with combined mineral and vitamin complex:

- Folic acid, oral, 2.5 mg as a single daily dose.

PLUS

- Multivitamin, oral, 5 mL as a single daily dose.

Anaemia in malnourished children

Non-acute management:

Although anaemia is common, do NOT give iron initially but wait until the child has a good appetite and starts gaining weight (usually by the second week).

Treat severe anaemia with blood transfusion, if:

» Symptomatic anaemia (Hb usually below 4 g/dL).

OR

» If there is respiratory distress with a low Hb.

- Packed red cells, IV, 5 mL/kg administered over 3 hours.

PLUS

- Furosemide, IV, 1 mg/kg at the start of the transfusion.

Repeat only if severe anaemia or respiratory distress persists and the haemoglobin is still low.

Once gaining weight and oedema has resolved:

- Iron, oral, 2 mg/kg elemental iron per dose 8 hourly with meals.
  - Continue for at least 2 months to replace iron stores.

Step 7: Stabilisation feeding

Immediate: stabilisation phase:

Begin feeding immediately – do not miss feeds.

Give F75/'stabilising' feed at 130 mL/kg/day divided into 3 hourly feeds, i.e. 8 times daily. Give all feeds including that at 03h00.

If child has gross oedema, i.e. if the oedema is up to or beyond the knee or anasarca, give 100 mL/kg initially and increase progressively.

Monitor and record intake carefully.

F75 formula/Stabilisation	
Fresh cow's milk	300 mL
Sugar	100 g
Vegetable oil	20 g
Combined mineral and vitamin complex*	As indicated by insert
Water to make up to:	1000 mL

**If no combined mineral and vitamin complex:*

- Trace element mix, oral, 20 mL daily.

If danger signs, hypothermia or hypoglycaemia present, feed the same daily volume but divided into 2 hourly feeds, i.e. 12 times daily. Give all feeds including those at 02h00 and 04h00.

Give from a cup. Very weak children may be fed by spoon, dropper or syringe.

If feeds refused/not finished (i.e. less than 80% of daily amount taken) give all feeds via nasogastric tube.

Weigh daily and plot weight gain.

Readiness to enter the rehabilitation phase is signalled by a return of appetite, usually about one week after admission.

Step 8: Transition feeding and catch-up growth

Feeding (rehabilitation phase)

» For the first two days replace the initial feeds with equal amounts of 'rebuilding'/'catch-up'/F100 formula. Gradually increase the volume by 10 mL/feed until some formula remains unfinished, usually ~200 mL/kg/day.

» When appetite returns, introduce a modified diet. Balance the intake by giving 3 modified meals and 5 feeds of F100. Prepare food without adding salt.

F100 formula/Rebuilding formula (catch-up)	
Fresh cow's milk	880 mL
Sugar	75 g
Vegetable oil	20 mL
Combined mineral and vitamin complex*	As indicated by insert
Water to make up to:	1000 mL

**If no combined mineral and vitamin complex:*

- Trace element mix, oral, 20 mL.

Monitor progress after the transition by assessing the rate of weight gain.
Weigh child each morning before feeding and plot the weight.
Each week calculate and record weight gain as g/kg/day.

If weight gain is:

» Poor (< 5 g/kg/day) – child requires full reassessment.
» Moderate (5–10 g/kg/day) – check whether intake targets are being met, or if infection has been overlooked.
» Good (> 10 g/kg/day) – continue to praise staff and mothers.

Step 9: Sensory stimulation

Stimulation and loving care

» Provide tender loving care.
» Help and encourage mothers to comfort, feed and play with their children.
» Involve occupational therapist, if available, for structured play otherwise arrange this as best possible in the ward.
» Provide a stimulation program in the ward.

Step 10: Prepare for follow up

Preparation for discharge

» Obtain information on household food security, family background and socio-economic status and refer appropriately.
» Instruct mothers how to modify family foods, how often to feed, what and how much to give.
» Ready to Use Therapeutic Foods (RUTF) may be supplied to facilitate earlier discharge where this is indicated and available. See the National Department of Health Integrated Management of Children with Acute Malnutrition in South Africa – Operational Guidelines.
» Advise caregiver on nutrient and energy-dense food options – see table 1 below.
» Involve mother in discharge planning and follow up plans.
» Social assessment: Before discharge, ensure parent/caregiver is able to access food for the child, ensure all financial supports and grants have been accessed. A social worker may assist in ensuring this. The social worker should also assess for other social risks.
» Make follow-up arrangements. Link patient to PHC systems and Family Health Teams/Community Care Workers for close follow-up and monitoring of feeding and compliance with therapeutic feeding program.
» Ensure all immunisations are up to date.
» Do not discharge any malnourished child without having adequately investigated for TB and HIV infection. Repeat TST before discharge as immunity may have returned to normal.
» Write full clinical summary in Road-to-Health booklet.

Table 1: Sample meal combinations

Starch	Protein	Fat	Other
» Bread	» Peanut butter (counted as fat and protein).	» Margarine	» Syrup/jam
» Pap/Potato	» Peanut butter (counted as fat and protein). » Milk (FC milk/milk powder) » Eggs » Sardines/Pilchards » Liver » Chicken » Beef » Mutton » Pork		» Sugar
» Rice/Samp	» Beans		
» Vegetables	» Peanut butter.		» Sugar

Discharge criteria

» good appetite,
» no infection,
» no oedema,
» continuous good weight gain for last 5 days,
» playful and alert, and
» all preparation in place for discharge.

Feed volume charts

Initial stabilisation/F75 formula volumes at 130 mL/kg/day.
Use 2 hourly if child very sick or has hypoglycaemia or hypothermia.

Child's weight (kg)	Amount to feed		If total volume taken in a day is less than the below figure change to nasogastric feeding
	Every 3 hours 8 times a day	Every 2 hours 12 times a day	
2.0	35	25	210
2.1	35	25	220
2.2	35	25	230
2.3	40	25	240
2.4	40	25	250
2.5	40	25	260
2.6	40	30	270
2.8	45	30	290
3.0	50	30	310
3.2	50	35	330
3.4	55	35	350
3.6	60	40	370
3.8	60	40	400

4.0	65	45	420
4.2	70	45	440
4.4	70	50	460
4.6	75	50	480
4.8	80	50	500
5.0	80	55	520
5.2	85	55	540
5.4	90	60	560
5.6	90	60	580
5.8	95	65	600
6.0	100	65	620
6.5	105	70	670
7.0	115	75	730
7.5	120	80	780
8.0	130	90	830
8.5	140	90	880
9.0	150	100	940
9.5	150	100	990
10.0	160	110	1050

If severe oedema, decrease volume by 25% per feed initially and then increase progressively to above volumes.

2.5 RICKETS

E55.0

DESCRIPTION

Failure to calcify osteoid tissue in a growing child, usually due to deficiency of vitamin D, its active metabolites, calcium, phosphorus or other rare causes. This leads to bone deformity.

Occurs in ex-premature babies during infancy and in children with developmental disability, on anticonvulsants or not exposed to sunlight. In older children, it is caused by renal tubulopathy and other rare conditions.

DIAGNOSTIC CRITERIA

Clinical

» Bowing of long bones, widening of metaphyses and cranial bossing.
» Occasionally convulsions or tetany due to hypocalcaemia.

Investigations

» Elevated alkaline phosphatase.
» Serum calcium and/or phosphate abnormalities.
» X-ray of wrists.

GENERAL AND SUPPORTIVE MEASURES

» Prevent vitamin D deficiency.
» Exposure to sunlight, at least 3 hours a week.

Note: Breast milk does not contain adequate vitamin D to prevent deficiency. Ensure adequate sunlight exposure of infant or provide vitamin D until weaning.

» Normal vitamin D-containing diet for lactating mothers.

MEDICINE TREATMENT

Prophylaxis

For premature babies:

- Vitamin D, oral, 800 IU, once daily.

Infants who are exclusively breastfed or not on adequate volume of commercial milk formula:

- Vitamin D, oral, 400 IU, once daily.

Treatment of active rickets

Treat only after confirmation of active rickets on X-ray.

- Vitamin D, oral, 5000 IU, once daily, in addition to milk in the diet.
  - Repeat X-ray after 6–8 weeks.
  - If no radiological improvement, further investigation is required.
  - If healing occurs, continue for 3 months. Confirm complete healing and adequate diet for the future.

REFERRAL

» Rickets presenting in children older than 2 years.
» No radiological response to treatment after 6–8 weeks.
» Incomplete radiological response.
» Rickets secondary to other disease processes.

2.6 WORM BOLUS

B77

DESCRIPTION

Partial or complete obstruction of the bowel by a 'knot' of *Ascaris lumbricoides* curled around each other. Usually presents with cramping abdominal pain with/without other evidence of obstruction. May occasionally lead to local necrosis and perforation of the small bowel.

DIAGNOSTIC CRITERIA

Clinical

Cramping abdominal pain associated with/without a palpable worm mass, which may also be identified on X-ray abdomen straight or with contrast (when considered safe).

Exclusion of other causes of acute abdomen or acute abdominal pain.

GENERAL AND SUPPORTIVE MEASURES

» Maintain fluid, electrolyte and nutritional needs – IV route may be needed.
» Nil per mouth and free drainage, where clinically indicated.
» Observe for failure of resolution, complete obstruction or evidence of necrosis/perforation.
» Surgery for complete obstruction, evidence of necrosis or perforation.
» Identify possible iron deficiency.
» Be alert for possible worm aspiration.

MEDICINE TREATMENT

Once the bolus resolves, treat the ascaris:
Children 1–2 years of age:

- Mebendazole, oral, 100 mg 12 hourly for 3 days.

Children > 2 years:

- Mebendazole, oral, 500 mg as a single dose immediately.

REFERRAL

» Inability to manage surgical problems, if present.
» Obstruction not relieved after 48 hours.

2.7 RECURRENT ABDOMINAL PAIN

R10.4

DESCRIPTION

Recurrent abdominal pain for which no cause can be found occurring at least monthly for 3 consecutive months with severity that interferes with routine function of the child.

DIAGNOSTIC CRITERIA

Clinical

» Peri-umbilical pain associated with belching, bloating with negative findings on clinical evaluation and no response to acid-blocking medication **OR** pain below the umbilicus accompanied by abdominal cramps, bloating and distension and with an altered bowel pattern that are consistent with Irritable Bowel Syndrome in adults.
» Either of the above syndromes with the exclusion of organic disease with appropriate investigation.
» Avoid excessive investigation where the diagnosis is strongly suspected in the presence of a normal clinical evaluation.
» Exclude the following:
  > Urinary tract infections, urinary tract anomalies, renal disease.

- GIT infection, infestation or inflammation.
- Chronic abdominal conditions such as tumours or infections, e.g. TB abdomen.
- Gall bladder disease.
- Pancreatic disease.

GENERAL AND SUPPORTIVE MEASURES

- Manage psychological stressors, anxiety or depression, where present, appropriately.
- Reassure child and family.
- Counselling to avoid the reinforcement of the symptoms with secondary gain.
- Adequate dietary fibre in children with irritable bowel syndrome-type condition.

MEDICINE TREATMENT

Manage constipation, where present. See section 2.2.2: Constipation/faecal loading.

Manage comorbid anxiety or depression appropriately. See Chapter 14: Child and Adolescent Psychiatry, section 14.4.1: Depression in childhood and adolescence and section 14.5: Anxiety disorders.

REFERRAL

- Failure to respond to management.
- For appropriate psychiatric/psychological management, if not locally available.

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CHAPTER 3

BLOOD AND BLOOD-FORMING ORGANS

APPROACH TO A CHILD WITH A HAEMATOLOGICAL PROBLEM

Common blood products – dosing, volumes and storage

Red cell products:

Storage: 1–6 °C (refrigerator).

Administration: Use blood administration sets.

- Paediatric red cell concentrate (25–150 mL).
- Paediatric red cell concentrate, leucodepleted (75 mL).
- Packed cells (volume in mL) = 4 x weight x desired increase in haemoglobin.
- Whole blood, leucodepleted (485 mL): used in exchange transfusion; volume to be infused in mL = 6 x weight x deficit.

Platelet products:

Storage: Do not refrigerate, use immediately.

Administration: Use special platelet administration sets.

- Paediatric platelet concentrate, single donor, apheresis, leucodepleted (50–60 mL).
- Platelet concentrate, single donor, apheresis, leucodepleted (100–300 mL).
- Random donor, pooled platelets (200–300 mL).
- Platelet concentrate = 5–10 mL/kg used for ordering, but administer the entire volume.

Plasma products:

Storage and administration: Transfuse immediately after reconstitution and issue.

Clotting Factors:

- Fresh frozen plasma (FFP) (75 mL) *(kept in blood bank)*.
  - 15 mL/kg/dose (100 IU/unit).
- Fresh dried plasma (FDP) (260 mL) *(can be kept on the shelf).*
  - 15 mL/kg/dose (100–160 mL).
- Cryoprecipitate – fibrinogen rich (30 mL).
  - 1 unit/10 kg/dose (150–200 IU/unit).
- Factor VIII concentrate.
  - 25–50 IU/kg/dose (100–500 IU/unit).

- Factor IX concentrate.
  - 40–60 IU/kg/dose.

For current prices, see: https://sanbs.org.za/product-price-list/

3.1 ANAEMIA, APLASTIC

D61.0

DESCRIPTION

Pancytopenia caused by bone marrow failure with a hypocellular bone marrow without infiltration or fibrosis. May be acquired or inherited. Inherited bone marrow failure syndromes include Fanconi anaemia, which has specific associated phenotypic features and chromosomal abnormalities.

DIAGNOSTIC CRITERIA

Clinical

» Pallor, petechiae, purpura, bleeding, with frequent and/or severe infections.
» Phenotypic features of Fanconi anaemia include:
  > Café-au-lait spots (skin pigmentary changes),
  > short stature and dysmorphic faces,
  > hypoplasia/absence of the radius, fingerised thumb,
  > microcephaly, small eyes, hyperreflexia,
  > renal tract and cardiac abnormalities,
  > hypogonadism.

Investigations

» Full blood count shows anaemia (may be macrocytic), leucopenia and thrombocytopenia.
» Hypoplastic bone marrow.

GENERAL AND SUPPORTIVE MEASURES

Limit the liberal use of blood products as the patient may become sensitised and jeopardise future bone marrow transplant prospects.
Avoid contact sport.

MEDICINE TREATMENT

For symptomatic anaemia (usually Hb < 7 g/dL):

- Packed red cells, IV, 4 x weight x deficit in haemoglobin.
  - Use leukocyte depleted products.

For active bleeding:

- Platelets, IV, 20 mL/kg, administered immediately and rapidly over 15–30 minutes through a platelet giving set.

- If transplant is a possibility, use single donor, apheresis platelets rather than pooled, random donor platelets; preferably group specific.
- Use the whole unit, unless the volume compromises cardiovascular status, (particularly in neonates). Apheresis platelets are available in paediatric volumes.

For fever (T > 38 ºC), manage as febrile neutropenia in discussion with appropriate specialist/subspecialist with broad-spectrum antibiotics.
Take blood cultures first.

For febrile neutropenia:
Within 48 hours of admission:
- Ceftriaxone, IV, 50 mg/kg twice daily.

PLUS
- Gentamicin, IV, 6 mg/kg daily.

After 48 hours from admission:
Consider local antimicrobial resistance patterns when treating empirically, however, if this is not known then:
- Piperacillin-tazobactam, IV, 100 mg/kg 8 hourly.

Antibiotic adjustment based on microbiology results.

REFERRAL
» All cases of suspected aplastic anaemia.
» Stabilise patient before transport with blood and/or platelet transfusions, if necessary, after consultation with a paediatrician or paediatric haematologist.
» All cases for consideration for bone marrow transplant or immunosuppressive therapy in the case of acquired aplastic anaemia.

3.2 ANAEMIA, HAEMOLYTIC
D55–59

DESCRIPTION
Anaemia caused by excessive destruction of red blood cells.
Destruction may be due to:
» Corpuscular defects:
  > abnormalities of the cell membrane (e.g. hereditary spherocytosis),
  > enzyme abnormalities (e.g. G6PD deficiency), or
  > abnormal haemoglobin (e.g. sickle cell anaemia, thalassaemia).
» Extra-corpuscular defects:
  > Autoimmune or isoimmune:
    idiopathic warm- or cold-antibodies,
    infection-triggered, e.g. Mycoplasma pneumoniae,

medicine-related, e.g. penicillin,
secondary to autoimmune disorders, e.g. SLE, juvenile arthritis,
secondary to tumours, e.g. lymphoma, thymoma.

> Non-immune:
secondary to microangiopathy, e.g. haemolytic uraemic syndrome,
infections causing haemolysis, e.g. malaria,
miscellaneous causes, including hypersplenism.

DIAGNOSTIC CRITERIA

Clinical

» Pallor, jaundice, fatigue.
» Splenomegaly.

Investigations (before transfusion)

» Full blood count.
» Evidence of haemolysis:
> anaemia,
> reticulocytosis,
> decreased haptoglobin,
> unconjugated hyperbilirubinaemia,
> increased lactate dehydrogenase (LDH),
> urobilinogen in the urine.
» Direct Coombs test (direct antiglobulin) is positive with autoimmune haemolysis.
» Haemoglobin electrophoresis.
» Renal function is abnormal in haemolytic uraemic syndrome.
» Exclude other autoimmune disorders.
» Consider underlying neoplasms.
» In patients receiving recurrent transfusions (e.g. thalassaemia), monitor ferritin levels 3 monthly and discuss with referral centre if > 1000 ng/mL.

GENERAL AND SUPPORTIVE MEASURES

» After appropriate investigations, transfuse and then discuss with paediatrician or paediatric haematologist.
» Coombs-positive autoimmune haemolytic anaemia may require transfusion with the least incompatible blood (if cross-matching yields no compatible units).
» In G6PD deficiency, avoid medicines known to cause haemolysis (e.g. aspirin, sulphonamides and primaquine) **and** be sure to give the patient a list of such medicines at discharge.

MEDICINE TREATMENT

Warm-antibody autoimmune haemolytic anaemia

Under specialist supervision:

- Prednisone, oral, 2 mg/kg/day until a satisfactory response is obtained.
  - Continue treatment for a minimum of 4 weeks.
  - Taper dose slowly over several weeks while monitoring for relapse.

Chronic haemolytic anaemia

All patients indefinitely:

- Folic acid, oral, 2.5 mg daily between birth and 6 months and 5 mg daily for > 5 kg and/or 6 months to 5 years.

SURGICAL TREATMENT

Splenectomy for hereditary spherocytosis with Hb < 10 g/dL and transfusion dependent, but **only** after 5 years of age and following consultation with a paediatric haematologist.

Pre-splenectomy immunization

Two weeks prior to surgery:

- Pneumococcus conjugate vaccine (PCV)-13, IM, 0.5 mL followed by pneumococcus polysaccharide (PPV)-23, IM, 0.5 mL 8 weeks later.
- Haemophilus influenzae, type B (Hib) booster, IM, 0.5 mL.
- Meningococcal conjugate vaccine (MCV), IM, 0.5 mL.

Post-splenectomy

- Phenoxymethylpenicillin, oral, 12 hourly.
  - If < 5 years: 125 mg.
  - If > 5 years: 250 mg.
  - Give until at least 18 years of age.
- Annual influenza vaccine, IM, 0.5 mL.
- After splenectomy:
  - Pneumococcus conjugate vaccine (PCV)-13, IM, followed by pneumococcus polysaccharide (PPV)-23, IM (a month later).
  - Haemophilus influenzae, type B (Hib) and meningococcal conjugate vaccine (MCV) booster.

Note: For catch-up of routine conjugate pneumococcal vaccination:

- < 12 months of age: 3-dose series.
- 12 months of age and older: 2 doses, 8 weeks apart. (See Primary Healthcare Standard Treatment Guidelines, Chapter 13: Immunisation).

REFERRAL

» Any child with haemolytic anaemia, e.g. thalassaemia, especially those who are transfusion dependent (more than 10 transfusions) to assess for chelation therapy.

» All cases associated with evidence of haemolysis as above should be managed in consultation with a paediatrician or paediatric haematologist.

3.2.1. THALASSAEMIA

D56

DESCRIPTION

Hereditary single gene defect causing abnormal production or translation of beta-globin mRNA, resulting in foetal haemoglobin (HbF) production. Presents with pallor, jaundice, fever, failure to thrive, abdominal distension hepatosplenomegaly, and skeletal changes.

DIAGNOSTIC CRITERIA

Investigations

» Microcytic, hypochromic anaemia.
» Haemoglobin electrophoresis.
» Genetic studies.
» Family screening.

MEDICINE TREATMENT

β-Thalassaemia major – homozygous:

- Regular blood transfusions to maintain Hb between 9.5 and 14 g/dL.

REFERRAL

» All cases for confirmation of diagnosis and a comprehensive care transfusion program.
» For consideration of chelation therapy once ferritin > 1000 ng/mL (generally after having received 20–25 units of PRCs).

3.2.2 ANAEMIA, SICKLE CELL

D57

DESCRIPTION

Haemolytic anaemia due to homozygous inheritance of sickle cell mutation. Patients may experience complications:

» Painful vaso-occlusive crises.
» Haemolytic crises (usually secondary to infection).
» Aplastic crises.
» Thrombotic crises, e.g. acute chest syndrome, priapism or stroke.
» Splenic sequestration.
» Severe infections.

DIAGNOSTIC CRITERIA

Clinical

» Pallor, jaundice, fatigue all of which may worsen abruptly (sequestration crisis, aplastic crisis).
» Features of complications:
  > painful swelling of the hands and feet (dactylitis),

> bone pain, abdominal pain,
> chest pain, fever, dyspnoea (acute chest syndrome),
> convulsions, hemiparesis,
> priapism.

Investigations

» Laboratory features of haemolytic anaemia. See section 3.2: Anaemia, haemolytic.
» Haemoglobin electrophoresis shows an SS pattern (both parents will be AS).

GENERAL AND SUPPORTIVE MEASURES

» Avoid exposure to cold, dehydration and stress.
» Increase fluid intake during painful crises.
» Heat and/or massage for pain.

MEDICINE TREATMENT

For sequestration crisis or aplastic crisis:

- Packed red cells, IV, 15 mL/kg.
  - Do not transfuse Hb > 13 g/dL as this may increase blood viscosity and consequently raise the risk of vasculopathy.

If hypoxic:

- Oxygen, by face mask.

Exchange transfusions may be used to treat severe complications (see referral criteria).

Prophylaxis against infection

Prophylaxis is given to all children because functional asplenia is present by 1–2 years of age.

- Routine vaccinations during infancy.
- Catch up conjugate pneumococcal vaccine:
  - If < 12 months of age: 3-dose series.
  - If 12 months of age and older: 2 doses, 8 weeks apart.
    - Pneumococcal polysaccharide vaccine at 2 years (at least 8 weeks after conjugate vaccine). Repeat vaccination as a booster 5 years after the initial dose.
- Annual influenza vaccination.
- Haemophilus influenzae, type B (Hib) booster, IM, 0.5 mL.
- Meningococcal conjugate vaccine (MCV), IM, 0.5 mL.
- Phenoxymethylpenicillin, oral, 12 hourly.
  - < 5 years: 125 mg
  - > 5 years: 250 mg
  - Give indefinitely.

Treatment

Analgesia as required:

- Paracetamol, oral, 15 mg/kg 6 hourly.

AND

- Ibuprofen, oral, 10 mg/kg 8 hourly.
- Hydroxyurea, oral, 15 mg/kg.
  - Increase by 5 mg/kg every 12 weeks.
  - Maximum dose: 35 mg/kg daily.

Infections

All children with axillary temperature ≥ 38 °C:

- Ceftriaxone, IV, 50–80 mg/kg/dose once daily.

Acute chest syndrome

Consult a paediatrician.

REFERRAL

» All children with sickle cell anaemia should be managed in consultation with a paediatric haematologist or paediatrician.
» All children with severe complications that may benefit from exchange transfusion or intensive care, e.g. stroke, severe vaso-occlusive disease and acute chest syndrome.
» All cases of stroke should be referred for a regular transfusion program.

3.3 ANAEMIA, MEGALOBLASTIC

D53.1

DESCRIPTION

Anaemia caused by a deficiency of folate and/or vitamin B_{12}.

DIAGNOSTIC CRITERIA

Clinical

» Pallor and fatigue.
» History of chronic diarrhoea.

Investigations

» Megaloblastic anaemia: elevated MCV (mean corpuscular volume) and MCH (mean corpuscular haemoglobin).
» Macro-ovalocytes on blood smear, hypersegmentation of neutrophils.
» Decreased serum vitamin B_{12} or red blood cell folate.
» Investigations to identify the reason for folate or vitamin B_{12} deficiency, e.g. malabsorption.
» Pancytopenia in severe cases.
» Actively exclude leukaemia and aplastic anaemia, which may cause macrocytosis.

GENERAL AND SUPPORTIVE MEASURES

» Dietary modifications to ensure adequate intake of folate and vitamin B_{12}.

» Packed red blood cell transfusion for symptomatic anaemia. Try to avoid blood transfusion until all investigations have been done.

MEDICINE TREATMENT

Folic acid deficiency:

- Folic acid, oral, 5 mg daily until haemoglobin returns to normal value for age. Prolonged treatment may be needed for malabsorption states and congenital deficiencies.

Vitamin B_{12} deficiency:

- Vitamin B_{12}, IM, 100 mcg monthly. Should be given together with folate to prevent developmental of subacute combined degeneration of the spinal cord. Prolonged treatment may be needed.

REFERRAL

» All cases of megaloblastic anaemia, except clear nutritional folate deficiency.

3.4 ANAEMIA, IRON DEFICIENCY

D50.9

DESCRIPTION

Iron deficiency is the most common cause of anaemia. The commonest causes of iron deficiency anaemia are poor nutritional intake, excessive milk ingestion and blood loss due to parasites (whipworm and hookworm).

Lower limits of normal haemoglobin:

Age	Hb (g/dL)
Birth	13.5
6 weeks	9.5
3 months	10.0
6–12 months	10.5
12–18 months	10.5
18 months–4 years	11.0
4–7 years	11.0
7–12 years	11.5
12 years and older	12 (F) : 13 (M)

DIAGNOSTIC CRITERIA

Clinical

Symptoms and signs vary with the severity of the deficiency:

» pallor,
» fatigue,
» irritability,
» behavioural and cognitive effects.
» delayed motor development,
» pica,
» soft ejection systolic murmur,

Investigations

» Haemoglobin below normal for age.
» Hypochromic, microcytic anaemia.
» Low MCV (mean corpuscular volume) and MCH (mean corpuscular haemoglobin), increased red cell distribution width.
» Decreased serum iron, ferritin and transferrin saturation.
» Elevated total iron-binding capacity.
» Stool examination to identify intestinal parasites or to confirm occult blood loss.
» Iron studies are not necessary if nutritional iron deficiency is strongly suspected. Document a response to a trial of iron therapy to confirm the diagnosis.

Note:
Chronic infections may also cause microcytic, hypochromic anaemia.
See section 3.5: Anaemia of chronic disorders (infection or disease).

GENERAL AND SUPPORTIVE MEASURES

» Dietary adjustment.
» Counselling.

MEDICINE TREATMENT

Treatment

In the presence of an acute, severe infection, delay initiating iron supplements until the infection resolves.

- Iron (elemental), oral, 3 mg/kg/dose 12 hourly with meals.
  - Follow up monthly.

Elemental iron per preparation

Ferrous gluconate elixir	350 mg/5 mL	40 mg elemental iron per 5 mL	8 mg elemental iron per mL
Ferrous gluconate syrup	250 mg/5 mL	30 mg elemental iron per 5 mL	6 mg elemental iron per mL
Ferrous lactate drops	25 mg/mL	25 mg elemental iron per mL	1 mg elemental iron per 0.04 mL

Ferrous sulphate compound tablets	170 mg	~65 mg elemental iron per tablet	~65 mg elemental iron per tablet

The expected response is an increase in Hb of ≥ 2 g/dL in 3 weeks.
Continue for 3–4 weeks after Hb is normal to replenish body iron stores.
The reticulocyte count will increase if there is a positive response and may be useful where the diagnosis is in doubt, if done within 1–2 weeks after iron therapy is started.

Treat for intestinal helminths
Children 1–2 years of age:
- Mebendazole, oral, 100 mg 12 hourly for 3 days.

Children > 2 years of age:
- Mebendazole, oral, 500 mg as a single dose immediately.

CAUTION
Iron is extremely toxic in overdose, particularly in children.
All medication should be stored out of reach of children.

Prophylaxis
All preterm babies, day 15 to 1 year:
- Iron (elemental), oral, 2 mg/kg daily.
- Multivitamin, drops, oral, 0.3 mL daily for formula fed babies.
- Multivitamin, drops, oral, 0.6 mL daily for breastfed babies.

REFERRAL
» Patients not responding to adequate therapy.
» Patients in whom easily treatable causes for non-response have been excluded, e.g.:
  > non-adherence to therapy,
  > on-going GIT/other blood loss,
  > on-going infection.

3.5 ANAEMIA OF CHRONIC DISORDERS (INFECTION OR DISEASE)
D63

DESCRIPTION
Anaemia caused by chronic infection or disease. This may be due to interference with nutrient supply or suppression of haemopoiesis. Iron may be trapped in the reticuloendothelial system resulting in relative iron deficiency.

Symptomatic anaemia may manifest with tachypnoea, tachycardia not attributable to other causes and heart failure.

DIAGNOSTIC CRITERIA

Clinical

» Pallor, fatigue.
» Features of malnutrition or chronic infection, e.g. TB, HIV, chronic renal failure.
» Autoimmune disease may be present.

Investigations

» Haemoglobin low with usually normocytic, normochromic red cells (may be microcytic).
» TST, chest X-ray and renal function tests.

GENERAL AND SUPPORTIVE MEASURES

» Emphasise a nutritionally balanced diet that is adequate in protein, vitamins and minerals for nutritional rehabilitation.
» Transfuse for symptomatic anaemia only.

MEDICINE TREATMENT

» Treat the underlying cause, e.g. TB infection.
» Defer iron treatment until acute diseases are controlled, then provide extra iron (see above) and multivitamins.

REFERRAL

» All cases with unresolving anaemia and no cause found.

3.6 HAEMOPHILIA A AND B

D66.7/D66.8

DESCRIPTION

Haemophilia A and haemophilia B are chronic bleeding disorders caused, respectively, by a lack of clotting factor VIII or clotting factor IX.

Sub classification of severity

Class	Clotting factor	% of normal	Signs
Mild	VIII or IX	5–40%	Occasional bleeds, usually after trauma or surgery.
Moderate	VIII or IX	1–5%	Less frequent bleeds than severe; usually post trauma/surgery/dental extraction.
Severe	VIII or IX	< 1%	Spontaneous bleeds, particularly joint and muscle.

DIAGNOSTIC CRITERIA

Clinical

» Major bleeds:
  > CNS,
  > severe injury,
  > muscle compartment (e.g. forearm and calf),
  > gastrointestinal tract,
  > neck/throat (airway),
  > advanced joint and soft tissue,
  > hip and ilio-psoas.
» Minor bleeds:
  > early joint bleed,
  > soft tissue,
  > mouth and gum,
  > muscle,
  > epistaxis,
  > haematuria.
» Pain/tingling in a joint suggests bleeding in a known haemophiliac.

Investigations

» Prolonged partial thromboplastin time (PTT).
» Normal INR.
» Factor VIII or factor IX concentration levels < 40% of normal activity.

GENERAL AND SUPPORTIVE MEASURES

» Haemophilia register *(*access relevant co-ordinators at*: https://haemophilia.org.za/make-contact/).*
» MedicAlert bracelet.
» Dental care (see below for management of tooth extraction).

Acute joint bleeds – Infuse IV factor concentrate first with the following adjunct measures:

» Apply ice packs: 5 minutes on and 10 minutes off.
» Rest the affected joint/limb until pain-free and no further swelling.
» Avoid weight-bearing.
» Splint. Do not use circumferential casts.
» **Do not** aspirate affected joints.

MEDICINE TREATMENT

For pain (as required):
Do not use NSAIDs or aspirin.

<u>Mild pain</u>

- Paracetamol, oral, 15 mg/kg 6 hourly.

<u>Moderate and Severe pain</u>

- Paracetamol, oral, 15 mg/kg 6 hourly.

PLUS

- Morphine, oral [Immediate release morphine (liquid)].
  - Starting dose:
    - If 0–1 month of age: 0.05 mg/kg 6 hourly.
    - If > 1–12 months of age: 0.1 mg/kg/dose 4 hourly.
    - If > 12 months of age: 0.2–0.4 mg/kg/dose 4 hourly.

For bleeds

Emergency treatment while awaiting transfer, if indicated.

If serious bleeding in a known haemophiliac, and no factor available:

- Lyophilised plasma (freeze dried), IV, 20 mL/kg over 20-30 minutes. Lyophilised plasma contains a minimum of 0.4 units/mL of each coagulation factor.

OR

- Fresh frozen plasma (FFP), IV, 20 mL/kg over 20-30 minutes.

Factor VIII deficiency (with no inhibitors)

Give until patient is pain free. Administration should be 12 hourly for major bleeds, but may be daily for minor bleeds.

Minor bleeds

- Factor VIII, IV, 20 units/kg.

Major bleeds

- Factor VIII, IV, 40 units/kg.

Use the entire contents of the appropriate volume ampoule.

Intracranial bleeds

- Factor VIII, IV, 40 units/kg 6 hourly.

Decrease frequency if trough factor level is > 60%, if possible.

Factor IX deficiency (with no inhibitors)

Give daily until patient is pain free.

Minor bleeds

- Factor IX, IV, 40 units/kg.

Major bleeds

- Factor IX, IV, 60 units/kg.

The available product is factor IX complex. It also contains factors II, VII and X.

Home treatment

Home treatment of bleeds is promoted by haemophilia treatment centres. Patients or caregivers are educated on the storage, reconstitution and administration of factor and provided with a supply of factor to be kept at home for use in the event of a bleed. Factor use and bleeding episodes are monitored through the use of an appropriate chart which can be reviewed at consultations and medication collection.

For dental extraction

Check that inhibitors are absent.

Admit for procedure and post-procedure care and observation.

Haemophilia A:

- Factor VIII, IV, 40 units/kg, immediately before extraction.

AND

- Tranexamic acid, oral, 25 mg/kg/dose 6–8 hourly for 5 days.

Haemophilia B:

- Factor IX, IV, 40 units/kg, immediately before extraction.

For mucous membrane bleeds

- Tranexamic acid, oral, 25 mg/kg/dose 6–8 hourly.
  - Contraindicated in haematuria.
  - Use with caution with factor IX complex or factor VIII inhibitor-bypassing activity and preferably only 12 hours after administration of the factor.

REFERRAL

» All cases with **suspected** or established haemophilia (prolonged PTT and normal INR), for assessment, genetic counselling and planning of management, to a haemophilia treatment centre.

3.7 VON WILLEBRAND DISEASE

D68.0

DESCRIPTION

Von Willebrand disease is the most common congenital bleeding disorder and is due to reduced amounts or abnormal forms of von Willebrand factor.

DIAGNOSTIC CRITERIA

Clinical

» Recurrent epistaxis, prolonged bleeding from lacerations, easy bruising or gum bleeds.

Investigations

» Reduction in one or more of the following:
  > von Willebrand factor antigen,
  > ristocetin co-factor and/or collagen binding activity,
  > factor VIII coagulant activity.

GENERAL AND SUPPORTIVE MEASURES

» Apply pressure to the bleeding site.
» For tooth socket bleeds, bite down on a piece of gauze.
» For epistaxis, see Chapter 17: Ear, nose, throat, section 17.4: Epistaxis (nose bleeds).

Avoid aspirin and avoid NSAIDS.

MEDICINE TREATMENT

For bleeds:

- Factor VIII, IV (Factor VIII containing von Willebrand factor).
  - Initial dose: 30 units/kg.

For mucous membrane bleeds:

- Tranexamic acid, oral, 25 mg/kg/dose 6–8 hourly.

For menorrhagia:

- Combined oral contraceptive, low dose.

REFERRAL

» All suspected cases of von Willebrand disease to a haemophilia treatment centre for assessment.

3.8 HAEMORRHAGIC DISEASE OF THE NEWBORN

P53

See section 19.8.1: Haemorrhagic disease of the newborn.

3.9 IMMUNE THROMBOCYTOPENIC PURPURA (ITP)

D69.3

DESCRIPTION

A common bleeding disorder of childhood due to the immune-mediated destruction of platelets.

It occurs most frequently in children aged 2 to 5 years and often follows infection with viruses (including HIV) and medications. Chronic ITP (more than 6 months duration) occurs in 10 to 20% of children with ITP.

Complications are rare, but include severe haemorrhage and bleeding into vital organs.

DIAGNOSTIC CRITERIA

Clinical

» Sudden onset of bruising and bleeding, either spontaneously or after minor trauma, into the skin and mucous membranes and rarely elsewhere in an otherwise well child.
» The lesions may range from pinpoint petechial bleedings to large ecchymoses, and are often increased on pressure points.
» Epistaxis is common.
» Exclude child abuse.
» The presence of the following makes the diagnosis of ITP unlikely:

- > splenomegaly,
- > hepatomegaly,
- > lymphadenopathy,
- > masses,
- > joint swelling,
- > bone pain,
- > rashes present other than petechiae or ecchymoses.

Investigations

» Thrombocytopenia with normal white cell count and differential, and normal haemoglobin and red cell morphology, other than the effects of blood loss. Mean Platelet Volume (MPV) is often increased.
» Normal INR (PT) and partial thromboplastin time (PTT).
» Abundant megakaryocytes on bone marrow aspiration with normal erythroid and myeloid cellularity.
» A normal LDH and uric acid help to rule out leukaemia.
» Indications for bone marrow biopsy/aspiration: Prior to starting steroids, or any other abnormality on FBC or any atypical cells on differential count.
» Test all newly diagnosed cases for HIV.

Follow up patients with a diagnosis of ITP not confirmed with bone marrow aspiration for development of new clinical signs and abnormalities on laboratory investigations.

GENERAL AND SUPPORTIVE MEASURES

» Avoid:
  > platelet transfusions unless bleeds are life-threatening,
  > contact sport, injury and trauma, and
  > dental procedures in the acute phase.
» Reassure patient and family that resolution usually occurs.

MEDICINE TREATMENT

Avoid medication that affects platelet function, e.g. NSAIDs, and aspirin.

Acute ITP

Most cases are self-limiting and will resolve without treatment. Consider such conservative management for mild cases (in discussion with relevant specialist/subspecialist).

Active bleeding:

- Prednisone, oral, 4 mg/kg/dose as a single daily dose for 4 days.
  - Stop after 4 days without tapering dose.

Chronic ITP

Intermittent treatment if platelets $\leq 10 \times 10^9$/L **and** significant bleeding episodes:

- Prednisone, oral, 4 mg/kg/dose as a single daily dose for 4 days.
  - Stop after 4 days without tapering dose.

Acute life-threatening bleeds (e.g. intracranial bleeding): (acute or chronic ITP)

- Methylprednisolone, IV, 30 mg/kg/dose administered over 30–60 minutes as a single daily dose for 3 days.
  - Maximum dose: 1 g.
  - Beware of arrhythmias, hypertension, etc.
  - Check BP daily.

AND

After administration of methylprednisolone:

- Paediatric platelet concentrate, leucodepleted, 5–10 mL/kg over 20 minutes.

Refer to specialist for advice on further management.

SURGICAL TREATMENT

Consider splenectomy in children 5 years and older with chronic ITP for more than one year plus significant bleeding or substantial limitation in activities as a result of the ITP.

Pre-splenectomy

- 2 weeks prior to surgery:
  - PCV-13, IM, 0.5 mL, followed by PPV-23, IM, 0.5 mL 8 weeks later.
  - Hib booster, IM, 0.5 mL.
  - Meningococcal vaccine, IM, 0.5 mL.

Post-splenectomy

- Phenoxymethylpenicillin, oral, 12 hourly.
  - If < 5 years of age: 125 mg.
  - If > 5 years of age: 250 mg.
  - Give indefinitely until at least until 18 years.
- Pneumococcal polysaccharide vaccine. Repeat vaccination as a booster 5 years after the initial dose.
- Annual influenza vaccine.
- Hib and MCV boosters every 5–10 years.
- Catch up conjugate pneumococcal vaccine:
  - If < 12 months of age: 3-dose series.
  - 12 months of age and older: 2 doses, 8 weeks apart.

REFERRAL

» Suspected ITP with unusual features such as splenomegaly or lymphadenopathy.
» ITP complicated by severe haemorrhage, bleeding into vital organs or an intracranial haemorrhage.
» ITP needing surgery.
» ITP that fails to resolve in 6–12 months on adequate treatment (chronic ITP).
» If there is no local capacity to fully investigate the condition.

3.10 THROMBOTIC THROMBOCYTOPENIC PURPURA/ HAEMOLYTIC URAEMIC SYNDROME

M31.1/D59.3

DESCRIPTION

An acute syndrome that presents with diarrhoea/dysentery (although diarrhoea-negative cases are increasingly recognised) with varying combinations of the following: Non-immune microangiopathic haemolytic anaemia with fragmentation haemolysis (schistocytes), thrombocytopenia often with purpura, acute kidney injury, fever and neurologic abnormalities.

DIAGNOSTIC CRITERIA

Investigations

» HIV testing.
» INR and PTT are normal as compared to DIC where they are abnormal.
» Stool for Shiga toxin producing *E. coli.*
» Blood cultures.
» FBC and smear.
» Urea and electrolytes.

MEDICINE TREATMENT

Specialist initiated

- Fresh frozen plasma (FFP), IV, 30 mL/kg/day over 20-30 minutes in 3–4 doses.

OR

- Freeze dried plasma (FDP), IV, 30 mL/kg/day over 20-30 minutes in 3–4 doses.

For infections

- Ceftriaxone, IV, 50–80 mg/kg once daily.

Need for platelet transfusion to be discuss with a haematologist.
Early dialysis – discuss with a nephrologist.

REFERRAL

All patients – early consultation and transfer to a regional centre.

3.11. DISSEMINATED INTRAVASCULAR COAGULATION

D65

DESCRIPTION

Complication of an underlying condition, e.g. severe sepsis that is characterized by widespread activation of the clotting cascade leading to consumption of platelets and clotting factors with generalized bleeding.

DIAGNOSTIC CRITERIA

Investigations

» Prolonged INR and PTT.
» Thrombocytopenia
» Decreased fibrinogen.
» Increased D-dimers.
» Repeat test for monitoring.
» Identify the cause.

MEDICINE MANAGEMENT

For low fibrinogen:

- Cryoprecipitate, IV, 1 unit/10 kg.

For an abnormal INR or PTT:

- Fresh frozen plasma (FFP) or Freeze dried plasma (FDP), IV, 15 mL/kg over 20-30 minutes.

Active bleeding with low platelets:

- Apheresis platelet transfusion, IV, 5–10 mL/kg over 20 minutes.

No bleeding with low platelets:

- No platelet transfusion.

REFERRAL

All unresponsive cases to a regional hospital.

3.12 VENOUS THROMBO-EMBOLIC DISEASE

I82

DESCRIPTION

An occlusive or non-occlusive thrombus in the venous circulation, with or without pulmonary embolus. Associated risk factors include central venous catheters, venous stasis, endothelial damage and hypercoaguable states, e.g. nephrotic syndrome. Causes include protein C and S deficiency, factor V Leiden and antithrombin III deficiency.

DIAGNOSTIC CRITERIA

Clinical

Depends on the site of thrombosis, may be silent.

» Deep venous thrombosis of an extremity presents with unilateral limb swelling.
» Upper extremity thrombus may present with associated facial and neck oedema.
» Pulmonary embolus presents with sudden onset of shortness of breath and chest pain.

» Cerebral sinus venous thrombosis presents with seizures or other neurological symptoms and signs.
» Renal vein thrombosis presents with haematuria, thrombocytopenia, oliguria and renal failure if bilateral.

Investigations

» Doppler ultrasonography, CT scan or MRI demonstrate thrombosis or embolus.
» D-dimer, antithrombin III, protein C, protein S, factor V Leiden and antiphospholipid antibody testing may reveal underlying thrombophilia.

GENERAL AND SUPPORTIVE MEASURES

» Appropriate fluid restriction and electrolyte management if in renal failure.

If hypoxic:

- Oxygen by face mask.

For acute thrombotic episode:

- Low molecular weight heparin (LMWH), e.g.
  - Enoxaparin sodium, SC, 1 mg/kg 12 hourly.

OR

- Unfractionated heparin (UFH), IV, administered over 10 minutes as a bolus followed by an initial maintenance dose as a continuous infusion.

	Bolus	Initial maintenance dose
Preterm neonates	25–50 units/kg	15 units/kg/hour
Term neonates	75–100 units/kg	28 units/kg/hour
Children	75–100 units/kg	20 units/kg/hour

Note: Term neonates need a higher maintenance dose per body weight compared with older children.

Target levels

If available, LMWH dosing can be guided by anti-Xa levels 3–4 hours after dose.

For UFH

PTT: 60–85 seconds or 2–3 times the baseline value (if normal for age).
Monitor PTT 4 hours after bolus injection and adjust the continuous IV dose according to the result (see table below).

Nomogram for adjusting UFH dose*

PTT (seconds)	Bolus (units/kg)	Hold infusion (minutes)	Dose change	Repeat PTT (hours)
< 50	50	0	Increase by 20%	4
50–59	0	0	Increase by 10%	4
60–85	0	0	No change.	24
86–95	0	0	Decrease by 10%	4
96–120	0	30	Decrease by 10%	4
> 120	0	60	Decrease by 15%	4

*The sensitivity of the PTT towards UFH depends on the reagent used.

Table reproduced from Venous thromboembolism: Prophylactic and therapeutic practice guideline. S Afr Med J 2013;103(4):260-267. Published with kind permission.

Maintain PTT 2.5–3.5 times the control.
Discontinue heparin once a therapeutic INR is achieved with warfarin.

AND

- Warfarin, oral, 0.1 mg/kg daily from day 1.
  - Target INR: 2–3.
  - Continue warfarin therapy for 3–6 months if no underlying severe thrombophilia.
  - Inherited thrombophilic conditions may need lifelong therapy.
  - Beware of drug interactions.

Weight	Starting dose of warfarin
10–20 kg	2.5 mg alternate days
20–35 kg	2.5 mg daily
35–50 kg	2.5 mg alternating with 5 mg daily
> 50 kg	5 mg daily

Adjust schedules using combinations of 2.5 mg and 5 mg **or** 5 mg and 7.5 mg **or** 7.5 mg and 10 mg if a standard daily dose does not provide a therapeutic INR. For example: 2.5 mg Monday, Wednesday, Friday and 5 mg Tuesday, Thursday, Saturday and Sunday.

REFERRAL

» All patients to an appropriate centre for diagnostic imaging.
» Long-term management of thrombophilic states should be in consultation with a paediatric haematologist or paediatrician.

3.13 SPECIAL CONSIDERATIONS IN HIV-INFECTED CHILDREN

In addition to the usual causes of blood disorders in childhood, HIV-infected children are at increased risk of developing anaemia, thrombocytopenia and neutropenia secondary to drugs (especially zidovudine in the case of

anaemia), opportunistic infections or neoplasms. They are also at increased risk of thrombo-embolic disease secondary to vasculopathy or the induction of a thrombophilic state.

3.13.1 THROMBOCYTOPENIA
D69.6

DESCRIPTION
Most cases of thrombocytopenia in children with HIV infection are due to immune thrombocytopenic purpura.
Exclude other causes of thrombocytopenia if the diagnosis is made clinically.

DIAGNOSTIC CRITERIA
Clinical
» Bleeding tendency in a child with HIV infection.
» Asymptomatic finding on full blood count.

Investigations
» Thrombocytopenia with normal white cell count and red cell indices, apart from the effects of blood loss.
» Normal INR and partial thromboplastin time (PTT).
» Abundant megakaryocytes on bone marrow aspiration with normal erythroid and myeloid cellularity.
» Indications for bone marrow investigation: Prior to starting steroids or any other abnormality on FBC or any atypical cells on differential count.

GENERAL AND SUPPORTIVE MEASURES
» As for the HIV-uninfected child.
» Avoid:
  > platelet transfusions, unless life-threatening bleeds,
  > contact sport, injury and trauma,
  > dental procedures in acute phase,
  > medications that affect platelet function, e.g. NSAIDs and aspirin.
» Check for interactions with ARTs.

MEDICINE TREATMENT
As for the HIV-uninfected child.

Initiate ART if not already initiated.

Acute ITP
Active bleeding:
- Prednisone, oral, 4 mg/kg/24 hours as a single daily dose for 4 days.

REFERRAL
» All children with refractory symptomatic thrombocytopenia.

CHAPTER 4

CARDIOVASCULAR SYSTEM

4.1 CARDIAC ARRHYTHMIAS

I49.9

DESCRIPTION

A heart rate that is either abnormally slow or fast for age or irregular.
Normal heart rate/minute for age:

Newborn	100–160
< 1 year	110–160
1–2 years	100–150
2–5 years	95–140
5–12 years	80–120
> 12 years	60–100

DIAGNOSTIC CRITERIA

Clinical

» Presenting features may vary with the age of the patient:

> infants:

colour changes (pale, mottled), irritability, feeding difficulties, sweating, tachypnoeic/apnoeic spells, irregular pulse, tachycardia, bradycardia, signs of cardiac failure,

> children:

dizziness, palpitations, fatigue, chest pain, tachycardia, bradycardia, syncope, signs of cardiac failure.

Investigations

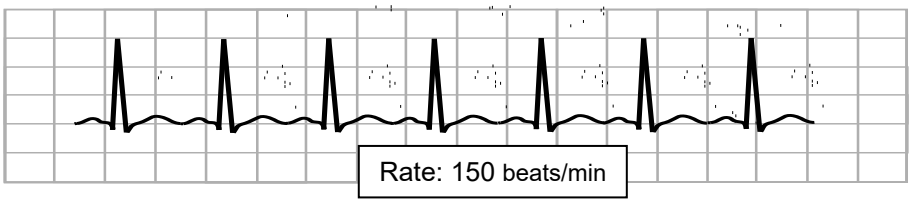
» ECG is essential for diagnosis, preferably a 12-lead ECG.

» Monitors are inadequate to diagnose most arrhythmias.

» A standard ECG is recorded at 25 mm/second. Each small block on the ECG paper is 1 mm x 1 mm and represents 40 milliseconds and each large block 5 mm x 5 mm and represents 200 milliseconds. A length of 300 large blocks represents 1 minute and the heart rate can be estimated from the ECG strip by dividing 300 by the number of large blocks between sequential R waves provided that there is not substantial variability in the RR interval lengths. The ECG tracings below show only the large (5 mm) blocks.

TACHYARRHYTHMIA

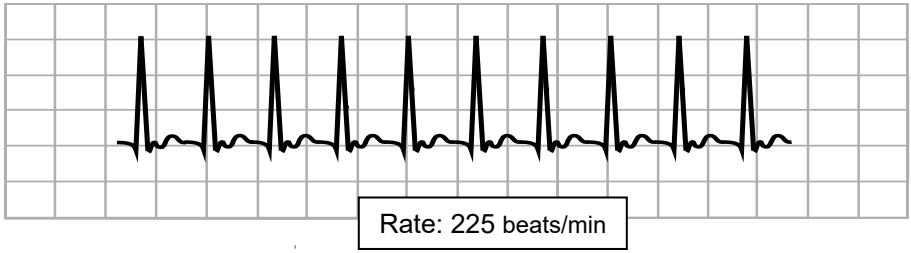
Sinus tachycardia



ECG Criteria

Rate: > upper limit for age
Rhythm: regular
P wave: present and normal
QRS: normal

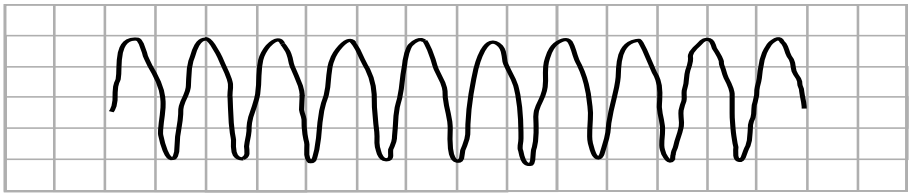
Supraventricular tachycardia



ECG Criteria

Rate: usually > 200 beats per minute
Rhythm: regular
P wave: abnormal
QRS: normal

Ventricular tachycardia



ECG Criteria

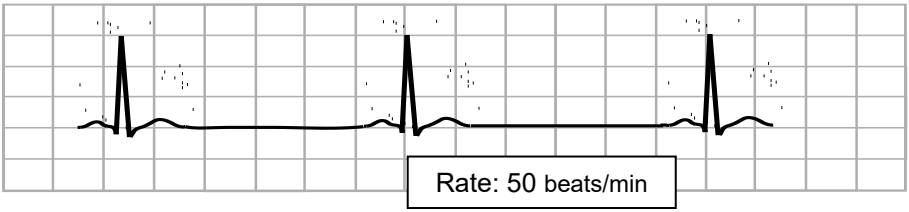
Rate: generally 100–220 beats per minute
Rhythm: generally regular
P wave: mostly not seen
QRS: abnormal, width of QRS > 120 milliseconds

BRADYARRHYTHMIA

» Important causes of bradycardia:

- > Hypoxia
- > Congenital heart block.
- > Hypothyroidism
- > Drug ingestion.
- > Excessive vagal stimulation.
- > Head injury.

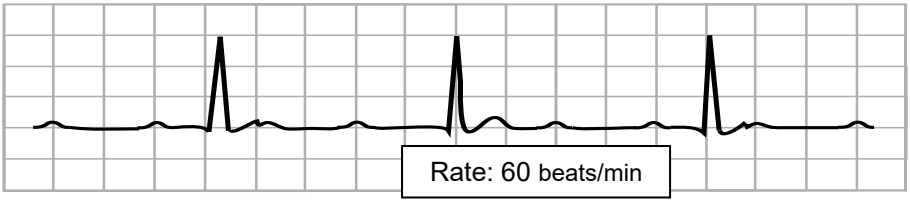
Sinus bradycardia



ECG Criteria

Rate: < lower limit for age
Rhythm: regular
P wave: present, all look the same
QRS: normal, 80–120 milliseconds

Heart block (Complete)



ECG Criteria

Rate: low, usually < 60 beats per minute
Rhythm: regular
P wave: independent P waves and QRS complexes with no relationship between the two (AV dissociation)
QRS complex: can be normal or wide, depending on escape rhythm

GENERAL AND SUPPORTIVE MEASURES

» Sinus tachycardia usually requires management of the underlying condition.
» Apply ABC of resuscitation if needed.
» Admit to high care or intensive care unit if indicated.
» Monitor:
  > ECG,
  > blood pressure,
  > heart rate,
  > respiratory rate,
  > oxygen saturation,
  > haemoglobin,
  > acid-base status,
  > blood gases.
» Maintain adequate nutrition and hydration.
» Treat pyrexia.

MEDICINE TREATMENT

Tachyarrhythmia

Emergency treatment.

Narrow complex tachycardia

Commonly due to supraventricular tachycardia.

Stable patient:

Attempt vagal stimulation:

» Place an ice bag on the face, or
» Infants: immerse the face in ice-cold water for a few seconds.
» Older children: try a Valsalva manoeuvre.
» Eye-ball pressure and carotid massage is contraindicated in children.

- In consultation with a paediatric specialist: Adenosine, IV, 0.1 mg/kg rapid IV push via a large bore cannula (within seconds). For infants, start with 0.2 mg/kg[1].
  - Follow immediately with a rapid flush of at least 5 mL sodium chloride 0.9%.
  - Increase dose in 0.1 mg/kg increments every 2 minutes until return of sinus rhythm. Follow each dose with a rapid flush of sodium chloride 0.9%.
  - Maximum dose: 0.5 mg/kg. Do not exceed 12 mg in total.
  - Because adenosine is rapidly metabolised, inject adenosine into an intravenous cannula capable of supporting rapid infusion and preferably located as centrally as possible (i.e. cubital rather than hand or foot). Follow immediately, with a rapid flush of a fluid bolus. It is helpful to have both the syringe with adenosine and the fluid bolus connected to the giving set. The line between the syringes and the patient should be as short as possible.

Unstable patient – heart failure/shocked:

» DC synchronised cardioversion at 1 J/kg, and then 2 J/kg.
» If possible, empty the stomach before cardioversion is attempted. Resuscitation facilities must be available.

- Ketamine for sedation, if necessary. Refer to Chapter 20 Pain: Section 20.1.2 Procedure Sedation and Analgesia, for ketamine dosing.

Broad complex tachycardia

Commonly due to ventricular tachycardia.
Causes include electrolyte disturbances and drug ingestion.

Stable patient (rare):

» Send ECG immediately to paediatric cardiologist.
» AVOID giving adenosine to patients with broad complex tachycardia unless the rhythm is regular with a monomorphic QRS complex.

Medicines that may be recommended by a paediatric cardiologist include:

- Magnesium sulphate, IV, 25–50 mg/kg over a few minutes for torsade de pointes.
- Amiodarone, IV, 5 mg/kg over 20 minutes.

LoE III[2]

Unstable patient – heart failure/shock:

» Pulseless – treat as ventricular fibrillation. See Chapter 1: Emergencies and Trauma, section 1.1.4: Cardiorespiratory arrest.
» DC synchronised cardioversion at 1 J/kg, and then 2 J/kg.
» If synchronised cardioversion fails, use asynchronised shocks.
» Resuscitation facilities must be available.
» Ketamine for sedation, if necessary. Refer to Chapter 20 Pain: Section 20.1.2 Procedure Sedation and Analgesia, for ketamine dosing.

Monitor and correct electrolytes and acid-base status on blood gases. Consider underlying causes.

If DC cardioversion fails:

- Amiodarone, IV, 5 mg/kg slowly over 20 minutes.

AND

Continue with DC cardioversion.

BRADYARRHYTHMIA

Try and correct underlying causes.

Stable patient:

Observe

Bradyarrhythmia due to vagal stimulation:

- Atropine, IV/IO, 0.02 mg/kg. Maximum single dose 0.5 mg.
  - If no response, repeat in 5 minutes.

LoE III[3]

Unstable patient:

Treat as impending arrest:

- Adrenaline (epinephrine), IV/IO, 0.01 mg/kg.
  - Repeat if necessary, conferring with referral institution.

If no sustained response, consider:

- Adrenaline (epinephrine), IV infusion, 0.05–2 µg/kg/minute.

LoE III[4]

REFERRAL

» All children with tachyarrhythmias after acute treatment, excluding sinus tachycardia due to other causes.
» Bradycardia unresponsive to medical treatment, or heart block.

4.2 CONGENITAL HEART DISEASE (CHD)

Q24.9

DESCRIPTION

Structural abnormalities of the heart or great vessels present at birth. They fall into 4 pathophysiological groups:

1. Acyanotic left to right shunts – ventricular septal defect (VSD), patent duct arteriosus (PDA), atrial septal defect (ASD), atrioventricular septal defect (AVSD).
2. Acyanotic obstructive lesions – pulmonary stenosis, aortic stenosis, coarctation of the aorta.
3. Cyanotic CHD – mostly right to left shunts – tetralogy of Fallot (TOF), pulmonary atresia (PA), truncus arteriosus, total anomalous pulmonary venous drainage (TAPVD), tricuspid atresia (TA), but including parallel circulation – transposition of great arteries (TGA) (see Chapter 19: Prematurity and Neonatal Conditions, section 19.4.2: Cyanotic heart disease in the newborn) and Eisenmenger syndrome.
4. Regurgitant lesions – aortic incompetence (AI), mitral incompetence (MI) which are not common in CHD.

Some patients with CHD present with life threatening symptoms in the newborn period, see Chapter 19: Prematurity and Neonatal Conditions, section 19.4.1: Heart failure in neonates. Left to right shunts, if large, may be symptomatic due to pulmonary over circulation and pulmonary hypertension or if small may present with an incidental murmur. Many will require surgery but this may follow a period of medical therapy.

Obstructive lesions are often asymptomatic until they precipitate ventricular failure or symptoms related to decreased cardiac output. The management is usually surgical or interventional. Angiotensin-converting enzyme inhibitors (ACE-inhibitors) should be avoided in the treatment of heart failure in patients with obstructive lesions.
Right to left shunts present with cyanosis and variable degrees of effort intolerance. Patients with tetralogy of Fallot may present with hypercyanotic spells.

4.2.1 CYANOTIC CONGENITAL HEART DISEASE WITH HYPOXAEMIA ATTACKS/SPELLS (HYPERCYANOTIC SPELLS)

Q24.9

DESCRIPTION

Acute worsening of central cyanosis in patients with a tetralogy of Fallot and certain other cyanotic heart diseases with pulmonary stenosis and a ventricular septal defect.

DIAGNOSTIC CRITERIA

Clinical

» Rapid worsening of central cyanosis, tachypnoea/dyspnoea, anxiety and alteration in consciousness in the presence of congenital cyanotic heart disease.
» Restlesnesss and crying in the presence of congenital cyanotic heart disease.
» Decrease in intensity or disappearance of the systolic murmur in tetralogy of Fallot during crying.

GENERAL AND SUPPORTIVE MEASURES

» Exclude and treat precipitants such as fever or dehydration.
» Calm the patient and keep on mother's lap, if possible.
» Place the patient in the knee-chest position to raise systemic blood pressure and increase systemic venous return.

» Monitor SaO_2, heart rate, respiratory rate and acid-base status.
» Ensure adequate hydration.

MEDICINE TREATMENT

- Oxygen, 100%, by facemask or by nasal cannula.
- Volume expander, e.g. sodium chloride 0.9%, IV bolus, 20 mL/kg administered over 5 minutes.
- Morphine, IV, 0.1–0.2 mg/kg as a single dose.
  - May cause impairment of airway reflexes and respiratory depression.

If clinically acidotic or pH < 7.2:

- Sodium bicarbonate 4.2%, IV, 2 mL/kg.

If failure to improve the cyanotic spell, consider:

- Ketamine, IV, 0.5–1 mg/kg.

OR

- Phenylephrine (in consultation with a specialist).

After resolution of spell:
If Hb < 10 g/dL, the child is anaemic:

- Packed red cells, 10 mL/kg administered over 3 hours.

- Propranolol, oral, 0.5–1 mg/kg/dose 6 hourly.
  - Do not exceed 5 mg/kg/day.

REFERRAL

» If above measures do not work, refer urgently.
» Refer all cases for assessment.

4.2.2 TETRALOGY OF FALLOT

Q21.3

DESCRIPTION

Ventricular septal defect with aortic override, right ventricular outflow tract obstruction and right ventricular hypertrophy.

Suspect tetralogy of Fallot in a child with cyanosis after the neonatal period.

DIAGNOSTIC CRITERIA

Clinical

» Child with central cyanosis.
» May be plethoric due to polycythemia – normal haemoglobin represents relative anaemia.
» May have clubbing.
» Possible history of cyanotic spells.

» Heart not clinically enlarged.
» Right ventricular hypertrophy usually not palpable.
» Single second heart sound.
» Coarse, ejection systolic murmur over the right ventricular outflow tract.
» Chest X-ray:
  > normal/small heart,
  > boot shaped/pulmonary bay – concavity where pulmonary artery should be,
  > oligaemic lung fields.
» ECG:
  > right axis deviation and right ventricular hypertrophy.

GENERAL AND SUPPORTIVE MEASURES
» Good dental hygiene.

MEDICINE TREATMENT
- Iron (elemental), oral, 1 mg/kg/dose 8 hourly.

- Folic acid, oral, 2.5–5 mg/day.

- Propranolol, oral, 0.5–1 mg/kg/dose 6 hourly.
  - Do not exceed 5 mg/kg/day.

Endocarditis prophylaxis:
See section 4.3: Endocarditis, infective.

REFERRAL
» Refer all children with cyanotic heart defects.

4.2.3 CONGENITAL HEART DISEASE WITH LEFT TO RIGHT SHUNT

DESCRIPTION
Structural abnormalities of the heart and great vessels that are usually associated with left to right shunting – most commonly: ventricular septal defect, atrial septal defect, patent ductus arteriosus and atrioventricular septal defect.

DIAGNOSTIC CRITERIA
Each condition has specific clinical, radiological and ECG findings.
Large left to right shunts present clinically with:
» Tachypnoea and indrawing.
» Sweating during feeds.
» Failure to thrive.
» Chest deformity: respiratory sulcus, praecordial bulge.
» Chest X-ray: usually cardiomegaly with plethoric lung fields.
» Cardiac impulse felt below the xiphisternum.

GENERAL AND SUPPORTIVE MEASURES

» Pay special attention to nutrition.

MEDICINE TREATMENT

- Furosemide, oral, 1 mg/kg/dose 8–12 hourly.
- Supplement with potassium chloride, oral, 25–50 mg/kg/dose 8–12 hourly.

If needed:

- Spironolactone oral, 1 mg/kg/dose 12 hourly, in which case, potassium supplementation should be stopped.

And if needed, in consultation with a paediatric cardiologist:

- ACE-inhibitor, e.g.
  - Captopril, oral:
    - Infants: 0.15–0.3 mg/kg/dose, 8–12 hourly (maximum 2 mg/kg/day).
    - Children: 0.3–0.5 mg/kg/dose 8–12 hourly (maximum 6 mg/kg/day).

LoE II[5,6]

REFERRAL

» All children with suspected left to right shunts due to CHD should be referred to a paediatric cardiology centre for diagnostic evaluation and planning of further management.

4.3 ENDOCARDITIS, INFECTIVE

I33.0

DESCRIPTION

Infection of the endothelial surface of the heart.
Suspect infective endocarditis in all children with fever and underlying heart disease.
Antibiotic therapy in these children is highly dependent on the results of microbiology.

DIAGNOSTIC CRITERIA

Clinical

» An underlying heart defect and a persistent low grade fever without an obvious underlying cause.
» Associated other findings include: fatigue, joint pain, new murmurs, clubbing, splenomegaly and haematuria.
» Must be differentiated from acute carditis due to rheumatic fever.
» The modified Duke criteria have been suggested as a guide to diagnosis, but have definite limitations as they were developed for use in adult patients.

Table 1: Major and minor clinical criteria used in the modified Duke criteria for diagnosis of infective endocarditis (IE)

MAJOR CRITERIA	MINOR CRITERIA
» Positive blood culture: > typical micro-organisms from two separate blood cultures: *S. viridans*, including nutritional variant strains, *S. bovis,* *HACEK group, *S. aureus,* or > Enterococci, in the absence of a primary focus, or > persistently positive blood culture with a micro-organism consistent with IE from blood cultures drawn > 12 hours apart, or > all 3 or a majority of 4 or more separate blood cultures, with the first and last drawn at least one hour apart, or > positive serology for Q fever, > single positive blood culture for *Coxiella burnetti* or anti-phase-1 IgG antibody titre > 1:800. » Evidence of endocardial involvement: > positive echocardiogram for IE (transoesophageal echocardiography is recommended for patients with prosthetic valves): oscillating intracardiac mass, on valve or supporting structures, or in the path of regurgitant jets, or on implanted materials, in the absence of an alternative anatomic explanation, or > abscess, or > new partial dehiscence of prosthetic valve, or > new valvular regurgitation.	» Predisposing heart condition or IV drug use. » Fever ≥ 38ºC. » Vascular phenomena: > major arterial emboli, > septic pulmonary infarcts, > mycotic aneurysm, > intracranial haemorrhage, > conjunctival haemorrhages, > Janeway lesions. » Immunologic phenomena: > Osler's nodes, > Roth spots, > glomerulonephritis, > rheumatoid factor. » Microbiologic evidence: > positive blood culture but not meeting major criterion, or > serologic evidence of active infection with organism consistent with IE.

*A group of fastidious Gram-negative organisms originating in the mouth.

Table 2: Modified Duke criteria for diagnosis of infective endocarditis (IE)

DEFINITE IE	POSSIBLE IE	REJECTED
Pathological criteria: » Micro-organisms: > by culture or histology in a vegetation, or > in a vegetation that has embolised, or > in an intracardiac abscess, or » Lesions: > Vegetation or intracardiac abscess present – confirmed by histology showing active IE. Clinical criteria – see Table 1: » 2 major criteria, » 1 major and 3 minor, or » 5 minor.	» At least 1 major and 1 minor criterion, or » 3 minor.	» Alternative diagnosis for manifestation of endocarditis, or » resolution of manifestations, with antibiotic therapy ≤ 4 days, or » no pathologic evidence of IE at surgery or autopsy, after antibiotic therapy for ≤ 4 days.

Limitations of the modified Duke criteria in children
The clinical criteria rely heavily on relatively rare clinical features.
In contrast, common clinical features like splenomegaly, clubbing and haematuria have not been included.
Investigations like CRP or ESR, which may be of value, have also not been included.

Investigations
» Blood cultures:
> Sterile blood culture technique is essential.
> Take 3 blood cultures (venous) from different sites within 2 hours if very ill, otherwise within 24 hours. There is little benefit from doing more than 5 blood cultures.
> Child need not necessarily have a fever as patients are mostly constantly bacteraemic.
» Urine test strips – haematuria.
» CRP/ESR may be helpful.

GENERAL AND SUPPORTIVE MEASURES
» Bed rest/limit physical activity.
» Ensure adequate nutrition.
» Maintain haemoglobin > 10 g/dL.
» Measures to reduce fever.

MEDICINE TREATMENT
For heart failure, see section 4.9: Heart failure.

For fever:

- Paracetamol, oral, 15 mg/kg/dose, 6 hourly as required.

Antibiotic therapy

Antibiotics are seldom indicated as part of emergency treatment.
It is important to obtain adequate blood culture specimens prior to initiation of antibiotics.

Antibiotics are **always** given IV.

Empiric treatment

If culture is not yet available or remains negative:

- Benzylpenicillin (Penicillin G), IV, 50 000 units/kg/dose, 6 hourly for 4–6* weeks.

PLUS

- Cloxacillin, IV, 50 mg/kg/dose 6 hourly for 4–6* weeks.

LoE III[7]

PLUS

- Gentamicin, IV, 3 mg/kg/day for 2 weeks.

LoE II[8]

**The longer duration of therapy is used for patients with complications or prosthetic valves.*

If positive culture available: Consult a paediatric cardiologist, infectious disease specialist or clinical microbiologist.

Prophylaxis

The use of prophylaxis is controversial but still recommended.

For children with the following cardiac conditions:

» rheumatic heart disease,
» prosthetic cardiac valve or prosthetic material used in valve repair,
» previous infective endocarditis,
» unrepaired cyanotic heart disease, including palliative shunts,
» during the first 6 months after complete repair of a congenital heart defect with prosthetic material or device (complete endothelialisation of prosthesis after 6 months),
» repaired cyanotic heart disease with residual defect at or adjacent to prosthetic patch or device, or
» cardiac transplant recipients who develop cardiac valvulopathy.

Children with the above cardiac conditions should receive prophylaxis when undergoing the following procedures:

» All dental procedures that involve manipulation of gingival tissues or periapical region of teeth or trauma to oral mucosa.
» Prophylaxis is not recommended for procedures involving the GIT, GUT, respiratory tract, skin or soft tissue in the absence of existing infections. (If infections of GIT/GUT are present, include cover for enterococcus, e.g. amoxicillin

or ampicillin, and for infections of respiratory tract, soft tissue and skin, include cover for staphylococcus aureus, e.g. cloxacillin or cephalexin).

Regimens for dental procedures

- Amoxicillin, oral, 50 mg/kg (maximum 2 g) 1 hour before the procedure.

Patients unable to take oral medication:

- Ampicillin, IV, 50 mg/kg (maximum 2 g) ½ hour before the procedure.

Patients with penicillin allergy:

- Azithromycin, oral, 10 mg/kg, ½ to 1 hour before procedure.

LoE III[9]

REFERRAL

» All patients with suspected (for echocardiography) and confirmed (for antibiotic and possible surgical management) infective endocarditis as soon as possible.

4.4 RHEUMATIC FEVER, ACUTE

I01.9

*Notifiable condition.

DESCRIPTION

Rheumatic fever is an inflammatory condition that may follow a throat infection with group A streptococci. It is an important cause of acquired heart disease with significant morbidity and mortality rates, both in the acute phase of the disease and as a result of chronic valvular sequelae.

DIAGNOSTIC CRITERIA

Revised Jones criteria:

» Evidence of recent streptococcal infection:
  > Elevated ASO-titre or other streptococcal antibody titres.
  > Positive throat culture for group A beta-haemolytic streptococcus.

PLUS

» Two major manifestations, **or** one major and two minor manifestations, justifies the presumptive diagnosis of acute rheumatic fever (Jones Criteria 2015 – South African children are defined as members of a high risk population).

Major manifestations	Minor manifestations
» Mono or polyarthritis/polyarthralgia » Carditis » Erythema marginatum » Subcutaneous nodules » Sydenham's chorea	» Monoarthralgia » Fever ≥ 38°C » Acute phase reactants: increased erythrocyte sedimentation rate (ESR) ≥ 30 mm/hr or C-reactive protein (CRP) ≥ 30 mg/l » ECG: prolonged PR-interval, ≥ 0.16 seconds in the absence of carditis

> Carditis is either defined clinically or after an echocardiographic study.
> Chorea, for which other causes have been excluded, provides adequate evidence of rheumatic fever without the other criteria for diagnosis being required.
> In children with rheumatic heart disease with fever, it is critical to differentiate recurrence of acute rheumatic fever from infective endocarditis.

For children with rheumatic heart disease, recurrence of some of the above criteria would suggest a recurrence of rheumatic fever but other causes such as IE should be excluded.

GENERAL AND SUPPORTIVE MEASURES

» Hospitalise with bed rest until sleeping pulse is normal and signs of rheumatic activity have resolved.
» Restrict physical activity for at least 2 weeks after acute phase reactants have normalised.
» Keep a record of patients on rheumatic fever prophylaxis so that attendance can be monitored.

MEDICINE TREATMENT

Antibiotic therapy

To eradicate any streptococci:

- Benzathine benzylpenicillin (depot formulation), IM, as a single dose.
  - If < 30 kg: 600 000 IU.
  - If ≥ 30 kg: 1.2 MU.

OR

- Phenoxymethylpenicillin, oral, 15 mg/kg (up to a maximum of 500 mg) 12 hourly for 10 days.

LoE III[10,11]

Patients with penicillin allergy:

- Azithromycin, oral, 10 mg/kg/day for 5 days.

Anti-inflammatory therapy

Do not start until a definite diagnosis is made. Paracetamol can be administered for joint pain. Anti-inflammatory therapy is no longer recommended for carditis alone.

Severe arthritis:

- Ibuprofen, oral, 10 mg/kg/dose, 8 hourly, oral, (non-steroidal anti-inflammatory agents are preferred to aspirin as a result of the side effect profile) until the arthritis resolves.

OR

- If necessary, with specialist consultation, aspirin, soluble, oral, 20 mg/kg/dose 6 hourly.

Cardiac failure: See section 4.9: Heart failure.

Chorea: See Chapter 13: The Nervous System, section 13.10: Sydenham's chorea.

Prevention of repeated attacks

Any patient with documented rheumatic fever must receive prophylaxis.
Intramuscular penicillin is superior to other forms of prophylaxis.

- Benzathine benzylpenicillin (depot formulation), IM, every 3–4 weeks.
  - If < 30 kg: 600 000 IU.
  - If > 30 kg: 1.2 MU.

OR

- Phenoxymethylpenicillin, oral, 250 mg 12 hourly.

Patients with penicillin allergy:

- Evidence is not robust in this area, thus consultation with a specialist on a case by case basis will be required.

Continue therapy until patients reach 21 years of age if no rheumatic valvular disease, and until 35 years of age in patients with rheumatic valvular disease.

LoE III[8]

REFERRAL

Rheumatic fever: all patients need to be referred for echocardiography and further evaluation.

4.5 MYOCARDITIS

I40

DESCRIPTION

Myocarditis is an inflammatory disease of the cardiac muscle. The majority of paediatric myocarditis cases are caused by viral infection. Viral myocarditis should be suspected whenever a child presents with arrhythmia, heart failure or cardiogenic shock following a viral illness. Myocarditis should be considered in children with unexplained shortness of breath.

DIAGNOSTIC CRITERIA

Clinical

» Tachycardia
» Clinical signs of biventricular heart failure.
» May present with cardiogenic shock.

Investigations

» ECG changes are non-specific but ST elevation, T wave inversion, prolonged QTc, small complexes, arrhythmias or extra-systole may be seen.
» Chest X-ray:
  > pulmonary congestion,
  > cardiomegaly,
  > possible pleural effusion.
» Elevated cardiac troponin-T levels are markers of myocarditis but normal levels do not exclude the diagnosis.

GENERAL AND SUPPORTIVE MEASURES

» Restrict fluid (75% of daily requirements) – not at expense of adequate caloric intake.
» Ensure adequate nutrition; tube-feeding may be necessary.

MEDICINE TREATMENT OF VIRAL MYOCARDITIS

To prevent hypoxia:

- Oxygen via face mask, nasal cannula, CPAP or high flow.

For pulmonary oedema:

- Furosemide, IV, 1 mg/kg, 8 hourly. Monitor urinary output.
- If response is inadequate, change to an IV infusion 0.1–1 mg/kg/hour.
- Switch to oral furosemide as soon as patient condition allows.
  - Monitor clinically and biochemically for, and avoid, over diuresis.
  - Monitor for hypokalaemia and other electrolyte disturbances.

LoE III[3]

If response is still inadequate, consider:

- Spironolactone, oral, 1–3 mg/kg/dose once daily in consultation with a paediatric cardiologist. May be divided 12 hourly.
- Inotropic support may be needed, see section 4.9.1: Heart failure, acute with pulmonary oedema.
- IV immunoglobulins are not recommended[12].

REFERRAL

» All children with suspected myocarditis should be managed in consultation with a paediatrician. Long-term (at least 6 months) exercise avoidance, medicine treatment and follow-up is needed.

4.6 DILATED CARDIOMYOPATHY

I42.0

DESCRIPTION

Dilated cardiomyopathy is a clinical diagnosis characterised by dilation and impaired contraction of the left or both ventricles that is not explained by abnormal loading conditions. It is difficult and sometimes impossible to distinguish myocarditis from dilated cardiomyopathy. Dilated cardiomyopathy is often a sequel to viral myocarditis.

DIAGNOSTIC CRITERIA

Clinical

» Cardiomegaly with clinical signs of heart failure and poorly localised apical impulse.
» May present with cardiogenic shock.

Investigations

» Chest X-ray:

  - > pulmonary congestion,
  - > cardiomegaly,
  - > there may be pleural effusion.
- » ECG:
  - > Mostly non-specific.
  - > Arrhythmias or extra-systoles may occur.

GENERAL AND SUPPORTIVE MEASURES

- » Fluid restriction (75% of daily requirements) – not at expense of adequate caloric intake.
- » Ensure adequate nutrition; tube-feeding may be necessary.
- » Advise bed rest.

MEDICINE TREATMENT

To prevent hypoxia:

- Oxygen via face mask, nasal cannula, CPAP or high flow.

See section 4.9: Heart failure.

REFERRAL

- » Urgent: To ICU for inotropic support if indicated.
- » All patients for assessment and consideration of underlying disorders.

4.7 PERICARDIAL EFFUSION

I30

DESCRIPTION

Accumulation of fluid in the pericardial space, usually secondary to pericarditis.

DIAGNOSTIC CRITERIA

Clinical

- » Most patients present with a prolonged history of:
  - > low cardiac output,
  - > distended neck veins,
  - > muffled or diminished heart sounds.
- » Patients with HIV may be asymptomatic and incidentally diagnosed on chest X-ray.
- » Often associated with TB.
- » Acute septic pericarditis may occur in patients with septicaemia.

Investigations

- » Exclude TB in all cases: Tuberculin skin test.
- » ECG:
  - > small complexes tachycardia,
  - > diffuse T wave changes.
- » Chest X-ray:

- > in pericardial effusion – 'water bottle' large globular heart or cardiac shadow with smoothed-out borders.
- » Ultrasound of heart and pericardium.
- » Diagnostic pericardiocentesis:
  - > in all patients with suspected bacterial or neoplastic pericarditis, and in all others in whom the diagnosis is not readily obtained;
  - > include cell count and differential, culture and Gram stain;
  - > an elevated adenosine deaminase (ADA) may be helpful in diagnosing TB.

CARDIAC TAMPONADE

Cardiac tamponade is the accumulation of pericardial fluid that restricts ventricular filling and stroke volume. The child usually presents with a tachycardia, pulsus paradoxus, elevated JVP, hypotension, shock or pulseless electric activity.

Features on ECG include electrical alternans and low voltage QRS.
Diagnosis is confirmed by ultrasound.

GENERAL AND SUPPORTIVE MEASURES

Urgent pericardiocentesis under ultrasound guidance by an experienced person.

Pericardiocentesis

- » Do a coagulation screen if coagulation problems are suspected.
- » Preferably under ultrasound guidance by an experienced person.
- » In an emergency, drainage by using a large bore intravenous cannula.

- » Technique:
  - > Ensure that full resuscitation equipment is available as well as an IV line and cardiac monitor.
  - > Administer oxygen via face mask, nasal cannula or head box.
  - > If the patient is restless, it may be necessary to sedate the patient. In an emergency situation, this is unnecessary.
  - > Position the patient in a 30° sitting-up position.
  - > Prepare the preferred site just to the left of the xiphoid process, 1 cm inferior to the costal margin.
  - > Infiltrate this area with 1% lidocaine (lignocaine).
  - > Maintaining negative pressure on the syringe, insert the needle at a 45° angle to the skin, advancing in the direction of the patient's left shoulder.
  - > While advancing the needle, observe closely on ECG for ventricular ectopic beats, a sign of myocardial contact. If this is noted, gradually withdraw the needle a few millimeters.
  - > Once air (pneumopericardium) or fluid begins to fill the syringe, advance the intravenous cannula, withdraw the needle, attach the syringe to the hub of the cannula and slowly aspirate the pericardial fluid.
  - > Potential complications include: haemopericardium (from laceration of the heart wall or coronary artery), cardiac dysrythmias, pneumothorax, and pneumopericardium.

MEDICINE TREATMENT

If suspected or proven TB pericarditis, give antituberculosis drugs for 6 months plus corticosteroids.

- Prednisone, oral, for 6 weeks:
  - Week 1: 2 mg/kg/day,
  - Week 2: 1.5 mg/kg/day,
  - Week 3: 1 mg/kg/day,
  - Week 4: 1 mg/kg/day,
  - Week 5: 0.5 mg/kg/day,
  - Week 6: 0.25 mg/kg/day.

LoE III[13,14]

Pain management

See Chapter 20: Pain Control, section 20.1.1: Management of pain.

Antibiotic therapy

If suspected bacterial pericarditis, give empiric antibiotic treatment until culture and sensitivity results are available.

Antibiotic therapy should be continued for 4 weeks.

In case of purulent pericarditis:

- Cloxacillin, IV, 50 mg/kg/dose 6 hourly.

PLUS

- Ceftriaxone, IV, 100 mg/kg as a single daily dose.

REFERRAL

» Refer all patients after stabilisation.

4.8 PERICARDITIS

I30.9

DESCRIPTION

An inflammation of the pericardium. Causes include viral or bacterial and autoimmune disease. The commonest cause is viral but the clinician should entertain a high index of suspicion for tuberculous and bacterial pericarditis as these require specific antimicrobial treatment.

DIAGNOSTIC CRITERIA

Inflammation of the pericardium:

» Classical presentation of viral pericarditis, with a loud pericardial rub and chest pain that is relieved by sitting up. Children often do not complain of chest pain.

» Acute septic pericarditis may occur in patients with septicaemia.

TB pericarditis

TB pericarditis may present as a pericardial effusion (most cases), effusive constrictive pericarditis or constrictive pericarditis.

Clinical features include:
» chronic cough,
» chest pain,
» night sweats,
» and weight loss.
» dyspnoea,
» fever,
» orthopnoea,

Severe pericardial pain is uncommon.

Investigations
» Exclude TB.
» Echocardiogram

MEDICINE TREATMENT
Treat the cause.

For tuberculous and bacterial pericarditis treatment, see section 4.7: Pericardial effusion.

Viral pericarditis
NSAIDs, e.g.:
- Ibuprofen, oral, 5 mg/kg/dose 6 hourly.

REFERRAL
» All patients in whom the cause is unidentifiable.

4.9 HEART FAILURE
I50.9

DESCRIPTION
A clinical syndrome reflecting the inability of the myocardium to meet the oxygen and nutritional/metabolic requirements of the body.

Causes include:
» volume overload:
  > L-R shunt lesions,
  > mitral/aortic regurgitation.
» pump failure:
  > myocarditis/cardiomyopathy.
» high output failure:
  > septicaemia,
  > severe anaemia.

DIAGNOSTIC CRITERIA
Clinical
» Acute cardiac failure may present with shock. See Chapter 1: Emergencies and Trauma, section 1.1.8: Shock.

» History of recent onset of:
  > poor feeding,
  > poor or excessive weight gain,
  > tachypnoea,
  > breathlessness,
  > sweating,
  > cough.
» Physical findings:
  > tachycardia,
  > cardiomegaly,
  > hypotension,
  > cold extremities,
  > weak pulses,
  > reduced urinary output,
  > gallop rhythm with/without a cardiac murmur.
  > pulmonary venous congestion and fluid retention:
    - tachypnoea,
    - dyspnoea,
    - orthopnoea,
    - recession,
    - wheezing,
    - coarse crepitations,
    - cyanosis.
  > systemic venous congestion:
    - hepatomegaly,
    - periorbital oedema – not seen in infants,
    - abnormal weight gain.
  > signs and symptoms of the underlying condition/disease.

Investigations as appropriate for the possible underlying cause
» Chest X-ray: cardiomegaly is almost always present.
» Electrocardiogram may show evidence of hypertrophy/enlargement of one or more heart chambers and/or arrhythmias.

4.9.1 HEART FAILURE, ACUTE WITH PULMONARY OEDEMA
I50.9

GENERAL AND SUPPORTIVE MEASURES
» Treat the underlying disorder/condition. Where the primary cause of acute pulmonary oedema is renal failure, treat as per renal failure. See Chapter 6: Nephrological/Urological Disorders, section 6.4: Acute kidney injury.
» Restrict fluids, beware of IV fluids.
» Place patient in an upright or semi-upright sitting position.
» Intubation and ventilation may be required in an ICU setting.

MEDICINE TREATMENT
- Oxygen 100%, administered via face mask, nasal cannula, CPAP or high flow.

Treat the underlying condition:
- Furosemide, IV, 1 mg/kg, 8 hourly.
- If response is inadequate, change to an IV infusion 0.1–1 mg/kg/hour.
- Switch to oral furosemide as soon as the patient's condition allows.
  - Monitor clinically and biochemically for, and avoid, overdiuresis.

- Monitor for hypokalaemia and other electrolyte disturbances.

LoE III[3]

If response still inadequate, consider:

- Hydrochlorothiazide, oral, 1 mg/kg/dose, 12 hourly in consultation with a paediatric cardiologist.

LoE III[15,16]

Manage severe hypotensive or refractory failure in an ICU setting.

Inotropic support may help to stabilise patients with severe myocardial dysfunction and hypotension.
May be lifesaving in severe myocarditis or cardiogenic shock.

- Dobutamine, IV infusion, 2–15 µg/kg/minute.
  - Continue until myocardial function and blood pressure improve.

If no response to dobutamine, consider adrenaline (epinephrine) infusion. Ensure adequate renal function.

Once patient stable and maintaining blood pressure, wean the inotrope and introduce:

- ACE-inhibitor. **Note**: ACEI should be avoided in patients with obstructive heart lesions.
- Captopril, oral:
  - Initial dose: 0.5–1 mg/kg/24 hours in 3 divided doses (8 hourly) for 24–48 hours.
  - Increase by 0.5 mg/kg/24 hours every 24–48 hours until maintenance dose of 3–5 mg/kg/24 hours is reached. Monitor blood pressure and renal function.
  - Continue for as long as needed to control the cardiac failure and allow myocardial recovery.

LoE III[17]

4.9.2 HEART FAILURE, MAINTENANCE THERAPY

I50.9

GENERAL AND SUPPORTIVE MEASURES

» Recognise and treat the underlying condition, e.g. infection, hypertension, cardiac tamponade, fluid overload.
» Fluid restriction (75% of daily requirements) – but not at the expense of adequate caloric intake.
» Ensure adequate nutrition; tube-feeding may be necessary.
» Monitor blood potassium levels, urea and electrolytes.

MEDICINE TREATMENT

- Oxygen 100%, administered via face mask or nasal cannula.

Combination drug therapy is usually indicated, i.e. start with a diuretic, then add an ACE-inhibitor.

Diuretic

- Furosemide, oral, 1–2 mg/kg/dose 12 hourly. Titrate dose against clinical response. Potassium supplements are necessary if furosemide is used without an aldosterone antagonist, i.e. spironolactone.
- Monitor for response.

LoE III[18]

If response still inadequate, consider:

- Hydrochlorothiazide 1 mg/kg/dose oral, 12 hourly in consultation with a paediatric cardiologist.

LoE III[15,12]

AND

ACE-inhibitor

Note:

ACE-inhibitors are contraindicated in bilateral renal artery stenosis, coarctation of the aorta, aortic stenosis and mitral stenosis.

- Captopril, oral:
  - Initial dose: 0.5–1 mg/kg/24 hours in 3 divided doses (8 hourly) for 24–48 hours.
  - Increase by 0.5 mg/kg/24 hours every 24–48 hours until maintenance dose of 3–5 mg/kg/24 hours is reached. If < 1 year do not exceed 4 mg/kg/day.
  - Continue as long as needed to control the cardiac failure and allow myocardial recovery.

LoE III[13]

OR

- Enalapril, oral, 0.2–1 mg/kg/day as a single dose or 2 divided doses. Start at the low dose and increase by 0.2 mg/kg/day at 1–2 day intervals.

If still symptomatic, add:

- Spironolactone, oral, 1–3 mg/kg/dose once daily. May be divided 12 hourly.

In those patients that are refractory, refer to a paediatric cardiologist for consideration of beta-blockers and digoxin.

REFERRAL

» For determination of the underlying cause where this is not known, and review of treatment after stabilisation.
» Deterioration despite adequate treatment.

4.10 DYSLIPIDAEMIA

E78.9

See Chapter 7: Endocrine System, section 7.5.2.5: Dyslipidaemia.

4.11 HYPERTENSION IN CHILDREN

I10

DESCRIPTION

Hypertension is defined as systolic and/or diastolic blood pressure ≥ the 95th percentile for gender, age and height percentile on at least three consecutive occasions. A sustained blood pressure of > 130/90 mmHg in a child older than 13 years is defined as hypertension. Measure blood pressure with the child in a sitting or supine position with the entire arm in line with the level of the heart.

In the majority of children, hypertension is due to an identifiable cause. Severe hypertension suggests renal disease.

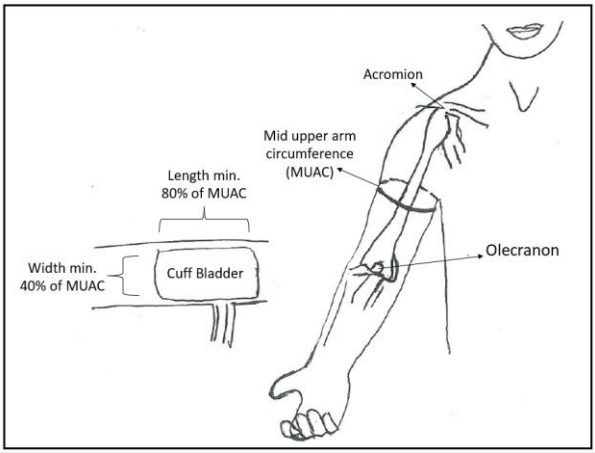
Hypertensive emergency/crisis exists when CNS signs of hypertension appear, such as encephalopathy, convulsions, retinal haemorrhages or blindness**.** Great care is required to reduce the blood pressure in a controlled manner to avoid potentially serious consequences of impaired auto-regulation of cerebral blood flow.

Hypertensive urgency is defined as a significant elevation of blood pressure without accompanying end-organ damage. Patients are generally symptomatic with complaints of headache, blurred vision and nausea, despite the lack of end-organ involvement.

A valid assessment of the blood pressure is of extreme importance. The blood pressure is measured by standard auscultation technique in children > 1 year of age.

Measure the BP in at least one limb, preferably the right upper arm. If hypertension is present, measure BP in all four limbs.

One should use the widest cuff that can be applied to the upper arm. The cuff bladder must encircle at least 80% of the upper arm and should cover at least 40% of the distance between the acromion and the olecranon.



1. Palpate the boney prominence of the acromion and olecranon posteriorly to determine the mid-upper arm point, where the mid-upper arm circumference (MUAC) is measured.
2. MUAC for BP measurement is done on the right arm whereas for malnutrition, use the non-dominant arm.

It is better to use a cuff that is slightly too large than one that is too small. Large cuffs, if covered with linen-like material, can be folded to the appropriate size in smaller infants as long as the bladder encompasses the arm.

DIAGNOSTIC CRITERIA

Clinical

» Symptoms and signs of any of the following systems:
  > central nervous,
  > cardiovascular,
  > respiratory,
  > urogenital.
» The most common associated features are:
  > oedema, haematuria, proteinuria,
  > skin sores (impetigo),
  > convulsions, coma and visual symptoms,
  > acute heart failure and pulmonary oedema,
  > acute respiratory distress, cyanosis and apnoea.
» Some children may be asymptomatic.
» Blood pressure in children correlates with body size and increases with age.

Categories of hypertension

» Normal: below 90th percentile.
» Elevated blood pressure: 90th–95th percentile or BP > 120/80 mmHg.
» Stage 1 hypertension: > 95th–99th percentile plus 12 mmHg.
» Stage 2 hypertension: > 99th percentile plus 5 mmHg.

Age of child	95th Percentile of systolic and diastolic blood pressure	
	First 12 hours	First week
Newborn – preterm	65/45 mmHg	80/50 mmHg
Newborn – full term	80/50 mmHg	100/70 mmHg

Screening blood pressure values requiring further evaluation[19]

Age (years)	Blood Pressure (mmHg)			
	Boys		Girls	
	Systolic	Diastolic	Systolic	Diastolic
1	98	52	98	54
2	100	55	101	58
3	101	58	102	60
4	102	60	103	62
5	103	63	104	64
6	105	66	105	67
7	106	68	106	68
8	107	69	107	69
9	107	70	108	71
10	108	72	109	72
11	110	74	111	74
12	113	75	114	75
≥ 13	120	20	120	80

Note: **Blood pressure levels by age and height percentiles. Various growth charts can be obtained from:**
https://www.cdc.gov/growthcharts/clinical_charts.htm#Set1

Blood pressure levels for Boys by age and height percentile[16]

Age (year)	BP Percentile	Systolic BP (mmHg) Percentile of Height							Diastolic BP (mmHg) Percentile of Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
1	Height (cm)	77.2	78.3	80.2	82.4	84.6	86.7	87.9	77.2	78.3	80.2	82.4	84.6	86.7	87.9
	50th	85	85	86	86	87	88	88	40	40	40	41	41	42	42
	90th	98	99	99	100	100	101	101	52	52	53	53	54	54	54
	95th	102	102	103	103	104	105	105	54	54	55	55	56	57	57
	95th + 12 mmHg	114	114	115	115	116	117	117	66	66	67	67	68	69	69
2	Height (cm)	86.1	87.4	89.6	92.1	94.7	97.1	98.5	86.1	87.4	89.6	92.1	94.7	97.1	98.5
	50th	87	87	88	89	89	90	91	43	43	44	44	45	46	46
	90th	100	100	101	102	103	103	104	55	55	56	56	57	58	58
	95th	104	105	105	106	107	107	108	57	58	58	59	60	61	61
	95th + 12 mmHg	116	117	117	118	119	119	120	69	70	70	71	72	73	73
3	Height (cm)	92.5	93.9	96.3	99	101.8	104.3	105.8	92.5	93.9	96.3	99	101.8	104.3	105.8
	50th	88	89	89	90	91	92	92	45	46	46	47	48	49	49
	90th	101	102	102	103	104	105	105	58	58	59	59	60	61	61
	95th	106	106	107	107	108	109	109	60	61	61	62	63	64	64
	95th + 12 mmHg	118	118	119	119	120	121	121	72	73	73	74	75	76	76
4	Height (cm)	98.5	100.2	102.9	105.9	108.9	111.5	113.2	98.5	100.2	102.9	105.9	108.9	111.5	113.2
	50th	90	90	91	92	93	94	94	48	49	49	50	51	52	52
	90th	102	103	104	105	105	106	107	60	61	62	62	63	64	64
	95th	107	107	108	108	109	110	110	63	64	65	66	67	67	68
	95th + 12 mmHg	119	119	120	120	121	122	122	75	76	77	78	79	79	80
5	Height (cm)	98.5	100.2	102.9	105.9	108.9	111.5	113.2	98.5	100.2	102.9	105.9	108.9	111.5	113.2
	50th	90	90	91	92	93	94	94	48	49	49	50	51	52	52
	90th	102	103	104	105	105	106	107	60	61	62	62	63	64	64
	95th	107	107	108	108	109	110	110	63	64	65	66	67	67	68
	95th + 12 mmHg	119	119	120	120	121	122	122	75	76	77	78	79	79	80
Age	BP	Systolic BP (mmHg)							Diastolic BP (mmHg)						

(year)	Percentile	Percentile of Height							Percentile of Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
6	Height (cm)	110.3	112.2	115.3	118.9	122.4	125.6	127.5	110.3	112.2	115.3	118.9	122.4	125.6	127.5
	50th	93	93	94	95	96	97	98	54	54	55	56	57	57	58
	90th	105	105	106	107	109	110	110	66	66	67	68	68	69	69
	95th	108	109	110	111	112	113	114	69	70	70	71	72	72	73
	95th + 12 mmHg	120	121	122	123	124	125	126	81	82	82	83	84	84	85
7	Height (cm)	116.1	118	121.4	125.1	128.9	132.4	134.5	116.1	118	121.4	125.1	128.9	132.4	134.5
	50th	94	94	95	97	98	98	99	56	56	57	58	58	59	59
	90th	106	107	108	109	110	111	111	68	68	69	70	70	71	71
	95th	110	110	111	112	114	115	116	71	71	72	73	73	74	74
	95th + 12 mmHg	122	122	123	124	126	127	128	83	83	84	85	85	86	86
8	Height (cm)	121.4	123.5	127	131	135.1	138.8	141	121.4	123.5	127	131	135.1	138.8	141
	50th	95	96	97	98	99	99	100	57	57	58	59	59	60	60
	90th	107	108	109	110	111	112	112	69	70	70	71	72	72	73
	95th	111	112	112	114	115	116	117	72	73	73	74	75	75	75
	95th + 12 mmHg	123	124	124	126	127	128	129	84	85	85	86	87	87	87
9	Height (cm)	126	128.3	132.1	136.3	140.7	144.7	147.1	126	128.3	132.1	136.3	140.7	144.7	147.1
	50th	96	97	98	99	100	101	101	57	58	59	60	61	62	62
	90th	107	108	109	110	112	113	114	70	71	72	73	74	74	74
	95th	112	112	113	115	116	118	119	74	74	75	76	76	77	77
	95th + 12 mmHg	124	124	125	127	128	130	131	86	86	87	88	88	89	89
10	Height (cm)	130.2	132.7	136.7	141.3	145.9	150.1	152.7	130.2	132.7	136.7	141.3	145.9	150.1	152.7
	50th	97	98	99	100	101	102	103	59	60	61	62	63	63	64
	90th	108	109	111	112	113	115	116	72	73	74	74	75	75	76
	95th	112	113	114	116	118	120	121	76	76	77	77	78	78	78
	95th + 12 mmHg	124	125	126	128	130	132	133	88	88	89	89	90	90	90

Age (year)	BP Percentile	Systolic BP (mmHg) Percentile of Height							Diastolic BP (mmHg) Percentile of Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
11	Height (cm)	134.7	137.3	141.5	146.4	151.3	155.8	158.6	134.7	137.3	141.5	146.4	151.3	155.8	158.6
	50th	99	99	101	102	103	104	106	61	61	62	63	63	63	63
	90th	110	111	112	114	116	117	118	74	74	75	75	75	76	76
	95th	114	114	116	118	120	123	124	77	78	78	78	78	78	78
	95th + 12 mmHg	126	126	128	130	132	135	136	89	90	90	90	90	90	90
12	Height (cm)	140.3	143	147.5	152.7	157.9	162.6	165.5	140.3	143	147.5	152.7	157.9	162.6	165.5
	50th	101	101	102	104	106	108	109	61	62	62	62	62	63	63
	90th	113	114	115	117	119	121	122	75	75	75	75	75	76	76
	95th	116	117	118	121	124	126	128	78	78	78	78	78	79	79
	95th + 12 mmHg	128	129	130	133	136	138	140	90	90	90	90	90	91	91
13	Height (cm)	147	150	154.9	160.3	165.7	170.5	173.4	147	150	154.9	160.3	165.7	170.5	173.4
	50th	103	104	105	108	110	111	112	61	60	61	62	63	64	65
	90th	115	116	118	121	124	126	126	74	74	74	75	76	77	77
	95th	119	120	122	125	128	130	131	78	78	78	78	80	81	81
	95th + 12 mmHg	131	132	134	137	140	142	143	90	90	90	90	92	93	93
14	Height (cm)	153.8	156.9	162	167.5	172.7	177.4	180.1	153.8	156.9	162	167.5	172.7	177.4	180.1
	50th	105	106	109	111	112	113	113	60	60	62	64	65	66	67
	90th	119	120	123	126	127	128	129	74	74	75	77	78	79	80
	95th	123	125	127	130	132	133	134	77	78	79	82	82	83	84
	95th + 12 mmHg	135	137	137	142	144	145	146	89	90	91	94	94	95	96

Age (year)	BP Percentile	Systolic BP (mmHg) Percentile of Height							Diastolic BP (mmHg) Percentile of Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
15	Height (cm)	159	162	166.9	172.2	177.2	181.6	184.2	159	162	166.9	172.2	177.2	181.6	184.2
	50th	108	110	112	113	114	114	114	61	62	64	65	66	67	88
	90th	123	124	126	128	129	130	130	75	76	78	79	80	81	81
	95th	127	129	131	132	134	135	135	78	79	81	83	84	85	85
	95th + 12 mmHg	139	141	143	144	146	147	147	90	91	93	93	96	97	97
16	Height (cm)	162.1	165	169.6	174.6	179.5	183.8	186.4	162.1	165	169.6	174.6	179.5	183.8	186.4
	50th	111	112	114	115	115	116	116	63	64	66	67	68	69	69
	90th	126	127	128	129	131	131	132	77	78	79	80	81	82	82
	95th	130	131	133	134	135	136	137	80	81	83	84	85	86	86
	95th + 12 mmHg	142	143	145	146	147	148	149	92	93	95	96	97	98	98
17	Height (cm)	163.8	166.5	170.9	175.8	180.7	184.9	187.5	163.8	166.5	170.9	175.8	180.7	184.9	187.5
	50th	114	115	116	117	117	118	118	65	66	67	68	69	70	70
	90th	128	129	130	131	132	133	134	78	79	80	81	82	82	83
	95th	132	133	134	135	137	138	138	81	82	84	85	86	86	87
	95th + 12 mmHg	144	145	146	147	149	150	150	93	94	96	97	98	98	99

Blood pressure levels for Girls by age and height percentile[17]

Age (year)	BP Percentile	Systolic BP (mmHg) Percentile of Height							Diastolic BP (mmHg) Percentile of Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
1	Height (cm)	75.4	76.6	78.6	80.8	83	84.9	86.1	75.4	76.6	78.6	80.8	83	84.9	86.1
	50th	84	85	86	86	87	88	88	41	42	42	43	44	45	46
	90th	98	99	99	100	101	102	102	54	55	56	56	57	58	58
	95th	101	102	102	103	104	105	105	59	59	60	60	61	62	62
	95th + 12 mmHg	113	114	114	115	116	117	117	71	71	72	72	73	74	74
2	Height (cm)	84.9	86.3	88.6	91.1	93.7	96	97.4	84.9	86.3	88.6	91.1	93.7	96	97.4
	50th	87	87	88	89	90	91	91	45	46	47	48	49	50	51
	90th	101	101	102	103	104	105	106	58	58	59	60	61	62	62
	95th	104	105	106	106	107	108	109	62	63	63	64	65	66	66
	95th + 12 mmHg	116	117	118	118	119	119	121	74	75	75	76	77	78	78
3	Height (cm)	91	92.4	94.9	97.6	100.5	103.1	104.6	91	92.4	94.9	97.6	100.5	103.1	104.6
	50th	88	89	89	90	91	92	93	48	48	49	50	51	53	53
	90th	102	103	104	104	105	106	107	60	61	61	62	63	64	65
	95th	106	106	107	108	109	110	110	64	65	65	66	67	68	69
	95th + 12 mmHg	118	118	119	120	121	122	122	76	77	77	78	79	80	81
4	Height (cm)	97.2	98.8	101.4	104.5	107.6	110.5	112.2	97.2	98.8	101.4	104.5	107.6	110.5	112.2
	50th	89	90	91	92	93	94	94	50	51	51	53	54	55	55
	90th	103	104	105	106	107	108	108	62	63	64	65	66	67	67
	95th	107	108	109	109	110	111	112	66	67	68	69	70	70	71
	95th + 12 mmHg	119	120	121	121	122	123	124	78	79	80	81	82	82	83
5	Height (cm)	103.6	105.3	108.2	111.5	114.9	118.1	120	103.6	105.3	108.2	111.5	114.9	118.1	120
	50th	90	91	92	93	94	95	96	52	52	53	55	56	52	57
	90th	104	105	106	107	108	109	110	64	65	66	67	68	64	70
	95th	108	109	109	110	111	112	113	68	69	70	71	72	67	73
	95th + 12 mmHg	120	121	121	122	123	124	125	80	81	82	83	84	79	85

Age (year)	BP Percentile	Systolic BP (mmHg) Percentile of Height							Diastolic BP (mmHg) Percentile of Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
6	Height (cm)	110	111.8	114.9	118.4	122.1	125.6	127.7	110	111.8	114.9	118.4	122.1	125.6	127.7
	50th	92	92	93	94	96	97	97	54	54	55	56	57	58	59
	90th	105	106	107	108	109	110	111	67	67	68	69	70	71	71
	95th	109	109	110	111	112	113	114	70	71	72	72	73	74	74
	95th + 12 mmHg	121	121	122	123	124	125	126	82	83	84	84	85	86	86
7	Height (cm)	115.9	117.8	121.1	124.9	128.8	132.5	134.7	115.9	117.8	121.1	124.9	128.8	132.5	134.7
	50th	92	93	94	95	97	98	99	55	55	56	57	58	59	60
	90th	106	106	107	109	110	111	112	68	68	69	70	71	72	72
	95th	109	110	111	112	113	114	115	72	72	73	73	74	74	75
	95th + 12 mmHg	121	122	123	124	125	126	127	84	84	85	85	86	86	87
8	Height (cm)	121	123	126.5	130.6	134.7	138.5	140.9	121	123	126.5	130.6	134.7	138.5	140.9
	50th	93	94	95	97	98	99	100	56	56	57	59	60	61	61
	90th	107	107	108	110	111	112	113	69	70	71	72	72	73	73
	95th	110	111	112	113	115	116	117	72	73	74	74	75	75	75
	95th + 12 mmHg	122	123	124	125	127	128	129	84	85	86	86	87	87	87
9	Height (cm)	125.3	127.6	131.3	135.6	140.1	144.1	146.6	125.3	127.6	131.3	135.6	140.1	144.1	146.6
	50th	95	95	97	98	99	100	101	57	58	59	60	60	61	61
	90th	108	108	109	111	112	113	114	71	71	72	73	73	73	73
	95th	112	112	113	114	116	117	118	74	74	75	75	75	75	75
	95th + 12 mmHg	124	124	125	126	126	129	130	86	86	87	87	87	87	87
10	Height (cm)	129.7	132.2	136.3	141	145.8	150.2	152.8	129.7	132.2	136.3	141	145.8	150.2	152.8
	50th	96	97	98	99	101	102	103	58	59	59	60	61	61	62
	90th	109	110	111	112	113	115	116	72	73	73	73	73	73	73
	95th	113	114	114	116	117	119	120	75	75	76	76	76	76	76
	95th + 12 mmHg	125	126	126	128	129	131	132	87	87	88	88	88	88	88

Age (year)	BP Percentile	Systolic BP (mmHg) Percentile of Height							Diastolic BP (mmHg) Percentile of Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
11	Height (cm)	135.6	138.3	142.8	147.8	152.8	157.3	160	135.6	138.2	142.8	147.8	152.8	157.3	160
	50th	98	99	101	102	104	105	106	60	60	60	61	62	63	64
	90th	111	112	113	114	116	118	120	74	74	74	74	74	75	75
	95th	115	116	117	118	120	123	124	76	77	77	77	77	77	77
	95th + 12 mmHg	127	128	129	130	132	135	135	88	89	89	89	89	89	89
12	Height (cm)	142.8	145.5	149.9	154.8	159.6	163.8	166.4	142.8	145.5	149.9	154.8	159.6	163.8	166.4
	50th	102	102	104	105	107	108	108	61	61	61	62	64	65	65
	90th	114	115	116	118	120	122	122	75	75	75	75	76	76	76
	95th	118	119	120	122	124	125	126	78	78	78	78	79	79	79
	95th + 12 mmHg	130	131	132	134	136	137	138	90	90	90	90	91	91	91
13	Height (cm)	148.1	150.6	154.7	159.2	163.7	167.8	170.2	148.1	150.6	154.7	159.2	163.7	167.8	170.2
	50th	104	105	106	107	108	108	109	62	62	63	64	65	65	66
	90th	116	117	119	121	122	123	123	75	75	75	76	76	76	76
	95th	121	122	123	124	126	126	127	79	79	79	79	80	80	81
	95th + 12 mmHg	133	134	135	136	138	138	138	91	91	91	91	91	92	93
14	Height (cm)	150.6	153	156.9	161.3	165.7	169.7	172.1	150.6	153	156.9	161.3	165.7	169.7	172.1
	50th	105	106	107	108	109	109	109	63	63	64	65	66	66	66
	90th	118	118	120	122	123	123	123	76	76	76	76	77	77	77
	95th	123	123	124	125	126	127	127	80	80	80	80	81	81	82
	95th + 12 mmHg	135	135	136	137	138	139	139	92	92	92	92	93	93	94

Age (year)	BP Percentile	Systolic BP (mmHg) Percentile of Height							Diastolic BP (mmHg) Percentile of Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
15	Height (cm)	151.7	154	157.9	162.3	166.7	170.6	173	151.7	154	157.9	162.3	166.7	170.6	173
	50th	105	106	107	108	109	109	109	64	64	64	65	66	67	67
	90th	118	119	121	122	123	123	124	76	76	76	77	77	78	78
	95th	124	124	125	126	127	127	128	80	80	80	81	82	82	82
	95th + 12 mmHg	136	136	137	138	139	139	140	92	92	92	93	94	94	94
16	Height (cm)	152.1	154.5	158.4	162.8	167.1	171.1	173.4	152.1	154.5	158.4	162.8	167.1	171.1	173.4
	50th	106	107	108	109	109	110	110	64	64	65	66	66	67	67
	90th	119	120	122	123	124	124	124	76	76	76	77	78	78	78
	95th	124	125	125	127	127	128	128	80	80	80	81	82	82	82
	95th + 12 mmHg	136	137	137	139	139	140	140	92	92	92	93	94	94	94
17	Height (cm)	152.4	154.7	158.7	163.0	167.4	171.3	173.7	152.4	154.7	158.7	163.0	167.4	171.3	173.7
	50th	107	108	109	110	110	110	110	64	64	65	66	66	66	67
	90th	120	121	123	124	124	125	125	76	76	77	77	78	78	78
	95th	125	125	126	127	128	128	128	80	80	80	81	82	82	82
	95th + 12 mmHg	137	137	138	139	140	140	140	92	92	92	93	94	94	94

GENERAL AND SUPPORTIVE MEASURES

» There is a strong association between overweight patients and high blood pressure.
» The majority of these patients have mild hypertension and usually only need lifestyle modification.
» Acute hypertension:
  > Bed rest – Fowler's position.
  > Control fluid intake and output (restriction).
  > Restrict dietary sodium.
  > Manage end-organ effects.
» Chronic hypertension:
  > Advise a change in lifestyle.
  > Institute and monitor a weight reduction programme for obese individuals.
  > Regular aerobic exercise is recommended in essential hypertension.
» Dietary advice:
  > Limit salt and saturated fat intake.
  > Increase dietary fibre intake.

4.11.1 HYPERTENSION, ACUTE SEVERE

I10

For acute or chronic hypertension, blood pressure needs to be lowered cautiously.
Initiate medicines for sustained control as soon as possible to maintain the effect when the emergency measures are discontinued.

Rate of BP reduction depends upon starting BP and age of the child.
In the absence of central nervous system signs, acute hypertension can be rapidly controlled over 24 hours. If in doubt about the duration of hypertension, reduce BP slower over 48 hours.

Aim to reduce the systolic BP with not more than ⅓ of the interval between the patient's systolic blood pressure and the 95th percentile for that age or height in the first 8 hours, then a further gradual decline over the next 24–48 hours.
Do not decrease BP to < 95th percentile in first 24 hours.

GENERAL AND SUPPORTIVE MEASURES

» Admit the patient to a paediatric intensive care unit, if possible.
» Monitor BP every 10 minutes until stable, thereafter, every 30 minutes for 24 hours.
» Set up two peripheral intravenous drips.

MEDICINE TREATMENT

Do not combine medicines of the same class.

- Furosemide, IV, 1–2 mg/kg as a bolus slowly over 5 minutes.
  - If oliguric, maximum dose: 5 mg/kg/dose.
  - Repeat appropriately for fluid overload.

AND

- Labetalol, IV, 0.5–3 mg/kg/hour.
  - 100 mg labetalol in 80 mL sodium chloride 0.45% = 1 mg/mL.
  - Infuse with an infusion pump.
  - Give a bolus of 0.5 mg/kg and then titrate the dose slowly upwards until the desired blood pressure is achieved.
  - Repeat, based on BP response.

If there is an inadequate response:
ADD

- Amlodipine, oral, 0.2 mg/kg/dose.
  - May be repeated after 12 hours.
  - Thereafter, every 24 hours.

If phaeochromocytoma suspected: Consult a specialist and refer.

Once blood pressure is controlled, taper to oral treatment.
See section 4.11.2: Hypertension, chronic.

URGENT REFERRAL

» Severe hypertension for specific diagnosis and treatment.

4.11.2 HYPERTENSION, CHRONIC

I10

DESCRIPTION

Primary/Essential hypertension

Occurs most commonly in adolescents.
The patient is often asymptomatic and well.
It is diagnosed by excluding underlying causes of hypertension.
Hypertension is confirmed by sustained high blood pressure measured on 3 follow-up occasions.

Chronic secondary hypertension

All children with incurable forms of persistent secondary hypertension require medicine treatment over and above general and supportive measures.

DIAGNOSTIC CRITERIA

Investigations

» Urine dipstick test.
» Urine MCS.
» Blood urea, calcium, creatinine and electrolytes.
» Chest X-ray, ECG and abdominal ultrasound.

If all tests are negative, start lifestyle intervention.

GENERAL AND SUPPORTIVE MEASURES

» Introduce physical activity, diet management and weight reduction, if obese.
» Advise teenagers against smoking.
» Follow up to monitor blood pressure and educate patient on hypertension:
  > if blood pressure decreases, continue with non-drug management and follow-up;
  > if BP is increasing progressively, reinvestigate to exclude secondary causes or refer;
  > if BP is stable but persistently > 95th percentile and secondary causes have been excluded, start medicine treatment after failed non-drug management for 6 months.
» Consider earlier initiation of medicine treatment if positive family history for cardiovascular disease, essential hypertension or diabetes mellitus.

MEDICINE TREATMENT

The goal of treatment in uncomplicated primary hypertension with no target-organ damage is to achieve BP < 95th percentile. For chronic renal disease, diabetes or hypertension with target-organ damage, the target is BP < 90th percentile.
Medicine treatment is initiated for Stage 2 hypertension. Consider therapy in Stage 1 hypertension if there is a family history of cardiovascular disease, hypertension or diabetes.

Aim to achieve control of BP over 48–72 hours in symptomatic patients.

For ambulatory patients start at the lowest dose of the preferred medicine and increase the dose until control is achieved.

Once the highest recommended dose is reached or if the patient experiences adverse effects from the medicine, add a second medicine from a different class.
For patients with persistent hypertension despite the use of first-line medicine, add a second/third medicine. There is no specific order in which medicine should be added.

There is no evidence of superiority of specific classes of drugs, however, daily dose improves compliance.

ACE-inhibitor

ACE-inhibitors are contraindicated in bilateral renal artery stenosis, coarctation of the aorta, aortic stenosis and mitral stenosis.

- Enalapril, oral, 0.04 mg/kg/dose 12 hourly.
  - Maximum dose: 0.3 mg/kg/dose up to 40 mg/day.

OR

For young children less than 10 kg body weight:

- Captopril, oral:
  - Initial dose: 0.1 mg/kg/dose 8 hourly.
  - Maximum dose: 2 mg/kg/dose.

β-blocker
Contraindicated in severe heart failure and asthma.

- Atenolol, oral, 0.5–1 mg/kg/dose once daily.
  - Maximum dose: 2 mg/kg/day.

OR
If child less than 10 kg body weight:
- Propranolol, oral, 0.25–1 mg/kg/dose 8–12 hourly.
  - Maximum dose: 1.5 mg/kg/dose.

Calcium channel blocker
- Amlodipine, oral, 0.1–0.2 mg/kg/dose once daily.
  - Maiximum daily dose: 10 mg/day

Diuretic
- Hydrochlorothiazide, oral, 0.5–1 mg/kg/dose once daily.
  - May cause hypokalaemia.

OR
- Furosemide, oral, 0.5–1.5 mg/kg/dose 12–24 hourly.
  - Maximum dose: 6 mg/kg/day.
  - May cause hypokalaemia.

α-blocker
May be indicated in patients with phaeochromocytoma-associated hypertension.
Consult a specialist and refer for management of phaeochromocytoma-associated hypertension.

REFERRAL
» All children with chronic hypertension for specific diagnosis, planning of treatment and long-term follow-up.
» Patients with phaechromocytoma-associated hypertension.

4.12 CHILDREN WITH PROSTHETIC HEART VALVES
Z95.2

DESCRIPTION
Valve replacement may be required for severe valvular disease when valve repair is not feasible or advisable. The valves may be mechanical valves or bioprosthetic valves or preserved human tissue valves.

In children, bioprosthetic valves tend to degenerate, calcify and have structural deterioration more frequently and more rapidly compared with adults.
Mechanical valves are more commonly used in children.

Complications include:
» Valve failure. May be abrupt (tearing of components) or gradual (with calcification and stiffening of leaflets).

» Prosthetic valve thrombosis.
» Prosthetic valve endocarditis.
» Haemolytic anaemia.

MEDICINE TREATMENT

After mechanical valve replacement warfarin therapy is indicated to achieve an INR of 2.5 (range 2.0–3.0):

- Warfarin, oral, 0.1 mg/kg/day.
  - Adjust the dose depending on INR.
  - Beware of haemorrhage.

PLUS

- Aspirin, oral, 1 mg/kg/day in patients at a low risk of bleeding.

LoE III[20]

Warfarin dose adjustment based on INR

INR < 1.5	Verify adherence. If non-adherent, resume at previous dose. If dosage adjustments needed, increase dose by 20% and review in 3–7 days.
INR 1.5–1.9	Verify adherence first. Increase maintenance dose by 10%.
INR 2.0–3.0	No change needed. In mitral valve prosthesis, INR should be closer to 3.0.
INR 3.1–4.0	Consider withholding one dose, and decrease by 10%.
INR 4.1–4.5	Decrease dose by 20%.
INR > 4.5	Withhold dose, evaluate INR daily until < 4.5, then restart at 20% below previous dose.

The half-life of warfarin is 40 hours; dose adjustments may thus be calculated over a 48-hour period. The 10% and 20% dose adjustments may not be precisely achieved; approximate doses are acceptable.
If warfarin of 1 mg per tablet is not available and dosage adjustments are problematic, discuss with paediatric cardiologist.
Some medicines and foods interfere with the warfarin effect.

Medicines that enhance anticoagulant effect include:
» allopurinol,
» aspirin,
» NSAIDS,
» paracetamol (regular use),

» valproate,
» phenytoin,
» imidazoles,
» metronidazole,
» macrolides, and
» quinolones.

Medicines that diminish anticoagulant effect include:
» carbamazepine,
» phenobarbital,
» phenytoin, (both diminished and enhanced effects have been reported)
» nevirapine,
» rifampicin.

Foods that contain high amounts of vitamin K can decrease the effectiveness of warfarin, e.g.:
» spinach,
» parsley, and
» brussel sprouts.

Certain drinks can increase the effect of warfarin, e.g. cranberry juice.

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CHAPTER 5

DERMATOLOGY

Skin lesions are best characterised by their morphologic appearance which allows consideration of a suitable differential diagnosis.

5.1 BULLAE

5.1.1 EPIDERMOLYSIS BULLOSA

Q81.9

DESCRIPTION

Congenital, hereditary blistering skin lesions with onset in the newborn. Lesions have an erythematous base. Involvement of the mucous membranes as well as loss of nails may occur.

GENERAL AND SUPPORTIVE MEASURES

» May require monitoring in a high or intensive care unit.
» Aseptic aspiration of bullae on the side can be performed to relieve pressure (ensure the roof of the blister remains intact to protect underlying skin).
» Prevent infection with appropriate wound care.
» Attend to fluid and nutrition balance.

Important to manage baseline pain and procedural pain, see Chapter 20: Pain Control.

REFERRAL

» All cases for biopsy, classification of type and management plan.

5.1.2 STAPHYLOCOCCAL SCALDED SKIN SYNDROME

L00

DESCRIPTION

Blistering skin condition that presents like scalded skin.

GENERAL AND SUPPORTIVE MEASURES

» Appropriate wound care.

MEDICINE TREATMENT

- Cloxacillin, IV, 50 mg/kg/dose 6 hourly for 5 days.
  - Neonates:
    Week 1–2 of age: administer 12 hourly.
    Week 2–4 of age: administer 8 hourly.

OR

- Cephalexin, oral, 25 mg/kg/dose 6 hourly for 7 days.
  Where weight is unknown:
  - Child < 2 years: 125 mg.
  - Child 2–10 years: 250 mg.
  - > 10 years: 500 mg.

OR

- Flucloxacillin, oral, 25 mg/kg/dose 6 hourly for 7 days.

LoE III[1]

Penicillin allergy:

- Clindamycin, oral, 6 mg/kg/dose, 6 hourly for 10 days.

For pain:
See Chapter 20: Pain Control, section 20.1.1: Management of pain.

REFERRAL

» Recalcitrant cases.

5.1.3 CHRONIC BULLOUS DISEASE OF CHILDHOOD

L12.2

DESCRIPTION

Tense blisters that lead to ulceration involving the groin, face and trunk.

DIAGNOSTIC CRITERIA

» Skin biopsy with immunofluorescence.

GENERAL AND SUPPORTIVE MEASURES

» Appropriate wound care.

REFERRAL

» All cases.

5.2 ERYTHEMA AND DESQUAMATION

5.2.1 ERYTHEMA MULTIFORME

L51.9

DESCRIPTION

An acute, self-limiting and commonly recurrent inflammatory eruption of the skin with variable involvement of the mucous membranes and without systemic symptoms.

Symmetrically distributed crops of target lesions, (dark centre, an inner, pale ring surrounded by an outer red ring) often involving palms and soles, are characteristic. This condition is mainly caused by:

» medicines, e.g. sulphonamides, phenytoin, phenobarbitone,
» exposure to toxic substances, and
» infections, e.g. herpes simplex and mycoplasma.

Complications include:

» conjunctivitis,
» uveitis,
» corneal scarring,
» fluid loss,
» infections,
» anaemia, and
» oesophageal strictures.

DIAGNOSTIC CRITERIA

Iris or target lesions consisting of a dark centre, an inner pale ring and an erythematous outer border. In erythema multiforme these lesions are pathognomonic.

Erythematous macules evolve into papules, vesicles, bullae, urticarial plaques or patches of confluent erythema. The centre of the lesion may be vesicular, purpuric or necrotic.

Erythema multiforme minor

Prodromal symptoms are generally absent. Symmetric crops of skin lesions of diverse morphology, primarily on the extensor surfaces of the arms and legs and often including soles and palms with relative sparing of the mucous membranes and the trunk.

Erythema multiforme major (often equated with Stevens-Johnson syndrome)

A serious, systemic condition involving the skin and at least two mucous membranes.

Eruption may be preceded by non-specific prodromal symptoms including:

» malaise,
» fever,
» rigors, or
» upper respiratory tract infection.

Cutaneous lesions tend to rupture, leaving the skin denuded leading to fluid loss, with high risk of infection. Anaemia is common. The oral mucosa is frequently involved.

GENERAL AND SUPPORTIVE MEASURES

» May require care in a high or intensive care unit.
» Examine daily for systemic involvement, infection and ocular lesions. If infection is suspected, send blood and skin lesion specimens for culture and sensitivity before initiating antibiotic therapy.
» Do not puncture bullae or vesicles.
» Cool compresses and wet dressings.
» Encourage oral fluids to prevent adhesions.
» Regular supervised oral, genital and eye care to prevent adhesions and scarring.
» Maintain fluid balance. Beware of shock.
» Nasogastric feeds if unable to eat; IV alimentation if enteral feeds are not possible.
» Stop all potentially causative medicines.

MEDICINE TREATMENT

For pain

These patients require effective pain control.
Change of dressing protocol: See Chapter 20: Pain Control.

Dressings

Skin hygiene, daily cleansing and bland, non-adherent dressings as needed.

Do not use silver sulfadiazine if Stevens-Johnson syndrome is thought to be due to cotrimoxazole or other sulphonamide.

Antibiotic therapy

For secondary infections:

Use IV antibiotics if the oral route cannot be used.

- Cloxacillin, IV, 50 mg/kg/dose 6 hourly.

OR

- Cephalexin, oral, 25 mg/kg/dose 6 hourly.
  Where weight is unknown:
  - Child < 2 years: 125 mg.
  - Child 2–10 years: 250 mg.
  - > 10 years: 500 mg.

OR

- Flucloxacillin, oral, 25 mg/kg/dose 6 hourly.

LoE III[1]

Penicillin allergy:

- Clindamycin, oral, 6 mg/kg/dose, 6 hourly.

Reconsider choice of antibiotic when the results of cultures become available or the child does not improve.

If Herpes Simplex Virus (HSV) is suspected to be the cause:

- Aciclovir, oral, 250 mg/m^2/dose 8 hourly for 7 days.

For oral lesions

- Chlorhexidine 0.2%, 15 mL as a mouthwash.
  - Use as needed.
  - Do not swallow.

Note: The use of systemic corticosteroids is not recommended.

REFERRAL

» Erythema multiforme not responding to adequate therapy.
» Erythema multiforme with ocular involvement.

5.2.2 STEVENS-JOHNSON SYNDROME (SJS)/TOXIC EPIDERMAL NECROSIS (TEN)

L51.1/ L51.2

DESCRIPTION

Life-threatening, acute hypersensitivity reaction with systemic upset, epidermal necrosis, and mucous membrane involvement. TEN and SJS are different ends of the same spectrum: in TEN, epidermal necrosis involves > 30% of body surface area, while in SJS the involvement is < 10%.

This condition is usually due to medication, e.g. sulphonamides, non-nucleoside reverse transcriptase inhibitors (especially nevirapine), antiepileptics (phenytoin, phenobarbitone, carbamazepine, lamotrigine), allopurinol, laxatives (phenolphthalein).

Complications include:

» dehydration, electrolyte disturbances and shock,
» hypoalbuminaemia,
» hypo- and more commonly hyperthermia,
» high output cardiac failure,
» secondary infection and sepsis; and
» adhesions and scarring.

DIAGNOSTIC CRITERIA

Cutaneous lesions may start as a dusky red macular rash, progressing to confluence with epidermal necrosis and large flaccid blisters which rupture, leaving large areas of denuded skin. Mucous membrane erosions are common and multi-organ involvement may be present.

GENERAL AND SUPPORTIVE MEASURES

» May require care in high or intensive care unit.
» Examine daily for systemic involvement, infection and ocular lesions. If infection is suspected, send blood and skin lesion specimens for culture and sensitivity before initiating antibiotic therapy.
» Do not puncture bullae or vesicles.
» Cool compresses and wet dressings.
» Regular supervised oral, genital and eye care to prevent adhesions and scarring.
» Encourage oral fluids, to prevent adhesions.
» Maintain fluid balance. Beware of shock.
» Nasogastric feeds if unable to eat; IV alimentation if enteral feeds are not possible.
» Stop all potentially causative medicines.

MEDICINE TREATMENT

For pain

These patients require effective pain control.
Change of dressing protocol: See Chapter 20: Pain Control.

Dressings

Skin hygiene, daily cleansing and bland, non-adherent dressings as needed.

Do not use silver sulfadiazine if Stevens-Johnson syndrome is thought to be due to cotrimoxazole or other sulphonamide.

Empiric antibiotic therapy

For secondary infections:
Use IV antibiotics if the oral route cannot be used.

- Cloxacillin, IV, 50 mg/kg/dose 6 hourly.

OR

- Cephalexin, oral, 25 mg/kg/dose 6 hourly.
  Where weight is unknown:
  - Child < 2 years: 125 mg.
  - Child 2–10 years: 250 mg.
  - > 10 years: 500 mg.

OR

- Flucloxacillin, oral, 25 mg/kg/dose 6 hourly.

LoE III[1]

Penicillin allergy:

- Clindamycin, oral, 6 mg/kg/dose, 6 hourly.

Reconsider choice of antibiotic when the results of cultures become available or the child does not improve.

For oral lesions

- Chlorhexidine 0.2%, 15 mL as a mouthwash.
  - Use as needed.
  - Do not swallow.

Note:
The use of systemic corticosteroids is not recommended.

REFERRAL

» Discuss with a specialist, if considering re-initiation of medicine treatment.

5.3 MACULES AND PAPULES

5.3.1 DRUG REACTIONS

L27.0

Commonly associated with:
» sulphur-containing agents,
» penicillin,
» antiepileptics (e.g. carbamazepine, lamotrigine),
» NSAIDs,
» anti-tuberculosis drugs, and
» non-nucleoside reverse transcriptase inhibitors.

A variety of rashes may occur, including:
» erythema multiforme (see section 5.2.1),
» urticarial eruptions,
» measles-like maculopapular rash, or
» fixed drug reactions, which are flat or slightly raised, purple, symmetrical patches of < 0.5 cm in size.

Lesions recur upon re-exposure to the causative agent and may present as blisters.

GENERAL AND SUPPORTIVE MEASURES

» Stop causative agents.

MEDICINE TREATMENT

Antihistamines

For children 2 years and older:

- Cetirizine, oral, as a single dose.
  - Children 2–6 years: 5 mg.
  - Children 6–12 years: 10 mg.

LoE III[2]

For children less than 2 years:

- Chlorphenamine, oral, 0.1 mg/kg/dose as a single dose at night. (Maximum 4 mg).

Where the oral route cannot be used:

- Promethazine, IV, 0.1 mg/kg/dose 8–12 hourly. (Maximum 25 mg).

REFERRAL

» Systemic involvement with organ dysfunction.

5.3.2 ACNE

L70

DESCRIPTION

An inflammatory condition of hair follicles leading to comedone formation; inflammatory papules and/or nodules that can cause scarring and post inflammation hyper-pigmentation, on healing.

DIAGNOSTIC CRITERIA

» Black-heads or white-heads (comedones).

GENERAL AND SUPPORTIVE MEASURES

» Avoid greasy and oily topical products.
» Discourage excessive facial washing.

MEDICINE TREATMENT

<u>For mild acne</u>

- Benzoyl peroxide 5%, gel, apply in the morning to affected areas as tolerated.
  - Wash off in the evening.
  - If ineffective and tolerated, increase application to 12 hourly.
  - If ineffective after 4 months, move to topical retinoid therapy.

<u>For comedonal acne</u>

Topical retinoid, e.g.:

- Tretinoin cream/gel 0.05%, topical, applied sparingly once daily at bedtime until substantial improvement.
  - To limit skin irritation, introduce topical retinoid gradually – apply on alternate days (at night) for 1–2 weeks.
  - Avoid contact with eyes and mucous membranes.
  - To prevent irritation, limit exposure to sunlight, especially with concomitant use of doxycycline.

<u>For inflammatory acne</u>

- Doxycycline, oral, 100 mg once daily for a maximum of 3 months.

AND

Topical retinoid, e.g.:

- Tretinoin cream/gel 0.05%, topical, applied sparingly once daily at bedtime.

Tretinoin is teratogenic.
Do not use where pregnancy is a possibility.
If used, ensure adequate contraception.

Teratogenic risk also applies to males.

To avoid sun irritation:

- Sunscreen, topical, applied daily.

REFERRAL

» Ineffective treatment: referral for consideration of isotretinoin oral therapy.
» Recalcitrant and/or fulminant acne.
» Psychologically disturbed or depressed patient.
» Young females with premenstrual flare or with clinical signs of hyperandrogenism for consideration of oral contraceptives.

5.3.3 CELLULITIS AND ERYSIPELAS

L03.9/A46

DESCRIPTION

Infection of the skin and subcutaneous tissue usually caused by streptococci, staphylococci or *H. influenzae.* In cellulitis, the border of the lesion is indistinct.

Erysipelas

The affected area is:

» well demarcated with clear borders,
» very tender and warm,
» bright red and swollen.

Erysipelas must be distinguished from necrotising fasciitis, where there is infection and inflammation by a gas-forming organism that spreads rapidly along the fascial tissue.
Complications include septicaemia.

DIAGNOSTIC CRITERIA

» Acutely ill child with fever and malaise.
» Affected area is swollen, indurated, erythematous and tender, with regional lymphadenopathy.

GENERAL AND SUPPORTIVE MEASURES

» Ensure adequate nutrition and hydration.

» Elevate the affected limb to reduce swelling.
» Exclude eczema, an immunocompromised state, diabetes and underlying osteomyelitis.

MEDICINE TREATMENT

Choice of intravenous or oral antibiotics depends on the severity of the condition.

Severe disease

- Cloxacillin, IV, 50 mg/kg/dose 6 hourly for 5 days.

Non-severe disease

- Cephalexin, oral, 25 mg/kg/dose 6 hourly for 7 days.
  Where weight is unknown:
  - Child < 2 years: 125 mg.
  - Child 2–10 years: 250 mg.
  - > 10 years: 500 mg.

OR

- Flucloxacillin, oral, 25 mg/kg/dose 6 hourly for 7 days.

LoE III[1]

Penicillin allergy:

- Clindamycin, oral, 6 mg/kg/dose, 6 hourly for 10 days.

For pain:

- Paracetamol, oral, 15 mg/kg/dose, 6 hourly as required.

If needed, **ADD**

- Ibuprofen, oral, 5–10 mg/kg/dose, 6–8 hourly for 72 hours.
  - Child < 30 kg, maximum dose: 500 mg/day.

REFERRAL

» **Urgent**: necrotising fasciitis.
» Poor response to therapy.
» Recurrent cellulitis.

5.3.4 ECZEMA

L20.9

DESCRIPTION

An inflammatory itchy skin condition characterised by:
» Vesicles, weeping and crusting during the acute stage.
» Scaling and lichenification during the chronic stage.

DIAGNOSTIC CRITERIA

» Intractable itch.
» Family history of allergies.
» Onset under the age of 2 years

» Dry skin.
» Typical distribution: face, flexures of knees and elbows, and creases of neck.

GENERAL AND SUPPORTIVE MEASURES

» Avoidance measures: use neutral soaps and rinse clothes properly after washing.
» Keep fingernails short to prevent scratching.
» Wrap with dressings soaked in sodium chloride 0.9%.
» Avoid sunlight and recommend the use of sunscreen.

MEDICINE TREATMENT

Antihistamine:
For children 2 years and older:

- Cetirizine, oral, as a single dose.
  - Children 2–6 years: 5 mg.
  - Children 6–12 years: 10 mg.

LoE III [2]

For children less than 2 years:

- Chlorphenamine, oral, 0.1 mg/kg/dose as a single dose at night. (Maximum 4 mg).

To relieve skin dryness:

- Emulsifying ointment.

For baths, as a soap substitute:

- Aqueous cream.

For the face and skin folds:

- Hydrocortisone 1%, topical, 12 hourly.

For the body:

- Betamethasone 0.1%, topical, undiluted applied once daily for 7 days.
  - Moisturise with emulsifying ointment during therapy and in subsequent weeks.

Secondary infection

Bacterial

- Cephalexin, oral, 25 mg/kg/dose, 6 hourly.

Viral
If HSV suspected:

- Aciclovir, oral, 250 mg/m^2/dose 8 hourly for 7 days

Note:
- Short-term use of topical steroids is recommended (as outlined above)
- Oral corticosteroids do not have a role in the management of this condition.

REFERRAL
» Recalcitrant cases.
» Concomitant food allergy (allergy clinic).

5.3.5 CANDIDIASIS
B37.2

DESCRIPTION
Skin infection involving axillae, neck and perineum. Commonly occurs in immunocompromised individuals. Involvement of mouth and perineal regions suggests systemic disease.

DIAGNOSTIC CRITERIA
Clinical
» Red, raw-looking patches with satellite white pustular lesions on an erythematous base.
» Mucosal involvement.

Investigations
» Wet preparation with potassium hydroxide or biopsy and culture.

GENERAL AND SUPPORTIVE MEASURES
» Control underlying immunosuppressive state, e.g. diabetes, HIV.
» Personal hygiene of mothers prior to breastfeeding.

MEDICINE TREATMENT
- Imidazole cream 1%, e.g. clotrimazole, topical, applied 8 hourly for 14 days.

If no response:
- Fluconazole, oral, 3–6 mg/kg/day for 14 days.

REFERRAL
» Recalcitrant infection.

5.3.6 PSORIASIS

L40.9

DESCRIPTION

An inflammatory condition of the skin and joints.

DIAGNOSTIC CRITERIA

» Scaly, red, itchy papules and plaques over scalp, perineum, and skin folds and extensor surfaces.
» Nails may be opaque, deformed and crumbling.
» Occasional pustules are seen.

GENERAL AND SUPPORTIVE MEASURES

» Avoid precipitants, e.g. medication (such as antiepileptic and antimalarial agents).

MEDICINE TREATMENT

Local plaques

To remove scales in children 12 years and older:

- Salicylic acid 2% and coal tar in white soft paraffin, applied 8 hourly.

OR

- Face: Hydrocortisone 1%, topical, applied 12 hourly.
- Body: Betamethasone 0.1%, topical, applied 12 hourly.

For scalp lesions

To remove scales on scalp:

- Salicylic acid 2% in white soft paraffin, if required, in children 12 years and older.

AND

- Wash with mild coal tar shampoo.

AND

- Betamethasone 1% scalp application, apply 12 hourly.

LoE III[3]

Severe pustular psoriasis (in consultation with a specialist)

- Prednisone, oral, 1–2 mg/kg as a single daily dose for 7 days.

REFERRAL

» Severe psoriasis and recalcitrant cases.
» Intolerance to salicylic acid.
» No response to treatment.

5.3.7 URTICARIA

L50.9

DESCRIPTION

An itchy, inflammatory skin and mucosal condition recognised by wheal and flare reaction. May be acute or chronic, often due to irritants, insect bites or allergens. Secondary infective features include excoriation, vesicles and pigmentary changes. Chronic papular eruptive urticaria is often seen in HIV-infected individuals.

DIAGNOSTIC CRITERIA

» History of a recent infection or parasitic infestation.
» History of allergen exposure.
» Wheal and flare reaction ('hives').
» Positive skin test if due to allergy.

GENERAL AND SUPPORTIVE MEASURES

» Limit exposure to precipitants, e.g. drugs, allergens and toxins.
» Limit exposure to insects by using topical insect repellent which contains more than 10% diethyltoluamide (DEET).
» Search for and treat an underlying infection or parasitic infestation.
» Wrap with dressings soaked in sodium chloride 0.9%.

MEDICINE TREATMENT

- Chlorphenamine, oral, 0.1 mg/kg/dose as a single dose at night.

AND

- Betamethasone 0.1%, topical, applied twice daily as required.
  - Useful when applied immediately after an insect bite.

Severe chronic urticaria

For children 2 years and older:

- Cetirizine, oral, as a single dose.
  - Children 2–6 years: 5 mg.
  - Children 6–12 years: 10 mg.

LoE III[2]

REFERRAL

» Recurrent cases.
» Recalcitrant and chronic cases.

5.3.8 TINEA CAPITIS

B35.0

Refer to the Primary Healthcare Standard Treatment Guidelines and Essential Medicines List, 2020:

- Chapter 5: Skin Conditions, section 5.5.2.3: Scalp infections – Tinea capitis.

5.4. PURPURA

D69.9

5.4.1 MENINGOCOCCAEMIA

A39.2/A39.4

DESCRIPTION

Palpable bleeding into skin caused by *N. meningitides* and is associated with rapid spread.

This is a medical emergency and can be fatal.
See Chapter 8: Infective/Infectious Diseases, section 8.27: Sepsis.

5.4.2 HENOCH-SCHÖNLEIN PURPURA

D69.0

See Chapter 12: Rheumatology and Vasculitides, section 12.1: Henoch-Schönlein purpura (HSP).

5.4.3 IMMUNE THROMBOCYTOPENIC PURPURA (ITP)

D69.3

See Chapter 3: Blood and Blood Forming Organs, section 3.9: Immune thrombocytopenic purpura (ITP).

5.5. VESICLES AND PUSTULES

5.5.1 INFECTIONS

R23.8/L08.9

See Chapter 8: Infective/Infectious Diseases, section 8.25: Varicella (chickenpox) and section 8.26: Zoster.

5.5.2 SKIN AND MUCOSAL DISORDERS IN HIV

Skin and mucosal disorders are more severe in immune suppressed (HIV-infected) patients and may be worsened by IRIS. HIV may present initially with skin or mucosal lesions, or these lesions may develop during the course of the illness.

Lesions respond to antiretroviral therapy together with treatment for the specific skin and/or mucosal disorder. Skin eruptions or rashes are relatively common in HIV-infected patients and may be due to antiretroviral and other medicines.

Conditions that are more common in patients with HIV, and that may be present atypically include:
» Papular pruritic eruption.
» Kaposi sarcoma.

5.5.2.1 HIV PAPULAR PRURITIC ERUPTION

T78.4

DESCRIPTION

A chronic itchy condition with a relapsing course. In HIV-infected patients, insect bites may be severe and recalcitrant with post-inflammatory pigmentation and scarring.

DIAGNOSTIC CRITERIA

» Initial lesion is a pruritic urticarial spot with a central red punctum.
» Lesions progress to pruritic papules with or without blisters. Scratching lesions may cause inflammatory changes, erosions, crusts or scabs with secondary infection.
» Post-inflammatory pigmentation and scarring are common.

GENERAL AND SUPPORTIVE MEASURES

» Prevent insect bites with use of, insect repellents.
» Eradicate fleas and other insects.

MEDICINE TREATMENT

- Calamine lotion, topical, applied as needed.

AND

- Chlorphenamine, oral, 0.1 mg/kg/dose 6 hourly.

AND

- Betamethasone 0.1%, topical, applied 12 hourly for 3 days.

THEN, until pruritus subsides:

- Face: Hydrocortisone 1%, topical applied 12 hourly.
- Body: Betamethasone 0.1%, topical applied 12 hourly.

Treat secondary infection with an appropriate antibiotic, if indicated.

Treatment of HIV. See Chapter 9: Human Immunodeficiency Virus Infections.

REFERRAL

» No response to treatment.

5.5.2.2 KAPOSI SARCOMA

C46.9

DESCRIPTION

Kaposi sarcoma is a vascular tumour that can present anywhere on the skin and oral mucosa. Lymph nodes and internal organs, primarily lungs and gastrointestinal tract, may also be involved.

It is associated with human herpes virus 8 and occurs most commonly in immunocompromised HIV-infected patients.
It can be asymptomatic and indolent or aggressive, characterised by explosive growth and death.

DIAGNOSTIC CRITERIA

» Presents with skin lesions on the limbs, particularly the lower leg and foot, but may occur anywhere on the body.
» Lesions (skin and mucosal) may be bruise-like patches, purple or purple-red plaques, subcutaneous papules or nodules.
» Lymphoedema, ulceration and secondary bacterial infection may occur.

GENERAL AND SUPPORTIVE MEASURES

» Counselling to assist patient in dealing with the condition.

MEDICINE TREATMENT

» Manage in consultation with an oncologist.
» Treat secondary infection with an appropriate antibiotic, if indicated.
» Treatment of HIV. See Chapter 9: Human Immunodeficiency Virus Infections.
» Supportive treatment, e.g. pain. See Chapter 20: Pain Control, section 20.1.1: Management of pain.

REFERRAL

» All suspected cases for initial diagnosis.
» Kaposi sarcoma cases unresponsive to ART.
» Extensive progressive disease.

5.5.2.3 WARTS

B07

MEDICINE TREATMENT

Common warts

- Salicylic acid 25% ointment, applied under plaster nightly.
  - Protect surrounding skin with petroleum jelly.
  - Repeat until the wart falls off.

Genital warts

- Podophyllin resin 20%, applied under plaster nightly.
  - Protect surrounding skin with petroleum jelly.
  - Repeat until the wart falls off.

REFERRAL

» Extensive warts involving the face.
» Genital warts: Refer to STI clinic.

5.5.3 IMPETIGO

L01

Refer to the Primary Healthcare Standard Treatment Guidelines and Essential Medicines List, 2020:
Chapter 5: Skin Conditions, section 5.4.2: Impetigo.

5.5.4 CUTANEOUS HAEMANGIOMAS

D18.0

DESCRIPTION

Benign tumours of the vascular endothelium that may be classified as either congenital or infantile. They are characterised by abnormal proliferation of endothelial cells and abnormal blood vessel architecture.

» Congenital haemangiomas: Fully grown at birth, and are either rapidly involuting or non-involuting.
» Infantile haemangiomas: Usually appear before 4 weeks of age and continue to grow until 5 months.

DIAGNOSTIC CRITERIA

» Most haemangiomas can be diagnosed clinically.

GENERAL AND SUPPORTIVE MEASURES

» Counselling to assist the patient in dealing with the condition.

REFERRAL

» Life-threatening (airways), function-threatening haemangiomas, ulcerating lesions, multiple lesions (> 5 lesions); for consideration of propranolol.
» Diagnostic uncertainty.
» Failure to respond to therapy.
» Peri-ocular haemangioma.
» Suspected airway haemangioma.
» Large segmental haemangioma on the face, neck or vital organ for echocardiogram.
» Propranolol pre-treatment evaluation reveals cardiac or pulmonary abnormalities.

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[3] Psoriasis therapy: Mosca M, Hong J, Hadeler E, Brownstone N, Bhutani T, Liao W. Scalp Psoriasis: A Literature Review of Effective Therapies and updated Recommendations for Practical Management. Dermatol Ther. 2021, 11:769-797.

CHAPTER 6

NEPHROLOGICAL/UROLOGICAL DISORDERS

6.1. POST-STREPTOCOCCAL GLOMERULONEPHRITIS

N00.9

DESCRIPTION

Acute post-streptococcal glomerulonephritis (APSGN) is a disorder of the kidneys caused by an immunological response of the kidney to nephritogenic strains of streptococci. It develops one to three weeks after a streptococcal throat or skin infection. Immune complexes are deposited in the glomerular basement membrane and/or mesangium of the glomeruli.

DIAGNOSTIC CRITERIA

Clinical

- » Occurs predominantly in children 3–12 years old.
- » Presents approximately 1 week after streptococcal pharyngitis OR approximately 3 weeks after skin infection (impetigo).
- » Characteristic features include:
  - > facial or generalised oedema,
  - > painless macroscopic haematuria (smoky or tea-coloured urine),
  - > oliguria, and
  - > hypertension.

Special investigations to confirm APSGN

Urine analysis	
Macroscopic appearance	smoky, brown, bloody
Urine test strips	1+ to 3+ haematuria; ~ trace to 2+ proteinuria
Microscopic examination	dysmorphic red blood cells; red blood cell and granular casts
Blood investigations	
Streptococcus serology ASO or Anti-DNAse B titre	positive in the absence of prior antibiotic treatment (ASO often negative in preceding skin infections)
Complement study C_3 C_4	 decreased normal

Serum biochemistry	
Serum electrolytes	dilutional hyponatraemia, hyperchloraemic hyperkalaemic metabolic acidosis is common
Serum Urea & Creatinine	mildly elevated in the acute phase
Full blood count	dilutional anaemia; thrombocyte count is normal

GENERAL AND SUPPORTIVE MEASURES

» Bed rest is necessary in children with severe hypertension or pulmonary oedema.
» Monitor fluid balance and prescribe fluid on a daily basis:
  > Weigh daily and record fluid intake and output strictly.
  > Allowed fluid intake should be calculated based on previous day's urine output and insensible losses.
  > In small children, fluid balance is best monitored with regular weighing.
  > Never use a potassium-containing solution in an anuric patient.
  > Do not use parenteral fluids if oral intake is possible.
» Ensure daily fluid calculations are performed using insensible losses and previous day's output. Fluid management according to fluid status:
  > **Pulmonary oedema plus oliguria/anuria**: Do not give fluid.
  > **Hydrated anuric patient without extra-renal fluid losses**: Oral fluid to replace insensible water losses only.
  > **Normally hydrated plus oliguria**: Oral fluid intake to replace insensible water loss and urine output of previous 24 hours.
  > **Normally hydrated plus normal urine output**: Give normal fluid intake.

IMPORTANT
Insensible water loss is calculated as:
- Older children: 25 mL/kg/day (400 mL/m^2/day)

» Dietary measures:
  > Restrict sodium intake in all patients.
  > Restrict potassium intake until result of serum electrolytes is available.
  > Restrict protein intake to 0.5 g/kg/day.

MEDICINE TREATMENT

Eradication of streptococci

- Phenoxymethylpenicillin, oral, 50 mg/kg/24 hours in 4 divided doses (6 hourly) for 10 days.

OR

If unable to take oral medication:

- Benzathine benzylpenicillin (depot formulation), IM, 30 000 units/kg/dose, 2 doses given 5 days apart.
  - Maximum dose: 1.2 million units.

For severe penicillin allergy:

- Refer to Chapter 25: Drug Allergy, section 25.4.1: Allergies to penicillins.

Hypertension

Hypertension usually develops acutely due to fluid overload and presents as hypertension emergency (crisis), hypertension urgency or persistent significant hypertension. See Chapter 4: Cardiovascular System, Section 4.11: Hypertension in children.

If **hypertensive emergency/crisis**: Patient with signs of hypertensive encephalopathy, i.e. convulsions, retinal haemorrhages, visual loss and end-organ disease, e.g. left heart failure.

Management for acute hypertensive emergency/crisis due to post-streptococcal glomerulonephritis:

- Furosemide, IV, 1–2 mg/kg/dose.

If oliguric:

- Furosemide, IV, 5 mg/kg/dose.
  - Administer IV bolus slowly over 5 minutes due to risk of ototoxicity.

AND

- Labetalol, IV, 0.2–1.0 mg/kg/dose as a bolus.
  - Maximum bolus dose: 40 mg.
  - Continue infusion: 0.25–3.0 mg/kg/hour.
  - Monitor blood pressure frequently (every 30 minutes).
  - Taper infusion rate up or down according to response.

If **hypertensive urgency:** Symptomatic patients with significant elevation of blood pressure with complaints of headache, blurred vision and nausea but lack the above clinical manifestations or persistent significant hypertension:

- Propranolol, oral, 1–2 mg/kg/dose, 6 hourly.
  - Maximum dose: 8 mg/kg/24 hours.

If blood pressure is not adequately controlled:

ADD

- Amlodipine, oral, 0.2 mg/kg/dose.
  - May be repeated 6 hours later, thereafter, once every 24 hours.
  - Maximum dose: 5 mg.
  - Crush 5 mg tablet and disperse in 5 mL water: amlodipine 1 mg/mL.

Once blood pressure has normalised, taper and stop antihypertensive treatment. Monitor blood pressure over the next 48 hours to exclude rebound hypertension.

If volume overloaded:
See fluid management in general and supportive measures.

- Furosemide, slow IV, 2 mg/kg/dose.
  - Maximum dose: 5 mg/kg/dose.
  - Maximum cumulative daily dose: 8 mg/kg/24 hours.

If pulmonary oedema:
See fluid management in general and supportive measures.

- Morphine, IV, repeat after 4 hours if required.
  - < 6 months of age: 0.025–0.1 mg/kg/dose.
  - ≥ 6 months of age: 0.05–0.2 mg/kg/dose.

LoE III[1]

- Oxygen, 100%, 2–3 L/minute by nasal cannula.

REFERRAL

Urgent (as soon as possible)

» Anuric patient with acute volume overload and unresponsive to furosemide.
» Uncontrolled hypertension.
» Oliguric and progressive renal failure.
» Cardiac failure or pulmonary oedema not responding to treatment.

For specialist advice

» Macroscopic haematuria persisting for more than 4 weeks or persistent proteinuria.
» Family history of renal disease.
» Streptococcal aetiology unproven (ASOT and anti-DNAse B negative, normal C_3 levels, decreased C_4 levels).
» Decreased complement levels which persist for more than 6 weeks.
» Persistent renal failure after initial recovery.
» Persistent hypertension.

6.2 URINARY TRACT INFECTION (UTI)

N39.0

DESCRIPTION

Bacterial infection of the urinary tract.

Uncomplicated urinary tract infection (UTI) is an infection, which is limited to the lower urinary tract, and there are no associated urological anomalies. It is seen most commonly in girls over two years of age.

Complicated urinary tract infection (UTI) is an infection of the urinary tract involving the renal parenchyma (acute pyelonephritis) or which is associated with underlying congenital anomalies of the kidneys and urinary tract. It may result in significant short-term morbidity, including septicaemic shock and acute renal failure, especially in infants. Permanent renal damage may occur in children who have recurring episodes of pyelonephritis.

DIAGNOSTIC CRITERIA

Clinical

» Signs and symptoms are related to the age of the child and are often non-specific.
Uncomplicated urinary tract infections present with localising symptoms of dysuria, frequency, urgency, cloudy urine and lower abdominal discomfort. Urine test strip shows positive leucocyte esterase, nitrites and haematuria.

» Complicated infections may present with fever and other systemic features described below:

» Neonates may present with:
- > fever,
- > hypothermia,
- > poor feeding,
- > sepsis,
- > vomiting,
- > prolonged jaundice,
- > failure to thrive,
- > renal failure.

» Infants and children may present with:
- > failure to thrive,
- > persisting fever,
- > abdominal pain,
- > frequency,
- > dysuria,
- > enuresis or urgency.

A urinary tract infection must be excluded in any child with fever of unknown origin.

Special investigations

» Urine bag specimens are used for screening purposes only.
- > When a urine strip test of a bag specimen reveals presence of leucocytes, nitrites, or haematuria, collect urine aseptically for urine MCS.
- > Urine specimen is collected aseptically:
  - by in-out catheter or suprapubic aspiration in acutely ill children < 2 years of age or in smaller children who are unable to co-operate **or**
  - by mid-stream clean-catch method in older children.

» Criteria for the diagnosis of UTI:
- > any culture from a suprapubic urine sample,

- > a culture of > 10^4 col/mL urine of a single organism from a catheter specimen,
- > a pure culture of > 10^5 col/mL in a mid-stream clean-catch sample or consistent culture of a pure growth even with counts as low as 10^4 col/mL.

» Ultrasound:
- > Do a renal ultrasound in **all** children with a first UTI as soon as possible, unless a normal ultrasound was previously seen.
- > Posterior urethral valve (PUV) disorder should be investigated in males.

» MCUG:
- > In children who have abnormalities of the kidneys, ureter or bladder demonstrated by ultrasound.

GENERAL AND SUPPORTIVE MEASURES

» Ensure adequate nutrition and hydration. Maintain hydration with oral and/or IV fluids if necessary.

» For recurring infections:
- > avoid irritant soaps and bubble baths,
- > treat constipation, if present,
- > treat pinworm,
- > attend to perineal hygiene,
- > regular complete emptying of the bladder and/or double voiding, i.e. making an additional attempt at voiding after the initial flow of urine has ceased.

Note: Consider the possibility of sexual abuse in children presenting with a UTI with genital, perineal and/or anal bruising, abrasions or laceration, secondary incontinence or a marked fear of examination.

MEDICINE TREATMENT

Uncomplicated UTI

See the Standard Treatment Guidelines and Essential Medicines List for Primary Health Care Level.

Note: Antibiotic therapy for 3 days only.

LoE I[2]

Complicated UTI

Antibiotic therapy

Total duration of antibiotic therapy: 7 days.

IMPORTANT

Increase duration to 10–14 days in infants who have acute pyelonephritis or septicaemia.

LoE I[3]

The empiric choice of antibiotics depends on the expected sensitivity of the suspected organism. Review antibiotic choice once culture and sensitivity results become available.

Oral treatment:
Children > 3 months old who are unwell but not acutely ill and who are not vomiting:
Children with uncomplicated UTI:

- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose of amoxicillin component, 12 hourly (amoxicillin/clavulanic acid in a ratio of 14:1).
  - Maximum dose of amoxicillin component: 1.5 g 12 hourly.

  (See annexure 1: Amoxicillin/Clavulanic weight band dosing table)

Parenteral treatment:
All neonates and acutely ill infants should preferably be treated parenterally for the first few days until temperature has normalised and they are able to tolerate feeds.

- Amoxicillin/clavulanic acid, IV, 25 mg/kg/dose 8 hourly.

OR

- Cefotaxime, IV, 50 mg/kg/dose 8 hourly.

If there is no improvement after 24 hours of IV amoxicillin/clavulanic acid treatment, a resistant organism may be the cause and treatment should be according to culture. Consult a specialist.

If there is evidence of good clinical response to amoxicillin/clavulanic acid alone, change to:

- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose of amoxicillin component, 12 hourly (amoxicillin/clavulanic acid in a ratio of 14:1).
  - Maximum dose of amoxicillin component: 1.5 g 12 hourly.

  (See annexure 1: Amoxicillin/Clavulanic weight band dosing table)

Penicillin allergy:
See Chapter 25: Drug allergies, section 25.4.1: Allergies to penicillins.

For pain:

- Paracetamol, oral, 15 mg/kg/dose, 6 hourly as required.

For children with a structural or functional abnormality of the urinary tract:
Investigate for recurrent UTIs if the patient has a temperature > 38.5˚C or symptoms of a urinary tract infection by performing a urine strip test.

If positive for leucocytes and/or nitrites are present in fresh urine, collect urine aseptically for MCS and treat empirically as above for a urinary tract infection.

Prophylactic antibiotic therapy

Prophylaxis may be indicated in specific risk groups, i.e. for children < 2 years of age and who have a structural or functional abnormality of the urinary tract associated with increased risk of recurrent infections, i.e. grade III or more vesico-ureteric reflux. In this setting, consult nephrologist and microbiologist.

Asymptomatic bacteriuria does not require treatment.
Use of long-term prophylactic antibiotic therapy for UTIs is not recommended.

REFERRAL

» Poor response to adequate therapy, i.e. persistent positive urine culture and/or fever.
» If complicated urinary tract infection, i.e. obstruction is suspected or renal failure present.
» If recurrent urinary tract infections or repeated positive pure culture of any micro-organism.

6.3 NEPHROTIC SYNDROME (NS)

N04

DESCRIPTION

Nephrotic syndrome (NS) is a clinical syndrome associated with massive proteinuria due to increased permeability of the glomerular basement membrane. Most children have primary (idiopathic) nephrotic syndrome associated with minimal change nephrotic syndrome (MCNS) or focal segmental glomerulosclerosis (FSGS). In an undefined proportion of patients, the disease is caused by genetic mutations in podocyte specific genes. Main causes of secondary nephrotic syndrome include infections (HIV, Hepatitis C), Systemic lupus erythematosus (SLE) and reflux nephropathy.

Main complications:

» Increased risk of infections with encapsulated organisms, *S. pneumoniae, E. coli.* Chicken pox and measles are the main major viral infections.
» Hypercoagulable state: increased risk of arterial and venous thrombosis. Aggressive investigation and treatment may be necessary to prevent fatal pulmonary embolism.

DIAGNOSTIC CRITERIA

Clinical

» Massive proteinuria.

» Hypo-albuminaemia.
» Oedema.
» Hyperlipidaemia (hypercholesterolaemia).
» Usually normal blood pressure.
» Transient microscopic haematuria and/or hypertension in 25% of children.
» Usually normal renal function.

Investigations

» Urine test strip: ≥ 3+ proteinuria; may have trace to 1+ haematuria.
» Spot random urine sample protein:creatinine ratio: > 0.2 g/mmol.
» Urine microscopy: hyaline and lipid casts. May have occasional red and white blood cells.
» Serum albumin: < 25 g/L.
» Serum urea and creatinine and electrolytes usually normal.
» Serum cholesterol: increased.
» Investigations to exclude secondary causes of nephrotic syndrome, including: ASO and anti-DNAse B titre, Hepatitis B s-antigen, Hepatitis C antibody, RPR, HIV and CMV antibodies.
» C_3 and C_4
» Antinuclear factor antibody and anti-dsDNA.

A presumptive diagnosis of MCNS can be made in children who are 2–6 years old and who have:

» normal blood pressure,
» normal renal function,
» only a trace/1+ haematuria, but no red cell casts,
» normal complement levels, and
» in whom secondary causes have been excluded.

GENERAL AND SUPPORTIVE MEASURES

» Monitor fluid balance.
» Monitor urine output strictly and weigh daily (1 kg = 1 L of fluid).
» Assess hydration status.
  > Suspect:
    - Hypovolaemia: in the presence of hypotension, small pulse volume and cold extremities.
    - Normovolaemia: with normal moist mucosa and normal blood pressure with well perfused limbs.
  > Replace ongoing extra-renal losses as for a dehydrated child, e.g. oral rehydration for gut losses, etc.

Continued weight gain or anuria is an indication for referral.

» Dietary measures:
  > Do not restrict oral fluid intake.

> Restrict salt intake in all patients. No salt should be added during preparation of food and there should be no salt on the table during meals. Restrict all salt-preserved foods.
> Limit intake of saturated fat.
> Normal energy intake.
> Normal protein diet for all with normal renal function.

MEDICINE TREATMENT

Specific treatment of causative conditions where possible, e.g.

» HIV infection.
» Syphilis infection.
» SLE.
» Streptococcal infection.

For hypovolaemia (hypovolaemic shock):

- Sodium chloride 0.9%, IV, 10ml/kg bolus, immediately over 20–30 minutes.

LoE III

Replace ongoing extra-renal losses as for a dehydrated child, e.g. oral rehydration solution for gut losses, etc.

Note: Beware of intravascular volume depletion, which can be induced by over aggressive diuresis. In patients with oedema, exclude hypovolaemia prior to the administration of furosemide.

For patients with oedema and hypervolaemia:

- Furosemide, oral, 1 mg/kg/dose, 12 hourly.

LoE III [4]

AND

- Potassium chloride (100 mg/ml), oral, 75–225 mg/kg/day (1–3 mmol/kg/day or 0.75–2.25 ml/kg/day) in divided doses.
  - Monitor serum potassium.

For patients with intractable oedema who fail to improve with furosemide treatment only:
ADD

- Hydrochlorothiazide, oral, 1 mg/kg, once daily.
  - Do not exceed 12.5 mg daily.

For severe ascites:
Add

- Spironolactone, oral 1.5–2.5 mg/kg/dose, 12 hourly.

For short-term treatment of congenital nephrotic syndrome and for patients with oedema (anasarca), volume contraction and oliguria:

- Albumin, human 20% (salt-poor solution), IV, 1 g/kg (i.e. 5 mL/kg) administered over 5 hours on 2 consecutive days.

AND

- Furosemide, IV, 2 mg/kg, slow IV infusion over 5 hours, i.e. 0.4 mg/kg/hour.

For all children with non-remitting nephrotic syndrome:

- Multivitamin, oral, 5 mL daily.
  (Formulation to include pyridoxine, other B vitamins, vitamin C 30 mg and vitamin D 400 IU.)
- Folic acid, oral, 5 mg daily.
- Calcium (elemental), oral, 10–15 mg/kg/dose, 12 hourly.
  - Maximum dose: 1000 mg (1 g) daily.
  - Calcium carbonate 420 mg = 168 mg elemental calcium.

Give all children with non-remitting nephrotic syndrome renoprotective treatment as for patients with chronic renal failure.

IMPORTANT
Renoprotective strategies are not indicated in children with steroid responsive nephrotic syndrome.

- **ACE inhibitor**

An ACE inhibitor is given to decrease proteinuria, irrespective of presence or absence of systemic hypertension. Begin with low dosage and titrate against response and blood pressure.

  - Enalapril, oral, 0.1 mg/kg once daily.
    - Increase dose to 0.5 mg/kg/day, as a single dose or two divided doses.
    - Monitor for adverse effects: hyperkalaemia (increased risk when potassium-sparing diuretic is used simultaneously) and acute renal failure (increased risk in children with impaired renal function or volume depletion).
    - Do not use if estimated CrCl < 30 mL/minute.

Cholesterol lowering drugs

For children > 8 years who have non-remitting nephrotic-range proteinuria and persistent cholesterol levels > 7 mmol/L:

- HMGCoA reductase inhibitors (statin), e.g.:
  - Simvastatin, oral, 10 mg at night.

Immunisation

Do not give live vaccines to patients receiving steroid and other immunosuppressive treatment.

Once in remission
Provide all other EPI vaccines according to the schedule.

In children > 2 years who received conjugate pneumococcal vaccine 13:
- Pneumococcal vaccine (polysaccharide), IM, 0.5 mL as a single dose.

Give:
- Varicella-zoster vaccine, 0.5 mL, SC, 2 doses 6 weeks apart.

Check Hepatitis B immunity. In the absence of any immunity:
- Hepatitis B vaccine, IM, 1 mL, 3 doses one month apart.
    - If the antibody level is considered non-protective or insufficient, give 2 booster doses one month apart.

Prophylactic antibiotics
For patients with anasarca who have an increased risk for spontaneous pneumococcal peritonitis, there is no evidence that prophylactic antibiotics are beneficial.

Spontaneous bacterial peritonitis
- Ceftriaxone, IV, 50 mg/kg/dose 12 hourly for 5 days.

LoE II[5]

Corticosteroids
Initiate corticosteroid treatment only in consultation with a specialist.

In the absence of a histological diagnosis, empiric steroid treatment should only be given to children with presumed minimal change disease where a rapid response is expected.

In patients with initial macroscopic haematuria, persistent hypertension, persistently low C_3 and renal function impairment, a diagnosis other than MCNS is suggested. These cases should be referred for kidney biopsy before steroid treatment is given.

Initial treatment (first course of steroid treatment)

- Prednisone, oral, 2 mg/kg/dose as a single dose in the morning for 4 weeks.
  - Maximum dose: 60 mg daily. If in remission:
  - Taper dose over next 16 weeks as follows:
    - 2 mg/kg/dose as a single dose on alternate mornings for 4 weeks.
    - 1.5 mg/kg/dose as a single dose on alternate mornings for 4 weeks.
    - 1 mg/kg/dose as a single dose on alternate mornings for 4 weeks.
    - 0.5 mg/kg/dose as a single dose on alternate mornings for 4 weeks.

A shorter initial treatment course, i.e. 8 weeks vs. 20 weeks, is associated with more frequent relapses.

If the patient fails to achieve remission after 4 weeks of treatment, continue with the high dose (2mg/kg to a max of 60mg/kg) for another 4 weeks (maximum of 8 weeks). Patients who go into remission must then use the tapering regimen above. Patients who fail to go into remission after 8 weeks of steroid treatment are considered steroid-resistant and should be referred for kidney biopsy.

IMPORTANT

Long-term corticosteroid treatment suppresses adrenal function. Therefore, additional steroids or steroid supplementation is necessary during periods of acute stress, e.g. surgery or septic shock.

Assessment of treatment response

For practical reasons, a urine strip test is usually performed on a spontaneously voided urine sample instead of a 24-hour urine sample.

» Test urine every morning during corticosteroid treatment.
» Urine strip tests should be negative for a minimum of 3 consecutive mornings before decreasing the dose.
» If proteinuria recurs, go back one step in the suggested dose for a few more days before again attempting to decrease the dose.

Classifying treatment responses

» **Remission**: No/trace protein on urine test strips for 3 consecutive days (spot sample urine protein:creatinine ratio < 0.02 g/mmol).
» **Steroid-sensitive NS**: No/trace protein on urine test strips for 3 consecutive days within 4 weeks after start of high dose oral prednisone therapy.
» **Steroid-dependent NS**: Relapse develops during tapering of steroid treatment or within 2 weeks after stopping treatment.
» **Steroid-resistant NS**: Failure to achieve remission in spite of maximum 8 weeks of treatment with prednisone 2 mg/kg/day. (Spot sample urine protein:creatinine ratio > 0.02 g/mmol).
» **Relapse of NS**: 3+ proteinuria on urine test strips or urine protein:creatinine ratio > 0.2 g/mmol for 3 consecutive days.

» **Frequently-relapsing NS**: Two or more relapses per 6 months or ≥ 4 per 12-month period.

Schedule for relapse: similar to the initial course, but for a shorter period:

- Prednisone, oral, 2 mg/kg/dose as a single daily dose for minimum of one week. Urine test strips should be negative for minimum of 3 consecutive mornings before the dose is decreased.
- Then taper dose as follows:
  - 2 mg/kg/dose as a single dose on alternate mornings for 2 weeks.
  - 1.5 mg/kg/dose as a single dose on alternate mornings for 2 weeks.
  - 1 mg/kg/dose as a single dose on alternate mornings for 2 weeks.
  - 0.5 mg/kg/dose as a single dose on alternate mornings for 2 weeks.
  - If proteinuria recurs, go back one step in the suggested dose for a few more days before again attempting to decrease the dose.

Second-line immunosuppressive treatment

» Second-line immunosuppressive treatment is indicated in children with steroid-sensitive nephrotic syndrome with frequently-relapsing NS, steroid-dependent NS and in those with steroid toxicity.

» It should only be prescribed after consultation with a paediatric nephrologist. It remains the prescriber's responsibility to monitor the patient at regular intervals for side-effects of treatment.

> Full blood count, urea, creatinine, electrolytes and albumin needs to be done every 10–14 days throughout the course of treatment.

» Second-line immunosuppressive treatment for steroid-sensitive nephrotic syndrome should only be started when the urine strip test is negative.

» It is always given in combination with steroid treatment.

» Kidney biopsy is preferably done before second-line immunosuppressive treatment is started due to the risks associated with this treatment.

» Immunosuppressive therapy – nephrologist initiated:

- Cyclophosphamide, oral, 2 mg/kg/dose once daily for 12 weeks.
- Ensure adequate fluid intake to avoid haemorrhagic cystitis.

IMPORTANT

Children with steroid-resistant nephrotic syndrome do not benefit from treatment with cyclophosphamide and should be referred to a paediatric nephrologist.

REFERRAL

» All with congenital nephrotic syndrome.

» All with clinical features and/or laboratory results, which suggest a diagnosis other than MCNS, e.g. initial macroscopic haematuria, persistent hypertension, persistently low C_3 and renal function impairment.
» Patients with steroid-resistant nephrotic syndrome.
» All patients before second-line immunosuppressive treatment is prescribed.

6.4 ACUTE KIDNEY INJURY (RENAL FAILURE, ACUTE)

N17.9

DESCRIPTION

Acute kidney injury (AKI) is a syndrome characterised by a rapid decline in glomerular filtration rate and retention of fluid and nitrogenous waste products. It often presents as a continuum of volume responsiveness 'pre-renal AKI' up to a point of volume unresponsiveness. AKI is classified as pre-renal, renal and post-renal failure.

Levels of AKI are defined by pRIFLE criteria (mnemonic p=paediatric, Risk, Injury, Failure, Loss and End Stage Renal Failure).

Paediatric modified RIFLE (pRIFLE) criteria

Level	Estimated creatinine clearance (eCrCl)*	Urine output
1	↓ eCrCl by 25%	< 0.5 mL/kg/hour for 8 hours
2	↓ eCrCl by 50%	< 0.5 mL/kg/hour for > 16 hours
3	↓ eCrCl by 75%	< 0.5 mL/kg/hour for > 24 hours or anuria for 12 hours

The previous method of measuring creatinine clearance using a 24-hour urine sample is not recommended due to the difficulty in obtaining an accurate 24-hour urine collection in children. A calculated glomerular filtration rate can be ascertained using the height of the child (in cm), the serum creatinine (in µmol/L) and a factor 'K'. (**Modified Schwartz formula**).

$$*\text{eCrCl (mL/min/1.73 m}^2) = \frac{[\text{K x height (cm)}]}{\text{S-creatinine (µmol/L)}}$$

Value of K	
Low birth weight (< 2.5 kg) infant	30
Infant 0–8 months	40
Girls 2–16 years	49
Boys 2–12 years	49
Boys 13–16 years	60

LoE III[6]

Normal values for GFR in children:

Age	Mean GFR (ml/min/1.73 m^2)	Range
Birth	20	
7 days	40	25–60
1 month	50	30–70
6 months	75	40–100
12 months	115	65–160
2–12 years	125	90–165

DIAGNOSTIC CRITERIA

Clinical

» In neonates, exclude a congenital abnormality of the urinary tract.
» Oliguria is the most common manifestation, i.e.:
  Neonates: output < 1 mL/kg/hour.
  Older children: output ≤ 0.3 mL/kg/hour.
» Pre-renal: shock and dehydration.
» Post-renal: exclude obstruction, e.g. a palpable bladder.
» Intrinsic kidney disease: oedema, volume overload, hypertension.
» Signs of underlying infection/septicaemia, e.g. fever, skin rash, etc.

Investigations

» Urine macroscopic appearance: brownish with acute tubular necrosis.
» Urine test strip: haematuria, proteinuria indicative of glomerular disease; leucocytes and nitrites in favour of pyelonephritis.
» Urine microscopy: red blood cell casts, leukocyte, hyaline and granular casts.
» Urine culture to exclude pyelonephritis.
» Urine biochemistry:

	Pre-renal failure	Intrinsic renal failure
U-Osmolality (mOsmol/L)	↑ > 320	Equal to serum osmolality
FeNa (%)*	< 1	≥ 3

$$\text{Fractional excretion of sodium (\%)} = \frac{\text{Urinary sodium}}{\text{Urinary creatinine}} \times \frac{\text{Serum creatinine}}{\text{Serum sodium}} \times 100$$

*FeNa becomes an invalid test for pre-renal failure if the child has received furosemide.

Note: Serum creatinine is measured in micromol/L (µmol/L) and urine creatinine in millimol/L (mmol/L). To convert micromol/L to millimol/L ÷ by 1000.

» Ultrasound of kidneys and bladder.
» Serum urea, urate, creatinine, electrolytes and osmolarity, glucose, calcium, phosphate and albumin.

» Typical biochemistry: hyperkalaemic metabolic acidosis, hyponatraemia, hypocalcaemia, hyperphosphataemia.
» Full blood count, differential and platelet count.
» Clotting profile.
» Cultures and DIC workup as indicated.
» ECG to exclude life-threatening hyperkalaemia.
» Chest X-ray to evaluate cardiomegaly, pleural effusions and pulmonary oedema.

GENERAL AND SUPPORTIVE MEASURES

» Treat the underlying cause.
» Monitor fluid intake and output, blood pressure.
» Weigh daily.
» Nutritional support:
  > High-energy diet. Give supplementary nasogastric feeds, if required. Infants should preferably be given breast feeds or an infant milk formula.
  > Daily requirements:
    - Protein: 1 g/kg maximum
    - Carbohydrate: 2–3 g/kg
    - Fat: 2 g/kg
» Restrict NaCl, potassium and phosphate intake.
» Restrict protein intake when serum urea > 25 mmol/L.

Avoid nephrotoxic or renally excreted medicines, e.g.

NSAIDs, aminoglycosides, vancomycin, cough and cold mixtures, radiocontrast drugs.

» Fluid management:
  > Depends on volume status, urine output and extra-renal losses.
  > Never use a potassium-containing solution in an anuric patient.
  > Only use parenteral fluids if oral intake is not possible.

IMPORTANT

Fluid balance is critical. Assess at a minimum, every 12 hours to make appropriate changes to the fluid prescription.

» Fluid management according to fluid status:

IMPORTANT

Insensible water loss is calculated as:

- Neonates and young babies: 30–40 mL/kg/day
- Older children: 25 mL/kg/day (400 mL/m^2/day)

> **Pulmonary oedema plus oliguria/anuria**: Do not give fluid.
> **Hydrated anuric patient without extra-renal fluid losses**: Oral fluid to replace insensible water losses only.
> **Normally hydrated plus oliguria**: Oral fluid intake to replace insensible water loss plus urine output of previous 24 hours.
> **Dehydrated, oliguric and ongoing extra-renal fluid losses**: Replace fluid losses with an appropriate solution which mirrors losses, e.g.:
  - for diarrhoea: sodium chloride 0.9%/dextrose 5%, IV or oral rehydration solution;
  - for vomiting/gastric fluid losses: sodium chloride 0.9% /dextrose 5%.
> **Normally hydrated plus normal urine output:** Give normal fluid intake.
> **Shock**: See Chapter 1: Emergencies and Trauma, section 1.1.8: Shock.
> **Polyuria** (urine output > 4 mL/kg/hour): which usually occurs during the recovery (diuretic) phase of acute tubular necrosis: Replace fluid and electrolyte losses with sodium chloride 0.9%/dextrose 5%, IV. Volume to replace is equal to urine output of preceding 12 hours.

MEDICINE TREATMENT

Hyperkalaemia

Monitor ECG for signs of hyperkalaemia.
Discontinue all sources of intake of potassium.
Treat when serum potassium > 6.5 mmol/L.
Monitor response to treatment and adjust accordingly.

- Calcium gluconate 10%, IV, 0.5 mL/kg/dose slowly over 3–5 minutes.
- Salbutamol, solution, 2.5–5 mg/dose, nebulised over 20 minutes. (0.5–1 mL salbutamol in 2–4 mL sodium chloride 0.9%.)
  OR
  Salbutamol, IV, 4 mcg/kg in 5 mL water administered over 30 minutes.
- Sodium bicarbonate 4.2%, IV, 4 mL/kg administered over 4 hours.
  - Do not mix calcium and sodium bicarbonate-containing solutions.

Check potassium level, and if there is still no improvement:

- Dextrose 10%, IV, 5 mL/kg over 20 minutes **with/without** insulin, soluble, 0.1 units/kg depending on the blood glucose level.
  - If insulin is used, monitor for hypoglycaemia hourly.
- Sodium polystyrene sulphonate, oral/rectal, 1 g/kg in dextrose water.

If hyperkalaemia persists despite above treatment, refer the patient urgently for dialysis.

OTHER COMPLICATIONS

Metabolic acidosis: serum pH ≤ 7.1

- Sodium bicarbonate 4.2%, IV, 4 mL/kg administered over 2–4 hours.
  - Do not mix calcium and sodium bicarbonate containing solutions.

Hypertension

See Chapter 4: Cardiovascular System, section 4.11: Hypertension in children.

Infection

Avoid nephrotoxic antibiotics.

Uraemic convulsions

See Chapter 13: The Nervous System, section 13.1: Seizures.

» Exclude specific causes of convulsions, e.g. hypoglycaemia, hyper- or hyponatraemia, hypocalcaemia or hypertension and treat accordingly.
» Ensure urea levels are appropriately high.
» Refer for urgent dialysis.

Anaemia

For acute blood loss/active haemolysis and Hb < 7 g/dL:

- Packed red blood cells, IV, 10 mL/kg administered over 6 hours.

Pulmonary oedema, volume overload and hypertension

Do not give fluid to anuric patients with pulmonary oedema.
Intubate and initiate positive pressure ventilation as necessary.

- Furosemide, IV, 2–5 mg/kg administered over 5 minutes.
  - Maximum daily dose: 8 mg/kg/24 hours.

- Morphine, IV, 0.1 mg/kg.
  - Repeat after 4 hours, if required.

- Oxygen, 100%, 2–3 L/minute by nasal cannula.

Pulmonary oedema is an indication for dialysis in non-responsive cases.

REFERRAL

Urgent for dialysis when:

» Fluid overload is causing pulmonary oedema.
» Anuria > 24 hours.
» Central nervous system signs, e.g. convulsions or coma.
» Uraemic bleeding diathesis.
» Uraemic pericarditis.
» Hyperkalaemia or hyponatraemia not responding to conservative treatment.
» Persistent metabolic acidosis, pH < 7.1 or serum bicarbonate < 10 mmol/L.

» Uncontrollable hypertension.
» Severe hyperphosphataemia and/or hypocalcaemia.

6.5 CHRONIC KIDNEY DISEASE (RENAL FAILURE, CHRONIC)

N18.9

DESCRIPTION

Chronic kidney disease (CKD) is defined as: "evidence of structural or functional kidney abnormalities (abnormal urinalysis, imaging studies or histology) that persist for at least 3 months, with or without a decreased glomerular filtration rate (GFR), as defined by a GFR of less than 60 mL/min/1.73 m^2".
It is characterised by a progressive decline in renal function to end-stage renal failure due to progressive loss of functioning glomeruli and is accompanied by the onset or worsening of proteinuria.

A calculated glomerular filtration rate can be ascertained using the height of the child (in cm), the serum creatinine (in µmol/L) and a factor 'K'. (**Modified Schwartz formula**).

$$\text{eCrCl (mL/min/1.73 m}^2\text{)} = \frac{\text{[K x height (cm)]}}{\text{S-creatinine (µmol/L)}}$$

Value of K	
Low birth weight (< 2.5 kg) infant	30
Infant 0–18 months	40
Girls 2–16 years	49
Boys 2–12 years	49
Boys 13–16 years	60

Staging of chronic kidney disease (KDQOI definition)

Stage	*eGFR (mL/min/1.73 m^2)	Features
0	≥ 90	Screening of 'at-risk for CKD' patients.
1	≥ 90	Renal parenchymal disease presents with normal eGFR – monitor annually.
2	60–89	Usually asymptomatic – biochemical abnormalities present – monitor annually.
3	30–59	Biochemical abnormalities and poor growth, poor appetite – monitor 3–6 monthly.
4	15–29	Severe disease – consider renal replacement therapy.
5	< 15 (ESRF)	End-stage renal failure – consider renal replacement therapy.

**eGFR: estimated glomerular filtration rate*

DIAGNOSTIC CRITERIA

Renal function may deteriorate without clinical symptoms.

» Children are likely to present with acute-on-chronic renal failure during episodes of acute intercurrent illness.
» Poor weight gain and stunting.
» Poor appetite, chronic constipation, polydipsia and polyuria.
» Children with renal tubular disorders or bilateral renal dysplasia have obligatory salt wasting and are often unable to concentrate urine. This may result in severe dehydration and metabolic acidosis if they do not have free access to water.
» May present with tachypnoea mimicking acute 'respiratory distress' to compensate for metabolic acidosis.
» Chronic anaemia.
» Renal osteodystrophy, i.e. bone pain and skeletal deformities.
» Volume overload: oedema, hypertension, heart failure, pulmonary oedema.
» Uraemic symptoms and signs: nausea, vomiting, pruritus, brownish skin pigmentation, uraemic frost.
» Bleeding tendency (mucosal).
» Convulsions due to hyponatraemia, hypernatraemia, hypocalcaemia, uraemia or hypertension.

Investigations

» Urine:
  > Protein:creatinine ratio is usually increased (normal < 0.02 g/mmol).
  > Iso-osmolar, i.e. urine osmolality ~ 300–350 mOsmol/L (normal maximal urine concentration > 1000 mOsmol/L).
» Urine volume may be:
  > normal, or
  > increased (polyuria): > 4 mL/kg/hour, or
  > decreased (oliguria): < 1.0 mL/kg/hour.
» Urine test strip:
  > May be normal or reveal proteinuria, haematuria, glycosuria.
  > Nitrites and leucocytes may indicate UTI. Do urine MCS.
» Urine microscopy:
  > May be normal or reveal casts.
  > Pus cells, leucocyte casts and bacteria may indicate UTI. Do urine MCS.
» Serum urea:
  > Increased, depending on hydration, nutritional state and protein intake.
» Serum creatinine is a better indicator of renal function than serum urea but:
  > It is influenced by age of the child and muscle bulk.
  > It may be only mildly increased in a malnourished child with little muscle bulk despite advanced renal failure (serum creatinine only

starts increasing once renal function has fallen to less than half normal).

» Serum electrolytes:
  > Hyperkalaemia.
  > Hyperchloraemia and decreased bicarbonate.
» Calcium, phosphate and ALP:
  > Decreased calcium.
  > Increased phosphate.
  > Increased ALP.
» Plasma parathyroid hormone:
  > Increased.
» Renal ultrasound:
  > To exclude obstruction.
  > Small shrunken kidneys are indicative of chronic renal failure.

There is no place for renal biopsy in patients with end-stage renal failure.

GENERAL AND SUPPORTIVE MEASURES

» Determine and treat the underlying cause of chronic renal failure.
» Monitor fluid intake and output, and blood pressure.
» Weigh daily.
» If in respiratory distress due to volume overload:
  > Place in sitting position.
  > Give oxygen, 100%, 2–3 L/minute by nasal prongs.
» Dietary management:
  > Monitor potassium closely.
  > Limit potassium intake if serum potassium > 5.5 mmol/L.
  > Restrict fruit juices, dried fruit, all citrus fruits, bananas, guavas and tomatoes.
  > All vegetables should either be soaked for 24 hours before cooking or water should be decanted twice during cooking.
  > Restrict phosphate once serum phosphate reaches or exceeds the upper limit of normal for age, usually > 1.8 mmol/L and when GFR < 70 mL/min/1.73 m^2.
  > Limit dairy products and other foods with high phosphate content like grains and cereals, carbonated cool drinks, etc.
  > Do not limit protein intake.
  > Restrict salt intake. No salt should be added during preparation of food, no salt on the table during meals and restrict all salt-preserved foods. Generally, salt is restricted for hypertensive, oedematous patients, but not for patients with salt-losing nephropathies who are polyuric, unless they are hypertensive.
  > High-energy diet with supplementary nasogastric feeds or nocturnal fluids for children with poor appetite, polyuria/nocturia and with inadequate intake to maintain growth.
» Fluid management:
  > Depends on underlying kidney disease.

> Use body weight to guide fluid prescription.
> Only use parenteral fluids if oral intake is not possible.
> Children with tubular abnormalities may be unable to concentrate their urine and, therefore, require free access to water.
> **Anuric**: Fluid to replace insensible water losses only.
Use an electrolyte-free solution, i.e. dextrose 5% or 10%, IV.
Insensible water loss is calculated as:
  - Neonate and young baby: 30–40 mL/kg/day.
  - Older children: 25 mL/kg/day (400 mL/m^2/day).
> **Oliguric with oedema and hypertension**

> **Total volume of fluid allowed is calculated as**:

INSENSIBLE WATER LOSS:
- Neonate and young baby: 30–40 mL/kg/day.
- Older children: 25 mL/kg/day (400 mL/m^2/day).

Use an electrolyte-free solution, i.e. dextrose 5% or 10%, IV.

PLUS
50% of urine output.

PLUS
Extra-renal losses (volume for volume).
Use a potassium-free solution, e.g. sodium chloride 0.9%.
Once euvolaemic, give same fluids as above to replace 100% of urine output.

> **Dehydrated and hypotensive**: Give sodium chloride 0.9%, IV bolus immediately and re-assess.
Repeat bolus, if necessary.
Strictly monitor urine output and fluid losses.

MEDICINE TREATMENT

Avoid nephrotoxic agents and appropriately adjust renally excreted medicines, e.g. NSAIDs, aminoglycosides, vancomycin, amphotericin B, radiocontrast drugs.

Vitamins and minerals
- Multivitamin, oral, 5 mL daily.
(Formulation to include pyridoxine, other B vitamins, vitamin C 30 mg and vitamin D 400 IU.)

AND
- Folic acid, oral, 5 mg daily.

For management of hyperphosphataemia/osteodystrophy and hyperparathyroidism:
In combination with restricted dietary intake of phosphate:

- Calcium carbonate, oral, 1–4 tablets chewed 8 hourly with meals.
  - 1 tablet is equivalent to 0.168 g elemental calcium.
- Alfacalcidol, oral, 0.25 mcg daily. Specialist initiated.

- If serum phosphate is > 2.5 mmol/L, treat the hyperphosphataemia first with:
  - Dietary modification.
  - Calcium (elemental), oral, 10–15 mg/kg/dose, 12 hourly.
    - Maximum dose: 1000 mg (1 g) daily.
    - Calcium carbonate 420 mg = 168 mg elemental calcium.

  To decrease to below 1.8 mmol/L before beginning the alfacalcidol (to avoid metastatic calcification).

In patients with serum calcium < 2.2 mmol/L start alfacalcidol early:

- Alfacalcidol, oral, 0.25 mcg, initially twice weekly. Specialist initiated.
  - Increase dose as necessary to maintain serum calcium in upper-normal range.

Chronic metabolic acidosis
If serum bicarbonate < 18 mmol/L:

- Sodium bicarbonate, oral, 1 mmol/kg/dose, 2–3 doses per day after meals.
  - Adjust according to response.

  Note: The intravenous formulation can be given orally.

Hyperkalaemia
Discontinue all medicines that may cause hyperkalaemia, e.g. potassium sparing diuretics, spironolactone, ACE inhibitors.
Exclude volume depletion as an underlying cause for hyperkalaemia.

If serum potassium remains > 5.5 mmol/L:

- Sodium polystyrene sulphonate, oral/rectal, 1 g/kg/dose in dextrose water, once or twice daily.
  - Treat accompanying metabolic acidosis.

Anaemia
Ensure adequate intake of haematinics.
Ensure adequate iron stores. Measure ferritin, transferrin, transferrin saturation and total iron binding capacity.
Avoid transfusions if possible due to the risk of developing antibodies in a patient who may be a potential candidate for renal transplantation.

If a patient has symptomatic anaemia, haemoglobin usually < 7 g/dL:

- Packed red blood cells, IV, 10 mL/kg administered over 6 hours.

If the patient has a persisting haemoglobin level < 8 g/dL despite correction of possible deficiencies of iron, folic acid or vitamin B_{12}, start recombinant human erythropoietin (rHuEPO) in consultation with a paediatric nephrologist.

Note:
Blood pressure must be controlled before starting rHuEPO treatment.
Dose of erythropoietin is gradually increased according to increase in haemoglobin. Target haemoglobin is 10–12 g/dL.

- Erythropoietin, SC, 75 units/kg/week in divided doses 2–3 times a week.
  - Monitor Hb levels every 4 weeks.
  - Adjust dose until target haemoglobin level of 12 g/dL is reached. Continue with this dose.
  - If the Hb level is increasing, do not change dose.
  - If the Hb level remains unchanged, increase by 25% at 4-week intervals until a maximum dose of 300 units/kg/week is reached.
  - If Hb level increases > 12 g/dL, stop treatment for one week. Thereafter, continue with 25% less than the previous dose per week.

For persistent anaemia:
Refer to tertiary centre for nephrologist assessment.

Hypertension
See Chapter 4: Cardiovascular System, section 4.11: Hypertension in children.

Dyslipidaemia
Dyslipidaemia may contribute to the progression of chronic kidney disease, particularly in children with nephrotic syndrome. Hypertriglyceridaemia and abnormal apolipoprotein metabolism is a feature of CRF. Dietary intervention is necessary, including limiting saturated fat and cholesterol intake.

For children > 8 years with persistent total cholesterol levels > 7 mmol/L:
- HMGCoA reductase inhibitors (statins), e.g.:
  - Simvastatin, oral, 10 mg at night.
    - Maximum dose: 20 mg at night.

Refer for advice on management.

Renoprotective treatment
All children with persistent nephrotic-range proteinuria and GFR > 30 mL/minute:
- ACE inhibitor (with nephrologist supervision).
  - Enalapril, oral, 0.1 mg/kg/dose, once daily.
    - Increase dose to 0.5 mg/kg/day, as a single dose or two divided doses.

- Monitor for adverse effects: hyperkalaemia (increased risk when potassium-sparing diuretic is used simultaneously) and acute renal failure (increased risk in children with impaired renal function or volume depletion).
- May cause hyperkalaemia, worsening metabolic acidosis and declining renal function while reducing proteinuria.
- Monitor serum urea and electrolytes, i.e. serum potassium and bicarbonate, and renal function within 7 days.
- If serum creatinine has doubled, check hydration status, stop diuretics and halve the dose of ACE inhibitors.
- If renal function does not improve, or hyperkalaemia > 5.5 mmol/L persists, stop ACE inhibitor treatment.

Immunisation
Give all EPI vaccines according to the schedule.
Provide all routine vaccinations or missing vaccinations in older children.
Check immunity against chicken pox and Hepatitis B.

In children > 2 years of age:
- Pneumococcal vaccine (polysaccharide), IM, 0.5 mL as a single dose.

In the absence of any immunity against chickenpox, give:
- Varicella-zoster vaccine, SC, 0.5mL, 2 doses 6 weeks apart.

In the absence of immunity against Hepatitis B, vaccinate as for any non-immune individual.
- Hepatitis B vaccine, IM, 1 mL, 3 doses one month apart.
  - If the antibody level is considered non-protective or insufficient, give 2 booster doses one month apart.

REFERRAL
» All children with chronic kidney disease.
» Patients with dyslipidaemia or hypercholesterolaemia.

6.6 ENURESIS
R32

See Chapter 14: Child and Adolescent Psychiatry, section 14.2.1: Enuresis.

6.7 DYSFUNCTIONAL BLADDER

N31

DESCRIPTION

Abnormalities of filling or emptying of the bladder, i.e. underactive or overactive bladder. Aetiology may be neurogenic, anatomical or functional.

DIAGNOSTIC CRITERIA

Clinical features include:

- Daytime frequency
- Incontinence
- Urgency
- Nocturia
- Hesitancy
- Straining
- Weak stream
- Dysuria
- Holding manoeuvres
- Post-micturition dribbling

Conditions include:

- Overactive bladder (OAB)
- Voiding postponement
- Underactive bladder
- Dysfunctional voiding
- Obstruction
- Stress incontinence
- Vaginal reflux
- Giggle incontinence

Common in co-morbid neurological and behavioural problems.

GENERAL AND SUPPORTIVE MEASURES

- Screen for UTI. See section 6.2: Urinary tract infections.
- May have concomitant constipation – bowel management is essential in management. See Chapter 2: Alimentary Tract, section 2.2.2: Constipation/Faecal loading.
- Intermittent catheterisation is necessary with large post-void residual volumes. Check post-void volume by catheterisation after voiding.
- Symptomatic school-going children may develop anxiety. See Chapter 14: Child and Adolescent Psychiatry, section 14.5: Anxiety disorders.

REFERRAL

All for assessment.

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CHAPTER 7

ENDOCRINE SYSTEM

7.1 DISORDERS OF SEX DEVELOPMENT (DSD)

Q52.9/ Q55.9

DESCRIPTION

The current terminology for neonates or children presenting with incomplete differentiation of the external genitalia is “disorder of sex development”.

DIAGNOSTIC CRITERIA

Clinical

» DSDs present with one or more of the following:
  > varying degrees of hypospadias,
  > maldescent of one or both gonads,
  > atypical size of the phallus,
  > scrotalisation of the labia, and
  > a urogenital sinus.
» Isolated hypospadias is not a DSD.

> Suspect congenital adrenal hyperplasia in an infant with non-palpable gonads and DSD.

Investigations

» Urgent urea/electrolytes, venous blood gas and blood glucose to identify possible adrenal insufficiency.
» Elevated 17-hydroxyprogesterone level to confirm a diagnosis of adrenal hyperplasia (to be done after day 3 of life for an accurate interpretation of the result).
» Further investigations (in discussion with referral centre):
  > Genitourinary imaging (e.g. ultrasound).
  > Genetic evaluation.

GENERAL AND SUPPORTIVE MEASURES

» Gender assignment in these infants should only be undertaken after extensive counselling and evaluation by a multidisciplinary team.
» Stabilise all neonates suspected of having congenital adrenal hyperplasia with a salt-losing crisis prior to urgent referral, as a crisis may be life threatening.

MEDICINE TREATMENT

Congenital adrenal hyperplasia can present with an adrenal crisis. See section 7.3: Adrenal insufficiency, acute.

REFERRAL

» All cases for confirmation of the diagnosis, counselling and possible initiation of treatment if necessary.
» Urgent: All cases of congenital adrenal hyperplasia.

7.2 ADRENAL HYPERPLASIA, CONGENITAL

E25.0

DESCRIPTION

Autosomal recessive enzymatic defects of the cortisol biosynthetic pathways in the adrenal gland. The presentation depends on the severity and type of the enzyme defect.

DIAGNOSTIC CRITERIA

Clinical

» Neonates with disorder of sex development (ambiguous genitalia).
» Adrenal insufficiency. See section 7.3: Adrenal insufficiency, acute.
» Accelerated growth velocity or precocious pseudopuberty.

Investigations

See section 7.3: Adrenal insufficiency, acute.
» Elevated 17-hydroxyprogesterone in the serum.
» Elevated serum renin.

GENERAL AND SUPPORTIVE MEASURES

» Psychological support for child and family.
See section 7.3: Adrenal insufficiency, acute – for stress management.

MEDICINE TREATMENT

Glucocorticoid and mineralocorticoid replacement. To be initiated in consultation with a subspecialist.

- Hydrocortisone, oral, 0.5 mg/kg/day in three divided doses. Specialist initiated.
  - The morning dose should be given as early as possible.
  - ½ dose on waking up, ¼ dose at midday, ¼ dose at 16h00.

- Fludrocortisone acetate, oral, 5 mcg/kg/day as a single daily dose.
  - Range: 50–200 mcg daily.

For salt losing patients:

- Sodium chloride, oral, 1–2 g daily, divided and given with feeds.

» Glucocorticoids are administered for life. Once growth is complete, prednisone may be given once daily. Long-acting glucocorticoids are generally avoided in children because of potential growth suppression.
» The dose is individualised by monitoring growth, bone-age and hormonal levels.

LoE II[1]

REFERRAL

» All cases for confirmation of the diagnosis, counselling and initiation, and monitoring of treatment.

7.3 ADRENAL INSUFFICIENCY, ACUTE

E27.4

DESCRIPTION

Acute failure of adrenal function, suspected when a patient presents with hypotension, hypoglycaemia, hyponatraemia, hyperkalaemia and metabolic acidosis.

Patients on chronic steroid therapy are at risk for adrenal insufficiency if treatment is abruptly stopped.

Increase steroid dose during times of stress (fever, trauma and surgery) to prevent adrenal crisis (see below).

DIAGNOSTIC CRITERIA

Clinical

» Acute circulatory collapse. The features include:
  - > tachycardia,
  - > pallor,
  - > cool clammy skin,
  - > coma,
  - > metabolic acidosis,
  - > hypotension,
  - > poor peripheral perfusion,
  - > dehydration,
  - > decreased level of consciousness.

» A history of weakness, anorexia, vomiting, weight loss, salt craving, hyperpigmentation (primary adrenal insufficiency).
» Auto-immune endocrinopathies, steroid-dependence and ambiguous genitalia may be present.
» Hyperkalaemia
» Hypoglycaemia
» Hyponatraemia
» Hypercalcaemia (uncommon).

Investigations
Take blood for estimation of:
» Serum electrolytes and blood glucose.
» In all suspected cases, take a sample of clotted blood for estimation of plasma cortisol prior to treating the patient. Send this sample with the patient to the central hospital if laboratory facilities are not locally available.

MEDICINE TREATMENT

Stabilisation

For shock
- Sodium chloride 0.9%, IV, 20 mL/kg bolus as needed.

For hypoglycaemia
- Dextrose 10%, IV, 2–5 mL/kg bolus as needed.
- Hydrocortisone, IV, 2 mg/kg immediately as a single dose.
  - Follow with 0.5 mg/kg/dose every 6 hours.

Manage hyperkalaemia. See Chapter 6: Nephrological/Urological Conditions, section 6.4: Acute kidney injury (renal failure, acute).

Prevention
Patients on chronic steroid therapy are at risk of adrenal insufficiency during stressful situations, e.g. sepsis, trauma, elective or emergency surgery. Increase the dose of steroids for the duration of the stressful period.

For major stress, e.g. > 39 °C:
- Treble hydrocortisone replacement until recovery (usually 3 days).

For minor stress, e.g. URTI, > 38 °C:
- Double hydrocortisone replacement until recovery (usually 3 days).

Adrenal insufficiency is a life threatening emergency.

REFERRAL
» All cases immediately after stabilisation.

7.4 DIABETES INSIPIDUS
E23.2/N25.1

DESCRIPTION
Suspect diabetes insipidus in any child with polydipsia and polyuria. Infants may present with failure to thrive.

Central diabetes insipidus is due to deficiency of antidiuretic hormone.
Nephrogenic diabetes insipidus occurs if the kidney is unable to respond to antidiuretic hormone.

DIAGNOSTIC CRITERIA

» Pathological polyuria, defined as excretion of > 1.5 L/m^2 of urine. In infants, the corresponding value is > 2.5 L/m^2.
» Serum osmolality > 300 mOsm/kg, with urine osmolality < 300 mOsm/kg is suggestive of diabetes insipidus.
» A positive water deprivation test. (Only conduct under specialist supervision.)

MEDICINE TREATMENT

Central diabetes insipidus (Specialist initiated)

Older children:

- Desmopressin, oral, 50–300 mcg/day given 8 hourly.
  - Start at the lowest dose and titrate up according to response. Use the lowest dose at which an antidiuretic effect is obtained.
  - Maximum dose: 1200 mcg daily.

Younger children:

- Desmopressin, nasal spray, 10 mcg/day (0.1 mL), starting dose.
  - Titrate according to response. Use the lowest dose at which an antidiuretic effect is obtained.
  - Maximum daily dose: 30 mcg/day once or twice daily.

Note: The dosing of oral and nasal formulations is different owing to the difference in absorption rates.

The patient must have a phase of urinary dilution or breakthrough urination before the next dose to ensure that water intoxication does not result.

Nephrogenic diabetes insipidus
If no response to desmopressin.

Treat the underlying cause.

- Hydrochlorothiazide, oral, 0.5–1 mg/kg/dose 12 hourly.
- Ibuprofen, oral, 5 mg/kg/dose 12 hourly.

REFERRAL

» All cases for evaluation.

7.5 DIABETES MELLITUS

DESCRIPTION

A syndrome of abnormal carbohydrate metabolism, associated with a relative or absolute impairment of insulin secretion with varying degrees of peripheral resistance to the action of insulin.

7.5.1 TYPE 1 DIABETES MELLITUS

E10

DESCRIPTION

Most diabetic children have type 1 diabetes, and:

» have auto-immune destruction of the pancreatic beta cells as the underlying cause,
» have an absolute requirement for insulin therapy, and
» will develop diabetic ketoacidosis (DKA) if not given insulin.

DIAGNOSTIC CRITERIA

The following are criteria for the diagnosis of diabetes mellitus:

» Classical features of diabetes (polydipsia, polyuria, weight loss or failure to gain weight, weakness or tiredness, glycosuria, recurrent protracted infections, pruritis vulvae in a girl with diabetes) with a random serum glucose concentration ≥ 11.1 mmol/L; or
» Fasting plasma glucose ≥ 7.0 mmol/L (fasting defined as no caloric intake for at least 8 hours).
» An oral glucose tolerance test is generally not needed.

GENERAL AND SUPPORTIVE MEASURES

» Refer to a unit that is able to manage type 1 diabetic patients.
» Educate the child and caregiver about all aspects of the disease.
» A medical alert bracelet should be worn at all times.
» Follow-up by a medical practitioner or at a clinic/hospital should occur at least every 3 months.
» Monitor thyroid function annually.
» Screen for coeliac disease at diagnosis, and 3 years post diagnosis.
» Annual screening for dyslipidaemia, microalbuminuria, retinopathy and peripheral neuropathy 5 years after diagnosis in non-pubertal children and 2 years after diagnosis in pubertal children.

Diet: healthy lifelong eating habits

» Refer a newly diagnosed patient and family to a dietitian.
» Principles of the prudent diet:
  > Encourage children to reduce the intake of fats and salt and to increase dietary fibre content.
  > Provide all diabetics with a meal plan, e.g. ‘constant carbohydrate meal plan’ or ‘carbohydrates counting meal plan’. There is no one

'diabetic' diet. Individualise the diet giving consideration to usual eating habits and other lifestyle changes required.

> Six main nutrition factors contribute to better glucose control, i.e. lower HbA1c levels. These are:
1. Following a meal plan. Keep day-to-day intake consistent.
2. Avoiding extra snacks that are not part of the meal plan.
3. Avoiding over-treatment of low blood glucose levels (hypoglycaemia).
4. Prompt correction of high blood glucose levels.
5. Adjusting insulin levels for meals in patients using the 'carbohydrates counting meal plan'.
6. Consistency of night snacks.

CONSTANT CARBOHYDRATE MEAL PLAN

Consistency is the key. The amount of insulin, usually two or three doses per day, is kept relatively constant from day-to-day. Carbohydrates should be manipulated to match the relatively constant insulin dose. **If able to count carbohydrates, give 1 unit of insulin per 15 g of carbohydrate during the day:**

Units of insulin	Grams of carbohydrate per day
1.5–2.5 units	per 15 g carbohydrates for breakfast
1.2 units	per 15 g carbohydrates for supper
0.5 units	per 15 g carbohydrates during the night

The amount of carbohydrates (types can vary) should be kept about the same for each meal and snack from one day to the next.

As part of the educational process, the family must get used to reading food labels to know the grams (g) of carbohydrates being eaten. The dietitian may suggest a range of carbohydrates for each meal.

Examples of carbohydrate content of some foods
The following foods have 15 g of carbohydrate per serving:
1 cup = 250 mL

Food	Serving size
Whole wheat/brown bread	1 slice
Whole wheat/brown roll	½
Pita bread	½
Small wrap	1
Cooked porridge	½ cup
High fibre cereal	½ cup
Whole grain wheat biscuit	1

Whole wheat crispbread	4
Rye crispbread	2
Rice cakes (10 cm)	2
Whole wheat rusk	1
Cooked rice	½ cup
Cooked pasta	½ cup
Cooked couscous	½ cup
Cooked samp	½ cup
Cooked maize meal	½ cup
Cooked samp and beans	½ cup
Cooked crumbly maize meal or pap	½ cup
Cooked lentils/split peas/beans	½ cup
Baked beans	½ cup
Plain popped popcorn	1½ cups
Thick homemade soup	1 cup
Starchy vegetables	
Medium potato	1
Mash potato	½ cup
Sweet potato	¼ cup
Butternut/pumpkin	1 cup
Mixed vegetables with sweet corn	1 cup
Sweet corn	½ cup
Medium mealie	1
Peas	½ cup

» Tailor advice to the patient's lifestyle, economic circumstances and usual diet. Where possible, avoid drastic changes.
» Do not forbid any particular food as this may lead to disturbed attitudes to food, e.g. carbohydrates are not forbidden but can be taken before exercise, incorporated into a main meal or used as a source of energy during illness when children have a poor appetite.
» Diet should provide adequate nutrition for growth and development.

Dietary composition
Referral to a dietitian for an individualized meal plan to meet dietary requirements.

Timing of meals and snacks
Children receiving twice daily injections of combined short and intermediate acting insulin regimens need three main meals, and a snack, 2 hours after an insulin injection.
Eat meals and snacks at the same time each day. The timing of insulin injections may need to be adjusted according to the patient's own circumstances.

Preschool-aged children may have unpredictable eating habits and may require frequent small meals.

Exercise

» Regular exercise helps increase insulin sensitivity, maintains proper weight, blood pressure, blood glucose and blood lipid levels.
» Exercise must be regular, i.e. daily. The same amount of exercise should ideally be done at the same time of the day.
» Some form of carbohydrate is necessary before and after intense exercise to reduce the risk of hypoglycaemia. Blood glucose monitoring may be necessary before and after intense exercise.

Blood glucose testing, record keeping and review of records

» Glucometers with compatible strips and blood-letting devices.
» Encourage children to perform their own finger-prick blood glucose testing.
» Finger-pricks should be performed at the side of the fingertips.
» Encourage the child to monitor his/her blood glucose prior to each main meal and at bedtime. A daily record of all tests performed should be recorded in a logbook. Review the logbook frequently to ensure optimal insulin adjustments.
» More frequent blood glucose testing is indicated if the child is unwell, partaking in unusual amounts of physical activity or feels hypoglycaemic.
» For a basal-bolus regimen, testing can be done up to 6 times a day (180 strips/month) and for other regimens, 2–4 times daily (60–120 strips/month). If control is poor, more frequent testing is recommended with appropriate adjustment to therapy.

Acceptable glycaemic target range before and after meals

» Balance the ability of the family to avoid recurrent hypoglycaemia. A paediatrician should assist in setting practical goals. See table ‘Monitoring, control and adjustments’.
» Severe hypoglycaemia is the presence of recurrent and unpredictable hypoglycaemic episodes, requiring third party assistance. It leads to anxiety about repeated episodes and results in a poorer quality of life.
» Ideally, 80% of the pre-meal blood glucose values should fall within the target range during home monitoring, but targets may need to be altered based on the age of the child and the ability of the family.
» Infants, toddlers, and preschoolers are unable to recognise or communicate signs and symptoms of low blood glucose. They also have unpredictable eating habits.
» Some school-aged children and young adolescents have more predictable eating habits, but may be lacking in judgement. They are able to recognise or communicate signs and symptoms of low blood glucose.
» Most adolescents and young adults are able to recognise and treat low blood glucose reactions. They have predictable eating habits and are able to plan ahead.
» Acceptable target range:

> Before meals: 4–8 mmol/L.
> After meals: 5–10 mmol/L.

» Monitor HbA1c levels 3-monthly. The aim is to maintain HbA1c as close as possible to the recommended range, i.e. 6.5–7.5%. Aim for a lower HbA1c in patients who are adherent to home glucose monitoring.

Monitoring, control and adjustments

Level of control	**Optimal**	**Suboptimal** (need to take action)	**High-risk** (refer patient to specialised diabetic clinic)
Clinical assessment			
Raised blood glucose	No symptoms.	» polyuria*, » polydipsia*, and » enuresis*.	» blurred vision, » poor weight gain, » poor growth, » delayed puberty, » poor school attendance, » skin or genital infections, and » signs of vascular compromise.
Low blood glucose	Few, mild. No severe hypo-glycaemic episodes.	Severe hypoglycaemia (un-consciousness and/or convulsions).**	
Monitoring Biochemical assessment. Self-monitoring finger-prick glucose monitoring (mmol/L).			
AM fasting (pre-prandial)	4–6	> 8	> 9
Postprandial	5–10	10–14	> 14
Bed time	6.7–10.0	< 6.7*** or 10.0–11.0	< 4.4*** or > 11.0
Nocturnal	4.5–9.0	< 4.2*** or > 9.0	< 4*** or > 11
HbA1c	6.5–7.5	7.5–9.0	> 9

* In situations with polyuria, polydipsia and enuresis, adjust the doses of the insulin upwards. Dose adjustments should usually not be greater than 10% of the daily dose at any one time.
** Identify and address the specific reasons for hypoglycaemia, e.g. skipping meals or snacks. In specific situations where the lifestyle cannot be modified or there are recurrent episodes of severe hypoglycaemia, consider referral to a tertiary centre.

*** Consider hypoglycaemia unawareness in situations where there are consistently low readings and the patient does not report symptoms.

» Hypoglycaemia unawareness is dangerous. The insulin dose may need to be adjusted downwards if more than 30% of the readings during a single week are below the target values indicated.

Urine ketone testing

» Test urine for ketones in the following circumstances:
  > if vomiting occurs,
  > any time the blood glucose > 15 mmol/L, especially if the child is unwell and particularly if the blood glucose has been high for more than 24 hours,
  > if unusual drowsiness is present,
  > in the presence of high temperature, vomiting or diarrhoea, even when the glucose is < 15 mmol/L,
  > if abdominal pains occur, and
  > if the breathing is deep and rapid or smells of acetone.

MEDICINE TREATMENT

Insulin therapy

Principles of insulin therapy:

» To provide sufficient insulin throughout the 24-hour period to cover basal requirements.
» To deliver boluses of insulin in an attempt to match the glycaemic effect of meals.
» The most suitable areas for insulin injection are:
  > the upper, outer area of the arms,
  > the front and side of the thigh,
  > the upper, outer surface of the buttocks; and
  > the abdomen, except the area close to the navel.
» Establish a pattern for injecting, i.e. horizontally or vertically. Vary the site of injection according to this pattern. When the area has been fully covered move to another area.
» Patients doing strenuous exercise should not inject into their legs.

Insulin injection technique

Pinching the skin to give an insulin injection. A small pinch with the finger and thumb is enough.

» Insulin injection by syringe is usually given into deep subcutaneous tissue through a two-finger pinch of skin at an angle of 45–90 degrees.
» The subcutaneous fat layer should be thicker than the needle length.
» There is significant risk of accidental intramuscular injections with more rapid absorption, especially in lean individuals. This can be minimised by using a two-finger pinch technique, an injection angle of 90 degrees and use of 5 mm needles rather than longer needles in all ages.
» Withdraw the needle and release the skin fold on the count of ten.
» Disinfection of the skin is not necessary prior to insulin injections, however, injections should be given through clean, healthy skin.
» Needles should not be used for more than 6 injections.
» Prefilled insulin syringes are recommended for children. Pen devices delivering less than 1 unit should be available for selected patients.
» Thoroughly mix all insulin suspensions before injection by rolling or inverting the vial ten times so that the cloudy suspension mixes thoroughly and uniformly.

Duration of action of standard insulins

Insulin	Onset of action	Peak action	Effective duration
Regular/short-acting	30–60 minutes	2–4 hours	5–8 hours
Intermediate-acting	2–4 hours	4–12 hours	12–20 hours

Choice of insulin regimen

» No insulin injection regimen satisfactorily mimics normal physiology. The choice of insulin regimen should be individualised and will depend on age, duration of diabetes, lifestyle (dietary patterns, exercise schedules, school, work commitments, etc.), targets of glycaemic control, and particularly, individual patient/family preferences.

» The choice of an insulin regimen is determined by the patient's circumstances. Depending on the patient's scope to undertake insulin therapy, a number of alternatives will allow insulin therapy to be tailored to their lifestyle. Discussion with parents should provide the basis for such important decisions.
» It is not possible to prescribe a single best regimen for preschool and primary school children. Individualise the choice of regimen according to family circumstances.
» Multiple daily injections provide for the best glycaemic control in young people with type 1 diabetes. If manageable, the basal-bolus regimen should be the regimen of choice. A twice daily injection regimen is not recommended, but 3 injections a day is a good alternative.

Questions to be considered when choosing a regimen

What scope does the patient have for insulin therapy?

» Will the patient be able to undertake, financially and culturally, an advanced insulin regimen if necessary?
» Is a responsible person available to give insulin injections at all times of the day or only at certain times?
» How goal-orientated is the patient/caregiver in terms of diabetes control?

What is the patient's eating pattern?

» What is the typical pattern of meals?
» What type of food do they typically eat at each meal, and how much?
» Is their eating pattern relatively constant, or does it vary?
» Can and will they change their eating habits?

All chosen insulin regimens should be supported by comprehensive education appropriate for the age, maturity and individual needs of the child and family.

Selecting an insulin regimen

Total daily insulin dose

This is individualised and varies according to age, puberty development, stress and individual variability. The usual range is 0.5–1 units/kg/day, but may be higher or lower.

The aim is to select a regimen that allows the achievement of glycaemic control without disabling hypoglycaemia. This also requires a comprehensive support programme for the child and family enabling the implementation of an appropriate diet and other care strategies. These include home blood glucose monitoring and the ability to recognise and manage hypoglycaemic episodes. Where glycaemic control is not achieved despite an adequate support programme, consider referral to a tertiary centre**.**

Insulin regimens

Consult with a paediatric endocrinologist or paediatrician with experience in diabetes care. Repeated consultations are indicated when glycaemic control targets are not achieved.

Basal-bolus regimen

- Short-acting insulin 15–30 minutes before a meal or rapid-acting insulin with main meals, e.g. breakfast, lunch and main evening meal; intermediate-acting insulin before bed.
- Normally, 30–40% of the total daily dose of insulin is given at bedtime as intermediate-acting insulin. The remaining insulin is given prior to breakfast, lunch and evening meal in the form of short-acting insulin.

Basal-bolus regimen Short-acting insulin is indicated in the child (especially < 5 years of age) with erratic eating habits despite adequate education.		
Breakfast	Short-acting insulin	20% of total daily dose (if able to count carbohydrates: give 1 unit per 15 g)
Lunch	Short-acting insulin	20% of total daily dose
Supper	Short-acting insulin	20% of total daily dose
At night (± 21h00)	Intermediate-acting insulin (ideally this ought to be a basal insulin acting over 24 hours)	40% of total daily dose

Three injections daily regimen

- A mixture of short- and intermediate-acting (premixed 70:30) insulin before breakfast; short-acting insulin alone before an afternoon snack or main evening meal; intermediate-acting insulin before bed; or variations of this regimen may be used at times.
- This requires that the caregiver is aware of three different insulin preparations and can differentiate between them.

Three injections daily regimen		
Breakfast	Short-acting insulin (30% of morning dose) + Intermediate-acting insulin (70% of morning dose)	$^2/_3$ of total daily dose
Supper	Short-acting insulin ($^1/_3$ of evening dose)	$^1/_3$ of total daily dose
At night (± 21h00)	Intermediate-acting insulin ($^2/_3$ of evening dose)	

None of these regimens can be optimised without frequent assessment of blood glucose monitoring.

Achieving a balance between food intake, insulin levels and energy expenditure is an essential pre-requisite for achieving glycaemic control.

Adjustment of insulin dosage for 3 injections daily regimen
The insulin dose should not be changed after a single abnormal blood glucose reading.

Adjust the dose only once a pattern has been established. The dose to be adjusted depends on the time of abnormal glucose readings, as indicated in the table below:

	Timing of the unsatisfactory blood glucose level			
	Before breakfast	**Before lunch**	**Before supper**	**At ± 21h00**
Three injections daily regimen				
Insulin dose to be **increased** if *glucose too high*	21h00 dose: intermediate-acting insulin	Breakfast dose: short-acting insulin	Breakfast dose: intermediate-acting insulin	Supper dose: short-acting insulin
Insulin dose to be **decreased** if *glucose too low*				
	Timing of the unsatisfactory blood glucose level			
	Before breakfast	**2 hours after breakfast**	**2 hours after lunch**	**At ± 21h00**
Basal-bolus regimen				
Insulin dose to be **increased** if *glucose too high*	21h00 dose: intermediate-acting insulin	Breakfast dose: rapid (or short-acting) insulin	Lunch dose: rapid (or short-acting) insulin	Supper dose: Rapid-acting (or short-acting) insulin
Insulin dose to be **decreased** if *glucose too low*				

REFERRAL

» Management of all children with diabetes should be supervised by a paediatrician with experience in managing diabetes in the young and should involve a multidisciplinary team, i.e. paediatrician, dietician, nurse educator, psychologist, ophthalmologist at a regional hospital.
» Complications.
» Uncontrolled diabetics, such as children with unpredictable blood glucose control, nocturnal or frequent hypoglycaemic events or children who do not reach their therapeutic goals for consideration of analogue insulin.
» Periodic screening of eyes by an ophthalmologist:
  > prepubertal onset of diabetes: 5 years after onset and annually thereafter;
  > pubertal onset of diabetes: 2 years after onset and annually thereafter.

7.5.1.1 GUIDELINES FOR MANAGEMENT OF DIABETICS ON SICK DAYS

DESCRIPTION

Illness associated with fever tends to raise blood glucose because of higher levels of stress hormones, gluconeogenesis and insulin resistance.

Illness associated with vomiting and/or diarrhoea may lower blood glucose, with the possibility of hypoglycaemia and the development of starvation ketones.

DIAGNOSTIC CRITERIA

» Unstable blood glucose measurements because of illness, stress or starvation.
» Increased insulin requirements are induced by a catabolic state and stress.
» Ketonuria may indicate the following:
  > In the presence of hyperglycaemia, it is indicative of severe insulin deficiency and calls for urgent therapy to prevent progression into ketoacidosis.
  > In the presence of low blood glucose levels, it is indicative of a starvation state or is the result of a counter-regulatory response to hypoglycaemia.

GENERAL AND SUPPORTIVE MEASURES

» Monitor glucose more frequently.
» Test urine for ketones.
» Ensure adequate intake of calories and fluids on sick days to prevent ketogenesis. If insufficient calories are consumed, ketones will appear in

the urine without hyperglycaemia. In this circumstance encourage the patient to eat whatever he/she feels like.

» Treat the underlying intercurrent illness.

» Special circumstances:

> Gastroenteritis:
If hypoglycaemia occurs especially with gastroenteritis, and there is mild ketonuria, ensure that the child takes regular frequent amounts of carbohydrate, using oral rehydration solution or intravenous fluids.

> Loss of appetite:
Replace meals with easily digestible food and sugar-containing fluids.

> Vomiting:
If the patient has difficulty eating or keeping food down and the blood glucose is < 10 mmol/L, encourage the patient to take sugar-containing liquids. Give small volumes. Some glucose will be absorbed. If there is no vomiting, increase the amount of liquid.

MEDICINE TREATMENT

Insulin therapy

Insulin must be given every day. Insulin injections should not be omitted because of sickness and/or vomiting. If vomiting occurs, IV fluids may be needed to avoid hypoglycaemia.

During an infection, the daily requirement of insulin may rise by up to 25%.

Generally, the body will require more energy during illness. Insulin allows more glucose to enter the cells, providing more energy to fight infection.

General guidelines when giving extra insulin:

» If the blood glucose is > 14 mmol/L and capillary beta-hydroxybutyrate ≥ 1.5 mmol/L or if ketones > 1+ in the urine, the patient must seek urgent medical attention.

» If no ketonaemia/ketonuria:

> Blood glucose 14–22 mmol/L: Add 5% of total daily dose (TDD) of insulin or 0.05 u/kg to ordinary bolus.

> Blood glucose > 22 mmol/L: Add 10% of TDD of insulin or 0.1 u/kg to ordinary bolus; drink sugar-free fluids.

Check blood glucose and ketones every 2 hours; repeat additional insulin if needed every 2–4 hours.

Extra fluids

In addition to taking extra insulin, extra sugar-free fluids are important to prevent dehydration. If blood glucose < 10 mmol/L (if intake is poor), sugar-containing fluid should be given (to prevent ketosis).

REFERRAL

» In a child with inter-current illness, **urgent** specialist medical or nursing advice must be obtained when:
  > the patient is unable to carry out the advice regarding sick days,
  > the diagnosis is unclear,
  > vomiting is persistent, particularly in young children,
  > blood glucose continues to rise despite increased insulin,
  > hypoglycaemia is severe,
  > ketonuria is heavy or persistent, and
  > the child is becoming exhausted, is confused, hyperventilating, dehydrated or has severe abdominal pain.

7.5.2 DIABETES MELLITUS, INSULIN DEPENDENT: ACUTE COMPLICATIONS

E10

7.5.2.1 CEREBRAL OEDEMA IN DIABETIC KETOACIDOSIS (DKA)

G93.6

DESCRIPTION

A condition of brain swelling during the course of treatment for DKA.

Cerebral oedema usually occurs 4–12 hours after the initiation of treatment, but may be present at the time of diagnosis. It often follows an initial period of clinical and biochemical improvement.

Cerebral oedema causes significant neurological morbidity and has a mortality of approximately 80%.

The cause of cerebral oedema during treatment remains unclear. However, very rapid reduction in intravascular osmolality may aggravate the process. Therefore, rehydration should occur more slowly in children with DKA than in other causes of dehydration.

DIAGNOSTIC CRITERIA

Clinical

» Signs and symptoms of cerebral oedema include:
  > headache,
  > confusion,
  > irritability and restlessness,
  > reduced consciousness,
  > papilloedema (late sign),
  > hypoxaemia, and
  > specific neurological signs and raised intracranial pressure.

» The risk of cerebral oedema is increased if urea levels are increased or if the PCO_2 is persistently low, i.e. < 20 mmHg (2.7 kPa).

GENERAL AND SUPPORTIVE MEASURES

» Admit to ICU, if possible, or to a centre experienced with managing this condition.
» Restrict intravenous fluids to ⅔ maintenance and replace deficit over 72 hours rather than 48 hours pending ICU admission.
» Elevate the head of the bed.
» Exclude hypoglycaemia.
» Do not use bicarbonate.
» Exclude thrombosis, intracranial haemorrhage or infection.
» Do not delay treatment while waiting for a CT scan to confirm cerebral oedema.

MEDICINE TREATMENT

For the management of cerebral oedema, see Chapter 13: The Nervous System, section 13.3: Status Epilepticus (convulsive), cerebral oedema.

7.5.2.2 DIABETIC KETOACIDOSIS

E10.1

DESCRIPTION

Diabetic ketoacidosis (DKA) occurs with relative or absolute insulin deficiency, either caused by non-adherence to insulin regimens or by excessive secretion of counter-regulatory hormones during stress, e.g. infection, trauma and surgery.

DIAGNOSTIC CRITERIA

» Heavy glycosuria (3+ or more).
» Hyperglycaemia, i.e. blood glucose > 11 mmol/L, ketonuria 2+.
» Blood gas: pH < 7.3, bicarbonate < 15 mmol/L.
» Polyuria, polydipsia and dehydration.
» Kussmaul respiration, nausea, vomiting, abdominal pain and depressed level of consciousness are all late signs.

Note:
In rare cases, blood glucose is not elevated.
Children with mild dehydration and not clinically unwell usually tolerate oral rehydration and subcutaneous insulin.
See section 7.5.1.1: Guidelines for management of diabetics on sick days.

GENERAL AND SUPPORTIVE MEASURES

» Admit all children and adolescents to an ICU or ward experienced in the management of DKA in children and adolescents, if possible.
» Ensure a patent airway.
» If the child is comatosed, secure the airway and insert a urinary catheter.

» If comatosed or has recurrent vomiting, insert an oro-/nasogastric tube and apply free drainage.

MEDICINE TREATMENT

Seek specialist advice early in the management.

If hypoxaemic:

- Oxygen via facemask.

The objectives of fluid and sodium replacement therapy in diabetic ketoacidosis are:

» To restore circulating volume.
» To replace sodium and water deficits from extracellular and intracellular compartments.
» To restore glomerular filtration rate to enhance clearance of glucose and ketones from the blood.
» To reduce the risk of cerebral oedema.

Fluids

a: Fluids for resuscitation in shock:

- Sodium chloride 0.9%, IV, 10–20 mL/kg over 10–30 minutes.
  - Repeat if shock persists.

b: Fluid requirements after resuscitation:

Maintenance (over 24 hrs)

≤ 10 kg	100 ml/kg/24 hrs
11–20 kg	1000 ml + 50 ml/kg/24 hrs for each kg from 11–20 kg
> 20 kg	1500 ml + 20 ml/kg/24 hrs for each kg > 20 kg

Obese children: Use ideal body weight for height.

+

Rehydration (over 48 hours)

5% dehydrated	50 ml/kg/48 hrs
10% dehydrated	100 ml/kg/48 hrs

Review at least 2 hourly.

+/-

Ongoing losses

Replace urine loss in excess of 2 ml/kg/hour	= urine output (in ml/kg/hr) - 2 ml/kg/hr

Review at least 2 hourly**.**

Examples of fluid volumes for the **subsequent phase** of rehydration (i.e. maintenance + 5% of body weight/24 hours).

Body weight (kg)	Maintenance (mL/24 hour)	Maintenance + 5% of body weight (mL/24 hrs)	Maintenance + 5% of body weight (mL/hour)
4	325	530	22
5	405	650	27
6	485	790	33
7	570	920	38
8	640	1040	43
9	710	1160	48
10	780	1280	53
11	840	1390	58
12	890	1490	62
13	940	1590	66
14	990	1690	70
15	1030	1780	74
16	1070	1870	78
17	1120	1970	82
18	1150	2050	85
19	1190	2140	89
20	1230	2230	93
22	1300	2400	100
24	1360	2560	107
26	1430	2730	114
28	1490	2890	120
30	1560	3060	128
32	1620	3220	134
34	1680	3360	140
36	1730	3460	144
38	1790	3580	149
40	1850	3700	154
45	1980	3960	165
50	2100	4200	175
55	2210	4420	184
60	2320	4640	193
65	2410	4820	201
70	2500	5000	208
75	2590	5180	216
80	2690	5380	224

Note: Sodium chloride 0.9% is preferred for resuscitation and the initial phase of rehydration. However, to prevent the occurrence of hyperchloraemic acidosis switch to sodium chloride 0.45%/dextrose 5% after blood glucose has fallen to 12 mmol/L or less. Monitor sodium and chloride (on VBG) 4–6 hourly and adjust maintenance fluids as necessary.

Note: One of the danger signals for cerebral oedema is a precipitous drop in the serum sodium level.

Bicarbonate

Bicarbonate use is associated with increased risk of cerebral oedema. It should not be used routinely to improve acidosis.

Caution
Consult a specialist before administering any bicarbonate solution.

Potassium

Commence potassium replacement immediately unless patient has anuria. If the serum potassium is high, start replacement after the patient has passed urine.

Early addition of potassium in the fluid regimen (KCl 15% 20 mL in 1 L = 40 mmol/L) is essential even if the serum concentration is normal as insulin will drive glucose and potassium into the cells.

DKA protocol:

Two-bag system – Alternative fluid and electrolyte treatment

Under supervision of a specialist.

The two-bag system consists of 2 bags of identical electrolyte content but different dextrose concentrations, 0% and 10%, administered simultaneously into a single IV line. Variations in dextrose delivery are achieved through changing the proportions of the 2 bags contributing to the total rate, which is determined by the degree of dehydration.

- Sodium chloride 0.9%, IV, 10–20 mL/kg.
  - May be repeated if necessary.
  - Then switch to the two-bag system.

LoE II [2,3]

Bag 1 (dextrose 0%)	Bag 2 (dextrose 10%)
• Sodium chloride 0.45%, 1 L **PLUS** • Potassium chloride, 20 mL	• Dextrose 10%, 1 L **PLUS** • Sodium chloride 5%, 90 mL **PLUS** • Potassium chloride, 20 mL

Run these two riders for easy titration of dextrose from dextrose 10% to dextrose 0%:

Fluid	Blood glucose > 15 mmol/L	Blood glucose 10–15 mmol/L	Blood glucose < 10 mmol/L
Bag 1	100%	50%	0%
Bag 2	0%	50%	100%

Insulin

- Insulin, short-acting, 0.05–0.1 units/kg/hour as a continuous IV infusion.

- Add insulin, 50 units (0.5 mL) to 50 mL sodium chloride 0.9% in a syringe pump to get a solution of 1 unit/mL.
- Use a separate cannula and line for insulin administration.
- Do not add insulin to the fluid bag administering maintenance and rehydration fluids.

If the rate of blood glucose fall exceeds 5 mmol/L/hour or the blood glucose falls to 17 mmol/L:

- Add a dextrose-containing fluid.
- Do not stop the insulin infusion while dextrose is being infused.

If the blood glucose falls below 5 mmol/L:

- Give a bolus of 2 mL/kg of dextrose 10% and increase the concentration of dextrose in the infusion.

Continue with IV insulin until:

- the base deficit is < 5 or bicarbonate is ≥ 15 mmol/L,
- there is no ketonuria, and
- the blood glucose is ≤ 10 mmol/L.

Alternative to insulin infusion

Where there are no facilities for insulin infusion, e.g. no syringe pumps, staff constraints, etc.:

- Insulin, short-acting, IV, 0.1 units/kg, hourly.

Changing from intravenous to subcutaneous insulin

Continue with intravenous fluids until the child is drinking well and able to tolerate snacks. When oral fluids are tolerated, reduce intravenous fluids. Subcutaneous insulin can be started once the child is well hydrated and able to tolerate a normal diet.

The most convenient time to change to subcutaneous insulin is just before a meal. Administer the first dose of subcutaneous insulin 30 minutes before the meal and continue with the insulin infusion for 90 minutes after the subcutaneous injection to prevent rebound hyperglycaemia.

In newly diagnosed diabetics, basal-bolus regimen is started as described in section 7.5.1: Type 1 Diabetes Mellitus – Insulin regimens, in a low range dose:

- Prepubertal children: 0.7 units/kg.
- Pubertal children: 1 unit/kg.

In established diabetics, give maintenance insulin.

Give supplemental subcutaneous short-acting insulin before meals if the blood glucose > 11 mmol/L:

Blood glucose (mmol/L)	Short-acting insulin (units/kg/dose)
11–12	0.06
13–16	0.09
16	0.12

REFERRAL

» No improvement.
» Deterioration of condition, i.e.:
  > pH < 7.1,
  > hyperventilation,
  > shock,
  > depressed level of consciousness,
  > persistent vomiting, and
  > age < 5 years.
» Rising blood glucose.

7.5.2.3 HYPOGLYCAEMIA IN DIABETICS

E16.0

DESCRIPTION

Autonomic symptoms (hunger, nausea, anxiety, pallor, palpitations, sweating, trembling) usually precede neuroglycopaenic symptoms (impaired thinking, change of mood, irritability, dizziness, headache, tiredness, confusion, and later convulsions and coma). Patients with frequent hypoglycaemic episodes develop hypoglycaemia unawareness, where the symptoms above do not occur despite a dangerously low blood glucose level.

Causes of hypoglycaemia include:
» A missed or delayed snack or meal.
» Exercise without appropriate dietary preparation.
» Alcohol.
» Overdose of insulin.
» Impaired food absorption, e.g. gastroenteritis.
» Addison's disease. Recurrent hypoglycaemia may necessitate investigation for this condition.
» Coeliac disease.

Nocturnal hypoglycaemia

Nightmares and headaches may be suggestive of nocturnal hypoglycaemia. Blood glucose concentrations fall to their lowest levels between 02h00 and 04h00.

DIAGNOSTIC CRITERIA

» Blood glucose < 3.5–4.0 mmol/L with symptoms in a known diabetic patient. Good glycaemic control is likely to be associated with occasional hypoglycaemic episodes.
» Grading of severity:
  Mild (Grade 1)
  > Child or adolescent is aware of, responds to and self-treats the hypoglycaemia.

> Children < 6 years of age can rarely be classified as grade 1 because they are unable to help themselves.

Moderate (Grade 2)

> Child or adolescent cannot respond to hypoglycaemia and requires help from someone else, but oral treatment is successful.

Severe (Grade 3)

> Child or adolescent is semiconscious or unconscious with or without convulsions and may require parenteral therapy with glucagon or intravenous glucose.

GENERAL AND SUPPORTIVE MEASURES

» Determine the underlying cause.
» Patient education on diabetes and its complications.

MEDICINE TREATMENT

Mild or moderate hypoglycaemia

Immediate oral, rapidly absorbed, simple carbohydrate, e.g.:

- Glucose, oral, 5–15 g or 1–3 level teaspoons of sugar (depending on the child's age) in a small amount of water.
  - Wait 10–15 minutes.
  - If blood glucose has not risen by 3–4 mmol/L, repeat above.
  - As symptoms improve, the next meal or oral complex carbohydrate should be ingested, e.g. fruit, bread, cereal, milk, etc.

Severe hypoglycaemia

Outside hospital

- Glucagon, IM/SC.
  - If < 12 years of age: 0.5 mg.
  - If > 12 years of age: 1.0 mg.

If glucagon is not available:
A teaspoon of sugar moistened with water placed under the tongue every 20 minutes until patient awakes.

LoE II[4]

In hospital

If there is an unsatisfactory response or inability to take oral carbohydrate and signs of disorientation, stupor, convulsions or coma:

- Dextrose 10%, IV, 2–5 mL/kg.
  - Dilute dextrose 50% solution to 10% strength before use, i.e. dextrose 50% 1 mL + water for injection 4 mL = 5 mL 10% dextrose solution.

If IV dextrose cannot be given:

- Glucagon, IM/SC.
  - If < 12 years of age: 0.5 mg.
  - If > 12 years of age: 1.0 mg.

Monitor blood glucose every 15 minutes until stable, then repeat 1–2 hourly. Keep blood glucose between 6 and 8 mmol/L.

REFERRAL

» Recurrent episodes of hypoglycaemia.

7.5.2.4 DIABETIC NEPHROPATHY

E10.21

DIAGNOSTIC CRITERIA

» Persistent micro-albuminuria:
  > Three specimens over a 3–6 month period all show increased albumin:creatinine ratio on a spot urine:
    - males: > 2.5 mg/mmol,
    - females: > 3.5 mg/mmol.

» Screening for micro-albuminuria should start from:
  > Prepubertal children: 5 years post diabetes diagnosis.
  > Pubertal children: 2 years post diabetes diagnosis.

GENERAL AND SUPPORTIVE MEASURES

» Optimise diabetes control.
» Monitor blood pressure.

MEDICINE TREATMENT

If urinary albumin:creatinine ratio is persistently above reference range for sex:

- ACE inhibitor, e.g.:
  - Enalapril, oral, 0.1 mg/kg/dose as a single dose or two divided doses.
  - Maximum dose: 0.5 mg/kg or 40 mg/day.

    Note: Exclude non-diabetic nephropathy.

Note: Discuss patient with an endocrinologist or nephrologist if there is a poor response to ACE inhibitor and improved glycaemic control.

7.5.2.5 DYSLIPIDAEMIA

E78.9

DESCRIPTION

Dyslipidaemia is a broad term used to describe disorders of lipid metabolism that may be classified according to the Frederickson classification.

Phenotype	Elevated particles	Lipid increased	Frequency
I	Chylomicron	TG	Rare
IIA	LDL	LDL-C	Common
IIB	LDL and VLDL	LDL-C, TG	Common
III	IDL	TC, TG	Rare
IV	VLDL	TG	Common
V	Chylomicron and VLDL	TG	Uncommon

The three common types of dyslipidaemia are important because they are associated with an increased risk of cardiovascular disease due to atherosclerosis.

DIAGNOSTIC CRITERIA

Children with severe hypercholesterolaemia may present with xanthomas or myocardial infarction but most children with hypercholesterolaemia will be asymptomatic in childhood.

Children should be screened for dyslipidaemia if any of the following are present:

» Family history of premature cardiac disease or dyslipidaemia.
  > Children should be screened from 8 years. Children should be screened earlier than 8 years if homozygous familial hypercholesterolaemia is suspected.
» A medical condition associated with dyslipidaemia: diabetes mellitus, nephrotic syndrome, liver disease, obesity.

INVESTIGATIONS

» Exclude causes of secondary hyperlipidaemia.
» In most cases, non-fasting total cholesterol is determined in children at risk.
  If the level is higher than the upper limit, a lipid profile is done after 12 hours of fasting.
  > Upper limit of serum cholesterol and triglycerides: Total cholesterol 5.2 mmol/L.
  > Triglycerides (after 12 hours of fasting):
    - influenced by lifestyle – needs attention if > 1.68 mmol/L,
    - pancreatitis risk if > 10 mmol/L.

GENERAL AND SUPPORTIVE MEASURES

Manage secondary causes of hyperlipidaemia according to guidelines.
Schedule for integrated cardiovascular health promotion in children:

» **Obesity**
  > See Chapter 7: Endocrine System, section 7.15: Obesity.

» **Blood pressure**
  > With a family history of hypertension < 55 years of age: routine BP measurement from 3 years of age, once a year.
  > If BP ≥ 95th percentile for sex, age, and height percentile, follow-up and investigate if persistently elevated.
» **Diet**
  > Refer to a dietician.
  > Learning healthy eating habits is an important preventative measure.
  > Moderate salt intake.
» **Physical activity**
  > Encourage active child-parent play.
  > Limit child's sedentary behaviour such as time watching television and playing video computer games to a maximum of 2 hours per day or 14 hours per week.
  > Children should not be allowed to eat while watching television, i.e. no 'grazing'.
  > Organised sport 5 times per week for at least 20–30 minute periods.
» **Smoking**
  > Encourage members of the household who smoke to stop.

MEDICINE TREATMENT

Consider medicine treatment only after failure of general and supportive measures to lower the cholesterol over 6–12 months.
Children should be at least 8 years of age for consideration of pharmacological intervention.
If LDL-C remains above 4.1 mmol/L in children with 2 or more risk factors, or above 4.9 mmol/L regardless of the presence of risk factors, refer to a paediatric specialist for consideration of statins:
Risk factors: smoking, hypertension, BMI ≥ 95th percentile (Z-score ≥ +1.96), HDL-C < 1 mmol/L, diabetes mellitus, renal disease, male sex.

- Statins, e.g.:
  - Simvastatin, oral, 10 mg at night.

Secondary hypercholesterolaemia due to nephrotic syndrome
See Chapter 6: Nephrological/Urological Disorders, section 6.3: Nephrotic syndrome.

REFERRAL

» Children with homozygous familial hypercholesterolaemia.
» Children under 10 years of age with dyslipidaemia unresponsive to appropriate lifestyle interventions.
» Children with inadequate response to statins.

7.5.3 DIABETES MELLITUS IN ADOLESCENTS

E10

DESCRIPTION

Adolescence is the period between 10 and 19 years of age. The adolescent and the transition should be managed with special planning, i.e.:

» the admission policy of the hospital,
» observing the wishes of the adolescent,
» emotional and physical maturity considerations, and
» the presence of any co-existing medical, surgical or psychiatric disorder that may be more appropriately managed in the paediatric service.

Aggression and agitation may be features of poorly controlled diabetes.

GENERAL AND SUPPORTIVE MEASURES

Promote:

» normal growth and pubertal development,
» psychological development,
» maintenance of glycaemic control and adherence,
» avoidance of risk-taking behaviours (smoking, substance abuse), and
» sex education.

Adolescents with diabetes may have concomitant behavioural and psychiatric disorders. Anxiety disorders are common in adolescents and should be differentiated from hypoglycaemic and hyperglycaemic episodes.

MEDICINE TREATMENT

Failure of current insulin regimens may be attributed to the endocrine changes of puberty which results in poor glycaemic control.
Insulin resistance occurs during puberty, being maximal in late puberty.
Other causes of poor glycaemic control include family dynamics (e.g. resistance to parental supervision), emotional lability and risk-taking behaviour (e.g. intentionally neglecting to inject and substance abuse).

Normal insulin requirements during puberty:

- 1.0–1.4 units/kg/day.

This may occasionally be higher (up to 2.0 units/kg/day), but as a general rule, a higher requirement generally necessitates the search for non-adherence and poor absorption through injections in lipohypertrophy sites.

After puberty, the insulin requirements fall to prepubertal levels.
Failure to reduce insulin requirements in the late adolescent stages may result in excessive weight gain.

7.5.4 DIABETES MELLITUS, TYPE 2

E11

DESCRIPTION

Type 2 diabetes develops when insulin secretion cannot meet the increased demand posed by insulin resistance. Type 2 diabetes may be associated with hyperlipidaemia, hypertension, acanthosis nigricans, ovarian hyperandrogenism and non-alcoholic fatty liver disease (features of insulin resistance).

DIAGNOSTIC CRITERIA

Clinical

» Obesity or overweight.
» Children with a strong family history of type 2 diabetes, usually in adolescents with BMI > 95th centile without auto-antibodies to islet cells and normal serum C-peptide levels.
» Ketoacidosis is unusual in type 2 diabetes.
» A fasting plasma glucose > 7.0 mmol/L.
» Type 2 diabetics may have minimal symptoms or signs for months or even years before the diagnosis.

Investigations

To confirm diagnosis:

» Symptoms of diabetes.

PLUS

» Fasting plasma glucose > 7.0 mmol/L.

OR

» Random plasma glucose > 11.0 mmol/L.

OR

» No symptoms, but an abnormal 2-hour serum glucose level on the oral glucose tolerance test:
  > Ingestion of 1.75 g/kg (maximum 75 g) of glucose dissolved in water.
  > Serum glucose > 11.0 mmol/L 2 hours post ingestion of oral glucose.

GENERAL AND SUPPORTIVE MEASURES

» Lifestyle modification:
  Manage patients who are not ill at diagnosis initially with advice on nutrition and exercise, but most will eventually require medicine therapy.
» Education on routine blood glucose monitoring. A logbook with all blood glucose readings should be kept. In most cases, fasting, pre-breakfast measurement and a 2-hour postprandial dinner measurement are sufficient.
» Initial medicine treatment is determined by symptoms, severity of hyperglycaemia and presence of ketosis. This should be decided in consultation with a specialist who is experienced in treating these children.

MEDICINE TREATMENT
Refer for initiation of therapy.

7.6 HYPOGLYCAEMIA IN CHILDREN
E16.2

DESCRIPTION
Infants and small children have relatively limited glycogen stores with larger brain/body ratios than adults and are, therefore, at greater risk of hypoglycaemia during starvation.

The causes of hypoglycaemia (outside the neonatal period) include:

- » hypopituitarism,
- » growth hormone deficiency,
- » hyper-insulinaemia,
- » malnutrition,
- » liver dysfunction,
- » severe illness with poor intake,
- » accelerated starvation (ketotic hypoglycaemia),
- » medicine, e.g. insulin, alcohol, aspirin, beta-blockers, oral hypoglycaemic agents, quinine.
- » adrenal insufficiency,
- » hypothyroidism,
- » inborn errors of metabolism,
- » sepsis,
- » malaria,

DIAGNOSTIC CRITERIA
Clinical
- » Acute autonomic symptoms: hunger, nausea, anxiety, pallor, palpitations, sweating, trembling.
- » Neuroglycopaenic symptoms: impaired thinking, change of mood, irritability, dizziness, headache, tiredness, confusion, and later, convulsions and coma.
- » Patients are often asymptomatic, especially younger children, who may be completely asymptomatic or present only with a behaviour change.

Investigations
- » Serum glucose concentration < 2.6 mmol/L.
- » Hypoglycaemia is a clinical emergency requiring prompt therapy. However, if possible, draw a blood sample for investigation prior to the administration of glucose. Collect 5 mL of blood in a plain tube at the earliest opportunity and send for separation and storage of plasma at –20°C. Such samples may provide clear biochemical evidence of the cause of the hypoglycaemic episode thus avoiding having to subject the child to further investigations.

MEDICINE TREATMENT
After collection of initial blood samples:

- Dextrose 10%, IV, 2–5 mL/kg.
  - Dilute dextrose 50% solution before use to 10% strength.

(1 mL/kg of dextrose 50% plus 4 mL/kg of water for injection, gives 10% dextrose solution).

Stabilisation

- Sodium chloride 0.9%/dextrose 5%.
- Increasing the dextrose concentration in the fluid to 7.5% or 10% may be necessary:
  - To increase from 5% to 10% dextrose concentration in 1 L of fluid, add 100 mL 50% dextrose water.
  - 10 mL 50% DW increases dextrose concentration of 100 mL of fluid by 5%.

For persistent hypoglycaemia consider the underlying cause, e.g. hyper-insulinism or adrenal insufficiency (see section 7.3: Adrenal insufficiency, acute.). For persistent hypoglycaemia in the neonate, see Chapter 19: Prematurity and Neonatal Conditions. An inappropriately high insulin or C-peptide level at the time of the confirmed hypoglycaemia is also strongly suggestive of hyper-insulinism.

If hyper-insulinism is suspected, administer:

- Glucagon, IM/SC.
  - If < 12 years of age: 0.5 mg.
  - If > 12 years of age: 1.0 mg.

OR

- Diazoxide, orally, 5 mg/kg/day in three divided doses; may increase to 15 mg/kg/day.

LoE III[5,6,7]

Ongoing treatment

Intravenous fluid therapy as needed.
Start oral feeds as soon as possible.

REFERRAL

» All patients with confirmed hypoglycaemia not explained by intercurrent illness or drugs.
» All neonates with persisting or recurrent hypoglycaemia.
» Suspected hyper-insulinism.

7.7 GROWTH DISORDERS

R62

DESCRIPTION

Pathological growth failure may be suspected if a child is short relative to his/her peers and, his/her parents and possibly disproportionate to his/her weight. It is confirmed by a reduced growth velocity. This could be due to endocrine causes, chronic or bone disease or dysmorphic syndromes.

Idiopathic short stature may be due to constitutional delay in growth and puberty or familial short stature. Constitutional delay in growth is defined by short stature with a disproportionately short trunk and a bone age that is significantly delayed relative to chronological age. Familial short stature is determined by genetic potential and a bone age equivalent to chronological age. Both have a normal growth velocity.

DIAGNOSTIC CRITERIA

» Measure and plot the child's height and weight on growth charts. Routine monitoring of height and weight for growth assists in timely diagnosis and treatment, and thus ensures maximum benefit.
» A child is regarded as short if his/her height-for-age Z-score is below –2 for age and sex.
» To further evaluate short stature, assess parental height. Target height:
  > for a boy = (father's height + (mother's height + 13 cm)) ÷ 2; range 10 cm above and below target height.
  > for a girl = ((father's height – 13 cm) + mother's height) ÷ 2; range 9 cm above and below target height.
» If the child's predicted final height is below the target height range, monitor growth velocity over 6 months to 1 year.
» If the child's height-for-age Z-score is below –3, refer immediately.
» Growth failure occurs when the child's height deviates further from Z-score of –2 over a period of 1 year or the growth velocity is below 25th percentile for gender and age.

GENERAL AND SUPPORTIVE MEASURES

» Identify and manage non-endocrine causes of stunted growth, e.g.:
  > intra-uterine growth retardation,
  > chronic disease,
  > psychosocial deprivation, and
  > skeletal dysplasia and other dysmorphic syndromes.

REFERRAL

» Height-for-age Z-score below –3.
» Height 10 cm or more below target height.
» Growth failure (height deviates further from Z-score of –2 over a period of 1 year) or the growth velocity is below 25th percentile for gender and age.
» Suspected endocrine causes as suggested by a child who is short with a normal or high BMI.
» A dysmorphic child with an unidentified syndrome.
» Untreated chronic disease.

7.8 HYPOCALCAEMIA IN CHILDREN

E83.5

DESCRIPTION

The main causes of hypocalcaemia in children are:

» vitamin D deficiency,
» calcium deficiency,
» magnesium deficiency,
» reduced parathyroid hormone production or resistance,
» impaired renal function, and
» hyperventilation.

DIAGNOSTIC CRITERIA

Clinical

» Signs and symptoms of tetany include:
  > paraesthesia,
  > cramps,
  > carpopedal spasm,
  > laryngospasm,
  > positive Chvostek's sign,
  > positive Trousseau's sign,
  > weakness,
  > lethargy,
  > prolonged QT interval on the ECG.

Investigations

» Blood levels to establish cause:
  > calcium,
  > albumin,
  > phosphate,
  > magnesium,
  > ALP,
  > 25-hydroxyvitamin D.

MEDICINE TREATMENT

Acute hypocalcaemia

- Calcium gluconate 10%, IV, 1–2 mL/kg administered over 5–10 minutes, 6–8 hourly.
  - Maximum dose: 10 mL.
  - ECG monitoring is advised.

If hypomagnesaemic:

- Magnesium sulphate 50%, IV/IM, 0.2 mL/kg every 12–24 hours.

Chronic therapy

Long-term therapy depends on the cause.

Manage hypophosphataemia or hyperphosphataemia, depending on the cause of hypocalcaemia, before long-term calcium is initiated.

- Calcium, elemental, oral, 45–65 mg/kg/day until a normal calcium level is achieved (given with meals).
  - Maintenance dose: 30 mg/kg/day.

If vitamin D deficient:

- Vitamin D, oral:

Under 6 months	2500 IU/day
6 months–12 years	5000 IU/day
12–18 years	10 000 IU/day

For hypoparathyroidism and pseudohypoparathyroidism:

- Calcitriol, oral, 0.01–0.04 mcg/kg/day.

OR

- Alfacalcidol, oral, 0.05 mcg/kg/day.
  - If < 20 kg: 0.05 mcg/kg/day.
  - If > 20 kg: 1 mcg/day.

REFERRAL

» Chronic hypocalcaemia.

7.9 HYPERKALAEMIA

E87.5

See Chapter 6: Nephrological/Urological Conditions, section 6.4: Acute kidney injury (renal failure, acute).

7.10 HYPOKALAEMIA

E87.6

DESCRIPTION

Causes include:

» prolonged decreased intake and protein energy malnutrition,
» increased renal excretion: renal tubular acidosis, amphotericin B and diuretics,
» increased extra-renal losses,
» transmembrane shifts: $ß_2$ stimulants, alkalosis; and
» mineralocorticoid excess.

DIAGNOSTIC CRITERIA

Clinical

» Cardiac arrhythmias, especially with digitalis.
» Neuromuscular dysfunction, e.g. muscle weakness.
» Renal: impairment of urine concentrating or diluting ability.

Investigations

» Serum potassium < 3.0 mmol/L.

MEDICINE TREATMENT

See Chapter 2: Alimentary Tract, section 2.2.4: Diarrhoea, acute.

Severe respiratory paralysis and or cardiac arrhythmias:

- Potassium chloride, IV, < 1 mEq/kg/hour.
  - ECG monitoring.
  - Potassium concentration should not be > 40 mmol/L/infusion.
  - Never give potassium as an IV bolus.

Less critical situations to correct potassium deficit over 2–3 days:

- Potassium chloride, oral, 2–6 mEq/kg/day.

Note: 1 g KCl = 13 mEq; 1 mL 15% KCl = 2 mmol; 1 mEq = 1 mmol.

7.11 HYPOPITUITARISM

E23.0

DESCRIPTION

Multiple or isolated deficiencies of adrenocorticoid hormone (ACTH), luteinising hormone, thyroid stimulating hormone, prolactin, and growth hormone manifesting as hypoglycaemia, abnormal body proportions and failure to grow and develop. If the posterior pituitary is involved (ADH deficiency), then this condition is known as panhypopituitarism.

The deficiency may be due to:

» congenital abnormalities with/without midline structural abnormalities of the brain,
» central nervous system tumours, e.g. craniopharyngioma, histiocytosis; and
» complications of radiation therapy.

DIAGNOSTIC CRITERIA

Clinical

» Neonates with hypopituitarism may present with:
  > persistent hypoglycaemia,
  > cholestatic jaundice (related to low cortisol), and
  > micropenis.
» Short stature with normal or high BMI.
» Polydipsia, polyuria, nocturia and enuresis in the case of panhypopituitarism.

Investigations

» Endocrine evaluation with pituitary function tests under specialist supervision.
» Confirm diagnosis in older children with stimulation tests.

MEDICINE TREATMENT

To correct hypoglycaemia:

- Hydrocortisone, IV, 2–3 mg/kg.

REFERRAL

» All patients after stabilisation of hypoglycaemia.

7.12 HYPOTHYROIDISM, CONGENITAL

E03.1

DESCRIPTION

Congenital deficiency of thyroid hormone due to:

» aplasia/hypoplasia or ectopia of the thyroid gland,
» thyroglobulin defects,
» defects in thyroid hormone biosynthesis, or
» intrauterine exposure to antithyroid medicines.

Congenital hypothyroidism is one of the common treatable causes of preventable intellectual disability in children. Congenital hypothyroidism must be treated as early as possible to avoid intellectual impairment. Symptoms and signs in neonates are unreliable, thus screening is essential for ensuring early intervention.

DIAGNOSTIC CRITERIA

Clinical

» Prolonged unconjugated hyperbilirubinaemia.
» Feeding difficulties.
» Lethargy
» Somnolence
» Abdominal distension.
» Umbilical hernia.
» Subnormal temperature.
» Periorbital oedema.
» Delayed dentition.
» Broad hands.
» Coarse, scanty hair.
» Hoarse voice and goitre.
» Oedema of the extremities and genitals.
» Bradycardia
» Anaemia
» Apnoeic episodes.
» Coarse cry.
» Constipation
» Wide open fontanelles.
» Enlarged tongue.
» Short and thick neck.
» Dry skin.
» Hypotonia.
» Delayed physical and mental development.

Investigations

» When suspected, perform a TSH test.
  > If elevated, perform a free T_4.

Delay in diagnosis and treatment is associated with irreversible neurodevelopmental damage**.**

GENERAL AND SUPPORTIVE MEASURES

» Routine screening of all newborns for congenital hypothyroidism.
» Growth and neurodevelopmental assessment.
» Regular follow-up.

MEDICINE TREATMENT

For neonates, start as soon as possible, ideally within the first three weeks after birth:

- Levothyroxine, oral, 10–15 mcg/kg as a single daily dose on an empty stomach.
  - Adjust dosage to blood levels of free T_4 (in the upper-half of the reference range) and normalise the TSH, especially in the first 3 years of life. Check TSH only 6 weeks after adjusting the thyroxine dose.
  - Continue treatment indefinitely.

REFERRAL

» All patients for confirmation of diagnosis, but initiation of therapy should not be delayed.

7.13 HYPOTHYROIDISM IN OLDER CHILDREN AND ADOLESCENTS

E03.9

DESCRIPTION

Acquired hypothyroidism in childhood and adolescents may be due to:

» auto-immune thyroiditis,
» goitrogen induced,
» iodine deficiency,
» post surgery,
» radioactive iodine,
» infiltrations,
» medicines.

DIAGNOSTIC CRITERIA

Clinical

» Low growth velocity or short stature with short limbs associated with a normal or elevated BMI.

» Subtle features with cold intolerance, dry skin, brittle hair, pallor and myxoedema.

Investigations

» Elevated TSH and low thyroxine levels.

MEDICINE TREATMENT

- Levothyroxine, oral, once daily on an empty stomach.

1–6 months	8–10 mcg/kg
6–12 months	6–8 mcg/kg
1–5 years	5–6 mcg/kg
6–12 years	4–5 mcg/kg
Over 12 years	2–3 mcg/kg

REFERRAL

» All cases for investigation and initiation of therapy.

7.14 HYPERTHYROIDISM, GRAVES DISEASE

E05.9/E05.0

DESCRIPTION

Hyperthyroidism is a pathological syndrome in which tissue is exposed to excessive amounts of circulating thyroid hormones.

The most common cause is Grave's disease, although thyroiditis may also present with thyrotoxicosis.

DIAGNOSTIC CRITERIA

Clinical

» Poor school performance.
» Warm moist hands.
» Thyromegaly
» Tremor
» Proptosis
» Fatigue
» Tachycardia
» Nervousness or anxiety.
» Weight loss.
» Palpitations
» Heat intolerance.

Investigations

» Elevated thyroxine (T_4) and suppressed TSH.

MEDICINE TREATMENT

- Carbimazole, oral, 0.5 mg/kg once daily.

AND

To block sympathetic hyperactivity:

- Atenolol, oral, 1–2 mg/kg as a single daily dose.

For children less than 10 kg:

- Propranolol, oral, 0.2–0.5 mg/kg 6–12 hourly.
  - Maximum dose: 1.5 mg/kg/dose 6–12 hourly.

REFERRAL

» All patients for confirmation of diagnosis, initiation and follow-up of therapy.

7.15 OBESITY

E66

DESCRIPTION

Most children with obesity do not have an underlying pathological cause and have so-called 'simple obesity', i.e. both weight and height are increased.

In children with pathological obesity, the height is not usually increased when compared to parental height. Causes of pathological obesity include syndromes, hypothalamic damage, endocrine abnormalities, immobility, impaired skeletal growth or medicines.

There has been a dramatic increase in the prevalence of childhood overweight and its resultant comorbidities.

DIAGNOSTIC CRITERIA

Clinical

» Measurement of weight alone is inadequate given the influence of height on weight.

» Assess severity using body mass index (BMI):

$$\text{Body mass index} = \frac{\text{weight (kg)}}{[\text{height (m)}]^2}$$

» The BMI varies with age. Use sex-specific BMI charts for accurate diagnosis. Obesity is defined by a Z-score > +2; overweight by a Z-score between +1 to + 2. Contrary to WHO teaching, the same cut-offs should be used at all ages of obesity.

» In general, obesity is likely if BMI:
> 19 kg/m^2 at age 5 years,
> 23 kg/m^2 at age 10 years, and
> 25 kg/m^2 at age 18 years.

Investigations

» Fasting glucose and lipid profile.

» ALT, AST, GGT.

GENERAL AND SUPPORTIVE MEASURES

» Weight control by:
> education about the nature of obesity and its long term consequences;

- > healthy eating, e.g. regular meal times, avoidance of excessive 'snacking', fried foods, added fats and sugars and high energy drinks while encouraging foods with high fibre content, with modest calorie restriction;
- > increasing physical activity;
- > reduce sedentary time, e.g. TV watching, computer games, videogames or time on the telephone;
- > parental guidance in managing abnormal behaviour, e.g. temper-tantrums.

» Weight loss down to an 'ideal body weight for height' is unrealistic. Prevention of further weight gain may produce significant longer-term benefits. If the patient is over 7 years, or if complications are present, aim for a weight loss of 0.5 kg/month. Ideally, target BMI should be in the overweight range.

MEDICINE TREATMENT

Look for and manage complications such as hyperlipidaemia, hypertension, sleep apnoea, slipped upper femoral epiphysis and non-alcoholic fatty liver. Insulin resistance is another important complication, and this is a key factor in the pathogenesis of metabolic syndrome. Metabolic syndrome is a cluster of cardiovascular and diabetes risk factors such as central abdominal obesity, dyslipidaemia, glucose intolerance, and hypertension (particularly common in patients on ARVs).

Refer to Chapter 4: Cardiovascular System, sections 4.10: Dyslipidaemia and 4.11: Hypertension in children; and section 7.5: Diabetes Mellitus.

REFERRAL

» All cases of pathological and morbid simple obesity (as defined by a Z-score > +3).
» Severe/progressive obesity < 2 years.
» Serious co-morbidity requiring weight loss.

7.16 DISORDERS OF PUBERTY

E30

DESCRIPTION

Abnormally early or late development of signs of puberty including the development of breasts (in girls) or enlargement of external genitalia (boys) and sexual hair growth.
Often associated with an abnormality of growth velocity.

DIAGNOSTIC CRITERIA

» Puberty begins after 9 years and usually not later than 14 years in males.

» Puberty begins after 8 years and usually not later than 13.5 years in females.
» Precocity or delay of puberty occurring outside these ages needs investigation.

Investigations
» Puberty staging.
» Radiological bone age.
» Endocrine investigation.

GENERAL AND SUPPORTIVE MEASURES
» Psychological support.
» Treat the cause, e.g. tumours.

REFERRAL
» All.

7.17 POLYCYSTIC OVARY SYNDROME
E28. 2

DESCRIPTION
Characterised by excessive androgen activity, with many having abnormal insulin activity.

DIAGNOSTIC CRITERIA
Clinical
» Hirsutism
» Acne
» Oligomenorrhoea or amenorrhoea due to chronic anovulation.
» Female pattern alopecia.
» Overweight or obese.

Investigations
» Polycystic ovaries on ultrasound.

GENERAL AND SUPPORTIVE MEASURES
» Assess and monitor for long-term health complications, including:
  > impaired glucose tolerance,
  > insulin resistance,
  > type 2 diabetes,
  > dyslipidaemia,
  > obesity,
  > fatty liver,
  > depression, and
  > infertility.

» Lifestyle changes in nutrition and exercise to reduce weight.

REFERRAL

All suspected cases for assessment and management

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CHAPTER 8

INFECTIVE/INFECTIOUS DISEASES

8.1 HELMINTHIASIS, INTESTINAL

B82.0

DESCRIPTION

Infestation of the intestine with adult worms. The following species are commonly encountered:

» *Ascaris lumbricoides* (round worm).
» *Enterobius vermicularis* (pin worm).
» *Trichuris trichiura* (whipworm).
» *Ancylostoma duodenale* and *Necator americanus* (hookworm).
» *Taenia saginatum* and *Taenia solium* (beef and pork tapeworms).

DIAGNOSTIC CRITERIA

Clinical

» Most infestations are asymptomatic and become apparent with the passage of a worm rectally or orally.
» Signs and symptoms include:
  > vague abdominal pains,
  > diarrhoea,
  > rectal prolapse,
  > protein losing enteropathy.
  > perianal itch,
  > vaginitis,
  > iron deficiency anaemia, and
» Surgical complications are secondary to mechanical obstruction in the bowel, pancreatic duct or biliary tree.
» Migration of worm larvae may cause cutaneous, pulmonary or cerebral symptoms. See Chapter 13: The Nervous System, section 13.7: Neurocysticercosis.

Investigations

» Identification of the adult worm from stool or vomitus.
» Stool microscopy (fresh sample): Recognition of the worm or identification of worm eggs or proglottids in stool.

GENERAL AND SUPPORTIVE MEASURES

Prevent infestation by:

» Hand washing.
» Careful preparation of foods by adequate washing and cooking.
» Wearing shoes (hookworm).
» Improved sanitation will protect the environment from contamination.

Deworming for all children between 12–60 months is performed 6 monthly as part of routine child health care.

MEDICINE TREATMENT

All helminths excluding *Taenia* and *Enterobius*:

Children 1–2 years of age:

- Mebendazole, oral, 100 mg 12 hourly for 3 days.

Children > 2 years:

- Mebendazole, oral, 500 mg as a single dose immediately.

Enterobius

- Mebendazole, oral, 100 mg immediately as a single dose.
  - Repeat after 2 weeks.

Taenia

- Albendazole, oral, daily for three days.
  - If 1–2 years of age: 200 mg.
  - If > 2 years of age: 400 mg.

REFERRAL

» All patients with mechanical obstruction and complications related to migration of worm larvae.

8.2 AMOEBIASIS (*ENTAMOEBA HISTOLYTICA*)

A06.9

DESCRIPTION

Amoebic colitis is caused by the parasite *Entamoeba histolytica*. It can cause localised intestinal disease or disseminated disease. Amoebiasis is now relatively uncommon in South Africa, but immunodeficiency is a risk factor.

DIAGNOSTIC CRITERIA

Clinical

» Diarrhoea with mucus, blood and pus (dysentery).
» Liver abscesses:
  > presents with point tenderness over the liver area,
  > pleuritic type pain,
  > fever (often fever of unknown origin).

Investigations (colitis):

» Trophozoites or cysts in fresh stool.
» Trophozoites in rectal smear (danger of perforation if biopsy is done).
» Serological tests (ELISA and agar gel diffusion).

GENERAL AND SUPPORTIVE MEASURES

Prevent infestation by:

» Hand washing.
» Careful preparation of foods by adequate washing and cooking.

Aspirate liver abscess if not responding to treatment in 5 days or if rupture is imminent.

MEDICINE TREATMENT

- Metronidazole, oral, 15 mg/kg/dose 8 hourly for 7 days.
  - 10 days in severe disease.

8.3 CUTANEOUS LARVA MIGRANS/*ANCYLOSTOMA BRAZILIENSE* (DOG HOOKWORM)

B76.9/B76.0

DESCRIPTION

Infestation of the skin by dog hookworm larvae. Maturation of the larvae cannot occur resulting in a self-limiting infection.

DIAGNOSTIC CRITERIA

» Presents as an itchy 'serpiginous' skin lesion.

GENERAL AND SUPPORTIVE MEASURES

» Regular deworming of dogs.
» Wearing shoes to protect against infection.

MEDICINE TREATMENT

- Albendazole, oral, daily for 3 days.
  - If 1–2 years of age: 200 mg.
  - If > 2 years of age: 400 mg.

8.4 HYDATID DISEASE

B67

DESCRIPTION

The development of hydatid (*Echinococcus granulosus)* cysts follows ingestion of worm ova that are usually passed in the stools of dogs in sheep farming areas. Cysts may occur in any organ, but are most commonly found in the liver and lungs.

DIAGNOSTIC CRITERIA

» Typical radiological features.
» Diagnostic aspiration of an organ cyst should never be attempted.

GENERAL AND SUPPORTIVE MEASURES

» Prevent infestation by:
  > hand washing,
  > adequate food preparation.

» Surgical removal of cysts may be indicated.

MEDICINE TREATMENT

- Albendazole, oral, 15 mg/kg/day up to a maximum of 400 mg 12 hourly with a fatty meal (e.g. a glass of full cream milk).
  - Duration is 3–6 months according to response on imaging for inoperable cysts or 14–28 days before and 28 days after PAIR [Percutaneous puncture, Aspiration, Injection (of a scolecidal agent), Re-aspiration] or surgery.
  - Monitor liver function tests and FBC monthly.

REFERRAL

» All with liver cysts refered for PAIR, which should be carried out under expert supervision.

8.5 SCHISTOSOMIASIS (BILHARZIA)

B65.0/B65.1

DESCRIPTION

» Disease manifestations caused by infestation by species of the genus Schistosoma.
» Infestations with *S. haematobium* and *S. mansoni* are endemic in certain areas of South Africa.
» Nematodes reside in the venous plexus draining the bladder wall (haematobium) or intestine (mansoni).

Complications include:

» haematuria,
» dysuria,
» cystitis,
» calcifications in the bladder wall,
» obstructive uropathy,
» bladder stones,
» intestinal perforation,
» fistulas,
» spinal cord granulomas with pressure effects.
» strictures,
» hepatosplenomegaly,
» portal hypertension,
» cirrhosis,
» ascites,
» pulmonary hypertension,
» bladder cancer,

DIAGNOSTIC CRITERIA

Clinical

» Transient pruritic papular rash (swimmers itch) after exposure to cercariae in the water.
» A few weeks after exposure:
  > fever,
  > chills,
  > headache,
  > wheezing,
  > hepatosplenomegaly,
  > arthralgia,

> urticaria,
> cough, and
> lymphadenopathy,
> eosinophilia.

» Haematuria and dysuria.
» Abdominal pain and diarrhoea often after ingestion of food.

Investigations
» Serology for schistosomiasis.
» Urine and stools microscopy for viable eggs or rectal biopsy specimens.

GENERAL AND SUPPORTIVE MEASURES
» Educate patient/caregiver on preventative measures.
» Symptomatic and supportive treatment.
» Avoid exposure to water contaminated by schistosoma.
» Surgical intervention to correct or prevent complications.

MEDICINE TREATMENT
Acute Schistosomiasis
- Prednisone, oral, 0.5–1 mg/kg daily for 5 days.

Start antihelmintic once acute symptoms have resolved:
- Praziquantel, oral, 40 mg/kg as a single dose or in 2 divided doses on the same day.

Chronic Schistosomiasis
- Praziquantel, oral, 40 mg/kg as a single dose or in 2 divided doses on the same day.
- If given within 6 weeks of exposure, to be repeated in 4–6 weeks.

REFERRAL
» Schistosomiasis with suspected complications following adequate therapy.

8.6 CANDIDIASIS, SYSTEMIC AND OTHER
B37

DESCRIPTION
Superficial and/or disseminated (systemic) fungal infection caused by *C. albicans, C. tropicalis* and other candida species.

Risk factors include:
» Prolonged, broad-spectrum antibiotic therapy.
» Compromised immune system, including patients infected with HIV or on cancer chemotherapy, and the premature baby.
» Steroid therapy.
» Diabetes mellitus.

» IV hyperalimentation – contaminated solution or as an associated risk factor.
» Instrumentation, and central or peripheral vascular catheters.

DIAGNOSTIC CRITERIA

Clinical

» Oral candidiasis (thrush):
  > White plaque adheres to inner cheeks, lips, palate and tongue.
  > Stomatitis with red mucosa and ulcers may also be present.
  > In immunocompromised patients, the lesions may extend into the oesophagus.
» Oesophageal candidiasis:
  > Presents as difficulty swallowing, drooling or retrosternal pain (irritability in small children).
» Skin lesions in the newborn:
  > A red, maculopapular or pustular rash is seen in infants born to women with candida amnionitis.
» Cutaneous lesions:
  > May be represented by scattered, red papules or nodules.
  > Superficial infections of any moist area, such as axillae or neck folds, are common and may present as an erythematous, intertriginous rash with ‘satellite’ lesions.
» Vulvovaginitis:
  > A thick cheesy vaginal discharge with intense pruritus; white plaques on the glans of the penis.
  > Common in diabetics and patients on broad-spectrum antibiotics.
  > In recurrent vulvovaginitis, exclude diabetes, foreign body or sexual abuse.
» Systemic or disseminated candidiasis:
  > Mimics bacterial sepsis but fails to respond to antibiotics.
  > Thrombocytopenia is common.
  > Ophthalmitis with ‘cotton wool’ retinal exudates may also occur.
  > Is usually nosocomial.

Investigations

» For oesophageal candidiasis:
  > It is reasonable to initiate treatment on clinical suspicion.
  > Oesophagoscopy or barium swallow.
» Systemic candidiasis:
  > Urine and blood fungal cultures are essential.
  > Biopsy specimens, fluid or scrapings of lesions: budding yeasts and pseudohyphae are seen on microscopy.

GENERAL AND SUPPORTIVE MEASURES

» Encourage cup feeding of formula fed infants, as bottles are difficult to clean and predispose to candida infection.
» Eradicate or minimise risk factors.

» Avoid use of pacifiers (dummies), teats and bottles but if used, these should be sterilised.
» Remove all invasive devices, drain abscesses and debride infected tissue.

MEDICINE TREATMENT

Oral candidiasis

- Nystatin suspension 100 000 IU/mL, oral, 1 mL 4 hourly.
  - Keep in contact with affected areas for as long as possible.

Suspect immunodeficiency if poor response to treatment.
If no response:

- Imidazole oral gel, e.g.:
  - Miconazole gel 2%, oral, apply 8 hourly.

Oesophageal candidiasis

- Fluconazole, IV/oral, 6 mg/kg immediately as a single dose.
  - Follow with 3 mg/kg/day for 3 weeks.

LoE III[1]

Vulvovaginitis

- Fluconazole, oral, 12 mg/kg as a single dose.
  - Maximum dose: 150 mg.

OR

- Imidazole topical/vaginal, e.g.
  - Clotrimazole OR miconazole, applied locally at night for 7–14 days.
    - Do not use applicator in girls who are not sexually active.

Systemic candidiasis

- Amphotericin B deoxycholate, IV infusion in **5% dextrose water only**, 1 mg/kg/dose once daily over 4 hours for at least 2 weeks after first negative culture, or if no repeat culture available at least 3 weeks after clinical improvement. Discuss options for de-escalation of anti-fungal treatment when sensitivity available with specialist.
  - Maximum cumulative dose: 30–35 mg/kg over 4–8 weeks.
  - Adjust dosing interval in patients with renal impairment.
  - Check serum potassium and magnesium at least 3 times a week.
  - Do **not** use a bacterial filter with amphotericin B deoxycholate.

Prehydration before administering amphotericin B deoxycholate to prevent renal impairment:

- Sodium chloride 0.9%, IV, 15 mL/kg **plus** potassium chloride, 20 mmol/L infused over 2–4 hours.

REFERRAL

» Candidiasis not responding to adequate therapy.
» Patients with renal and hepatic failure.
» Confirmed azole resistance.

8.7 CYTOMEGALOVIRUS (CMV) INFECTION

B25.9

DESCRIPTION

CMV is an extremely common childhood infection, with almost all children infected by 5 years of age.

The majority of childhood infections are asymptomatic or present with a mononucleosis-like syndrome NOT requiring anti-viral treatment.

CMV can cause clinically significant disease following congenital infection and infections in immunocompromised children (especially HIV-infected children and transplant recipients).

DIAGNOSTIC CRITERIA

Clinical

» Congenital infections vary from asymptomatic through isolated neural deafness, to severe disease, including microcephaly.

» Infections in immunocompromised children can result in pneumonia, encephalitis, retinitis and gastrointestinal infections.

Investigations

Diagnostic tests should be only performed if clinical disease is suspected.

Congenital infections (performed within 3 weeks post-delivery – in children with suspected CMV older than 3 weeks, discuss with a specialist):

» Serology: CMV IgM indicates recent infection.

» CMV PCR – qualitative: blood, or urine/saliva in viral transport medium.

Hearing assessment at baseline and annually for the first 5 years of life.

Infections in immunocompromised children:

» Serology: Presence of antibodies to CMV does not imply active infection or causality.

» CMV PCR – qualitative: blood, or urine/saliva in viral transport medium.

» Quantitative CMV PCR (CMV Viral load > 10 000 copies/mL).

» Intranuclear inclusion bodies may be seen in biopsy material.

AND

» Clinical features suggestive of CMV disease.

MEDICINE TREATMENT

<u>Symptomatic congenital infections:</u>

- Valganciclovir, oral, 16 mg/kg, 12 hourly for 6 months.
  - Monitor FBC & differential white cell count, AST/ALT weekly initially, then monthly.

- If unable to tolerate oral medication:
  - Ganciclovir, IV, 5 mg/kg administered over 1 hour, 12 hourly until able to tolerate oral medication.

Infections in immunocompromised children:
Pneumonia and biopsy-proven GIT disease (specialist initiated):

- Initial therapy:
  - Ganciclovir, IV, 5 mg/kg administered over 1 hour, 12 hourly for 7 days.
  - Follow with: Valganciclovir, oral, 16 mg/kg 12 hourly for 5 weeks.

- Maintenance therapy: Not indicated.

CNS disease **(Specialist initiated)**:

- Initial therapy:
  - Ganciclovir, IV, 5 mg/kg administered over 1 hour, 12 hourly for 7 days.
  - Follow with: Valganciclovir, oral, 16 mg/kg 12 hourly for 5 weeks.
- Maintenance therapy: Indicated for patients with good clinical response.
  - Valganciclovir, oral, 16 mg/kg daily until CD4 count rises for > 6 months to > 15% (< 6 years) or > 100 cells/mm^3 (> 6 years) on ART.

Retinitis:
See Chapter 16: Eye Conditions, section 16.4: Cytomegalovirus (CMV) retinitis.

REFERRAL

» All cases of severe organ-related disease or disseminated disease.

8.8 DIPHTHERIA

A36.9
*****Notifiable condition

Telephone Hotline	
NICD hotline (24 hours)	082 883 9920
National Institute of Communicable Diseases	011 555 0327 or 011 555 0352

DESCRIPTION

Diphtheria is an acute, communicable infection of the upper respiratory tract, caused by *Corynebacterium diphtheriae*. Disease is unlikely if the patient shows documented evidence of complete immunisation.
Cutaneous diphtheria can also occur.
Incubation period is between 2 and 7 days.

Complications include:

» In the first 2 weeks of the disease:
  > Cervical lymphadenopathy with peri-adenitis and with swelling of the neck ('bull-neck').

> Upper airway obstruction by membranes.
> Myocarditis

» Usually after 3 weeks:
> Neuritis resulting in paresis/paralysis of the soft palate and bulbar, eye, respiratory and limb muscles.

DIAGNOSTIC CRITERIA

Clinical

Any person presenting with: pharyngitis, nasopharyngitis, tonsillitis, laryngitis, tracheitis (or any combination of these), where fever is absent or low-grade.

AND

One or more of the following:

» Adherent pseudomembrane which bleeds if manipulated or dislodged.
» Features suggestive of severe diphtheria, including: stridor, 'bull-neck', cardiac complications (myocarditis, acute cardiac failure and circulatory collapse), acute renal failure.
» Link to a confirmed case.

Investigations

» Nasal or pharyngeal swab: Microscopy and culture.
» Culture of membrane.
» Important: Inform the laboratory that the specimen is from a patient with suspected diphtheria.

GENERAL AND SUPPORTIVE MEASURES

» Staff in direct contact with the patient should wear a protective mask (N-95).
» Isolate the patient in a high or intensive care unit until 3 successive nose and throat cultures at 24-hour intervals are negative.
» Usually non-communicable within 4 days of antibiotics.
» Nutritional support.
» If respiratory failure develops, provide ventilatory support.
» Tracheostomy if life-threatening upper airway obstruction.
» Bed rest for 14 days.

MEDICINE TREATMENT

Note:

Do **not** withhold treatment pending culture results.

Antibiotic therapy (must be given for a total of 14 days).

Parenteral treatment for patients unable to swallow: Switch to oral as soon as patient able to swallow:

- Benzylpenicillin, IV, 50 000 units/kg/dose 6 hourly.

Oral treatment for patients able to swallow:

- Phenoxymethylpenicillin, oral, 15 mg/kg/dose 6 hourly.
- Maximum: 500 mg per dose.

In severe penicillin allergy:
Parenteral treatment for patients unable to swallow. Switch to oral as soon as patient able to swallow:

- Azithromycin, IV, 10 mg/kg daily.

Oral treatment for patients able to swallow:

- Azithromycin, oral, 10 mg/kg daily.

Diphtheria antitoxin treatment (DAT):
DAT should be given to all probable classic respiratory diphtheria cases without waiting for laboratory confirmation. DAT neutralises circulating unbound diphtheria toxin and prevents progression of disease; delaying administration increases mortality. The dosing of DAT is product-specific; refer to package insert.

Close contacts (household and regular visitors):
Regardless of immunisation status, isolate contact and swab throat for culture. Keep under surveillance for 7 days. Give antibiotic prophylaxis as follows:

Prophylactic treatment for contacts:

Age group	Benzylpenicillin
Children	< 6 years: Single dose: 600 000 units, IM.
	> 6 years: Single dose: 1.2 million units, IM.
Adults	Single dose: 1.2 million units, IM.

In severe penicillin allergy:

Age group	Azithromycin
Children	Oral, 10 mg/kg per day on day one, **THEN** 5 mg/kg per day for 4 days (total of 5 days).
Adults	Oral, 500 mg on day one, **THEN** 250 mg daily for 4 days (total of 5 days).

All close contacts:
If 1st culture was positive, follow up throat culture after 2 weeks and treat again.

REFERRAL

» All

8.9 MALARIA

B54

*Notifiable disease.

DESCRIPTION

Malaria is transmitted by the bite of an infected female *Anopheles* mosquito. The incubation period varies with the species of the parasite, *Plasmodium falciparum* being shortest, usually 7–21 days, and *P. malariae* the longest. The incubation period may be prolonged by use of malaria prophylaxis or certain antibiotics.

The confirmation of the diagnosis and treatment of malaria is an emergency as complications develop rapidly. Malaria can be missed outside transmission areas.

DIAGNOSTIC CRITERIA

Clinical

» A child living in, or with recent **travel history** to a malaria transmission area.
» Fever, which may be intermittent.
» Flu-like symptoms including sweating or rigors, i.e. cold, shaking feeling.
» Body pains and headache.
» Occasionally diarrhoea, loss of appetite, nausea and vomiting, tachypnoea and cough.
» A young child may present with fever, poor feeding, lethargy, vomiting, diarrhoea or cough.
» Clinical features are non-specific and overlap with many other infections.

Investigations

» Testing is urgent. Obtain the result immediately.
  > Rapid diagnostic test.
    In areas where malaria transmission occurs, rapid tests should always be available for malaria screening but cannot be used for monitoring response to treatment as they may remain positive for over 4 weeks.

» Malaria parasites in blood smear – thick and thin smears.
  > One negative malaria test does not exclude the diagnosis.
  > Repeat smears if initially negative, and malaria suspected.
  > If severe malaria suspected, commence therapy and repeat smears after 6–12 hours.
  > Repeat smears after 48 hours and if no improvement in degree of parasitaemia, consider alternative therapy.

If severe malaria is suspected and the diagnosis cannot be confirmed immediately, treat while awaiting laboratory results.

8.9.1 *P. FALCIPARUM* MALARIA, NON-SEVERE, UNCOMPLICATED

B50.9

DESCRIPTION

A child with uncomplicated malaria is alert, can tolerate oral medication, has an age-appropriate level of consciousness and has no clinical or laboratory evidence of severe malaria.

Ideally, treatment should be started in hospital. Initial doses should be directly observed. Observe for 1 hour to ensure dose is not vomited.

MEDICINE TREATMENT

Treat according to the National Malaria Guidelines.

Option 1:

Only for clearly uncomplicated, low risk malaria cases (> 5 kg):

- Artemether/lumefantrine 20/120 mg, oral, with fat-containing food/milk to ensure adequate absorption.
  - Give first dose immediately.
  - Follow with second dose 8 hours later.
  - Then 12 hourly for another 2 days (total number of doses in 3 days = 6).

Weight	Dose	Total tablets per course
5–≤ 15 kg	1 tablet	6
15–≤ 25 kg	2 tablets	12
25–≤ 35 kg	3 tablets	18
> 35 kg	4 tablets	24

OR

Option 2:

Manage children < 5 kg with uncomplicated malaria with quinine plus clindamycin:

- Quinine, oral, 10 mg/kg/dose 8 hourly for 7–10 days.

2–3 days after initiating treatment with quinine:

- Clindamycin, oral, 10 mg/kg/dose 12 hourly for 7 days.

Children who are vomiting but who have no other indications of severe malaria:

Children ≥ 20 kg:

- Artesunate, IM or IV, 2.4 mg/kg at hours 0, 12 and 24, then daily until patient is able to tolerate oral treatment.

Children < 20 kg:

- Artesunate, IM or IV, 3 mg/kg at hours 0, 12 and 24, then daily until patient is able to tolerate oral treatment.

8.9.2 *P. FALCIPARUM* MALARIA, SEVERE, COMPLICATED (OR IF REPEATED VOMITING)

B50.0/B50.8

DIAGNOSTIC CRITERIA

Clinical

» Unable to drink or breast feed.
» Vomits everything.
» Renal failure.
» Cerebral malaria: manifests with convulsions, which may be subtle, and/or any change in mental state, ranging from irritability, lethargy to coma, stiff neck or bulging fontanelle.
» Respiratory distress and metabolic acidosis similar to pneumonia.
» Anaemia: can be severe and lead to cardiac failure and a depressed mental state.
» Shock: cold moist skin, low blood pressure and evidence of poor peripheral perfusion.
» Hypoglycaemia: can present with convulsions and a depressed mental state.
» Jaundice, bleeding, acute renal failure and ARDS are less common in children than adults.

Investigations

» Hyperparasitaemia: > 5% of RBCs infected indicates severe malaria but a lower parasite density does not exclude severe malaria.
» Low Hb (< 6 g/dL).
» Test glucose immediately with a fingerprick test. Low blood glucose: < 2.2 mmol/L.
» Acidosis: serum lactate (venous) > 5 mmol/L or bicarbonate < 15 mmol/L.
» Severe thrombocytopenia: < 50 x 10^9/L.
» In severe cases, repeat smear after 72 hours and after the completion of the course of treatment.

GENERAL AND SUPPORTIVE MEASURES

» Check airway, breathing, circulation (ABC).
» Admit to a high care or intensive care unit.
» Review the child at least twice daily, including holidays.
» Avoid overhydration.
» Control convulsions.
» Ventilatory support, if necessary.
» Agitation and respiratory distress can be as a result of severe metabolic acidosis. Treat shock and acidosis. See Chapter 1: Emergencies and Trauma, section 1.1.8: Shock.
» Nutritional support.

MEDICINE TREATMENT

Urgent:

Children ≥ 20 kg:

- Artesunate, IM or IV, 2.4 mg/kg at hours 0, 12 and 24, then daily until patient is able to tolerate oral treatment.

Children < 20 kg:

- Artesunate, IM or IV, 3 mg/kg at hours 0, 12 and 24, then daily until patient is able to tolerate oral treatment.

LoE III[2]

2–3 days after initiating treatment with artesunate and able to swallow, switch to any of the 2 regimens:

Children > 5 kg:

- Artemether/lumefantrine 20/120 mg, oral, with fat-containing food/milk to ensure adequate absorption.
  - Give first dose immediately.
  - Follow with second dose 8 hours later.
  - Then 12 hourly for another 2 days (total number of doses in 3 days = 6).

Weight	Dose	Total tablets per course
5–≤ 15 kg	1 tablet	6
15–≤ 25 kg	2 tablets	12
25–≤ 35 kg	3 tablets	18
> 35 kg	4 tablets	24

OR

Children < 5 kg

- Quinine, oral, 10 mg/kg/dose 8 hourly to complete 7–10 day course.

PLUS

- Clindamycin, oral, 10 mg/kg/dose 12 hourly for 7 days.

For concurrent bacterial sepsis:

- Ceftriaxone, IV, 100 mg/kg as a single daily dose once daily for 10 days.
  - Maximum dose: 4 g/day.

For fever:

- Paracetamol, oral, 15 mg/kg/dose 6 hourly as required.

For hypoglycaemia:

- Dextrose 10%, IV, 4 mL/kg.

If Hb < 7 g/dL:

- Packed red cells, IV, 10 mL/kg over 3 hours.

Note:

Fluid loss is often underestimated in a febrile, vomiting, sweating child.

REFERRAL

» **Urgent**: Severe or complicated malaria.
» High-risk children under 2 years, splenectomised patients.
» Malaria not responding clinically to adequate treatment within 48–72 hours (possible resistance).

8.9.3 *P. OVALE, P VIVAX* AND *P. MALARIAE*

B53.0/B51.9/B52.9

- Chloroquine, oral, 10 mg base/kg as a single dose.
  - Follow with 5 mg base/kg given 6, 24 and 48 hours after the first dose.

PLUS (for *P. ovale* and/or *P. vivax*)
To eradicate the organism:

- Primaquine, oral, 0.25 mg base/kg/day for 14 days (obtained using section 21 approval).
  - Continue chloroquine once weekly until primaquine is obtained.

Note: Exclude G6PD deficiency before prescribing primaquine for non-falciparum malaria.

8.9.4 MALARIA PROPHYLAXIS

Malaria chemoprophylaxis should be used in moderate-risk malaria-endemic areas in South Africa from September to May, both together with preventive measures against mosquito bites. Risk maps are provided in the National Guidelines for the Prevention of Malaria (2018). It is recommended that persons intending to travel to malaria-endemic areas outside of South Africa take the relevant chemoprophylaxis. There are moderate- and high-risk areas in neighbouring countries.

MEDICINE TREATMENT

- Doxycycline (children > 8 years), oral, 2.2 mg/kg (maximum 100 mg) daily.
  - Begin 2 days before travel; continue daily during travel, and for 4 weeks after leaving the area.

Children under 8 years: Refer to the National Guidelines for the Prevention of Malaria (2018) for alternative chemoprophylaxis options, which have to be procured in the private sector.

Preventative measures against mosquito bites include:
» Use of treated mosquito nets, screens, coils or pads.
» Application of a N,N-diethyl-3-methylbenzamide or N,N-diethyl-m-

toluamide (DEET) insect repellent to exposed skin and clothing.
» Wearing long sleeves, long trousers and socks if outside between dusk and dawn, as mosquitoes are most active at this time.
» Visiting endemic areas only during the dry season.

CAUTION
Pregnant women and children under 5 years of age should avoid visiting malaria-endemic areas, as they are more prone to the serious complications of malaria.

8.10 MEASLES

B05
*Notifiable condition

DESCRIPTION

The following case definition is an epidemiological and not a diagnostic tool:
» Fever and maculopapular rash with any one of the following:
  > cough,
  > coryza/runny nose,
  > conjunctivitis.

Suspect measles in any child fulfilling the case definition.

An acute, highly contagious, viral, childhood exanthem.
Incubation period: 8–14 days from exposure to first symptoms and 14 days between appearance of rash in source and contact.

Complications include:
» pneumonia,
» laryngotracheobronchitis (croup),
» encephalitis,
» stomatitis, and
» feeding difficulties,
» diarrhoea,
» otitis media,
» corneal ulceration.

Subacute sclerosing panencephalitis is a rare long-term complication.

DIAGNOSTIC CRITERIA

Clinical
» Prodromal (catarrhal) phase:
  > duration 3–5 days,
  > fever,
  > runny nose (coryza),
  > cough,
  > conjunctivitis.
» Koplik's spots, followed 3–5 days later with a maculopapular rash.
» The rash begins to fade after 3 days in the order of its appearance leaving temporary darker staining.

» If fever is still present after the third day of the rash, a complication should be suspected.

Investigations

» Serum measles IgM antibodies for confirmation of diagnosis.

GENERAL AND SUPPORTIVE MEASURES

» Notify provincial EPI manager when case is suspected, prior to confirmation.
» Only admit high risk patients:
  > children less than 6 months old,
  > immune compromised/suppressed children,
  > children with severe malnutrition,
  > children with complications.
» Minimal exposure to strong light, if patient is photophobic.
» Isolate the patient in a separate room, if possible away from other children.
» All entering the room to wear mask, gloves and gown.
» Patient is infectious for 4 days after onset of the rash, longer if HIV-infected.
» Screen outpatient waiting areas for children with measles.
» If pneumonia with hypoxia, give humidified oxygen by nasal cannula.

MEDICINE TREATMENT

All patients

- Vitamin A, oral, as a single daily dose for 2 days.
  - If < 6 months of age: 50 000 units.
  - If 6–12 months of age: 100 000 units.
  - If > 1 year of age: 200 000 units.

For fever:

- Paracetamol, oral, 10–15 mg/kg/dose, 6 hourly as required until fever subsides.

Pneumonia

Also see Chapter 15: Respiratory System, section 15.1.1: Pneumonia.

Empiric antibiotics for suspected secondary bacterial infection:

To cover *S. pneumoniae* and Gram negative infection.
Total duration of therapy: 5–7 days.

- Amoxicillin/clavulanic acid, IV, 25 mg/kg/dose 8 hourly.

When child improves, follow with oral therapy to complete 5–7 days treatment:

- Amoxicillin/clavulanic acid, oral, 30 mg/kg/dose 12 hourly.

Penicillin allergy

See Chapter 25: Drug Allergy, section 25.4.1: Allergies to penicillins.

In very severe progressive or unresponsive pneumonia consider use of aciclovir for possible herpes infection.

Croup
See Chapter 15: Respiratory System, section 15.5.2: Laryngotracheo-bronchitis, acute viral (croup).

Diarrhoea
See Chapter 2: Alimentary Tract, section 2.2.4: Diarrhoea, acute.

Encephalitis
See section 8.13: Meningo-encephalitis/encephalitis, acute viral.

Convulsions
See Chapter 13: The Nervous System, section 13.3: Status epilepticus (convulsive).

Conjunctivitis
- Chloramphenicol ophthalmic ointment 1%, inserted 6 hourly for 5 days.

If corneal clouding/ulceration present, obtain urgent ophthalmologic consultation.

Management of contacts
Immunise children older than 6 months if unvaccinated and less than 72 hours since exposure.
Between 3 and 6 days after exposure and for contacts less than 6 months old:
- Human normal immunoglobulin, IM, 0.25 mL/kg.

If immunodeficient:
- Human normal immunoglobulin, IM, 0.5 mL/kg.

Immunise all children > 6 months of age if an outbreak occurs.

REFERRAL
» Children in need of intensive care unit.
» Children with depressed level of consciousness.
» Children with corneal ulceration/opacity.

8.11 MENINGITIS, ACUTE BACTERIAL
G00
*Notifiable condition. (*N. meningitidis and H. influenzae)*

This guideline applies to children > 60 days old. For the management of neonates, see Chapter 19: Prematurity and Neonatal Conditions, section 19.5.1: Meningitis bacterial, neonatal.

DESCRIPTION

Bacterial meningitis most commonly results from haematogenous dissemination of micro-organisms from a distant site, e.g. the nasopharynx.
In children, *S. pneumoniae* and *N. meningitidis* are the usual pathogens.

Note:
Tuberculosis, cryptococcal and partially treated acute bacterial meningitis should be considered when the clinical and laboratory features are not typical of pyogenic meningitis, or when there is a slow onset of disease (> 2 days), especially in any high risk settings such as immune suppression, TB contact and malnourished children.
Differentiation of TB or cryptococcal meningitis from acute bacterial meningitis is not always easy on presentation.

Complications include:
» Raised intracranial pressure due to cerebral oedema, subdural effusion/empyema or hydrocephalus.
» Other acute complications include:
  > cerebral infarctions,
  > shock,
  > seizures,
  > metastatic infection, e.g. arthritis, pneumonia, pericarditis,
  > disseminated intravascular thrombosis,
  > inappropriate antidiuretic hormone (ADH) secretion.

Long-term neurological sequelae include deafness, blindness, intellectual disability and motor paralysis, e.g. hemiparesis.

DIAGNOSTIC CRITERIA

Clinical

» Fever
» Headache
» Vomiting
» Convulsions
» Feeding problems.
» Irritability
» Lethargy
» Photophobia

» Signs of increased intracranial pressure, e.g. bulging anterior fontanel.
» Papilloedema is not a useful sign in young children with meningitis. It is difficult to elicit and may be absent even with acutely raised ICP.

Investigations
» Lumbar puncture (LP) – send CSF for biochemistry, microscopy and culture.
  > In typical cases of bacterial meningitis: CSF glucose is low, CSF protein is raised, CSF pleocytosis with neutrophil predominance is found, and bacteria may be visualised on Gram stain. However, many cases do not have these typical CSF findings. All abnormal findings should lead to serious considerations of acute bacterial meningitis.

> If contra-indications to LP are present, defer LP and initiate treatment immediately. For contra-indications to LP, see Chapter 13: The Nervous System, section 13.12: Lumbar puncture.

» Clinical meningococcaemia (septicaemia) with petechiae/purpura.
> Confirm with skin scrape, Gram stain and blood culture.

GENERAL AND SUPPORTIVE MEASURES

» Admit to a high or intensive care unit, if appropriate.
» Monitor, where indicated:
> neurological status,
> heart rate,
> blood pressure,
> acid-base status,
> blood glucose,
> fluid balance, i.e. hydration,
> respiration,
> body temperature,
> haematocrit,
> electrolytes,
> blood gases,
> serum and urine osmolality.

» Ensure adequate nutrition by enteral feeding where possible.
> Use a nasogastric tube if necessary.
> If enteral feeding is not possible, give intravenous fluids: paediatric or neonatal maintenance solution with dextrose.

MEDICINE TREATMENT

Antibiotic therapy

Empiric treatment:

- Ceftriaxone, IV, 100 mg/kg once daily.

Adjust antimicrobial therapy according to culture and sensitivity.

Treatment duration in culture positive meningitis:

» *N. meningitidis*: 5 days.
» *S. pneumoniae*: 10 days.
» *H. influenzae*: 10 days.
» Other gram-negative bacilli: 21 days.

In stable patients with uncomplicated culture-negative meningitis, 5 days is adequate.

In complicated or non-responsive cases, a longer duration of therapy may be required.

Reassess antimicrobial therapy when blood and CSF culture and sensitivity results become available, or when improvement is not evident within 72–96 hours.

Seek immediate advice on what treatment to start with when ventriculo-peritoneal shunt infection, spread from sinuses, mastoids, or direct penetrating source of infection is present.

For shunts:

- 3rd generation cephalosporin, e.g.:
  - Ceftriaxone, IV, 100 mg/kg once daily.

PLUS

- Vancomycin, IV, 15 mg/kg/dose 6 hourly infused over 1 hour.

PLUS

- Rifampicin, IV, 10 mg/kg 12 hourly.
  - Do not exceed 600 mg/dose (in patients where TB has been excluded).

Fever and headache:

- Paracetamol, oral, 15 mg/kg/dose 6 hourly as required.

Convulsions

See Chapter 13: The Nervous System, section 13.3: Status epilepticus (convulsive).

Raised intracranial pressure or cerebral oedema

Elevate head of bed ~30°.

Maintain P_aCO_2 at 4–5 kPa (30–35 mmHg); intubate and ventilate if necessary.

Avoid fluid overload.

- Mannitol, IV, 250 mg/kg administered over 30–60 minutes.

- Dexamethasone, IV, 0.5 mg/kg 12 hourly.

Chemoprophylaxis for close contacts

A close contact is defined as someone living in the same household, dormitory, institution, children in the same crèche, or any other 'kissing' contact. Health care workers who have intimate contact should receive prophylaxis.

N. meningitidis

- Ciprofloxacin, oral, as a single dose.
  - If < 12 years of age: 10 mg/kg.
  - If > 12 years of age: 500 mg.

  Note:
  If < 12 years of age and able to swallow, use a a single 250 mg tablet.

OR

- Ceftriaxone, IM, single dose.
  - If < 12 years of age: 125 mg.
  - If > 12 years of age: 250 mg.

Close contacts who are pregnant:

- Ceftriaxone, IM, 250 mg.

H. influenzae prophylaxis for **all** contacts under 5 years who are household contacts (including index case) or day care contacts:

- Rifampicin, oral, 20 mg/kg/dose once daily for 4 days.
  - Maximum dose: 600 mg.
  - Neonatal dose: 10 mg/kg/dose once daily for 4 days.

Check vaccination status of index case and all contacts; and update if necessary – Refer to Primary Health Care Standard Treatment Guidelines and Essential Medicines List, Chapter 13: Immunisation.

REFERRAL

» Where lumbar puncture is deferred due to suspected raised intracranial pressure and/or localising signs, start bacterial and tuberculous meningitis treatment immediately.
» Meningitis with complications.
» All cases of suspected shunt infection. Start treatment immediately before referral.

8.12 MENINGITIS, CRYPTOCOCCAL

G02.1

DESCRIPTION

An uncommon childhood meningitis that may occur in older HIV-infected children with severe CD4 T-cell depletion. Pulmonary and skin involvement can occur.

DIAGNOSTIC CRITERIA

Clinical

» Acute or chronic headache in an older HIV-infected child. Meningism need not be present.
» Often presents with cranial nerve palsy.
» Can occur as result of Immune Reconstitution Inflammatory Syndrome (IRIS) after initiation of antiretroviral therapy.

Investigations

» Test all cerebrospinal fluid (CSF) specimens from HIV-infected children with suspected meningitis.
» CSF: India ink stain, and/or cryptococcal antigen test (more sensitive than India ink stain). Measure CSF opening pressure.
» Fungal culture – CSF, blood and urine.

If indicated:

» Chest X-ray.
» Ophthalmological assessment.

GENERAL AND SUPPORTIVE MEASURES

» Admit to a high or intensive care unit, if appropriate.
» Monitor, where indicated:
  > neurological status,
  > heart rate,
  > blood pressure,
  > haematocrit,
  > acid-base status,
  > respiration,
  > body temperature,
  > electrolytes,
  > blood glucose,
  > blood gases,

> fluid balance, i.e. hydration, > serum and urine osmolality.

» Ensure adequate nutrition by enteral feeding where possible. Use a nasogastric tube if necessary. If enteral feeding is not possible, provide appropriate intravenous fluids.

MEDICINE TREATMENT

Treatment

Preferred initial treatment (2 weeks):

First week:

- Amphotericin B deoxycholate, IV, 1 mg/kg/day as a daily infusion in **5% dextrose water** over 4 hours.
  - Adjust dosing interval in patients with renal impairment.
  - Check serum potassium and magnesium at least 3 times a week.
  - Do not use a bacterial filter with amphotericin B deoxycholate.

Prehydration before administering amphotericin B deoxycholate to prevent renal impairment:

- Sodium chloride 0.9%, IV, 15 mL/kg **plus** potassium chloride, 20 mmol/L infused over 2–4 hours.

PLUS

- 5-Flucytosine 100 mg/kg/day in 4 divided doses.

Second week:

- Fluconazole, IV/oral, 12 mg/kg/day.
  - Maximum dose: 800 mg.

OR

Alternative initial treatment (2 weeks):

- Amphotericin B deoxycholate, IV, 1 mg/kg/day as a daily infusion in **5% dextrose water** over 4 hours.

PLUS

- Fluconazole, IV/oral, 12 mg/kg/day.
  - Maximum dose: 800 mg.

Prehydration before administering amphotericin B deoxycholate to prevent renal impairment:

- Sodium chloride 0.9%, IV, 15 mL/kg plus potassium chloride, 20 mmol/L infused over 2–4 hours.

OR

Additional alternative: Only if Amphotericin B deoxycholate is not available/not tolerated or contraindicated, as this regimen is associated with poorer outcomes. Initial treatment (2 weeks):

First week:

- Fluconazole, IV/oral, 12 mg/kg/day.
    - Maximum dose: 800 mg.

PLUS

- 5-Flucytosine 100 mg/kg/day in 4 divided doses.

Second week:

- Fluconazole, IV/oral, 12 mg/kg/day.
    - Maximum dose: 800 mg.

THEN

Consolidation treatment (8 weeks):

- Fluconazole, oral, 12 mg/kg/day for 8 weeks.
    - Maximum dose: 800 mg.

Secondary prophylaxis (maintenance treatment):

- Fluconazole, oral, 6 mg/kg/day.
    - Maximum dose: 400 mg.

Discontinue secondary prophylaxis:

» Children < 6 years of age, on ART: CD4 count > 25% for at least 6 months.
» Children > 6 years of age, on ART: CD4 count > 200 for at least 6 months.
» Adolescents on ART: CD4 count increases to between 100–200 cells/mm^3 for at least 6 months.
» Re-start prophylaxis if CD4 count drops below thresholds above.

For continued raised intracranial pressure:

» Daily therapeutic lumbar puncture is indicated if initial LP manometric pressure > 25 cm of water in the lateral recumbent position.
» Continue until pressure stabilises below 25 cm of water.
» Remove 10–20 mL daily and obtain a closing pressure.
» Refer for neurosurgical intervention if pressure persistently high and/or above 40 cm water.

REFERRAL

» All cases not responding to initial treatment.
» All patients with IRIS.

8.13 MENINGO-ENCEPHALITIS/ENCEPHALITIS, ACUTE VIRAL

A86

DESCRIPTION

A number of viruses cause infection of the brain and meninges. Herpes simplex is the most important because it is treatable. A high mortality and morbidity is associated with untreated herpes meningo-encephalitis.

Complications include:

- » increased intracranial pressure,
- » cerebral oedema,
- » blindness,
- » inappropriate antidiuretic hormone (ADH) secretion.
- » permanent neurological deficits,
- » seizures,
- » deafness,

Clinical

- » Severe headache, fever, nausea, vomiting, lethargy and abnormal behaviour.
- » Alteration in level of consciousness, i.e. drowsiness, confusion, stupor or coma.
- » Generalised and/or focal convulsions.
- » Focal neurological deficits.
- » Abnormal movements, i.e. basal ganglia involvement.
- » Cranial nerve palsies (brainstem involvement), loss of sphincter control, paresis of limbs and segmental sensory loss (spinal cord involvement).
- » Some patients may have signs of meningeal irritation.
- » Herpes encephalitis may have an acute and fulminant course. It can result from primary infection or reactivation.
- » **Herpetic skin lesions are usually NOT present in children with HSV encephalitis.**

Investigations

- » Laboratory tests are important in excluding bacterial, fungal or TB meningitis.
- » CSF & blood for HSV PCR if the diagnosis is suspected.
- » CSF may be normal or reveal:
  - > mildly raised protein,
  - > normal glucose level, and
  - > mild pleocytosis, mostly lymphocytes.
  - > Red cells are commonly observed with herpes encephalitis.
- » CT brain, if focal signs or seizures, unexplained reduced level of consciousness, status epilepticus or diagnostic uncertainty.
  - > May reveal oedema.
  - > Herpes simplex preferentially involves the temporal lobes and orbital surfaces of the frontal lobes.
  - > CT findings may only be apparent after 3–5 days.

» EEG, if focal or prolonged seizures, diagnostic uncertainty, suspected non-convulsive seizures.
  > May demonstrate changes suggestive of herpes encephalitis.

GENERAL AND SUPPORTIVE MEASURES

» Admit to a high or intensive care unit, if appropriate.
» Monitor, where indicated:
  > neurological status,
  > heart rate,
  > blood pressure,
  > haematocrit,
  > acid-base status,
  > fluid balance, i.e. hydration,
  > respiration,
  > body temperature,
  > electrolytes,
  > blood glucose,
  > blood gases,
  > serum and urine osmolarity.
  > Ensure adequate nutrition, nasogastric feeding if necessary.
  > If enteral feeding is not possible, give maintenance intravenous fluids.

MEDICINE TREATMENT

If herpes simplex virus or varicella zoster virus encephalitis suspected:

- Aciclovir, IV, 8 hourly administered over 1 hour.
  If 0–12 years of age: 20 mg/kg/dose.
  If > 12 years of age: 10 mg/kg/dose.
  - Herpes simplex: 14 days.
  - Varicella: 7 days.
  - If an alternative diagnosis is made and CSF PCR is negative, stop acyclovir.

Note: CSF PCR may be negative in the first 3 days of illness.

Acute convulsions

See Chapter 13: The Nervous System, section 13.3: Status epilepticus (convulsive).

Provide adequate analgesia (see Chapter 20: Pain control).

Raised intracranial pressure or cerebral oedema

Elevate head of bed ~ 30°.
Maintain P_aCO_2 at 4–5 kPa; intubate and ventilate, if necessary.
Avoid fluid overload.

- Mannitol, IV, 250 mg/kg administered over 30–60 minutes.
  - Do not repeat without consulting a paediatrician.

REFERRAL

» Deterioration of clinical condition despite adequate treatment.
» Meningo-encephalitis with complications or loss of consciousness.

8.14 MUMPS

B26

See Primary Health Care Standard Treatment Guidelines and Essential Medicines List, Chapter 10: Infections and Related Conditions, section 10.11: Mumps.

8.15 MYCOBACTERIUM AVIUM COMPLEX (MAC) INFECTION

A31.0

DESCRIPTION

Atypical mycobacterium, causing disease in extremely immunocompromised patients.
MAC infection in HIV-infected children usually presents with disseminated disease, often enlarged intra-abdominal lymph nodes and pancytopenia.
Pulmonary, GIT or skin disease is less common.

DIAGNOSTIC CRITERIA

» MAC may be isolated from blood, bone marrow, lymph node, other sterile fluids and tissues.
» Confirm diagnosis with a biopsy for histology and culture **or** 2 culture-positive sputa or gastric aspirates. MAC commonly colonizes the lungs and when isolated is most frequently not of clinical relevance. When diagnosis is in doubt, consult a paediatric infectious disease specialist or microbiologist prior to initiating therapy.
» PCR line probe test can be used for diagnosis.

GENERAL AND SUPPORTIVE MEASURES

If MAC infection is localised to a single enlarged peripheral lymph node, an excision of the lymph node is therapeutic.

MEDICINE TREATMENT

Specialist initiated

Identify and treat predisposing immune suppression.
Therapy consists of a combination of at least 3 medicines:

- Macrolide, e.g.:
  - Clarithromycin, oral, 7.5 mg/kg/dose 12 hourly.

  OR
  - Azithromycin, oral, 10 mg/kg/day, if currently on efavirenz.

PLUS

- Ethambutol, oral, 20–25 mg/kg once daily.

PLUS

- Rifampicin, oral, 10–20 mg/kg once daily.
  - Max dose: 600 mg.

REFERRAL

» Poor response to treatment should be referred for consideration of a quinolone, amikacin, or rifabutin.

8.16 PERTUSSIS

A37.9
*Notifiable condition

DESCRIPTION

A communicable respiratory infection classically causing a paroxysmal cough followed by an inspiratory whoop (absent in young infants) with associated vomiting. Subconjunctival haemorrhages may be present. The cough can persist for 3 months or longer with the infectious period being between 2 weeks and 3 months. The disease is more severe in young infants where it may present with apnoea rather than an inspiratory whoop.

Classic pertussis is uncommon in the vaccine era and most cases present with non-specific respiratory symptoms.

Incubation period: 7–10 days. Range: 6–21 days.

DIAGNOSIS

» A definitive diagnosis is often not possible and treatment should be initiated in suspected cases prior to microbiological confirmation.
» May have profound leucocytosis, predominantly lymphocytosis, although leucocytosis is often absent, particularly in infants.
» PCR on nasopharyngeal aspirates is the preferred diagnostic modality.
» Cultures are usually negative, even in confirmed cases.
» Serology is of limited value early in the disease.

GENERAL AND SUPPORTIVE MEASURES

» Standard and droplet precautions for 5 days whilst on appropriate antibiotic therapy; for 21 days if not.
» Appropriate respiratory support for apnoea or respiratory distress/failure.
» Encourage oral feeding. If unsuccessful, provide nasogastric feeds.

MEDICINE TREATMENT

If hypoxic:

- Oxygen, 1–2 L/minute via nasal prongs.

- Macrolide e.g.:
  - Azithromycin:
    - < 6 months: 10 mg/kg/day for 5 days.
    - ≥ 6 months: 10 mg/kg (max 500 mg) on day 1, then 5 mg/kg/day (maximum 250 mg) on days 2–5.

Management of contacts

Prophylaxis for all household contacts and for health care workers with close contact:

- Azithromycin: as for treatment above.

REFERRAL

» Children with seizures or encephalopathy for further evaluation.
» Patients requiring intensive care, where none is available on site.

8.17 *PNEUMOCYSTIS JIROVECI* PNEUMONIA (PJP)

B20.6

See Chapter 15: Respiratory System, section 15.1.1.3: Pneumonia in HIV exposed or infected children.

8.18 POLIOMYELITIS (ACUTE FLACCID PARALYSIS)

A80.3

*Notifiable condition.

Also see Chapter 13: The Nervous System, section 13.8.1: Inflammatory polyneuropathy (Guillain-Barré Syndrome).

DESCRIPTION

Poliomyelitis is eradicated in South Africa. Most cases of acute flaccid paralysis (AFP) are caused by Guillain-Barré Syndrome, but all cases of AFP must be notified as the clinical signs are indistinguishable.

DIAGNOSTIC CRITERIA

Clinical

» Suspect in all children with acute flaccid paralysis, often asymmetrical with intact sensation.

Investigations

» Send two stool specimens (on ice) taken 24–48 hours apart to the NICD via the local laboratory.

GENERAL AND SUPPORTIVE MEASURES

» Isolate patient to prevent faecal-oral spread.
» Rehabilitative measures:
  > Most patients need physiotherapy and occupational therapy.

REFERRAL

» Discuss all cases with a specialist.
» Children requiring intensive care if none is available on site.

8.19 RABIES

A82.9

*Notifiable condition. (Inform state veterinarian or local veterinary official.)

DESCRIPTION

A viral infection of the central nervous system following transmission of the rabies virus from the saliva of affected animals through bites or contamination of mucosa or skin lesions.

Incubation period 2–8 weeks.

DIAGNOSTIC CRITERIA

Clinical

» Signs and symptoms may begin with:
  > fever,
  > headache,
  > nausea,
  > diarrhoea,
  > irritability.
» Early signs include paraesthesia or itching at the site of the bite in ⅓ of cases.
» The acute neurologic phase interspersed with lucid periods manifests with:
  > agitation,
  > mania,
  > hyperactivity,
  > hallucinations.
» Seizures may be precipitated by auditory or tactile stimuli.
» Hypersalivation, hydrophobia or aerophobia may occur.
» Death is usually due to cardio-respiratory failure.

Investigations

» Testing of animals with suspected rabies: Virus specific fluorescent antigen in brain tissue confirms the diagnosis in animals.
» Preserve brain tissue of the dead animal.
» Testing of humans with suspected rabies: Clinical diagnosis with Rabies RT-PCR of saliva, CSF and/or nuchal skin biopsy.

GENERAL AND SUPPORTIVE MEASURES

» Symptomatic and supportive treatment.
» Prompt cleansing of the bite wound.
» Do not suture puncture wounds.
» Seek advice.

Telephone Hotline	
National Institute of Communicable Diseases	011 386 6337 or 011 386 6000
After hours	082 883 9920

Post exposure prophylaxis

Caution
Start post exposure prophylaxis immediately.
Do not wait for confirmatory laboratory tests in the animal.

Post exposure prophylaxis may be lifesaving and should always be given if there is a reasonable suspicion that the animal may have been rabid.
The decision to give post exposure prophylaxis is based on the risk of rabies transmission, the species and behaviour of the animal and the nature of the bite. Diagnosis is largely clinical.

MEDICINE TREATMENT TO PREVENT INFECTION

Treatment depends on the risk category.

Risk Category	Type of exposure	Action
1.	» Touching or feeding animal. » Licking intact skin.	» None if reliable history.
2.	» Nibbling uncovered skin. » Superficial scratch without bleeding. » Licking broken skin.	» Wound treatment. » Give rabies vaccine. » Do not give rabies immunoglobulin (RIG). Stop vaccination if laboratory tests of animal are negative for rabies or animal, i.e. dog or cat, remains well after 10 days of observation.
3.	» Bites or scratches penetrating skin and drawing blood. » Licking of mucous membranes.	» Wound treatment. » Give rabies vaccine. » Give rabies immunoglobulin (RIG). » Give tetanus toxoid vaccine and antibiotic. Stop vaccination if laboratory tests of animal are negative for rabies or animal, i.e. dog or cat, remains well after 10 days of observation.

Wound treatment
Local wound care:
Flush wound thoroughly and clean with soap and water or sodium chloride 0.9% or chlorhexidine 0.05%.

- Povidone iodine 10%, topical.

For penetrating wounds:

- Tetanus toxoid (TT), IM, 0.5 mL.

Pre-emptive antibiotic only if hand is bitten or for extensive wounds or human bites. Data does not support the use of antibiotics in minor animal bites.

- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose of amoxicillin component, 12 hourly (amoxicillin/clavulanic acid in a ratio of 14:1).
    - Maximum dose of amoxicillin component: 1.5 g 12 hourly.
      (See annexure 1: Amoxicillin/Clavulanic weight band dosing table)

Rabies Vaccine

Must be given for category 2 and 3 bites.
Vaccine is administered on days 0, 3, 7, 14. Vaccine is ideally given as soon as possible after exposure, but should still be given if patient presents some time after the exposure. An additional dose on day 28 may be appropriate for immune compromised patients.
If vaccine administration is delayed > 48 hours, a double dose should be given initially.
Rabies vaccine is given IM but **never in the buttock**. Give into the deltoid muscle in older children & adolescents and antero-lateral aspect of the thigh in infants (dose as per available product instructions).

Rabies Immunoglobulin (RIG)

Must be given for all category 3 exposures.
In HIV-infected children also give for category 2 exposures.
Give rabies vaccine first.
Immunoglobulin must be given as soon as possible after exposure, but may be administered up to 7 days after the first vaccine is given.
Do not give RIG if the patient has previously received pre- or post-exposure prophylaxis.

- Rabies immunoglobulin (RIG).
    - Human RIG: 20 IU/kg.
        - Infiltrate as much as anatomically feasible around the wound.
        - Administer remaining immunoglobulin into deltoid muscle opposite to vaccine administration site.
        - If multiple wounds, dilute in sodium chloride 0.9% to 2–3 times so that **all** wounds are infiltrated.
        - **Do not** exceed maximum dose as antibody production to the vaccine is inhibited.
        - If unavailable, **do not** delay active immunisation.

REFERRAL

» Where prophylactic treatment is not immediately available.
» All cases of human clinical rabies for appropriate palliative care.

8.20 TETANUS

A35
*Notifiable condition.

DESCRIPTION

Tetanus is an acute spastic paralytic illness caused by tetanospasmin, the neurotoxin produced by *Clostridium tetani*. The toxin prevents neurotransmitter release from spinal inhibitory neurons.

Complications include:

- » asphyxia,
- » dehydration,
- » hyperpyrexia,
- » inability to suck, chew and swallow.
- » bronchopneumonia,
- » respiratory failure,
- » laryngospasm,

DIAGNOSTIC CRITERIA

The diagnosis is made on clinical grounds.

Clinical

- » Unimmunised/incompletely immunised child.
- » History of wound/trauma or unhygienic care of umbilical cord/stump.
- » Trismus
- » Stiffness of the neck, back and abdominal muscles.
- » Pharyngospasm, laryngospasm, dysphagia, inability to suck, chew and swallow which severely compromises feeding and eating activities.
- » Spontaneous muscle contractions/spasms or muscle contractions/ spasms triggered by minimal stimuli such as touch, sound, light or movement.
- » No involvement of sensorium, i.e. consciousness is not disturbed.
- » Autonomic nervous system instability with hypertension, tachycardia and dysrhythmias.

GENERAL AND SUPPORTIVE MEASURES

- » Admit to a high or intensive care unit, if available.
- » Ventilatory support, if needed.
- » Monitor:
  - > temperature,
  - > respiration,
  - > heart rate,
  - > blood gases,
  - > S_aO_2.
  - > blood pressure,
  - > blood glucose,
  - > electrolytes,
  - > acid-base status,
- » Protect the patient from all unnecessary sensory and other stimuli.
- » Ensure adequate hydration and nutrition.
- » Wound care and debridement/umbilical cord care.
- » Educate parents/caregivers regarding prevention of tetanus by vaccination.

MEDICINE TREATMENT

For hypoxia:

- Oxygen 100% by nasal cannula.

- Tetanus immunoglobulin, IM, 3000 IU as a single dose.

- Tetanus toxoid (TT), IM, 0.5 mL.
  - Not required in immunised patients who have received a booster within the past 5 years.

- Metronidazole, IV, 7.5 mg/kg/dose 8 hourly for 10 days duration.

For control of muscle spasms:

- Diazepam, IV, 0.1–0.2 mg/kg/dose 4–6 hourly, titrated according to response.
  - Do not exceed 10 mg/dose.
  - After improvement, use enteral form in a high care setting.
  - For ventilation and muscle relaxants, see Chapter 23: Paediatric Intensive Care, section 23.1: Rapid Sequence Induction.

After recovery from tetanus, the patients should be actively immunised as the disease does not confer immunity.

Prevention of tetanus

Minor wounds

Children with clean minor wounds do not require tetanus immunoglobulin or antibiotics. Tetanus vaccine should be given, except in fully immunised patients who have received a booster within the past 5 years.

For more severe wounds

If a child with a penetrating wound is not completely immunised:

- Tetanus immunoglobulin (TIG), IM.
  - If < 5 years of age: 75 IU.
  - If 5–10 years of age: 125 IU.
  - If > 10 years of age: 250 IU.

- Tetanus toxoid (TT), IM, 0.5 mL.
  - Not required in immunised patients who have received a booster within the past 5 years.

REFERRAL

» All cases.

8.21 TICK BITE FEVER

A79.9

DESCRIPTION

A tick-borne febrile illness caused by *Rickettsia conorii* or *africae.*
The rash appears on days 3–5 of the illness. It spreads from the extremities to the trunk, neck, face, palms, and soles within 36 hours.
The lesions progress from macular to maculopapular and may persist for 2–3 weeks.
Atypical cutaneous findings may occur.

Complications include:

- vasculitis,
- thrombosis,
- myocarditis,
- thrombocytopenia.
- encephalitis,
- renal failure,
- pneumonitis, and

DIAGNOSTIC CRITERIA

The diagnosis is made on clinical grounds.

Clinical

- Fever, headache, malaise, myalgia and arthralgia.
- Maculopapular rash that may involve the palms and soles.
- Eschar at the site of the tick bite is associated with regional lymphadenopathy and splenomegaly.

Investigations

- Initiate treatment empirically.
- If diagnostic uncertainty: PCR on blood sample or on swab from base of eschar.
- Do not perform serology.

GENERAL AND SUPPORTIVE MEASURES

- Remove tick as soon as possible after detection.

MEDICINE TREATMENT

Antibiotic therapy

Treatment must be started before confirmation of diagnosis.

Severe disease:

- Doxycycline, oral.
  - If < 50 kg: 4 mg/kg/24 hours in 2 divided doses on the first day, then 2 mg/kg/24 hours in 2 divided doses for second day.
  - If > 50 kg: 100 mg 12 hourly for 2 days.

Then switch to:

- Azithromycin, IV/oral, 10 mg/kg daily for 3 days.

Mild to Moderate disease:

- Azithromycin, IV/oral, 10 mg/kg daily for 3 days.

REFERRAL

» Patients not responding to adequate therapy.
» Patients with complications.

8.22 TOXOPLASMOSIS

B58.9

DESCRIPTION

Rarely occurs in children caused by infection with *Toxoplasma gondii*
Usually presents as encephalitis, with focal neurological abnormalities occurring in association with headache.
Ocular and pulmonary disease is also seen.

DIAGNOSTIC CRITERIA

Investigations

» Diagnosis may be made on blood and CSF serology.
» CSF PCR for toxoplasmosis may also be helpful.
» CT scan brain usually reveals multiple bilateral, focal, hypodense ring-enhancing lesions.

REFERRAL

» All cases.

8.23 TYPHOID

A01.1
*Notifiable condition.

DESCRIPTION

A systemic disease caused by *Salmonella typhi*.

DIAGNOSTIC CRITERIA

Clinical

» fever,
» headache,
» diarrhoea or constipation,
» abdominal pain or tenderness,
» cough,
» delirium,
» meningismus,
» anorexia,
» vomiting,
» ileus,
» epistaxis,
» hepatomegaly and/or splenomegaly,
» stupor.

Investigations
» Leucopenia, anaemia and thrombocytopenia.
» Positive cultures from blood (1st week), stool (after 1st week), urine and bone marrow.
» Serology not recommended.

GENERAL AND SUPPORTIVE MEASURES
» Isolate patient until eradication confirmed.
» Correct and maintain fluid and electrolyte status.

Collect 3 stool samples: 1 week after completion of treatment and every 48 hours thereafter.

MEDICINE TREATMENT
Note:
Relapse and carrier state may occur despite adequate therapy.

Initiate therapy with:
- Ceftriaxone 100 mg/kg daily for 10 days, consider 14 days for more severe cases.
  - Maximum: 2 g/dose.

Once patient is stable, consider switching to oral ciprofloxacin based on clinical response and susceptibility testing results:
- Ciprofloxacin 15 mg/kg/dose 12 hourly for 7–10 days.

Retreatment
If any one of the 3 follow-up stool samples are positive for *S. typhi*: retreat and repeat stool sampling 1 week later.
If any of these 3 samples are positive for *S. typhi*: treat for carriage (ciprofloxacin x 4–6 weeks).
Check stool cultures monthly.

REFERRAL
» Inadequate response to treatment.
» Patients with complications.
» Chronic carriers (stool positive x ≥ 12 months).

8.24 NON-TYPHOID SALMONELLA (NTS)
A02.9

DESCRIPTION
Present as:
» gastroenteritis, or
» extra-intestinal (invasive) disease.

DIAGNOSTIC CRITERIA

Clinical

» Self-limiting mucosal intestinal disease presenting with diarrhoea and vomiting in immunocompetent patients.
» Young infants (< 3 months) and immunodeficient children (especially HIV-infected children) are prone to invasive, often recurrent disease.
» Invasive disease includes bacteraemia (fever), osteomyelitis and meningitis.
» There is also an association of invasive NTS with malaria and severe anaemia.

Investigations

» Positive blood cultures, less commonly, stool, urine and bone biopsy.

GENERAL AND SUPPORTIVE MEASURES

» Correct and maintain fluid and electrolyte status.

MEDICINE TREATMENT

Note:
Relapse may occur despite adequate therapy. Antibiotic therapy in NTS gastroenteritis may prolong excretion of Salmonella.

Antibiotic therapy is **not** generally recommended for non-invasive disease. However, in infants < 3 months of age and severely immunocompromised children at high risk of developing invasive disease, treat as for invasive disease.

Invasive disease

If < 1 month of age:

- Cefotaxime, IV/IM.

Gestational age	Postnatal age	Dose
< 32 weeks	< 14 days	50 mg/kg/dose every 12 hours
	14–28 days	50 mg/kg/dose every 8 hours
≥ 32 weeks	≤ 7 days	50 mg/kg/dose every 12 hours
	8–28 days	50 mg/kg/dose every 8 hours

OR

If > 1 month of age:

- Ceftriaxone, IV, 100 mg/kg once daily, (maximum 4 g/day).
  Duration:
  - Bacteraemia: 10–14 days.
  - Acute osteomyelitis: 4–6 weeks.
  - Meningitis: 4 weeks.

If cephalosporin resistance reported, treat according to sensitivity.

REFERRAL

» Inadequate response to treatment.
» Patients with complications.

8.25 VARICELLA (CHICKEN POX)

B01

DESCRIPTION

An acute, highly contagious, viral disease caused by herpes varicella-zoster. It spreads by infective droplets or fluid from vesicles. One attack confers permanent immunity. Varicella is contagious from about 2 days before the onset of the rash until all lesions crusted.

Re-activation of the virus may appear later as herpes zoster or shingles (in children, consider immunosuppression if this occurs).
Incubation period is 2–3 weeks.

Complications are more common in immunocompromised patients and include:

» secondary skin infection,
» necrotising fasciitis,
» pneumonia,
» encephalitis,
» haemorrhagic varicella lesions with evidence of disseminated, intravascular coagulation.
» Two important bacteria causing complications are *Staphylococcus aureus* and *Streptococcus pyogenes*.

DIAGNOSTIC CRITERIA

Clinical

» Mild headache, fever and malaise.
» Characteristic rash.
» The lesions progress from macules to vesicles in 24–48 hours.
» Successive crops appear every few days.
» The vesicles, each on an erythematous base, are superficial, tense 'teardrops' filled with clear fluid that dries to form fine crusts.
» The rash is more profuse on the trunk and sparse at the periphery of extremities.
» At the height of eruption, all stages (macules, papules, vesicles and crusts) are present at the same time.
» The rash lasts 8–10 days and heals without scarring, unless secondarily infected.
» Mucous membranes may be involved.
» Pruritus may be severe.
» Patients are contagious from 1–2 days before onset of the rash until crusting of lesions.

GENERAL AND SUPPORTIVE MEASURES

» Isolate the patient.
» Maintain adequate hydration.

MEDICINE TREATMENT

Antiviral therapy

Indicated for immunocompetent patients with complicated varicella and for all immunocompromised patients.
Initiate as early as possible, preferably within 24 hours of the appearance of the rash.

Neonates, immunocompromised patients and all cases with severe chickenpox (not encephalitis):

- Aciclovir, oral, 20 mg/kg/dose 6 hourly for 7 days.
  - Maximum dose: 800 mg/dose.

In severe cases or in cases where oral medicine cannot be given:

- Aciclovir, IV, 8 hourly administered over 1 hour for 7 days.
  - If < 12 years: 20 mg/kg/dose 8 hourly.
  - If > 12 years: 10 mg/kg/dose 8 hourly.

For encephalitis:
See section 8.13: Meningo-encephalitis/encephalitis, acute viral.

For mild pruritus:

- Calamine lotion, topical, applied 8 hourly.

For severe pruritus:

- Less than 2 years: Chlorphenamine, oral, 0.1 mg/kg 6–8 hourly for 24–48 hours.
- Over 2 years: Cetirizine, oral, 2.5–5 mg 12–24 hourly.

Secondary skin infection

- Cephalexin, oral, 12.5 mg/kg/dose, 6 hourly for 5 days.

Prophylaxis

Post exposure prophylaxis must be given to:
Neonates whose mothers develop varicella from 5 days before delivery to 2 days after delivery:

- Varicella-zoster immunoglobulin, IM, 1 mL (100 units) given within 96 hours of exposure.

If varicella-zoster immunoglobulin is not available:

- Aciclovir, oral, 20 mg/kg/dose 6 hourly for 10 days.

Note:
In neonates, prophylaxis may not prevent disease.

Infants and children > 28 days:

Immunocompromised children exposed to varicella:

- Aciclovir, oral, 20 mg/kg/dose 8 hourly for 10 days given in the second week after exposure.

Hospitalised immunocompetent children exposed to varicella (to limit spread).

- Varicella-zoster vaccine, IM, 0.5 mL given within 72 hours of exposure.

OR

- Aciclovir, oral, 20 mg/kg/dose 8 hourly for 10 days given in the second week after exposure.

REFERRAL

» Patients with complications.

8.26 ZOSTER

B02

DESCRIPTION

A vesicular eruption in a dermatomal pattern, due to reactivation of varicella-zoster virus.

Occurs commonly in immunocompromised children and occasionally in immunocompetent children.

DIAGNOSTIC CRITERIA

Usually made on clinical grounds.

Investigations

» Confirm diagnosis by varicella-zoster PCR.

GENERAL AND SUPPORTIVE MEASURES

» Isolate the patient.

MEDICINE TREATMENT

Within 24 hours of the appearance of the rash for less severe cases:

- Aciclovir, oral, 20 mg/kg/dose 6 hourly for 7 days.
  - Maximum dose: 800 mg/dose.

If oral treatment cannot be taken and for severe cases:

- Aciclovir, IV, 8 hourly administered over 1 hour for 7 days.
  - < 12 years: 20 mg/kg/dose.
  - > 12 years: 10 mg/kg/dose.

For post-herpetic neuralgia, see Chapter 20: Pain Control.

REFERRAL

» Disseminated zoster.

8.27 SEPSIS

A41.9

For neonatal sepsis, see Chapter 19: Prematurity and Neonatal Conditions, section 19.5.2: Septicaemia of the newborn.

DESCRIPTION

Severe sepsis is an uncontrolled inflammatory response as a result of suspected or proven infection.

DIAGNOSTIC CRITERIA

Clinical

» A systemic inflammatory response with at least two of the following four criteria, one of which must be abnormal temperature or leucocyte count:
  > core temperature of < 36 ºC or > 38.5 ºC,
  > tachycardia,
  > tachypnoea,
  > elevated leucocyte count.

  PLUS one of the following:
  > cardiovascular dysfunction,
  > acute respiratory distress syndrome, or
  > ≥ 2 other organ dysfunctions.

Investigations

» Blood culture and identify focus of infection, e.g. osteomyelitis, abscess.
» Investigate for malaria, especially in endemic areas, or if there is a relevant travel history.
» Where meningitis due to meningococcus is suspected, i.e. with petechial rash, lumbar puncture is contraindicated (see Chapter 13: The Nervous System, section 13.12: Lumbar puncture). Do petechial scrapes and blood culture to confirm diagnosis.

GENERAL AND SUPPORTIVE MEASURES

» For suspected meningococcaemia: Notifiable condition and requires isolation for 24 hours after commencement of appropriate antibiotics.
» Admit to a high care area.
» Early recognition and treatment of septic shock.
» Antimicrobials do not penetrate necrotic tissue or abscesses, so debridement, incision and drainage are essential aspects of care.

MEDICINE TREATMENT

Empiric antibiotic therapy

Choice of antibiotic depends on the severity of the condition and predisposing factors.

- Ceftriaxone, IV, 100 mg/kg, once daily for 7 days.

Confirmed meningococcal septicaemia

- Benzylpenicillin (Penicillin G), IV, 100 000 units/kg/dose immediately, then 4 hourly for 7 days.

Suspected staphylococcal infection (e.g. osteomyelitis)

- Cloxacillin, IV, 50 mg/kg/dose 6 hourly.

PLUS

- Ceftriaxone, IV, 100 mg/kg, once daily.

Reconsider choice and descalation of antibiotics, aiming for monotherapy where possible, when the results of cultures become available or if the child does not improve.

Continue IV antibiotics until there is a good clinical response and laboratory markers of infection improve (usually less than a week). Oral antibiotics are then appropriate.

See section 8.28: Staphylococcal septicaemia, for management of invasive *S. aureus* infections.

Nosocomial sepsis: Manage according to the background microbiological flora within your institution.

Septic shock

See Chapter 1: Emergencies and Trauma, section 1.1.8: Shock.

REFERRAL

» Septicaemia with complications.
» Patients requiring intensive care.
» Patients requiring debridement of necrotic areas or drainage of collections.

8.28 STAPHYLOCOCCAL SEPTICAEMIA

A41.2

DESCRIPTION

Staphylococci cause disease by direct invasion of tissues with liberation of toxins. Septicaemia may occur when haematogenous dissemination occurs from a focus of infection.

DIAGNOSTIC CRITERIA

Clinical

Features of septicaemia should raise an index of suspicion of staphylococcal infection.

Suggestive features of staphylococcal infection include:
» presence of abscesses,
» erythema of palms and soles,
» drip site infections,
» osteomyelitis,
» septic arthritis, and
» endocarditis.

Investigations
» Send pus for culture and sensitivity.
» Blood cultures are frequently negative in serious staphylococcal infection, a finding that highlights the need for performing cultures on other specimens.

GENERAL AND SUPPORTIVE MEASURES
» Surgical drainage or aspiration of pus.
» If infection is associated with a foreign body, such as an intravenous catheter, remove the catheter and submit the tip for culture and sensitivity.

MEDICINE TREATMENT
When *S. aureus* isolates are likely to be the cause of infection, the most appropriate agents to administer for empiric treatment are based on the relative frequency of community associated – methicillin resistant staphylococcus aureus (CA-MRSA) isolates in the particular community.

Sensitive staphylococcal bacteraemia:
- Cloxacillin, IV, 50 mg/kg/dose 6 hourly for at least 14 days; longer courses often required.

Sensitive staphylococcus (bone and joint):
- Cloxacillin, IV, 50 mg/kg/dose 6 hourly. Can transition to oral therapy once there is sustained clinical improvement, resolution of fever and CRP < 30 mg/L.
  - Septic arthritis: 2–4 weeks of treatment.
  - Acute osteomyelitis: 4–6 weeks of treatment.
  - Infective endocarditis: see Chapter 4: Cardiovascular System, section 4.3: Endocarditis, infective.

Methicillin resistant staphylococci (proven/suspected):
- Vancomycin, IV, 15 mg/kg/dose, 6 hourly infused over 1 hour.
  - Where available, therapeutic drug level monitoring recommended:
    - Check vancomycin trough level within 1 hour before 4th or 5th dose.
    - Adjust dose to keep trough level within recommended range (severe infections 15–20 µg/mL, less severe infections 10–15 µg/mL).

REFERRAL

» Severe sepsis with organ dysfunction.
» Septic shock after resuscitation.
» Staphylococci resistant to above antibiotics.
» Patients requiring debridement of necrotic areas or drainage of collections.

8.29 ARTHRITIS, SEPTIC (PYOGENIC)

M00.9

DESCRIPTION

Septic arthritis may occur as a result of haematogenous seeding of the synovium during transient periods of bacteraemia.
Septic or pyogenic arthritis is often part of a generalised septicaemia which may involve more than one joint and is caused by pyogenic micro-organisms. The organisms involved vary:

» Neonates – *S. aureus*, Group B Streptococci, *E. coli*, fungi.
» Infants/children – *S. aureus*, *H. influenzae*, Group A Streptococci, *S. pneumoniae, Kingella kingae.*
» Adolescents (sexually active) – *N. gonorrhoea.*
» Chronic septic arthritis – *Brucella*, tuberculosis, atypical mycobacteria, fungi and other uncommon organisms.

DIAGNOSTIC CRITERIA

The diagnosis is largely clinical and confirmed by finding pus in the joint space.

CAUTION
Do not carry out needle aspiration in haemophiliacs.

Clinical

» Fever, local pain, loss of function and toxic looking child.
» Subtle, non-specific signs of sepsis early in the course of the disease, especially in neonates.
» Local tenderness, warmth, swelling at a joint with restriction of passive and active movement.
» Malaise, irritability, feeding problems and pseudo-paralysis.
» If lower extremities are involved, development of a limp or refusal to bear weight.

Investigations

» Blood cultures prior to antibiotic administration.
» Aspiration of pus from the joint space under ultrasound guidance, if possible, and submit for microscopy, Gram stain, culture and sensitivity.
» Raised CRP and white cell count and/or ESR.

GENERAL AND SUPPORTIVE MEASURES

» Septic arthritis of the hip (emergency) requires prompt open surgical drainage at the time of presentation, in consultation with an orthopaedic surgeon.
» Manage most infections of other sites by repeated aspiration or open drainage (not antibiotic instillation), if frank pus is obtained on initial diagnostic aspiration.
» Immobilise affected limb in position of function.
» Identify other effects of septicaemia or haematogenous spread and treat appropriately.
» Supportive and symptomatic care.

MEDICINE TREATMENT

Antibiotic therapy

» Minimum duration of therapy: 4–6 weeks.

IV antibiotics

Initiate IV antibiotic treatment immediately.

Adjust antibiotic therapy based on culture results or if response to empiric antibiotic treatment is unsatisfactory.

Continue with IV antibiotics until there is evidence of good clinical response and laboratory markers of infection improve. Once clinical improvement and inflammatory markers are normalising, patients can be switched to oral antibiotic therapy.

Neonates:

- Cloxacillin, IV, 50 mg/kg/dose.
  - If 1st week of life: 12 hourly.
  - If 2nd–4th week of life: 8 hourly.
  - If > 4 weeks old: 6 hourly.

PLUS

- Cefotaxime, IV.

Gestational age	Postnatal age	Dose
< 32 weeks	< 14 days	50 mg/kg/dose every 12 hours
	14–28 days	50 mg/kg/dose every 8 hours
≥ 32 weeks	≤ 7 days	50 mg/kg/dose every 12 hours
	8–28 days	50 mg/kg/dose every 8 hours

1 month to < 3 months:

- Cloxacillin, IV, 50 mg/kg/dose 6 hourly.

PLUS

- Ceftriaxone, IV, 100 mg/kg, once daily.

Infants > 3 months and children:

- Cloxacillin, IV, 50 mg/kg/dose 6 hourly.

If gram-negative organisms are seen on Gram stain, or when clinically suspected, e.g. sickle cell disease:

ADD

- Ceftriaxone, IV, 100 mg/kg, once daily.

Special Circumstances

If MRSA, replace cloxacillin with vancomycin.

- Vancomycin IV, 15 mg/kg/dose administered over 1 hour given 6 hourly.
  - Where available, vancomycin doses should be adjusted on the basis of therapeutic drug levels.
    - Trough levels (taken immediately prior to next dose), target plasma level 15–20 µg/mL.

Oral antibiotics

- Can transition to oral therapy once there is sustained clinical improvement, resolution of fever and CRP < 30 mg/L.
  - Duration: 2–4 weeks of treatment.

Antibiotics according to sensitivities:

- Clindamycin, oral, 6 mg/kg/dose 6 hourly.

OR

For children able to swallow a capsule:

- Flucloxacillin, oral, 12.5–25 mg/kg/dose, 6 hourly.

PLUS

Corticosteroids

- Dexamethasone, IV, 0.15 mg/kg 6 hourly for 4 days.

LoE I[3]

For pain and inflammation:

See Chapter 20: Pain control.

REFERRAL

» Multi-organ involvement.
» Failure to achieve progressive improvement on treatment.
» Rehabilative care including occupational and physiotherapy.

8.30 ARTHRITIS, JUVENILE IDIOPATHIC

M08.0

See Chapter 12: Rheumatology and Vasculitides, section 12.2: Juvenile idiopathic arthritis (JIA).

8.31 OSTEITIS/OSTEOMYELITIS, ACUTE

M86.1

DESCRIPTION

Most cases result from haematogenous deposition of organisms in the bone marrow after a transient bacteraemic episode. Osteomyelitis most commonly begins in the metaphyses of long bones, which are highly vascular. The spread of infection through the epiphysis can result in septic arthritis.

The organisms involved vary:

» Neonates: *S. aureus*, Group B Streptococci, gram-negative (*E. coli*).
» Infants/children: *S. aureus*, *H. influenzae*, Group A Streptococci, *S. pneumoniae.*
» Traumatic direct infection: *P. aeruginosa* (penetrating foot wounds).
» Co-existing medical conditions, e.g. diabetes, HIV, leucopenia: *M. tuberculosis*, fungi.
» Sickle cell disease: Salmonella, pneumococcus.

DIAGNOSTIC CRITERIA

Clinical

» Local pain and tenderness, loss of function, general toxicity and fever.
» If lower extremities are involved (development of a limp or refusal to bear weight).
» In neonates, early signs may be subtle or non-specific, e.g. irritability, feeding problems and pseudoparalysis.
» Investigate for multi-organ disease, e.g. endocarditis, pericarditis and pneumonia.

Investigations

Diagnostic

» Aspiration of pus for microscopy, Gram stain, culture and sensitivity.
» **Blood culture and full blood count –** raised white cell count.
» CRP

The following may be helpful:

» X-ray after 2 weeks.
» Bone scan (Tc99).
» MRI

GENERAL AND SUPPORTIVE MEASURES

» Immobilise affected limb in position of function.
» Supportive and symptomatic care.

MEDICINE TREATMENT

Antibiotic therapy

Minimum duration of therapy: 4–6 weeks.

IV antibiotics

Initiate IV antibiotic treatment immediately as diagnosis is made and blood and pus specimens have been collected.

Adjust antibiotic therapy based on culture results or if response to antibiotic treatment is unsatisfactory.

Where a single agent has been found to be sensitive, continue treatment on that single agent.

Continue with IV antibiotics until there is evidence of good clinical response and laboratory markers of infection improve. Once clinical improvement and inflammatory markers are normalising, patients can be switched to oral antibiotic therapy.

Ongoing fever suggests an undrained focus of pus.

Neonates:

- Cloxacillin, IV, 50 mg/kg/dose.
  - If 1st week of life: 12 hourly.
  - If 2nd–4th week of life: 8 hourly.
  - If > 4 weeks old: 6 hourly.

PLUS

- Cefotaxime, IV, 50 mg/kg/dose.

Gestational age	Postnatal age	Dose
< 32 weeks	< 14 days	50 mg/kg/dose every 12 hours
	14–28 days	50 mg/kg/dose every 8 hours
≥ 32 weeks	≤ 7 days	50 mg/kg/dose every 12 hours
	8–28 days	50 mg/kg/dose every 8 hours

Infants and children:

- Cloxacillin, IV, 50 mg/kg/dose 6 hourly.

PLUS

- Ceftriaxone, IV, 100 mg/kg, once daily.

Special Circumstances

If MRSA, replace cloxacillin with vancomycin.

- Vancomycin, IV, 15 mg/kg/dose administered over 1 hour, given 6 hourly.
  - Where available, vancomycin doses should be adjusted on the basis of therapeutic drug levels.
    - Trough levels (taken immediately prior to next dose), target plasma level 15–20 µg/mL.

Penetrating foot bone injuries: replace cefotaxime with ceftazidime plus an aminoglycoside:

- Ceftazidime, IV, 50 mg/kg/dose 6 hourly.

PLUS

- Gentamicin, IV, 6 mg/kg once daily.

- Where available, gentamicin doses should be adjusted on the basis of therapeutic drug levels.
  - Trough levels (taken immediately prior to next dose), target plasma level < 1 mg/L.
  - Peak levels (measured 1 hour after commencement of IV infusion or IM/IV bolus dose), target plasma level > 8 mg/L.

Oral antibiotics

- Can transition to oral therapy once there is sustained clinical improvement, resolution of fever and CRP < 30 mg/L.
  - 4–6 weeks of treatment.

ANTIBIOTICS ACCORDING TO SENSITIVITIES

- Clindamycin, oral, 6 mg/kg/dose 6 hourly.

OR

For children able to swallow a capsule:

- Flucloxacillin, oral, 25 mg/kg/dose, 6 hourly.

For pain and inflammation:
Refer to Chapter 20: Pain control.

REFERRAL

» Refer to specialist for confirmation of diagnosis, and consideration of surgical drainage.
» Multi-organ involvement.
» Failure to achieve progressive improvement on treatment.

8.32 COVID-19 IN CHILDREN

U07.1
*Notifiable condition.

Also see:
» National Department of Health – Guide to antigen testing for SARS-CoV-2 in South Africa, revision. January 2023.[4]

DESCRIPTION

SARS-CoV-2 infections range from asymptomatic to severe.
Case definition of COVID-19 (NICD/NDOH):
» A suspected COVID-19 case includes any person presenting with an acute (≤ 14 days) respiratory tract infection (cough, sore throat, shortness of breath, anosmia or dysgeusia) or other clinical illness compatible with COVID-19 including fever, weakness, myalgia or diarrhoea, or an asymptomatic person who is a close contact of a confirmed case.

Many children with COVID-19 will have no respiratory symptoms or fever, therefore, clinicians should consider COVID-19 in all acutely ill patients, especially those requiring admission.

DIAGNOSTIC CRITERIA

Testing

» Rapid antigen tests or PCR-based tests are both acceptable options to use for diagnosis. Rapid antigen tests may be performed on all patients for whom the PCR test is indicated in situations where no PCR tests are available, or when the PCR turnaround time limits the clinical or public health response utility.
» Upper respiratory tract (nasopharyngeal or oropharyngeal) samples should be sent on all patients. Sputum can be sent when available.
» A single positive rapid or PCR test is sufficient proof of COVID-19 infection.
» A negative rapid test should be followed up by a PCR test if the patient has symptoms compatible with COVID-19 or if the patient has had a recent exposure to a confirmed case.
» Due to poor sensitivity within the first 1–2 weeks after symptom onset, serology (antibody test) is not recommended for the diagnosis of acute COVID-19 infection.
» All healthcare workers should wear appropriate personal protective equipment (PPE) for both contact and respiratory precautions when obtaining specimens.
» Record and report and notify all confirmed COVID-19 cases.

Consider testing individuals suspected of having COVID-19 AND:

» Admitted to hospital with symptoms suggestive of COVID-19 disease.
» At high risk of severe disease (e.g. those with co-morbidities or immune-compromised).
» Suspected multisystem inflammatory syndrome in children (MIS-C).
» As the pandemic matures and evolves, testing recommendations may change – please consult NICD and NDoH sources for current recommendations.

Assessment

Use the following criteria to assess and classify the severity of the child's condition:

	MILD	MODERATE	SEVERE
Mental status	Normal	Restless	Irritable/lethargic
Feeding	Finishes feed	Does not finish feed	Unable to feed
Talking	Full sentences	Interrupted sentences	Unable to talk
Respiratory rate	< 40 < 1 year	40–60 < 2 months 40–50 2–12 months	> 60 < 2 months > 50 2–12 months

	MILD	MODERATE	SEVERE
(breaths/ minute)	< 30 1–5 years < 20 > 5 years	30–40 1–5 years 20–30 > 5 years	> 40 1–5 years > 30 > 5 years
Respiratory signs	No distress	Lower-wall indrawing	Lower-wall indrawing Grunting
SpO_2	≥ 95% in room-air	< 92% in room-air	< 92% in room-air Central cyanosis

GENERAL AND SUPPORTIVE MEASURES

Isolation

Isolation is recommended for laboratory-confirmed COVID-19 disease for 7 days from onset of symptoms or, if asymptomatic, from the date of testing.

MEDICINE TREATMENT

Ensure holistic care and review the immunization, nutritional, HIV and TB risk status of the child.

Exclude other differential diagnoses.

» Mild disease:
  > Provide symptomatic treatment at home.
  > Provide caregiver with a patient information pamphlet.
  > Implement suitable infection prevention and control practices.
  > Special investigations and imaging are not routinely indicated.
  > Routine micronutrient and vitamin supplementation are not recommended.
  > Do not prescribe steroids unless indicated for a concomitant non-COVID-19 condition, e.g. asthma exacerbation, croup.

» Moderate/Severe disease:
  > Admit for supportive in-patient care and consult/refer.
  > For pneumonia – see Chapter 15: Respiratory System, section 15.1.1: Pneumonia.
  > In addition, children with hypoxic pneumonia can be considered for corticosteroid therapy (discuss with specialist).
  > For acute diarrhoea – see Chapter 2: Alimentary Tract, section 2.2.4: Diarrhoea, Acute.

REFERRAL

Consult with a specialist for advice prior to referral when a child requires supportive care that cannot be safely and effectively provided at the current facility, including:

» Prior to prescribing corticosteroids.
» When the child requires ≥ 40% oxygen to maintain SpO_2 above 92%.
» If the child's clinical condition worsens.
» If the child meets criteria for Multisystem Inflammatory Syndrome in Children, (MIS-C) associated with COVID-19 (see below).

Discharge/De-isolation

Children can be discharged from hospital once they no longer require supplementary oxygen, are feeding well and can be safely cared for at home. They can be de-isolated when they are no longer likely to be shedding virus:

Mild disease	7 days from onset of symptoms.
Moderate/Severe disease	7 days after they are clinically stable, i.e. cessation of oxygen or return to baseline if receiving oxygen prior to SARS-CoV-2 infection.

8.32.1 MULTISYSTEM INFLAMMATORY SYNDROME IN CHILDREN (MIS-C)

U10.9

*Notifiable condition.

DESCRIPTION

A rare but serious inflammatory syndrome has been linked to COVID-19. Also known as Paediatric Inflammatory Multisystem Syndrome Temporally associated with SARS-CoV-2 infection (PIMS-TS) or Kawasaki-like syndrome. The syndrome occurs after resolution of acute COVID-19 or following asymptomatic SARS-CoV-2 infection.

DIAGNOSTIC CRITERIA

Clinical presentation varies but the condition should be considered in children and adolescents (0–19 years of age) with fever ≥ 3 days **AND** 2 of the following:

» Rash or bilateral non-purulent conjunctivitis or mucocutaneous inflammation signs (oral, hands or feet).
» Hypotension or shock.
» Features of myocardial dysfunction, pericarditis, valvulitis, or coronary abnormalities (including ECHO findings or elevated troponin/NT-proBNP).
» Evidence of coagulopathy (by PT, PTT, elevated D-dimers).
» Acute gastrointestinal problems (diarrhoea, vomiting, or abdominal pain).
AND
» Elevated markers of inflammation such as ESR, C-reactive protein, or procalcitonin.
AND
» No other obvious microbial cause of inflammation, including bacterial sepsis, staphylococcal or streptococcal shock syndromes.
AND
» Evidence of COVID-19 (RT-PCR, antigen test or IgG serology positive), or likely contact with patients with COVID-19.

TREATMENT

» If the child meets the above case definition, evaluate for shock and manage accordingly (see Chapter 1: Emergencies and Trauma, section 1.1.8: Shock).
» Consult a tertiary centre for advice and referral.

REFERRAL

» All cases.

8.32.2 NEONATAL ISSUES RELATED TO COVID-19

DESCRIPTION

» Most neonates born to mothers with COVID-19 will not be seriously affected, although prematurity seems to be more common.
» Vertical and breast milk associated transmission are exceedingly rare.

GENERAL AND SUPPORTIVE MEASURES

» Preferably, do not separate babies from their mothers.
» Encourage breastfeeding unless contra-indicated for other medical reasons.
» Medical care, if required, should preferably be offered without separating babies from their caregivers (e.g. phototherapy, naso-gastric feeds, blood sugar monitoring, parenteral antibiotics) – the ability to do this will depend on local circumstances.
» If separation is unavoidable, keep isolated in a closed incubator with appropriate non-pharmaceutical infection control measures until discharge, 7 days from onset of mother's symptoms or from birth (whichever comes first).
» Routine neonatal testing for SARS-CoV-2 infection is unnecessary, however, if symptoms not explained by other neonatal diseases develop, then nasopharyngeal sampling for SARS-CoV-2 PCR testing is appropriate.

MEDICINE TREATMENT

Concomitant neonatal conditions: As per existing neonatal guidelines (see Chapter 19: Neonatal Conditions).

» For suspected/confirmed COVID-19: supportive therapy as needed.

References

[1] Fluconazole dose: South African Medicines Formulary. 12th Edition. 2016.

2 Artesunate, IV (dosing for < 20 kg): Hendriksen IC, Mtove G, Kent A, Gesase S, Reyburn H, Lemnge MM, et al. Population pharmacokinetics of intramuscular artesunate in African children with severe malaria: implications for a practical dosing regimen. Clin Pharmacol Ther. 2013 May;93(5):443-50. https://pubmed.ncbi.nlm.nih.gov/23511715/

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[3] Dexamethasone: Odio CM, *et. al*. Double blind, randomized, placebo-controlled study of dexamethasone therapy for hematogenous septic arthritis in children. Pediatr Infect Dis J. 2003, 22:883-886; Harel L, *et. al.* Dexamethasone therapy for septic arthritis in children. J Pediatr Orthop. 2011; 31:211-215.

[4]National Department of Health. Guide to antigen testing for SARS-CoV-2 in South Africa, revision. January 2023. https://sacoronavirus.co.za/wp-content/uploads/2023/01/Covid-19-updated-testing-guidelines-PROF-NDJEKA.pdf

CHAPTER 9

HUMAN IMMUNODEFICIENCY VIRUS INFECTIONS

9.1 HUMAN IMMUNODEFICIENCY VIRUS INFECTIONS

B20–24

Comprehensive guidelines are available for ART and the care of children with HIV infection in the 2023 ART Clinical Guidelines for the Management of HIV in Adults, Pregnancy and Breastfeeding, Adolescents, Children, Infants and Neonates.[1]

DESCRIPTION

Human Immunodeficiency Virus (HIV) is a retrovirus infecting immune cells, especially CD4 T-lymphocytes. In advanced HIV disease, the body loses its ability to fight infections, and this stage is characterised by severe damage to organs, opportunistic infections, malignancies and very low CD4 counts.

In infants, most infections are vertically transmitted, but in adolescents and adults, sexual transmission is the usual route for new infections.

Infants born to mothers with HIV may be:

- HIV-infected.
- 'HIV-exposed':
  - At risk of being/becoming HIV-infected.
  - HIV-uninfected.

For the purpose of the ART guidelines:

- Children (< 10 years and < 30 kg): follow the Paediatric Antiretroviral Therapy (ART) Guidelines.
- Adolescents (10–19 years): follow the Adult and Adolescent ART Guidelines.

DIAGNOSTIC CRITERIA

All infants/children accessing care should have their HIV status determined.

- Patients with a previously positive HIV test and on ART should not be re-tested.
- Where mothers tested negative during pregnancy, maternal HIV status should be determined three-monthly whilst breastfeeding.

Confirmation of HIV infection

Children < 18 months:

- **Birth:** Do an HIV PCR at birth in all HIV-exposed infants.

» **10 Weeks:** Do an HIV PCR at 10 weeks of age (chronological age) in all HIV-exposed infants.
» **6 Months:** Do an HIV PCR at 6 months of age in all HIV-exposed infants.
» The HIV status of all children not already known to be HIV-exposed should be established by offering the mother an HIV test at any time point.
» **Post cessation of breastfeeding:** If the child is breastfed and previous HIV PCRs were negative, repeat testing 6 weeks after complete cessation of breastfeeding. (If the child is 18 months or older, do an HIV ELISA or rapid test).
» **Suspected symptomatic HIV infection:** If the child has evidence suggesting HIV infection at any time, even if the child has had a previous negative HIV PCR test, the child should be tested for HIV infection.
» If the HIV PCR is positive at any time point:
  > Confirm with a repeat HIV PCR test.
  > Initiate treatment while awaiting the second HIV PCR test result.

Children ≥ 18 months:

» **18 months:** Universal HIV testing at 18 months (HIV rapid test for ALL infants regardless of HIV exposure, except in those who previously tested HIV-positive and are on ART).
» **Suspected symptomatic HIV, possible HIV, HIV unknown or Ongoing HIV exposure:** Do an HIV rapid or ELISA test.
» If the first rapid test is positive, confirm the result with:
  > An HIV PCR test if the infant is between 18–24 months.
  > A second rapid test using a different manufacturer kit, preferably on a different blood specimen, if the infant is > 24 months.

Note:
Rapid tests may be less reliable in children with advanced disease. If clinical findings suggest HIV infection, but the rapid test is negative, send a further specimen of blood to the laboratory for formal HIV ELISA testing. If test results are still equivocal, do an HIV PCR test.

Note:

» A child cannot be confirmed as HIV-negative until at least 4–6 weeks after other potential HIV exposure (including cessation of breastfeeding). Exposure to ART through prophylaxis (NVP/AZT) or maternal ART may affect the sensitivity of HIV PCR tests.
» Manage children with discordant or indeterminate HIV test results as per the National Department of Health Guidelines for the Prevention of Mother to Child Transmission of Communicable Infections (HIV, Hepatitis, Listeriosis, Malaria, Syphilis and TB).

9.1.1 THE HIV-EXPOSED INFANT

Z20.6

DESCRIPTION

Infants and children born to mothers living with HIV until HIV infection in the infant or child is reliably excluded and the infant or child is no longer exposed through breastfeeding are defined as HIV-exposed.

Transmission of HIV infection may occur during pregnancy, during delivery, or via breastfeeding. Vertical transmission prevention (VTP) can be effectively carried out with a very high success rate by fully suppressing the mother's viral load with ART and giving prophylactic antiretroviral therapy to the infant. Maternal viral loads must be done, checked, recorded and acted upon during pregnancy and breastfeeding. The risk of breast milk transmission remains significant when the mother's viral load cannot be suppressed.

The VTP strategies include the initiation of ART in the mother (either pre- or post-conception) and the provision of HIV post-exposure prophylaxis to the infant. The mother's response to ART by the time of delivery is measured by the delivery VL. The delivery VL will determine the risk profile of the infant at birth. The risk profile of the infant (low-risk or high-risk) will determine the appropriate infant prophylaxis regimen that should be prescribed. All HIV-exposed infants will be considered high-risk until the results of the delivery viral load are known. Therefore, if the delivery VL result is not available at the time of discharge, the HIV-exposed infant will be considered high-risk until the result can be reviewed at the 3–6 day postnatal visit.

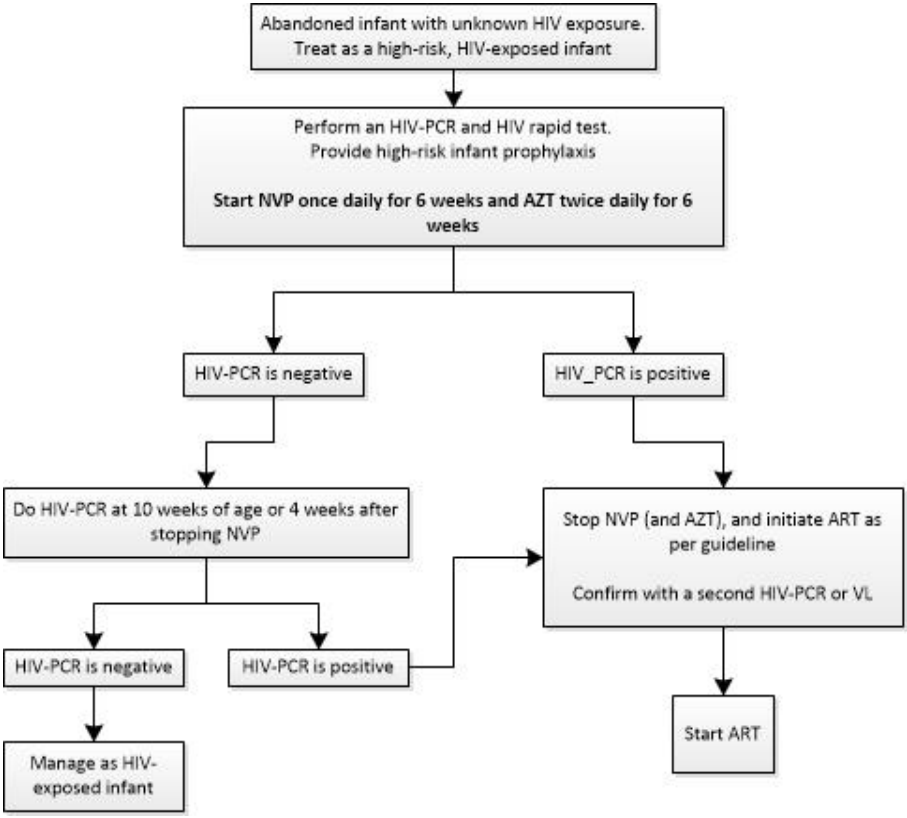
MANAGEMENT OF HIV-EXPOSED INFANTS

Maternal VL	Risk profile	Prophylaxis	Comment
Maternal delivery VL as yet unknown at discharge from labour ward (results pending).	High-risk (until maternal delivery VL results become available)	Provide dual prophylaxis: AZT at birth and then twice daily for 6 weeks. NVP at birth and then daily for a minimum of 12 weeks.	All HIV-exposed infants will be considered high-risk until the final risk profile can be determined by the maternal delivery VL. If the maternal delivery VL result is not available at discharge from labour ward, review result at the 3–6 day postnatal visit and reclassify the infant accordingly.

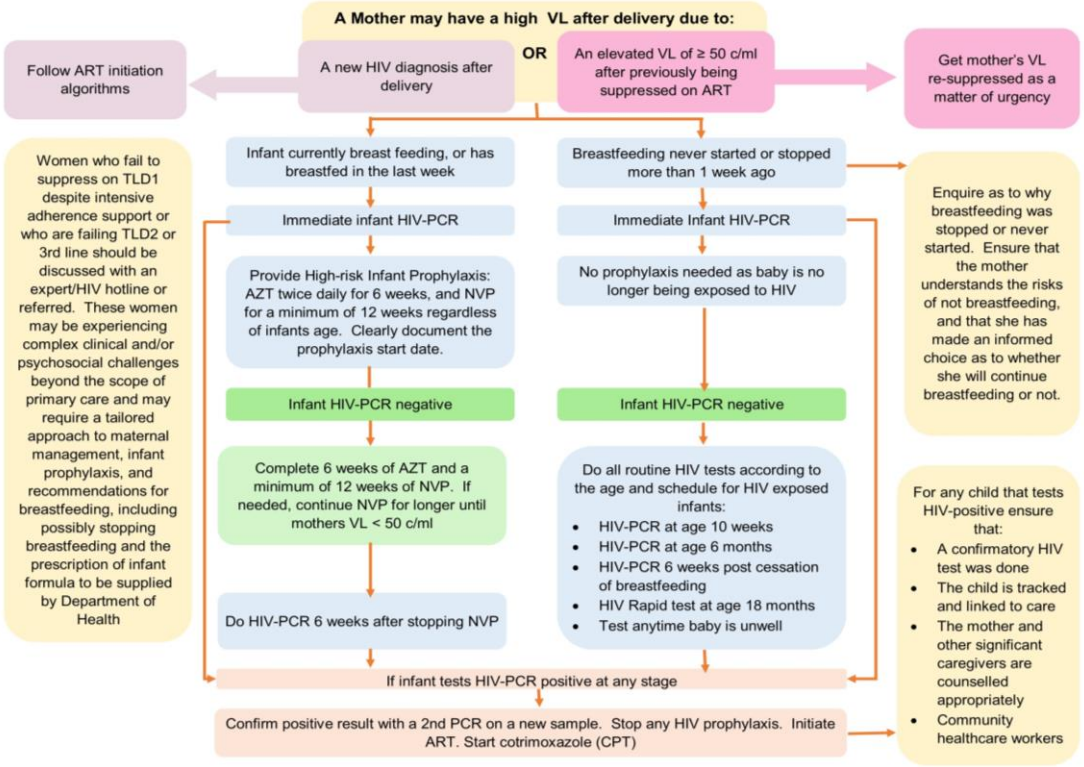
Maternal VL	Risk profile	Prophylaxis	Comment
			Dispense a full 6 weeks supply of dual prophylaxis. Ask the mother to return with all medication at the 3–6 day postnatal visit.
Maternal delivery VL ≥ 50 copies/mL in a breastfeeding mother.	High-risk	Provide dual prophylaxis: AZT at birth and then twice daily for 6 weeks. NVP at birth and then daily for a minimum of 12 weeks.	Do an ABCDE assessment and get the mother's VL re-suppressed as a matter of urgency. Stop infant NVP only after confirmation of maternal VL being < 50 copies/mL, or until 4 weeks after cessation of all breastfeeding.
Maternal delivery VL ≥ 50 copies/mL in a mother who is exclusively formula feeding her infant from birth.*	High-risk	Provide dual prophylaxis: AZT at birth and then twice daily for 6 weeks. NVP at birth and then daily for 6 weeks.	Do an ABCDE assessment and get the mother's VL re-suppressed as a matter of urgency.
Maternal delivery VL < 50 copies/mL regardless of feeding choice.	Re-classify as low-risk.	Change to low-risk prophylaxis: NVP at birth and then daily for 6 weeks.	Affirm and encourage good adherence. Repeat maternal VL 6-monthly during breastfeeding.

***Non-breastfeeding mother diagnosed HIV-positive > 72 hours after delivery:** *Do not start the infant on prophylaxis. Start maternal ART. Perform an HIV PCR test on the infant and, if positive, initiate ART, if negative, continue to monitor HIV risk and perform HIV testing as above.*

Unknown maternal status



Management of high maternal viral load after delivery



Nevirapine (NVP) and Zidovudine (AZT) doses for an infant on PMTCT

- Nevirapine, oral, daily (syrup 10 mg/mL) and zidovudine, oral, twice daily (syrup 10 mg/mL).
    - Newborns ≥ 2 kg and term infants:

	Birth–6 weeks		***6 weeks–6 months***	***6–9 months***	***9–24 months***
	2.0–2.49 kg	≥ 2.5 kg			
NVP (Daily)	1 mL (10 mg) daily	1.5 mL (15 mg) daily	2 mL (20 mg) daily	3 mL (30 mg) daily	4 mL (40 mg) daily
AZT (Twice daily)	1 mL (10 mg) twice daily	1.5 mL (15 mg) twice daily	6 mL (60 mg) twice daily	Children > 6 months of age requiring AZT prophylaxis should use treatment doses.	

LoE I[2]

    - Preterm newborn < 2 kg:
        - Nevirapine, oral, daily:

Weight	**First 2 weeks after birth (mg of NVP)**	**After first 2 weeks after birth (mg of NVP)**
500 to < 625 g	1 mg	2 mg
625 to < 850 g	1.5 mg	3 mg
850 to < 1200 g	2 mg	4 mg
1.2 to < 1.5 kg	3 mg	5 mg
1.5 to < 2 kg	3.5 mg	6 mg
If the infant at the time of discharge is severely underweight-for-age (3 SD or 3 z-scores below the mean), give NVP according to weight (i.e. 4 mg/kg/dose daily) until in the normal weight-for-age range.		

        - Zidovudine, oral, twice daily:

Gestational age at birth	**First 2 weeks after birth**	**2–4 weeks after birth**	**4–6 weeks after birth**	**> 6 weeks after birth**
30–35 weeks	2 mg/kg	3 mg/kg	4 mg/kg	
< 30 weeks	2 mg/kg		3 mg/kg	4 mg/kg

LoE II[3,4,5]

See table above.

» Ideally, the birth HIV PCR test should be done before administration of infant NVP and AZT, but any delay in testing should not delay administration.

» Repeat the dose if the baby vomits.

» If the infant's HIV PCR is positive at any time, stop NVP and AZT, perform a second HIV PCR test and initiate ART immediately. Counsel the mother to continue breastfeeding.

ART Prophylaxis for infants who are unable to tolerate oral medication

Infants who are unable to tolerate oral medication/feeds should be initiated on intravenous zidovudine (AZT). On re-establishment of oral feeds/ medications, intravenous zidovudine should be stopped, and the infant should commence on the appropriate oral infant prophylaxis regimen. Ideally, gestational age should be used to determine the optimal dose.

Gestational Age	Approximate birth weight	AZT IV dosing for the first 14 days (If unable to tolerate oral agents)
≥ 35 weeks	≥ 2.5 kg	3 mg/kg body weight, IV every 12 hours
< 35 weeks	< 2.5 kg	1.5 mg/kg body weight, IV every12 hours

HIV TESTING

Age appropriate testing

» < 18 months – do an HIV PCR.
» ≥ 18 months – do a rapid HIV antibody test or ELISA.
  > Confirm the HIV test in children between 18–24 months with an HIV PCR.
  > Confirm the HIV test in children > 24 months with an HIV rapid test.

Routine testing for HIV-exposed children < 18 months:

» **Birth:** Do an HIV PCR at birth in all HIV-exposed infants.
» **10 Weeks:** Do an HIV PCR at 10 weeks of age (chronological age) in all HIV-exposed infants.
» **6 Months:** Do an HIV PCR at 6 months of age in all HIV-exposed infants.
» The HIV status of all children not already known to be HIV-exposed should be established by offering the mother an HIV test at any time point.
» **Post cessation of breastfeeding:** If the child is breastfed and previous HIV PCRs were negative, repeat testing 6 weeks after complete cessation of breastfeeding. (If the child is 18 months or older, do an HIV ELISA or rapid test).

Routine testing for all children ≥ 18 months:

» **18 months:** Universal HIV testing at 18 months (HIV rapid test for ALL infants regardless of HIV exposure, except in those who previously tested HIV-positive and are on ART).
» If the first rapid test is positive, confirm the result with:
  > An HIV PCR test if the infant is between 18–24 months.
  > A second rapid test using a different manufacturer kit, preferably on a different blood specimen, if the infant is > 24 months.

Testing for all children regardless of age or HIV-exposure status:

» **Symptomatic child/infant:** If the child has evidence suggesting HIV infection at any time, even if the child has had a previous negative HIV PCR test, the child should be tested for HIV infection using an age-appropriate HIV test (HIV PCR or rapid test).
» If the HIV test is positive at any time point:
  > Confirm with a repeat age-appropriate HIV test.
  > Initiate treatment while awaiting the second HIV test result.

Note:

» Repeat HIV PCR testing at 10 weeks and 6 months should be done on all HIV-exposed infants with a prior negative or indeterminate HIV PCR.
» Any infant with a positive birth HIV PCR should be urgently initiated on ART as per section 9.1.2: The HIV-Infected neonate.
» A child cannot be confirmed as HIV-negative until at least 4–6 weeks after other potential HIV exposure (including cessation of breastfeeding). Exposure to ART through prophylaxis (NVP/AZT) or maternal ART may affect the sensitivity of HIV PCR tests.
» Rapid tests may be less reliable in children with advanced disease. If clinical findings suggest HIV infection, but the rapid test is negative, send a further blood specimen to the laboratory for formal HIV ELISA testing. If test results are still equivocal, do an HIV PCR test.
» Patients already on ART should not have a repeat HIV antibody (rapid) test.

If an HIV PCR test is indeterminate or discordant, refer to the National Department of Health Guidelines for prevention of Mother to Child Transmission of Communicable Infections. 2023.

All HIV PCR results need to be followed-up as a matter of urgency.

Feeding advice

» It is strongly recommended that exclusive breastfeeding be initiated within 1 hour of birth and continued for the first 6 months of life, after which the child's nutritional requirements will require the introduction of complementary foods in addition to breastfeeding.
» Women living with HIV should be fully supported for ART adherence during the breastfeeding period and thereafter.
» Women with a VL > 50 copies/mL on TLD1 should continue breastfeeding while every effort is made to regain viral suppression. Their infants should receive high-risk prophylaxis during breastfeeding.
» The following may be indications to discontinue breastfeeding:
  > Infants of mothers who are failing TLD2.
  > Infants of mothers who are failing third-line PI-based treatment.
» Discuss appropriate feeding practices with the mother regarding the risks and benefits of continuing breastfeeding vs replacement feeding.

» The use of flash pasteurisation or 'Pretoria' pasteurisation to reduce HIV transmission is supported but may pose significant barriers to successful breast milk feeding due to the effort involved. For instance, it can be used as an interim measure during maternal mastitis.

Cotrimoxazole prophylaxis

Indications:

» According to the current guideline, only babies with a positive HIV PCR should be started or continued on cotrimoxazole prophylaxis as per section 9.1.2: The HIV-Infected neonate, medicine treatment, cotrimoxazole prophylaxis below.

9.1.2 THE HIV-INFECTED NEONATE (< 1 MONTH OF AGE)

B20-B24

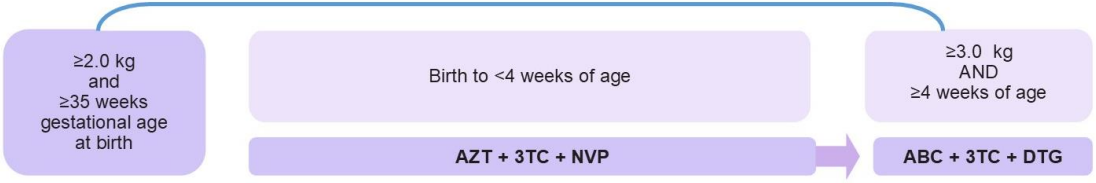
DESCRIPTION

Defined as an infant < 1 month of age, in whom HIV infection has been confirmed with two appropriate tests. For confirmation of HIV infection, see section 9.1: Human immunodeficiency virus infections.

MEDICINE TREATMENT

This treatment protocol is meant as a guide, and there is an allowance for flexibility after discussion with an expert.

Protocol for initiation of ART at < 4 weeks of age: HIV-infected neonates ≥ 2.0 kg & 35 weeks gestational age at birth



Baseline Assessment

- Clinical review
- Bloods: confirmatory HIV PCR (or HIV VL), CD4 count, FBC +/- HIV drug resistance test if mother failing treatment on TLD2 or a protease inhibitor regimen
- Counsel parent / caregiver
- Ensure mother on ART / advise on breastfeeding

Review after 1 week then 1-2 weekly

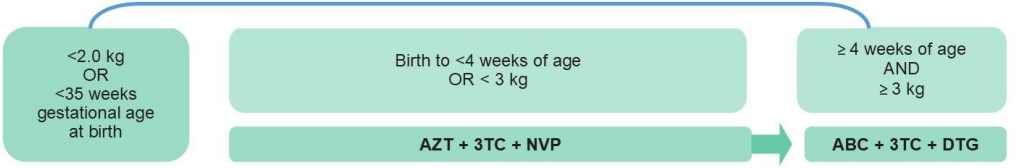
- Clinical review and counselling
- Check baseline blood results
- If indeterminate / negative confirmatory HIV PCR test result, refer to Guideline for Family-Centered Transmission Prevention of Communicable Infections

Review when 4 weeks of age

- Clinical review and counselling
- If <3 kg, assess reasons for poor weight gain & manage appropriately, continue ART with AZT (12 mg/kg/dose twice daily) + 3TC (4 mg/kg/ dose twice daily) + NVP (6 mg/kg/dose twice daily) until ≥3.0 kg
- If >3 kg, switch ART to ABC + 3TC + DTG (refer to ARV dosing chart for doses)
- Continue monitoring and evaluations as per section 9.1.3 of Paediatric Hospital Level EML

	Zidovudine (AZT)		Lamivudine (3TC)		Nevirapine (NVP)	
Available formulation	Solution 10 mg/mL		Solution 10 mg/mL		Solution 10 mg/mL	
Weight (kg) at birth	Dose		Dose		Dose	
	AM	PM	AM	PM	AM	PM
≥2.0 – <3.0	10 mg (1 mL)	10 mg (1 mL)	5 mg (0.5 mL)	5 mg (0.5 mL)	15 mg (1.5 mL)	15 mg (1.5 mL)
≥3.0 – <4.0	15 mg (1.5 mL)	15 mg (1.5 mL)	8 mg (0.8 mL)	8 mg (0.8 mL)	20 mg (2 mL)	20 mg (2 mL)
≥4.0 – <5.0	20 mg (2 mL)	20 mg (2 mL)	10 mg (1 mL)	10 mg (1 mL)	30 mg (3 mL)	30 mg (3 mL)

Protocol for initiation of ART at < 4 weeks of age: HIV-infected preterm infants < 2 kg & 35 weeks gestational age at birth



Baseline Assessment

- Clinical review
- Bloods: confirmatory HIV PCR (or HIV VL), CD4 count, FBC +/- HIV drug resistance test if mother failing treatment on TLD2 or a protease inhibitor regimen
- Counsel parent / caregiver
- Ensure mother on ART / advise breastfeeding recommended for all positive infants.

Review after 1 week then 1-2 weekly

- Clinical review an counselling
- Check baseline blood results
- If indeterminate / negative confirmatory HIV PCR test result, refer to Guideline for Family-Centered Transmission Prevention of Communicable Infections
- Monitor weight gain and adjust ARV doses

Review when ≥4 weeks of age

- Clinical review and counselling
- If <3 kg, continue AZT + 3TC + NVP
- If >3 kg, switch to ABC + 3TC + DTG (refer to ARV dosing chart for doses)
- Continue monitoring and evaluations

Gestational age at birth	Chronological age	Zidovudine (AZT)	Lamivudine (3TC)	Nevirapine (NVP)
		Solution 10 mg/mL	Solution 10 mg/mL	Solution 10 mg/mL
<30 weeks	Birth to < 4 weeks	2 mg/kg/dose twice daily	2 mg/kg/dose twice daily	2 mg/kg/dose twice daily
	> 4 weeks to < 8 weeks	3 mg/kg/dose twice daily	4 mg/kg/dose twice daily	4 mg/kg/dose twice daily
	> 8 weeks to < 10 weeks	12 mg/kg/dose twice daily		6 mg/kg/dose twice daily
≥ 30 to < 35 weeks	Birth to < 2 weeks	2 mg/kg/dose twice daily	2 mg/kg/dose twice daily	2 mg/kg/dose twice daily
	> 2 to <4 weeks	3 mg/kg/dose twice daily		4 mg/kg/dose twice daily
	> 4 to <6 weeks		4 mg/kg/dose twice daily	6 mg/kg/dose twice daily
	> 6 to < 8 weeks	12 mg/kg/dose twice daily		

Caregivers administering ARV medication to the child must be supplied with a syringe (1 mL or 2 mL) for each of the three ARVs and shown how to prepare and administer the correct dose. If possible, bottles and syringes should be colour-coded with stickers, and a sticker of the relevant colour should be used to mark the correct dose on the syringe.

LoE III[6]

9.1.3 THE HIV-INFECTED INFANT/CHILD (< 10 YEARS)

B20-24

DESCRIPTION

Defined as an infant or child in whom HIV infection has been confirmed with two appropriate tests.

For confirmation of HIV infection, see section 9.1: Human immunodeficiency virus infections.

GENERAL AND SUPPORTIVE MEASURES

Counselling is a vital part of the successful care of children with HIV infection and their families. Specific matters requiring attention are:

» The implications of the disease to the family.
» Implications of treatment, non-adherence and understanding of the condition and its care.
» The disclosure process within the family and extended family/friends should be encouraged. Help from family/friends is often useful.
» Disclosure to the child of appropriate age and maturity.

Treatment of mothers, caregivers and other family members:

» Always ask about the caregiver's health and the health of other members of the family.
» Ensure that mothers and other family members have timeous access to medical care, including ART.
» Encourage breastfeeding in all mothers with HIV-infected children, with the introduction of weaning foods from 6 months of age. Breastfeeding duration is recommended for 2 years or longer, as in HIV-unexposed children.
» Always ask, at every visit, about TB contacts and TB symptoms in all children and their caregivers.

STANDARDISED NATIONAL MONITORING FOR INFANTS AND CHILDREN WITH HIV

At initial diagnosis of HIV	Purpose
Confirm HIV status.	To ensure that the national testing algorithm has been followed.
Document weight, height, head circumference (HC if < 2 years of age) and development.	To monitor growth and development.
Screen for TB symptoms.	To identify TB co-infection.
Do CD4 count.	To determine eligibility for cotrimoxazole prophylaxis (CPT): < 1 year: CPT irrespective of CD4 count. 1–5 years: CPT if CD4 count < 25% or WHO Stage 2–4. > 5 Years: CPT if CD4 count < 200 cells/mm^3 or WHO Stage 2–4.
At the initiation of ART (baseline)	**Purpose**
Hb or FBC.	If < 8 g/dL, manage appropriately.
CD4 count (if not performed in the last 6 months).	Baseline assessment.
ALT (if jaundiced or on TB treatment).	To assess for liver dysfunction at baseline.
On ART	**Purpose**
Height, weight, head circumference (HC if < 2 years of age) and development.	To monitor growth and development stages. Adjust dosing at each visit as necessary according to weight gain.
Clinical assessment, including drug-related adverse events.	To monitor response to ART and exclude adverse effects.
CD4 count: At 1 year on ART, and then every 6 months until they meet the criteria to stop cotrimoxazole. Thereafter, stop CD4 count monitoring if the patient remains virologically suppressed.	To monitor response to ART and stop cotrimoxazole prophylaxis as indicated.

If not virologically suppressed, monitor CD4 count every 6 months.	
Viral load (VL): At month 3 on ART, after 12 months on ART, then every 12 months if virologically suppressed. More frequent monitoring (3–6 monthly) recommended in patients with treatment failure.	To monitor viral suppression on ART. To identify treatment failure and identify adherence problems.
If on AZT, Hb or FBC and differential WBC at months 3 and 6. Thereafter, repeat if clinically indicated.	To identify AZT-related anaemia.
If on a PI, cholesterol + triglyceride at month 3. If above the acceptable range, do fasting cholesterol and TGs, and obtain expert advice if still above the acceptable range.	To monitor for PI-related metabolic side effects.

MEDICINE TREATMENT

Cotrimoxazole prophylaxis

Indications:

» According to the current guideline, babies with a positive HIV PCR should be started and continued on cotrimoxazole prophylaxis until criteria for discontinuation are met.

- Cotrimoxazole (sulfamethoxazole/trimethoprim), oral, once daily (every day).

Recommended daily dosage by weight band	Dose of sulfa-methoxazole/ trimethoprim	Suspension (200/40 mg per 5 mL)	Single strength tablet (400/80 mg)	Double strength tablet (800/160 mg)
3 to 5.9 kg	100/20 mg	2.5 mL	¼ tablet	–
6 to 13.9 kg	200/40 mg	5 mL	½ tablet	–
14 to 24.9 kg	400/80 mg	10 mL	1 tablet	½ tablet
25 kg	800/160 mg	–	2 tablets	1 tablet

Discontinuation:

» If HIV-infected, the immune system is fully reconstituted on ART and child > 1 year of age (i.e. child 1 to 5 years of age: CD4 > 25% or child > 5 years of age: CD4 > 200 cells/mm^3 on two tests at least 3–6 months apart).

Immunisation, deworming and vitamin A program

» Continue deworming and vitamin A programme as in the HIV-negative child.

» Continue immunisation as in the HIV-negative child. See the Standard Treatment Guidelines and Essential Medicines List for Primary Health Care, Chapter 13: Immunisation.

Nutritional support

Specific nutritional conditions should be treated appropriately.

Antiretroviral therapy (ART)

Initiation of ART in clinically stable HIV-infected children without complications should be at PHC level – see national NIMART guidelines (IMCI) and Standard Treatment Guidelines and Essential Medicines List for Primary Health Care.

Preparing the child and family to start ART is critical to the success of the treatment. Failure to achieve adherence may lead to resistance and adversely affect the child's prognosis.

Eligibility criteria for antiretroviral therapy

» Confirmation of diagnosis of HIV infection irrespective of CD4 count or WHO clinical staging.

AND

» No medical contraindication (e.g. major organ dysfunction). If medical contraindications are present, refer to the hospital for rapid review and planning.

Social issues that must be addressed to ensure successful treatment

These are extremely important for success as they impact adherence.

Social challenges should be continuously addressed and not be barriers to access to care.

Disclosure to another adult living in the same house is encouraged so that someone else can assist with the child's treatment.

» Mandatory component: at least one identifiable caregiver can supervise the child and/or administer medication. All efforts should be made to ensure that the social circumstances of vulnerable children, e.g. orphans, be addressed to facilitate treatment.

» Adherence:
  > High levels of adherence should be maintained for adequate virological response and prevention of viral resistance. This can be achieved with regular education and support.
  > All efforts to encourage this level of adherence should be made.
  > Viral load measurements are useful for monitoring adherence.

» Sensitive, age-appropriate disclosure facilitates adherence.

Requirements before ART is used

The child's family (parents, caregivers) should understand:

» that antiretroviral therapy is long-term,
» the prognosis of the condition (treated and untreated),
» adverse effects of the medicines, their mode of action, and the risk and implications of developing resistance, if incorrectly used,
» that all medications should be given as prescribed and adequately stored.

ART Regimens

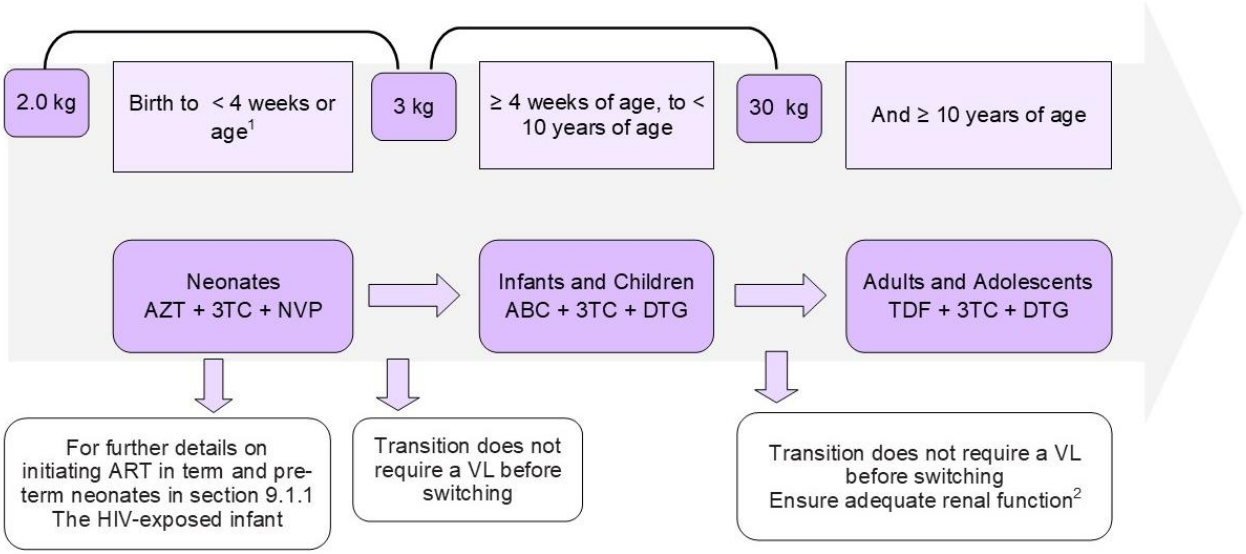
» These are chosen according to age, weight, expected adverse effects, efficacy, and prior antiretroviral exposure.
» Adjust the dosage of antiretroviral therapy according to weight during follow-up visits. Assess weight gain and need for adjustment at each visit.
» Do not change regimens or move to second-line therapy without clear guidance from an experienced practitioner in child ARV medicine. An unnecessary loss of effective regimens can shorten life expectancy. Adherence problems need to be addressed thoroughly when switching to a second- or third-line regimen.
» Single drug substitution should be discussed with an experienced practitioner in child ARV medicine.

TLD1: Clients on a DTG-containing regimen, having never failed a previous regimen (old 'first-line' terminology).

TLD2: Clients on a DTG-containing regimen, who have failed a previous regimen (old 'second- line' terminology).

TLD: tenofovir, lamivudine, dolutegravir.

Recommended regimen in ART-naïve Neonates, Infants, Children 0 to < 10 years of age



1. For neonates with severe anaemia, obtain advice from an expert or through one of the helplines
2. Before switching to TDF, ensure adequate renal function by checking eGFR/creatinine

Switching existing clients to DTG-containing regimens

Non VL-dependent regimen switches Regimens where the VL result will not influence nor delay the decision to switch to DTG-containing regimen			
VL considerations	**Current Regimen**	**Criteria for switch**	**Regimen if change indicated**
Switching regardless of VL result	**TEE** **ABC/3TC/EFV** **AZT/3TC/EFV** **AZT/3TC/DTG** **Any LPV/r or ATV/r regimen for less than 2 years**	**Switch all to a DTG-containing regimen, regardless of VL result** Review VL in last 12 months. If VL in last 12 months was not suppressed, continue to switch same day, but do ABCDE assessment and provide enhanced adherence counselling (EAC) if needed. If VL was not done in last 12 months, do it at this visit, but do not wait for results to switch.	**TLD** Provided no renal dysfunction and age > 10 years and weight > 30 kg If client does not quality for TDF **ABC[1]/3TC/DTG** If client does not quality for TDF and has ABC hypersensitivity **AZT/3TC/DTG**

VL-dependent regimen switches Relevant to all clients who have been on PI-based regimens for more than two years: their VL result in the last 12 months will influence the decision of how and when to switch to a DTG-containing regimen			
VL considerations	**Current Regimen**	**Criteria for switch**	**Regimen if change indicated**
VL < 1000 c/mL	**Any LPV/r or ATV/r regimen for more than 2 years**	**Switch all to a DTG-containing regimen** If VL in last 12 months was not < 50 c/mL, continue to switch same day, but do ABCDE assessment and provide EAC if needed.	**TLD** provided no renal dysfunction and age > 10 years and weight > 30 kg If clients does not qualify for TDF **ABC[1]/3TC/DTG**
[2] Two or more VLs ≥ 1000 c/mL taken two or more years after starting PI regimen	Adult or adolescent on any **LPV/r or ATV/r** regimen and adherence **less than 80%[3]**	**Switch all to a DTG-containing regimen** **Do not do a resistance test** These clients are unlikely to have PI resistance mutations. Rather switch to a more tolerable once daily FDC regimen which is likely to support adherence.	**TLD** provided no renal dysfunction and age > 10 yrs and weight > 30 kg If clients does not qualify for TDF **ABC[1]/3TC/DTG**
	Adult or adolescent on any **LPV/r or ATV/r regimen and adherence more than 80%[3]**	Clients who meet the definition of confirmed virological failure despite confirmed adherence more than 80% may need a resistance test. **These clients do not qualify for a same-day switch**. Discuss with an HIV expert[4] to authorise and interpret a resistance test. Provide individualised regimen as recommended by HIV expert.	
	Child < 10 years, or weight < 30 kg on any **LPV/r or ATV/r regimen**	These clients do not yet qualify for TLD and may require a resistance test. Refer to algorithm "**Switching children on PI-containing regimens to DTG-containing regimens**"	

1. If clients are not eligible to use TDF and they have ABC hypersensitivity, use AZT/3TC/DTG.
2. Confirmed virological failure is defined as two or more VLs ≥ 1000 c/mL taken two or more years after starting a DTG or PI containing regimen, despite adherence > 80% by objective measurement. A patient who has only 1 VL > 1000 after 2 years on a PI-based regimen should have an ABCDE assessment, EAC if applicable, and their VL repeated in 3 months. The result of the repeat VL will allow the patient to be grouped into one of the categories in the table above and will inform the further course of action.
3. Objective measures of good adherence include at least one of:
   - Pharmacy refills > 80% in the last 6-12 months (if this is known).
   - Attendance of > 80% of scheduled clinic visits in the last 6-12 months (if this is known).
   - Detection of current antiretroviral drug/s in the client's blood or urine, if available.

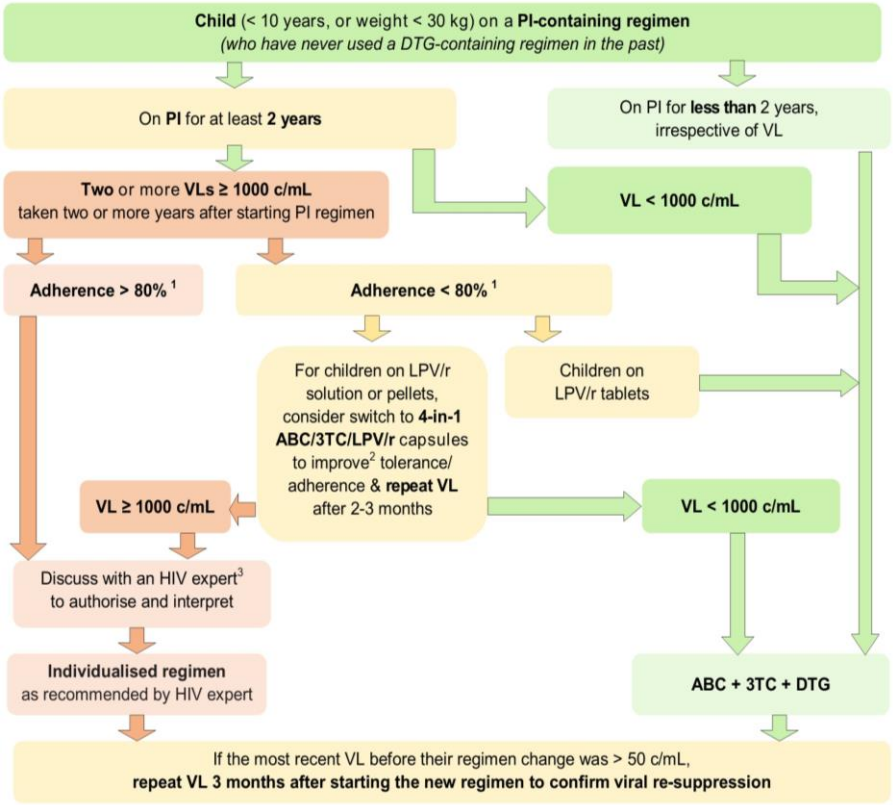
   Note: Self-reported adherence is not considered a reliable measure of good adherence.
4. For advice from an HIV expert, approach an HIV Hotline, an infectious disease specialist, or the Third Line ART committee.

Transition from ABC/3TC/LPV/r to DTG based regimens

ALL children < 10 years and < 30 kg on ABC/3TC/LPV/r switch to ABC/3TC/DTG.
EXCEPT if VL > 1000 copies/mL (performed in the last 12 months) for > 2 years.

- Consider switching to ABC/3TC/LPV/r 4-in-1 formulation and repeating HIV VL in 3 months. If HIV VL < 1000 copies/mL, change to ABC/3TC/DTG and if > 1000 copies/mL, perform an HIV drug resistance test (DR)
- Perform an HIV DR if 4-in-1 formulation not available.
- If NRTI mutations on the HIV DR show:
    - No mutations or only M184V – switch to ABC/3TC/DTG.
    - M184V + other mutations – discuss with an experienced practitioner in child ARV medicine.

Switching children on PI-containing regimens to DTG regimens



1. Although objective measures of poor adherence include pharmacy refills or attendance of scheduled clinic visits in the previous 6-12 months of <80%, adherence difficulties in young children are often linked to poor tolerability of unpalatable formulations, particularly LPV/r solution. It is important to ask the caregiver about how the child tolerates the medication e.g., does the child refuse to swallow the medicine or spit out or vomit the medicine, and whether the caregiver has been able to overcome this. Considering these limitations, objective measures of good adherence could include one of the following:
    a. Pharmacy refills > 80% in the last 6-12 months (if this is known)
    b. Attendance of > 80% of scheduled clinic visits in the last 6-12 months (if this is known)
    c. Detection of current antiretroviral drug/s in the client's blood or urine, if available
2. If a switch to the 4-in1 capsules does not improve adherence, or is not available, continue to switch to ABC + 3TC + DTG as for non-adherent children on LPV/r tablets.
3. The following would qualify as HIV experts: the HIV Helplines, a paediatric infectious disease specialist or the paediatric Third line ART committee .

Treatment failure

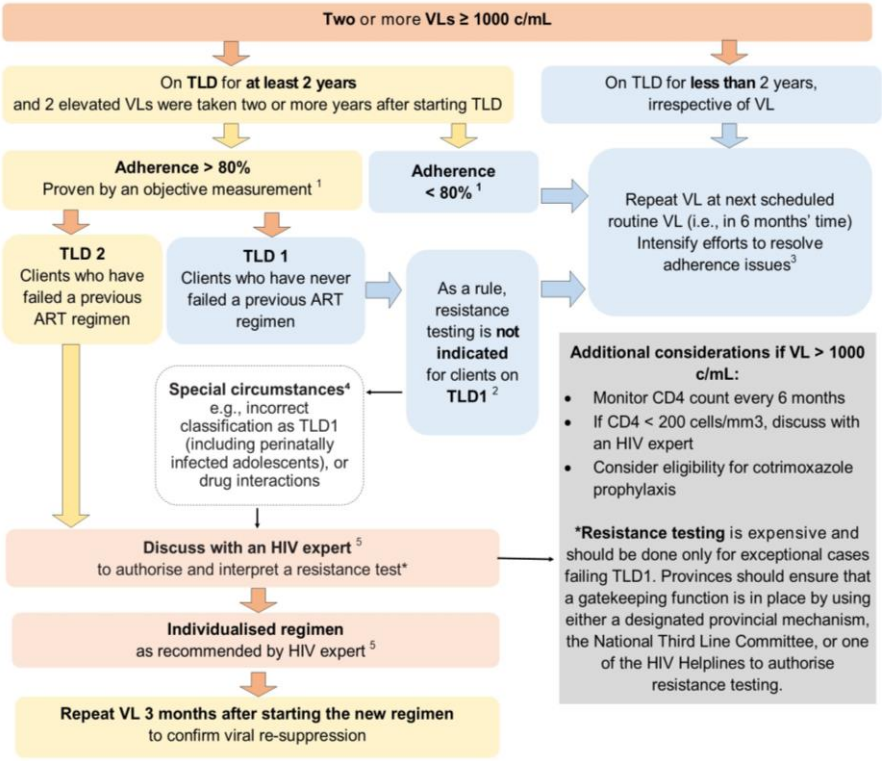
The HIV viral load is the most sensitive method to detect failure of response to ART.

Virological failure can be defined as a measurable viral load despite optimal adherence and dosage over 4 months. Treatment failure is primarily defined by viral loads, as waiting for clinical or immunological failure increases the chances of increasing viral resistance to other available antiretroviral agents.

Poor adherence is the most common cause of treatment failure. Adherence issues should be assessed and then implement strategies to improve adherence.

*For guidance on the step-up adherence package, refer to the National adherence guidelines.
https://www.nacosa.org.za/wp-content/uploads/2016/11/Integrated-Adherence-Guidelines-NDOH.pdf

Management of confirmed virological failure in adolescents on TLD



1. Objective measures of good adherence include at least one of:
   - Pharmacy refills > 80% in the last 6-12 months (if this is known)
   - Attendance of > 80% of scheduled clinic visits in the last 6-12 months (if this is known)
   - Detection of current antiretroviral drug/s in the client's blood or urine, if available

   Note: Self-reported adherence is not considered a measure of good adherence!
2. Due to their high genetic barrier, resistance to a first-line DTG-containing regimen (TLD1) is extremely rare. If other reasons for an unsuppressed VL have been addressed or excluded, e.g., drug interactions and the client remains unsuppressed at their repeat VL, suboptimal adherence remains the most probable cause for non-suppression. The highest probability of improving adherence would be to remain on a once-daily, well-tolerated, fixed-dose combination regimen (TLD) while identifying and addressing the underlying root causes of non-adherence. 99,9% of these clients will re-suppress on TLD if adherent.
3. Repeat the ABCDE assessment. Remember to ask about treatment side-effects, the potential cost of transport or loss of income related to clinic visits, mental health conditions, non-disclosure, poor social support, or substance abuse. If necessary, discuss with an expert or refer to other multidisciplinary team members, if available.
4. Special circumstances that may warrant a resistance test for clients on TLD1 include:
   - Incorrect classification as TLD1 (clients who declare themselves as never having had ART before, but who have actually been exposed to ART and may have failed a regimen in the past).
   - Perinatally infected adolescents: Unless a clearly documented drug history is available, perinatally infected adolescents should be classified as TLD2 due to the high likelihood of ART exposure and virological failure in the past.
   - Current or previous drug interactions with rifampicin, carbamazepine, phenytoin, phenobarbital, or the polyvalent cations may have resulted in the development of resistance. Drug interactions may also warrant an expert discussion and authorisation of a resistance test earlier than 2 years on the regimen.

   In these types of exceptional circumstances, TLD1 clients with persistent virological failure despite confirmed good adherence may be discussed with an expert to authorise a resistance test on a case-by-case basis.
5. For advice from an HIV expert, approach an HIV Hotline, an infectious disease specialist, or the Third Line ART committee.

Third-line

Application forms for third-line antiretroviral therapy can be accessed at the following link:

Application for Third Line Antiretrovirals_2017.pdf (sahivsoc.org)

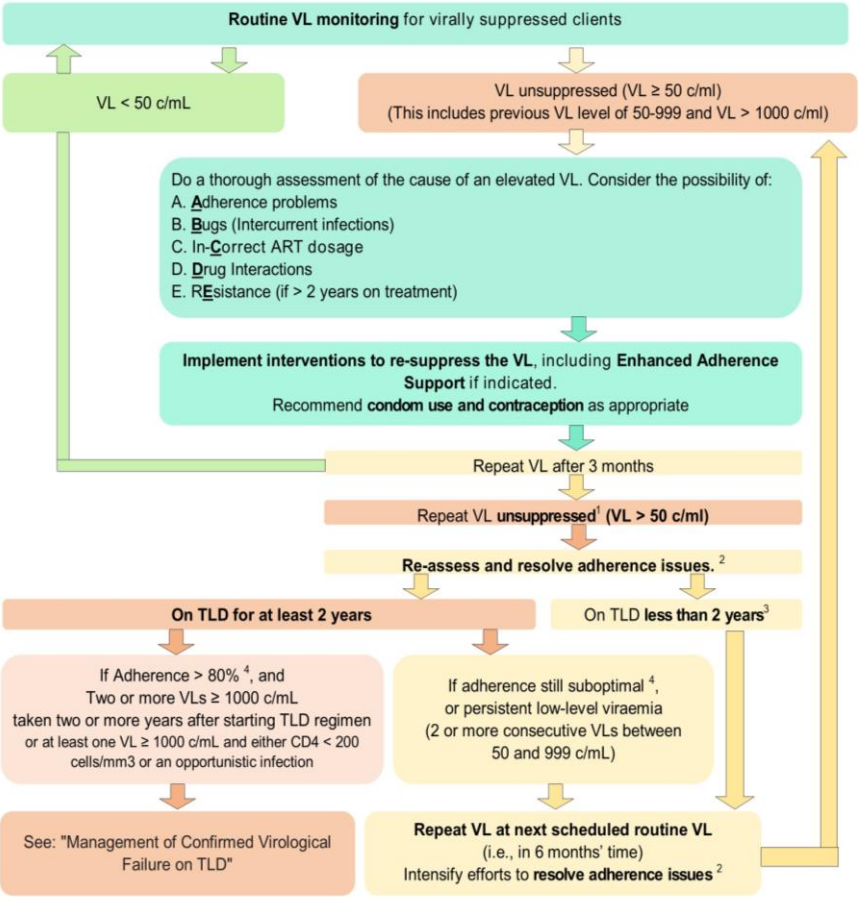
» Important information to assist in applying for third-line antiretrovirals can be found at www.righttocare.org/what-we-do/third-line-art/

Applications can be emailed to TLART@health.gov.za

General comments

Switch to tablets or capsules from syrups or solutions as soon as possible.
Use fixed-dose combinations in preference to single agents.
If available, use once daily regimens.

Viral Load Monitoring for clients on TLD



1. Due to their high genetic barrier, resistance to a first-line DTG-containing (TLD1) regimen is extremely rare. If other reasons for an unsuppressed VL have been addressed or excluded, e.g., drug interactions, and the client remains unsuppressed at their repeat VL, suboptimal adherence remains the most probable cause for non-suppression. The highest probability of improving adherence would be to remain on a once-daily, well-tolerated, fixed-dose combination regimen (TLD) while identifying and addressing the underlying root causes of non-adherence. 99,9% of these clients will re-suppress on TLD if adherent!
2. Repeat ABCDE assessment as outlined on "ABCDE assessment of an Elevated Viral Load" on page 20. Remember to ask about treatment side-effects, the potential cost of transport or loss of income related to clinic visits, non-disclosure, gender-based violence (GBV), and current or prior drug interactions. Current or previous drug interactions with rifampicin, carbamazepine, phenytoin, phenobarbital, or the polyvalent cations may have resulted in the development of resistance.
3. Drug interactions may also warrant an expert discussion and authorisation of a resistance test earlier than 2 years on the regimen. If necessary, discuss with an expert
4. Objective measures of good adherence include at least one of:
   a. Pharmacy refills > 80% in the last 6-12 months (if this is known)
   b. Attendance of > 80% of scheduled clinic visits in the last 6-12 months (if this is known)
   c. Detection of current antiretroviral drug/s in the client's blood or urine, if available

Note: Self-reported adherence is not considered a measure of good adherence.

ART regimens for children with confirmed virological failure

All children and adolescents with confirmed virological failure should be discussed with an expert.

	NNRTI-based regimen	PI-based regimen[3]	InSTI-based regimen[3]		
Regimen	ABC/AZT/TDF + 3TC/FTC + EFV/NVP	AZT/TDF + 3TC/FTC + LPV/r or ATV/r	ABC/AZT/TDF + 3TC/FTC + DTG		
Resistance testing[4]	Resistance test not required.	Resistance test required.	Resistance test required.		
Resistance test results	Not applicable.	No PI resistance.	PI resistance (or genotype unsuccessful).	No InSTI resistance.	InSTI resistance.
New regimen or Other action required	If < 10 years and < 30 kg: AZT + 3TC + DTG	If < 10 years and < 30 kg: 2 NRTIs + DTG (1 active NRTI in consultation with an experienced practitioner in child ARV medicine.) Adherence issues must be addressed.	Refer to Third-Line Committee. Adherence issues must be addressed.	If < 10 years and < 30 kg: 2 NRTIs + DTG (1 active NRTI in consultation with an expert in child ARV medicine). Adherence issues must be addressed.	Refer to Third-Line Committee. Adherence issues must be addressed.
	If > 10 years and > 30 kg: TDF + 3TC + DTG[1,2]	If > 10 years and > 30 kg: TDF + 3TC + DTG.[1,2] Adherence must be addressed.		If > 10 years and > 30 kg: TDF + 3TC + DTG.[1,2] Adherence must be addressed.	

1. Always check hepatitis B status before stopping TDF. If the client has chronic hepatitis B, stopping TDF may lead to a severe hepatitis flare. If hepatitis B-positive, TDF should be continued in the second-line regimen.
2. Before switching to TDF, ensure renal function by checking eGFR/creatinine. (See Chapter 6: Nephrological/Urological Disorder, section 6.4: Acute Kidney Injury, for calculation).
3. See Transition to ABC/3TC/DTG.
4. Criteria for HIV Drug resistance (refer to the 2023 HIV Guidelines)

	Abacavir (ABC)	Lamivudine (3TC)	Abacavir + Lamivudine (ABC + 3TC)	Dolutegravir (DTG)	Dolutegravir when on rifampicin
Target dose	8 mg/kg **TWICE daily** **OR** If ≥ 10 kg: 16 mg/kg **ONCE daily**	4 mg/kg **TWICE daily** **OR** If ≥ 10 kg: 8 mg/kg **ONCE daily**	As for individual medications **ONCE daily**	By weight band **ONCE daily**	By weight band **TWICE daily**
Available formulations	Sol. 20 mg/mL Tabs 60 mg (scored, dispersible), 300 mg (not scored)	Sol. 10 mg/mL, Tabs 150 mg (scored)	Dispersible tablets (FDC): ABC/3TC 120/60 mg Tablet FDC: ABC/3TC 600/300 mg ABC/3TC/DTG 600/300/50 mg	Dispersible tabs (DT) 10 mg, film coated (FC) tabs 50 mg, FDC: TLD 300/300/50 mg **OR** ABC/3TC/DTG 600/300/50 mg **DT AND FC TABLETS ARE NOT BIOEQUIVALENT**	Dispersible tabs (DT) 10 mg, film coated (FC) tabs 50 mg, FDC: TLD 300/300/50 mg **OR** ABC/3TC/DTG 600/300/50 mg **DT AND FC TABLETS ARE NOT BIOEQUIVALENT**
Weight (kg)	Consult with a clinician experienced in paediatric ARV prescribing for neonates (< 28 days of age) and infants weighing < 3 kg.				
3–5.9	3 mL 12 hourly **OR** 1 x 60 mg tab 12 hourly	3 mL 12 hourly	1 x 120/60 mg tab daily	0.5 x 10 mg DT daily	0.5 x 10 mg DT 12 hourly
6-9.9	4 mL 12 hourly **OR** 1.5 x 60 mg tabs 12 hourly	4 mL 12 hourly	1.5 x 120/60 mg tabs daily	1.5 x 10 mg DT daily	1.5 x 10 mg DT 12 hourly
10–13.9	4 x 60 mg tabs daily **OR** 12 mL daily	12 mL daily	2 x 120/60 mg tabs daily	2 x 10 mg DT daily	2 x 10 mg DT 12 hourly

<table>
<tr><th></th><th>Abacavir
(ABC)</th><th>Lamivudine
(3TC)</th><th>Abacavir +
Lamivudine
(ABC + 3TC)</th><th>Dolutegravir
(DTG)</th><th>Dolutegravir when on rifampicin</th></tr>
<tr><td>14–19.9</td><td>5 x 60 mg tabs daily
OR
1 x 300 mg tab daily</td><td>1 x 150 mg tab daily</td><td>2.5 x 120/60 mg tabs daily</td><td>2.5 x 10 mg DT daily</td><td>2.5 x 10 mg DT
12 hourly</td></tr>
<tr><td>20–24.9</td><td>1 x 300 mg tab
PLUS
1 x 60 mg tab daily
OR
6 x 60 mg tabs daily</td><td rowspan="4">2 x 150 mg tabs daily</td><td rowspan="4">1 x ABC/3TC 600/300 mg tab daily
OR
ABC/3TC/DTG FDC (600/300/50 mg) if eligible, daily</td><td>3 x 10 mg DT daily
OR
1 x 50 mg FC tab daily</td><td>3 x 10 mg DT 12 hourly
OR
1 x 50 mg FC tab
12 hourly</td></tr>
<tr><td>25–29.9</td><td rowspan="3">2 x 300 mg tabs daily</td><td>1 x 50 mg tab daily
OR
FDC: ABC/3TC/DTG 600/300/50 mg tab daily</td><td>1 x 50 mg tab 12 hourly
OR
FDC: ABC/3TC/DTG 600/300/50 mg tab
12 hourly</td></tr>
<tr><td>30–39.9</td><td rowspan="2">1 x 50 mg FC tab daily
OR
FDC: TLD if eligible daily
OR
FDC: ABC/3TC/DTG if eligible daily</td><td rowspan="2">1 x 50 mg FC tab
12 hourly
OR
FDC: TLD if eligible daily + 50 mg DTG FC tab 12 hours later
OR
FDC: ABC/3TC/DTG if eligible daily + 50 mg DTG FC tab 12 hours later</td></tr>
<tr><td>≥ 40</td></tr>
</table>

	Lopinavir/ritonavir (LPV/RTV)	**Abacavir + Lamivudine + Lopinavir/ ritonavir**	**Lopinavir/ritonavir when on rifampicin (and for 2 weeks after stopping rifampicin)** ***Choose one of the 2 options below as appropriate***		**#Atazanavir (ATV) + ritonavir (RTV)**	**Efavirenz (EFV)**	**Zidovudine (AZT)**
Target dose	300/75 mg/m^2/dose LPV/RTV **TWICE daily**	By weight band **TWICE daily**	LPV/RTV std dose + super-boosting with ritonavir (RTV) powder **TWICE daily** (≥ 0.75 x LPV dose 12 hourly)	Double-dose LPV/RTV tabs ONLY if able to swallow whole LPV/RTV tabs **TWICE daily**	By weight band **ONCE daily**	By weight band **ONCE daily**	180–240 mg/m^2/dose **TWICE daily**
Available formulations	Sol. 80/20 mg/mL Adult tabs 200/50 mg, Paed tabs 100/25 mg **TABLETS MUST BE SWALLOWED WHOLE** Pellets 40/10 mg per capsule **ONLY FOR USE IF NOT TOLERATING LPV/RTV SOLUTION. CAPSULES ARE NOT RECOMMENDED < 6 MONTHS OF AGE**	Caps 30/15/ 40/10 mg **IF PATIENT IS ON RIFAMPICIN TB TREATMENT, ADD RTV POWDER** (next column)	Oral powder 100 mg per packet	Adult tabs 200/50 mg, Paed tabs 100/25 mg	ATV caps 150, 200 mg: RTV tabs 100 mg; FDC: ATV/RTV 300/100 mg; **RTV TABLETS AND ATV/R FDC TABLETS MUST BE SWALLOWED WHOLE**	Caps/tabs 50, 200, 600 mg; FDC: TEE 300/200/600 mg; **TABLETS MUST BE SWALLOWED WHOLE**	Sol. 10 mg/mL Tabs 100 mg, 300 mg (not scored), AZT/3TC 300/150 mg
Weight (kg)	Consult with a clinician experienced in paediatric ARV prescribing for neonates (< 28 days of age) and infants weighing < 3 kg.						

	Lopinavir/ritonavir (LPV/RTV)	Abacavir + Lamivudine + Lopinavir/ ritonavir	Lopinavir/ritonavir when on rifampicin (and for 2 weeks after stopping rifampicin) *Choose one of the 2 options below as appropriate*		#Atazanavir (ATV) + ritonavir (RTV)	Efavirenz (EFV)	Zidovudine (AZT)
3–5.9	*1 mL 12 hourly **OR** 2 capsules 12 hourly	2 capsules 12 hourly	LPV/RTV std dose **PLUS** oral RTV powder 100 mg (1 packet) 12 hourly	Do not use double-dose LPV/RTV tabs	Not recommended	Not recommended	6 mL 12 hourly
6–9.9	*1.5 mL 12 hourly **OR** 3 capsules 12 hourly	3 capsules 12 hourly					9 mL 12 hourly
10–13.9	2 mL 12 hourly **OR** 4 capsules 12 hourly **OR** 2 x 100/25 mg paed tabs in morning **PLUS** 1 x 100/25 mg paed tab at night	4 capsules 12 hourly	LPV/RTV std dose **PLUS** oral RTV powder 200 mg (2 packets) 12 hourly	3 x 100/25 mg tabs 12 hourly	ATV 1 x 200 mg cap daily **PLUS** RTV 1 x 100 mg tab or 100 mg oral powder (1 packet) daily	1 x 200 mg cap/tab at night	12 mL 12 hourly **OR** 1 x 100 mg tab 12 hourly
14–19.9	2.5 mL 12 hourly **OR** 5 capsules 12 hourly **OR** 2 x 100/25 mg paed tabs 12 hourly **OR** 1 x 200/50 mg adult tab 12 hourly	5 capsules 12 hourly		4 x 100/25 mg paed tabs 12 hourly **OR** 2 x 200/50 mg adult tabs 12 hourly		1 x 200 mg cap/tab + 2 x 50 mg caps/tabs at night	2 x 100 mg tab in morning **PLUS** 1 x 100 mg tab at night **OR** 15 mL 12 hourly

	Lopinavir/ritonavir (LPV/RTV)	Abacavir + Lamivudine + Lopinavir/ ritonavir	Lopinavir/ritonavir when on rifampicin (and for 2 weeks after stopping rifampicin) *Choose one of the 2 options below as appropriate*		#Atazanavir (ATV) + ritonavir (RTV)	Efavirenz (EFV)	Zidovudine (AZT)
20–24.9	3 mL 12 hourly **OR** 6 capsules 12 hourly **OR** 2 x 100/25 mg paed tabs 12 hourly **OR** 1 x 200/50 mg adult tab 12 hourly	6 capsules 12 hourly					2 x 100 mg tabs 12 hourly **OR** 20 mL 12 hourly
25–29.9	3.5 mL 12 hourly **OR** 7 capsules 12 hourly **OR** 3 x 100/25 mg paed tabs 12 hourly **OR** 1 x 200/50 mg adult tab 12 hourly **PLUS** 1 x 100/25 mg paed tab 12 hourly	Not recommended	LPV/RTV std dose **PLUS** oral RTV powder 300 mg (3 packets) 12 hourly	6 x 100/25 mg paed tabs 12 hourly **OR** 3 x 200/50 mg adult tabs 12 hourly	1 x ATV/RTV 300/100 mg FDC daily **OR** ATV 2 x 150 mg caps daily **PLUS** RTV 1 x 100 mg tab or 100 mg oral powder (1 packet) daily	2 x 200 mg caps/tabs at night	1 x 300 mg tab 12 hourly **OR** 1 x AZT/3TC 300/150 mg tab 12 hourly
30–39.9	5 mL 12 hourly **OR** 10 capsules 12 hourly **OR** 4 x 100/25 mg paed tabs 12 hourly			8 x 100/25 mg paed tabs 12 hourly **OR**			
≥ 40						2 x 200 mg caps/tabs at night **OR**	

	Lopinavir/ritonavir (LPV/RTV)	Abacavir + Lamivudine + Lopinavir/ ritonavir	Lopinavir/ritonavir when on rifampicin (and for 2 weeks after stopping rifampicin) *Choose one of the 2 options below as appropriate*		#Atazanavir (ATV) + ritonavir (RTV)	Efavirenz (EFV)	Zidovudine (AZT)
	OR 2 x 200/50 mg adult tabs 12 hourly			4 x 200/50 mg adult tabs 12 hourly		FDC: TEE if eligible, daily	

*Avoid LVP/r solution in any full-term infant < 14 days of age and any preterm infant < 42 weeks post conceptual age (corrected gestational age) or obtain expert advice.
Children weighing 25 to 29.9 kg may also be dosed with LPV/r 200/50 mg adult tabs: 2 tablets in the morning and 1 tablet at night.
#Atazanavir plus ritonavir should not be used in children/adolescents on treatment with rifampicin, obtain expert advice.
No dosage adjustments are required for children receiving treatment with efavirenz and rifampicin.

Specific information on ARVs		
	Storage	**Adverse effects**
Nucleoside reverse transcriptase inhibitors (NRTIs)		
Zidovudine (AZT)	Room temperature.	» Haematological, e.g. anaemia, neutropenia.
Dolutegravir (DTG)	Room temperature.	» Insomnia – rare.
Lamivudine (3TC)	Room temperature.	» Pure red cell aplasia – uncommon.
Abacavir (ABC)	Room temperature.	» Abacavir Hypersensitivity Reaction: » Very rare in our population: > usually occurs in first 6 weeks of initiation of therapy, > symptoms and signs become worse with each subsequent dose, > multi-system manifestations, > fever, and rash common, > other systems include gastrointestinal signs (nausea, vomiting, abdominal pain) and respiratory symptoms (dyspnoea, sore throat and cough). » Laboratory abnormalities include raised transaminases and creatinine phosphokinase, and lymphopenia. » **Discuss with an expert. If ABC discontinued, do not re-challenge with abacavir.**
Non-nucleoside reverse transcriptase inhibitors (NNRTIs)		
Nevirapine (NVP)	Room temperature.	» Skin rash usually occurs in first 6 weeks. » Do not increase the dosage until the rash resolves. » Beware of liver toxicity.
Efavirenz (EFV)	Room temperature	» Give at night to avoid CNS side effects: > dysphoria > vivid dreams > dizziness > distracted » Hepatotoxicity » Breast enlargement in males and females.

Specific information on ARVs		
	Storage	**Adverse effects**
Protease inhibitors (PIs)		
Ritonavir (r)	Tablets/ powder – room temperature.	» Bitter taste.
Lopinavir/ ritonavir (LPV/r)	Syrup – refrigerator. Tablets/ pellets and granules – room temperature.	» Nausea » Vomiting » Diarrhoea

Important side effects of ARVs

*(*Consult an expert before stopping ART)*

	Continue ART with careful monitoring.	**Consult an expert and/or stop treatment.**
Anaemia	» Hb: 7.0–9.9 g/dL	» Hb < 7 g/dL or cardiac failure
Neutropenia	» 0.4–1.2 x 10^9/L	» ≤ 0.399 x 10^9/L
Increased liver enzymes and hepatitis	» ≤ 9.9 x upper normal limit	» ≥ 10.0 x upper normal limit
Increased serum triglycerides	» 1.54–8.46 mmol/L	» ≥ 8.47 mmol/L*
Increased cholesterol	» 4.43–12.92 mmol/L	» ≥ 12.93 mmol/L*
Severe skin reactions	» diffuse maculo-papular rash, or » dry desquamation	» vesiculation, or » ulcers, or » exfoliative dermatitis, or » Stevens-Johnson syndrome, or » erythema multiforme, or » moist desquamation, or » with elevated ALT or AST
» Peripheral neuropathy » Myopathy » Abdominal pain » Nausea and vomiting » Pancreatitis » Headache » Fatigue » Sedative effect » Sleep disturbance » Confusion » Abnormal thinking	Clinical evaluation: » Discuss all cases urgently with an HIV expert before interrupting therapy.	

Criteria for changing therapy

Adverse effects

Children may occasionally need to change antiretroviral drugs because of intolerance or a serious adverse reaction. There is no need to change an entire regimen for a single adverse drug reaction.

Note: A single drug substitution can only be made if the viral load is < 50 copies/mL/undetectable or if the change is made in the first 6 months of starting a regimen. The decision to swap must be made by a doctor with antiretroviral experience (this can be by telephonic consultation), as inappropriate choices of antiretrovirals may be ineffective or dangerous.

Treatment failure

The HIV viral load is the most sensitive method to detect failure of response to ART.

Virological failure can be defined as a measurable viral load despite optimal adherence and dosage over 4 months. Treatment failure is primarily defined by viral loads, as waiting for clinical or immunological failure increases the chances of increasing viral resistance to other available antiretroviral agents.

Poor adherence is the most common cause of treatment failure. Adherence issues should be assessed and then implement strategies to improve adherence.

» For guidance on the step-up adherence package, refer to the National adherence guidelines.

https://www.nacosa.org.za/wp-content/uploads/2016/11/Integrated-Adherence-Guidelines-NDOH.pdf

REFERRAL

» Complicated or very ill children should be referred to a practitioner skilled in the care of such children.
» Attempts should be made to refer patients to accredited primary health care sites once stable on ART.

9.2 TUBERCULOSIS AND HIV

B20.0

DESCRIPTION

TB and HIV are often comorbid conditions. Exclude TB by a history of TB contacts, clinical examination, chest X-ray, tuberculin skin test (TST), or lateral flow urine lipoarabinomannan (TB-lam), *M tuberculosis* PCR test and mycobacterial culture (where TB disease is suspected on clinical or radiological grounds) in all patients before starting ART. Every attempt should

be made to obtain microbiologic specimens for TB testing (sputum, NGAs or other, as applicable), as this presents the opportunity to prove TB disease in the child.

Re-evaluate the risk for TB and TB contacts at each visit on history (including contact history) and clinical examination.

MEDICINE TREATMENT

TB prophylaxis

Give TB prophylaxis to all HIV-infected children exposed to close contact with an infectious pulmonary TB case (sputum microscopy smear-positive, culture-positive or *M tuberculosis* PCR test positive) or TST **but** in whom no evidence of TB disease is present.

- Isoniazid, oral, 10 mg/kg/dose once daily for 6 months.
  - Maximum dose: 300 mg daily.

Repeat the course if an HIV-infected patient, irrespective of age, is re-exposed to a TB contact at any point after completing TB treatment or prophylaxis.

If the patient has been exposed to a known MDR-TB or XDR-TB source case or the contact case has failed standard TB treatment, refer for an expert opinion. See Chapter 10: Tuberculosis, section 10.2: Tuberculosis, pulmonary in children.

TB treatment

<u>If the child is not yet on ART</u>:

» TB treatment and ART can be started at the same time, with the exception of children with TB meningitis – start ART at 4 weeks regardless of CD4 count to avoid IRIS.
» Assess the child for possible disseminated TB disease.
» Be aware of the possibility of Immune Reconstitution Inflammatory Syndrome (IRIS).

<u>If the child is already on ART</u>:

» Commence TB treatment, considering possible drug interactions and the need for ART dosage adaptations.

<u>If the child needs to take concomitant ART and rifampicin-containing treatment</u>:

- Dolutegravir: use dolutegravir twice daily.
- Efavirenz: use the normal recommended dosage as per the dosing table.
- Abacavir and lamivudine: no adjustment of dosages.
- Lopinavir/ritonavir: refer to the dosage table for the ritonavir boosting doses.
- <u>Avoid using double-dose lopinavir/ritonavir solution in young children</u>. If ritonavir powder is not available, consult an expert.

- Give pyridoxine (vitamin B_6) to all children on TB and ARV treatment due to shared toxicities of the regimens.

9.3 IMMUNE RECONSTITUTION INFLAMMATORY SYNDROME (IRIS)

D89.3

DESCRIPTION

Clinical deterioration can occur after starting ART due to an improvement in the immune system's response to organisms already causing infection, e.g.

- *M bovis BCG,*
- *M tuberculosis (MTB),*
- *M avium complex,*
- *M leprae,*
- *P jiroveci,*
- CMV,
- JC virus.
- *C neoformans,*
- *Aspergillus*,
- *C albicans,*
- Human Herpes viruses,
- Human Papilloma virus,
- Hepatitis B and C viruses (HBV, HCV),

There are two manifestations of IRIS:

1. Unmasking occurs when a previously unsuspected condition manifests.
2. Paradoxical, i.e. a known condition on appropriate treatment worsens.

DIAGNOSTIC CRITERIA

» Exclude other active or inadequately treated diseases (including MDR-TB).
» Ensure adherence to the prescribed therapy.
» Presentation:
  > Usually during the first 6 weeks after starting ART.
  > Clinical presentation depends on the causative organism and the organ system involved, e.g. TB presents with fever, lymph–adenopathy, worsening of the original tuberculous lesion, and/or deteriorating chest radiographic manifestations such as a miliary pattern or pleural effusion.

MEDICINE TREATMENT

Treat underlying disease aggressively.
Antimicrobial therapy for specific infections.

In severe reactions:

- Prednisone, oral, 1.5 mg/kg daily for 2 weeks, followed by 0.75 mg/kg daily for 2 weeks.

Usually, ART is continued, and the underlying condition is managed.
Local IRIS with *M bovis BCG* usually does not require antimicrobial therapy.

9.4 POST-EXPOSURE PROPHYLAXIS FOLLOWING ALLEGED PENETRATIVE SEXUAL ABUSE

See Standard Treatment Guidelines and Essential Medicines List for Primary Health Care.

9.5 HIV IN ADOLESCENCE

B20-24

DESCRIPTION

Adolescence encompasses the period of physical and psychological development from the onset of puberty to maturity. HIV in adolescents may be due to:

1. Vertical infection in infancy that presents as long-term non-progressors; or
2. Sexually acquired HIV from unprotected intercourse.

Increasing numbers of perinatally infected infants are surviving to adolescence.

Adolescence is a high-risk period for non-adherence to therapy.
Mood disorders, denial, peer pressure, self-esteem and suicide risk are more common, and patients may need to be referred for psychological support.

Education about sexual and reproductive health should be commenced early. Every encounter with the adolescent needs to be maximally utilised to discuss condom and contraception use to protect against unplanned pregnancies and STI transmission, including HIV. Schools should be taking an active role in this education. Sexually active youth need to be screened for STI symptoms and managed appropriately.

Consent

The current acts and regulations should be followed for testing, treatment and disclosure.

Disclosure

All adolescents need to be aware of their HIV status. This should be handled sensitively. In addition, disclosure of diagnosis has ramifications for adherence. Disclosure should be planned with the caregiver and usually takes place over 2–3 visits. Disclosure should start in childhood using non-specific terms such as ‘germ’ and ‘medicine’, building up to full disclosure around 10 years of age. Intervention by a social worker is useful where appropriate, although skilled counsellors often manage disclosure. Determine what the adolescent already knows and discuss with the caregiver who should disclose it and where.

Dosage of ARVs

In children over the age of 10 years and over 30 kg, use adult dosage regimens – consult ART guidelines.[1]

The transition from paediatric ART regimens to adolescent/adult regimens:

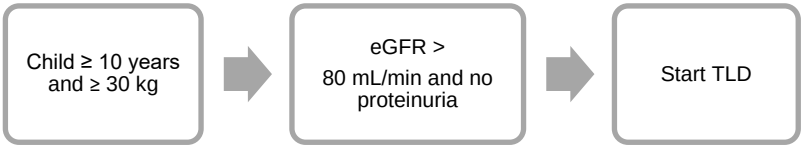
» Adolescents with an undetectable VL (< 50 copies/mL) and no side effects on ABC + 3TC + DTG can remain on the same regimen until the patient becomes eligible for the TDF + 3TC + DTG (TLD FDC) at 10 years of age and weighing ≥ 30 kg.

» When an adolescent reaches 10 years of age and is ≥ 30 kg, a creatinine level, calculation of the estimated glomerular filtration rate (eGFR) using a standard formula, and urine strip test should be performed.

> If the eGFR is > 80 mL/min and there is no proteinuria on a urine strip test, the patient can be switched to TDF + 3TC + DTG (TLD FDC).

> If the eGFR is < 80 mL/min or there is > 1+ proteinuria on a urine strip test, then refer to an expert for advice before switching.

Transition from child to adolescent regimen



Contraception in HIV-infected adolescents on ART

Hormonal contraceptives and IUCDs do not prevent sexually transmitted infections. Additional use of condoms is required.

- Intra-uterine contraceptive device (IUCD): HIV is not a contraindication to IUCD use and may be used in adolescents on ART, e.g. 380 mm^2 copper – standard type.
- Progestogen-only subdermal implant contraceptive, e.g. levonorgestrel, 150 mg, subdermal two-rod implant.

Note: Progestogen-only subdermal implant should NOT be used in patients on efavirenz. Additional non-hormonal contraception is required during and for up to 28 days after discontinuation of enzyme-inducing agents, including rifampicin, efavirenz, and many anticonvulsants (e.g. carbamazepine, phenobarbital, phenytoin).

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- Injectable contraception: e.g. medroxyprogesterone acetate (long-acting), IM, 150 mg, 12 weekly.

Note: It is unnecessary to shorten the dosage interval for women taking concomitant enzyme-inducing drugs, e.g. rifampicin, antiretrovirals and anticonvulsants.

» Combined oral contraceptives (COCs) are indicated for motivated patients where adherence is more likely but are associated with drug-drug interactions.

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CHAPTER 10

TUBERCULOSIS

10.1 TUBERCULOSIS, PERINATAL

P37.0
*Notifiable condition.

DESCRIPTION

Tuberculosis acquired in the first 3 months of life. Perinatal tuberculosis may be acquired in one of the following ways:

» Transplacental transmission – usually extrapulmonary or disseminated TB.
» Via the passage of swallowed maternal blood or amniotic fluid during delivery – usually extrapulmonary TB.
» Inhalation of the bacilli during the neonatal period – usually pulmonary TB.

DIAGNOSTIC INVESTIGATIONS

» Hepatosplenomegaly, a suggestive chest X-ray, TB exposure via a mother or close contact with another source case.
» Positive smear or culture on any suitable sample, e.g. gastric aspirate in the neonate or tissue histology suggestive of TB.
» Endometrial swabs or sputum samples in the mother positive for *M. tuberculosis*. See section 10.2: Tuberculosis, Pulmonary in children.

GENERAL AND SUPPORTIVE MEASURES

» Have a low threshold for starting presumptive treatment based on clinical assessment.
» Check drug sensitivity of the source. If drug resistant, refer.
» Check HIV status of the mother and, if positive, test the baby with HIV PCR.
» Screen all household contacts.
» Monitor the nutritional status of the neonate closely.
» Do not give BCG vaccine at birth but administer BCG after completing TB treatment or prophylaxis.

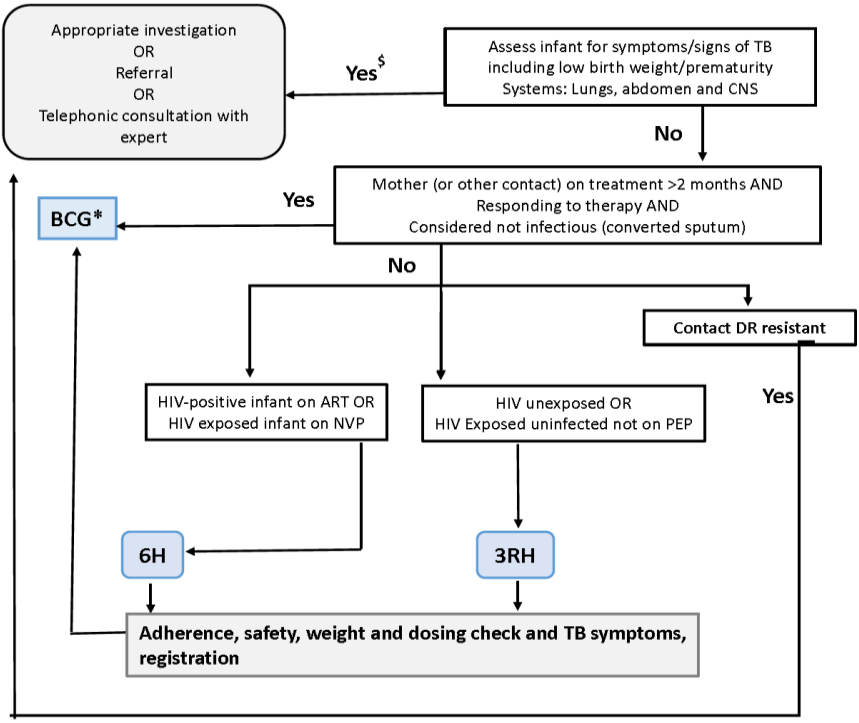
MEDICINE TREATMENT

Treatment for Drug Sensitive (DS) Tuberculosis

Newborn infant of mother with DS tuberculosis with newborn having any signs suggestive of illness:

Intensive Phase	Continuation Phase
• Rifampicin, oral, for 2 months. **PLUS** • Isoniazid, oral, for 2 months. **PLUS** • Pyrazinamide, oral, for 2 months.	• Isoniazid, oral, for 4 months. **PLUS** • Rifampicin, oral, for 4 months.

TB Preventative Therapy (TPT)



$ These infants must be investigated for TB disease – if TB disease is definitely excluded, infants should also return to algorithm for TPT

* BCG to be given in all infants after completion of TB preventive therapy

- ART=antiretroviral therapy; BCG=bacillus Calmette-Guérin; CNS=central nervous system; DST=drug susceptibility testing; INH=isoniazid; PEP=post exposure prophylaxis for HIV, RIF=rifampicin; Rx=treatment; TPT=tuberculosis preventive therapy
- For management of DR TB exposure, refer to next level of care and/or consult, refer to 2019 National DR TB Guidelines

All asymptomatic neonates:

- Rifampicin/Isoniazid, oral, once daily for 3 months (3RH) – HIV-unexposed or HIV-exposed, uninfected, not on NVP.

Weight band	Daily Rifampicin/Isoniazid 75/50 mg tablet	
	75/50	If dispersed in 10 mL water
2–2.9 kg	½ tablet	5 mL
3–3.9 kg	¾ tablet	7.5 mL
4–5.9 kg	1 tablet	10 mL
6–7.9 kg	1½ tablets	15 mL

- Isoniazid, oral, 10 mg/kg/dose once daily for 6 months (IPT) – HIV-infected or HIV-exposed, on NVP.

Weight band	Daily Isoniazid (H) 100 mg tablet
2–3.4 kg	¼ tablet
3.5–4.9 kg	½ tablet
5–7.4 kg	¾ tablet

During prophylaxis, monitor the infant for active TB disease (including growth monitoring) and re-evaluate for TB if necessary. Administer BCG vaccine after completing TPT to prevent inactivation of BCG by TB medication.

In severely immunosuppressed patients, the tuberculin reaction test can be negative in the presence of active tuberculosis.

REFERRAL

» Patients not responding to adequate therapy.
» Perinatal TB with a drug resistant (DR) source.

10.2 TUBERCULOSIS, PULMONARY IN CHILDREN

A16.9
*Notifiable condition.

DESCRIPTION

A chronic, granulomatous disease of the lungs caused by *M. tuberculosis*. Most children acquire tuberculosis from infected adults by inhalation.

Malnourished, immunosuppressed (HIV-infected) and children < 3 years of age with pulmonary tuberculosis (PTB) are always regarded as having serious disease.

Complications include:

» enlarged hilar and mediastinal lymphadenopathy with obstruction, e.g. tracheal or bronchial airway compression or occlusion with secondary atelectasis or hyperinflation;

» local spread of infection, e.g. TB bronchopneumonia, pleural effusion or cavitation;
» disseminated disease, e.g. miliary TB, TB meningitis and metastatic extrapulmonary involvement.

DIAGNOSTIC CRITERIA

Any child presenting with symptoms and signs suggestive of pulmonary TB is regarded as a child with TB if there is:
» A chest X-ray suggestive of TB.
AND/OR
» History of exposure to a person with infectious TB.
» Positive Tuberculin Skin Test (TST), e.g. Mantoux.

The diagnosis is supported by a positive rapid TB molecular test (e.g. GeneXpert®) if a specimen can be obtained. Culture, usually on gastric aspirates, induced sputum or other appropriate sample, is a confirmatory test.

» Signs and symptoms include (not an exhaustive list):
  > unexplained weight loss or failure to thrive,
  > lack of energy, child is less playful,
  > unexplained fever for ≥ 2 weeks,
  > chronic, unremitting cough for > 14 days,
  > lymphadenopathy (especially cervical, often matted),
  > hepatosplenomegaly,
  > consolidation and pleural effusion on chest examination.

» The following may be evident on chest X-ray:
  > Direct or indirect evidence of hilar or mediastinal adenopathy with or without parenchymal opacification and/or bronchopneumonia, miliary changes, or pleural effusions.

  Note:
  Miliary pattern on chest X-rays of HIV-infected children may also be suggestive of a diagnosis of lymphoid interstitial pneumonitis (LIP). (The miliary pattern of TB extends into the periphery of the lungs whereas LIP usually does not).

» Exposure to an adult with symptoms of TB or known pulmonary tuberculosis.
» Tuberculin skin test (TST), e.g. Mantoux.
  > A positive TST has an induration of ≥ 10 mm.
  > A TST may be falsely negative in the presence of:
    - malnutrition,
    - immunodeficiency, e.g. HIV,

- immunosuppression, e.g. steroid therapy, cancer chemotherapy,
- following overwhelming viral infection, e.g. measles or post vaccination.

In these circumstances a TST induration of ≥ 5 mm may be regarded as positive. Frequently, the TST will be non-reactive in these cases and a decision not to start TB treatment should not be based on a negative TST test.

» *M. tuberculosis* is suggested by a positive rapid TB molecular test (e.g. GeneXpert®) and confirmed by culture on the following specimens, noting that most children will not have microbiological confirmation of TB:
  > early morning gastric aspirate (empty stomach, no oral food intake for ≥ 4 hours),
  > sputum (older children),
  > induced sputum,
  > stool (if testing is available),
  > CSF,
  > pleural and ascitic fluids,
  > fine needle aspirate biopsies of lymph nodes,
  > ear swabs for tuberculosis culture in chronic otorrhoea.

GENERAL AND SUPPORTIVE MEASURES

» Identify and treat persons considered to be the TB source.
» In case of known contact with a person with DR TB, the child requires referral for appropriate DR TB prophylaxis or treatment.
» Screen all close contacts for symptoms and signs of TB disease.
» Provide TPT to child and high-risk adult contacts (HIV-infected) once TB disease excluded.
» Monitor the nutritional status of the child to assess response to treatment.
» Only symptomatic pleural effusions should be drained via pleural aspiration (in such cases consider adjunctive steroid therapy).
» Ensure household infection control practices.
» Refer for nutrition support.

MEDICINE TREATMENT

Tuberculosis control programme drug regimens (2013) and Circulars

Directly observed therapy (DOT), short-course, using fixed medicine combinations is used to avoid the development of antimicrobial resistance.

Give treatment daily in both the intensive (initial) and the continuation phase.

HIV-infected children with tuberculosis should be treated according to the standard treatment protocol with clinical, radiologic and microbiologic follow-up to determine response to treatment.

	Recommended dose ranges in mg/kg	
	Daily	Max. daily
Isoniazid (H)	10–15	300 mg
Rifampicin (R)	10–20	600 mg
Pyrazinamide (PZA/Z)	30–40	2 g
Ethambutol (EMB/E)	15–25	1200 mg

10.2.1 NON-SEVERE TUBERCULOSIS DISEASE

Indications:
Includes smear-negative pulmonary TB (low bacillary load) or with no more than mild to moderate lymph node enlargement and/or lung field opacification, or simple pleural effusion.

See:
https://theunion.org/sites/default/files/2022-03/The%20Union_Diagnostic%20Atlas%20for%20TB%20in%20Children_2022.pdf

Dosing:
» Adjust treatment dosages to current body weight.
» If calculating dosages, rather give ½ tablet more than ½ tablet less.

Children up to 8 years:

Dosing recommendations for dispersible combinations tablets:

Pre-treatment body weight	2 months intensive phase given daily	2 months continuation phase given daily
	RHZ	RH
	75/50/150 mg dispersible tablet (scored) **OR** 75/50/150 mg per 4 mL solution*	75/50 mg dispersible tablet (scored) **OR** 75/50 mg per 4 mL solution*
2–2.9 kg	½ tablet or 2 mL	½ tablet or 2 mL
3–3.9 kg	¾ tablet or 3 mL	¾ tablet or 3 mL
4–7.9 kg	1 tablet or 4 mL	1 tablet or 4 mL
8–11.9 kg	2 tablets or 8 mL	2 tablets or 8 mL
12–15.9 kg	3 tablets or 12 mL	3 tablets or 12 mL
16–24.9 kg	4 tablets or 16 mL	4 tablets or 16 mL

Note: Children should be taught and encouraged to swallow whole tablets or, if required, fractions of tablets so as to avoid large volumes of liquid medication.
*If oral suspension required, for each dose, disperse 1 x RHZ 75/50/150 mg or 1 x RH 75/50 mg tablet in 4 mL of water, administer required dose, discard unused suspension.

	Intensive phase 2 months			**Continuation phase 2 months**
Weight	**RH**	**PZA**		**RH**
	60/60 mg	Give one of the following:		60/60 mg
		150 mg* **OR** 150 mg/3 mL	500 mg	
2–2.9 kg	½ tablet	1.5 mL	Expert advice on dose	½ tablet
3–3.9 kg	¾ tablet	2.5 mL	¼ tablet	¾ tablet
4–5.9 kg	1 tablet	3 mL	¼ tablet	1 tablet
6–7.9 kg	1½ tablets		½ tablet	1½ tablets
8–11.9 kg	2 tablets		½ tablet	2 tablets
12–14.9 kg	3 tablets		1 tablet	3 tablets
15–19.9 kg	3½ tablets		1 tablet	3½ tablets
20–24.9 kg	4½ tablets		1½ tablets	4½ tablets
25–29.9 kg	5 tablets		2 tablets	5 tablets

*For each dose, dissolve 150 mg dispersible (1 tablet) in 3 mL of water to prepare a concentration of 50 mg/mL (150 mg/3 mL).

LoE I[1]

AND

- Pyridoxine, oral, daily for 6 months if HIV-infected, malnourished, or with existing neuropathy:
  - Child < 5 years: 12.5 mg.
  - Child ≥ 5 years: 25 mg.

Children > 8 years of age and adolescent (and > 25 kg):

Pre-treatment body weight	2 months intensive phase given daily	2 months continuation phase given daily	
	RHZE (150, 75, 400, 275)	**RH** (150, 75)	**RH** (300, 150)
25–37.9 kg	2 tablets	2 tablets	
38–54.9 kg	3 tablets	3 tablets	
55–70.9 kg	4 tablets		2 tablets
> 71 kg	5 tablets		2 tablets

AND

- Pyridoxine, oral, daily for 6 months if HIV-infected, malnourished, or with existing neuropathy:
  - Child < 5 years: 12.5 mg.
  - Child ≥ 5 years: 25 mg.

10.2.2 SEVERE TUBERCULOSIS DISEASE

Indications:

» Includes more serious pulmonary TB, such as smear-positive TB, cavitatory pulmonary TB, bronchopneumonic TB, extensive (multiple lobes involved) pulmonary TB disease, and tuberculous empyema.
» Includes all HIV/TB co-infected cases.
» Includes extrapulmonary TB, e.g. spinal, osteo-articular or abdominal TB.

However:

» Exclude TB meningitis and miliary TB.

Dosing:

» Weigh at each visit and adjust treatment doses to body weight. If calculating dosages, rather give ½ tablet more than ½ tablet less.
» Keep strictly to the correct dose and the duration of treatment.
» The patient should be weighed regularly and the dose adjusted according to the current weight.

Children up to 8 years of age:
Intensive phase:
Standard dose 4-drug therapy daily (RHZE) for 2 months.

Follow with:
Continuation phase:
Standard dose 2-drug therapy daily (Isoniazid + Rifampicin) for 4 to 7 months.

Dosing recommendations for dispersible combinations tablets:

Pre-treatment body weight	2 months intensive phase given daily		4–7*** months continuation phase given daily
	RHZ	E	RH
	75/50/150 mg dispersible tablet (scored) **OR** 75/50/150 mg per 4 mL solution*	400 mg tablet **OR** 400 mg/8 mL solution**	75/50 mg dispersible tablet (scored) **OR** 75/50 mg per 4 mL solution*
2–2.9 kg	½ tablet or 2 mL	1 mL	½ tablet or 2 mL
3–3.9 kg	¾ tablet or 3 mL	1.5 mL	¾ tablet or 3 mL
4–7.9 kg	1 tablet or 4 mL	2.5 mL	1 tablet or 4 mL
8–11.9 kg	2 tablets or 8 mL	½ tablet or 4 mL	2 tablets or 8 mL
12–15.9 kg	3 tablets or 12 mL	¾ tablet or 6 mL	3 tablets or 12 mL
16–24.9 kg	4 tablets or 16 mL	1 tablet or 8 mL	4 tablets or 16 mL

Note: Children should be taught and encouraged to swallow whole tablets or, if required, fractions of tablets so as to avoid large volumes of liquid medication.

*If oral suspension required, for each dose, disperse 1 x RHZ 75/50/150 mg or 1 x RH 75/50 mg tablet in 4 mL of water, administer required dose, discard unused suspension.

**If oral suspension required, for each dose, crush 1 x ethambutol 400 mg tablet to a fine powder, disperse in 8 mL of water to prepare a concentration of 400 mg/8 mL (50 mg/mL), administer required dose as indicated in above chart, discard unused suspension.

***Continuation phase may be prolonged to 7 months in slow responders and children with HIV.

	Intensive phase 2 months				Continuation phase at least 4 months (up to 7 months ***)
Weight	**RH**	**PZA Give one of the following:**		**EMB**	**RH**
	60/60	150 mg* **OR** 150 mg/3 mL	500 mg	400 mg tablet **OR** 400 mg/8 mL** solution	60/60
2–2.9 kg	½ tablet	1.5 mL	Expert advice on dose	1 mL	½ tablet
3–3.9 kg	¾ tablet	2.5 mL	¼ tablet	1.5 mL	¾ tablet
4–5.9 kg	1 tablet	3 mL	¼ tablet	2 mL	1 tablet
6–7.9 kg	1½ tablets		½ tablet	3 mL	1½ tablets
8–11.9 kg	2 tablets		½ tablet	½ tablet	2 tablets
12–14.9 kg	3 tablets		1 tablet	¾ tablet	3 tablets
15–19.9 kg	3½ tablets		1 tablet	1 tablet	3½ tablets
20–24.9 kg	4½ tablets		1½ tablet	1 tablet	4½ tablets
25–29.9 kg	5 tablets		2 tablets	1½ tablets	5 tablets

Notes:
*For each dose, dissolve 150 mg dispersible (1 tablet) in 3 mL of water to prepare a concentration of 50 mg/mL (150 mg/3 mL).
**For each dose, crush 400 mg (1 tablet) to a fine powder and dissolve in 8 mL of water to prepare a concentration of 400 mg/8 mL. Discard unused solution.
***Continuation phase may be prolonged to 7 months in slow responders and children with HIV.

AND

- Pyridoxine, oral, daily for 6 months if HIV-infected, malnourished, or with existing neuropathy:
  - Child < 5 years: 12.5 mg.
  - Child ≥ 5 years: 25 mg.

Children > 8 years and adolescent:

Pre-treatment body weight	2 months intensive phase given daily	4 months continuation phase given daily	
	RHZE (150, 75, 400, 275)	**RH** (150, 75)	**RH** (300, 150)
25–37.9 kg	2 tablets	2 tablets	
38–54.9 kg	3 tablets	3 tablets	
55–70.9 kg	4 tablets		2 tablets
> 71 kg	5 tablets		2 tablets

AND

Pyridoxine, oral, daily for 6 months if HIV-infected, malnourished, or with existing neuropathy:

- Child < 5 years: 12.5 mg.
- Child ≥ 5 years: 25 mg.

Adjust treatment dosages to body weight.
If calculating dosages, rather give ½ tablet more than ½ tablet less.

REFERRAL

» Poor response to standard TB treatment.
» Failure to exclude MDR-TB.
» Adverse drug reactions (ADR) requiring single drug combinations.
» MDR or MDR-TB contact.

10.3 MILIARY TB IN CHILDREN

A19.9

DESCRIPTION

Miliary tuberculosis is a potentially fatal form of TB disease due to the spread of the organism in the bloodstream to the lungs, brain and other organs. Patients with miliary TB are assumed to have CNS involvement and are treated accordingly.

MEDICINE TREATMENT

Children < 8 years:
The 75/50 RH and 75/50/150 RHZ formulations are not suitable for achieving the required doses in miliary TB, TBM/CNS TB, so the 60/60 RH formulation should be used for such children.

A 6-month regimen of all 4 of the following medicines:

- Rifampicin, oral, 20 mg/kg as a single daily dose.
  - Maximum dose: 600 mg daily.

PLUS

- Isoniazid, oral, 20 mg/kg as a single daily dose.
  - Maximum dose: 400 mg daily.

PLUS

- Pyrazinamide, oral, 40 mg/kg as a single daily dose.
  - Maximum daily dose: 2000 mg.

PLUS

- Ethionamide, oral, 20 mg/kg as a single daily dose.
  - Maximum daily dose: 1000 mg.

<table>
<tr><th rowspan="2">Body weight</th><th colspan="3">Single phase of treatment, 6–9 months
Once daily; 7 days a week</th></tr>
<tr><th>Rifampicin/ Isoniazid (RH)</th><th>Pyrazinamide (Z)</th><th>Ethionamide (Eto)</th></tr>
<tr><td></td><td>60/60 mg dispersible tablet (scored)</td><td>500 mg tablet (scored) OR 500 mg/8 mL suspension</td><td>250 mg tablet (scored) OR 250 mg/8 mL suspension</td></tr>
<tr><td>< 2</td><td colspan="3">Obtain Expert Advice</td></tr>
<tr><td>2–2.9</td><td>¾ tablet or 3 mL</td><td>1 mL</td><td>1.5 mL</td></tr>
<tr><td>3–3.9</td><td>1 tablet or 4 mL</td><td>2 mL</td><td>2 mL</td></tr>
<tr><td>4–4.9</td><td>1½ tablets or 6 mL</td><td>2.5 mL</td><td>2.5 mL</td></tr>
<tr><td>5–5.9</td><td>1¾ tablets or 7 mL</td><td>3 mL</td><td>3 mL</td></tr>
<tr><td>6–6.9</td><td>2 tablets or 8 mL</td><td rowspan="2">½ tablet or 4 mL</td><td rowspan="2">½ tablet or 4 mL</td></tr>
<tr><td>7–8.9</td><td>2½ tablets or 10 mL</td></tr>
<tr><td>9–9.9</td><td>3 tablets or 12 mL</td><td rowspan="2">¾ tablet or 6 mL</td><td rowspan="2">¾ tablet or 6 mL</td></tr>
<tr><td>10–11.9</td><td>3½ tablets or 14 mL</td></tr>
<tr><td>12–12.9</td><td>4 tablets or 16 mL</td><td rowspan="3">1 tablet or 8 mL</td><td rowspan="2">1 tablet or 8 mL</td></tr>
<tr><td>13–14.9</td><td>4½ tablets or 18 mL</td></tr>
<tr><td>15–16.9</td><td>5 tablets or 20 mL</td><td rowspan="2">1¼ tablet or 10 mL</td></tr>
<tr><td>17–17.9</td><td rowspan="2">5½ tablets or 22 mL</td><td rowspan="2">1¼ tablets or 10 mL</td></tr>
<tr><td>18–19.9</td><td rowspan="2">1½ tablets or 12 mL</td></tr>
<tr><td>20–24.9</td><td>6 tablets or 24 mL</td><td>1½ tablets or 12 mL</td></tr>
</table>

Note: Children should be taught and encouraged to swallow whole tablets or, if required, fractions of tablets so as to avoid large volumes of liquid medication if possible.

*If oral suspension required, for each dose, disperse 1 x HR 60/60 mg tablet in 4 mL of water, administer required dose as indicated in above chart, discard unused suspension.
**If oral suspension is required, crush 1 x 500 mg pyrazinamide tablet to a fine powder, disperse in 8 mL water to prepare a concentration of 500 mg/8 mL (62.5 mg/mL), administer required dose as indicated in above chart, discard unused suspension.
***If oral suspension is required, crush 1 x 250 mg ethionamide tablet to a fine powder, disperse in 8 mL of water to prepare a concentration of 250 mg/8 mL (31.3 mg/mL); administer required dose as indicated in above chart; discard unused suspension.

PLUS

- Pyridoxine 25 mg daily for 6 months.

Children ≥ 8 years:
Treatment as per adult guidelines for pulmonary tuberculosis. See Adults Hospital Level STGs and EML, section 16.9: Tuberculosis, pulmonary.

» Treatment duration: 6 to 9 months.

Note:
All cases of miliary TB should have a lumbar puncture (LP) performed. Any abnormal CSF results, or where a LP is not performed, should be treated as a patient with TBM. See section 10.4: Meningitis, tuberculosis (TBM) in children.

10.4 MENINGITIS, TUBERCULOUS (TBM) IN CHILDREN

A17.0
*Notifiable condition.

DESCRIPTION

Tuberculous meningitis is an infection of the meninges caused by *M. tuberculosis*. Early diagnosis and treatment improves the prognosis.

Differentiation from acute bacterial meningitis may be difficult. If in any doubt, treat for both conditions.

Complications may be acute or long term:

» Acute:
- > raised intracranial pressure,
- > cerebral oedema,
- > hemi/quadriplegia,
- > hydrocephalus,
- > brain infarcts,
- > convulsions,
- hyponatraemia due to inappropriate antidiuretic hormone (ADH) secretion or cerebral salt wasting.

Syndrome of inappropriate antidiuretic hormone secretion (SIADH) and cerebral salt wasting both present with hyponatraemia; the former responding to fluid restriction and the latter to fluid replacement, i.e. sodium chloride 0.9%.

SIADH has lower serum uric acid and low urine output. Cerebral salt wasting has a normal serum uric acid and high urine output.

» Long-term neurological sequelae include: mental handicap, blindness and deafness.

DIAGNOSTIC CRITERIA

Clinical

» History of contact with an infectious tuberculosis case.
» Onset may be gradual with vague complaints of drowsiness (or fatigue), vomiting, fever, weight loss, irritability and headache.
» Later symptoms such as convulsions and neurological fall-out may occur.
» Older children may present with behavioural changes.
» Examination may reveal signs of meningeal irritation and raised intracranial pressure, convulsions, cranial nerve palsies, localising signs (such as hemiparesis), altered level of consciousness or coma and choroidal tubercles.
» The degree of involvement is classified into 3 stages. Prognosis relates to the stage of the disease.
  > Stage 1: Non-specific signs, conscious, rational, no focal neurological signs, no hydrocephalus.
  > Stage 2: Signs of meningeal irritation, confusion and/or focal neurological signs.
  > Stage 3: Stupor, delirium, coma and/or neurological signs, i.e. hemiplegia.

Investigations

» CSF findings:
  > May vary depending on the stage.
  > Protein is usually raised.
  > Chloride and glucose are moderately low.
  > Lymphocytes usually predominate.
  > Gram stain is negative and acid-fast bacilli are seldom found.
  > A rapid TB molecular test (e.g. GeneXpert®) should be done on CSF. It is helpful where it is positive, but a negative rapid TB molecular test (e.g. GeneXpert®) does not exclude TBM.
  > A negative result does not exclude TB and CSF cultures must still be done.

  Bacilli may be cultured from the CSF but may take up to 4–6 weeks. If culture is positive, drug susceptibility testing will be done. Always send for culture, do not perform a stain as there is a low diagnostic yield from low concentration of organisms and wastes the CSF sample.
» A TST and chest X-ray must be done, but are often unhelpful.

» If depressed level of consciousness or focal neurological signs are present, a CT scan is useful to determine if safe to LP (do CT first before LP in such cases).
» Electrolytes: check for hyponatraemia.

GENERAL AND SUPPORTIVE MEASURES

» Monitor neurological status on a regular basis. If rapid deterioration in level of consciousness, consider neurosurgical referral for a ventriculoperitoneal shunt (VP shunt).
» Ensure optimal nutrition. Initially naso-gastric feeding is usually needed. Refer for nutrition support.
» Rehabilitative measures: most patients need physiotherapy and occupational therapy.
» Surgical treatment (VP shunt) is needed for a non-communicating hydrocephalus, diagnosed by air-encephalogram.
» Communicating hydrocephalus with severely raised pressure may be managed with medicines once hydration status is stable and/or with serial lumbar puncture with specialist consultation (tertiary hospital care).

MEDICINE TREATMENT

Differentiation from acute bacterial meningitis may be difficult.
If in doubt, treat for both conditions.

Anti-tuberculosis treatment

» Requires therapy with a combination of 4 drugs as a special regimen.
» All treatment should be directly observed therapy.
» Single drugs may form part of the regimen to provide the total daily required dose for each medicine by supplementing the combination to give the necessary therapeutic dose per kilogram.

A 6-month regimen of all 4 of the following drugs:

- Rifampicin, oral, 20 mg/kg as a single daily dose.
  - Maximum daily dose: 600 mg.

PLUS

- Isoniazid, oral, 20 mg/kg as a single daily dose.
  - Maximum daily dose: 400 mg.

PLUS

- Pyrazinamide, oral, 40 mg/kg as a single daily dose.
  - Maximum daily dose: 2000 mg.

PLUS

- Ethionamide, oral, 20 mg/kg as a single daily dose.
  - Maximum daily dose: 1000 mg.

The 75/50 RH and 75/50/150 RHZ formulations are not suitable for achieving the required doses in disseminated TB & TBM, so the 60/60 RH formulation should be used for such children.

Body weight (kg)	Single phase of treatment, 6–9 months Once daily; 7 days a week		
	Rifampicin/Isoniazid (RH)*	**Pyrazinamide (Z)**	**Ethionamide (Eto)**
	60/60 mg dispersible tablet (scored)	500 mg tablet (scored) **OR** 500 mg/8 mL suspension**	250 mg tablet (scored) **OR** 250 mg/8 mL suspension***
< 2	**Obtain Expert Advice**		
2–2.9	¾ tablet or 3 mL	1 mL	1.5 mL
3–3.9	1 tablet or 4 mL	2 mL	2 mL
4–4.9	1½ tablets or 6 mL	2.5 mL	2.5 mL
5–5.9	1¾ tablets or 7 mL	3 mL	3 mL
6–6.9	2 tablets or 8 mL	½ tablet or 4 mL	½ tablet or 4 mL
7–8.9	2½ tablets or 10 mL		
9–9.9	3 tablets or 12 mL	¾ tablet or 6 mL	¾ tablet or 6 mL
10–11.9	3½ tablets or 14 mL		
12–12.9	4 tablets or 16 mL	1 tablet or 8 mL	1 tablet or 8 mL
13–14.9	4½ tablets or 18 mL		
15–16.9	5 tablets or 20 mL		1¼ tablets or 10 mL
17–17.9	5½ tablets or 22 mL	1¼ tablets or 10 mL	
18–19.9			1½ tablets or 12 mL
20–24.9	6 tablets or 24 mL	1½ tablets or 12 mL	

Note: Children should be taught and encouraged to swallow whole tablets or, if required, fractions of tablets so as to avoid large volumes of liquid medication if possible.

*If oral suspension required, for each dose, disperse 1 x RH 60/60 mg tablet in 4 mL of water, administer required dose as indicated in above chart, discard unused suspension.

**If oral suspension is required, crush 1 x 500 mg pyrazinamide tablet to a fine powder, disperse in 8 mL water to prepare a concentration of 500 mg/8 mL (62.5 mg/mL), administer required dose as indicated in above chart, discard unused suspension.

***If oral suspension is required, crush 1 x 250 mg ethionamide tablet to a fine powder, disperse in 8 mL of water to prepare a concentration of 250 mg/8 mL (31.3 mg/mL); administer required dose as indicated in above chart; discard unused suspension.

Consider prolonging treatment for another 3 months if there are concerns about ongoing disease. Consult with a specialist.

In case of suspected/confirmed multidrug-resistant TBM, refer immediately for admission and treatment.

Steroid therapy:

- Prednisone, oral, 2 mg/kg as a single daily dose for 4 weeks.
  - Maximum daily dose: 60 mg.
  - Taper to stop over further 2 weeks.

Hydrocephalus

Avoid low sodium IV fluids in these patients, i.e. < 60 mmol/L.

To differentiate communicating from non-communicating hydrocephalus an air-encephalogram is usually required. Communicating hydrocephalus is more common in this condition.

In children with a sudden deterioration of level of consciousness and other comatose children with TBM, inform the neurosurgeon before doing the air-encephalogram so that shunt surgery can immediately be done if the hydrocephalus is non-communicating. Air-encephalogram procedure: do a lumbar puncture, inject 5 mL of air with a syringe and do an immediate lateral X-ray of the skull. Air in the lateral ventricles on skull X-ray indicates communicating hydrocephalus; air at the base of the brain (not in lateral ventricles), indicates non-communicating hydrocephalus.

Communicating hydrocephalus

If dehydrated, rehydrate with sodium chloride 0.9%, IV.

Start diuretics as soon as the patient is well hydrated and serum electrolytes are within the normal range:

- Acetazolamide, oral, 20 mg/kg/dose 8 hourly.
  - Maximum daily dose: 1000 mg.
  - Monitor for metabolic acidosis and serum potassium derangements.

PLUS

- Furosemide, oral, 0.3 mg/kg/dose 8 hourly for the first month of treatment.
  - Taper slowly over 2 weeks if the intracranial pressure has normalised, as indicated by clinical response or resolution of hydrocephalus on follow-up scan.
  - Do not restrict fluids once on diuretics.

Sudden deterioration of level of consciousness:

- Mannitol, IV, 250 mg/kg administered over 30–60 minutes.

REFERRAL

» TBM not responding to adequate therapy.
» TBM with complications.
» Suspicion of non-communicating hydrocephalus.
» Suspected drug-resistant TB (contact with drug-resistant TB case).

10.5 TB PREVENTIVE THERAPY (TPT) FOR TB EXPOSURE/INFECTION

Screen all children in close contact with an infectious pulmonary TB case for TB disease. Screening includes clinical history and examination with appropriate investigations of children with suspected TB disease. Give full anti-tuberculosis treatment if the diagnosis of TB disease is confirmed or suspected.

Indications for TB Preventive Therapy (TPT):

» All asymptomatic children and adolescents, i.e. clinically well, normal chest X-ray irrespective of TST, in close contact with an infectious pulmonary TB case should receive TPT.

» Previous TPT or treatment does not protect the child against subsequent TB exposure/infection. If there is a new exposure to an infectious pulmonary TB case after completion of a course of TPT, it can be given again. TPT should be repeated after each episode of documented TB exposure. In cases of a new exposure to an infectious source case while the child is on TPT, the duration of TPT should continue for at least as long as the source case remains infectious.

Preventive therapy in case of a drug-susceptible TB contact:

- Isoniazid, oral, 10 mg/kg daily for 6 months.

Preventive therapy in case of a drug-resistant TB contact:

Isoniazid monoresistance (rifampicin susceptible):

- Rifampicin, oral, 15 mg/kg daily for 4 months.

Rifampicin monoresistance (isoniazid susceptible):

- Isoniazid, oral, 10 mg/kg daily for 6 months.

MDR-TB with second line sensitivity:

- Levofloxacin 15–20 mg/kg daily for 6 months (maximum dose: 1000mg)

AND/OR

- Isoniazid, oral, 15–20 mg/kg daily for 6 months (maximum dose: 600mg)

Refer case or discuss with specialist if simplification of prophylaxis regimen is required.

Also see the National Department of Health Clinical Reference Guide: **Management of Rifampicin-Resistant Tuberculosis**, 2019[2] for further guidance.

XDR-TB:

- Close follow-up for two years.
- Ensure household infection control practices are observed.
- Refer all cases.

10.6 TREATMENT OF CHILDREN WHO WERE PREVIOUSLY SUCCESSFULLY TREATED FOR TB (RETREATMENT)

A child who was previously successfully treated for pulmonary TB is at increased risk for re-infection with TB. It is imperative to exclude drug-resistant TB by carrying out a sputum rapid TB molecular test (e.g. GeneXpert®) plus culture with drug susceptibility testing (DST), and also determine DST of any known TB source case. If the above does not indicate resistant TB, treat as drug susceptible TB (high bacillary load) with close monitoring of response. Consider an extension of the duration of the continuation phase of therapy in these retreatment cases.

REFERRAL

» Poor clinical response to TB retreatment.

10.7 DRUG RESISTANT TB (DR-TB)

U84.3

See the National Department of Health Clinical Reference Guide: **Management of Rifampicin-Resistant Tuberculosis**, 2019.[2]

References

[1] Turkova A, Wills GH, Wobudeya E, Chabala C, Palmer A, Kinikar S. Shorter Treatment of Nonsevere Tuberculosis in African and Indian Children. NEJM. 2022, 386 (10): 911-922.

[2] National Department of Health. Management of Rifampicin-Resistant Tuberculosis. November 2019. https://www.health.gov.za/wp-content/uploads/2020/11/management-of-rifampicin-resistant-tb-booklet-1219-v6.pdf

CHAPTER 11

SURGICAL PROPHYLAXIS

DESCRIPTION

Surgical prophylaxis is the pre- or intra-operative administration of antibiotics to patients to reduce the risk of postoperative wound infection. Specific epidemiological considerations may alter the choice of agents.

PRINCIPLES OF SURGICAL PROPHYLAXIS

» The need for prophylactic antibiotic therapy is based on the risk of wound contamination.
» The medication chosen should be active against the pathogens most likely to be associated with wound infections.
» Prophylaxis must be given within 60 minutes of the first incision, usually at induction of anaesthesia.
» If a patient is receiving antimicrobials for a remote infection prior to surgery, antibiotic prophylaxis should still be given in order to ensure adequate serum and tissue levels with activity against the pathogens during the surgery. If the agent being used for treatment is appropriate for surgical prophylaxis, administering an extra dose within 60 minutes before surgical incision is sufficient.

LoE II [1,2,3,4,5]

Risk factors for developing surgical site infection

Classification of degree of contamination likely to be present during operation:

» Class I: Clean procedures, only microorganisms from skin or external environment are likely to be introduced (includes operations for blunt trauma).
» Class II: Clean procedures with limited contamination, exposure to micro-organisms colonising the epithelial surfaces and/or lumen of respiratory, gastrointestinal, urinary or genital tract. No evidence of infection.
» Class III: Contaminated, open fresh accidental wounds, operations with major breaks (e.g. open cardiac massage or gross spillage from gastrointestinal tract) and incisions in which non-purulent inflammation is encountered.
» Class IV: Dirty and/or infected surgical site indicates that the organism causing postoperative infection was in the operation area before surgery, traumatic wounds with devitalised tissue not immediately attended to, and wounds that involve existing clinical infection or perforated viscera.

These guidelines cover prophylaxis and not therapy for infective conditions.

Other risk factors include:

» Prolonged duration of operation.
» Medical characteristics of the patient (nutritional status, immunosuppression and co-existent infection at remote body site).

Consider antibiotic prophylaxis for class II procedures or if these risk factors are present.

For most class III and IV procedures, antibiotics are indicated for therapy rather than single dose prophylaxis. Additional procedures (some Class I) for which antibiotic prophylaxis is recommended include the following:

» Head and neck: CSF shunt and middle ear ventilation tube (grommet) insertion.
» Cardiothoracic: cardiac pacemaker insertion, interventional cardiac catheter device placement.
» Gastrointestinal: insertion of percutaneous endoscopic gastrostomy.

The prophylactic dose is a single dose equal to the standard therapeutic dose given within 60 minutes of starting the procedure.
A second dose is **ONLY** given if surgery is prolonged,
i.e. > 4 hours for cefazolin **OR** > 8 hours for metronidazole.

For Cardiac Surgery: post-operative dosing for up to 24 hours may be considered.

ANTIBIOTIC PROPHYLAXIS

Cefazolin has been found to be the drug of choice for most prophylaxis settings, as it is the most widely studied antimicrobial agent, with proven efficacy.

See Table below to inform appropriate choice of antibiotic:

» Cefazolin, IV, 30 mg/kg (maximum dose 2000 mg).
» Metronidazole, IV, 7.5 mg/kg (maximum dose 500 mg).

LoE II [1]

Type of Surgery	Recommended Antibiotic(s)
Head & Neck	Cefazolin
Neurosurgery	Cefazolin
Ophthalmic *LoE III*[1]	Chloramphenicol ophthalmic drops 0.5%, instil in the affected eye, one drop every 5-15 minutes for a total of five doses in the hour before starting procedure.
Middle Ear Ventilation Tubes	Ofloxacin, ophthalmic drops, instil 1 drop, in the affected ear after the procedure.
Oropharyngeal mucosal	Cefazolin AND Metronidazole
Upper GIT	Cefazolin
Cardiothoracic	Cefazolin
Biliary	Cefazolin AND Metronidazole
Nephro-urological	Cefazolin
Colorectal & Appendix	Cefazolin AND Metronidazole
Pelvic	Cefazolin AND Metronidazole
Orthopaedic	Cefazolin
Lower Limb	Cefazolin

BETA-LACTAM ALLERGIES

Avoid beta-lactam antimicrobials in patients with a history of anaphylaxis, urticaria or angioedema after exposure to one of these agents.
In these cases:

- Clindamycin, IV, 6 mg/kg
  (Single dose unless procedure is > 4 hours)

ADD

- Gentamicin, IV, 6 mg/kg for the following procedures:
  - » Oropharyngeal mucosal
  - » Biliary
  - » Nephro-urological
  - » Colorectal & appendix
  - » Pelvic

For Infective Endocarditis Prophylaxis: Refer to Chapter 4: Cardiovascular System, Section 4.3 Endocarditis, infective.

References

[1] Bratzler DW, et. al. Clinical Practice Guidelines for antimicrobial prophylaxis in surgery. Am J Health-Syst Pharm. 2013; 70:195-283.
[2] Steinberg JP, C et. al. Timing of antimicrobial prophylaxis and the risk of surgical site infection: results from the Trial to Reduce Antimicrobial Prophylaxis Errors. *Ann Surg.* 2009; 250:10-6.
[3] Soriano A, et. al. Timing of antibiotic prophylaxis for primary total knee arthroplasty performed during ischemia. Clin Infect Dis. 2008; 46:1009-14.
[4] Weber WP, et. al. The timing of surgical antimicrobial prophylaxis. *Ann Surg.* 2008; 247:918-26.
[5] Dellinger EP. What is the ideal time for administration of antimicrobial prophylaxis for a surgical procedure? *Ann Surg.* 2008; 247:927-8.

CHAPTER 12
RHEUMATOLOGY AND VASCULITIDES

12.1 IMMUNOGLOBULIN A VASCULITIS (PREVIOUSLY HENOCH SCHÖNLEIN PURPURA (HSP))

D69.0

DESCRIPTION

Immunoglobulin A vasculitis is an acute leucocytoclastic vasculitis of small blood vessels usually involving skin, gastrointestinal tract, joints and the kidney. Aetiology is unknown.

Complications include:

» acute severe abdominal pain, bowel infarction/perforation;
» nephritis with renal impairment or nephrotic syndrome.

DIAGNOSTIC CRITERIA

Clinical

Syndrome consisting of:

» Non-thrombocytopenic palpable purpuric skin **rash** with a very typical distribution on lower extremities and buttocks. The rash occurs in 100% of cases, but may not be present initially. Trunk and upper extremities may be involved. Angio-oedema of scalp, eyelids, lips and ears.
» **Arthralgia/arthritis** (60–70%): mostly of large joints, i.e. knees and ankles.
» **Abdominal pain** with 'colic' (60–70%): may develop gastrointestinal bleeding, intussusception, or infarction.
» **Renal involvement** (25–50%) manifesting with haematuria and/or proteinuria.

Investigations

» No specific diagnostic test.
» Full blood count (FBC): Platelets may be normal or increased (differentiating this form of purpura from that caused by thrombocytopenia), mild leucocytosis is seen in some children. Normochromic anaemia often related to gastro-intestinal loss.
» Coagulation studies are normal.
» Urine test strip to evaluate renal involvement.
» Serum urea, creatinine, electrolytes and albumin with renal involvement.
» Check stools for occult or frank bleeding.

GENERAL AND SUPPORTIVE MEASURES

» Short period of immobilisation during acute arthritis.
» Soft diet for acute gastrointestinal involvement.
» Clinical review with blood pressure monitoring and urine test strip testing weekly or biweekly for first 2 months, then monthly for the next year.

MEDICINE TREATMENT

For arthritis, oedema, fever, malaise:

- Paracetamol, oral, 15 mg/kg/dose, 6 hourly as required.

OR

- Ibuprofen, oral, 10 mg/kg/dose 6 hourly.
  - Reduce dosing interval to 8 hourly once pain starts improving.

For complicated HSP (severe pain, severe extrarenal symptoms or renal disease):

- Prednisone, oral, 1–2 mg/kg/dose once daily for 10 days in the morning.
  - Reduce dose gradually over 2 weeks.

REFERRAL

HSP with complications, i.e. in patients with:

» Persistent proteinuria, persistent microscopic haematuria, hypertension or worsening renal function for age (renal biopsy indicated).
» Persistent abdominal pain.

12.2 JUVENILE IDIOPATHIC ARTHRITIS (JIA)

M08.0

DESCRIPTION

Juvenile Idiopathic Arthritis (JIA) is of unknown origin with unexplained symptoms for at least 6 weeks with onset before the age of 16 years. Other causes of arthritis must be excluded, e.g. infections, malignancy, trauma, other autoimmune disease. Different clinical subgroups are recognised according to the pattern of onset that manifests within the first 6 months.

DIAGNOSTIC CRITERIA

Systemic onset JIA

» Arthritis in one or more joints.
» Plus at least 2 weeks of daily (quotidian) fever.
» With one of the following:
  > erythematous macular rash, or
  > serositis, i.e. pericarditis and pleuritis, or
  > hepato- or splenomegaly, or
  > generalised lymphadenopathy.

Note: There may be a prolonged delay between the onset of fever and the development of the arthritis.

Oligoarthritis

Always consider TB if only one joint is involved.
Arthritis affecting one to four joints for the first 6 months of disease.

» Two categories are recognised:
  > Persistent oligoarthritis: affects ≤ 4 joints throughout the disease course.
  > Extended oligoarthritis: affects > 4 joints after the first 6 months.

» Occurs more commonly in girls than in boys.
» Typically, onset is before 6 years of age.
» Usually asymmetric arthritis that affects mainly large joints.
» High risk of developing chronic iridocyclitis.
» Up to 70% of patients are anti-nuclear antibody (ANA) positive.

Polyarthritis (Rheumatoid factor (RF)-negative)
» Arthritis affecting ≥ 5 joints in the first 6 months of disease.
» Negative rheumatoid factor polyarthritis includes 2 subsets:
  > one that is similar to adult onset RF-negative rheumatoid arthritis, characterised by symmetric synovitis of large and small joints, onset at school age (between 10 and 14 years) and absence of ANA expression;
  > another that resembles oligoarthritis apart from the number of joints affected in the first 6 months of the disease. This subset of children usually presents between 2 and 5 years of age.

Polyarthritis (Rheumatoid factor (RF)-positive)
» Arthritis affecting ≥ 5 joints in the first 6 months of disease.
» Positive rheumatoid factor on 2 separate occasions at least 3 months apart.
» Involves large and small joints.
» Equivalent to RF-positive adult rheumatoid arthritis but with onset younger than 16 years of age.

Enthesitis-related arthritis
» Arthritis **and** enthesitis
  OR
» Arthritis **or** enthesitis, **and** 2 of the following:
  > sacroiliac joint involvement,
  > HLA-B27-positive,
  > first-degree relative with HLA-B27 associated disease,
  > arthritis in a boy after the age of 6 years,
  > anterior uveitis associated with pain, redness or photophobia.

Psoriatic arthritis
» Arthritis **and** psoriasis in a child,
  OR
» Arthritis **and** 2 of the following:
  > dactylitis,
  > nail pitting,
  > psoriasis in a first-degree relative.

Undifferentiated arthritis
» Arthritis not meeting criteria for one of the above categories or fitting more than one of the above groups.

Differential diagnosis
JIA is a clinical diagnosis and depends on the persistence of arthritis or typical systemic manifestations and by exclusion of other diseases:

» Pyogenic and tuberculous joint infection and osteomyelitis.
» Arthritis associated with other acute infectious illnesses.
» Acute leukaemia and other malignancies.
» Acute rheumatic fever.
» Autoimmune disorders, SLE or mixed connective tissue disease.
» Reiter syndrome, i.e. arthritis, urethritis and conjunctivitis.
» Arthritis associated with inflammatory bowel disease.

Investigations

Investigations must be tailored for each case; in consultation with a specialist, consider the following investigations:

» Full blood count with differential and platelet count.
» C-reactive protein and erythrocyte sedimentation rate.
» Liver function screen before starting methotrexate.
» Serum urea, creatinine and electrolytes.
» Muscle enzymes, albumin, calcium, phosphate and alkaline phosphatase.
» Auto-antibodies and rheumatoid factor.
» X–ray or ultrasound of affected joints.
» Arthroscopy and synovial biopsies in cases of possible TB arthritis.
» Eye screen for uveitis.

GENERAL AND SUPPORTIVE MEASURES

» Occupational and physiotherapy programs may provide the following:
  > exercises to increase range of movements of joints and to maintain muscle strength;
  > hot water baths, swimming pool exercises;
  > splints, e.g. nocturnal splints, for pain relief and prevention of contractures;
  > shoe inserts/raises;
  > aids for activities of daily living.
» Orthodontic treatment if temporomandibular joints are involved.
» All children should have a slit lamp examination initially, with follow-up thereafter, at the discretion of the ophthalmologist.
» Explore individualised evidence-based non-pharmacological strategies for management of pain.

MEDICINE TREATMENT

There is no cure for JIA.

The goal of treatment is to eliminate active disease, to normalise joint function, to preserve normal growth, to prevent long-term joint damage and disease complications. Outcome is improved with early aggressive therapy. Treatment should be decided in consultation with a specialist.

Oligoarthritis

NSAID, e.g.:

- Ibuprofen, oral, 10 mg/kg/dose 6–8 hourly.

LoE III[i]

NSAIDs as monotherapy are given for 1–2 months in patients with low disease activity and without joint contractures.

If no improvement:

ADD Intra-articular steroids.

- Intra-articular corticosteroid injection for all active joints (rheumatologist or orthopaedic specialist):
- Methylprednisolone acetate, 1 mg/kg with lignocaine 1%, 0.5 mL.
  - If no response: repeat in 3 months.
  - Young children may require light sedation with midazolam and ketamine.
  - Large joints, if possible, should be aspirated at the same time.
  - Can be repeated after 3 months if there was an initial response, but the disease is not yet in remission.
  - Intra-articular steroids can also be used as initial therapy.

If disease activity still present after 3 months:

ADD

- Methotrexate, oral, 10–15 mg/m^2/week as a single dose on an empty stomach. (Specialist initiated.)
  - Maximum dose: 25 mg/week.
  - Adverse effects include: nausea, mood changes, raised liver enzymes, bone marrow toxicity and proteinuria/haematuria.
  - Monitor: Pre-treatment FBC, liver transaminases and creatinine; then FBC and either ALT or AST 3 monthly. Serum creatinine 6 monthly.

PLUS

- Folic acid, oral, 5 mg weekly, (on the day after methotrexate) for the duration of the treatment.

If no remission in 6 months, refer to a rheumatologist.

Note: Screen all patients early for uveitis (highest risk if ANA positive).

Polyarthritis – early

Start NSAID as soon as possible.

- NSAID, e.g.:
  - Ibuprofen, oral, 10 mg/kg/dose 6–8 hourly.

LoE III[1]

If no significant improvement in 1 month, or if severe at onset, start disease-modifying drugs (DMARDs):

- Methotrexate, oral, 10–15 mg/m^2/week as a single dose on an empty stomach. (Specialist initiated.)
  - Maximum dose: 25 mg/week.

PLUS

- Folic acid, oral, 5 mg weekly (on the day after methotrexate) for the duration of the treatment.

Note:

Intra-articular steroids (IAS) may be used in conjunction with methotrexate.

For rapid relief of symptoms in severe early disease consider adding:

- Prednisone, oral, starting dose: 1 mg/kg/dose once daily.
  - Reduce dose gradually to 5–7.5 mg daily, depending on response.

Systemic onset JIA

Systemic JIA is an aggressive systemic disease. Refer to a rheumatologist early. Initiate treatment after consultation with a rheumatologist.

- **NSAID, e.g.:**
  - Ibuprofen, oral, 10 mg/kg/dose 6–8 hourly.

LoE III[i]

For patients with mild disease begin with:

- Prednisone, oral, 2 mg/kg as a single daily dose.
  - Once disease is controlled, reduce dose gradually.

Critically ill patients with internal organ involvement, such as pleuritis, pericarditis, myocarditis or evidence of early macrophage activation syndrome should be referred urgently:

- Methylprednisolone, IV, 30 mg/kg/day (maximum 1 gram) for 3 days.

Follow with:

- Prednisone, oral, 2 mg/kg as a single daily dose until disease is controlled.
  - These patients may respond to methotrexate or cyclosporine in the long-term, but the response is not as good as other JIA patients.

Psoriatic arthritis

Treat as for oligoarthritis if ≤ 4 joints, or polyarthritis if severe disease or > 4 joints at onset.

Refer early as most children will require a DMARD.

Enthesitis related arthritis

Start NSAID as soon as possible.

- NSAID, e.g.:
  - Ibuprofen, oral, 10 mg/kg/dose 6–8 hourly.

LoE III[i]

If severe disease:

- Prednisone, oral, 1–2 mg/kg as a single daily dose for 2 weeks and wean over 2 weeks (in discussion with a rheumatologist).
  - Refer all children early for consideration of a DMARD therapy.

Uveitis management

Manage in consultation with an ophthalmologist.

Management of a flare of disease

- NSAID, e.g.:
  - Ibuprofen, oral, 10 mg/kg/dose 6–8 hourly.

If severe flare, consider:

- Prednisone, oral, 1–2 mg/kg daily.

Prompt referral to a subspecialist.

With residual pain not relieved by DMARDs, NSAIDs and corticosteroids, consult a specialist for appropriate management. Adopt a holistic multimodal pain management plan, see Chapter 20: Pain Control.

REFERRAL

» **Urgent:** uncontrolled systemic disease.
» Paediatric specialist or subspecialist referral:
  > All for confirmation of diagnosis.
  > All patients requiring DMARD.
  > Adverse reaction to NSAID therapy.
  > Suspected JIA not responding to NSAID therapy.
» Ophthalmology referral:
  > For slit lamp examination.
  > Patients with iridocyclitis and uveitis.
» For orthopaedic treatment, e.g. where intra-articular corticosteroids are indicated, or if TB oligoarthritis is suspected.

12.3 KAWASAKI DISEASE/MUCOCUTANEOUS LYMPH NODE SYNDROME

M30.3

DESCRIPTION

Kawasaki disease is an acute systemic vasculitis of unknown aetiology occurring predominantly in children. It involves small and medium arteries. The most serious complication is coronary artery aneurysms.

Important: MIS-C, a complication of SARS-CoV-2, can mimic Kawasaki disease.

DIAGNOSTIC CRITERIA

Clinical

» There is no diagnostic test.
» Confirm diagnosis by the presence of fever for ≥ 5 days, lack of another known disease process to explain the illness and the presence of 4 of the 5 criteria listed below:
  1. Bilateral bulbar conjunctival injection without exudates.
  2. Changes of the lips and oral cavity: reddening of the oral mucosa, pharynx, lips, strawberry tongue, cracking of lips.
  3. Polymorphous rash, primarily on the trunk.
  4. Cervical lymphadenopathy (lymph nodes > 1.5 cm diameter).
  5. Changes of the extremities, including reddening of the palms and soles, oedema of the hands and/or feet and desquamation of the finger tips and toes.
» A high index of suspicion is required, especially in younger children, who may present without all the above or may have incomplete/atypical Kawasaki disease.
» Important differential diagnoses:

> aseptic/bacterial meningitis,
> viral or drug eruption,
> bacterial adenitis,
> diseases mediated by staphylococcal or streptococcal toxins,
> rickettsial diseases.

Investigations

» C-reactive protein.
» FBC: leucocytosis and thrombocytosis (thrombocytosis usually only occurs in the second week of illness).
» Urine test strip: transient pyuria.
» ESR: elevated.
» Cardiology assessment, including echocardiography to detect coronary artery aneurysms: 100% sensitivity, 97% specificity, done initially and 6 weeks after disease improvement.

GENERAL AND SUPPORTIVE MEASURES

» Routine supportive care.
» Maintain hydration with oral fluids.

MEDICINE TREATMENT

As soon as diagnosed and preferably within the first 10 days from onset of fever, after specialist consultation:

- Immunoglobulin, IV, 2 g/kg as a single dose administered over 12 hours.
  - Repeat dose, if necessary, if temperature does not normalise or rash does not resolve within 24 hours.

If fever continues after 2 doses:

- Methylprednisolone, IV, 30 mg/kg/dose. Specialist consultation.

All children:

- Aspirin (high dose), oral, 20 mg/kg/dose 6 hourly for 72 hrs or until fever settles.

Follow with:

- Aspirin, oral, 3–5 mg/kg/day until ESR and platelet count are normal if there are no coronary artery aneurysms.
  - If coronary aneurysms are present, continue for at least 2 years after aneurysms have resolved or lifelong if coronary aneurysms persist.

REFERRAL

» All patients for confirmation of diagnosis.
» For echocardiography to confirm the presence of coronary artery aneurysms.

12.4 SYSTEMIC LUPUS ERYTHEMATOSUS (SLE)

M32.9

DESCRIPTION

Systemic lupus erythematosus (SLE) is a multisystem inflammatory disease characterised by the presence of auto-antibodies directed against various cellular components, particularly DNA. It is often associated with antiphospholipid-antibody-mediated hypercoagulability. In children it predominantly targets the kidneys (in 50–80%), central nervous system, skin and joints.

Treatment of acute lupus depends on severity of illness, with more aggressive treatment for CNS, renal and haematologic involvement.

DIAGNOSTIC CRITERIA

Clinical

Diagnosis may be elusive due to its variations in presentation and is confirmed with: **SLICC CLASSIFICATION FOR SLE**.

Requirements: ≥ 4 criteria (at least 1 clinical and 1 laboratory criteria) ***OR*** *biopsy-proven lupus nephritis with positive ANA or anti-double stranded DNA antibody.*

CLINICAL CRITERIA	IMMUNOLOGIC CRITERIA (positive result)
1. Acute Cutaneous Lupus 2. Chronic Cutaneous Lupus 3. Oral or nasal ulcers 4. Non-scarring alopecia 5. Arthritis 6. Serositis 7. Renal 8. Neurologic 9. Haemolytic anaemia 10. Leukopenia 11. Thrombocytopenia (<100 000/mm^3)	1. ANA 2. Anti-double stranded DNA antibody 3. Anti-Sm 4. Antiphospholipid Ab 5. Low complement (C3, C4, CH50) 6. Direct Coombs test (do not count in the presence of haemolytic anaemia)

Investigations

Note: Normal urine analysis does not exclude renal disease.

» Urine test strip: haematuria and proteinuria.
» Urine microscopy: cellular casts.
» FBC: differential and platelet count.
» Complement, anti-nuclear antibodies, anti-double stranded DNA antibodies.
» Screen for thyroid involvement.
» Serum urea, creatinine, electrolytes, albumin and cholesterol.
» Clotting profile, antiphospholipid antibody and lupus anticoagulant.
» Electrocardiography and chest X-ray.

GENERAL AND SUPPORTIVE MEASURES

» Counselling, education and a team approach.
» Adequate rest and appropriate nutrition.
» Protect from sunlight: use sunscreen and hats; avoid sunlight if unprotected.
» Physiotherapy to relieve arthralgia.
» Psychological support.
» Immunisation, especially pneumococcal vaccine.
» Prompt management of infections.

MEDICINE TREATMENT

All children should be treated by a specialist.

- Vitamin D and calcium supplementation.

All children:

- Chloroquine (as base), oral, 5 mg/kg/dose daily, Monday to Friday.
- Maximum dose: 200 mg.
    - 6-monthly eye examination necessary.

Chloroquine has a disease-modifying role and is particularly useful for skin and joint disease; some patients can be managed with chloroquine alone or with the addition of low-dose steroids.

Induction therapy

The options depend on the severity of the disease and major organ involvement.
For general systemic disease, serositis or musculoskeletal disease:

- Corticosteroid treatment:
- Prednisone, oral 2 mg/kg/day; maximum daily dose 60 mg.
    - Reduce dose to 0.5 mg/kg once daily by 2 months.

For major organ involvement (severe lupus nephritis class III or IV and neuropsychiatric lupus):

- Methylprednisolone, IV, 30 mg/kg/day (maximum 1000 mg) for 3 days followed by oral prednisone 2 mg/kg/day.
- Reduce dose to 0.5 mg/kg once daily by 2 months.

AND

- Cyclophosphamide, IV, 500–750 mg/m^2/dose, administered over 2 hours.
    - Repeat once a month for 6 months.
    - Cyclophosphamide must be given with pre-hydration and continue increased fluid intake for 24 hours after cyclophosphamide infusion.
    - Monitor vital signs during administration of cyclophosphamide.

Maintenance treatment (steroid sparing treatment)

For mild/moderate disease (vasculitic rash, cytopenia, serositis):

- Azathioprine, oral, 1–2.5 mg/kg/dose as a single daily dose.
    - Maximum dose: 150 mg.
    - Refer if contraindication to azathioprine or if patient develops adverse effects with treatment.

For musculoskeletal and skin disease:

- Methotrexate, oral, 10–15 mg/m^2/week as a single dose on an empty stomach. Specialist initiated.
  - Maximum dose: 25 mg/week.

PLUS

- Folic acid, oral, 5 mg weekly (on the day after methotrexate) for the duration of the treatment.

REFERRAL

Specialist referral:

» All patients for confirmation of diagnosis and initiation/supervision of treatment.
» All patients receiving chloroquine treatment must be referred for ophthalmologic examination.
» Macrophage activation syndrome.
» For kidney biopsy if any evidence of renal disease (deteriorating renal function, significant proteinuria/haematuria or hypertension).

12.5 TAKAYASU ARTERITIS

M31.4

DESCRIPTION

Takayasu arteritis is a chronic inflammatory disease involving large vessels, including the aorta and its main branches and the pulmonary vasculature. Lesions are typically segmental – obliterative and aneurysmal. Symptoms reflect end-organ ischaemia.

DIAGNOSTIC CRITERIA

EULAR/PRINTO/PRES CRITERIA

Angiographic abnormalities of the aorta or its main branches and pulmonary arteries (aneurysm/dilatation, narrowing, occlusion or arterial wall thickening not due to fibromuscular dysplasia).

AND

At least one of the following five:

» Pulse deficit (lost/decreased/unequal peripheral artery pulses and/or claudication induced by activity).
» Systolic blood pressure > 10 mmHg difference between any limbs.
» Bruits or thrills over the aorta and/or its major branches.
» Hypertension
» Elevated acute phase reactants.

May be associated with:

» Congestive cardiac failure associated with aortic regurgitation/dilated cardiomyopathy/hypertension.
» Neurologic signs secondary to hypertension/ischaemia.
» Any signs of unexplained inflammatory activity.
» Strongly positive Tuberculin Skin Test (TST).
» Discrepancy in kidney sizes.

Investigations

» C-reactive protein.
» ESR
» Plasma renin.
» Serum urea, creatinine and electrolytes.
» TST
» Electrocardiography
» Chest X-ray.

GENERAL AND SUPPORTIVE MEASURES

» Refer to Chapter 4: Cardiovascular System, section 4.11.1: Hypertension, acute severe.

MEDICINE TREATMENT

Treat hypertension – refer to Chapter 4: Cardiovascular System, section 4.11.1: Hypertension, acute severe.
Consider TB treatment if tuberculosis cannot be conclusively excluded.

- Aspirin soluble, oral, 5 mg/kg/day as a single daily dose.

Induction therapy

- Prednisone, oral, 2 mg/kg/day (maximum 60 mg) for maximum of 4 weeks.
  - Reduce dose slowly over 12 weeks to 0.25 mg/kg on alternate days.

LoE II[ii]

Continue maintenance treatment with:

- Methotrexate, oral, 10–15 mg/m^2/week. Specialist initiated.
  - Maximum dose: 25 mg/week.

PLUS

- Folic acid, oral, 5 mg weekly (on the day after methotrexate) for the duration of the treatment.

REFERRAL

Specialist referral:

» All patients for confirmation of diagnosis with conventional angiography or magnetic resonance imaging angiography.
» Poor response to initial therapy.

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CHAPTER 13

THE NERVOUS SYSTEM

13.1 SEIZURES

R56.8

DESCRIPTION

A seizure is a change in movement, attention or level of awareness that is sustained or repetitive and occurs as a result of abnormal and excessive neuronal discharges within the brain.

For recurrent seizures, see section 13.4: Epilepsy.

Classification of seizures using International League against Epilepsy (ILAE): Classification of seizures is aetiological and clinical.

Aetiology

» Genetic
» Metabolic
» Structural
» Infectious
» Immune
» Unknown

The causes of seizures are multifactorial. CNS infections are a common cause in the South African setting. The commonest seizures in children are febrile convulsions but the history, examination and investigations must be aimed at excluding the following conditions:

Perinatal conditions	Infections	Poisoning
» congenital infection » hypoxic-ischaemic damage » trauma » cerebral haemorrhage or thrombosis	» meningitis » encephalitis » brain abscess » neurocysticercosis	» accidental ingestion of medicines » medicine withdrawal » environmental toxins » toxicity of antiepileptic drugs (AED)
Metabolic conditions	**Systemic disorders**	**Primary cerebral causes**
» hypoglycaemia » hypocalcaemia » hypomagnesaemia » hyponatraemia » hypernatraemia » inborn errors of metabolism	» vasculitis » hypertensive encephalopathy » uraemia (renal failure) » hyperammonaemia (liver failure)	» cerebral malformation » genetic/familial (syndromic) » tumour » idiopathic

Clinical

Within each of the above categories, generalised, focal or syndromic seizures occur.

Generalised seizures:

The epileptic focus arises at some point within and rapidly spreads to involve networks in both hemispheres of the brain.

Generalised seizures may be:

» tonic-clonic,
» absence (typical or atypical),
» clonic,
» tonic or atonic,
» myoclonic.

Generalised tonic-clonic seizures (GTCS) that continue or recur for more than 5 minutes in which there is incomplete recovery of consciousness are called Convulsive Status Epilepticus: See section 13.3: Status epilepticus (convulsive).

Focal seizures:

The epileptic activity arises at some point from a particular focus or networks limited to one hemisphere of the brain.

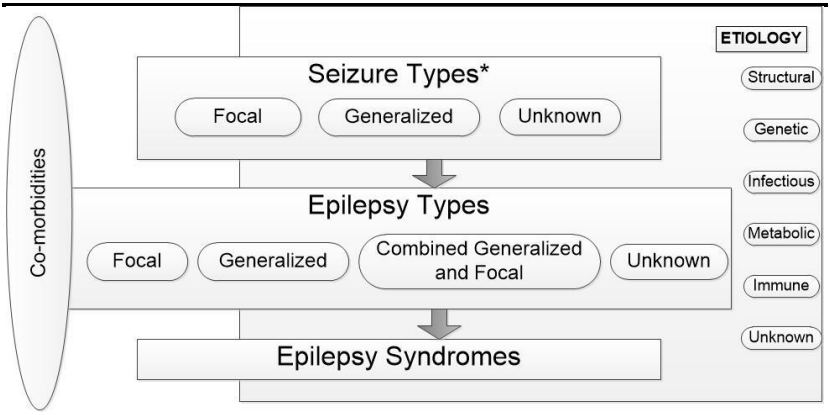
Focal seizures occur with:

» observable aura, motor or autonomic components,
» altered consciousness or awareness (previously termed complex partial seizures).

The presentation of focal seizures depends on the site of origin and may be frontal lobe seizures, temporal lobe seizures, parietal lobe seizures and occipital lobe seizures.

Focal seizures may progress to generalised tonic-clonic seizures and this is known as secondary generalisation.

Epileptic Syndromes – See section 13.4: Epilepsy.



**Denotes onset of seizure.*

International League Against Epilepsy Classification of Seizures[1]

DIAGNOSTIC CRITERIA

Clinical

» Obtain a history:
  > Eye witness account, aura, video recording.
  > Perinatal history, drug history, developmental history, school record, family history and environment.

» Examine to exclude obvious aetiology, but in particular, look for occult causes:
  > General: skin abnormalities, e.g. Sturge-Weber syndrome and tuberous sclerosis complex.
  > CNS examination for loss of consciousness, neck stiffness, localising signs, head growth, developmental milestones and fundoscopy.
  > CVS examination: check blood pressure.

Investigations

Investigations should be individualised according to clinical indication.

Always consider hypoglycaemia and hypertension as a primary or aggravating cause of any seizure.

Basic investigations:
» Blood glucose in all children.
» Rapid test for malaria for those who have recently travelled to a malaria area.
» Electrolytes (Na, Ca, Mg) in sick and young children.
» Blood culture in febrile children.
» Full blood count.
» Lumbar puncture: if meningitis is suspected.

It is difficult to clinically exclude meningitis in children under 12 months, therefore, a LP may be warranted.

Note:

If the seizure has progressed to established status epilepticus (i.e. lasted 20–30 minutes), then lumbar puncture is contraindicated until raised intracranial pressure is excluded. For contraindications to LP see section 13.12: Lumbar puncture.

» Neuroimaging: CT scan (brain) – if persistently reduced Glascow coma score (GCS < 12/15) without known cause, raised intracranial pressure or focal intracranial pathology is suspected.

GENERAL AND SUPPORTIVE MEASURES

» Ensure an open airway and administer oxygen.
» Position to prevent aspiration of vomitus, i.e. recovery position.
» Check glucose during the seizure and blood pressure after the seizure.
» Obtain intravenous access if seizure duration is > 5 minutes.
» Keep child nil per mouth and intravenous fluid volumes at maintenance rates.
» Aetiology will determine further management.

MEDICINE TREATMENT

Urgent medicine treatment is indicated if the seizure is generalised and lasts more than 5 minutes or is causing systemic compromise. Treat as for Status epilepticus: see section 13.3: Status epilepticus (convulsive).

If meningitis cannot be excluded, commence antibiotic therapy. See Chapter 8: Infective/Infectious Diseases, section 8.11: Meningitis, acute bacterial.

13.2 SEIZURES, FEBRILE

R56.0

DESCRIPTION

Seizures occurring in children between the ages of 6 months and 6 years associated with a fever but without evidence of intracranial infection or defined cause for the seizure.
Febrile seizures can be classified as simple or complex.

Simple febrile seizures:

» are generalised tonic-clonic seizures,
» are self-limiting, usually less than 5 minutes and always less than 15 minutes,
» cause no neurological deficit after the convulsion,
» have a good prognosis and very rarely develop into epilepsy,
» consist of only one seizure during the febrile illness which needs no specific treatment, and

» there is often a family history of febrile seizures.

Complex febrile seizures – febrile seizures with *one or more* of the following:
» last longer than 15 minutes,
» are recurrent within the same febrile illness or occur within 24 hours,
» have a focal onset,
» have post-ictal, focal neurological abnormalities.

Risk factors for recurrent febrile seizures include:
» seizure disorder in a first-degree relative,
» onset before 12 months of age,
» initial complex seizures.

DIAGNOSTIC CRITERIA

Clinical

» Investigate for intracranial, extracranial and biochemical causes of fever or seizure.
» Signs of meningism are unreliable in children < 2 years of age.
» If raised intracranial pressure or meningitis cannot be excluded, the diagnosis of febrile seizures cannot be made. Treat children empirically for meningitis if suspected.

Investigations

Lumbar puncture

» Lumbar puncture is indicated in:
  > All children with clinical features of possible meningitis.
» Lumbar puncture may be indicated in:
  > Children where meningitis cannot be excluded, e.g. < 1 year of age or those who have received a course of antibiotics prior to the event.
» In children > 1 year of age, where a focus of extracranial infection is present and intracranial infection such as meningitis has been excluded clinically, no further investigation is required.

Neuroimaging

» Children with complex febrile seizures and persistent lethargy may require neuroimaging and then a lumbar puncture if raised intracranial pressure can reliably be excluded.
» Based on clinical findings, investigate complex febrile seizures for possible underlying conditions such as meningitis, focal brain lesions and epilepsy.

Note:
An EEG is of no value in simple febrile seizures, but consider in recurrent complex febrile seizures.

GENERAL AND SUPPORTIVE MEASURES

» Reassure parents and caregivers.

» Educate parents and caregivers regarding the first aid management of seizures.

MEDICINE TREATMENT

For fever related symptoms (temperature > 38.5 ˚C):

- Paracetamol, oral, 15 mg/kg/dose 6 hourly.
  - Paracetamol has no effect on seizure prevention.

If convulsing:
See section 13.3: Status epilepticus (convulsive).

Continuous anticonvulsant drug prophylactic therapy
Routine daily antiepileptic drug prophylaxis is not recommended for patients with simple febrile seizures.
For children with recurrent complex febrile seizures, discuss the treatment options with a specialist.

REFERRAL

» All patients with recurrent complex febrile seizures without an obvious cause of the seizure and/or not responding to initial management should be discussed with a specialist.
» Developmental delay/regression.

13.3 STATUS EPILEPTICUS (CONVULSIVE)

G41.9

DESCRIPTION

ILAE 2015

Convulsive status epilepticus (SE) is characterised by abnormally prolonged seizures lasting more than 5 minutes. It is a **medical emergency.**

After 30 minutes of generalised tonic-clonic seizures, the brain begins to suffer from hypoxia, acidosis, and depletion of local energy stores, cerebral oedema and structural damage.

Complications include:

» hyperpyrexia,
» respiratory depression,
» cerebral oedema,
» blood pressure disturbances,
» inappropriate antidiuretic hormone (ADH) secretion,
» hypoxic ischaemic damage to brain, myocardium and muscles.
» disturbances of blood glucose,
» renal failure,
» acidosis,

DIAGNOSTIC CRITERIA

Clinical

» Convulsive seizure lasting 5 minutes or longer to be managed as status epilepticus.
» The causes of convulsive status epilepticus may be:
- Unknown
- Symptomatic with a known cause:
  > Acute: secondary to an insult to the brain, e.g. encephalitis, hypoxic episode, trauma and complex febrile seizures; as a result of treatment non-adherence and changes in anticonvulsant therapy.
  > Remote: cerebral palsy, post-stroke.
  > Progressive: brain malignancy, neurodegenerative disease.
  > Epilepsy syndromes.

GENERAL AND SUPPORTIVE MEASURES

» Maintain an open airway.
» Place patient on side.
» Admit to high- or intensive-care, if possible.
» Monitor:
  > heart rate,
  > respiratory rate,
  > blood pressure,
  > electrolytes,
  > blood glucose,
  > antiepileptic drug blood levels,
  > acid-base status,
  > blood gases,
  > SaO_2,
  > neurological status,
  > fluid balance,
  > osmolality.
» Cardiovascular and/or respiratory support if the patient is unable to maintain blood gases and blood pressure within the normal physiological range.
» If it is necessary to ventilate, maintain P_aCO_2 in the low-normal range, i.e. 4.0–4.5 kPa.

Maintain $S_aO_2 \geq 95\%$:

» Oxygen, by facemask or nasal cannulae while convulsing.
» Measure antiepileptic drug blood levels if there are breakthrough seizures on medication, signs of toxicity, drug interactions or concerns about adherence.

MEDICINE TREATMENT

Status epilepticus

Follow ABCD approach.
See flow chart on next page for management of status epilepticus.
For buccal midazolam and rectal diazepam, use the intravenous formulation.

For the purpose of rationalising the management of convulsive status epilepticus (SE), it helps to divide or classify it into different stages as below:

» Early SE (5–20 minutes).
» Established SE (20–30 minutes).

» Refractory SE (beyond 30 minutes).

Intravenous fluid:

- Dextrose 5% in sodium chloride 0.9%, IV.
  - Avoid over-hydration. Keep fluid volume at maintenance.
  - Maintain normoglycaemia and electrolytes within the normal range.

Other biochemical disorders

Correct abnormalities, if present, e.g. glucose, calcium and sodium.

DRUG MANAGEMENT OF STATUS EPILEPTICUS		
PHASE	**MANAGEMENT**	**GOALS**
EARLY STATUS 0–5 minutes **EMERGENCY INITIAL AED 5 minutes**	Early stabilisation phase: • Immediate ABC • Diagnose hypoglycaemia • Establish IV access <u>If IV access:</u> Lorazepam, IV, 0.1 mg/kg <u>If no IV access:</u> Lorazepam, IM, 0.1 mg/kg **OR** Diazepam, rectal, 0.5 mg/kg **OR** Midazolam, buccal, 0.5 mg/kg	• Maintain saturation, cerebral perfusion pressure (CPP) • Support haemodynamic status
ESTABLISHED STATUS 5–30 minutes	**If still convulsing after 5–10 minutes:** Repeat Lorazepam, IV, 0.1 mg/kg **AND load with** Phenytoin, IV, 20 mg/kg *(infused in sodium chloride 0.9% over 20 minutes, not exceeding 3 mg/kg/min with cardiac monitoring)* **OR** Phenobarbital, IV, 20 mg/kg **If still convulsing after 15–20 minutes:** *(use alternative option to what was used above)* Phenytoin, IV, 20 mg/kg **OR** Phenobarbital, IV, 20 mg/kg **Refer to ICU**	• Stop seizure

PHASE	MANAGEMENT	GOALS
REFRACTORY STATUS 30–60 minutes	**ICU** **Consideration for:** • Midazolam infusion • Endotracheal intubation with neuroprotective ventilation strategy (See Intensive Care Chapter)	• Stop seizure • Support haemodynamic status

Note:
Once intravenous access is attained, take blood for glucose, blood gas analysis, electrolytes, LFTs, FBC and antiepileptic drug levels if patient is a known epileptic.

Monitor carefully for drug related respiratory depression.

Seizures due to poisoning should PREFERABLY NOT be treated with phenytoin.

Once convulsions are controlled, consider maintenance therapy.

Cerebral oedema
Treat when clinically proven.
See section 13.13: Raised intracranial pressure.

REFERRAL

Caution:
Attempt to control seizures and stabilise the patient before referral.

» Failure to control seizures within 30 minutes.
» Where the primary cause is unknown, or if the primary cause itself requires referral.

13.4 EPILEPSY

G40.9

DESCRIPTION

Epilepsy is a disease of the brain characterised by any of the following conditions:

» At least two unprovoked (or reflex) seizures occurring > 24 hours apart.
» One unprovoked (or reflex) seizure and a probability of further seizures similar to the general recurrence risk (at least 60%) after two unprovoked seizures, occurring over the next 10 years.
» Diagnosis of an epilepsy syndrome.

An epileptic seizure is defined as a transient occurrence of signs and/or symptoms due to abnormal excessive or synchronous neuronal activity in the brain.

Generalised epileptic seizures originate within, and rapidly engage, bilaterally distributed networks in the cortical and subcortical structures.

Focal epileptic seizures originate within networks limited to one hemisphere. These may be discretely localized or more widely distributed.

Besides the classification according to types, there are also specific seizure syndromes with specific treatment.

1. Childhood Absence Epilepsy.
2. Childhood Epilepsy with Centrotemporal Spikes.
3. Epileptic spasms (West syndrome).
4. Lennox-Gastaut syndrome.
5. Dravet syndrome.
6. Febrile seizures plus (FS+).

Epilepsy syndromes include:

Childhood Absence Epilepsy

» Short spells of sudden onset of motor arrest and impairment of consciousness lasting between 5 and 30 seconds.
» Little or no associated automatic movements.
» No post-ictal effect.
» Onset from 5–7 years old until puberty.

Childhood Epilepsy with Centrotemporal Spikes

» Sleep related events of hemifacial clonic spasm.
» Inability to speak but retained awareness.
» Peak onset at ± 6–10 years.
» Usually resolves by late adolescence.

Epileptic spasms (West syndrome)

» An infantile-onset encephalopathy with epileptic spasms associated with hypsarrhythmia on the EEG and developmental regression.
» Frequent age of onset 3–6 months old.
» It is a neurological emergency. Do not delay diagnosis, treatment and referral. Early intervention reduces subsequent neuro-disability.
» Clinically, the child appears to stare, gives a sudden flexion of the trunk and head, with the limbs in extension or flexion but held in this tonic spasm for a few seconds.
» Events occur in clusters and are most common when the infant is going to sleep or rousing.
» The episodes are distressing to the infant and he/she will often appear red in the face and may cry-out.
» Events are often confused with colic.

Lennox-Gastaut syndrome (LGS)
» Combinations of GTCS, atypical absences, myoclonic seizures, tonic seizures, atonic drop attacks and occasionally complex focal seizures.
» May occur spontaneously but usually structural.
» Onset between 2–3 years of age.
» Behavioural problems and neuroregression occurs.

Dravet syndrome
» A severe form of myoclonic epilepsy with onset in children < 1 year of age with recurrent clusters of febrile convulsions, severe neuroregression and other non-febrile seizures by 2–3 years.

Febrile seizures plus (FS+)
» Children with febrile convulsions that persist beyond 6 years.
» These children have epilepsy triggered by fever and may warrant antiepileptic drug intervention.
» There is often a family history of febrile convulsions.

Note:
West syndrome, Dravet syndrome and Lennox-Gastaut syndrome are regarded as epileptic encephalopathies and are associated with neuroregression and behavioural problems.

DIAGNOSTIC CRITERIA

A child may be diagnosed:
» with a specific anatomical or systemic cause for the seizure type (see table of possible causes),
» as having an epilepsy syndrome, i.e. a specific seizure type associated with a characteristic EEG, natural history, response to anticonvulsant therapy and prognosis,
» with epilepsy of unknown aetiology.

Investigations:
» MRI of the brain is the preferred investigation for recurrent seizures in children. If not available, a CT scan of the brain is indicated.
» EEG is indicated for recurrent or syndromic seizures where a diagnosis cannot be made on clinical grounds alone. Delay an EEG for at least one week after the convulsive episode.
» If atypical, a 12-lead ECG should be considered in diagnostic uncertainty – it is important to consider prolonged QT interval syndromes.

GENERAL AND SUPPORTIVE MEASURES

» Minimise the impact of the epilepsy by obtaining complete seizure control to maximise the child's full potential.
» Educate the patient and caregiver about epilepsy and associated complications and comorbidities, i.e. learning difficulties and ADHD.

MEDICINE TREATMENT

Acute therapy

Manage as per seizures/status epilepticus, see sections 13.1: Seizures, and 13.3: Status epilepticus (convulsive).

Maintenance therapy

» Monotherapy is preferred.
» Combination therapy, if necessary, should be specialist initiated.
Caution: Potential drug-drug interactions.
» As a general rule, start with small doses and titrate upwards slowly.
» Aim for low-to-mid-therapeutic dose range and accept the lowest dose at which seizures are controlled.
» If seizures continue, titrate to high therapeutic doses, if there are no unacceptable side-effects.
» Measuring drug levels is rarely indicated unless there is concern about toxicity or adherence and in polytherapy.

Maintenance medicine treatment choices for different types of epileptic seizures.

	1st line	2nd line (specialist advice)
Generalised tonic and/or clonic	• Valproate **OR** • Phenobarbital (< 6 months old)	• Levetiracetam* *(if unable to swallow tablets)* • Lamotrigine *(if able to swallow tablets)*
Focal	• Carbamazepine	• Levetiracetam* *(if unable to swallow tablets)* • Lamotrigine *(if able to swallow tablets)* • Topiramate
Infantile epileptic spasms	Refer all.	
Absence	• Valproate	• Lamotrigine
Myoclonic	Refer all for specialist investigation and initiation of therapy with valproate.	

*Levetiracetam solution is used initially when patients are unable to swallow; patients are to be switched to lamotrigine tablets once they can swallow.

Caution

The choice of AED for girls and women of childbearing potential must be carefully considered. Valproate should be avoided in adolescent women and preadolescent girls who are likely to remain on treatment into their childbearing years unless other treatment is ineffective or effective contraception is in place. This is due to the risk of adverse developmental outcomes to the foetus.

If the decision is made to use Valproate in patients this population, complete the 'Acknowledgement of Risk' form:
https://www.sahpra.org.za/wp-content/uploads/2020/08/6.28_Valproate_Annual_Risk_Acknowledgement_Form_Dec18_v1.pdf

- Valproate, oral, 5 mg/kg/dose (starting dose), 8–12 hourly.
  - Increase by 5 mg/kg weekly to 15–20 mg/kg/day given 8–12 hourly over 4 weeks.
  - Maximum total daily dose: 40 mg/kg/day.
  - Exclude liver dysfunction prior to initiating therapy (at least ALT), in children under 2 years or if clinical suspicion of liver dysfunction or metabolic disease.
  - Monitor at least clinically for hepatotoxicity.

- Carbamazepine, oral, 5 mg/kg/day (starting dose), 8–12 hourly.
  - Increase slowly by 0.2 mg/kg at 2 weekly intervals to 5–10 mg/kg/dose 8–12 hourly.
  - Usual maintenance total daily dose: 10–20 mg/kg/day.
  - Maximum total daily dose: 20 mg/kg/day.
  - Dosage intervals: syrup 8 hourly, tablets 12 hourly.
  - Exacerbates myoclonic seizures and absence seizures.

- Lamotrigine, oral, 0.2 mg/kg/dose (starting daily dose) (specialist initiated).
  - Increase slowly at 2 weekly intervals to 1–5 mg/kg/dose 12–24 hourly.
  - Rapid escalation associated with adverse side-effect of skin rash.
  - Maximum total daily dose when given with valproate: 5 mg/kg/day.
  - Lamotrigine is given as add-on therapy for different seizure types and in drug-resistant paediatric epileptic syndromes, such as Lennox-Gastaut syndrome.
  - Double the maximum dose of lamotrigine when using carbamazepine or phenobarbital.
  - Lamotrigine must be given at a reduced dosage of no more than half the recommended dose in patients using valproate.

- Phenobarbital, oral, 3–5 mg/kg/dose as single dose at night.
  - May be used in children under six months of age.
  - Is not recommended as maintenance therapy for children older than 2 years due to undesirable side-effects such as sedation, behaviour

disturbances, hyperkinesia and dependence, except in situations where there is poor adherence to other drugs.
  - Exacerbates absence seizures.

- Topiramate, oral, 1–3 mg/kg/dose as a single dose at night.
  - Increase at 1–2 weekly intervals by 0.5–1.5 mg/kg twice daily.
  - Maximum dose:
    - ≥ 2 years: 16 mg/kg/day
    - ≥ 4 years: 30 mg/kg/day

- Levetiracetam, oral,
  - Infants 1 to < 6 months: Initial: 7 mg/kg/dose twice daily; increase dosage every 2 weeks by 7 mg/kg/dose twice daily based on response and tolerability to the recommended dose of 21 mg/kg/dose twice daily.
  - Infants ≥ 6 months and children < 4 years: Initial: 10 mg/kg/dose twice daily; increase dosage every 2 weeks by 10 mg/kg/dose twice daily based on response and tolerability to the recommended dose of 25 mg/kg/dose twice daily.
  - Children > 4 years: initial: 10 mg/kg/dose twice daily; increase dosage every 2 weeks by 10 mg/kg/dose twice daily based on response and tolerability to the recommended dose of 30 mg/kg/dose twice daily.

LoE: III[2]

REFERRAL

» Suspected but undiagnosed secondary cause for seizures.
» Focal seizures for neuroimaging (MRI preferred), if facilities or expertise not available.
» All seizures other than simple febrile convulsions in children < 2 years.
» Seizures that are not controlled within 2 months on one agent with minimal side-effects.
» Neuroregression.
» Mixed seizure types in one patient.
» All myoclonic seizures and epileptic spasms at presentation.

13.5 ANTIRETROVIRAL THERAPY (ART) AND ANTIEPILEPTIC DRUGS (AED)

Co-administration of antiepileptic drugs in patients on antiretroviral therapy has not been well studied yet, and remains a therapeutic challenge. Drug interactions between AED and ART can arise from a number of mechanisms, including liver metabolism (increased or decreased) and competition for protein binding, resulting in increase in viral replication. There is no strong evidence to guide clinicians at present.

The following points are important to remember when treating seizures and epilepsy in patients on ART:

» Great caution should be taken when using drugs metabolised in the liver by the cytochrome P450 enzyme system as this may alter levels of both AED and ART, leading to toxic or sub-therapeutic drug levels. This particularly pertains to the NNRTIs and PIs.
» If clinically indicated, monitor AED levels in patients taking concurrent ART and AED therapy.
» Avoid prescribing carbamazepine, phenobarbital and phenytoin for patients receiving NNRTIs, PIs and InSTIs, as there are serious P450 interactions involved. In this setting, consider lamotrigine, valproate or levetiracetam. See section 13.4: Epilepsy.
» Treat children on ART presenting to casualty with acute seizures or in status epilepticus according to the existing standard status epilepticus or acute seizure protocols.
» Although benzodiazepines, phenytoin and phenobarbital may interact with antiretroviral metabolism, the acute management of acute seizures or SE takes precedence in these instances.

13.6 HEADACHES

R51

DESCRIPTION

Headache is the most common pain syndrome in children of all ages. Recurrent headaches are a common health problem and can be:

» primary, e.g. migraine, or
» secondary/symptomatic, e.g. raised intracranial pressure.

The actual perception of headache varies according to age and is influenced by factors such as experience, memory and cultural environment.

Extract from the International Classification of Headache Disorders (ICHD)

Migraine (without aura)

Five or more headaches lasting 1–48 hours (duration in children is often shorter, lasting a few hours only) fulfilling at least 2 of the following:

» bilateral or unilateral, frontal or parietal in location,
» pulsating in character,
» moderate or severe,
» aggravated by routine activity,
» nausea and/or vomiting plus photophobia and/or phonophobia during headache.

Migraine (with aura)

At least 2 attacks fulfilling at least 3 of the following:

» one or more reversible aura symptoms,

» at least one aura developing over > 4 minutes or 2 or more successive symptoms,
» no aura lasting > 1 hour,
» headache follows aura in less than 1 hour.

Episodic tension-type headache
At least 10 prior episodes, occurring less than 15 times per month and lasting 30 minutes to 7 days with at least 2 of the following:
» pressing or tightening quality,
» mild or moderate intensity,
» bilateral location,
» no aggravation by routine physical activity,
» no nausea, vomiting, photophobia or phonophobia.

Cluster headache
» Severe unilateral sharp headache associated with conjunctival injection and lacrimation.
» Rare in childhood.

Paroxysmal Hemicrania Continua
» Cluster headache of shorter duration.

Each of the above can occur in combination in any patient, i.e. mixed/comorbid headache.
Headaches can also be sub-classified according to temporal patterns, i.e. acute, acute recurrent, chronic progressive/non-progressive, episodic or constant.

DIAGNOSTIC CRITERIA

» Exclude secondary causes of headache, e.g. raised intracranial pressure.
» Red flags in childhood headaches:
  > change in pattern (e.g. 'worst headache ever'),
  > progressive course over time,
  > age younger than 3 years,
  > nocturnal/wakes child from sleep,
  > early morning vomiting,
  > ataxia,
  > focal neurological signs,
  > alteration of level of consciousness.

GENERAL AND SUPPORTIVE MEASURES

» Environmental and lifestyle changes, e.g. avoid precipitants such as bright lights, sleep deprivation and certain foods, excessive video games.
» Adequate hydration.
» Avoid skipping meals, excessive caffeine ingestion.
» Regular exercise.
» Stress alleviation and coping skills training where possible.

» Headache diary and identify possible triggers.

MEDICINE TREATMENT

Treat non-migraine headaches with analgesics.

- Paracetamol, oral, 15 mg/kg/dose 6 hourly as required.

For migraine:

- Ibuprofen, oral, 10 mg/kg/dose, 6 hourly.

Persistent vomiting and not tolerating oral feeds:

- Metoclopramide, oral, 0.15–0.3 mg/kg as a single dose.

OR

- Metoclopramide, IM/IV, 0.1 mg/kg as a single dose.

OR

- Ondansetron, oral, 0.1–0.2 mg/kg 12 hourly.

Note:

Headaches can be an adverse effect associated with the of use ondansetron. Patients with ongoing symptoms should be investigated.

Migraine prophylaxis

Indicated when headaches occur frequently, impacting on the child's activity and requiring substantial relief medication.

Treat for six months then review.

- Propranolol, oral, 0.5–3 mg/kg/day in 2–3 divided doses.
  - Contraindicated in asthma and heart block.
  - Avoid in diabetes and depression.

In children who are unable to take propranolol, e.g. asthma:

- Topiramate, oral, 1–3 mg/kg/day in 1–2 doses (specialist initiated).
  - Starting dose: 0.5 mg/kg/day.
  - Titrate dose slowly every 1–2 weeks.
  - Reinforce behavioural management before considering topiramate.

REFERRAL

» Secondary intracranial cause suspected.
» Failure to respond to first line treatment.

13.7 NEUROCYSTICERCOSIS

B69.0

DESCRIPTION

Neurocysticercosis is caused by the cysticercal form, i.e. larval form, of the pork tapeworm, *Taenia solium*. The larvae may locate in the brain parenchyma, intraventricular and meningeal areas, spinal canal/cord and eye,

or a combination of these regions. Viable cysticerci incite little inflammatory response, but dead cysticerci elicit an increased inflammatory response.

Cysticerci in the brain may remain dormant or may cause complications such as:

- » headache,
- » behavioural disorders,
- » visual disturbances,
- » seizures,
- » meningo-encephalitis,
- » focal neurological deficits,
- » raised intracranial pressure,
- » hydrocephalus,
- » meningitis,
- » spinal cord compression.

DIAGNOSTIC CRITERIA

Clinical

- » Location and stage of the life cycle of the parasite in the brain determines the clinical features.
- » Suspect if child from an endemic area, i.e. pig farming area, presents with neurological abnormalities such as:
  - > seizures,
  - > raised intracranial pressure/hydrocephalus,
  - > focal neurological deficits,
  - > cranial nerve palsies.
  - > meningo-encephalitis,
  - > meningitis,
  - > behavioural disorders,
  - > headache,

Investigations

- » Computed tomography (CT scan) and/or magnetic resonance imaging (MRI scan) of brain showing cysts, granulomas, peri-lesional oedema or calcification of cysts.
- » MRI scan may identify more lesions and viable cystic lesions than the CT scan.
- » Soft tissue radiology of muscles of lower limbs may demonstrate calcified cysticerci, i.e. 'rice grain' calcifications in muscles.
- » Follow-up CT scans and/or MRI scans may help to assess the response to therapy.

GENERAL AND SUPPORTIVE MEASURES

Prevention:

- » Prolonged freezing or thorough cooking of pork to kill the parasite.
- » Thorough washing of fresh fruit and vegetables in *T. solium* endemic areas.
- » Attention to personal hygiene after use of toilet.
- » Proper sanitation facilities and safe water.
- » Avoid the use of human excreta as fertiliser.
- » Look for Taenia ova in the stools of the family members.

MEDICINE TREATMENT

Calcified cysticerci and a single dying lesion visible on CT scan require no anti-helminthic treatment.

Patients with multiple cysts usually have a mixture of live and dying cysts and are assumed to have active disease and require treatment.

- Albendazole, oral, 7.5 mg/kg/dose 12 hourly for 7 days.
  - Maximum dose: 400 mg/dose.

Prevention of neurological manifestations

In massive infestations, cysticidal therapy may trigger an inflammatory response. Delaying anti-helminthic therapy and adding corticosteroids may lessen the risk.

24 hours **prior** to albendazole therapy:

- Dexamethasone, IM, 0.15 mg/kg/dose 6 hourly.

Then follow with oral therapy as soon as possible:

- Prednisone 1 mg/kg/day for the duration of albendazole therapy, and then taper and discontinue.

Seizure control

See section 13.4: Epilepsy.
Treat according to the type of seizure.
AED treatment for 6–12 months after resolution of lesions on neuroimaging.
Recurrent seizures require chronic treatment until seizure-free for 2 years.

REFERRAL

» Neurocysticercosis not responding to adequate therapy.
» Neurocysticercosis with complications, such as hydrocephalus.
» Intractable epilepsy.

13.8 NEUROMUSCULAR DISORDERS

13.8.1 INFLAMMATORY POLYNEUROPATHY (GUILLAIN-BARRÉ SYNDROME)*

G61.0
* Notifiable condition

DESCRIPTION

Guillain-Barré syndrome (GBS) is an acute autoimmune-mediated polyradiculoneuropathy which is precipitated by a preceding viral or other infection. It is the most common acquired polyneuropathy in children.

Different forms or **variants of** Guillain-Barré syndrome are described depending on the clinical and/or neurophysiological characteristics.

Acute Inflammatory Demyelinating Polyradiculoneuropathy (AIDP)

» This is the most common form, accounting for 80–90% of cases.
» Characterised mainly by:

- > symmetrical, ascending motor weakness,
- > areflexia, i.e. absence of tendon reflexes,
- > distal sensory alteration,
- > pain/paraesthesia.

Acute Motor Axonal Neuropathy (**AMAN**)

» A purely motor form of GBS.
» It involves predominantly motor nerves and has an axonal pattern on electrophysiology (nerve conduction studies).
» Although there are similarities with AIDP, the clinical picture tends to be more severe with more patients suffering from respiratory failure.

Acute Motor-Sensory Axonal Neuropathy (**AMSAN)**

» Another axonal form of GBS but with sensory involvement.
» It is not frequently found in children.

Miller-Fisher syndrome

» Patients have external ophthalmoplegia, sensory ataxia, weakness with areflexia.
» Electrophysiological and CSF studies are similar to AIDP.

Chronic Inflammatory Demyelinating Polyradiculoneuropathy (**CIDP**)

» May be considered a chronic variant of AIDP.
» Most often starts insidiously and progresses slowly, but can have onset like GBS.
» It is managed differently from GBS and should be referred.

DIAGNOSTIC CRITERIA

Clinical

» Preceding respiratory tract or gastrointestinal infection.
» Symmetrical, flaccid muscle weakness with early areflexia.
» The muscle weakness may ascend rapidly upwards to involve the trunk, arms, face and cranial nerves.
» Bulbar paralysis and respiratory failure may develop.
» Autonomic dysfunction.
» Relatively mild, or absence of, sensory signs.
» Exclude the following:
  - > Acute Disseminated Encephalomyelitis (ADEM),
  - > poliomyelitis, a rare cause of hypotonia with abrupt onset of weakness (usually asymmetrical) in association with a febrile illness,
  - > transverse myelitis:
    - initial flaccid weakness and areflexia typically involving the lower limbs maximally,
    - occasionally with pain at the onset, but rapidly progressing to spasticity and hyperreflexia,
    - a sensory level on the trunk,
    - bladder and rectal sphincter involvement.

- > diphtheria,
- > botulism.

Investigations

Follow the Acute Flaccid Paralysis (AFP) investigation protocol

» Send two stool specimens taken 24–48 hours apart to the National Institute of Virology via the local laboratory.
» The stool sample needs to be sent within 14 days of onset of paralysis to exclude poliovirus infection.

CSF

» CSF findings after 1 week show elevated protein and few or no cells, i.e. albumino-cytological dissociation.
» CSF glucose is normal.

GENERAL AND SUPPORTIVE MEASURES

» Notify as AFP.
» Admit to a high care or intensive care unit.
» Monitor respiratory and autonomic functions closely:
  - > peak expiratory flow rate,
  - > respiratory rate,
  - > forced vital capacity (FVC),
  - > arterial blood gases.
  - > blood pressure,
  - > heart rate,
  - > bulbar functions,

» Ventilation is recommended when:
  - > rapidly progressing ascending paralysis, including shoulder weakness, head lag, weak cough and swallowing difficulties,
  - > there is a progressive fall in the peak expiratory flow rate,
  - > tachycardia and sweating occur,
  - > inspiratory efforts are weak (typical signs of respiratory distress will be absent),
  - > inability to talk,
  - > P_aCO_2 levels start rising.

  Note:
  These changes precede hypoxaemia detected on blood gas analysis, and ventilation should begin before frank hypoxaemia occurs.
  Respiratory care must be meticulous.

» To determine fluid losses from autonomic instability, monitor urine output and degree of sweating.
» Provide adequate nutrition.
» Provide bladder and bowel care as well as pressure-point care.
» Routine physiotherapy for chest and limbs, keep ankles in neutral position (90°) (may require foot/hand splints).
» Protect eyes and keep moist.
» Communicate with child as awareness is maintained. Staff should remember that children may be very frightened but unable to express their emotions and needs.

MEDICINE TREATMENT

- Immunoglobulin, IV, 1 g/kg/day, slowly over 12–16 hours on two consecutive days **or** 0.4 g/kg as a single daily dose on 5 consecutive days early in the disease process.
    - Use under specialist supervision.

Substantial pain is present (in up to 90%) in the severely affected patients.
Pain in this setting is often unrecognised and underestimated.
Pain management is essential. See section 20.1.1: Management of pain.

For neuropathic pain**:**

- Carbamazepine, oral, 5 mg/kg/dose 12 hourly.

REFERRAL

» Chronic inflammatory demyelinating polyradiculoneuropathy.
» Guillain-Barré syndrome with bulbar paralysis and/or early signs of respiratory failure.
» Patients who have lost or are losing ambulation for management in consultation with a paediatric neurologist.
» Patients with complex Guillain-Barré syndrome.

13.8.2 MYASTHENIA GRAVIS

G70.0

DESCRIPTION

An auto-immune disorder resulting in muscle fatigue. Mild cases involve the eyes alone, i.e. ptosis and ophthalmoplegia, and severe cases involve proximal muscle groups, respiratory and bulbar control.

DIAGNOSTIC CRITERIA

Clinical

» Muscle fatigability with exercise and demonstration of this in the clinic setting:
    > Lid-lag test, i.e. failure to maintain upward gaze for 1 minute.
    > Arm-raising test, i.e. failure to maintain the arms at 90° from the trunk for 1 minute.

Note:
Myasthenia gravis patients not uncommonly present in a myasthenic crisis, with bulbar and respiratory compromise. Sometimes this may be the first mode of clinical presentation.

MEDICINE TREATMENT

- Pyridostigmine, oral, 1–5 mg/kg/day in 4–6 divided doses. (Specialist initiated).

REFERRAL

» All for confirmation of diagnosis and initiation of treatment (consideration of steroids, immuno-modulation therapy).
» Myasthenic crisis.

13.8.2.1 MYASTHENIC CRISIS (MC)

G70.01

DESCRIPTION

Acute onset of respiratory failure due to worsening myasthenia gravis, requiring ICU admission. Respiratory and bulbar insufficiency is common with an inability to breathe or swallow, or may have worsening of existing symptoms. MC is most frequently precipitated by systemic infections.

Myasthenic crisis may be the initial presentation.

DIAGNOSTIC CRITERIA

Clinical

» Worsening of existing weakness.
» Respiratory compromise.
» Inability to swallow.

GENERAL AND SUPPORTIVE MEASURES

» Admit to ICU for close observation.
» Provide ventilatory and feeding support as required.

MEDICINE TREATMENT

For consideration of glucocorticoid therapy and intravenous immunoglobulin, in discussion with neurologist.

- Dexamethasone, IV or IM,

- Immunoglobulin, IV, 1 g/kg/day, slowly over 12–16 hours on two consecutive days **or** 0.4 g/kg as a single daily dose on 5 consecutive days early in the disease process.

REFERRAL

» All cases for further management.

13.8.3 DUCHENNE MUSCULAR DYSTROPHY (DMD)

G71.01

» An X-linked recessive disorder causing progressive muscle weakness, typically in males.

» Carrier females may have some degree of weakness.
» Due to a mutation in the gene coding for dystrophin.
» There may be a family history of DMD.

DIAGNOSTIC CRITERIA

Clinical

» Delayed walking.
» Toe walking.
» Gowers sign.
» Waddling gait.
» Lumbar lordosis.
» Calf pseudohypertrophy.
» Short stature.
» Progressive proximal muscle weakness, usually confined to a wheelchair by age 13 years.
» Cardiomyopathy
» May have mild cognitive impairment.
» Behavioural issues.

Investigations

» CK markedly elevated.
» AST/ALT may be elevated.

GENERAL AND SUPPORTIVE MEASURES

» Pain may be present and should be treated appropriately.
» Physiotherapy
» Occupational therapy.
» Nutritional support.
» Encourage gentle aerobic exercise.
» Psychosocial support for patient and family.

MEDICINE TREATMENT

Consider oral corticosteroids once plateau or decline in motor function, in consultation with neurologist.

- Prednisone, oral, 0.75 mg/kg daily.
    - Maximum dose 30–40 mg.
- Long term use of corticosteroids is associated with various complications. Monitor patients and manage as needed.

If pain is present, refer to Chapter 20: Pain Control, section 20.1.1: Management of pain.

REFERRAL

All cases for specialist assessment.

13.9 ACUTE DISSEMINATED ENCEPHALOMYELITIS (ADEM)

G04.0

DESCRIPTION

» Most common demyelinating disorder in childhood.
» Affects children with a peak incidence between 5 and 8 years.
» May occur following a systemic viral illness or vaccination.
» Demyelination of white matter in multiple areas of the brain and spinal cord.

DIAGNOSTIC CRITERIA

» ADEM is a diagnosis of exclusion.
» Consider and exclude differential diagnoses: SLE, infectious or autoimmune encephalitis, metabolic disorders, hypertensive encephalopathy.

Characterised by acute onset of encephalopathy with focal or multifocal neurological deficits.

» Seizures
» Cranial nerve palsies.
» Meningism
» Optic neuritis.
» Gait disturbances.
» Hemiparesis
» Pyramidal signs.
» Ataxia
» Aphasia

Symptoms usually peak between 2 and 5 days from onset, but may change or worsen for up to 3 months.

CSF

» Normal pressure.
» May have mild pleocytosis.
» Increased protein.
» Normal glucose.

Diagnostic criteria:

1. A first, polyfocal clinical CNS event with a presumed inflammatory demyelinating cause.
2. Encephalopathy (alteration in consciousness or behavior unexplained by fever, systemic illness or postictal syndrome).
3. Brain MRI abnormalities consistent with demyelination during the acute (initial three-month) phase.
4. No new clinical or MRI findings three months or more after clinical onset.

GENERAL AND SUPPORTIVE MEASURES

» Supportive care including ICU and mechanical ventilation may be necessary.

MEDICINE TREATMENT

Consider treatment with immune modulators and immunoglobulins in consultation with a neurologist.

REFERRAL

» As MRI is required for diagnosis, all patients should be referred prior to implementing treatment.

13.10 SYDENHAM CHOREA

I02.9

DESCRIPTION

A movement disorder with rapid involuntary jerks affecting any part of the body often incorporated into a voluntary movement in an attempt to mask it. It is an acute post-streptococcal infection movement disorder and constitutes one of the major criteria for the diagnosis of rheumatic fever. Patient has the appearance of being restless with constant movement which improves with sleep. The movements are classically random in place and random in time.

DIAGNOSTIC CRITERIA

Clinical

» Exclude drug reactions, hyperthyroidism, systemic lupus erythematosus and neurodegenerative disorders.

Investigations

» Cardiac screening, i.e. ECG, echocardiogram.
» Serum ASOT, anti-DNAse B.
» Erythrocyte sedimentation rate.
» Anti-dsDNA, if clinically indicated.

GENERAL AND SUPPORTIVE MEASURES

» Emotional support.
» School support.
» Occupational therapy.

MEDICINE TREATMENT

Movement disorders:

- Haloperidol, oral, 0.025 mg/kg/day in 2–3 divided doses.
  - Increase dose slowly and incrementally to 0.05 mg/kg/day.

PLUS

If streptococcal infection:
- Phenoxymethylpenicillin, oral, 500 mg 12 hourly for 10 days.

OR
- Amoxicillin, oral, 45 mg/kg/dose 12 hourly for 10 days.

THEN
Until 21 years of age:
- Benzathine benzylpenicillin (depot formulation), IM, 1.2 million units every 28 days.

OR
- Phenoxymethylpenicillin, oral, 250 mg 12 hourly.

REFERRAL
» All patients for specialist assessment.

13.11 CEREBROVASCULAR DISEASE/STROKE
I67.9

DESCRIPTION
Cerebrovascular disease can be ischaemic (thrombotic or embolic) or haemorrhagic, arterial or venous. Arterial ischaemic stroke must always be considered in any child with sudden onset of hemiparesis or other focal neurological disturbance. The clinical features of cerebral venous thrombosis (CVT) include headache, papilloedema, focal neurological signs, seizures (often focal), and alteration of consciousness.

Risk factors:
» cardiac disorders,
» infections, e.g. meningitis, varicella, HIV, etc.,
» prothrombotic disorders, e.g. nephrotic syndrome, protein S/C deficiencies, etc.,
» haematologic disorders, e.g. sickle cell anaemia,
» vasculopathies, e.g. vasculitis, HIV, Moyamoya syndrome.

The initial evaluation in children includes the following:
CT/MRI brain to ascertain whether it is an ischaemic or haemorrhagic infarct.
» Electrocardiography, echocardiography.
» Full blood count, INR, PTT.
» CSF analysis as indicated.
» Infectious screening, including varicella, HIV, mycoplasma, TB.
» Connective tissue and vasculitic screening.
» Thrombophilia screening. See Chapter 3: Blood and Blood Forming Organs, section 3.12: Venous thrombo-embolic disease.

GENERAL AND SUPPORTIVE MEASURES

Acute supportive and neuroprotective care directed at preserving damaged but salvageable brain tissue includes the following:

» Maintain body temperature in the low to normal range.
» Maintain euglycaemia.
» Maintain O_2 saturation above 95%.
» Maintain adequate cerebral perfusion and manage raised intracranial pressure.
» Treat anaemia.
» Treat acute seizures promptly.

Haemorrhagic stroke requires referral to a centre with neurosurgical expertise and facilities.
Early disability assessment and management, includes physiotherapy, speech therapy, occupational therapy, etc.

MEDICINE TREATMENT

Arterial ischaemic stroke without haemorrhage

All patients with confirmed arterial ischaemic stroke:

- Aspirin soluble, oral, 1–5 mg/kg as a daily dose.
  - Contraindicated in haemorrhagic stroke or bleeding tendency.

REFERRAL

» All patients to specialist paediatrician for investigation.
» Anticoagulation with enoxaparin and warfarin is best done in a specialised setting under cardiologist, haematologist and neurologist supervision.

13.12 LUMBAR PUNCTURE

CONTRAINDICATIONS TO LUMBAR PUNCTURE

» Focal neurological signs and depressed level of consciousness.
» Clinical signs of raised intracranial pressure, or impending cerebral herniation:
  > deep coma, i.e. GCS < 9, or sudden deterioration of level of consciousness,
  > decerebrate or decorticate posturing,
  > neurogenic hyperventilation,
  > unequal dilated or poorly reactive pupils,
  > absent doll's eye reflex,
  > papilloedema.
» Haemodynamic/respiratory unstable patients.
» Clinical meningococcaemia (septicaemia) with petechiae/purpura. (confirm with skin scrape, Gram stain and blood culture).
» Skin sepsis or abnormalities over the lumbar puncture site.
» Coagulopathy

» Spinal anatomic abnormality.
» Acute paraplegia.
» Status epilepticus.

PROCEDURE

» Positioning and restraint are vital in determining the success of the procedure.
» The ability of the assistant in restraining is as important as the skill of the 'operator'.
» Preparation entails not only positioning, but attention to sedation/analgesia, 'patient comfort' and safety, as well as factors such as adequate lighting.
» Resuscitation equipment must be available at the bed side.
» Pay attention to the sterility of the operating field.
» Local analgesia with/without sedation may be required. See Chapter 20: Pain Control, section 20.1.1: Management of pain.
» Ensure that all necessary equipment, e.g. needles, manometers and specimen tubes are close at hand.
» Only the interspaces below L3 (L3/L4 or L4/L5) are used in order to avoid damaging the conus medullaris.
» With the patient in the lateral recumbent position, the L3/L4 interspace is found at the level of the line joining the highest points of the two iliac crests.
» Turn the bevel of the needle (with stylet) to face the patient's side to avoid cutting the longitudinal dural fibres.
» As the needle is advanced, the first 'give' or loss of resistance is encountered with the piercing of the ligamentum flavum. A slight 'popping' sensation is felt as the needle penetrates the dura. Remove the stylet to allow CSF to drain out passively. If no fluid appears, then rotate the needle a quarter turn (90°). If this does not help, replace the stylet and advance the needle a few millimetres and then check for fluid as before.
» Measure the opening pressure using a manometer, with the child relaxed in the lateral decubitus position. In a young relaxed child, the opening pressure is in the range of 6-18 cm H_2O.
» At the end of the procedure, re-insert the stylet before removing the needle completely.

Note:
If intracranial infection is suspected, do a blood culture and initiate antimicrobial treatment immediately. See Chapter 8: Infective/Infectious Diseases, section 8.11: Meningitis, Acute Bacterial.

Remember to catch a few drops of CSF on a labstick to check the glucose and for the presence of white cells which may give an indication of an infection.

13.13 RAISED INTRACRANIAL PRESSURE

DESCRIPTION

Raised intracranial pressure (ICP) is an emergency requiring prompt recognition and treatment.

The cranial vault contains the brain, blood and CSF. It has a fixed volume, therefore, an increase in one component requires a compensatory decrease in others to maintain the pressure within the compartment. There is a limited capacity for compensation, i.e. by decreasing CSF volume, decreasing cerebral blood volume or by increasing the cranial volume. Thereafter, there is a rise in pressure.

Herniation syndromes are an important complication to consider. They may arise in the course of untreated underlying disease or as a result of injudicious lumbar puncture.

Normal CSF pressures range from:

- Infants: 20 – 27 cmH_2O (1.5–6 mmHg)
- Children: 4 – 10 cmH_2O (3–7 mmHg)

These values are for well children and may vary in those who are critically ill on ventilation.
Any CSF pressure above 27 cm of CSF (20 mmHg) for more than 20 minutes should be treated.

Increased brain volume	Intracranial space occupying lesion: Brain tumour, brain abscess, haematoma, vascular malformation, arachnoid/ epidermoid cyst.
	Cerebral oedema: encephalitis, meningitis, hypoxic ischaemic encephalopathy, traumatic brain injury, hepatic encephalopathy, Reye's syndrome, stroke, diabetic ketoacidosis, hyponatraemia.
Increased blood volume	Vascular malformations, cerebral venous thrombosis, meningitis, encephalitis.
Increased CSF volume	Obstructive/communicating hydrocephalus, choroid plexus papilloma.
Disordered CSF dynamics	Idiopathic intracranial hypertension.

Source[3]

Vitamin A administration may cause benign raised ICP.

DIAGNOSTIC CRITERIA

Presentation may have an acute or insidious onset depending on the underlying pathology. A detailed history and examination are essential.

Clinical

Features vary with age.

Infants:

- Increasing head circumference.
- Sun setting eyes.
- Distended scalp veins.
- Irritability
- Lethargy
- Vomiting
- Developmental delay or regression.
- Persistent head lag.

Older children:

- Headache
- Vomiting
- Depressed level of consciousness.
- Seizures
- Ataxia
- Abnormal eye movements.
- Double vision.
- Behavioural changes.
- Meningism

Late signs:

- Papilloedema
- Sixth nerve palsy.
- Pupillary dilation.
- Decerebrate or decorticate posturing.
- Cheyne-Stokes respiration.
- Focal neurological deficits.
- Cushing Triad:
  - Increased systolic pressure (with widening pulse pressure).
  - Irregular breathing.
  - Bradycardia

Herniation syndromes	
Unilateral transtentorial herniation	Declining consciousness. Increased blood pressure. Slow pulse. Homonymous hemianopia. Respiratory irregularity.
Bilateral transtentorial herniation	Decerebrate or decorticate rigidity. Declining consciousness. Impaired upward gaze. Irregular respiration. Pupillary constriction or dilatation.
Cerebellar herniation	Declining consciousness. Impaired upward gaze. Irregular respiration. Lower cranial nerve palsies. Neck stiffness or head tilt.

Source[3]

Investigations

- CT brain to determine underlying cause and whether it is safe to perform a lumbar puncture.
- CSF opening pressure (if no contraindication).

GENERAL AND SUPPORTIVE MEASURES

» Follow the ABCD algorithm.
» Position head in midline and elevate to 30°.
» Cautious ventilation maintaining P_aCO_2 between 4.5 and 5 kPa.
» Monitoring and maintenance of blood pressure
» Elevated BP is usually reactive and required to maintain cerebral perfusion.
» Monitor fluid balance, use 0.9% NaCl/5% dextrose water as maintenance fluid.
» Keep serum sodium in the upper range of normal, up to 150 mmol/L.
» Maintain normothermia.
» Maintain glucose within 6 to 10 mmol/L.

MEDICINE TREATMENT

Initiate treatment for underlying cause.
If meningitis cannot be excluded, commence treatment as soon as possible (see Chapter 8: Infective/Infectious Diseases, section 8.11: Meningitis, acute bacterial).

Sodium chloride, 5%, IV, 2 mL/kg infused over 30 minutes.

- Monitoring of serum sodium is essential with repeat doses or infusion.

OR

Mannitol, IV, 250 mg/kg administered over 30–60 minutes.

- Do not exceed two doses without consulting with a specialist.

If a space occupying lesion is diagnosed:
Add

- Dexamethasone, IV, 0.5 mg/kg 12 hourly.
- Maximum dose 12 mg per dose.

Sedation and analgesia, see Pain Control Chapter and Intensive Care Chapter.
Management of seizures if present, refer to section 13.1: Seizures.

REFERRAL

» According to underlying condition.
» Neurosurgical intervention may be required.

13.14 CEREBRAL PALSY (CP)

ICD 10 G80.9

DESCRIPTION

Cerebral palsy (CP) describes a group of disorders of movement and posture. It is the commonest cause of developmental disturbances in children. CP results from an insult to the developing foetal or infant brain, which is non-progressive. There may be associated abnormalities of sensation, perception, cognition, communication and behaviour.

DIAGNOSTIC CRITERIA

» Motor deficit with delay in motor milestones.
  > Not sitting by 8 months (corrected for gestational age).
  > Not walking by 18 months (corrected for gestational age).
  > Hand preference before 12 months (corrected for gestational age).
» No loss of function (i.e. milestone regression).
» Serial examinations may be needed to establish the diagnosis.

Clinical picture may be described by:

» The predominant abnormality of tone and the distribution of areas involved.

Regional involvement	Spastic	Hemiplegia
	Spastic	Diplegia
Global involvement	Spastic	Quadriplegia
	Dyskinetic	Athetoid
	Dyskinetic	Dystonic
	Ataxic	Ataxia

Risk factors:

» Preterm labour and birth.
» Small for gestational age.
» Multiple pregnancy.
» Neonatal encephalopathy.
» Neonatal sepsis.
» Meningitis or septicaemia.

Developmental follow up from birth to 2 years is essential in high risk patients.

GENERAL AND SUPPORTIVE MEASURES

» Multidisciplinary team approach.
» Screen for ophthalmologic and hearing impairments.
» Screen for speech and language disorders.
» Monitor growth, nutrition and swallowing function.
» Physiotherapy
» Occupational therapy.
» Psychology
» Assess level of functioning according to the Gross Motor Function Classification System (GMFCS).

MEDICINE TREATMENT

Medication for relief of spasticity, dystonia and dyskinesia may be used in some patients for improvement in function, range of motion at various joints, disturbances from uncontrolled movements.

Co-morbidities and complications:

Neurological	Epilepsy, hydrocephalus, visual and hearing impairment.	See section 13.4: Epilepsy.
Behavioural and learning	Sleep disturbance, depression, autistic features, learning difficulties, vulnerability.	See Chapter 14: Child and Adolescent Psychiatry, sections 14.4.1: Depression, 14.12: Autism spectrum disorders.
Gastro-intestinal	Difficulty swallowing, gastro-oesophageal reflux, constipation.	See Chapter 2: Alimentary Tract, sections 2.2.2: Constipation and 2.2.8: Gastro-oesophageal reflux disease (GORD).
Bone	Osteoporosis, scoliosis, hip dislocation, pathological fractures.	
Respiratory	Susceptibility to chest infections and aspiration.	See Chapter 15: Respiratory System.
Skin	Drooling, pressure sores.	
Dental	Poor oral hygiene, susceptibility to dental caries.	See Primary Health Care STGs and EML, Chapter 1 Dental and oral conditions, section 1.1: Abscess and caries.
Genito-urinary	Neurogenic bladder	See Chapter 6: Nephrological/Urological disorders, Dysfunctional bladder.

Table adapted from: Smith, M and Kurian, M. Medical management of cerebral palsy. Paediatrics and Child Health, 2016-09-01, Volume 26, Issue 9, Pages 378–382.

These patients frequently experience pain as a result of these complications.
Remember to suspect and manage pain in children with CP.

REFERRAL

For consideration of medical treatment of spasticity, dystonia or dyskinesia in consultation with the multidisciplinary team.

References

[1]Scheffer IE, Berkovic S, Capovilla G, Connolly MB, French J, Guilhoto L. ILAE classification of epilepsies: Position paper of the ILAE Commission for Classification and Terminology. Epilepsia. 2017, 58 (4): 512-521.
[2]Topiramate dose: The British National Formulary for Children, BMJ Group. 2016-2017.
[3]Rajesh A, Kingston-Hepner M and Krishnakumar. Raised intracranial pressure. Paediatrics and Child Health 27;6:260–267.

CHAPTER 14

CHILD AND ADOLESCENT PSYCHIATRY

PRINCIPLES FOR THE SAFE AND EFFECTIVE PRESCRIBING OF PSYCHOTROPIC MEDICATION

Child and adolescent psychiatry patient management involves a systemic, holistic approach requiring a multidisciplinary team. A skilled clinician performs a thorough clinical diagnostic evaluation in keeping with a recognised classification system like DSM 5 and then includes the pharmacological management as part of a holistic treatment plan.

» Multiple aspects need to be considered when prescribing psycho-active medication for children and adolescents, e.g. co-morbidities, home environment stability.
» Complicated cases, uncertain diagnoses and poor treatment response are indications for referral to a Child and Adolescent Psychiatrist for evaluation.
» Children and adolescents may require higher dosages of psycho-active medication per unit of body weight compared to adults to achieve similar blood levels and therapeutic efficacy.
» Psycho-education of the patient and the family is vital.
» Regular monitoring of effectiveness and the need to continue medication should be done with the view to tapering and discontinuing medication after 6 months to a year, unless the medication is for a chronic condition, e.g. ADHD or epilepsy.
» Baseline assessments require a medical history and physical examination. Baseline laboratory investigations, pregnancy testing, drug screening, EEG and ECG should be done where indicated.
» Psychotropic medication is generally well tolerated by children and adolescents. Lowest dosages should be initiated and increased as clinically indicated. Side effects and adherence should be monitored. Monotherapy is ideal. However, childhood-onset psychiatric disorders can be severe and may present with multiple co-morbidities needing polypharmacy. Preferably, add one medication at a time to monitor side effects and effectiveness. Change medications one-at-a-time.

COMMON MEDICATIONS USED IN PSYCHIATRY AND THEIR SIDE EFFECTS

Selective serotonin re-uptake inhibitors (SSRIs) (e.g. fluoxetine)

Adverse effects in children and adolescents

» Agitation, behavioural disinhibition or 'activation', headache, skin rashes, GIT disturbances (decreased appetite, nausea, diarrhoea) and CNS effects, e.g. insomnia, tremor, and sedation.
» Increased risk of suicidality is associated with the use of SSRIs in depressed children and adolescents.
» A less common but potentially serious side effect is serotonin syndrome, which presents, in increasing severity, as restlessness, tremor, shivering, myoclonus, confusion, convulsions and death.
» Less commonly, SSRIs can induce bleeding and mania and may reduce the seizure threshold.

Special precautions/investigations/monitoring

» Adverse events may be dose related; reduce where indicated.
» Monitor for:
  > suicidal ideation/agitation,
  > 'manic switch' (SSRIs may precipitate mania), and
  > serotonin syndrome symptoms (high dosages of SSRIs or the simultaneous use of two SSRIs in cross tapering).

Tricyclic antidepressants (e.g. amitriptyline)

Adverse effects in children and adolescents

» Sedation, anticholinergic side effects, cardiac side effects, convulsions, coma.
» May be more cardio-toxic in children than in adults.

Special precautions/investigations/monitoring

» Dangerous and potentially fatal in overdose. Avoid in children and adolescents with pre-existing cardiovascular disease.
» Do not use in conjunction with other drugs that prolong the QT interval.
» Baseline and on-treatment ECGs should be performed in patients with pre-existing cardiovascular conditions or a positive family history.
» May precipitate mania.

Stimulant medications (e.g. methylphenidate)

Adverse effects in children and adolescents

» Common: loss of, or decreased appetite, poor weight gain and insomnia.
» Common initially: headache, abdominal pain.
» Dysphoria or emotional blunting at high doses.
» May precipitate or worsen tics.
» May, at higher doses, lower the seizure threshold and precipitate seizures in children and adolescents suffering from epilepsy.

Special precautions/ investigations/monitoring

» Monitor blood pressure, pulse rate, height and weight.
» Monitor for mood changes and the development of tics.
» Use with caution in children who suffer from epilepsy.
» Exclude absence seizures prior to initiating stimulants (clinical/EEG).
» Perform an ECG prior to initiating stimulants where a cardiac history or clinical cardiac pathology is present.

'Atypical' antipsychotics (e.g. risperidone, olanzapine)

Adverse effects in children and adolescents

» Common in children/adolescents: insomnia, agitation, anxiety, headache, sedation and extrapyramidal side effects (EPSE), e.g. acute dystonia, Parkinsonism, akathisia, tardive dyskinesia.
» Weight gain and metabolic syndrome.
» Sedation at higher dosages.
» Hyperprolactinaemia (gynaecomastia, galactorrhoea, menstrual disturbances) – particularly risperidone.
» Hyponatraemia due to polydipsia or SIADH – particularly risperidone.

Special precautions/investigations/monitoring

» Monitor weight.
» Monitor prolactin level, glucose and lipid profile in patients initiated on atypical antipsychotics.

'Typical' antipsychotics (e.g. haloperidol)

Adverse effects in children and adolescents

» EPSE: acute dystonia, akathisia, tardive dyskinesia, Parkinsonism.
» Life threatening side effect: Neuroleptic malignant syndrome (NMS): fever, altered mental status, muscle rigidity, autonomic dysfunction, raised creatinine kinase and white cell count. In case of suspected NMS, stop all antipsychotics.

Special precautions/investigations/monitoring

» Monitor for EPSE.
» Avoid long-term use where possible due to the risk of irreversible tardive dyskinesia.

Benzodiazepines (e.g. lorazepam, diazepam, clonazepam)

Adverse effects in children and adolescents

» Sedation, restlessness and paradoxical reaction of disinhibition, especially in children and adolescents with intellectual disability, neurological illnesses or brain trauma.

Special precautions/investigations/monitoring

» Not for long-term use.

Mood stabilisers (e.g. lithium carbonate, sodium valproate/ valproic acid)

Lithium carbonate:

Adverse effects in children and adolescents

» Drug interactions – preferably avoid (or monitor closely): NSAIDS, ACE inhibitors, angiotensin receptor blockers, antithyroid agents, thiazide and loop diuretics, xanthines and SSRIs.
» Dose-related effects: ataxia, lethargy, thirst, GIT intolerance.
» *Toxicity: confusion, vomiting, tremor, convulsions, coma.*
» Non-dose-dependent: GIT, tremor, weight gain, goitre (hypothyroidism), hypoparathyroidism, nephrogenic diabetes insipidus, EPSE, polyuria.

Special precautions/investigations/monitoring

» Blood investigations: FBC, urea, creatinine and electrolytes, CMP, TSH and BHCG.
» Cardiac investigation: ECG.
» Ongoing monitoring: lithium levels 1–3 monthly, TSH and creatinine 6–12 monthly.

Valproic acid/Sodium valproate:

Adverse effects in children and adolescents

» Common: GIT (nausea, vomiting, constipation, diarrhoea).
» Dose-related effects: fatigue, sedation, ataxia.
» Uncommon: hair loss, skin rashes, increased appetite, tremor, amenorrhoea, aggression, depression.
» Rare: hepatotoxicity (potentially lethal), pancreatitis, hyperammonaemia.
» Pregnancy: facial anomalies, neural tube abnormalities.

Special precautions/investigations/monitoring

» Check liver functions and ammonia levels prior to initiation and then 6 monthly.
» Blood levels must be done in the morning prior to the morning dosage if there are concerns about compliance and toxicity. No routine indication.
» Monitor for signs of hepatotoxicity.

Caution

The choice of agent for girls and women of childbearing potential must be carefully considered. Valproate should be avoided in adolescent women and preadolescent girls who are likely to remain on treatment into their childbearing years unless other treatment is ineffective or effective contraception is in place. This is due to the risk of adverse developmental outcomes to the foetus.

If the decision is made to use valproate in patients in this population, complete the 'Acknowledgement of Risk' form:
http://www.sahpra.org.za/wp-content/uploads/2020/08/6.28_Valproate_Annual_Risk_Acknowledgement_Form_Dec18_v1.pdf

14.1 SEDATION OF AN ACUTELY DISTURBED CHILD OR ADOLESCENT

GENERAL AND SUPPORTIVE MEASURES

» Ensure safety of the patient, caregivers, staff members and the environment.
» De-escalation techniques are first-line to try to calm the patient.
» Physical restraint should only be used to protect the patient and caregivers; for the shortest period and should be monitored every 10–20 minutes.
» A thorough physical examination must be done.
» Exclude general medical causes, e.g. intracranial pathology like encephalopathy, seizures, metabolic disease, medication adverse effects and intoxication.

Investigations to exclude medical causes:

» Baseline BMI.
» Baseline laboratory work-up: FBC, urea and creatinine, electrolytes, AST, ALT, TSH, fasting glucose.
» Monitor for extrapyramidal side effects, e.g. acute dystonia.

MEDICATION TREATMENT

For children under the age of six years:

Sedation with psychotropic agents should only be considered in extreme cases and only after consultation with a specialist.

For children over the age of six years:

- Lorazepam, oral/IM.
  - 0.05–0.1 mg/kg/dose.
  - Onset of action: 20–40 minutes.
  - Always consider the use of oral lorazepam first.

If sedation is inadequate:

- Haloperidol, IM.
  - 0.025–0.05 mg/kg/day.
  - Onset of action: 20–30 minutes.
  - Maximum dose: 0.15 mg/kg/day.

In case of an acute dystonic reaction secondary to haloperidol:

- Biperiden, IM/slow IV, 0.05–0.1 mg/kg.
  - 1–6 years: 2 mg.
  - 7–10 years: 3 mg.
  - > 10 years: 5 mg.

14.2 ELIMINATION DISORDERS

F98.0; F98.1

DESCRIPTION

Enuresis and encopresis involve the inappropriate passing of urine or faeces in childhood or adolescence. The diagnoses are based on developmental age (not chronological age) and passing of urine/faeces may be voluntary or involuntary.

14.2.1 ENURESIS

F98.0

DESCRIPTION

Enuresis is bedwetting after the age or developmental level of 5 years.
Primary mono-symptomatic (nocturnal) enuresis refers to incontinence during sleep only. It is of great importance to differentiate between mono-symptomatic enuresis and enuresis with associated bladder dysfunction during daytime, as they are distinct conditions with different treatment modalities.

Enuresis is a benign condition with a 15% spontaneous annual resolution rate. Intervention must carry minimal risk or have minimal side effects. The cure rate of 'treatment' should be significantly greater than the spontaneous cure rate before it can be considered effective.

DIAGNOSTIC CRITERIA (DSM 5)

» Enuresis involves the repeated voiding of urine into the bed or clothing, whether involuntary or intentional.
» Occurs more than twice per week for 3 months or causes significant distress or impairment in social or academic functioning.
» Chronological or mental age of 5 years.
» Exclude medical illness, medication or substance usage.
» Classified as nocturnal, diurnal or both.

GENERAL AND SUPPORTIVE MEASURES

» Assess the type of enuresis, e.g. primary nocturnal enuresis (mono-symptomatic).
» Take a thorough history, including a family history of elimination disorders, aspects of toilet training, trauma, abuse, anxiety and current medications use, e.g. SSRIs, risperidone, or diuretics.
» Perform medical examination and investigations (e.g. urine test strip) to exclude UTI, constipation, obstructive sleep apnoea, diabetes mellitus, diabetes insipidus, neurological and structural abnormalities.
» If sexual abuse is suspected, refer to a social worker.

» Secondary enuresis may benefit from psychotherapy in cases where trauma is suspected, or parent-child conflict appears to be prominent.
» Primary mono-symptomatic enuresis has a high rate of spontaneous resolution (about 15% per year).
» Management of primary nocturnal enuresis may involve one or a combination of interventions. Education and motivational therapies are usually tried initially. More active intervention is warranted as the child gets older, social pressures increase and self-esteem is affected.
» General education and advice about bedwetting should be provided to all children and families of children with mono-symptomatic enuresis. It is important to emphasize that enuresis is not the child's fault; provide practical suggestions to reduce the impact of bedwetting; encourage regular voiding during the day and just before going to bed; and provide guidelines about the timing and type of fluid intake.
» Motivational therapy (e.g. a star chart) is usually the first intervention for younger children (between five and seven years) who do not wet the bed every night and are mature enough to accept some responsibility for treatment. If motivational therapy fails to lead to improvement after three to six months, active interventions may be warranted.
» Address the manner in which the enuresis is managed at home. The parents should not be punitive but reward when the child remains dry. The child should assist in cleaning up the wet bedding or clothing.
» Ensure the child drinks 6–8 glasses of water daily.
» Ensure regular voiding 5–6 times per day.
» No diapers/nappies as these may lower self-esteem.
» Bladder training and lifting can also be used.
» Enuresis alarms are the most effective long-term therapy and have few adverse effects. They can be expensive and require a long-term commitment (usually three to four months).
» A bell-and-pad system is effective but only use in children > 7 years and who are well motivated.

MEDICATION TREATMENT

If general measures have failed after 6 months, consult with a specialist for consideration of desmopressin, which is supported only for short-term use in low esteemed patient with enuresis:

- Desmopressin, oral, 200–400 mcg at night for 3 months. (Specialist consultation).
    - Adverse effects include fluid retention, hyponatraemia and cerebral oedema.

REFERRAL

» Suspected underlying systemic illness or chronic kidney disease.
» Persistent enuresis in a child > 7 years.
» Referral to psychiatry for secondary enuresis, or for primary enuresis in a child > 7 years where basic measures fail and general medical disorders have been excluded.

14.2.2 ENCOPRESIS

F98.1

DESCRIPTION

When the passage of faeces is involuntary, there is usually constipation, impaction and retention with subsequent overflow. The constipation may develop due to psychological reasons, e.g. anxiety around defaecation that leads to avoidant behaviour or physiological reasons, e.g. paradoxical contraction of the external sphincter. Deliberate encopresis may be part of a disruptive behaviour disorder, e.g. oppositional defiant disorder. Constipation can lead to enuresis, urinary reflux and chronic UTIs.

DIAGNOSTIC CRITERIA (DSM 5)

Involves the involuntary or intentional, repeated passage of faeces into inappropriate places. This occurs at least once each month for 3 months and the chronological or mental age of the child is at least 4 years. Substances, medications and medical illnesses need to be excluded. Encopresis is specified as either with or without constipation and overflow incontinence.

GENERAL AND SUPPORTIVE MEASURES

» History to include medical and psychological factors.
» Assess the type of encopresis.
» Medical examination and investigations, e.g. urine test strip.
» Refer to paediatrician for further work-up as needed.
» Treat constipation with diet and exercise.
» For the retentive subtype – educate the child and parent about bowel function and use laxatives if necessary.
» Management requires educational, psychological and behavioural approaches, e.g. timed daily intervals on the toilet with rewards.

14.3 ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD)

F90.0-F90.9

DESCRIPTION

Children with ADHD display developmentally inappropriate degrees of inattention, impulsiveness and hyperactivity that interfere with their functioning.

DIAGNOSTIC CRITERIA (DSM 5)

May be mild, moderate or severe:
» predominantly inattentive,
» predominantly hyperactive-impulsive, and
» combined.

Inattention: (9 symptoms)
> Failing to give close attention to details or making careless mistakes.
> Having difficulty sustaining attention in tasks or play.
> Not listening when spoken to directly.
> Failing to complete tasks or follow-through on instructions.
> Often losing things for tasks or activities.
> Often having difficulty organising tasks and activities.
> Being forgetful in daily activities.
> Being easily distracted by extraneous stimuli.
> Avoiding or being reluctant to engage in tasks requiring sustained mental effort.

Hyperactivity: (6 symptoms)
> Often fidgeting, squirming or tapping.
> Leaving his/her seat.
> Running or climbing inappropriately.
> Is "on the go", or behaves as if "driven by a motor".
> Is unable to play quietly.
> Talking excessively.

Impulsivity: (3 symptoms)
> Blurts out answers.
> Has difficulty waiting his/her turn.
> Interrupts or intrudes on others.

» Onset of several symptoms before 12 years.
» Requires 6 symptoms of inattention or hyperactivity/impulsivity.
» Symptoms have persisted for 6 months to a degree inconsistent with their developmental level.
» Symptoms present in two or more settings.
» Interferes with or reduces the quality of social, academic or occupational functioning.
» Exclude psychotic or other psychiatric disorders.

Note:
» Common co-morbid conditions include specific learning disabilities, oppositional defiant disorder, conduct disorder, depression (particularly in girls) and substance use disorders (SUDs), as well as epilepsy.
» Certain conditions may mimic ADHD such as, developmental disorders, motor coordination problems, intellectual disability, post-traumatic and post infectious encephalopathy as well as anxiety and mood disorders.
» Girls may more commonly present with inattentive-type ADHD. The diagnosis may, therefore, be missed.

GENERAL AND SUPPORTIVE MEASURES

Identify and treat co-morbidities such as depressive disorders early, as this may prevent the onset of substance misuse (to 'self-medicate') and other risk-taking behaviours during adolescence.

» Parent counselling:
  > Rules and limit-setting.
  > Positive reinforcement of pro-social behaviour.
  > Consistent routine.
  > Restrictive diets and OTC medications are of no proven value.
» Behaviour-based interventions:
  > Reward positive behaviour.
  > Improve social awareness and adjustment.
» Social skills groups.
» Identify learning difficulties and refer to educational support services.

MEDICATION TREATMENT

For children under the age of six years:

Refer for diagnostic assessment by a child and adolescent psychiatrist or paediatrician.

For children over the age of six years:

Initiate treatment using the short-acting methylphenidate formulation until effective dosage achieved. Reduce the dose or withdraw methylphenidate if a paradoxical increase in symptoms occurs.

- Methylphenidate, short-acting, oral, 1 mg/kg/day.
  - Initial dose: 5 mg, 2–3 times daily, at breakfast, lunch and no later than 14h30 (approximately every 3 to 3½ hours).
  - Increase the dose at weekly intervals by 5–10 mg until symptoms are controlled. Use the lowest effective dose.
  - Recommended maximum daily dose: 60 mg (adult dose)/maximum of 2 mg/kg/day. Any dose greater than 60 mg/day should be prescribed by a child psychiatrist or paediatrician.

LoE III[1]

Contraindications to methylphenidate

Absolute**:**

» Hyperthyroidism
» Glaucoma
» Concomitant mono-amine oxidase inhibitor therapy.
» There is no absolute contraindication to the concomitant use of methylphenidate with antiepileptic drugs (AEDs) or antiretroviral therapy (ART). However, exercise caution with the prescribed dosages, be aware of potential drug-drug interactions and monitor for adverse effects.

Relative**:**

» Hypertension

» Cardiac abnormality – needs ECG and cardiology assessment.
» Anxiety
» Agitation
» Epilepsy
» Tics

Discontinuation of treatment

» If no objective improvement of symptoms has been observed, e.g. using an ADHD rating scale, after appropriate dosage adjustments over a two-month period, discontinue treatment and refer to a specialist.
» To establish whether on-going treatment is indicated in a child on long-term stimulant therapy, trial periods off treatment should be part of the management plan.
» Indications for a trial off treatment:
  > treatment duration in excess of 2–3 years,
  > adolescent age (particularly late adolescence), and
  > a substantial reduction in core ADHD symptoms, evident in more than one setting.
» Trials off treatment should be planned at times least disruptive to the child's academic and social functioning, i.e. time the treatment withdrawal outside of major commitments such as examinations.
» Duration of treatment withdrawal can be for one week to a month, depending on whether stability is maintained.
» Treatment can be withdrawn abruptly, with no need to taper dosages.
» Obtain feedback from teachers and parents (verbal feedback, completion of parent and teacher ADHD rating scales), before and during the trial off treatment.
» Assess the child and document the mental state (symptoms of ADHD), before and during the trial off treatment.
» Monitor 3-monthly for one year.
» Re-initiate treatment (at last dosage prescribed), if:
  > there is a significant re-emergence of symptoms after one week off treatment and/or during the month off medication, or
  > after a longer trial off medication, e.g. at 3-monthly follow up visits, there is evidence of symptom re-emergence.

Note:

Adolescents are more likely to present with poor concentration, inattentiveness or impulsivity, rather than hyperactivity.

» Hyperactivity symptoms usually decrease but inattention symptoms may persist during adolescence.
» Remission is achieved in 30% of patients during adolescence.

REFERRAL

» No response to treatment after 8 weeks.

» Presence of comorbid psychiatric conditions with severe functional impairment: oppositional defiant disorder, mood disorders, anxiety disorders, debilitating tics.
» Presence of uncontrollable seizures.
» HIV infected status.

14.4 MOOD DISORDERS

F31–F34

14.4.1 DEPRESSION IN CHILDHOOD AND ADOLESCENCE

F32-34

DESCRIPTION

The clinical picture of a child and adolescent with major depressive disorder is similar to that of adults except that there are some developmental differences, i.e. 'atypical' symptoms:

» mood is often irritable rather than sad,
» failure to gain weight, rather than weight loss,
» somatic complaints, e.g. headaches and abdominal pain,
» behavioural and academic/school problems occur frequently,
» withdrawal from social activities,
» vegetative symptoms are less common than in adults,
» suicide attempts increase in number and tend to be more lethal, and
» impairment of functioning worsens with increasing age.

The first episode of bipolar disorder can present with depression in adolescents. Bipolar depression is often associated with a more sudden onset, psychomotor retardation, anxiety symptoms, and in some instances, psychotic symptoms and a family history of bipolar disorder.

A number of depressed children and adolescents have co-morbid psychiatric disorders. The most frequent co-morbid diagnoses are:

» Anxiety disorders.
» ADHD
» Oppositional defiant disorder.
» Trauma/Post traumatic stress disorder (PTSD).
» Substance misuse, particularly in adolescents.

DIAGNOSTIC CRITERIA (DSM 5)

The clinical presentation of major depressive disorder includes 5 symptoms present for a period of 2 weeks and represents a change from previous functioning. Changes in either mood or interests must be present:

» depressed mood reported or observed by others,
» decreased pleasure or interest in activities,
» vegetative symptoms including sleep/appetite disturbances,
» fatigue/loss of energy,

» poor concentration/indecision,
» psychomotor agitation/retardation,
» excessive, inappropriate guilty ruminations or feelings of worthlessness, and
» thoughts of death and suicide, suicide attempt or suicide plan.

Symptoms cause distress or impairment in functioning.
Exclude other psychiatric disorders, medical conditions, the effects of substances and manic/hypomanic episodes.

A suicide attempt is self-inflicted harm where the intention is to die.
Increased suicide risk is associated with the following:

- male gender,
- adolescence,
- previous attempts and lethality of method used,
- family history of suicide,
- presence of a psychiatric or chronic medical illness,
- social isolation and poor family support, and
- associated substance abuse or physical aggression.

Consider the following in a child presenting with depressed mood:

» Exclude underlying medical conditions such as:
  > infections, e.g. HIV, cerebral cysticercosis, encephalitis and tuberculous meningitis,
  > neurological conditions, e.g. temporal lobe epilepsy, brain tumours, and
  > endocrine disorders, e.g. thyroid conditions, diabetes mellitus.
» Exclude medication-induced mood disturbances, e.g. corticosteroids, antiretrovirals (zidovudine, efavirenz), high doses of stimulant medication and barbiturates.
» Exclude substance abuse, including alcohol and methamphetamine ('tik').
» Assess for suicide risk.

GENERAL AND SUPPORTIVE MEASURES

» Psychological interventions are considered 'first line' for mild to moderate depression and should be administered by a suitably skilled clinician:
  > Cognitive behavioural therapy (CBT): to address distorted, negative cognitions, maladaptive patterns of behaviour and communication.
  > Psychodynamic/play therapy: to identify feelings, improve self-esteem and social interactions.
» Additional interventions:
  > Family counselling: to address family disharmony, stressors and provide psycho-education.
  > Input to school: to address academic issues and psycho-education.
  > Social worker: to investigate suspicion of child abuse or neglect.

MEDICATION TREATMENT

» If there is a failure to respond to psychotherapeutic interventions after 4–6 weeks or if the severity of symptoms increases, consider a trial of antidepressant medication, while continuing with psychotherapy and other interventions. Initiate treatment in consultation with a psychiatrist. Children 12 years and under should be referred to a child psychiatrist for the initiation of medication.
» Response to treatment should bring about a meaningful reduction in symptoms and improvement in functioning.
» Once remission is achieved, continue medication therapy for at least a further 6–12 months.

First line:

- Fluoxetine, oral, 0.5 mg/kg/day.

Fluoxetine tablets are registered in South Africa, however, may not be available in the public sector. Fluoxetine may only be available in 20 mg capsules, in which case citalopram tablets can be used initially, titrated to 20 mg and then changed to fluoxetine 20 mg if that dose has been reached.

  - Dose range: 20–40 mg daily.
  - Recommended average dose: 20 mg/day.

If there is a poor response to fluoxetine after an adequate trial of treatment, i.e. 4–6 weeks, or if significant symptoms of anxiety are present, or if the child is HIV-infected, consider an alternative SSRI.

Second line:

- Citalopram, oral, 0.4 mg/kg/day.
  - Dose range: 5–40 mg daily.
  - Recommended average dose: 10–20 mg/day.

A trial of treatment is considered ineffective if the patient presents with ongoing, significant depressive symptoms and/or suicidal ideation and where the patient has not achieved an improvement in overall level of functioning.

Be aware of the risk of bipolar 'switch' or precipitation of mania in patients with a family history of bipolar disorder.

Tricyclic antidepressants are not recommended in children due to insufficient evidence of efficacy, potential adverse cardiovascular side effects and lethality in overdose.

REFERRAL

» Poor response to an adequate trial of treatment, i.e. medication trial of 6–8 weeks in combination with psychological treatment and psychosocial interventions.
» Presence of co-morbid conditions.
» Psychotic symptoms such as delusions or hallucinations.

14.4.2 BIPOLAR DISORDER

F31

DESCRIPTION

The bipolar disorder presentation in children and adolescents differs from the adult discrete manic or depressive episodes. They usually present with mixed mood states and significant mood lability that fluctuates within a day resembling a rapid cycling pattern and rage attacks or 'affective storms'.

Short-lived episodes of exuberance are normative in children and adolescents, while temper outbursts and mood lability can present in many other psychiatric disorders, e.g. anxiety disorders, autism spectrum disorder (ASD). There is a risk of misdiagnosis or 'over-diagnosis' of bipolar disorder in children and adolescents presenting with severe aggression and 'dysregulated' moods.

DIAGNOSTIC CRITERIA (DSM 5)

Manic episode

A distinct period of abnormally and persistently elevated, expansive or irritable mood and abnormally and persistently increased goal-directed activity or energy. This should represent a significant change in the patient's baseline mental status, last for at least 1 week and be present, most of the day, nearly every day.

During the period of mood disturbance, the patient should display the following symptoms:

» Elevated self-esteem or grandiosity.
» Decreased need for sleep.
» More talkative than usual or pressured speech.
» Flight of ideas or feeling that thoughts are racing.
» Distractibility
» Increased goal-directed activity (socially, at school or hyper-sexuality) or psychomotor agitation.
» Involvement in activities with potentially painful consequences, e.g. sexual indiscretions.

Depressive episode

Similar to symptoms of major depressive episode except that the onset may be more rapid and may be associated with psychomotor retardation, anxiety symptoms and/or psychotic symptoms.

Mixed mood state

This includes the presence of a major depressive episode with at least 3 manic/hypomanic symptoms present during the depressive episode. These are more common in children and adolescents.

Causes distress or impairment in functioning.

Exclude other psychiatric disorders, medical conditions, the effects of substances and manic/hypomanic episodes.

MEDICATION TREATMENT

Acute phase treatment

» Refer patients with a suspected manic episode or suicidal ideation to a psychiatrist immediately for assessment and possible admission.
» Sedate before transfer. Refer to section 14.1: Sedation of an acutely disturbed child or adolescent.
» If no previous medication used, while awaiting admission and in consultation with a psychiatrist, initiate atypical antipsychotic and mood stabilizer.

Atypical antipsychotic:

- Risperidone, oral.
  5–12 years (under 50 kg):
  - Starting dose: 0.01 mg/kg/day.
  - Maintenance dose: 0.02–0.04 mg/kg/day.

  13–17 years:
  - Starting dose: 0.5 mg daily.
  - Maximum dose: 3 mg daily.
  - Use lowest effective dose to limit adverse long-term side effects and to facilitate adherence.
  - Increase dose by 0.25–0.5 mg daily every 1–2 weeks, depending on tolerability and age.

Mood stabiliser: lithium carbonate or sodium valproate (sodium valproate not recommended in females) or a second-generation antipsychotic (risperidone/olanzapine) with specialist consultation:

- Lithium carbonate, oral (for patients aged 12–17 years).
  - Initial dose: 20 mg/kg/day in 2–3 divided dosages. Lithium level after 5 days. Increase accordingly. Therapeutic range: 0.6–0.8 mmol/l. Be careful of narrow therapeutic margin – risk of toxicity.
  - Ensure investigations are done prior to initiation of treatment.
  - Blood investigations: FBC, U&E, CMP, TSH and BHCG.
  - Cardiac investigation includes ECG.
  - Ongoing monitoring: Lithium levels 1–3 monthly, TSH and creatinine 6–12 monthly.
  - Contraception if sexually active.
- Sodium valproate, oral (teratogenic and to be avoided in females).
  - 20 mg/kg/day divided 12 hourly.
  - Usual range: 20–30 mg/kg/day.

- Risperidone, oral.
  5–12 years (under 50 kg):
  - Starting dose: 0.01 mg/kg/day.
  - Maintenance dose: 0.02–0.04 mg/kg/day.

  13–17 years:
  - Starting dose: 0.5 mg daily.
  - Maximum dose: 3 mg daily.
  - Use lowest effective dose to limit adverse long-term side effects and to facilitate adherence.
  - Increase dose by 0.25–0.5 mg daily every 1–2 weeks, depending on tolerability and age.

- Olanzapine, oral, for children 13 years and older.
  - Initially: 2.5–5 mg once daily.
  - Increase to 10 mg daily if necessary.

LoE III[1]

Maintenance treatment

» If previously on maintenance medication: re-initiate treatment in consultation with a psychiatrist.
» Ongoing psycho-education regarding the illness, medication, compliance etc.
» Once stabilised, the patient can be referred for individual psychotherapy.
» The family may benefit from referral for family therapy.

REFERRAL

» Refer all patients with suspected bipolar disorder for an assessment by a psychiatrist.
» Sedate or stabilise prior to transfer.

14.4.3. DISRUPTIVE MOOD DYSREGULATION DISORDER (DMDD)

F34.81

DESCRIPTION

This is a new addition to DSM 5. Children and adolescents present with a history of chronic, severe, persistent irritability. The irritability presents as frequent temper outbursts with an underlying angry, irritable mood. The onset of symptoms is before 10 years and should not be applied to children with a developmental age less than 6 years. Conversion of non-episodic irritability to bipolar disorder is low. They are at higher risk of developing depressive and anxiety disorders in adulthood.

It is important to consider the differential diagnoses. These include:
» Mood disorders, e.g. major depressive disorder, bipolar disorder.

» Behavioural disorders, e.g. oppositional defiant disorder (ODD); anxiety disorders.
» Neurodevelopmental disorders, e.g. ADHD, autism spectrum disorder (ASD).
» Impulse control disorders, e.g. intermittent explosive disorder.

DIAGNOSTIC CRITERIA (DSM 5)

» Temper outbursts that are severe and recurrent that manifest verbally or behaviourally, are out of proportion in intensity and duration to the situation or provocation, are inconsistent with the developmental level and occur > 3 times per week.
» The mood between the temper outbursts is persistently irritable or angry for most of nearly every day and is observable by others.
» Symptoms must be present for > 12 months with symptom-free periods that do not exceed 3 months.
» Occurs in > 2 settings and is severe in at least one setting.
» Age of diagnosis: 6–17 years.
» Age of onset of symptoms: < 10 years.
» Exclude psychiatric disorders, medical conditions and the effects of substance use.
» There are high rates of comorbidity that include disruptive behavioural disorders, mood disorders, anxiety disorders and autistic spectrum disorders. If children meet the oppositional defiant disorder or intermittent explosive disorder criteria with DMDD, then only the DMDD diagnosis is given.

Functional consequences

DMDD is associated with significant functional impairment in all areas of patients' lives due to their extremely low frustration tolerance. This has a severe impact on family and peer relationships, academic performance and participation in extra-mural activities.

MEDICATION TREATMENT

Currently no specific treatment guidelines exist due to the lack of studies. Many patients present with ADHD and DMDD. The ADHD can be treated with methylphenidate but worsening of the mood may occur with severe aggression.

REFERRAL

» Co-morbid DMDD should be referred to a psychiatrist.

14.5 ANXIETY DISORDERS

F41.9

DESCRIPTION

Separation anxiety disorder and selective mutism are diagnostic categories previously exclusive to childhood, while social anxiety disorder (social phobia), specific phobia, panic disorder, agoraphobia and generalised anxiety disorder (GAD) present across the lifespan. Anxiety disorders are common in children and adolescents affecting 6–20%.

Medication does not form part of the primary management of separation anxiety disorder and selective mutism.

Anxiety in a child can be misdiagnosed as ADHD, as both conditions may present with increased levels of activity and problems with concentration.

14.5.1 GENERALISED ANXIETY DISORDER (GAD)

F41.1

DESCRIPTION

Excessive anxiety or worry about a number of factors or events, occurring on most days for at least 6 months. The intensity, frequency or duration of the anxiety is out of proportion to the actual likelihood or impact of the anticipated event. The individual finds it hard to control the worry and to keep worrisome thoughts from interfering with attention to tasks. During the course of the disorder, the focus of the worry may shift from one concern to another. The worries interfere with psychosocial functioning, are pervasive and distressing and often have no precipitants.

DIAGNOSTIC CRITERIA (DSM 5)

Excessive anxiety or worry that is both difficult to control and associated with 1 of the following 6 symptoms for 6 months:

» restlessness or a feeling ‘keyed-up’ or ‘on edge’,
» difficulty concentrating or ‘mind going blank’,
» irritability,
» muscle tension,
» sleep disturbance, and
» being easily fatigued.

GAD causes significant distress or impairment in functioning.

Exclude other psychiatric disorders, general medical conditions or effects of substances.

GENERAL AND SUPPORTIVE MEASURES

A suitably qualified clinician should perform these interventions.

» Cognitive behavioural therapy (CBT): aimed at changing pessimistic, anxiety-based cognitions and developing strategies to reduce anxieties and avoidant behaviour patterns.

» Behaviour therapy: relaxation, desensitisation by imagining or exposure to anxiety-provoking situations.
» Psychodynamic/supportive psychotherapy: aimed at promoting self-esteem, assertiveness and autonomy.

MEDICATION TREATMENT

- Fluoxetine, oral, 0.5 mg/kg/day.
  - Dose range: 20–40 mg daily.
  - Recommended average dose: 20 mg/day.

Fluoxetine may only be available in 20 mg capsules, in which case citalopram tablets can be used initially, titrated to 20 mg and then changed to fluoxetine 20 mg.

If there is a poor response to fluoxetine after an adequate trial of treatment, i.e. 4–6 weeks, consider an alternative SSRI.

- Citalopram, oral, 0.4 mg/kg/day.
  - Dose range: 5–40 mg daily.
  - Recommended average dose: 10–20 mg/day.

REFERRAL

» 12 years and under.
» Failure to respond after 6–8 weeks to an adequate trial of therapy and medication.
» Adverse events to fluoxetine/citalopram.

14.6 OBSESSIVE COMPULSIVE DISORDER (OCD)

F42.9

DESCRIPTION

Obsessions:
These are persistently recurring thoughts, impulses or images that are experienced as intrusive, inappropriate and not simply excessive worries about realistic problems. Children may not experience these as distressing but the obsessions may interfere with day-to-day functioning. The child may try to suppress, ignore or neutralise them with another thought or action. Obsessions are not pleasurable or voluntary.

Compulsions:
Repetitive behaviours or mental acts that a person feels driven to perform in response to an obsession or according to a rigidly applied rule in order to reduce distress or to prevent some dreaded outcome. The behaviour or mental acts are not connected in a realistic way with what they are supposed to prevent or are excessive.

Compulsions are easier to diagnose than obsessions in children, as they are observable. Most children have both obsessions and compulsions. Adult symptoms are stable over time whereas children's may be variable. The content differs and may reflect the different developmental stages. Adolescents have higher rates of sexual and religious obsessions than children, and children and adolescents have more harm obsessions, e.g. death or illness to self or loved ones, than adults.

Comorbid conditions:
» rheumatic fever,
» streptococcal throat infection [paediatric autoimmune neuropsychiatric disorders associated with streptococcal infections (PANDAS)], and
» tic disorders, ADHD, anxiety and depressive disorders, ODD, and impulse-control disorders.

DIAGNOSTIC CRITERIA (DSM 5)

This requires the presence of obsessions, compulsions or both that are time-consuming or cause distress or functional impairment. General medical illnesses, other psychiatric disorders and the effects of substances should be excluded. Specifiers include the degree of insight and presence of tic disorders.

GENERAL AND SUPPORTIVE MEASURES

» Provide cognitive behavioural therapy (CBT), if available and appropriate.
» Exposure-based interventions (e.g. contact with 'dirt' in a child with contamination fears), thought stopping techniques, 'response prevention' (i.e. blocking of rituals).

A suitably qualified professional should carry out these interventions.

MEDICATION TREATMENT

OCD in children and adolescents is often resistant to treatment and high dosages of medication are often needed for long periods. Full therapeutic effect may take up to 8–12 weeks. Dosages should be gradually increased.

- Fluoxetine, oral, 0.5 mg/kg/day.
  - Dose range: 20–40 mg daily.
  - Recommended average dose: 20–40 mg.

However, fluoxetine may only be available in 20 mg capsules, in which case citalopram tablets can be used initially, titrated to 20 mg and then changed to fluoxetine 20 mg.

OR

- Citalopram, oral, 0.4 mg/kg/day.
  - Dose range: 5–40 mg daily.
  - Recommended average dose: 10–20 mg/day.

Duration of treatment: 6 months after resolution of OCD symptoms.

REFERRAL

» Twelve years and under.
» Poor response to adequate trial of cognitive behavioural therapy and medication, i.e. persistence of obsessions and/or compulsions, with impairment in functioning after 12 weeks.
» Co-morbid conditions.

14.7 POST TRAUMATIC STRESS DISORDER (PTSD)

F43.1

DESCRIPTION

The core features of experiences which place patients at risk of PTSD are:
» Exposure to a traumatic event (directly, witnessing or learning of it happening to someone else).
» There is threat of serious injury or death.
» Violent personal assault, such as sexual violence.

DSM 5 DIAGNOSTIC CRITERIA

» Intrusive symptoms.
» Persistently re-experiencing:
  > Recurrent memories and dreams of the traumatic event.
  > Dissociative reactions, e.g. flashbacks, reliving experiences.
  > Physiological or psychological distress to traumatic cues.
» Marked avoidance:
  > Avoiding memories, thoughts or feelings related to trauma.
  > Avoiding external reminders.
» Negative alterations in mood and cognitions, e.g. amnesia, detachment.
» Marked alterations in arousal and reactivity, e.g. hypervigilance, sleep disturbance.
» Significant distress/impairment.
» Duration more than a month.

GENERAL AND SUPPORTIVE MEASURES

Debriefing in the immediate aftermath of the trauma is not recommended, often having worse outcomes.
Psychological interventions should be made available, including:
» general supportive counselling,
» cognitive behavioural strategies, and
» group and family interventions.

MEDICATION TREATMENT

Consider medication when other interventions have not been effective or there is severe impairment in functioning.

- Fluoxetine, oral, 0.5 mg/kg/day.
  - Dose range: 20–40 mg daily.

However, fluoxetine may only be available in 20 mg capsules, in which case citalopram tablets can be used initially, titrated to 20 mg and then changed to fluoxetine 20 mg.

If poor response, consider higher doses in consultation with a child psychiatrist.

OR

- Citalopram, oral, 0.4 mg/kg/day.
  - Dose range: 5–40 mg daily.
  - Recommended average dose: 10–20 mg/day.

REFERRAL

» Persistent symptoms despite therapy.

14.8 FEEDING AND EATING DISORDERS

F50/F98

DESCRIPTION

These disorders are characterised by a persistent disturbance of eating or eating-related behaviour that results in the altered consumption or absorption of food and has an impact on physical health or psychosocial functioning. The more common types include pica, avoidant/restrictive food intake disorder, anorexia nervosa, bulimia nervosa and binge-eating disorder.

14.8.1 PICA

F98.3

DESCRIPTION

This is the persistent eating of non-nutritive, non-food substances for more than a month, inappropriate to developmental level. The ingestion is out of keeping with cultural and social norms.

GENERAL AND SUPPORTIVE MEASURES

» Vitamin and mineral deficiencies, e.g. zinc, iron, should be excluded.
» Physical examination.
» Explore co-morbid conditions, e.g. autism spectrum disorder (ASD), intellectual disability, schizophrenia, OCD, impulse control disorders.

14.8.2 AVOIDANT/RESTRICTIVE FOOD INTAKE DISORDER

F50.8

DESCRIPTION

This is an eating or feeding disturbance that manifests by a persistent failure to meet appropriate nutritional and/or energy requirements. There may be lack of interest in food, food avoidance due to sensory sensitivity or concerns about the aversive consequences of eating. Criteria include one or more of: failure to make the expected weight gains, nutritional deficiency, dependence on enteral feeding or nutritional supplements or marked interference with psychosocial functioning. There is no lack of food, socially acceptable practice present or perceptual disturbance of body weight or shape.

GENERAL AND SUPPORTIVE MEASURES

» Exclude medical, neurological or neuromuscular disorders.
» Assess the relationship between caregiver and infant and the attachment concerns that may manifest with feeding regulatory disorders in children.
» Exclude other psychiatric disorders, e.g. OCD, MDD, factitious disorder imposed on another (previously termed 'Munchausen's by proxy').

14.8.3 ANOREXIA NERVOSA

F50.01/F50.02

DESCRIPTION

This disorder presents with restricted energy intake relative to requirements leading to a low body weight, an intense fear of gaining weight or becoming fat or behaviour that limits weight gain and a disturbance in body weight/shape perception, with poor insight into the seriousness of the low body weight. Children and adolescents may fail to make expected weight gains or maintain normal growth patterns, e.g. increased height without weight gain. The Centre for Disease Control has used Body Mass Index (BMI)-for-age below the 5th percentile as being underweight. Physiological disturbances and cessation of menses should also be considered.

The semi-starvation and purging can result in medical sequelae, even medical emergencies, e.g. arrhythmias.
Co-morbid psychiatric disorders are common, e.g. MDD, OCD.

GENERAL AND SUPPORTIVE MEASURES

» A thorough physical examination.
» Blood investigations including: FBC, U&E, CMP, TSH.
» Cardiac investigation: ECG.
» Suicide risk assessment.

MEDICATION TREATMENT

Supportive measures for medical complications including a dietician referral.

» Refer to a paediatrician for severe medical complications.
» Refer to a psychiatrist for psychiatric management.
» Medication such as fluoxetine and olanzapine should be initiated by a psychiatrist.
» Family based therapy is the gold standard of treatment for eating disorders in adolescents.

14.8.4 BULIMIA NERVOSA

F50.2

DESCRIPTION

This disorder is characterised by recurrent episodes of binge eating in which the individual eats large amounts of food in a short period with a sense of lack of control over the eating. Compensatory behaviours then follow, e.g. self-induced vomiting or laxative usage. These behaviours occur at least once a week for three months. The individual's self-evaluation is influenced by body shape and weight and their BMI may be within the normal to overweight range.

GENERAL AND SUPPORTIVE MEASURES

» A thorough physical examination.
» Blood investigations including: FBC, U&E, CMP, TSH.
» Cardiac investigation: ECG.
» Suicide risk assessment.
» Supportive measures for medical complications.

REFERRAL

» Refer to a paediatrician for severe medical complications.
» Refer to a psychiatrist for psychiatric management.

14.9 CHILDHOOD PSYCHOSIS

F09

DESCRIPTION

It is important to note that children who present with symptoms such as hallucinations, confusion and intensely aggressive or disturbed behaviour may not be psychotic or suffer from schizophrenia. Delirium should be the first diagnosis to consider, before a psychotic disorder is suspected. Failure to recognise a delirium may delay the diagnosis of the underlying medical condition or drug-related delirium and place the child at risk.

Delirium is a non-specific neuropsychiatric disorder, which indicates global encephalopathic dysfunction in medically ill patients. The core features

consist of attentional disturbances, an altered level of consciousness and diffuse cognitive deficits. It is fluctuating in nature and may present with perceptual disturbances, commonly visual hallucinations.

Any child presenting with an apparent psychosis is considered a medical emergency and should have a medical work-up before being referred to a psychiatrist. This should include FBC, U&E, LFT, TSH, drug screen, EEG and brain CT scan.

Sedate before transfer if behaviourally disturbed. Refer to section 14.1: Sedation of an acutely disturbed child or adolescent.

14.9.1 SCHIZOPHRENIA

F20.9

DESCRIPTION

Schizophrenia is a chronic psychotic disorder characterised by disturbances in thinking, perceptions, emotions and behaviour and is associated with significant functional impairment. Childhood and adolescent schizophrenia are rare.

» Very early onset schizophrenia (VEOS) is defined as the onset before age 13 years.
» Early onset schizophrenia (EOS) is defined as the onset before age 18 years.
» Onset during childhood and adolescence confers a poorer prognosis for the illness, treatment refractoriness and significant impairment in functioning.
» Similar diagnostic criteria for adults are used. However, in children, the delusions are not as bizarre or systematised as in adults. The clinical presentation in adolescents more closely resembles that in adults. The child or adolescent may not reach expected levels of interpersonal, academic or occupational functioning.

DIAGNOSTIC CRITERIA (DSM 5)

» Two or more of the following symptoms need to be present for a significant portion of time during a 1-month period. At least one of these must include items (1), (2) or (3) below:
    1. Delusions
    2. Hallucinations
    3. Disorganised speech.
    4. Grossly disorganised or catatonic behaviour.
    5. Negative symptoms, i.e. affective flattening or avolition.
» The level of functioning declines or there is failure to achieve expected levels of interpersonal, academic or occupational functioning.

» The disturbance has lasted at least 6 months with a 1-month period of previously mentioned symptoms. Prodromal, attenuated or residual features may be included in the time period.
» Exclude other psychiatric disorders, general medical conditions or effects of substances.

GENERAL AND SUPPORTIVE MEASURES

» Supportive individual and family counselling is an important part of the comprehensive treatment plan.
» The aim of individual counselling is to develop understanding of the illness, to improve coping strategies, to provide structure and limit regression.
» Family interventions focus on psycho-education and facilitating acceptance of the diagnosis to ensure adequate compliance and support for the patient.
» Educational issues include transitioning back into school after a psychotic episode and academic support.

MEDICATION TREATMENT

Pharmacotherapy is the first line treatment for psychosis in children and adolescents.

Acute phase treatment

Sedate before transfer. Refer to section 14.1: Sedation of an acutely disturbed child or adolescent.

If previously prescribed antipsychotic medication:
» Re-initiate treatment, in consultation with a psychiatrist.

If no previous medication (while awaiting admission and in consultation with a psychiatrist):

- Risperidone, oral.
  5–12 years (under 50 kg):
  - Starting dose: 0.01 mg/kg/day.
  - Maintenance dose: 0.02–0.04 mg/kg/day.

  13–17 years:
  - Starting dose: 0.5 mg daily.
  - Maximum dose: 3 mg daily.
  - Use lowest effective dose to limit adverse long-term side effects and to facilitate adherence.
  - Increase dose by 0.25–0.5 mg daily every 1–2 weeks, depending on tolerability and age.
  - Refer if doses in excess of 3 mg are required.

Maintenance phase (12–24 months)

» Gradually lower the dose of risperidone from that needed to treat the acute psychotic phase to that needed to prevent relapse and to ensure adequate adherence.

REFERRAL

» All children and adolescents for assessment and initial management.
» **Urgent**: Young children, individuals responding to command hallucinations or behaviourally-disturbed psychotic children or adolescents.

14.10 TIC DISORDERS

F95.9

DESCRIPTION

A tic is a sudden, rapid, recurrent, non-rhythmic stereotyped motor movement or vocalisation and includes the following subtypes:

» Chronic motor or vocal tic disorder.
» Transient tic disorder.
» Tourette's disorder.

Tourette's disorder is a chronic neuropsychiatric disorder that is characterised by both vocal and motor tics, and related somatosensory urges. It is commonly associated with a number of co-morbid conditions such as OCD, ADHD as well as disturbances of mood.

GENERAL AND SUPPORTIVE MEASURES

» Psycho-education of patient, parents, teachers and peers: to reduce the stigma and social consequences of tics and behavioural therapy.
» Supportive psychotherapy: to assist the individual to cope with the stigma/teasing, improve self-esteem and improve social skills.
» Family therapy: to assist the family in managing associated symptoms and to reduce stress.

MEDICATION TREATMENT

Medication is used when the tics impair functioning and ideally for short periods only in order to reduce severe symptoms. The natural course of tics is to 'wax and wane'.

- Risperidone, oral.
  - Starting dose: 0.25 mg/day (< 20 kg) and 0.5 mg/day (> 20 kg).
  - Recommended average dosage: 1 mg/day.
  - Dosage range: 0.25–3 mg.

If risperidone cannot be tolerated due to side effects:

- Clonidine, oral, daily.
  - Starting dose at 25 mcg and titrate gradually to 3–5 µg/kg. Divide doses larger than 0.1mg/kg/day into 2 doses (morning and evening)

LoE III[2]

REFERRAL

» Tourette's disorder not responding to therapy.
» Tourette's disorder with comorbid psychiatric or medical conditions.

14.11 PSYCHIATRIC PRESENTATIONS IN HIV-INFECTED CHILDREN AND ADOLESCENTS

F06.0; F06.2; F06.31-34; F06.4; F06.8

DESCRIPTION

» HIV-infected children and adolescents are at increased risk of psychopathology, such as ADHD, depression and anxiety disorders. Psychosis and mania are less common than in the adult population.
» The increased risk of psychopathology is due to the virus itself, side effects of antiretroviral therapy (ART) and psychosocial stressors.
» Symptom presentation of psychiatric disorders in HIV-positive children is the same as in the general paediatric population.
» ADHD often co-occurs with significant learning difficulties, despite treatment with antiretroviral therapy.
» Psychotic disorders are rare in HIV-infected children. Consider a delirium or partial seizures if an HIV-infected child presents with psychotic symptoms. A full medical workup including CSF and HIV viral load is required before assuming that the symptoms are due to a psychiatric disorder.

GENERAL AND SUPPORTIVE MEASURES

» Psychological interventions are similar to those for HIV-negative children.
» Issues specific to the child's HIV status may need specific intervention, e.g. for problems related to disclosure of HIV status, stigma, grief counselling, adherence issues, orphanhood and living with a chronic illness.
» Refer to the hospital social worker to address social issues.

MEDICATION TREATMENT

» Start all medications at lower doses and then titrate up slowly.
» Initiate treatment according to guidance in this chapter.

Note: Due to drug-drug interactions between fluoxetine and some antiretroviral medication, initiate treatment with citalopram when an SSRI is required.

REFERRAL

» All HIV-infected children on ART who present with severe psychiatric symptoms such as severe depression, psychosis and/or mania for general medical evaluation, and if no general medical cause is found, for psychiatric evaluation and initiation of psychotropic medication.

14.12 AUTISM SPECTRUM DISORDER (ASD)

F84

DESCRIPTION

ASD presents with persistent deficits in social communication and interaction, e.g. deficits in socio-emotional reciprocity and restricted, repetitive patterns of behaviour, interests and activities, e.g. inflexibility when confronted with change.

GENERAL AND SUPPORTIVE MEASURES

» Social skills and family interventions.
» Functional assessments (like OT) and diagnostic screens are essential.
» Education and school placement.
» Behaviour modification, specifically adapted for autism spectrum disorders.
» Early intervention is important for optimal outcome.
» Screen for comorbidities such as ADHD, mood and anxiety disorders, which commonly co-exist.

MEDICATION TREATMENT

Not for core autistic symptoms.

For irritability, severe aggression and self-injurious behaviour:

- Risperidone, oral.
  5–12 years (under 50 kg):
  - Starting dose: 0.01 mg/kg/day.
  - Maintenance dose: 0.02–0.04 mg/kg/day.

REFERRAL

» Refer all patients not responding to risperidone to a psychiatrist, or appropriate sub-specialist.

14.13 SUBSTANCE USE DISORDER

F10–19

DESCRIPTION

The essential feature of a substance use disorder (SUD) is a cluster of cognitive, behavioural and physiological symptoms that indicate that the

individual continues to use the substance despite significant substance-related problems.

Age of onset of substance abuse can be as early as 8 years. Illicit drugs such as cocaine, amphetamines and cannabis, as well as alcohol abuse are associated with a greater risk for psychosis. Behavioural disturbance in the context of a SUD may be due to intoxication, withdrawal, or due to a substance-induced mood or psychotic disorder. Initial treatment of SUDs begins with medical stabilisation of the patient ideally in a medical facility. About one third of youth with SUDs, present with a 'dual diagnosis', i.e. a co-occurring psychiatric disorder. Be aware of the mental state changes associated with illicit drugs.

DIAGNOSTIC CRITERIA (DSM 5)

» The substance is used in larger amounts or for longer period than intended.
» A persistent desire or unsuccessful efforts to cut down or control use.
» A great deal of time is spent in activities to obtain, use or recover from the substance.
» Cravings or strong urges to use the substance.
» Failure to meet obligations at work, home or school.
» Continued use despite social and interpersonal problems caused by effects of the substance.
» Use results in decreased or stopping social or recreational activities.
» Continued use in hazardous situations.
» Ongoing use despite knowing of a physical or psychological problem caused by substance.
» Withdrawal
» Tolerance

14.13.1 SUBSTANCE-INDUCED PSYCHOTIC DISORDER

F10.1, F11.1, F12.1, F13.1, F14.1, F15.1, F15.1, F16.1, F17.1, F 18.1, F18.1, F19.1

DESCRIPTION

» Prominent hallucination or delusions.
» Symptoms occur during or within one month of proven substance abuse or intoxication.
» A psychiatric disorder such as schizophrenia or a general medical condition is not the cause of the psychosis.
» The disturbance does not occur in the course of a delirium, which must be excluded.

14.13.2 SUBSTANCE-INDUCED MOOD DISORDER

F10.8, F11.8, F12.8, F14.8, F16.8, F18.8

DESCRIPTION

» A significant and sustained disturbance in mood, i.e. depressed, irritable, expansive or elevated.
» Symptoms occur during or within one month of proven substance abuse or intoxication.
» A psychiatric disorder such as bipolar or a general medical condition is not the cause of the mood disturbance.

GENERAL AND SUPPORTIVE MEASURES

» Conduct a medical assessment (pulse rate, temperature, blood pressure, ECG) and laboratory investigations (FBC, U&E, LFT, BHCG, urine toxicology), depending on the specific drug of abuse.
» Manage withdrawal states, depending on the substance of abuse.
» Refer to a social worker for an evaluation of the family circumstances and for brief motivational interviewing.

MEDICATION TREATMENT

Several medications have been approved by the FDA for treating addiction to opioids, alcohol or nicotine in adults, but not in adolescents. Only preliminary evidence exists for the effectiveness and safety of these medications in individuals under 18 years and no evidence exists for the neurobiological impact of these medications on the developing brain. There are currently no FDA-approved medications to treat addiction to cannabis, cocaine or methamphetamine in any age group.

14.13.3 SUBSTANCE WITHDRAWAL

F10.3, F11.3, F12.3, F13.3, F14.3, F15.3, F16.3, F17.3,

MEDICATION TREATMENT

Consult with a psychiatrist or specialised referral unit. Mild withdrawal states can be managed as an outpatient whereas more severe cases should be referred to the local casualty for medical stabilisation. Children under 6 years old should be referred immediately to casualty.

Alcohol, Benzodiazepines, Stimulants (Cocaine, Methamphetamine) and less commonly Cannabis/Mandrax withdrawal

Management of mild withdrawal:

- Diazepam, oral.
  - 6–14 years: 2–10 mg daily in 2–3 divided doses.
  - > 14 years: up to 20 mg daily in 2–3 divided doses.
  - Taper dose over 3–5 days.

Hallucinogens/Volatile solvents
No detoxification indicated.

14.13.3.1 ALCOHOL WITHDRAWAL

F10.239

GENERAL AND SUPPORTIVE MEASURES

Refer children under 6 years and patients with:
» convulsions,
» psychiatric illnesses: psychosis, intellectual impairment,
» suicidal ideation,
» significant medical co-morbidity such as heart disease; pregnancy,
» inadequate social support, and
» a history of withdrawal delirium.

Assess for co-morbid infections and other pathology.
Ensure adequate hydration. Over-hydration is a common error made in this setting.

MEDICATION TREATMENT

Alcohol detoxification may be managed on an outpatient basis in cases of mild, uncomplicated alcohol withdrawal.

- Thiamine, oral.
  - Children: 0.5–1 mg/kg daily for 14 days.
  - Adults: 50 mg daily for 14 days.
- Diazepam, oral.
  - 1–6 years: 1–6 mg/day.
  - 6–14 years: 2–10 mg daily in 2–3 divided doses.
  - > 14 years: up to 20 mg daily in 2–3 divided doses.
  - Wean dose from 8 hourly, to 12 hourly, to daily every 3–5 days.

14.13.3.2 ALCOHOL WITHDRAWAL DELIRIUM

F10.232

DESCRIPTION

Although the typical delirium occurs 2–3 days following cessation of prolonged alcohol intake, reaching a peak at around 5 days, some withdrawal symptoms, such as the typical tremor, may start within 12 hours.

Typical clinical features include:
» predominantly visual hallucinations; may have delusions,
» disorientation, fluctuating level of consciousness,
» agitation,

» seizures (tonic-clonic), and
» hypertension, tachycardia.

A low-grade fever may be present. Withdrawal tonic-clonic seizures may occur between 24 and 48 hours following cessation of alcohol intake. General medical conditions, e.g. meningitis and other substance use, e.g. sedative-hypnotics should be excluded.

Mortality 1–5%.

GENERAL AND SUPPORTIVE MEASURES

» Monitor vital signs regularly.
» Cardiac monitoring and oximetry should be used when administering large doses of benzodiazepines.
» Correct dehydration and abnormalities of electrolytes and nutrition.
» Consider parenteral fluids to compensate for severe losses, i.e. in hyperthermia.

MEDICATION TREATMENT

Adult management can be applied to adolescents (for young children, management and dosing to be determined in conjunction with a specialist):

- Thiamine, IV.
  - Thiamine must be given prior to glucose to prevent Wernicke-Korsakoff syndrome.
  - 500 mg 8 hourly, diluted in 100 ml normal saline infused over 30 minutes for 3 days.
  - Followed by 250 mg 8 hourly.

- Thiamine, oral.
  - 100 mg daily once stable.

Benzodiazepines:

- Diazepam, slow IV, 10 mg (not IM due to erratic absorption).
  - Repeat dose after 5–10 minutes if required.
  - If this dose is not sufficient, use 10 mg every 5–10 minutes for another 1–2 doses.
  - If patient is not yet sedated, continue with doses of 20 mg.
  - Usual initial dose is 10–20 mg, but up to 60 mg is occasionally required.

Where intravenous access is not possible:

- Clonazepam, IM, 1–2 mg as a single dose.
  - If no response, repeat dose after 60 minutes.
  - Maximum daily dose: 10 mg.

OR

- Lorazepam, IM, 1–4 mg every 30–60 minutes until the patient is sedated.
  - Repeat doses hourly to maintain mild sedation.
  - Maximum daily dose: 6 mg.

Once patient is sedated, i.e. light somnolence, maintain mild sedation with:

» Diazepam, oral, 5–20 mg 2–6 hourly.

Severe agitation and restlessness:

- Haloperidol, IV/IM, 0.5–5 mg.
  - Repeat after 4–8 hours as required to a maximum of 10 mg daily.
  - Once patient has responded and is able to take oral medication: Haloperidol, oral, 0.75–5 mg 6–8 hourly.

Note: Haloperidol, may reduce the seizure threshold. Consider only for severe agitation and restlessness and give in combination with one of the sedative-hypnotic agents above.

For children with hyperactive delirium:

» Medication may be considered to reduce symptoms such as anxiety, agitation, hallucinations and disturbed sleep. Pharmacokinetics in children is different from adults. Before starting pharmacological treatment, the risk of side effects and interactions with other medications and the route of administration have to be considered and weighed against the potential benefits of treatment.

- Diazepam, IV.
  - 0.2 mg/kg, very slowly over 3 minutes.
  - This may be repeated over 24 hours to a maximum of 5 mg for < 5 years and 10 mg for > 5 years.
  - The IV solution can be given rectally if the IV route is inaccessible. Maximum dose over 24 hours: 5 mg for < 3 years and 10 mg for > 3 years.

Oral therapy

Oral doses of haloperidol and risperidone are the same for hyperactive paediatric delirium.

- Risperidone, oral.

  Weight: < 45 kg
  - Loading dose: 0.02 mg/kg.
  - Maintenance dose: 0.01–0.08 mg/kg/day divided into 2–4 doses.
  - Maximum dose: 4 mg/day divided into 2–4 doses.

  Weight: > 45 kg
  - Loading dose: 0.5–1 mg.
  - Maintenance dose: 0.01–0.08 mg/kg/day divided into 2–4 doses.
  - Maximum dose: 6 mg/day divided into 2–4 doses.
  - Dosages > 6 mg have not been studied.

OR

- Haloperidol, oral.
  Weight: < 45 kg
  - Loading dose: 0.02 mg/kg.
  - Maintenance dose: 0.01–0.08 mg/kg/day divided into 2–4 doses.
  - Maximum dose: 4 mg/day divided into 2–4 doses.

  Weight: > 45 kg
  - Loading dose: 0.75–1 mg.
  - Maintenance dose: 0.01–0.08 mg/kg/day divided into 2–4 doses.
  - Maximum dose: 6 mg/day divided into 2–4 doses.
  - Dosages > 6 mg have not been studied.

» Extrapyramidal symptoms are seen frequently, particularly if antipsychotics are increased rapidly. Start low and go slow is an important principle. It can take 24 to 48 hours before an adequate response is achieved. Recognizing and treating adverse effects is important.
» Treatment consists of reducing the dose of antipsychotic and administration of an anticholinergic medication such as biperiden (50 mcg/kg, IV, over 15 minutes).
» In adult patients, lengthening of the QTc interval has been reported with the possibility of Torsade's de Pointes. This has not been reported in children. An ECG is required before starting treatment with haloperidol.
» Risperidone has fewer adverse effects than haloperidol and is thus the treatment of choice when symptoms are not extreme and oral administration is possible.
» When no benefit is obtained with one medication, a switch to the other should be considered.
» A paediatric delirium rating scale should be used at least three times daily to score delirium when medication is started and for as long as the patient receives medication.
» It is not known for how long treatment should continue. Experts advise to continue treatment at least until symptoms have disappeared and until risk factors that possibly led to the delirium have lessened. Medication should be weaned gradually, over a few days.

REFERRAL

» Refer all children and adolescents with suspected alcohol withdrawal delirium immediately once stabilised.

14.13.3.3 OPIOID WITHDRAWAL

F11.23

DESCRIPTION

The illicit use of prescription medication and opioids in children and adolescents has risen significantly. Behavioural manifestations of withdrawal include anxiety, agitation, insomnia, and tremors. Physiological changes linked to withdrawal include increased muscle tone, nausea, vomiting, diarrhoea, decreased appetite, tachycardia, fever, sweating, and hypertension.

Most patients who take an opioid for less than a week do not experience withdrawal and can have their medication discontinued quickly.

However, a prevention approach is preferred for those exposed for longer than 14 days. These children will usually need to be weaned, by gradually decreasing the opioid dose with time.

The only validated tool to assess withdrawal symptoms in children is the Sophia Observation Withdrawal Symptoms Scale.

MEDICATION TREATMENT

Mild withdrawal may be managed as an outpatient.

Symptomatic treatment:

- Diazepam, oral.
  - 6–14 years: 2–10 mg daily in 2–3 divided doses.
  - > 14 years: up to 20 mg daily in 2–3 divided doses.
  - Wean dose from 8 hourly, to 12 hourly, to daily every 3–5 days.

For stomach cramps:

- Hyoscine butyl bromide, oral.
  - 1–3 years: 5–10 mg 8 hourly.
  - 3–6 years: 10 mg 8 hourly.
  - 6–18 years: 10–20 mg 8 hourly.

For diarrhoea:

- Loperamide, oral.
  - Over 2 years: initially 1 mg/12.5 kg body mass, followed by 0.5 mg/12.5 kg after each loose stool. Alternatively, 0.08–0.24 mg/kg/day in 2–3 divided doses.
  - 12–18 years: initially 4 mg, followed by 2 mg after each loose stool. Maximum dose of 6 mg in 24 hours.

The weaning protocol should take into account the length of opioid exposure and total daily opioid dose. The generally approach is to transition to a longer-acting opioid formulation, such as extended-release morphine. Weaning is usually accomplished by steps of a 10% to 20% decrease in the original dose every 24 to 48 hours.

- Morphine:
  - Oral: 0.05 mg/kg/dose 3 hourly.
  - IV: 0.02 mg/kg/dose 3 hourly.

  Weaning after 48 hours:
  - Oral: 0.01 mg/kg/dose 3 hourly.
  - IV: 0.005 mg/kg/dose 3 hourly.

For CNS disturbances (e.g. seizures):
- Phenobarbitone, oral.
  - 5 mg/kg/dose 12 hourly or daily.

OR
- Phenytoin, oral.
  - 5 mg/kg/day in 2–3 divided doses.
  - Maximum dose: 300 mg daily.
  - Maintenance dose: 5–8 mg/kg/day.

Patients with moderate to severe withdrawal should be admitted.
Substitution treatment is reserved for a specialist rehabilitation centre.

14.13.3.4 STIMULANT/METHAQUALONE (MANDRAX)/ CANNABIS WITHDRAWAL

F14.23; F15.23

GENERAL AND SUPPORTIVE MEASURES

Patients do not usually require admission but assess for depression and suicide risk.

MEDICATION TREATMENT

No substitution medication is available for detoxification.

For symptomatic treatment of anxiety, irritability and insomnia:
- Diazepam, oral.
  - 6–14 years: 2–10 mg daily in 2–3 divided doses.
  - > 14 years: up to 20 mg daily in 2–3 divided doses.
  - Wean dose from 8 hourly, to 12 hourly, to daily every 3–5 days.

14.13.3.5 BENZODIAZEPINE WITHDRAWAL

F13.239; F13.232

GENERAL AND SUPPORTIVE MEASURES

Psycho-education about dependence including withdrawal and tolerance within a close therapeutic relationship will assist with compliance. Encourage the patient and caregivers not to seek medication from other doctors and negotiate each reduction with the patient and caregivers. Withdrawal from

benzodiazepines takes time. The patient will require regular monitoring and motivation.

MEDICATION TREATMENT

Replace short-acting benzodiazepines with an equivalent long-acting benzodiazepine (diazepam) dose. Patients may present with medicines that are unavailable in the public sector.

Approximate equivalent doses to diazepam 5 mg are:

- lorazepam 1 mg
- alprazolam 0.5 mg
- bromazepam 1.5 mg
- flunitrazepam 0.5 mg
- nitrazepam 5 mg
- oxazepam 15 mg
- temazepam 10 mg
- zopiclone 7.5 mg
- zolpidem 10 mg

Decrease the dose of diazepam every 2 weeks by 2.5 mg. If symptoms reappear, increase the dose a little and reduce more slowly.

MEDICATION TREATMENT OF COMORBID PSYCHIATRIC CONDITIONS

» Treat according to the primary psychiatric condition, as per treatment guidelines. Refer to section 14.1: Sedation of acutely disturbed child or adolescent; section 14.4: Mood disorders; and section 14.9: Childhood psychosis.

» Beware of adverse interactions between illicit drugs and psychotropic medication, i.e. drug levels of both illicit drugs and psychotropic medications are altered.

REFERRAL

» All for psychotherapeutic interventions or drug rehabilitation.

» Outpatient treatment: refer to SANCA (South African National Council on Alcoholism and Drug Dependence).

Tel: 011 8923829 or toll free: 0861472622.

» In-patient treatment: refer for in-patient drug rehabilitation.

» Patients with severe and persistent behavioural disturbance, psychotic or manic symptoms to an in-patient child and adolescent psychiatric facility, for ongoing containment and management of psychiatric symptoms.

14.14 BEHAVIOURAL PROBLEMS ASSOCIATED WITH INTELLECTUAL DISABILITY

F81.9

DESCRIPTION

Co-occurring psychiatric, neurodevelopmental, medical and physical conditions are frequent, some with rates 3–4 times higher than the general population. The most common co-occurring psychiatric and neurodevelopmental disorders are ADHD, bipolar and depressive disorders, anxiety disorders, ASD, stereotypic movement disorder with/without self-injurious behaviour and impulse-control disorders. Severe intellectual disability may present with aggression including harm to others and property destruction. Inappropriate sexual behaviour may also occur. Epilepsy is associated with increased rates of ADHD, behavioural dysregulation and psychosis.

DIAGNOSTIC CRITERIA

Diagnostic criteria for psychiatric disorders in children with intellectual disability are the same as those for the general paediatric population. However, symptom expression may vary with developmental stage or level of intellectual functioning.

GENERAL AND SUPPORTIVE MEASURES

» Exclude medical conditions in children presenting with behavioural disturbances, particularly in children who are not able to communicate symptoms verbally (e.g. seizures, dental caries, covert infections, poisoning, foreign bodies, space occupying brain lesions and drug side effects).
» Exclude emotional, physical or sexual abuse in a child presenting with persistent adverse behaviour and emotional distress (especially in non-verbal children).
» Parental guidance is an important part of the management of children presenting with behavioural problems (psycho-education, behaviour management).
» Behaviour modification principles form the basis of psychosocial intervention.

MEDICATION TREATMENT

» Psychotropic medication treatment should only occur as part of a multidisciplinary diagnostic and therapeutic intervention.
» Treat according to the primary psychiatric condition, as per treatment guidelines.

For disruptive behaviour disorders in intellectual disability:

- Risperidone is registered for children with developmental disorders > 5 years old:

  - Dose 5–12 years: 0.01 mg/kg/day.
  - Maintenance dose: 0.02–0.04 mg/kg/day.
- Do baseline blood tests and ECGs, particularly in children with underlying medical conditions.
- Start with the lowest doses possible.
- Increase dosages cautiously as children with intellectual disability may be more susceptible to adverse effects such as extrapyramidal side effects (EPSEs), neuroleptic malignant syndrome (NMS) or the disinhibiting effects of benzodiazepines.

REFERRAL

» Children who fail to respond to initial treatments should be referred to a paediatrician for further assessment and management.
» Children presenting with severe aggression, inappropriate sexual behaviour or significant self-injurious behaviour should be referred for a diagnostic assessment or admission to an intellectual disability service (if such a service exists in the region) or to a tertiary level child psychiatry service.
» Children presenting with psychosis or a manic episode should undergo medical work-up and be referred to a paediatrician or child psychiatrist as appropriate.
» Refer to a social worker or child protection services if abuse is suspected.

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CHAPTER 15

RESPIRATORY SYSTEM

ACUTE LOWER RESPIRATORY TRACT INFECTIONS IN YOUNG CHILDREN

The term acute lower respiratory tract infection is used here to embrace acute viral bronchiolitis as well as acute viral and bacterial pneumonia. Antibiotics are indicated in the empiric treatment of pneumonia and are not usually indicated for the treatment of bronchiolitis.

If it is not possible to confidently diagnose acute viral bronchiolitis clinically or if there are concerns about bacterial co-infection it is recommended that the World Health Organisation (WHO) treatment guidelines should be followed.[1]

Nebulize all wheezing children with a β_2-agonist and if a good clinical response is noted and wheezing is recurrent, a diagnosis of asthma should be considered.

15.1 COUGH WITH PREDOMINANT FEVER AND TACHYPNOEA

15.1.1 PNEUMONIA

J18.9

DESCRIPTION

Infection of the lung parenchyma characterized by inflammation and consolidation of lung tissue. Management depends on the clinical assessment and classification of severity.

For bacterial pneumonia

Empiric antibiotics are indicated in all cases of pneumonia, as delay in treatment is associated with poor outcome. Antibiotic choice is based on an assessment of severity and likely aetiology.

Common bacterial causes of pneumonia include:
Neonates:

- Group B beta-haemolytic Streptococci.
- *Klebsiella spp.*
- *E. coli.*
- Chlamydia.
- *S. aureus.*

Children:
» *S. pneumoniae.*
» *H. influenzae.*
» *S. aureus.*
» *M. catarrhalis.*
» *M. pneumoniae.*

Staphylococcal pneumonia should be suspected if there is empyema, pulmonary cavitation or pneumatocoele formation or the presence of extrapulmonary pyogenic infections.

Complications of pneumonia include:
» respiratory failure,
» empyema,
» pleuritis,
» pleural effusion,
» pneumothorax,
» bronchiectasis.

DIAGNOSTIC CRITERIA

» Tachypnoea is age dependent.

Age	Respiratory rate
< 60 days	> 60/minute
2–12 months	> 50/minute
1–5 years	> 40/minute
5–12 years	> 25/minute

Categories of pneumonia (WHO classification)

Category	Characteristics
1. Severe pneumonia or very severe disease	Diagnose in an infant under 2 months of age with: » A general danger sign *or* » Lower chest wall indrawing *or* » Tachypnoea (> 60 breaths per minute)
	Diagnose in an HIV-exposed infant or HIV-infected, immune-compromised or malnourished child with lower chest indrawing.
2. Pneumonia	Diagnose in an immune-competent child over 2 months with lower chest wall indrawing *or* tachypnoea.
	Tachypnoea is defined as: » > 50 breaths per minute for infants 2–12 months » > 40 breaths per minute for children 1–5 years
3. No pneumonia	No signs of pneumonia or severe pneumonia, i.e. upper respiratory tract infection.
4. Danger signs	Diagnose in a child aged 2 months to 5 years with any ***general danger sign***: » Inability to drink » Convulsions » Abnormal sleepiness » Persistent vomiting

Investigations

» Chest X-ray only when there is failure to respond to therapy, in children with severe pneumonia in whom complications or tuberculosis are suspected, and for admissions. Perform a lateral and AP or PA view if possible. TB work-up if tuberculosis suspected (e.g. TB contact), see Chapter 10: Tuberculosis, section 10.2: Tuberculosis, pulmonary.

» In children with severe and very severe disease, perform a blood culture, preferably before initiating antibiotics.

GENERAL AND SUPPORTIVE MEASURES

» Bed rest.

» Clear nasal and oral passages of thick secretions.

» Monitor:
  > respiratory rate,
  > heart rate,
  > SaO_2,
  > temperature,
  > hydration,
  > blood pressure.

» Hypoxia (SATS monitor) and/or hypercapnia (blood gas) are indications for ventilatory support.

» Maintain nutrition: continue breast and oral feeds.
  > Consider small frequent feeds by oro/nasogastric tube or IV fluids if respiratory rate > 60/minutes or enteral feeds are not tolerated.

MEDICINE TREATMENT

- Oxygen at 1–2 L/min, humidified, by nasal prongs is preferred.
  - Continue oxygen until respiratory distress and hypoxia resolves (a saturation of ≥ 92% off oxygen).

To relieve discomfort:

- Paracetamol, oral/NGT, 15 mg/kg, 6 hourly as required.

If a significant degree of wheezing is present:

- Salbutamol, inhalation, 100–200 mcg, as required using a metered-dose inhaler with a spacer device or a nebulizer until symptoms are relieved.

Empiric antibiotic therapy

Choice of antibiotic depends on the severity of the condition, the age of the child and the presence of co-morbidity.

Reconsider choice of antibiotic when the results of cultures become available or the child does not improve.

<u>Pneumonia (non-severe):</u>

- Amoxicillin, oral, 45 mg/kg/dose, 12 hourly for 5 days.

<u>Severe or very severe disease:</u>

- Amoxicillin/clavulanate, IV, 25 mg/kg/dose of amoxicillin component 8 hourly (do not exceed 10 mg/kg/day of clavulanate component).

Switch to oral as soon as there is a response:

- Amoxicillin/clavulanate, oral, 45 mg/kg/dose of amoxicillin component 12 hourly to complete 10 days total. (See annexure 1: Amoxicillin/Clavulanic weight band dosing table)

MODIFICATION OF ANTIMICROBIAL THERAPY

If there is a poor response to first line empiric therapy and in the absence of positive cultures consider the possibility of infection with Methicillin Resistant *S. aureus* (MRSA), or an extended spectrum beta lactamase (ESBL) producing organism, or atypical pathogen.

If mycoplasma is considered, do blood polymerase chain reaction for the specific pathogen.

If nosocomial pneumonia suspected, refer to section 15.1.1.4 Nosocomial pneumonia. Re-evaluate for possible co-morbidity (foreign body, immunodeficiency, heart disease).

Change to:

- Piperacillin/tazobactam, IV, 100 mg/kg/dose 8 hourly.

PLUS

- Amikacin, IV, 15 mg/kg/dose, daily.

If an MRSA pneumonia is confirmed:

- Vancomycin, IV, 15 mg/kg/dose 6 hourly infused over 1 hour for 14 days.

For Mycoplasma pneumonia and other atypical pneumonias:

- Macrolide, e.g.:
- If severely ill initiate:
  - Azithromycin, IV, 10 mg/kg/dose daily for 2 days

    THEN
  - Azithromycin, oral, 5 mg/kg/dose daily for 3 days.

  OR
  - Azithromycin, oral, 5 mg/kg/dose daily for 5 days.

For management of complications

» To relieve a tension pneumothorax, do needle aspiration followed by intercostal drain placement.

» Small or asymptomatic pneumothoraces in infants and children (excluding neonates) usually do not require treatment other than close observation, but identify and treat the underlying cause of the pneumothorax.

» For symptomatic pleural effusion, do needle aspiration; if an empyema, insert a chest tube for drainage. See section 15.2.1: Effusion and empyema.

REFERRAL

» Patients not improving within 48–72 hours of initiating second-line therapy should be discussed with a paediatrician.
» For possible ICU care if not maintaining saturation in the normal range on oxygen or if clinical features of fatigue.

15.1.1.1 PNEUMONIA, VIRAL INFECTION

J12.9

DESCRIPTION

The commonest cause of pneumonia in children is viral infection. Respiratory syncytial virus, adenovirus, cytomegalovirus, influenza, parainfluenza, adenovirus, herpes, human metapneumovirus and measles are the common viruses responsible for infections of the respiratory tract. Children present with fever, cough, rhinorrhoea and chest indrawing. Scattered fine crackles may also occur.

Common viral causes in infancy and early childhood include:

» influenza virus,
» measles virus,
» respiratory syncytial virus,
» para-influenza virus,
» cytomegalovirus,
» adenovirus.

Measles is recognized by the typical features of cough, coryza, koplik spots, a maculopapular rash and its other systemic manifestations.

DIAGNOSTIC CRITERIA

» As for pneumonia, see section 15.1.1: Pneumonia, above.
» It is not possible to discriminate viral from bacterial pneumonia on clinical or radiological grounds.
» Chest X-ray is not routinely indicated.

GENERAL AND SUPPORTIVE MEASURES

» Maintain nutrition.
» Maintain hydration.

MEDICINE TREATMENT

Only if saturation < 92%:

- Oxygen, humidified, 1–2 L/min via nasal prongs or nasal cannula.

To relieve discomfort:

- Paracetamol, oral, 15 mg/kg/dose 6 hourly.

There is no role for routine antiviral therapy.

For Measles Pneumonia:
Treat as severe pneumonia, and refer to Chapter 8: Infectious Diseases, section 8.10: Measles.

Complications
Monitor for secondary bacterial infection and institute empiric antibiotics for pneumonia if suspected. Do a blood culture.

REFERRAL
» Patients not improving within 48–72 hours of admission should be discussed with a paediatrician.
» For possible ICU care if not maintaining saturation in the normal range on oxygen or if clinical features of fatigue are present.

15.1.1.2 PNEUMONIA DUE TO ANAEROBIC INFECTION

DESCRIPTION
Often seen in comatosed patients with aspiration syndromes or children who inhaled a foreign body that has been misdiagnosed for a period of time.

DIAGNOSTIC CRITERIA
» Putrid odour from mouth and foul smelling sputum.

Investigations
» Sputum and blood culture using anaerobic media.

MEDICINE TREATMENT
Empiric antibiotic therapy for at least 7 days.

- Amoxicillin/clavulanate, IV, 25 mg/kg/dose of amoxicillin component 8 hourly (do not exceed 10 mg/kg/day of clavulanate component).

Change antibiotics according to culture and sensitivity results. Watch for complications. Some patients may require longer antibiotic duration.

15.1.1.3 PNEUMONIA IN HIV-EXPOSED OR HIV-INFECTED CHILDREN

DESCRIPTION
In additional to common bacterial and viral pathogens causing pneumonia, opportunistic micro-organisms in a ‘polymicrobial mix’ are common in these children. Many of these children may fail to respond to the standard antibiotic treatment for pneumonia. Micro-organisms commonly involved are:

- » *P. jiroveci* (PJP),
- » Mycobacteria, e.g. *M. tuberculosis*
- » Candida,
- » Cytomegalovirus.

In addition, S. pneumonia, S. aureus and gram negative bacteria, e.g. *Klebsiella pneumoniae* and Non-Typhoid Salmonella cause a significant proportion of HIV-related pneumonia in early childhood.

P. jiroveci (PJP)

- » PJP is a common fungal infection of the lung in infants from 2–6 months.
- » Presents as an acute onset of respiratory distress with minimal/absent chest signs in a child who is HIV-exposed or HIV-infected.
- » Hypoxaemia and cyanosis are common features in severe disease.
- » Chest X-ray shows a range of abnormalities including bilateral perihilar interstitial changes.

Other fungal pneumonias

- » Candida albicans and other species, Cryptococcus neoformans and Aspergillus fumigatus may cause pneumonia in immunocompromised children.
- » Skin and CNS manifestation may be helpful in suggesting the specific diagnosis.

Cytomegalovirus associated pneumonia in HIV-infected infants

- » Presents as an interstitial pneumonitis with acute hypoxic respiratory failure.
- » It may present as a multisystem sepsis-like syndrome, with hepatitis, neutropenia, pneumonitis, colitis and thrombocytopenia.
- » Often occurs in children who are severely immunosuppressed (CDC Immune category 3) and carries a significant mortality.
- » Risk of CMV transmission through breastfeeding is low and, therefore, breastfeeding is not contraindicated.
- » CMV co-infection occurs commonly as polymicrobial infection with PJP and bacteria.

Tuberculosis in HIV infected children

- » Occurs in children at all ages.
- » Presents as acute or chronic illness.
- » Multisystem disease.

HIV-infected children with chronic lung disease

- » Often presents with lymphoid interstitial pneumonitis and bronchiectasis.
- » Secondary infection with bacteria similar to those seen in acute pneumonia are commonly isolated from these children.

DIAGNOSTIC CRITERIA

Investigations

In addition to investigations for pneumonias:

» Screen for HIV infection:
  > See Chapter 9: Human Immunodeficiency Virus infection, section 9.1: Human Immunodeficiency Virus infection, for guidance on testing.
» Investigate for PJP:
  > Immunofluorescence on induced sputum sample.
» Fungal infection:
  > Request MCS for fungi (blood or sputum).
» Screen children with very severe pneumonia immediately for CMV using CMV viral load, where available.
  > A viral load of > 10 000 copies/mL suggests CMV disease: treat.
  > A viral load below 10 000 copies/mL is regarded as CMV infection: no therapy recommended.
» Tuberculosis:
  > See Chapter 10: Tuberculosis, section 10.2: Tuberculosis pulmonary in children, for guidance on testing.

GENERAL AND SUPPORTIVE MEASURES

» Appropriate infection prevention and control measures.
» Adequate nutrition.
» Monitor oxygen saturation.
» Restrict fluid intake.

MEDICINE TREATMENT

If saturation < 92%:

- Oxygen, via nasal prongs or nasal cannula.

Treat for very severe bacterial pneumonia. See section 15.1.1: Pneumonia.

In all infants between 2 and 6 months with pneumonia **consider PJP** and, **ADD**

- Co-trimoxazole, IV/oral, 5 mg trimethroprim/25 mg sulphamethoxazole /kg/dose, 6 hourly for 21 days.
  - Continue co-trimoxazole prophylaxis at the end of this treatment period until CD4 count recovers to normal.

Children who remain hypoxic on oxygen with proven or highly suspected PJP:

- Prednisone, oral, 1–2 mg/kg, daily for 7 days.
  - Taper dose over the next 7 days.

For suspected or confirmed fungal pneumonia (other than PJP):

- Amphotericin B deoxycolate, IV, 0.6–1.0 mg/kg as a single daily dose infused over 4 hours for at least 14 days.

Note: Pre-hydrate before administering amphotericin to prevent renal impairment:

- Sodium chloride 0.9%, IV, 20 mL/kg **plus** potassium chloride, 20 mmol/L infused over 2–4 hours.

OR

- Fluconazole, IV/oral, 10 mg/kg as a single daily dose for at least 14 days.

For confirmed CMV disease:

- Ganciclovir, IV, 5 mg/kg 12 hourly until oral is tolerated

THEN

- Valganciclovir, oral, 16 mg/kg 12 hourly to complete the first 21 days of therapy

THEN

- Valganciclovir, oral, 16 mg/kg daily to complete 42 days of therapy.

For Mycobacterium Tuberculosis:
See Chapter 10: Tuberculosis.

Ensure follow-up for antiretroviral therapy.

REFERRAL

» Not responding to therapy.
» In cases of CMV disease under 6 months of age for follow-up for hearing deficit.

15.1.1.4 PNEUMONIA, NOSOCOMIAL

J18.9

DESCRIPTION

Children acquiring pneumonia 48–72 hours after hospitalisation.
The common pathogens are:

» ß-lactamase producing pathogens,
» Extended spectrum ß-lactamase producing *Klebsiella pneumoniae*, *P. aeruginosa*,
» Multidrug resistant Acinetobacter species,
» Methicillin resistant *S. aureus*,
» Respiratory viruses, i.e. respiratory syncytial virus, adenovirus, influenza, herpes, parainfluenza.

GENERAL AND SUPPORTIVE MEASURES

» Sepsis screen including blood cultures.

MEDICINE TREATMENT

Empirical antibiotic therapy

» Broad spectrum antibiotics should be administered according to local susceptibility patterns and underlying predisposing factors.

» Review antibiotic choice once culture and sensitivity results become available.

For bacterial infections:

Empiric therapy in the absence of local data:

- Piperacillin/tazobactam, IV, 100 mg/kg/dose 8 hourly

PLUS

- Amikacin, IV, 15 mg/kg/dose, daily.

Adjust therapy according to sensitivities.

Reconsider empirical antibiotic therapy and duration of therapy daily.

For methicillin resistant *S. aureus* pneumonia:

- Vancomycin, IV, 15 mg/kg/dose 6 hourly infused over 1 hour.

15.1.1.5 RECURRENT PNEUMONIA

J18.9

DESCRIPTION

Recurrence of parenchymal and bronchial airways infection clinically and radiologically after a similar episode had completely resolved during that year. Must be distinguished from persistent pneumonia where there is clinical non-recovery of parenchymal ± bronchial infection after a period of 10 days.

Common aetiologies of recurrent pneumonia include immunosuppression from corticosteroid use, inappropriate antibiotic use, primary and secondary immune-suppression, congenital and structural lung abnormalities, e.g. congenital cystic adenomatous malformation, bronchiectasis, lymphoid interstitial pneumonitis etc.

Common pathogens are community acquired and include *Streptococcus pneumoniae, Haemophilus influenzae, Staphylococcus aureus,* respiratory syncytial virus (RSV), influenza, candida. Nosocomial pathogens are uncommon, even in HIV-infected patients.

DIAGNOSTIC CRITERIA

» Confirmation of the presence and resolution of the previous pneumonia radiologically.

» Confirmation of the current pneumonia clinically, on chest radiograph ± microbiologically (see section 15.1.1: Pneumonia).

GENERAL AND SUPPORTIVE MANAGEMENT

» Identify the underlying cause and exclude HIV and TB.
» Oxygen if saturation <93%.
» Fluid and feeds according to severity of illness.
» Blood transfusion if haemoglobin < 7 g/dL.

MEDICINE TREATMENT

- Amoxicillin/clavulanate, IV, 25 mg/kg/dose of amoxicillin component 8 hourly (do not exceed 10 mg/kg/day of clavulanate component).

Adjust antibiotics according to cultures and sensitivity.

If non-responsive: exclude foreign body and mycobacterium tuberculosis.

REFERRAL

» Underlying systematic chronic disease for consideration of prophylaxis.
» Deterioration

15.1.2 BRONCHIOLITIS

J21.9

DESCRIPTION

Bronchiolitis is an acute viral infection of the small airways of the lower respiratory tract affecting children between 4 months and 2 years of age. The most common pathogen is the respiratory syncytial virus. Recurrent episodes of wheeze associated with bronchiolitis may occur, and some of these children may develop asthma.

Risk factors for severe bronchiolitis:

» Age less than 3 months.
» Ex-preterm infants.
» Chronic lung disease.
» Congenital heart disease.

DIAGNOSTIC CRITERIA

» Prodrome of viral infection: irritability and rhinorrhoea.
» A wheeze that is slowly responsive or non-responsive to bronchodilators.
» Crepitations and signs of hyperinflation of the chest.
» Chest X-ray should be reserved for clinically severe or complicated cases.
» Tachypnoea is age dependent.

Age	Respiratory rate
< 60 days	> 60/minute
2–12 months	> 50/minute
1–5 years	> 40/minute
5–12 years	> 25/minute

Bronchiolitis (mild)
» Cough and fast breathing (tachypnoea).

Bronchiolitis (moderate)
Above plus one of the following:
» lower chest wall in-drawing,
» nasal flaring,
» grunting.

Bronchiolitis (severe)
Above plus at least one of the following:
» central cyanosis, oxygen saturation < 90% in room air;
» inability to feed,
» convulsions, lethargy or decreased level of consciousness,
» severe respiratory distress (e.g. very severe chest wall indrawing).

GENERAL AND SUPPORTIVE MEASURES

» Isolate from other infants, if possible.
» Mild cases without risk factors are managed as outpatients. Provide counselling to the caregiver and devise a plan for the eventuality that the child deteriorates or does not improve. Mild cases with risk factors, moderate and severe cases require admission.
» Patients with signs of moderate or severe disease or associated complications or underlying cardiorespiratory disorders should be hospitalised for monitoring of:
  > breathing pattern (apnoea monitoring if < 3 months of age),
  > heart rate and respiratory rate,
  > temperature,
  > SaO_2,
  > hydration and nutrition,
  > IV maintenance fluid if oral/nasogastric feeds/fluids are not tolerated. Avoid over hydration.

MEDICINE TREATMENT

For all hospitalised patients

Only if saturation < 92%:

- Oxygen, humidified, 1–2 L/min via nasal prongs or nasal cannula.
  - Ensure clear nasal passages and correctly position the nasal prongs.

In children with recurrent wheezing, nebulise with a β_2-agonist; if there is a response, consider asthma, see section 15.4: Conditions with predominant wheeze.

Antibiotic therapy
Routine antibiotic therapy is not indicated. Only use antibiotics if there is concern about bacterial co-infection.

For bacterial co-infection:
- Amoxicillin, oral, 45 mg/kg/dose, 12 hourly for 5 days.

REFERRAL
» Discuss all severe cases with a paediatrician.

15.2 PLEURAL DISEASE

15.2.1 EFFUSION AND EMPYEMA
J90

DESCRIPTION
A pleural effusion is an accumulation of fluid between the visceral and parietal pleura. The fluid can be an exudate or a transudate (see Lights criteria: https://www.mdcalc.com/lights-criteria-exudative-effusions).

Common causes for exudates are infections, inflammation and malignancy. Common causes of a transudate are cardiac failure, renal failure and hepatic failure. A straw-coloured or haemorrhagic effusion is indicative of tuberculosis. A cloudy or frankly purulent fluid indicates an empyema.

DIAGNOSTIC CRITERIA
» Decreased breath sounds and stony dull on percussion.
» Pleural rub early in disease.
» Chest X-ray shows uniform opacities in a lamellar distribution at the costophrenic angles.

GENERAL AND SUPPORTIVE MEASURES
» Treat small effusions conservatively.
» Drain other effusions by either chest drain (preferably valved) or needle aspiration.
» Send samples for protein, glucose, cytology, microscopy and culture. If pus is identified, insert a chest drain.
» Transudates do not require drainage unless respiration is significantly compromised by the size of the effusion.
» More aggressive surgical procedures such as open drainage or decortication are rarely indicated in children.

MEDICINE TREATMENT

For purulent effusion:

- Amoxicillin/clavulanate, IV, 25 mg/kg/dose of amoxicillin component 8 hourly (do not exceed 10 mg/kg/day of clavulanate component for 10 days).

OR

- Cefazolin, IV, 25 mg/kg 8 hourly.

If there is evidence of good clinical response, change to:

- Cephalexin, oral, 6.25–12.5 mg/kg/dose 6 hourly.

OR

- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose of amoxicillin component 12 hourly. (See annexure 1: Amoxicillin/Clavulanic weight band dosing table)

If pathogens are cultured in blood from sanctuary sites, e.g. bone, heart valves, etc., treat according to sensitivity for prolonged period of 21–42 days.

For straw-coloured or haemorrhagic effusion:

» Start anti-tuberculosis therapy, see Chapter 10: Tuberculosis.

REFERRAL

If no response to any of the above therapy.

15.3 CHRONIC LUNG INFECTIONS

15.3.1 BRONCHIECTASIS

J47

DESCRIPTION

Irreversible dilatation of the subsegmental airways, inflammatory destruction of bronchial and peribronchial tissue, and accumulation of exudative material in dependent bronchi that occurs as a result of recurrent bacterial infections and aspiration pneumonia. There is bronchial luminal obstruction; ciliary dyskinesia; thick, tenacious secretions and lung tissue damage.

Complications include pulmonary hypertension, cor-pulmonale and respiratory failure. Predisposing conditions include HIV, TB, cystic fibrosis, primary ciliary dyskinesia and primary immunodeficiency syndromes.

DIAGNOSTIC CRITERIA

» Chronic cough, usually with mucopurulent sputum and occasional haemoptysis.
» Clubbing and halitosis.
» Recurrent and persistent lower respiratory tract infections.

» A bout of coughing on physical activity or change in posture, particularly while reclining.
» Fever, malaise, anorexia, poor weight gain.
» Respiratory failure, cyanosis.
» Pulmonary hypertension and cor-pulmonale.
» Chest X-ray showing cystic dilatation and tram-tracking.
» If diagnosis is uncertain or where localised disease on chest X-ray is suspected, perform high-resolution computed tomography. Features include cystic dilatation, 'signet ring' sign and tram-tracking.
» Usual pathogens are community acquired, including *Streptococcus pneumoniae*, non-typeable *Haemophilus influenzae, Staphylococcus aureus*. Must exclude tuberculosis and fungal infections.

GENERAL AND SUPPORTIVE MEASURES

» Identify and treat the underlying disorder or bacterial source.
» Clear secretions effectively with postural drainage and physiotherapy.
» Eliminate all foci of infection.
» Nutritional support.

Method of sputum induction

Precaution: If undertaking this procedure in an acutely sick child with respiratory compromise, be prepared to manage acute bronchospasm, as this may be an associated adverse effect.

- Nebulise with sodium chloride 0.9% or sodium chloride 3% (hypertonic saline) to aid sputum expectoration. Mix 3 mL of 5% sodium chloride with 2 mL sterile water to make a 3% solution.

In the acutely sick child:

Nebulise with a bronchodilator:

- Salbutamol, solution, 0.15–0.3 mg/kg/dose in 2–4 mL of sodium chloride 3% delivered at a flow of 5 L/minute with oxygen for 20 minutes.

» Perform physiotherapy.
» Encourage patient to cough up sputum or if infant or small child, obtain nasopharyngeal aspirate post physiotherapy.
» Send sample for culture and cytology as indicated.

MEDICINE TREATMENT

Acute lung infections: worsening cough accompanied by increased dyspnoea or tachypnoea and/or signs of sepsis.

Empiric antibiotic therapy for acute lung infections:

- Amoxicillin/clavulanate, IV, 25 mg/kg/dose of amoxicillin component 8 hourly (do not exceed 10 mg/kg/day of clavulanate component).

Change antibiotics according to culture and sensitivity results.

If poor response and no culture to guide antibiotic choice, consider infection due to *S. aureus*, TB or fungal infection.

If there is evidence of good clinical response, change to:

- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose of amoxicillin component 12 hourly.
  - Total antibiotic duration of 10 days.

  (See annexure 1: Amoxicillin/Clavulanic weight band dosing table)

Note: These antibiotic regimens **do not** apply to children with cystic fibrosis, seek specialist advice.

In the acute phase if wheeze is present:

- Salbutamol solution, 5 mg/mL, nebulise 4 hourly.
  - 5 mg salbutamol in 2–4 mL sodium chloride 0.9%.

- Annual influenza vaccination.

- Pneumococcal vaccine (conjugated), 2 additional doses 8 weeks apart.

SURGICAL TREATMENT

- Consider surgery in localised severe disease or progressive disease despite adequate medical treatment.

ROLE OF CHEMOPROPHYLAXIS

- Azithromycin, oral, 5 mg/kg/dose daily for 3 alternate days per week for 3 months duration and then repeat after 6 months.

REFERRAL

» All patients for confirmation of the diagnosis, assessment of severity and evaluation of the underlying condition.
» Poor response to therapy, increased frequency of exacerbations, poor lung function.
» For early surgical intervention of localised disease.

15.3.2 LUNG ABSCESS

J85

DESCRIPTION

A suppurative process that results from destruction of the pulmonary parenchyma and formation of a cavity. The cavity may be single, e.g. after aspiration, or multiple, e.g. staphylococcal disease and cystic fibrosis.

Lung abscess may follow pneumonia caused by:

- » *S. aureus,*
- » anaerobic organisms,
- » *H. influenza,*
- » *K. pneumoniae,*
- » *S. pneumoniae,*
- » *M. tuberculosis.*

Metastatic lung abscesses due to septicaemia or septic emboli may also occur.

Complications include:

- » bronchiectasis,
- » rupture into the bronchial tree or pleural cavity or vessels,
- » bronchopleural fistula.
- » empyema,
- » pulmonary osteo-arthropathy,
- » brain abscess,

DIAGNOSTIC CRITERIA

- » Intermittent or recurrent fever, malaise, weight loss, anorexia and productive, purulent cough with halitosis and haemoptysis.
- » Clubbing and amphoric breathing over the cavity may be present.
- » Chest X-ray will confirm cavity/cavities with or without an air-fluid level.

GENERAL AND SUPPORTIVE MEASURES

- » Identify the underlying cause and exclude inhalation of a foreign body.
- » Physiotherapy and postural drainage.
- » Correct anaemia.
- » Nutritional support.

MEDICINE TREATMENT

Empiric antibiotic therapy for at least 14 days.

- Amoxicillin/clavulanate, IV, 25 mg/kg/dose of amoxicillin component 8 hourly (do not exceed 10 mg/kg/day of clavulanate component).

Change antibiotics according to culture and sensitivity results.
If there is a poor response and no culture to guide antibiotic choice: consider local surveillance of pathogens and change accordingly.
If there is evidence of good clinical response, change to:

- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose of amoxicillin component 12 hourly. (See annexure 1: Amoxicillin/Clavulanic weight band dosing table)

SURGICAL TREATMENT

Consider surgical drainage of abscess and/or resection if medical treatment fails.

REFERRAL

- » Complicated lung abscess not responding to therapy.
- » Lung abscess where the underlying cause has not been established.

15.4 CONDITIONS WITH PREDOMINANT WHEEZE

15.4.1 ASTHMA ATTACK, ACUTE

J46

DESCRIPTION

Acute exacerbation of wheezing that is unresponsive to bronchodilator therapy that is usually effective in a child who had been previously diagnosed with asthma.

DIAGNOSTIC CRITERIA

Clinical signs include:

- » intense wheezing,
- » hyperinflation,
- » tachypnoea,
- » hypoxaemia,
- » restlessness,
- » difficulty or inability to talk or feed,
- » decreased air entry,
- » dyspnoea,
- » tachycardia,
- » anxiety,
- » palpable pulsus paradoxus,
- » reduced peak flow rate.

The following are danger signs in acute, severe asthma and require referral:

- » restlessness,
- » disturbance in level of consciousness,
- » rising P_aCO_2,
- » silent chest with auscultation,
- » PEFR < 60% of predicted value,
- » decreasing oxygen saturation < 85%,
- » palpable pulsus paradoxus,
- » chest pain (air leaks).

Classification of Severity of Acute Asthma Exacerbations

	Mild	Moderate	Severe
Oxygen saturation ***(performed off oxygen)***	> 95%	92–95%	< 92%
PEFR*	70–90%	50–70%	< 50%
Arterial P_aCO_2	< 35 mmHg < 3.7 kPa	< 40 mmHg < 5.3 kPa	> 40 mmHg > 5.3 kPa
Pulsus paradoxus	< 10 mmHg < 1.3 kPa	10–20 mmHg 1.3–2.7 kPa may be palpable	20–40 mmHg 2.7–5.3 kPa palpable
Wheezing	expiratory	expiratory and inspiratory	breath sounds soft
Respiratory rate	< 40/minute	> 40/minute	> 40/minute

	Mild	Moderate	Severe
Additional signs		» speaks normally » difficulty with feeding » chest indrawing	» unable to speak » confusion » cyanosis » use of accessory muscles
Management	• Short-acting ß$_2$-agonist, e.g. salbutamol, inhalation **PLUS** • Prednisone, oral	• Oxygen, • Short-acting ß$_2$-agonist, e.g. salbutamol, inhalation • ± Ipratropium bromide, inhalation • Prednisone, oral	• Oxygen, • Short-acting ß$_2$-agonist, e.g. salbutamol, inhalation stat • Ipratropium bromide, inhalation, • Hydrocortisone, IV If no response: ± $MgSO_4$, IV bolus stat **OR** ± Salbutamol, IV bolus stat **AND** Consider ICU care

*Peak expiratory flow rate (PEFR) – as percentage of predicted value.

GENERAL AND SUPPORTIVE MEASURES

» Admit child to a high care unit, if available.
» Monitor:
  > heart rate,
  > respiratory rate,
  > PEFR,
  > pulse oximetry.
  > blood pressure,
  > acid-base status,
  > blood gases,
» Ensure adequate hydration:
  > Encourage intake of normal maintenance volume of oral fluids; avoid overhydration.
» If unable to drink, give 0.45% sodium chloride/5% dextrose IV. Patients with prolonged severe asthma may become dehydrated as a result of poor intake or vomiting. It is, however, inadvisable to overhydrate patients with acute asthma: do not exceed the recommended IV fluid volume in children, i.e. 50 mL/kg/24 hours.
» Monitor potassium levels in a patient on continuous ß$_2$-agonist.

Note:

» Physiotherapy, antihistamines, antibiotics and sedation are not beneficial in the acute setting.

» Agitation and restlessness are signs of severe hypoxia.

MEDICINE TREATMENT

Mild exacerbation of asthma

- Bronchodilator, i.e. short-acting ß2-agonist.
  - Salbutamol, inhalation, using a metered-dose inhaler with a spacer device.
    - 200–400 mcg (2–4 puffs of 100 mcg/puff) repeated every 20–30 minutes depending on clinical response.

  OR
  - Salbutamol, solution, 0.15–0.3 mg/kg/dose nebulised at 20 minute intervals for 3 doses.
    - Maximum dose: 5 mg/dose.
    - 5 mg salbutamol in 4 mL sodium chloride 0.9% delivered at a flow of 5 L/minute with oxygen.

PLUS

- Prednisone, oral, 1–2 mg/kg, daily immediately up to a maximum of:
  - 20 mg: Children < 2 years for 5 days.
  - 30 mg: Children 2–5 years for 5 days.
  - 40 mg: Children 6–12 years for 5 days.

Moderate or severe asthma

Step 1:

To maintain arterial oxygen saturation ≥ 95%:

- Oxygen, at least 4–6 L/minute by face mask **or** 1–2 L/minute by nasal cannula.

PLUS

- Short-acting $ß_2$-agonist:

  Severe disease:
  - Salbutamol, inhalation, using a metered-dose inhaler with a spacer device, 10 puffs (100 mcg/puff) = 1 mg per administration, repeated every 20–30 minutes depending on clinical response.

  Moderate severity:
  - Salbutamol, 400–600 mcg (4–6 puffs of 100 mcg/puff) repeated every 20–30 minutes depending on clinical response.

OR

- Salbutamol, solution, 0.15–0.3 mg/kg/dose nebulised at 20 minute intervals for 3 doses.
  - Maximum dose: 5 mg/dose.
  - 5 mg salbutamol in 4 mL sodium chloride 0.9% delivered at a flow of 5 L/minute with oxygen.

PLUS

- Ipratropium bromide, solution, 0.25 mg, nebulised immediately.
  - If severe, follow with 0.25 mg every 20–30 minutes for 4 doses over 2 hours.
  - Maintenance dose: 0.25 mg 6 hourly.
  - 0.25 mg (2 mL) ipratropium bromide in 2 mL sodium chloride 0.9%.

- Ipratropium bromide may be mixed with a ß$_2$-agonist.

PLUS

- Prednisone, oral, 1–2 mg/kg, immediately up to a maximum of:
  - 20 mg: Children < 2 years for 5 days.
  - 30 mg: Children 2–5 years for 5 days.
  - 40 mg: Children 6–12 years for 5 days.

Step 2:

Assess response to treatment in step 1 by using the following table:

	Responder	Non-responder
PEFR	Improvement > 20% OR > 80% (best/predicted)	Improvement < 20% OR < 80% (best/predicted)
Respiratory rate	< 40/minute	> 40/minute
Retraction	absent	present
Speech	normal	impaired
Feeding	normal	impaired

Responder: patient who maintains an adequate response for at least 1 hour.
Non-responder: patient who fails to respond adequately to treatment in step 1.

Proceed to step 3.

Step 3:

Responder:

Review current treatment, possible precipitating or aggravating factors and commence:

- Prednisone, oral, 2 mg/kg as a single daily dose for 5 days.
  - To a maximum of:
    - 20 mg: Children < 2 years for 5 days.
    - 30 mg: Children 2–5 years for 5 days.
    - 40 mg: Children 6–12 years for 5 days.

PLUS

- Short-acting ß$_2$-agonist:
  - Salbutamol, inhalation, 200 mcg (2 puffs of 100 mcg/puff) as required using a metered-dose inhaler with a spacer device.

Review maintenance asthma therapy at follow-up.

Non-responder:

Intensify treatment as follows:

Continue

- Short-acting ß$_2$-agonist:
  - Salbutamol, solution, 0.15–0.3 mg/kg/dose nebulised at 20 minute intervals for 3 doses.
    - Maximum dose: 5 mg/dose.

- 5 mg salbutamol in 4 mL sodium chloride 0.9% delivered at a flow of 5 L/minute with oxygen.

AND

- Ipratropium bromide, solution, 0.25 mg, nebulised immediately.
  - If severe, follow with 0.25 mg every 20–30 minutes for 4 doses over 2 hours.
  - Maintenance dose: 0.25 mg 6 hourly.
  - 0.25 mg (2 mL) ipratropium bromide in 2 mL sodium chloride 0.9%.
  - Ipratropium bromide may be mixed with a $ß_2$-agonist.

PLUS

Continue corticosteroid:

- Prednisone, oral, 2 mg/kg as a single daily dose.
  - To a maximum of:
    - 20 mg: Children < 2 years for 5 days.
    - 30 mg: Children 2–5 years for 5 days.
    - 40 mg: Children 6–12 years for 5 days.

OR

- Hydrocortisone, IV, 2 mg/kg/dose 6 hourly.

Consult paediatrician for use of:

- Magnesium sulphate, IV bolus, 25–75 mg/kg administered over 20 minutes.

OR

- Salbutamol, IV, 15 mcg/kg as a single dose administered over 10 minutes.

AND

- Need for intensive care.

Step 4: *(Assess response to treatment in Step 3.)*

If non-responsive, admit to intensive care unit for consideration of:

- Magnesium sulphate, IV bolus, 25–75 mg/kg administered over 20 minutes (if not already given).

AND

- Salbutamol, IV.
  - Loading dose: 15 mcg/kg (do not give if stat dose already given).
  - Follow with: 1 mcg/kg/minute.
  - If necessary, increase dose by 1 mcg/kg every 15 minutes.
  - Maximum dose: 5 mcg/kg/minute.
  - Monitor electrolytes and side effects.

No further response

In cases of life threatening asthma in the intensive care unit:

- Aminophylline, IV, 5 mg/kg, loading dose administered over 20–30 minutes. Omit loading dose in children receiving maintenance oral theophylline.
  - Follow with: 1 mg/kg/hour continuous infusion.
  - ECG monitoring is mandatory.

REFERRAL
» Acute exacerbation not responding to treatment.

15.4.2 ASTHMA, CHRONIC
J45

DESCRIPTION
Asthma is a chronic inflammatory airways disease in which many cells and cellular elements play a role. Susceptible individuals present with recurrent episodes of early morning wheezing, breathlessness, chest tightness and cough.

There is widespread variable airflow obstruction that is reversible either spontaneously or with treatment. A variety of stimuli, e.g. allergens, viral infections, weather changes, emotional upsets or other irritants precipitate inflammation that is associated with increased bronchial hyper-responsiveness.

DIAGNOSTIC CRITERIA
» Chronic, persistent/recurrent cough and/or wheezing that responds to a bronchodilator.
» Objective evidence of reversible airway obstruction, as measured by > 15% improvement of the peak flow or > 12% improvement in the forced expiratory volume in 1 second (FEV_1) 20 minutes after administration of an inhaled bronchodilator, confirms the diagnosis.
» A family history of atopy, night or exercise-induced coughing and/or wheezing.

Control of asthma
The severity of asthma can vary with time and regular reassessments (at least every 3 months) are necessary.

On treatment, chronic asthma is classified as:
» controlled,
» partially controlled, or
» uncontrolled.

The following criteria are used to classify control:

	Controlled	Partially controlled (Any present in any week)	Uncontrolled
Daytime symptoms	None (2 or less/ week)	More than twice/week	3 or more features of partly controlled asthma present in any week
Limitations of activities	None	Any	
Nocturnal symptoms/ awakening	None	Any	
Need for 'rescue'/ 'reliever' treatment	None (2 or less/ week)	More than twice/week	
Lung function (PEF or FEV_1)	Normal	< 80% predicted or personal best (if known) on any day	
Exacerbation	None	One or more/year	

Partially controlled or uncontrolled cases require escalation in therapy while cases controlled for > 4 months require gradual reduction in therapy.

Assessment of severity and classification of chronic asthma
Before initiating treatment, classify the grade of severity of patient illness according to the presence of the most severe feature. This assists in choosing the most appropriate initial maintenance therapy.

Infrequent asthma: less than one acute exacerbation in 4–6 months.
Persistent asthma: mild, moderate or severe.

Criteria	Mild	Moderate	Severe
Day time symptoms	2–4/week	> 4/week	continuous
Night time symptoms	2–4/month	> 4/month	frequent
Prior admission to hospital for asthma	None	one previous admission	> one previous admission or admission to ICU
PEFR*	> 80%	60–80%	< 60%

*Peak expiratory flow rate (PEFR) – patient's best as percentage of predicted value.

GENERAL AND SUPPORTIVE MEASURES

» Environmental control, avoid triggers, e.g.:
  > exposure to cigarette smoke,
  > preservatives such as sulphites and benzoates,
  > house pets such as cats and dogs,
  > house-dust mite sensitisation: use plastic mattress covers, and remove bedroom carpets.
» Wash bedding covers in hot water (> 70 °C).
» Educate children, parents, caregivers and teachers.

MEDICINE TREATMENT

Medicine delivery systems

Use spacer devices with a metered dose inhaler. Prime all spacers with 2 doses of inhaled medication prior to first use. The size of the spacer is dependent on the tidal volume of the child:

	Spacer volume	Face mask/ mouthpiece	Valve
Infants	150–250 mL	face mask	mandatory
Children < 5 years **Children > 5 years**	500 mL	face mask mouthpiece	recommended
Adolescents	750 mL	mouthpiece	not necessary

The technique of using the spacer varies with age:
» Infants and young children: use tidal breathing of 10 long, deep, slow breaths.
» Older children and adolescents: breathe out fully, actuate the inhaler, inhale the entire contents in one long, slow breath and hold breath for 10 seconds.

Inhaled corticosteroid use

» Inhaled corticosteroids are indicated for all cases of persistent asthma.
» Spacer devices increase the efficacy of inhaled corticosteroids.
» Rinse the mouth after inhalation of inhaled corticosteroids to reduce systemic absorption and adverse effects.
» Wash face if a face mask is used.
» Use the lowest possible effective dose of steroids.

15.4.2.1 INFREQUENT ASTHMA

Although infrequent asthma is thought not to exist in the adolescent and adults, it is still considered in the classification for children up to 12 years of age.
To relieve symptoms:

- ß$_2$-agonist (short-acting), e.g.:
  - Salbutamol, inhalation, 100–200 mcg, as required 3–4 times daily using a metered-dose inhaler with a spacer device until symptoms are relieved.

Note: Failure to respond to 2 doses of an inhaled bronchodilator given 20 minutes apart is an indication of an **acute exacerbation** of asthma. See section 15.4.1: Asthma, acute attack.

15.4.2.2 PERSISTENT ASTHMA

Mild persistent asthma
When needed for acute exacerbations:
- ß2-agonist (short-acting), e.g.:
  - Salbutamol, inhalation, 100–200 mcg, as required 3–4 times daily using a metered-dose inhaler with a spacer device until symptoms are relieved.

PLUS
For daily maintenance treatment:
- Low dose inhaled corticosteroids, e.g.:
  - Beclomethasone **or** budesonide, inhalation, 50–100 mcg, 12 hourly using a metered-dose inhaler with a spacer device.

Moderate persistent asthma
To relieve symptoms:
- ß2-agonist (short-acting), e.g.:
  - Salbutamol, inhalation, 100–200 mcg, as required 3–4 times daily using a metered-dose inhaler with a spacer device until symptoms are relieved.

PLUS
- Regular anti-inflammatory treatment with medium-dose inhaled corticosteroids:
  - Beclomethasone **or** budesonide, inhalation, 100–200 mcg, 12 hourly using a metered-dose inhaler with a spacer device.

OR
- In children > 6 years with multiple allergies on other steroid formulations, low-dose inhaled corticosteroids plus long-acting beta agonist (LABA), e.g.:
  - Fluticasone plus salmeterol by inhalation, 12 hourly. Specialist initiated.
    Metered dose inhaler:
    - Salmeterol/fluticasone, 25/50 MDI, 2 puffs 12 hourly.

    OR
    - Salmeterol/fluticasone 25/125 MDI, 2 puffs, 12 hourly.

    OR
    Accuhaler:
    - Salmeterol/fluticasone 50/100, 1 inhalation, 12 hourly.

OR

- Salmeterol/fluticasone 50/250, 1 inhalation, 12 hourly.

Severe persistent asthma

To relieve symptoms:

- $ß_2$-agonist (short-acting), e.g.:
  - Salbutamol, inhalation, 100–200 mcg, as required 3–4 times daily using a metered-dose inhaler with a spacer device until symptoms are relieved.

PLUS

- Low-dose inhaled corticosteroids plus LABA, e.g.:
  - Fluticasone plus salmeterol, inhaled, 12 hourly. Specialist Initiated.

    Metered dose inhaler:
    - Salmeterol/fluticasone, 25/50 MDI, 2 puffs, 12 hourly.

    OR
    - Salmeterol/fluticasone 25/125 MDI, 2 puffs, 12 hourly.

    OR

    Accuhaler:
    - Salmeterol/fluticasone 50/100, 1 inhalation, 12 hourly.

    OR
    - Salmeterol/fluticasone 50/250, 1 inhalation, 12 hourly.

REFERRAL

» Diagnostic uncertainty.
» After a life-threatening episode.
» Unstable or difficult to control asthma.
» Asthma interfering with normal life, despite treatment.
» Severe persistent asthma not responding to therapy.

Suggested reference peak expiratory flow (PEF) values for children:

Height (cm)	PEF		PEF	
	Caucasian		African*	
	Male	Female	Male	Female
100	127	142	120	126
101	131	145	124	130
102	135	149	128	133
103	138	152	131	137
104	142	156	135	140
105	146	159	139	144
106	150	163	143	148
107	154	166	147	151
108	158	170	151	155
109	162	174	155	159
110	166	178	159	163
111	170	182	163	167
112	175	185	168	171
113	179	189	172	175
114	184	193	176	179

Height (cm)	PEF		PEF	
	Caucasian		African*	
	Male	Female	Male	Female
115	188	197	181	184
116	193	202	186	188
117	197	206	190	192
118	202	210	195	197
119	207	214	200	201
120	212	218	205	206
121	217	223	210	210
122	222	227	215	215
123	227	232	220	220
124	232	236	226	225
125	237	241	231	230
126	243	245	236	235
127	248	250	242	240
128	254	255	248	245
129	259	259	253	250
130	265	264	259	255
131	271	269	265	260
132	276	274	271	266
133	282	279	277	271
134	288	284	283	277
135	294	289	289	282
136	300	294	295	288
137	307	299	302	293
138	313	304	308	299
139	319	309	315	305
140	326	315	322	311
141	332	320	328	317
142	339	325	335	323
143	345	331	342	329
144	352	336	349	335
145	359	342	356	342
146	366	348	363	348
147	373	353	371	354
148	380	354	378	361
149	387	365	386	368
150	395	371	392	374
151	402	377	401	381
152	410	382	409	388
153	417	388	417	395
154	425	394	425	402
155	433	401	433	409
156	440	409	441	416
157	448	413	442	423
158	456	419	458	430
159	464	426	466	437
160	473	432	475	445
161	481	438	484	452

Height (cm)	PEF		PEF	
	Caucasian		African*	
	Male	Female	Male	Female
162	489	445	492	460
163	498	451	501	468
164	506	458	510	475
165	515	465	520	483
166	524	471	529	491
167	533	478	538	499
168	542	485	548	507
169	551	492	557	515
170	560	499	567	523
171	569	506	577	532
172	578	513	587	540
173	588	520	597	548
174	597	527	607	557
175	607	534	617	566
176	617	541	627	574
177	626	549	638	583
178	636	556	648	592
179	646	563	659	601
180	657	571	670	610

**Based on African American data.*

For optimal control, 80% of the predicted peak flow is required.

15.5 UPPER AIRWAY DISEASES

15.5.1 EPIGLOTTITIS

J05.1

DESCRIPTION

Life-threatening upper airway obstruction at the level of the supraglottic structures (epiglottis and arytenoids). The condition is rare since *H. influenzae* type b vaccination has been introduced.

DIAGNOSTIC CRITERIA

» Acute onset, high fever, sore throat, dysphagia, refusal to eat or swallow, drooling and muffled voice.
» Position of comfort to protect the upper airway: sitting upright, head forward, open mouth, neck in extension.

GENERAL AND SUPPORTIVE MEASURES

» Do not interfere with the protective mechanism of the patient. Allow the child to remain sitting up.
» Avoid all measures that could agitate the patient:
  > make no attempt to see the epiglottis,
  > do not routinely perform X-rays of neck and chest.

» Secure the airway before IV line insertion and blood sampling.
» Monitor oxygen saturation (pulse oximeter).

Acute airway obstruction

Caution
Epiglottitis is an upper airway emergency.
Total upper airway obstruction is imminent by the time stridor appears.
Prepare equipment for bag-mask ventilation, endotracheal intubation, needle cricothyroidotomy and tracheostomy.

» If the airway obstructs completely or respiratory arrest occurs, attempt to establish an airway: ventilate with bag and mask.
» If unable to ventilate: intubate.
» If unable to intubate: perform needle or surgical cricothyroidotomy.

Total airway obstruction may occur suddenly and quite unpredictably; the patient should ideally be intubated before referral. Intubation should preferably be performed under general anaesthesia in an operating theatre.

If intubation prior to referral is not possible, transfer patient as an emergency, advising transfer staff to avoid lying the child down. Inform the receiving hospital before departure.

During transport, if the child decompensates, attempt bag and mask ventilation.
After an open airway has been secured:
» take blood for cultures,
» swab epiglottis for microscopy, culture and sensitivity,
» monitor heart rate, respiratory rate, blood pressure and SaO_2,
» ensure adequate nutrition and hydration.

MEDICINE TREATMENT
- Oxygen, humidified, if needed.
- Ceftriaxone, IV, 50 mg/kg/dose, once daily for 7 days.

REFERRAL
» All, once airway is secured.

15.5.2 LARYNGOTRACHEOBRONCHITIS, ACUTE VIRAL (CROUP)
J05.0

DESCRIPTION
Potentially life-threatening airway obstruction in children and one of the most common causes of stridor in children aged between 6 months and 2 years.

The most important viruses causing laryngotracheobronchitis (LTB) include:
» para-influenza virus (most common),
» measles,
» herpes simplex,
» adenovirus.

DIAGNOSTIC CRITERIA

Clinical

» A previously healthy child who, a day or two after the onset of an upper respiratory tract infection, develops progressive airway obstruction with a barking cough and stridor.
» A mild fever may be present.
» Stridor becomes softer as airway obstruction becomes more severe.

The following features suggest a different diagnosis:
» acute onset of obstruction without prodromal features (foreign body or angioneurotic oedema),
» incomplete immunisation and a membrane in the upper airway (diphtheria),
» high fever, dysphagia, drooling or sitting position (epiglottitis, retro-pharyngeal abscess, bacterial tracheitis),
» recurrent upper airways obstruction (laryngeal papilloma).

Assessment of severity of airway obstruction in LTB

Severity	Inspiratory obstruction (Stridor)	Expiratory obstruction (Stridor)	Pulsus paradoxus
Grade 1	+		
Grade 2	+	+ passive expiration	
Grade 3	+	+ active expiration using abdominal muscles	+
Grade 4	cyanosis, apathy, marked retractions, impending apnoea		

GENERAL AND SUPPORTIVE MEASURES

» Monitor the nutritional status and fluid requirements.
» Monitor oxygen saturation, heart rate and respiratory rate.
» Avoid arterial blood gas estimations. Clinical criteria are more effective in determining severity.
» Depending on severity, admit child to high care or intensive care ward.

MEDICINE TREATMENT

Grade 1 obstruction

- Prednisone, oral, 2 mg/kg as a single dose.
  - To a maximum of:
    - 20 mg: Children < 2 years for 5 days.
    - 30 mg: Children 2–5 years for 5 days.
    - 40 mg: Children 6–12 years for 5 days.

OR

- Dexamethasone, IV/IM, 0.5 mg/kg as a single dose.

Note: Avoid steroids in patients with measles or herpes infection.

Grade 2 obstruction

As above

PLUS

- Adrenaline (epinephrine), 1:1000, nebulised with oxygen, every 15–30 minutes until expiratory obstruction is abolished.
  - 1 mL adrenaline (epinephrine) 1:1000 diluted in 1 mL sodium chloride 0.9%.

Grade 3 obstruction

As above:

» if improvement, treat as in grade 2 but reduce frequency of adrenaline (epinephrine) nebulisations with time,
» if no improvement within 1 hour, intubate, preferably under general anaesthetic,
» refer.

Grade 4 obstruction

As above, and:

» continue steroids,
» continue with adrenaline (epinephrine) nebulisation with 100% warm humidified oxygen,
» emergency intubation or intubation under general anaesthesia, if circumstances permit,
» if unable to intubate, bag and mask ventilate and refer urgently.

For suspected herpes:

- Aciclovir, IV, 10–15 mg/kg/dose 8 hourly for 5–7 days.

For suspected bacterial infection in children:

- Amoxicillin/clavulanate, IV, 25 mg/kg/dose of amoxicillin component 8 hourly (do not exceed 10 mg/kg/day of clavulanate component) for 7 days.

REFERRAL

» Intubated children for ICU care. Intubate all children with grade 3 airway obstruction not responding to adrenaline nebulisations and all children with grade 4 airway obstruction before referral.
» Children with an uncertain diagnosis.

15.6 OBSTRUCTIVE SLEEP APNOEA

G47.3

DESCRIPTION

Affects all ages as either partial or complete airway obstruction that disrupts gas exchange and sleep patterns. Associated with truncal obesity and increased BMI, recurrent otitis media, allergic rhinitis/asthma and syndromic conditions e.g. Down syndrome, Treacher-Collins syndrome, Apert syndrome etc.

Presents with daytime (sleepiness, decreased cognition) and night (habitual snoring, paradoxical breathing, and sweating, breathing pauses) symptoms. Clinical signs include developmental delay, adenoidal facies, tonsillar and adenoidal hypertrophy, pulmonary hypertension and cor-pulmonale.

DIAGNOSTIC CRITERIA

» Lateral neck X-ray.
» Overnight pulse oximetry.
» FBC (polycythaemia), hypothyroidism (Down syndrome).
» ECG/ECHO (pulmonary hypertension/cor-pulmonale).
» Polysomnography (if available).
» Apnoea/hypopnoea index > 1.

GENERAL AND SUPPORTIVE MEASURES

» Avoid tobacco smoke exposure.
» Lose weight.

MEDICINE TREATMENT

Intranasal steroid, e.g.:

- Fluticasone 50 mcg/spray.
  - < 12 years: 1 spray into each nostril daily.
  - > 12 years: 1 spray into each nostril twice daily.

Discuss with paediatrician for management of obesity.

Surgical management

Refer to ENT for consideration of surgical options.

Complications

» Neurodevelopmental regression, low self-esteem, aggressive, moody, ADHD.
» Decreased quality of life.
» Failure to thrive.

REFERRAL

Refer all patients.

References

[1] World Health Organisation. Revised WHO classification and treatment of childhood pneumonia at health facilities. Evidence Summaries. WHO Library. 2014. https://apps.who.int/iris/bitstream/handle/10665/137319/9789241507813_eng.pdf;jsessionid=DC9BAB4C398AE239AE3110330E619294?sequence=1

CHAPTER 16
EYE CONDITIONS

16.1 EYE INFECTION, COMPLICATED (SEVERE EYE INFECTION)

H44

DESCRIPTION

Intensely painful eye infection characterised by a red eye with or without a discharge (excluding simple or non-painful conjunctivitis).

Assess clinically for:

» Herpes conjunctivitis, indicated by vesicles on skin next to the eye.
» Loss of vision.
» Irregularity of the pupil.
» Haziness of the cornea.

Investigations

Swab the eye for microbiological culture.

GENERAL AND SUPPORTIVE MEASURES

Patient education on personal hygiene to avoid spread.
Educate patient on correct application of ophthalmic drops.
Advise patient:

» to wash hands thoroughly before applying ophthalmic ointment,
» not to share ophthalmic ointments or drops,
» not to rub eyes, and
» never to use urine or milk to wash the eyes.

MEDICINE TREATMENT

If herpes infection is suspected, treat as outlined in section 16.3: Herpes keratitis and conjunctivitis. If a bacterial cause is demonstrated or suspected:

During the day:

- Tobramycin, ophthalmic drops, instil 1 drop 4–6 hourly.

OR

- Chloramphenicol, 0.5% ophthalmic drops, instil 1 drop 4–6 hourly.

AND

Apply at night:

- Tobramycin, 0.3% ophthalmic ointment.

OR

- Chloramphenicol, 1% ophthalmic ointment.

REFERRAL

To an ophthalmologist within 24 hours if associated with any of the following acute signs:

» Reduced vision.
» A cloudy cornea.
» A corneal opacity or a staining corneal ulcer.
» Pus and blood level in the anterior chamber (hypopion and hyphaema).
» Cloudiness in the anterior chamber (poor view of iris details).
» An irregular or dilated (including partially dilated) pupil.
» A cloudy or poor view of the retina.
» A poor or greyish red-reflex.
» Proptosis.
» Restricted ocular movements.
» Severe ocular pain.

Non-urgent referral:

» A unilateral red eye for more than one day.
» No improvement after 5 days of treatment**.**

16.2 CONJUNCTIVITIS

H10.1

See Primary Healthcare Level Standard Treatment Guidelines and Essential Medicines List, Chapter 18: Eye Conditions, sections:

» 18.1 Conjunctivitis:
  > 18.1.1 Conjunctivitis, allergic.
  > 18.1.2 Conjunctivitis, bacterial (excluding conjunctivitis of the newborn).
  > 18.1.3 Conjunctivitis of the newborn.
  > 18.1.4 Conjunctivitis, viral (pink-eye).

16.3 HERPES KERATITIS AND CONJUNCTIVITIS

B00.5

DESCRIPTION

Herpes infection of the cornea and/or conjunctiva.

DIAGNOSTIC CRITERIA

There are three most common forms of this disease.

Blepharoconjunctivitis

» Primary ocular infection involving the eyelids and/or conjunctivae.
» The condition is benign and self-limiting.
» May be associated with keratitis: tiny punctuate stains on the cornea when stained with fluorescein and viewed with the cobalt blue light of the direct ophthalmoscope.

Disciform keratitis

» Immune response to herpes virus.
» Decreased visual acuity and corneal sensation.
» Round, dull, swollen area in the central cornea.
» Decreased sensation when compared to the other eye. (Use a thread of cotton from a cotton bud and touch the cornea from the side, away from the visual axis).
» Refer to an ophthalmologist.

Dendritic ulcer

» A linear branching ulcer (dendritic ulcer) when stained with fluorescein and viewed with the cobalt blue light of the direct ophthalmoscope.
» Decreased sensation when compared to the other eye. (Use a thread of cotton from a cotton bud and touch the cornea from the side, away from the visual axis).

GENERAL AND SUPPORTIVE MEASURES

» Pad the eye.

MEDICINE TREATMENT

- Aciclovir, ophthalmic ointment, applied 5 times per day for 10 days.

OR

- Aciclovir, orally, 20 mg/kg, 5 times per day for 10 days.

LoE II[1] III[2]

If painful ciliary spasm is present:

- Atropine, ophthalmic drops, instil 1 drop, 12 hourly.

REFERRAL

Urgent within 24 hours:

» If the corneal lesion is not clean/clear or has whitish areas within the bed of the epithelial ulcer.
» If the area of corneal staining is not smaller within 24 hours of treatment.
» If there is a history of recurrence.
» Disciform keratitis for assessment and treatment.

16.4 CYTOMEGALOVIRUS (CMV) RETINITIS

B25.8

DESCRIPTION

Characteristic appearance: opacification of the retina with areas of haemorrhage, exudate and necrosis.
Occurs in immunocompromised patients and could be an important cause of visual impairment in HIV-infected patients.

DIAGNOSTIC CRITERIA

» Confirm retinitis with ophthalmological assessment.
» Confirm CMV disease with DNA PCR.

MEDICINE TREATMENT

Ganciclovir, intravitreal, 2 mg, once a week (ophthalmologist treatment). Once immune function has been restored with antiretroviral therapy, i.e. CD4 > 100 cells/mm^3, maintenance ganciclovir can be stopped but monitor for recurrence.

REFERRAL

» All patients to confirm diagnosis and manage treatment.

16.5 CHEMICAL BURN TO THE EYE

T26.9

DESCRIPTION

Damage to one or both eyes caused by contact with irritating chemical substances, either alkali or acid.

Presentation:

» pain,
» inability to open the eye(s),
» blurred vision, and
» excessive tearing.

DIAGNOSTIC CRITERIA

To assess the extent of epithelial loss, after irrigating the eye(s), stain the cornea with fluorescein 2%.

Note: If the entire cornea stains, then all the epithelium has been removed by the chemical substance. Compare to fluorescein staining in the other eye.

GENERAL AND SUPPORTIVE MEASURES

Try to ascertain the exact nature of the chemical agent (without causing a delay in management and referral) by checking the pH of the conjunctival sac with litmus paper. (Alternatively, the pH-square of a urine test-strip may be used.) Normal tear pH: 6.5–7.6.

Irrigate affected eye(s) immediately and continuously with copious amounts of sterile water (at least 2 L). Use an eye speculum and an IV fluid delivery set. If the chemical agent is alkaline, prolong irrigation.

Note: Do not attempt to neutralise alkali with acid or vice versa.

MEDICINE TREATMENT

Anaesthetise eye(s) after rinsing the eye(s) and before instilling fluorescein.

- Topical anaesthetic, e.g. oxybuprocaine, ophthalmic drops, instil 1 drop. Repeat every 15 minutes, if necessary.

For pain:

- Paracetamol, oral, 15 mg/kg/dose 6 hourly as required.

REFERRAL

Urgent:

» Any severe chemical burn producing any epithelial loss or cloudiness of the cornea and/or conjunctival blanching.

16.6 PENETRATING EYE INJURY WITH/WITHOUT A FOREIGN BODY

S05.5/S05.6

DESCRIPTION

Penetration through the cornea or sclera to deeper structures with/without a foreign body still present.

DIAGNOSTIC CRITERIA

Urgently refer the patient with a penetrating eye injury or a severely contused eye to an ophthalmic specialist to avoid endophthalmitis and loss of the eyeball**.**

GENERAL AND SUPPORTIVE MEASURES

Note:

Use only preservative-free sterile eye drops if there is a possibility of an open eye injury. Do not apply ointment.

Apply a clean sterile eye shield that does not cause pressure on the globe and transfer the patient to the nearest specialist eye unit. If no eye shield is available, the bottom ⅓ of a paper cup may be used.

In cases of high velocity injury with radio-opaque material (metals, certain glass types), an orbital X-ray will reveal a suspected retained intra-ocular foreign body.

SURGICAL TREATMENT

Should be done by an ophthalmic specialist with an operating microscope.

REFERRAL

Urgent

» Any severe blunt trauma to the eye.
» A penetrating eye injury with/without a foreign body.
» Corneal or scleral laceration.
» Distorted pupil.
» Flat, shallow or deep anterior chamber (comparative to the other eye).
» Blood inside the eye.

16.7 NON-PENETRATING EYE INJURY

S05.1

DESCRIPTION

An intact cornea and sclera, but severely contused eye.
A foreign body on or embedded in the cornea of an intact eye.

DIAGNOSTIC CRITERIA

Signs depend on the site affected and nature of the non-penetrating trauma.

Corneal injury
» Contusion: hazy oedematous cornea.
» A foreign body embedded on/in the cornea.

Iris injury
» Sphincter rupture: dilated or irregular pupil margin.
» Hyphaema: blood in the anterior chamber due to rupture of the blood vessels.

Lens injury
» Cataract: reduced red-reflex.

Lens suspensory ligaments injury
» Subluxed or dislocated lens: abnormal lens position.

Retinal injury
» Blood vessel injury: blood in vitreous or blood on/in the retina.
» Retinal breaks and tears.

Choroidal injury
» Choroidal break: blood or sclera visible under the retina.

Optic disc
» Disc swelling or pallor.

MEDICINE TREATMENT

Corneal injury

A superficial corneal foreign body may be removed with a bud or hypodermic needle.

To anaesthetise the cornea for removal of a foreign body:
- Topical anaesthetic, e.g. oxybuprocaine, ophthalmic drops, instil 1 drop. Repeat every 15 minutes, if necessary.

To relieve discomfort caused by iris spasm:
- Atropine, 1% ophthalmic drops, 1 drop instilled immediately and 12 hourly until epithelialisation is complete.
- Chloramphenicol, ophthalmic ointment, applied 8 hourly for 5–10 days.

Iris injury

Sphincter rupture

Manage conservatively. Follow-up in four days to exclude hyphaema.

Hyphaema (blood behind the cornea)

Bed rest for five days.

Monitor for complications, i.e. increased intraocular pressure, corneal staining, secondary bleed.

- Atropine, 1% ophthalmic drops, instil 1 drop 12 hourly for 5 days.

PLUS

Topical corticosteroid drops:

- Dexamethasone, ophthalmic drops, instil 1 drop 4 hourly for 5 days.

REFERRAL

» A deeply embedded or full thickness corneal foreign body.
» Hyphaema, if unable to monitor for complications or if complications develop.
» Any eye with severe trauma and decreased visual acuity.
» Lens, retina and choroidal injuries – refer within 12 hours.

16.8 RETINOPATHY OF PREMATURITY (ROP)

H35.1

DESCRIPTION

ROP is a potentially preventable cause of blindness.

ROP is classified into five stages, ranging from mild (stage I) to severe (stage V):

Stage I – Mildly abnormal blood vessel growth.

» Many children who develop stage I improve with no treatment and eventually develop normal vision.
» The disease resolves on its own without further progression.

Stage II – Moderately abnormal blood vessel growth.

» Many children who develop stage II improve with no treatment and eventually develop normal vision.
» The disease resolves on its own without further progression.

Stage III – Severely abnormal blood vessel growth.

» The abnormal blood vessels grow toward the centre of the eye instead of following their normal growth pattern along the surface of the retina.
» Some infants who develop stage III improve with no treatment and eventually develop normal vision.
» However, when infants have a certain degree of stage III and ‘plus disease’ develops, treatment is considered.
» ‘Plus disease’ means that the blood vessels of the retina have become enlarged and twisted, indicating a worsening of the disease.
» Treatment at this point has a good chance of preventing retinal detachment.

Stage IV – Partially detached retina.
» Traction, from the scar produced by bleeding and abnormal vessels, pulls the retina away from the wall of the eye.

Stage V – Completely detached retina and the end-stage of the disease.
» If the eye is left alone at this stage, the baby can have severe visual impairment and even blindness.

TIMING OF SCREENING
Screening should be done at ~~4~~ 6 weeks' chronological age or 31–33 weeks' post conception age (whichever comes later).

MEDICINE TREATMENT
Dilation of the pupils for ROP screening by ophthalmologist:
- Cyclopentolate 0.5%/phenylephrine 2.5%, ophthalmic drops, instil 1 drop every 5 minutes for 3 doses 1 hour before examination.

REFERRAL
» All neonates weighing less than 1250 g OR ≤ 30 weeks' gestational age OR those 1250 g–1500 g with high risk for ROP (on prolonged oxygen) should be screened for ROP by ophthalmological examination.

16.9 CONGENITAL GLAUCOMA
Q15.0

DESCRIPTION
Congenital glaucoma is caused by abnormal development of the draining angle of the eye.

DIAGNOSTIC CRITERIA
Symptoms:
» Tearing
» Photophobia
» Blepharospasm

Signs:
» Enlarged eye (buphthalmos or 'cow eye' appearance).
» Corneal haziness (due to corneal oedema or scarring).
» Optic disc cupping.
» Raised intraocular pressure.

REFERRAL
Urgent (to ophthalmologist):
» All patients.

16.10 LEUKOCORIA

H44.53

DESCRIPTION

Common causes of leukocoria (white pupil) include:

» retinoblastoma,
» cataract,
» persistent foetal vasculature, and
» end-stage ROP.

DIAGNOSTIC CRITERIA

» A white appearance of the pupil instead of the usual black colour.
» An absent or diminished red-reflex of the fundus of the eye when examined with a direct ophthalmoscope or on a photograph of the child.

REFERRAL

Urgent (to ophthalmologist):

» All patients.

16.11 STRABISMUS

H50.9

DESCRIPTION

Strabismus (squint) is a misalignment of the two eyes.

A non-paralytic squint (concomitant strabismus): will not have restrictions of ocular movements in any of the eye positions.

A paralytic squint (incomitant strabismus): will have a restriction in one or more of the six cardinal eye positions. Consider cranial nerve palsy (III, IV or VI). Do a full neurological examination.

Complications of strabismus

» Amblyopia: a sensory state of an eye where abnormal visual development occurs if that eye is not being used by the brain. Untreated amblyopia leads to permanent visual impairment.
» Diplopia: when a strabismus occurs after the development of binocularity, the child will perceive a sensation of double vision (diplopia). Binocularity develops during the first decade.

DIAGNOSTIC CRITERIA

» The corneal light reflex: Patient is asked to fixate on a light held by the examiner at a distance of 33 cm. The light glistening on the cornea is displaced relative to the pupil.
» The cover test: Cover one eye and then the other. This elicits a re-fixation movement of the non-fixating eye.

REFERRAL

» All children with a squint.
» **Urgent**: any acute onset of strabismus.
» Within 24 hours: incomitant strabismus.
» Within 1 week: if complications of strabismus are present.
» Within 1 month: concomitant strabismus.

16.12 LOSS OF VISION

H53.1

DESCRIPTION

Causes of sudden loss of vision in an outwardly normal eye include:
» retinal detachment,
» occlusion of the retinal artery or retinal vein(s),
» vitreous haemorrhage,
» optic and retrobulbar neuritis, and
» choroiditis.

Causes of gradual loss of vision in an outwardly normal eye include:
» refractive errors,
» cataracts,
» retinopathies,
» malignancies, and
» optic nerve and chiasmal disease.

Loss of vision may also be associated with trauma, inflammation or other abnormalities.

REFERRAL

» **Urgent**: all children with sudden visual loss for full ophthalmic assessment and management.
» As soon as possible: all children with gradual visual loss, which is not fully corrected by refraction.

16.13 PRESEPTAL AND ORBITAL CELLULITIS

H05.019/H05.012

DESCRIPTION

Preseptal cellulitis (cellulitis of the tissues anterior to the orbital septum) is generally a mild condition that rarely leads to serious complications, whereas orbital cellulitis (involving the tissues posterior to the orbital septum, including the fat and muscle within the bony orbit) may cause loss of vision and even loss of life.

DIAGNOSTIC CRITERIA

Patients with local tenderness (lid erythema/oedema only) and a normal eye examination can be treated for preseptal cellulitis with oral antibiotics.

However, care should be taken to identify those at risk of orbital cellulitis, who require admission and intravenous antibiotics. CT scan is warranted in patients with central signs (drowsiness, vomiting, headache, seizures or cranial nerve lesions), where vision cannot be accurately assessed, gross proptosis, ophthalmoplegia, deteriorating visual acuity or colour vision, bilateral oedema, no improvement or deterioration at 24 hours, or a swinging pyrexia not resolving within 36 hours.

MEDICINE TREATMENT

Initial management:

- Ceftriaxone, IV, 50 mg/kg once daily.

OR

If one month old or younger:

- Cefotaxime, IV, 50 mg/kg/dose 6–8 hourly.

If the diagnosis of **preseptal cellulitis is confirmed**, switch to:

- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose of amoxicillin component, 12 hourly (amoxicillin/clavulanic acid in a ratio of 14:1).
  - Maximum dose of amoxicillin component: 1.5 g 12 hourly.

  (See annexure 1: Amoxicillin/Clavulanic weight band dosing table)

If the diagnosis of **orbital cellulitis is confirmed**, continue on intravenous antibiotics.

REFERRAL

» Patients with central signs.
» Patients where vision cannot be accurately assessed.
» Patients with gross proptosis, ophthalmoplegia, deteriorating visual acuity or colour vision.
» Patients with bilateral oedema.
» No improvement or deterioration after 24 hours of therapy.
» Swinging pyrexia not resolving within 36 hours.
» Orbital cellulitis secondary to chronic sinusitis (may be at risk of multiple abscesses).

References

[1] Aciclovir: Wilhelmus KR. (2015). Antiviral treatment and other therapeutic interventions for herpes simplex virus epithelial keratitis. The Cochrane database of systematic reviews, 1, CD002898. https://doi.org/10.1002/14651858.CD002898.pub5

[2] White ML, Chodosh J. Herpes Simplex Virus Keratitis: A Treatment Guideline. Hoskins Center for Quality Eye Care and American Academy of Ophthalmology Website; 2014. Available at: https://www.aao.org/clinical-statement/herpes-simplex-virus-keratitis-treatment-guideline

CHAPTER 17

EAR, NOSE AND THROAT

17.1 ABSCESS, RETROPHARYNGEAL

J39.0

DESCRIPTION

An infective process of the retropharyngeal space either due to:

» abscess formation in a retropharyngeal lymph node (lymphadenitis),
» rarely, extension of infection from surrounding tissues, or
» rarely, local injury.

Always consider cold abscess of TB as a possible cause.

DIAGNOSTIC CRITERIA

Clinical

» In severe cases, stridor and difficulty in breathing,
» more commonly, fever with dysphagia and drooling,
» may have extension of the neck, or torticollis and,
» swelling, usually in the midline of posterior pharyngeal wall.

Investigations

» Lateral X-ray of the neck may show the retropharyngeal space to be more than one-half of the width of the adjacent vertebral bodies when the neck is extended; air may be seen in the retropharynx and there is loss of the cervical lordosis.
» Blood cultures.

GENERAL AND SUPPORTIVE MEASURES

» Referral to ENT for surgical drainage of abscesses.
» Protect the airway.
» Ensure adequate hydration, either IV fluids or by NGT.

MEDICINE TREATMENT

Empirical antibiotic therapy

» Initiate antibiotic treatment immediately even if transfer of the patient is anticipated.
» Adjust antibiotic therapy based on culture results, if available.
» Early cases may be treated with antibiotic therapy alone.

- Amoxicillin/clavulanic acid, IV, 25 mg/kg/dose of the amoxicillin component 8 hourly (do not exceed 10 mg/kg/day of the clavulanic acid component).

As soon as there is a response and patient can tolerate oral medication:

- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose of amoxicillin component, 12 hourly for 14 days (amoxicillin/clavulanic acid in a ratio of 14:1).
  - Maximum dose of amoxicillin component: 1.5 g 12 hourly.

  (See annexure 1: Amoxicillin/Clavulanic weight band dosing table)

LoE III[1]

Note: *S. aureus* and *M. tuberculosis* are also possible aetiological agents. Adjust antibiotics once culture and sensitivity results are available.

Penicillin allergy:
See Chapter 25: Drug Allergies, section 25.4.1: Allergies to penicillins.

For pain and fever:
- Paracetamol, oral, 15 mg/kg/dose 6 hourly as required.

REFERRAL
» All children.

17.2 TONSILLITIS AND PHARYNGITIS
J03

See Primary Healthcare Standard Treatment Guidelines and Essential Medicines List, Chapter 19: Ear, Nose and Throat Conditions, section 19.6: Tonsillitis and pharyngitis.

17.3 TONSILLITIS, COMPLICATED (PERITONSILLAR CELLULITIS, PERITONSILLAR ABSCESS)
J03.9

DESCRIPTION
An infective process involving the tonsils with spread of infection into the adjacent tissue. It must be differentiated from hypertrophy of the tonsils without infection and a viral upper respiratory tract infection (these are associated with rhinorrhoea, nasal congestion and cough).

Local complications include peritonsillar abscess (quinsy) and parapharyngeal extension.

Systemic complications include glomerulonephritis, rheumatic fever and bacterial endocarditis.

DIAGNOSTIC CRITERIA
Clinical
» Pyrexia, malaise.

» Sore throat, dysphagia, drooling, trismus.
» Enlarged, inflamed tonsils, often with superficial pus visible in crypts.
» Earache (referred otalgia).
» Tender and enlarged cervical lymph nodes.

Signs of peritonsillar abscess/cellulitis:
» Usually unilateral.
» Soft palate and uvula on the infected side are oedematous and displaced medially towards the uninvolved side.
» Trismus.

Investigations
» Blood microscopy, culture and sensitivity.

GENERAL AND SUPPORTIVE MEASURES
» If necessary, maintain the airway.

MEDICINE TREATMENT
Empiric antibiotic therapy
» Initiate antibiotic treatment immediately even if transfer of the patient is anticipated.
» Adjust antibiotic therapy based on culture results, if available.

Early complications may be treated with antibiotic therapy alone.
- Amoxicillin/clavulanic acid, IV, 25 mg/kg/dose of the amoxicillin component 8 hourly (do not exceed 10 mg/kg/day of the clavulanic acid component).

As soon as there is a response and patient can tolerate oral medication:
- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose of amoxicillin component, 12 hourly for 10 days (amoxicillin/clavulanic acid in a ratio of 14:1).
  - Maximum dose of amoxicillin component: 1.5 g 12 hourly.

  (See annexure 1: Amoxicillin/Clavulanic weight band dosing table)

LoE III[1]

Adjust antibiotics once sensitivity results are obtained.

Penicillin allergy:
See Chapter 25: Drug Allergies, section 25.4.1: Allergies to penicillins.

For pain and fever:
- Paracetamol, oral, 15 mg/kg/dose 6 hourly as required.

See Chapter 20: Pain Control, section 20.1.1: Management of pain.

REFERRAL
» Tonsillitis with local complications not responding to adequate treatment.
» All cases where drainage may be required and is not available locally.

17.3.1 ACUTE BACTERIAL TRACHEITIS

J04.1

DESCRIPTION

An acute infective process characterised by marked subglottic oedema, with ulceration, erythema, pseudomembranous formation on the tracheal surface, and thick, mucopurulent secretions that frequently obstructs the lumen. Commonly due to *S. aureus*.

DIAGNOSTIC CRITERIA

Clinical

» Severely ill and toxic with airway obstruction and respiratory distress.
» Insidious onset, brassy cough, neck pain, dysphagia, no drooling.
» Associated co-infection, e.g. pneumonia.

Investigations

» Raised white cell count with left shift.
» Lateral neck X-ray: hazy tracheal air column.
» Upper airway endoscopy.
» Bacterial cultures on blood and pharyngeal secretions.

GENERAL AND SUPPORTIVE MEASURES

» Intubate and suction secretions if features of severe upper airway obstruction are present.
» Mechanical ventilation if associated pneumonia present.

MEDICINE TREATMENT

- Ceftriaxone, IV, 80 mg/kg once daily.

OR

If one month old or younger:

- Cefotaxime, IV, 50 mg/kg/dose, 6–8 hourly.

Adjust antibiotics according to sensitivity results.

For pain and fever:

- Paracetamol, oral, 15 mg/kg/dose 6 hourly.

Give 3 doses of corticosteroids to intubated patients prior to extubation:

- Dexamethasone, IV, 0.15 mg/kg/dose 8 hourly.

REFERRAL

» All cases requiring intubation.

17.4 EPISTAXIS (NOSE BLEED)

R04.0

DESCRIPTION

Nose bleeds may be caused by local or systemic diseases, or local trauma, especially nose picking and contact sports. It occurs from an area anterior and inferior on the nasal septum. Recurrent nose bleeds should alert one to possible systemic diseases, e.g. hypertension and bleeding tendency. Persistent or severe bleeds may require hospital care.

Complications include anaemia and hypovolaemic shock.

DIAGNOSTIC CRITERIA

» History of spontaneous and/or recurrent nose bleeds.
» Underlying problems include bleeding disorders and local intranasal pathology.
» Examine child for nasal lesions and signs of haematological disease and coagulopathies.

GENERAL AND SUPPORTIVE MEASURES

Digital pressure

» Squeeze the nasal wings (alae) of the nose between the thumb and forefinger to apply pressure to the nasal septum and maintain pressure for about 10 minutes.
» The child should sit up and lean forward so as not to swallow the blood, and should breathe through the mouth.
» If digital pressure fails, remove blood clots from the nose. The child may be able to do this by blowing his/her nose.

MEDICINE TREATMENT

Vasoconstrictor

If digital pressure fails:

- Oxymetazoline 0.025%, nose drops, instil 1–2 drops into the affected nostril(s) and repeat digital pressure as above.

Nasal pack

If bleeding continues and appears to originate from the anterior nasal cavity, pack the nasal cavity (rather than the apex) with cotton gauze tape impregnated with:

- BIPP (bismuth iodoform paraffin paste).

Apply topical anaesthesia to packing material:

- Lidocaine spray 2% solution.
  - Do not exceed 3 mg/kg/dose applied topically.

Anaemia

If symptomatic anaemia:

» haemoglobin is less than 8 g/dL and/or haematocrit is < 25% with ongoing epistaxis, or
» there is an underlying disorder in which severe re-bleeding is likely.

- Packed red cells, IV, 10–15 mL/kg over 2 to 4 hours.

Treat the underlying disorder appropriately.

REFERRAL

» Epistaxis caused by a serious underlying disorder.
» Epistaxis that is not controlled by the above measures.
» Recurrent epistaxis.

17.5 ACUTE MASTOIDITIS

H70.9

DESCRIPTION

A serious condition involving acute infections of the mastoid antrum that could spread to the adjacent brain and could occur secondary to an ear infection. Usually due to bacterial infections but tuberculosis should also be considered.

DIAGNOSTIC CRITERIA

Clinical

» Fever, severe pain, hearing impairment, tenderness over mastoid antrum.
» Swelling in post-auricular area. Pinna is pushed down and forward.
» Tympanic membrane is often perforated with otorrhoea.
» Occasionally, pus breaks through the mastoid tip and forms an abscess in the neck.
» If seizures, headache, loss of consciousness or neck stiffness, do CT scan of brain.

Investigations

» CT scan of brain to exclude intracranial spread.
» Collect blood and pus for Gram stain, microscopy, culture and sensitivity tests before initiation of antibiotic therapy.

GENERAL AND SUPPORTIVE MEASURES

» Dry mopping of the external auditory canal.

MEDICINE TREATMENT

Empiric antibiotic therapy

- Ceftriaxone, IV, 100 mg/kg once daily.

Note: Adjust antibiotic therapy based on culture results or if response to antibiotic therapy is unsatisfactory.

As soon as there is a response and patient can tolerate oral medication:

- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose of amoxicillin component, 12 hourly (amoxicillin/clavulanic acid in a ratio of 14:1).
  - Maximum dose of amoxicillin component: 1.5 g 12 hourly.

  (See annexure 1: Amoxicillin/Clavulanic weight band dosing table)

LoE III[1]

Total duration of therapy: at least 14 days.

For pain and fever:

- See Chapter 20: Pain Control, section 20.1.1: Management of pain.

REFERRAL

Urgent

» To ENT surgeon after initiation of antibiotics.

17.6 OTITIS EXTERNA

H60.9

See Primary Healthcare Standard Treatment Guidelines and Essential Medicines List, 2018, Chapter 19: Ear, Nose and Throat Conditions, section: 19.4.1 Otitis externa.

REFERRAL

» Suspected necrotising otitis externa: to ENT specialist.

17.7 OTITIS MEDIA, ACUTE (AOM)

H66.9

DESCRIPTION

» Inflammation of the middle ear that may be complicated by perforation and a purulent ear discharge, which usually resolves spontaneously within 14 days. Acute otitis media (AOM) needs to be distinguished from otitis media with effusion (OME), which is NOT treated with antibiotics.

DIAGNOSTIC CRITERIA

» Frequently preceded by a viral upper respiratory tract infection.
» Pain (earache; not due to referred pain), irritability and fever.
» Acute purulent otorrhoea may develop with associated relief of otalgia.

OR at least one of the following:

» Distinct fullness or bulging of the tympanic membrane.
» Marked redness of the tympanic membrane.

Signs and Symptoms	Otitis Media with Effusion	Acute Otitis Media
Impaired hearing	Mild-to-moderate	Mild-to-moderate
Pain (otalgia)	No	Moderate-to-severe
Tenderness	No	No
Purulent drainage (otorrhoea)	No	Only after perforation of tympanic membrane
Bacterial infection	No	Yes
Systemic symptoms (i.e. fever, malaise)	No	Yes

GENERAL AND SUPPORTIVE MEASURES

» Avoid getting the inside of the ear wet.

MEDICINE TREATMENT

- Amoxicillin, oral, 45 mg/kg/dose 12 hourly for 10 days.
  - Maximum dose: 1.5 g 12 hourly.

LoE I[2]

Note: For poor response to amoxicillin therapy, or in patients who have received amoxicillin in the last 30 days:

- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose of amoxicillin component, 12 hourly for 10 days (amoxicillin/clavulanic acid in a ratio of 14:1).
  - Maximum dose of amoxicillin component: 1.5 g 12 hourly.

  (See annexure 1: Amoxicillin/Clavulanic weight band dosing table)

LoE III[1], *I*[2, 3]

For pain and fever:

- See Chapter 20: Pain Control, section 20.1.1: Management of pain.

REFERRAL

» If symptoms persist despite appropriate antibiotic therapy, the patient shows severe toxicity or there is progression beyond the middle ear, refer to ENT specialist.

17.8 OTITIS MEDIA, WITH EFFUSION (OME)

H66.0

DESCRIPTION

A sequela of acute middle ear infection, an entrapment in the middle ear cleft of mucus or mucopus. There is an intact tympanic membrane, no otalgia, and no fever. May be associated with mild hearing loss and speech delay. May be associated with clumsiness.

DIAGNOSTIC CRITERIA

» Bubbles or air-fluid interfaces.

OR at least two of following:

» Abnormal colour of tympanic membrane: white, yellow, amber, blue.
» Opacification not due to scarring and retraction.
» Decreased or absent mobility of tympanic membrane.

GENERAL AND SUPPORTIVE MEASURES

» Advise parents and caregivers that most cases resolve spontaneously with no medication required. Review after 12 weeks.

Antibiotics and antihistamines are not indicated.

REFERRAL

» All patients with OME with delayed speech development or poor school performance require referral.
» All cases lasting longer than 3 months should be referred to Audiology for hearing testing and ENT specialist review.

17.9 OTITIS MEDIA, CHRONIC, SUPPURATIVE

H66.1–3

DESCRIPTION

A purulent discharge from the middle ear with perforation of the ear drum for more than two weeks.

Note: TB is a rare cause of a chronic discharge from the ear.

Persistent or chronic otitis media is also associated with HIV infection in children.

GENERAL AND SUPPORTIVE MEASURES

» Dry mopping is the most important part of the treatment. It should be demonstrated to the child's caregiver or patient if old enough.
» Continue with dry mopping for 4 weeks.
» Then dry the canal as much as possible with paper towel twisted into a wick.
» Then frequently instil acetic acid 2% ear drops, 4 drops, 4 times daily for 5 days.
» Avoid getting the inside of the ear wet during swimming and bathing by using earplugs only during these activities.

MEDICINE TREATMENT

- Fluoroquinolone ear drops, e.g.:
  - Ciprofloxacin ear drops, instil 2 drops, 8 hourly into the affected ear after dry mopping.

REFERRAL

Emergency

» All with a suspected intracranial complication.

Elective (referral to ENT specialist)

» Suspected cholesteatoma.
» Persistent tympanic membrane perforation.
» No improvement after 4 weeks.
» Further antimicrobial choices should be based on definitive diagnosis based on culture and sensitivity.

17.10 RHINITIS, ALLERGIC/ALLERGIC RHINOSINUSITIS

J30.4

DESCRIPTION

Recurrent inflammation of the nasal mucosa due to hypersensitivity to inhaled allergens. May present with a running, itchy nose and eyes, and excessive sneezing (“runner”) and/or with nasal obstruction (“blocker”). Look for the salute sign and allergic "shiners". Recurrent symptoms or symptoms lasting longer than 14 days. This diagnosis is unusual in patients under 2 years of age; similar symptoms in this age group are most likely due to the common cold.

GENERAL AND SUPPORTIVE MEASURES

» Avoid allergens and irritants.
» Consider other allergic conditions such as asthma and allergic conjunctivitis, see Primary Healthcare Standard Treatment Guidelines and Essential Medicines List, Chapter 18: Eye Conditions, section 18.1.1: Conjunctivitis, allergic.

MEDICINE TREATMENT

<u>For patients whose symptoms affect their quality of life:</u>

- Corticosteroid aqueous nasal solution, e.g.:
  - Fluticasone, 50 mcg, 1 spray into each nostril daily. (Children > 12 years old, 2 sprays in each nostril daily.)

During periods of exacerbation of symptoms, a short course of non-sedating antihistamine can help, e.g.:

- Cetirizine, oral, as a single dose at night if the predominant symptoms are sneezing, nasal itching and rhinorrhoea:
  - Children 3–12 years: 5 mg.
  - Children older than 12 years: 10 mg.

17.11 RHINOSINUSITIS, ACUTE BACTERIAL (ABRS)

J01

DESCRIPTION

Inflammation or infection of one or more of the sinuses that occurs most often after a viral infection or with allergic rhinitis.

DIAGNOSTIC CRITERIA

Child with an acute upper respiratory tract infection presenting with:

» persistent illness (nasal discharge, facial pain/pressure, or daytime cough lasting more than 10 days without improvement), a worsening course (worsening or new onset of nasal discharge, daytime cough, or pain/fever after initial improvement),
OR

» severe onset (concurrent fever [temperature ≥ 39°C], pain and purulent nasal discharge for at least 3 consecutive days).

GENERAL AND SUPPORTIVE MEASURES

» Steam inhalation to liquefy and remove secretions blocking the nose.

MEDICINE TREATMENT

For infection:

- Amoxicillin, oral, 45 mg/kg/dose 12 hourly for 10 days.
  - Maximum dose: 1.5 g 12 hourly.

Note: For poor response to amoxicillin therapy, or in patients who have received amoxicillin in the last 30 days:

- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose of amoxicillin component, 12 hourly for 5–10 days (amoxicillin/clavulanic acid in a ratio of 14:1).
  - Maximum dose of amoxicillin component: 1.5 g 12 hourly.

  (See annexure 1: Amoxicillin/Clavulanic weight band dosing table)

LoE III[1,4]

For pain and fever:

- See Chapter 20: Pain Control, section 20.1.1: Management of pain.

If allergic rhinitis is suspected, see section 17.10: Rhinitis, allergic/allergic rhinosinusitis.

17.12 SINUSITIS, COMPLICATED

J32.9

DIAGNOSTIC CRITERIA

Clinical

» Signs and symptoms of complications:
  > Peri-orbital swelling and fever.

» Signs of meningeal irritation:
  > Neck stiffness, positive Kernig's and Brudzinski's signs.
» Signs of increased intracranial pressure:
  > Hypertension, bradycardia, papilloedema and headache.
» Signs of involvement of orbital structures:
  > Periorbital oedema, erythema, chemosis, proptosis, vision loss and ophthalmoplegia.
» Signs of brain involvement:
  > Neurological signs, ataxia, paresis, paralysis, convulsions and altered level of consciousness.

Investigations

» CT scan of brain, sinuses and orbits may show opacities and complications.
» CT scan will show if there is involvement of intracranial structures, e.g. brain abscess and intraorbital involvement.
» Pus, CSF and blood for culture and sensitivity tests. Microscopy and Gram-staining of pus and CSF specimens may give some indication of the micro-organism(s) involved.

MEDICINE TREATMENT

Empiric antibiotic therapy

» Initiate empiric antibiotic therapy and reassess as soon as culture and sensitivity results become available or if there is no clinical improvement within 48–72 hours.

- Ceftriaxone, IV, 100 mg/kg once daily.

See Chapter 16: Eye Conditions, section 16.13: Preseptal and orbital cellulitis.

As soon as there is a response and patient can tolerate oral medication:

- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose of amoxicillin component, 12 hourly (amoxicillin/clavulanic acid in a ratio of 14:1).
  - Maximum dose of amoxicillin component: 1.5 g 12 hourly.

  (See annexure 1: Amoxicillin/Clavulanic weight band dosing table)

LoE III[2]

Total duration of therapy: 14 days.

Penicillin allergy:
See Chapter 25: Drug Allergies, section 25.4.1: Allergies to penicillins.

For pain and fever:

- Paracetamol, oral, 15 mg/kg/dose 6 hourly as required.

REFERRAL

Urgent

» Spread of infection to eye/orbital structures or intracranial structures/brain.

References

[1] Brink AJ, Cotton MF, Feldman C, Finlayson H, Friedman RL, Green R, et.al. Recommendations – Updated recommendations for the management of upper respiratory tract infections in South Africa. SAMJ. 2015, 105(5):345-352.
[2] Hoberman A, et al. Shortened Antimicrobial Treatment for Acute Otitis Media in Young Children. NEJM. 2016, 375:2446-2456.
[3] Lieberthal AS, et al. Clinical Practice Guideline: The Diagnosis and Management of Acute Otitis Media. American Academy of Pediatrics. Pediatrics. 2013; 131:e964-e999.
[4] Wald ER, et al. Clinical Practice Guideline for the Diagnosis and Management of Acute Bacterial Sinusitis in Children Aged 1–18 Years. American Academy of Pediatrics. 2013;132:e262-e280.

CHAPTER 18

POISONING

For advice contact:

POISON INFORMATION CENTRES		
Poisons Information Helpline (National service)	24 hours/day, every day for poisons queries	0861 555 777
Red Cross War Memorial Children's Hospital Poisons Information Centre Email: poisonsinformation@uct.ac.za http://www.paediatrics.uct.ac.za/poisons-information-centre	Office Hours	(021) 658 5308
Tygerberg Poison Information Centre Email: toxicology@sun.ac.za www.sun.ac.za/poisoncentre	Office Hours	(021) 938 9596
University of the Free State Poison Control and Medicine Information Centre	24 hours/day	082 491 0160

The Afritox poisons information database is available free of charge to public hospitals in South Africa: see www.afritox.co.za for information on how to access it.

18.1 POISONING

DESCRIPTION

Frequently encountered poisonings in children include:

- analgesics,
- hydrocarbons,
- pesticides,
- plant material,
- household cleaning products.
- vitamins and minerals,
- anticonvulsants,
- antipsychotics,
- sedatives and antidepressants,

Suspect intentional ingestion in older children and adolescents.

DIAGNOSTIC CRITERIA

Clinical

Can be divided into 'toxidromes':

Cholinergic, e.g. organophosphates:

- salivation,
- lacrimation,
- urination,
- pinpoint pupils,
- diarrhoea,
- vomiting,
- bronchorrhoea,
- bradycardia.

Salicylism, e.g. aspirin:

- tachypnoea,
- metabolic acidosis,
- seizures.
- agitation,
- coma,

Anticholinergic, e.g. antihistamines, *Amanita pantherina*, atropine:

- fever,
- ileus,
- flushing,
- tachycardia,
- urinary retention,
- dry/warm skin,
- blurred vision,
- dilated pupils,
- coma,
- hallucinations and seizures.

Sedative-hypnotic, e.g. alcohol, benzodiazepines:

- Obtundation or coma.

Opiates, e.g. morphine:

- Pinpoint pupils,
- respiratory depression,
- bradycardia,
- hypotension.
- decreased bowel sounds,
- hypothermia,
- altered (decreased) mental status,

Dystonic reaction, e.g. haloperidol, antihistamines, anti-emetics:

- torticollis,
- opisthotonus,
- intermittent spasms and tongue thrusting.

Sympathomimetic, e.g. cocaine, amphetamines:

- hypertension,
- tachycardia,
- hyperthermia,
- agitation,
- sweating,
- dilated pupils.

Sympathomimetic toxidrome resembles anticholinergic toxidrome, i.e. fight, flight and fright response, however, the sympathomimetic toxic patient is sweaty as opposed to hot, dry skin seen with anticholinergic toxicity.

Toxic alcohols, e.g. ethylene glycol, methanol:

- » metabolic acidosis,
- » increased osmolar gap,
- » increased anion gap,
- » visual disturbances (methanol),
- » hypoglycaemia,
- » convulsions,
- » renal failure (ethylene glycol),
- » depressed level of consciousness.

TREATMENT

- If the ingestion has definitely occurred: establish whether toxicity is expected and act accordingly.
- If the possibility of ingestion was remote: only observation is necessary.

Principles of treatment

- » Stabilise the patient if necessary.
- » Decontaminate the patient if indicated (see below) and contra-indications are not present.
- » Give antidote if available. There are a limited number of antidotes for poisoning by certain substances, e.g. N-acetylcysteine for paracetamol, naloxone for opioids. Each antidote has specific criteria and indications for use.
- » Enhance elimination if possible.
- » Monitor hydration status carefully.

Decontamination:

1. Gastric lavage

Gastric lavage is seldom indicated and may cause more harm than benefit. If indicated, it should only be performed by experienced staff and within 60 minutes of ingestion.

Indicated only if patient:

- has ingested a potentially life-threatening poison,
- has a protected airway, i.e. fully awake and cooperative or intubated with a depressed level of consciousness.

Gastric lavage is contraindicated after ingestion of corrosive substances and volatile hydrocarbons such as paraffin.

Technique:

- Place patient in left lateral head down position.
- Insert orogastric tube if possible, with largest bore and rounded tip.
- Insert 200 mL warmed water or normal saline, and aspirate.

Continue until recovered solution is clear of particulate matter.

2. Activated charcoal

May reduce systemic absorption of a variety of poisonous substances. The greatest benefit is achieved if activated charcoal is given within one hour after ingestion; however, where gastric emptying is delayed by certain substances, there may be a longer period of time in which it is effective.

Activated charcoal must only be given in cases where the airway is protected, i.e. fully awake and cooperative patient or intubated with a depressed level of consciousness.

Repeated doses of activated charcoal every 4 hours are effective in enhancing elimination of substances that undergo enterohepatic circulation, e.g. carbamazepine, dapsone, phenobarbital, quinine or theophylline overdose.

- Activated charcoal, oral, given as a slurry:
  - If < 6 years of age: 1 g/kg in 50–100 mL water.
  - If > 6 years of age: 20–50 g in 100–300 mL water.

LoE III[1]

Note: In the intubated patient with a protected airway, the activated charcoal can be administered via a nasogastric tube (the slurry is thick and requires administration to be pushed through a syringe).

Contra-indications:
» If patient is unconscious and the airway is not protected.

Poisons where charcoal is **ineffective** and should not be given	Charcoal may be useful if these poisons are taken in toxic doses
» ethanol » methanol » brake fluid » petrol or paraffin » iron salts » lithium » bleach and caustic alkalis » boric acid	» carbamazepine, barbiturates, phenytoin » dapsone, quinine » theophylline » salicylates » mushroom poisoning (*Amanita phalloides*) » slow-release preparations » digoxin » beta-blockers » NSAIDs

3. Whole bowel irrigation

Whole bowel irrigation can be done for potentially toxic ingestions of substances that are:
» not absorbed by activated charcoal (e.g. iron and lithium),
» sustained-release and enteric-coated products, or
» for removal of illicit drugs in body packers.
Patients must have a protected airway, i.e. fully awake and cooperative or intubated with a depressed level of consciousness.

- Polyethylene glycol (PEG) balanced electrolyte solution, NGT:
  - Child (9 months to 6 years): 500 ml per hour
  - Child (6 to 12 years): 1000 ml per hour
  - Continue until rectal effluent is clear.

LoE III[2]

REFERRAL

» Severely ill patient for ventilatory/circulatory support.
» If relevant diagnostic testing is not available, e.g. paracetamol levels.
» If relevant medication/antidotes are not available.
» If dialysis/haemoperfusion is required.
» For psychiatric evaluation where deliberate self-harm is suspected.

SECONDARY PREVENTION

All cases of accidental poisoning require an assessment of home circumstances. The opportunity must be taken to educate childcare providers on safe storage practices, particularly of medications and household products.

18.1.1 ANTICHOLINERGIC POISONING

T44.3

DESCRIPTION

Various plant species and pharmaceutical preparations can cause anti-cholinergic toxicity.

Plants: *Datura stramonium*, e.g. 'stinkblaar' and 'malpitte'.

Medicines: atropine, diphenoxylate with atropine and diphenhydramine. Other classes of medicines include antiparkinsonism agents, antispasmodics, antipsychotics, antihistamines and tricyclic antidepressants.

DIAGNOSTIC CRITERIA

Clinical

» Alteration of mental status, including delirium, hallucinations, agitation and seizures.
» Peripheral anticholinergic effects include:
  > dilated pupils,
  > tachycardia and arrhythmias,
  > flushing,
  > urinary retention,
  > decreased GIT motility,
  > dry skin and mucous membranes.

Investigations

» ECG and continuous cardiac monitoring.
» Pulse oximetry.

GENERAL AND SUPPORTIVE MEASURES

» Stabilise patient, i.e. airway, breathing and circulation.
» Cooling for hyperthermia.
» Perform decontamination depending on route of exposure.

MEDICINE TREATMENT

- Activated charcoal, see section 18.1: Poisoning.

For agitation:

- Diazepam, IV/oral, 0.1–0.2 mg/kg.
  - Maximum dose: 10 mg.

For seizures:
See Chapter 13: The Nervous System, section 13.3: Status epilepticus (convulsive).

REFERRAL

» Cardiac dysrhythmia.
» No response to treatment.

18.1.2 ANTICOAGULANT POISONING

T45.5
*Notifiable condition (if poisoning due to agricultural or stock remedy, e.g. rodenticide).

DESCRIPTION

Poisoning due to warfarin and 'super-warfarins' (long-acting warfarin) (products such as pellets, granules, wedges, blocks and powder marketed as rodent pesticides). These may be accidentally ingested by toddlers or young children.

Note: Where the history is of an unspecified rat poison or pesticide ingestion, consider other active ingredients such as amitraz and organophosphates.

DIAGNOSTIC CRITERIA

Clinical

» Signs and symptoms depend on the potency, and onset of coagulopathy may be delayed by 48–72 hours. May be asymptomatic if a small quantity has been ingested.
» Bruising or bleeding.

Investigations

» Measure prothrombin time.
  > Obtain baseline INR if symptoms/signs present.
  > A baseline or repeat INR should be done in all cases of significant ingestion at 36–72 hours post-ingestion.

GENERAL AND SUPPORTIVE MEASURES

» Observe an asymptomatic child: may be as outpatient depending on history (amount ingested) and ability to return if symptoms develop.

MEDICINE TREATMENT

ONLY if INR deranged (> 2.5 IU):
Vitamin K1, IV/oral, 1–5 mg/dose administered slowly.

Note: Intravenous solution can be used orally.

Oral vitamin K1 is usually preferred to intravenous vitamin K1 unless more rapid reversal is required (e.g. the patient is bleeding). Intravenous vitamin K1 may cause hypersensitivity reactions.

If significant bleeding present:
ADD

- Lyophilised plasma, IV, 20 mL/kg.

OR

- Fresh frozen plasma, IV, 20 mL/kg.

Repeat vitamin K_1 dosing and length of therapy is dependent on INR response to treatment and clinical response—contact poison center for patient specific advice.

Ingestion of 'super-warfarins' may be refractory to large doses of vitamin K_1 and therapy may be required for several weeks after ingestion.

18.1.3 TRICYCLIC ANTIDEPRESSANT POISONING

T43.0

DESCRIPTION

Poisoning with tricyclic antidepressants (TCAs) represent a large portion of poisoning fatalities. There is a high risk of tricyclic antidepressant toxicity in children because of its narrow therapeutic index. Serious toxicity may occur with low doses in children. Patients can deteriorate rapidly.

DIAGNOSTIC CRITERIA

» Can cause anticholinergic syndromes.
» Mainly affects the cardiovascular and nervous systems leading to:
> QRS widening,
> ventricular dysrhythmias,
> hypotension,
> altered mental status,
> seizures.

GENERAL AND SUPPORTIVE MEASURES

» Gastric lavage for large ingestions or patients presenting within a few hours post ingestion, unless the patient is unconscious and the airway is

not protected.
» Circulatory and respiratory support as needed.
» Cardiac and ECG monitoring for 48 hours.

MEDICINE TREATMENT

- Activated charcoal: see section 18.1: Poisoning.
  - TCAs delay gastric emptying, therefore, activated charcoal may be effective for a longer period than usual.

For hypotension:
- Sodium chloride 0.9% or Ringer's Lactate, IV bolus, 20 mL/kg.

Serum alkalinisation for all patients with:
» ventricular dysrhythmias,
» prolonged QRS > 100 ms,
» hypotension unresponsive to fluids, or
» seizures.

- Sodium bicarbonate, bolus doses (1–2 mEq/kg as an 8.4% solution), to achieve a pH of 7.45–7.55. (Specialist consultation with Poisons Information Centre if possible.)
- Monitor acid-base status, serum potassium and sodium.

LoE III[3]

In severe cases, inotropic support and anti-arrhythmic agents may be required in addition to serum alkalinisation. Hypotension is due to myocardial dysfunction and alpha-adrenergic vasodilation, therefore be careful to avoid fluid overload.

For seizures:
» See Chapter 13: The Nervous System, section 13.1: Seizures.
Note: Phenytoin should be avoided (due to potential cardiotoxicity).

LoE III[4,5]

For circulatory and respiratory support:
See Chapter 1: Emergencies and Trauma, section 1.1.4: Cardiorespiratory arrest.

REFERRAL

» Any cardiac arrhythmia.

18.1.4 INGESTION OF CAUSTIC OR CORROSIVE AGENTS

T54

DESCRIPTION

Alkalis, e.g. sodium hydroxide, potassium permanganate.
Acids, e.g. hydrochloric acid.
The severity of the injury is dependent on the concentration and duration of exposure to the acid or alkali.

DIAGNOSTIC CRITERIA

Clinical

» Chief symptom is pain.
» Young children may present with:
  > crying, > refusal to swallow,
  > drooling, > vomiting.
» Stridor or hoarseness indicates laryngeal injury.
» The presence of oral or pharyngeal burns does not predict the presence of oesophageal or gastric injury.
» Oesophageal or gastric injury can cause perforation or subsequent fistula formation.
» Asymptomatic patients are unlikely to have significant oesophageal or gastric injury.

GENERAL AND SUPPORTIVE MEASURES

Asymptomatic

» Monitor for development of symptoms:
  > A 12-hour symptom-free period usually indicates that no intervention is necessary.

Symptomatic

» Gastric lavage/emesis/activated charcoal are contraindicated in all cases.
» Keep patient nil per mouth.
» Insertion of a NGT is contraindicated.
» Airway injury may necessitate endotracheal intubation.
» Endoscopic evaluation.

MEDICINE TREATMENT

» Prophylactic antibiotics are not indicated.
» Empiric steroid therapy is not indicated, however, based on endoscopy findings, may be appropriate (sub-specialist initiated).

For pain control:
See Chapter 20: Pain Control, section 20.1.1: Management of pain.

REFERRAL

» All symptomatic cases for endoscopic evaluation as soon as possible.

18.1.5 VOLATILE SOLVENTS

T53

DESCRIPTION

Inhalants include: spray-paint, glue and paint thinners that may contain hydrocarbons such as toluene and/or n-Hexane. If these are ingested, hydrocarbon poisoning with possible chemical pneumonitis must also be considered.

DIAGNOSTIC CRITERIA

» distinctive odour,
» discolouration around mouth/nose,
» palpitations,
» dizziness,
» cardiac arrhythmias,
» euphoria,
» headaches,
» progressive CNS depression,
» syncope,
» hypokalaemia,
» mucous membrane irritation, i.e. sneezing, coughing and tearing,
» GIT complaints, i.e. nausea, vomiting and abdominal pain,
» distal renal tubular acidosis, i.e. hyperchloraemic metabolic acidosis with a normal anion gap.
» Complications include peripheral neuropathy and hepatotoxicity.

GENERAL AND SUPPORTIVE MEASURES

» Stabilise airway, breathing and circulation.
» Perform a chest X-ray if respiratory symptoms present.
» Monitor patient for respiratory symptoms: if absent after 6–8 hours, child can be discharged.
» Correct fluid and electrolyte abnormalities.

MEDICINE TREATMENT

For agitation:

- Diazepam, IV/oral, 0.1–0.2 mg/kg.
  - Maximum dose: 10 mg.

For cardiac dysrhythmias, e.g. ventricular fibrillation, see Chapter 4: Cardiovascular System, section 4.1: Cardiac dysrhythmias.

REFERRAL

» Cardiac dysrhythmia.

18.1.6 ETHANOL POISONING

T51.0

DESCRIPTION

Ethanol is a selective CNS depressant at low concentrations, and a generalised depressant at high concentrations.

DIAGNOSTIC CRITERIA

Clinical

- » lack of co-ordination,
- » ataxia,
- » slurred speech,
- » gait disturbances,
- » drowsiness.
- » stupor,
- » coma,
- » hypoglycaemia,
- » convulsions,

Investigations

- » Monitor blood glucose levels.

MEDICINE TREATMENT

Obtunded patients with hypoglycaemia:

- Dextrose 10%, IV, 2 mL/kg followed by 10% dextrose maintenance infusion. Titrate until blood glucose is controlled.

If patient responds to glucose administration, perform serial glucose levels to detect recurrent hypoglycaemia.

REFERRAL

- » Persistent hypoglycaemia despite treatment.
- » Depressed level of consciousness despite treatment.

18.1.7 IRON POISONING

T45.4

DESCRIPTION

Iron is widely available as an over-the-counter product and is commonly ingested accidentally by toddlers.

DIAGNOSTIC CRITERIA

- » Toxicity is related to the ingested dose of elemental iron.
- » A single dose of elemental iron > 20 mg/kg requires hospital assessment and management.

Clinical

- » gastrointestinal features,
- » shock and metabolic acidosis,
- » coma,
- » hepatic necrosis.

Elemental iron per preparation

Iron product	Strength	Elemental content	Elemental content per mL or tablet
Ferrous gluconate syrup	350 mg/5 mL	40 mg elemental iron per 5 mL	8 mg elemental iron per mL
Ferrous lactate drops	125 mg/mL	25 mg elemental iron per mL	25 mg elemental iron per mL
Ferrous sulphate compound tablets	170 mg	55 mg elemental iron per tablet	± 55 mg elemental iron per tablet

Categories of iron toxicity

Low risk	Medium risk	High risk
» No history of: • abdominal pain, • nausea, • vomiting, or diarrhoea. » Asymptomatic for 6 hours. • 20 mg/kg of elemental iron ingested.	» Clinical features of toxicity and serum iron > 300 mcg/dL (60 µmol/L).	Any of these features present: » Lethargy/decreased level of consciousness. » Metabolic acidosis. » Shock/hypotension. » Evidence of haematemesis or melaena. » Serum iron > 500 mcg/dL (90 µmol/L) irrespective of clinical features.

» Low risk patients are unlikely to have ingested enough iron to lead to serious poisoning and can be discharged.
» Admit high and medium risk patients.

Investigations

Medium and high risk:

» Abdominal X-ray; if history is uncertain or to assess the efficacy of gut decontamination.
» Arterial blood gas.
» Serum electrolytes.
» Liver function tests.
» Serum iron levels within 2–6 hours after ingestion.

GENERAL AND SUPPORTIVE MEASURES

General supportive treatment, including airway management if required.

MEDICINE TREATMENT

Medium and high risk

Fluid resuscitation:

- Sodium chloride 0.9%, IV, 20 mL/kg as an initial bolus followed by maintenance therapy.

If no signs of gastrointestinal dysfunction, e.g. perforation/haemorrhage:

» Whole bowel irrigation is recommended if:
  > > 60 mg/kg elemental iron has been ingested.
  > Modified-release preparations are ingested.
  > Undissolved tablets are still visible on abdominal X-ray.

LoE III[2]

Chelation therapy

All medium and high-risk cases (see table above).

For iron ingestion > 60 mg/kg of elemental iron:

- Desferrioxamine, IV, 15 mg/kg/hour as a continuous infusion until acidosis resolves and urine is no longer pink.
  - Beware of hypotension.

REFERRAL

» All medium and high-risk cases should be managed in a high care unit or ICU with access to serial serum iron measurement. Chelation therapy should preferably be initiated prior to urgent referral/transfer.

18.1.8 NEUROLEPTIC POISONING

T43.5

DESCRIPTION

Neuroleptic overdose may cause a depressed level of consciousness, hypotension, tachycardia and cardiac dysrhythmias and seizures.

Commonly used neuroleptics include chlorpromazine, haloperidol and phenothiazine anti-emetics (e.g. promethazine).

Acute dystonic reactions/extrapyramidal symptoms are distressing adverse reactions (sustained muscle spasms) occurring after an overdose or during chronic therapy with neuroleptics. A typical dystonic reaction includes hyperextension or hyperflexion of the limbs with abnormal posturing of the trunk. Other extrapyramidal symptoms may occur.

The neuroleptic malignant syndrome is uncommon following an overdose and is an idiosyncratic life threatening reaction, presenting with:

» temperature dysregulation,
» altered mental state,
» musculoskeletal effects (pipe-like rigidity).
» autonomic instability,
» diaphoresis,

DIAGNOSTIC CRITERIA

» Dystonic reactions.
» Other extrapyramidal symptoms.

GENERAL AND SUPPORTIVE MEASURES

» Observe asymptomatic patients for a minimum of 6 hours.
» Admit all symptomatic patients for continuous cardiac monitoring.

» Patients with hyperthermia, muscular rigidity or seizures are more at risk for rhabdomyolysis and subsequent renal failure; test urine for myoglobin (urine test strip for haemoglobin) and serum for creatine kinase and creatinine.

MEDICINE TREATMENT

- Activated charcoal, see section 18.1: Poisoning.

For acute dystonic reactions:

- Biperidin, IV, slow injection.
  - If < 1 year of age: 1 mg.
  - If 1–6 years of age: 2 mg.
  - If 6–10 years of age: 3 mg.

If concomitant significant anticholinergic findings are present, such as fever and dry skin and mucous membranes, a benzodiazepine is preferred.

REFERRAL

» Patients with neuroleptic malignant syndrome.
» Patients with conduction abnormalities (prolonged QT).
» Patients with acute kidney injury.

18.1.9 ORGANOPHOSPHATE POISONING

T60.0
*Notifiable condition

DESCRIPTION

Organophosphates are potent inhibitors of acetylcholinesterase.

Note: Where the history is of an unspecified rat poison or pesticide ingestion, consider other active ingredients such as amitraz and 'super-warfarin' anticoagulants.

DIAGNOSTIC CRITERIA

Clinical

» Acute cholinergic toxidrome has central and peripheral effects.

Peripheral effects:

> Muscarinic: diarrhea, vomiting, urinary incontinence, lacrimation, pinpoint pupils, bronchorrhoea, bronchoconstriction, hyper-salivation, sweating, bradycardia, hypotension.

> Nicotinic: tachycardia, hypertension, dilated pupils, muscle weakness and fasciculations.

Cardiac features of bradycardia and tachycardia depend on whether muscarinic or nicotinic effects predominate.

Central effects:
> Nicotinic: confusion, coma, convulsions.

» Intermediate syndrome can occur within 1–4 days after recovery from cholinergic crisis. Patients develop weakness or paralysis predominantly affecting the muscles of respiration (including the neck flexors and bulbar muscles) and proximal limb muscles, sparing the distal muscles. Cranial nerves may also be affected. Supportive care is the mainstay of therapy.

LoE III[6]

» Signs depend on dose and route of exposure (vapour or liquid) as well as the time exposed (vapour).

Investigations

» Decreased levels of pseudocholinesterase.
  > Use for confirmation only.
  > Do not wait for levels before treating.

GENERAL AND SUPPORTIVE MEASURES

» Ensure use of personal protective equipment.
» Remove all patient's clothing and wash clothes thoroughly.
» Wash affected skin with soap and water.
» Suction secretions frequently.
» Monitor respiratory function closely and ventilate if necessary. If using suxamethonium or mivacurium for intubation, consider that metabolism may be delayed and prolonged respiratory support may be required. Use alternative agents if possible.

LoE III[7]

» Also monitor heart rate, pupillary size and level of consciousness.

MEDICINE TREATMENT

For bradycardia, bronchorrhoea or bronchospasm:

- Atropine bolus, IV, 0.05 mg/kg.
  - Reassess after 3–5 minutes for evidence of atropinisation as indicated by reduced bronchial secretions, dry skin, increasing heart rate and blood pressure, and dilating pupils (note: pupil dilatation may be delayed).
- Give repeated atropine boluses, incrementally doubling the dose until adequate clinical response achieved, e.g.:
  - 10 kg child: 0.5 mg, 1 mg, 2 mg, 4 mg, 8 mg, (no maximum dose).
  - If no clinical response, give double the dose.
  - If some response, give the same or reduced dose.

» Follow with infusion. Calculate the total dose of atropine given as boluses (as described above). Give 10–20% of this dose per hour.

» Reassess frequently and adjust atropine infusion as follows:
  > Bronchial secretions, bronchospasm or bradycardia recur—increase dose.
  > Good control of bronchial secretions and signs of atropine overdose (tachycardia, dilated pupils, agitation, pyrexia, reduced bowel sounds and urinary retention): decrease dose.
  > No recurrence of bronchial secretions and no signs of atropine overdose: reduce dose slowly.

Note: Do not stop atropine infusion abruptly, but wean over at least 24 hours. Tachycardia and dilated pupils are not contraindications for giving atropine in the acute resuscitation setting.

Glycopyrrolate is not a substitute for atropine. However, it does not penetrate the CNS and therefore, may be useful in patients who are suffering from central cholinergic toxicity as a result of atropine but still require control of peripheral muscarinic symptoms.

- Glycopyrrolate, 0.025 mg/kg, IV.

LoE III [6]

Patients with organophosphate poisoning may be extremely agitated or develop seizures due to central toxicity. Treat both with a benzodiazepine. See Chapter 13: The Nervous System, section 13.3: Status epilepticus (convulsive).

REFERRAL

» All severe cases for ICU care.

18.1.10 OPIOID POISONING

T40.2

DESCRIPTION

Codeine is a common drug of abuse.

The duration of action of morphine is 3–6 hours. Other oral agents, e.g. codeine and long acting morphine, demonstrate a delayed effect of up to 4–12 hours.

DIAGNOSTIC CRITERIA

» Altered level of consciousness.
» Classic triad of CNS depression, respiratory depression and pinpoint pupils.
» Hypotension, hypothermia, bradycardia and hyporeflexia.
» Vomiting is common with the risk of aspiration, especially in patients with depressed level of consciousness.

Note: Symptoms may take time to develop. May be awake and alert in the early phase 1–2 hours after ingestion. Neonates of mothers using heroin may present with withdrawal, manifested as jitteriness.

GENERAL AND SUPPORTIVE MEASURES

» Airway protection is a priority.
» Supportive care, ventilate with bag-mask device.
» Monitor oxygen saturation constantly.
» Observe for urinary retention.

MEDICINE TREATMENT

- Activated charcoal.

If respiratory depression or depressed level of consciousness:

» Provide airway support.
» Ventilate until $PaCO_2$ normal.

- Naloxone, IV, 0.1 mg/kg:
  - If no response after 5 minutes, repeat dose and titrate according to response.
  - Duration of action of naloxone is 20–30 minutes.
  - If repeated doses of naloxone are necessary, a continuous IV infusion of naloxone can be instituted (0.01 mg/kg/hour).

CAUTION

All patients treated with naloxone should be observed for at least 12 hours for relapse, especially if a long acting opioid has been ingested.

REFERRAL

» Patients requiring multiple doses of naloxone.

18.1.11 PARACETAMOL POISONING

T39.1

DESCRIPTION

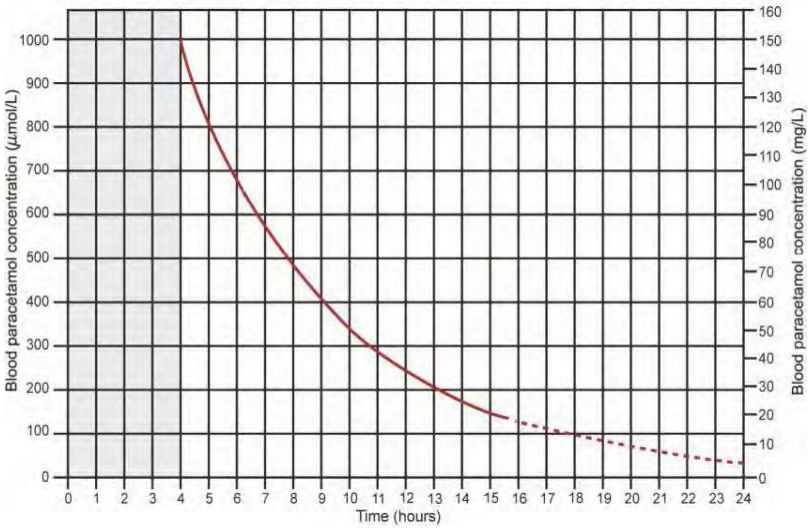
Poisoning due to paracetamol by adolescents is generally due to intentional ingestion. The accidental ingestion of paracetamol elixir preparations by toddlers very rarely causes toxicity. Toxicity can be due to acute ingestions or repeated supratherapeutic ingestion (RSTI). Toxicity due to IV paracetamol may also occur.

Patients with predisposing risk factors for hepatotoxicity, so-called ‘high-risk’ patients (glutathione deficiency, liver disease, use of enzyme- inducing drugs, patients with recent illness or dehydration) may experience toxicity at lower doses.

DIAGNOSTIC CRITERIA

» An acute ingestion in excess of 200 mg/kg per 24-hour period in healthy children is potentially toxic.
» Serum paracetamol concentration must be measured at least four hours following ingestion.
» Use nomogram to assess risk of toxicity.

Paracetamol treatment nomogram



Source: Daly FF, Fountain JS, Murray L, Graudins A, Buckley NA; Panel of Australian and New Zealand clinical toxicologists. Guidelines for the management of paracetamol poisoning in Australia and New Zealand—explanation and elaboration. A consensus statement from clinical toxicologists consulting to the Australasian poisons information centres. Med J Aust. 2008 Mar 3;188(5):296-301.

» Cautions for use of this chart:
  > The time co-ordinates refer to time since ingestion.
  > Serum levels drawn before 4 hours may not represent peak levels.
  > Use the graph only in relation to a single acute ingestion.
  > Do not use when there is a history of RSTI, or delayed presentation (> 24 hours post-ingestion).

Repeated supratherapeutic ingestions (RSTI)

Can occur with repeated high doses of the same product or the concurrent use of multiple paracetamol-containing products.

RSTI is defined as:

  > > 200 mg/kg or 10 g (whichever is less) over a single 24-hour period.
  > > 150 mg/kg or 6 g (whichever is less) per 24-hour period for the preceding 48 hours.
  > > 100 mg/kg or 4 g/day (whichever is less) per 24-hour period for

more than 48 hours AND patients with symptoms suggestive of liver injury.

This nomogram is not designed for use in RSTI. Management of RSTI is complex; contact the Poisons Information Helpline for advice.

LoE III[8]

Investigations

If toxic dose ingested or patient symptomatic, do:

» Serum paracetamol level.
» Baseline electrolytes.
» ALT.
» INR, if abnormal ALT or showing signs of hepatotoxicity.

MEDICINE TREATMENT

Acute ingestion:

» Gastric lavage is unlikely to be required.
» Activated charcoal can be considered for large intentional overdoses.
» For acute ingestion, initiate treatment with N-acetyl cysteine (NAC) if the blood paracetamol concentration for the time since ingestion falls to the right of the curved line on the nomogram.
» If a patient has taken a potentially toxic dose [≥ 10 g (20 tablets) or ≥ 200 mg/kg, whichever is smaller] AND the serum paracetamol level results will not be available before 8 hours post-ingestion OR the patient presents > 8 hours post-ingestion, do not delay initiation of NAC. It can always be stopped if the serum level plotted on the nomogram does not indicate its continued use.
» If the time of ingestion is unknown, start treatment for any detectable level of paracetamol or any elevation of AST or ALT.

RSTI:

Management of RSTI is complex; contact the Poisons Information Helpline for advice.

- N-Acetylcysteine, IV:
  20-hour regimen:
  - 200 mg/kg in 7 mL/kg of 5% dextrose over 4 hours.
  - Followed by 100 mg/kg in 14 mL/kg 5% dextrose over 16 hours.

  Repeat infusions according to second dose.

REFERRAL

Patients with severe hepatotoxicity as indicated by any of the following:

» INR > 2 IU at 24 hours or > 3 IU at any time after overdose,
» pH < 7.3, bicarbonate < 18 mmol/L or lactate > 3 mmol/L,
» hypotension despite adequate fluid resuscitation,
» encephalopathy,
» creatinine > 200 µmol/L.

18.1.12 PETROCHEMICAL POISONING

T53.6

DESCRIPTION

Accidental ingestion of paraffin, particularly by toddlers, is common in South Africa.

DIAGNOSTIC CRITERIA

Clinical

» Paraffin is volatile and inhalation of the fumes or aspiration of liquid can cause respiratory distress due to chemical pneumonitis.
» CNS symptoms: depressed level of consciousness.

Investigations

» Chest X-ray if respiratory distress present.

GENERAL AND SUPPORTIVE MEASURES

CAUTION

Do not attempt gastric lavage.

» Observe patient for up to 6–8 hours if asymptomatic.
» Administer oxygen, if necessary.
» Remove contaminated clothes and wash skin to prevent chemical burns.

MEDICINE TREATMENT

If infection develops 48 hours after ingestion:

» See Chapter 15: Respiratory, section 15.1.1: Pneumonia.

REFERRAL

» For ventilatory support.

18.1.13 SALICYLATE POISONING

T39.0

DESCRIPTION

Salicylate poisoning may result from oral and/or topical exposure. Salicylate products vary widely in concentration, e.g. oil of wintergreen is almost 100% methylsalicylate. As little as 4 mL of oil of wintergreen may be fatal in a child.

DIAGNOSTIC CRITERIA

Clinical

» Ingestion of less than 150 mg/kg of aspirin will not cause toxicity except in a child with hepatic or renal disease.
» Ingestion of 150–300 mg/kg of aspirin may result in mild to moderate toxicity.

» Ingestion of > 300 mg/kg of aspirin may result in severe toxicity.
» Ingestion of > 500 mg/kg of aspirin should be considered a potentially lethal dose.
» Features include:
  » fever,
  » nausea,
  » epigastric pain,
  » vomiting,
  » tinnitus,
  » hyperventilation,
  » renal failure,
  » hypoglycaemia,
  » CNS depression,
  » respiratory alkalosis (initially) followed by metabolic acidosis.

» Monitor blood gases and electrolytes, urine output and urine pH.
» Monitor salicylate levels if possible (do not always correlate with clinical severity):
  > Asymptomatic: peak plasma salicylate level of < 20 mg/dL (< 30 mg/dL in adolescents).
  > Mild toxicity: Peak plasma salicylate level 20 to <45 mg/dL in child (30 to <60 mg/dL in adolescents).
  > Moderate toxicity: Peak plasma salicylate 45 to 70 mg/dL in child (60 to 80 mg/dL in adolescents).
  > Severe toxicity: Peak plasma salicylate level > 70 mg/dL in child (> 80 mg/dL in adolescents).
» Serial monitoring until declining levels are documented.
» Monitor and treat hypoglycaemia; patients with normoglycaemia may still be neuroglycopaenic.

GENERAL AND SUPPORTIVE MEASURES

» Consider gastric lavage, see section 18.1: Poisoning.
» Correct hydration.

MEDICINE TREATMENT

After gastric lavage:

- Activated charcoal.
  - May be used for up to 12 hours due to delayed gastric emptying or if sustained-release/enteric-coated preparations were ingested.

Urinary alkalinisation

If metabolic acidosis (pH < 7.3) is present and/or salicylate levels are high, give:

- Sodium bicarbonate 8.4%, IV, 1 mL/kg bolus dose to increase pH to 7.4, administered over 1 hour (with maintenance fluid).
  - Repeat bolus doses, if necessary, to maintain urine pH above 7.5.
  - Monitor urine pH hourly and potassium levels 3 hourly.

For hydration:

- 5% dextrose saline, IV.

For bleeding:

- Vitamin K_1, IV/oral, 1–5 mg/dose administered slowly 6 hourly.

Note: Intravenous solution can be used orally.

REFERRAL

» Severe cases for ICU care: if arterial pH remains < 7.2, refer for urinary alkalinisation and possible haemodialysis.

18.1.14 BENZODIAZEPINE POISONING

T42.4

DESCRIPTION

Young children or toddlers are typically involved in accidental exposure and ingest small amounts of sedatives.

Adolescents may ingest large amounts during suicide, suicidal gesture or for recreational use.

DIAGNOSTIC CRITERIA

Clinical

» Cardiorespiratory depression.
» Decreased level of consciousness.

Investigations

» Serum drug levels are of no value in the acute treatment phase.
» Urine test: may have medico-legal implications.

GENERAL AND SUPPORTIVE MEASURES

» If there is respiratory depression, intubate, ventilate and transfer.
» Only supportive treatment is necessary in most patients.

REFERRAL

» Respiratory depression.

18.1.15 SULFONYLUREA POISONING

T38.3

DESCRIPTION

Sulfonylureas may cause severe and protracted hypoglycaemia. The half-life of the sulfonylureas varies:

» Glibenclamide	T½ = 10 hours
» Gliclazide	T½ = 10–12 hours
» Glimepiride	T½ = 5–8 hours

DIAGNOSTIC CRITERIA

Clinical

» Coma and seizures.
» Profound hypoglycaemia, usually within 4 hours of ingestion.

Investigations

» Glucose monitoring is the mainstay of diagnostic testing.

GENERAL AND SUPPORTIVE MEASURES

» Observe for at least 24 hours, even if a single tablet is ingested.
» Glucose-containing fluid orally.

MEDICINE TREATMENT

- Activated charcoal; see section 18.1: Poisoning.

If symptoms of hypoglycaemia are present or blood glucose is below 2.6 mmol/L:

- Dextrose 10% (2 mL/kg), IV bolus followed by 10% dextrose maintenance infusion. Titrate until blood glucose is controlled.

If desired response not achieved,

ADD

- Octreotide 1–1.5 mcg/kg IV or SC.

Note: Corticosteroids are not indicated.

REFERRAL

» Patients not responding to intravenous glucose.

18.1.16 SYMPATHOMIMETIC AGENT POISONING

T43.6/F14

DESCRIPTION

Pseudoephedrine in decongestants, methylphenidate and illicit drugs such as cocaine and amphetamines ('Tik') are sympathomimetic agents. These agents are frequently abused as recreational drugs.

DIAGNOSTIC CRITERIA

Clinical

» hypertension,
» tachycardia,
» tachypnoea,
» agitation,
» psychosis,
» dilated pupils,
» diaphoresis,
» hyperthermia: effects of sympathomimetics that predispose to hyperthermia include:

- peripheral vasoconstriction and impaired cutaneous heat loss,
- agitation,
- seizures,
- increased muscle activity,
- impaired behavioural response.

» With cocaine toxicity, cardiovascular manifestations predominate, including:
- supraventricular and ventricular dysrhythmias,
- myocardial ischaemia.

» Neonates of mothers using cocaine may present with withdrawal signs, manifested by jitteriness.

Investigations

» ECG monitoring to evaluate dysrhythmias.

GENERAL AND SUPPORTIVE MEASURES

» Admit all seriously ill children to ICU.
» Maintain hydration.
» Cooling for hyperthermia.
» Mildly toxic patients require no specific treatment.

MEDICINE TREATMENT

- Activated charcoal, see section 18.1: Poisoning.

For agitation and tachycardia:

- Diazepam, IV/oral, 0.1–0.2 mg/kg.
  - Maximum dose of 10 mg.

For severe hypertension:

See Chapter 4: Cardiovascular System, section 4.11.1: Hypertension, acute severe.

For seizures:

See Chapter 13: The Nervous System, section 13.3: Status epilepticus (convulsive).

REFERRAL

» Status epilepticus requiring ICU.
» Hypertensive crisis.

18.1.17 ISONIAZID POISONING

T37.1

DESCRIPTION

INH interferes with pyridoxine and niacin metabolism, leading to impaired synthesis of gamma aminobutyric acid (GABA). Acute poisoning, which may follow intentional or accidental ingestions, may be severe.

DIAGNOSTIC CRITERIA

Clinical

Triad of refractory seizures, metabolic acidosis and coma within 2–3 hours of ingestion. Hyperthermia and rhabdomyolysis can develop after prolonged seizure activity.

Investigations

» Metabolic acidosis - high anion gap due to lactate accumulation.

GENERAL AND SUPPORTIVE MEASURES

» Respiratory and circulatory support.

MEDICINE TREATMENT

- Activated charcoal, see section 18.1: Poisoning.

For seizures:

- Pyridoxine is the primary treatment of seizures and coma, which once controlled, should help resolve metabolic acidosis.
- Asymptomatic patients presenting within 2 hours, give an initial prophylactic dose of 70 mg/kg of oral pyridoxine up to a maximum dose of 5 g.
- Symptomatic patients with significant symptoms or seizures: replace INH with pyridoxine gram-for-gram, up to a maximum of 5 g.
- Oral pyridoxine 25 mg tablets can be crushed and given with fluids via nasogastric tube.
- If seizures recur, repeated doses of pyridoxine may be given up to a maximum daily dose of 15-30 g.

Note: Benzodiazepines and phenobarbitone may be used to control seizures (whilst pyridoxine is being prepared/given). Phenytoin should be avoided (due to potential cardiotoxicity).

LoE III[4]

Metabolic acidosis should improve with seizure control, but additional sodium bicarbonate may be required.

REFERRAL
» Refractory seizures.

18.1.18 THEOPHYLLINE POISONING
T48.6

DESCRIPTION
Agents such as aminophylline and caffeine have similar features in overdose. Sustained release preparations can cause prolonged toxicity. Toxicity can occur with therapeutic dosing.

DIAGNOSTIC CRITERIA
Clinical
» Mainly affects the gastrointestinal, cardiovascular and central nervous systems:
  > Central nervous system: agitation, tremor, seizures, coma, hyperventilation.
  > Gastrointestinal tract: nausea and vomiting.
  > Cardiovascular: tachycardia, arrhythmias, hypotension.

Investigations
» Serum levels; a theophylline level 111 µmol/L (> 20 mg/L) is considered toxic.
» Hyperglycaemia.
» Hypokalaemia.
» Respiratory alkalosis and/or metabolic acidosis.

GENERAL AND SUPPORTIVE MEASURES
» Observe all patients who have ingested 10 mg/kg or more of theophylline for at least 4 hours for a normal release preparation and at least 12 hours for a sustained release preparation.
» Manage hypotension.
» Cardiac monitoring.
» Potassium levels should be monitored and replaced if required.

MEDICINE TREATMENT
- Ondansetron for vomiting. See Chapter 21: Palliative care.
- Activated charcoal. Repeated doses may be required to enhance elimination of theophylline. See section 18.1: Poisoning.
- **Note**: Phenytoin should be avoided (due to potential cardiotoxicity).

LoE III[4]

REFERRAL
Refer for consideration of haemodialysis, severe poisonings as evidenced by:
» serum theophylline > 555 µmol/L (> 100 mg/L),
» seizures,

» refractory shock,
» life-threatening dysrhythmias,
» rising theophylline level and/or clinical deterioration despite optimal care.

18.1.19 AMITRAZ POISONING

T60.9
*Notifiable condition.

DESCRIPTION

Amitraz is a pesticide used in tick-dips for animals and as an insecticide in crop sprays. Liquid formulations often contain solvents that may cause additional clinical effects. Significant skin contact may lead to systemic effects.

Note: Where the history is of an unspecified rat poison or pesticide ingestion, consider other active ingredients such as 'super-warfarin' anticoagulants and organophosphates.

DIAGNOSTIC CRITERIA

Clinical

Symptoms occur between 30 minutes to 4 hours.

» Gastrointestinal: vomiting.
» Central nervous system: ataxia, drowsiness (leading to coma), seizures. No excessive secretions. Pinpoint pupils or dilated pupils may be present.
» Cardiovascular: bradycardia, hypotension (or hypertension).
» Respiratory depression, or tachypnoea, aspiration and chemical pneumonitis.
» Hypothermia and hyperglycaemia are common.

Amitraz poisoning can be confused with organophosphate poisoning, but it does not cause excessive sweating and salivation, urinary and faecal incontinence or muscle fasciculation which are seen with organophosphate poisoning. Furthermore, organophosphate toxicity results in reduced serum pseudocholinesterase levels.

Investigations

» Acidosis (respiratory or metabolic).
» Liver enzymes.
» Chest X-ray, if respiratory symptoms.

GENERAL AND SUPPORTIVE MEASURES

» Decontaminate skin and clothes if applicable.
» Monitoring (blood pressure, pulse, respiration, level of consciousness, temperature, blood gas, blood sugar).

- **Asymptomatic:** observe for 4 hours.
- **Symptomatic:** supportive treatment as required.

MEDICINE TREATMENT

- Activated charcoal, see section 18.1: Poisoning.

Specific treatment should only be used if there is inadequate response to standard resuscitation measures.

- Atropine may be used for severe bradycardia.

REFERRAL

» Severe cases requiring intensive care.

18.1.20 ANTIRETROVIRAL AGENTS POISONING

T37.5

DESCRIPTION

» Limited data is available regarding overdose of these medicines.
» Toxicological effects are generally extensions of adverse effects.

GENERAL MEASURES

» Monitor FBC, serum electrolytes, renal and liver function.
» Monitor serum lipase in patients with abdominal pain.
» Lactic acid and serum pH should be monitored in acidotic patients.

TREATMENT

» There are no specific antidotes.
» Treatment is symptomatic and supportive.

18.1.21 CARBON MONOXIDE POISONING

Y17

DESCRIPTION

Poisoning caused by accidental or intentional exposure to fires in poorly ventilated areas, combustion engines, faulty stoves and faulty heating systems.

Patients present with:

» dizziness,
» headache,
» seizures and other CNS symptoms,
» nausea and vomiting,
» chest pain,
» tachycardia,
» high arterial carboxyhaemoglobin levels,
» impaired level of consciousness,
» retinal haemorrhages,
» respiratory alkalosis (mild),
» metabolic acidosis (severe).

Note: There may be a normal arterial PaO_2, but low oxygen saturation on pulse oximetry. Neither are useful in assessing severity of carbon monoxide poisoning. Ideally, a blood gas sample should be sent for co-oximetry to specifically detect carboxyhaemoglobin levels.

GENERAL MEASURES

» Remove patient from toxic environment.
» Ventilation may be needed in deeply comatosed patients.
» Monitor ECG and neurological status.

MEDICINE TREATMENT

» Give 100% oxygen via positive pressure facemask.
» Evidence for the benefit of hyperbaric oxygen therapy is unclear, therefore, it cannot be routinely advised.

For seizures:

- Benzodiazepines. See Chapter 13: The Nervous System, section 13.3: Status epilepticus (convulsive).
- **Note**: Phenytoin should be avoided (due to potential cardiotoxicity).

LoE:III[4]

Metabolic acidosis:
Metabolic acidosis shifts the oxygen-dissociation curve to the right and, therefore, aids in maintaining tissue oxygenation despite reduced haemoglobin carrying capacity. Metabolic acidosis should only be treated if profound and persistent, following standard treatment protocols.

Patients should be followed up after discharge for the persistence of neurocognitive symptoms.

In patients not responding to 100% oxygen, consider exposure to cyanide during the fire and refer patient urgently.

18.2 ENVENOMATION

» The management of severe envenomation, particularly by snakes and scorpions, is complex.
» Please contact the Poisons Information Helpline for advice.
  - **0861 555 777.**

18.2.1 INSECT BITES AND STINGS

T63.4 + (X29.99/X23.99) + External Cause Code (V,W,X,Y)

DESCRIPTION

Toxicity due to insect bites and stings usually results in local effects only; systemic effects are rare. Occasionally, hypersensitivity reactions are

encountered, which may vary from minor local inflammation to acute anaphylaxis.

Multiple bee stings can result in toxicity and may require ICU care.

GENERAL MEASURES

» Allergic reactions may be acutely life-threatening.
» Patients with multiple stings may develop delayed systemic toxicity. Beware of premature discharge from the healthcare facility.

MEDICINE TREATMENT

For anaphylaxis:
See Chapter 1: Emergencies and Trauma, section 1.1.3: Anaphylaxis/Anaphylactic reactions.

For pain:
- Paracetamol, oral, 15 mg/kg/dose 6 hourly as required.

18.2.2 SCORPION STINGS

T63.2

DESCRIPTION

Some scorpion species can cause serious systemic toxicity. Thick-tailed scorpions with small pincers are extremely toxic, resulting in both local and systemic features. Thin-tailed scorpions with large pincers are much less toxic and usually cause local symptoms only.

DIAGNOSTIC CRITERIA

» Pain and paraesthesia occur immediately after envenomation.
» Autonomic and motor findings may differentiate scorpion stings from other causes of pain.
» In severe cases, cranial nerve dysfunction, blurred vision, pharyngeal muscle incoordination, drooling and respiratory compromise can occur.
» Excessive motor activity may present as restlessness, or uncontrollable jerking of extremities.
» Nausea, vomiting, tachycardia and severe agitation can also occur.
» Other serious effects include cardiac dysfunction, pulmonary oedema, and pancreatitis.

GENERAL AND SUPPORTIVE MEASURES

» If unidentified scorpion or confirmed thick-tailed scorpion, observe for a minimum of 12 hours in hospital.
» Monitor airway, breathing and circulation.
» Ventilatory support may be required.

MEDICINE TREATMENT

For pain:

- Paracetamol, oral, 15 mg/kg/dose, 6 hourly as required.

Very painful scorpion stings

- Lidocaine (lignocaine) 2%, 2 mL injected around the sting as a local anaesthetic.

Caution
Opiates increase the risk of respiratory depression and if required, should only be used with caution in severe uncontrolled pain.

For muscle cramps:

- Calcium gluconate 10%, IV, 0.5 mL/kg by slow intravenous injection.
  - Give 0.5–1 mL/minute.
  - Monitor ECG.
  - Monitor response and repeat as needed.

If not immunised in the past 5 years:

- Tetanus toxoid, IM, 0.5 mL.

Complete course in previously unvaccinated patients.

Antivenom therapy

Antivenom therapy is recommended only in cases with systemic signs.

Obtainable from South African Vaccine Producers (SAVP):

SAVP For procurement of snake/spider/scorpion antivenom: Email: Benita.mouton@nhls.ac.za	Office hours: (011)386 6062/6063/6078 After hours: 071 680 9897

- Scorpion antivenom, slow IV, 10 mL administered over 3–5 minutes. If consistency is too thick, can be diluted in sodium chloride or 5% dextrose.

CAUTION
Never administer antivenom without being prepared to manage acute anaphylaxis.

REFERRAL

» Severe cases requiring intensive care.

18.2.3 SNAKEBITE

T63.0

DESCRIPTION

The effects of snakebites may be cytotoxic, neurotoxic and/or haemotoxic. The overall effect is determined by the predominant toxin in the snake venom.

In the majority of cases, the species of snake is unknown. The patients can be divided into:

» no evidence of bite, no envenomation,
» evidence of bite, minor envenomation, i.e. fang marks, minimal pain, minimal swelling and no systemic signs,
» evidence of serious envenomation.

DIAGNOSTIC CRITERIA

Cytotoxic venom

» Puff adder, spitting cobra, gaboon adder.
» Rinkhals has both cytotoxic and neurotoxic features.
» Venom causes severe local damage to tissues and vascular endothelium.
» Severe swelling and local necrosis occurs.

Neurotoxic venom

» Mamba, non-spitting cobra, e.g. Cape cobra, berg adder.
» Rinkhals has both cytotoxic and neurotoxic features.
» Venom causes a paresis and paralysis of skeletal muscles.
» Paralysis of respiratory muscles with respiratory failure may occur.
» Preceded by severe pain and paraesthesias.
» Ophthalmoplegia occurs when ocular muscles become paralysed.
» Speech and swallowing may be affected.
» Signs and symptoms start within 15–30 minutes.

The bite site can be rather unremarkable, except for the berg adder, which also has some swelling.

Haemotoxic venom

» Boomslang, vine snake.
» Venom may cause: spontaneous bleeding, headache, dizziness, fainting.

GENERAL AND SUPPORTIVE MEASURES

» Patients with no evidence of bite and patients with evidence of bite but only minor envenomation should be admitted for observation. No anti-venom is indicated.
» Do not suck or cut the wound.
» Do not apply tourniquet.
» Where serious envenomation is suspected, immediate treatment

includes:
  - minimising movement of affected limb,
  - emergency treatment by bandaging affected limb with crepe bandage without compromising blood supply,
  - rapid transportation to a facility with antivenom available is the most important principle of pre-hospital care,
  - optimal therapy consisting of placing the patient at rest with the affected body part raised to the level of the heart,
  - stabilising circulation and blood pressure.

» For cytotoxic envenomation, surgical intervention, i.e. decompression surgery for established compartment syndrome and debridement of necrotic tissue should only be done when absolutely necessary and as conservatively as possible.

» For neurotoxic envenomation, ventilatory and cardiovascular support may be needed in an ICU.

MEDICINE TREATMENT

Analgesia:

- Paracetamol, oral, 15 mg/kg/dose, 6 hourly as required.

Avoid NSAIDS and aspirin due to concerns of coagulopathy.
Opioids can be used for severe pain, but should be used cautiously in neurotoxic snakebite.

All patients not immunized within the past 5 years:

- Tetanus toxoid, IM, 0.5 mL.

In children with a penetrating wound and who are not completely immunised:

- Tetanus immunoglobulin, IM.
  - If < 5 years of age: 75 IU.
  - If 5–10 years of age: 125 IU.
  - If > 10 years of age: 250 IU.

Clean wound:

- Chlorhexidine 0.05% solution in water.

Antibiotics are seldom needed, except for secondary infection.

Antivenom therapy

Two types of snake antivenom are available:

- Polyvalent antivenom: active against puff adder, gaboon adder, rinkhals, green mamba, black mamba, Jameson's mamba, Cape cobra, forest cobra, snouted cobra, Mozambique spitting cobra.
- Monovalent antivenom: for boomslang bites only.

Obtainable from South African Vaccine Producers (SAVP):

SAVP For procurement of snake/spider/scorpion antivenom: Email: Benita.mouton@nhls.ac.za	Office hours: (011)386 6062/6063/6078 After hours: 071 680 9897

Indications:

» Consider antivenom in children who are persistently and severely affected even after the first day.

» Polyvalent antivenom:
  > Positively identified snake included in polyvalent antivenom AND evidence of severe cytotoxic envenomation.
  > Unidentified snake and evidence of progressive severe cytotoxic envenomation:
    - Painful swelling of whole hand/foot within 1 hour.
    - Swelling to the elbow/knee in less than 6 hours.
    - Swelling of the whole limb in less than 12 hours.
    - Swelling progression > 2.5 cm per hour.
    - A threatened airway due to swelling.
    - Evidence of complication, e.g. compartment syndrome.
    - Systemic evidence of severe cytotoxicity.
      - Shock.
      - Haematological abnormalities: INR > 1.5 IU, Hb < 8 g/dL, thrombocytopaenia (< 100 x 10^9/L) or leukocytosis (> 10 x 10^9/L).
      - Arrhythmias (rare).
  > Any signs of neurotoxicity, i.e. weakness or paralysis.

» Monovalent antivenom:
  > Positively identified boomslang AND clinical or laboratory features of coagulopathy.
  > Unidentified snakebite with evidence of coagulopathy AND no swelling at the bite site.

Administration and antivenom dose:

CAUTION
Never administer antivenom without being prepared to manage acute anaphylaxis.

» In most cases patients do not need and should not be given antivenom.
» Adverse reactions to antivenom are common and may be severe.
» Pre-medication with adrenaline (epinephrine) may reduce the risk of severe adverse reactions to polyvalent snake antivenom.

- Adrenaline (epinephrine) 1:1000, SC, 0.01 mL/kg, to a maximum of 0.25 mL.

» The dose of antivenom is the same for adults and children.
» Monitor for any deterioration in respiratory function as patients may need ventilation whether or not polyvalent antivenom has been given.
» Antivenom should be given as soon as possible, however, administration may be considered even as late as 48–72 hours after the bite, if there is continued clinical deterioration indicating ongoing venom activity.

- Polyvalent snake antivenom, IV.
  - 1 ampoule contains 10 mL antivenom.
    - Cytotoxic snakebite: give 50 mL.
    - Neurotoxic snakebite: give 80–100 mL (and up to 200 mL in black mamba bites).
  - Dilute in sodium chloride 0.9%, 50–100mL.
  - Administer IV, over 30 minutes.

LoE III[9]

- Boomslang monovalent antivenom:
  - Slow IV, 10 mL administered over 3–5 minutes.

  OR
  - IV infusion, 10–20 mL diluted in sodium chloride 0.9% or dextrose 5%, 50–100 mL administered over 5–10 minutes.

Spontaneous systemic bleeding should stop within 15–30 minutes and blood coagulability be restored within 6 hours.

» After administration of antivenom, observe patient for 24 hours.
» Contact the Poisons Information Helpline for further advice.
» Correct anaemia and bleeding tendency.

REFERRAL

» Snakebite with neurotoxic or haemotoxic manifestations may need intensive care.

18.2.4 SNAKE VENOM IN THE EYE

S05.9 + (X20.99)

DESCRIPTION

Direct or indirect snake venom exposure to the eye, particularly from various species of spitting cobras and rinkhals, can cause chemical injury with varying clinical presentations ranging from periocular swelling and mild conjunctival and corneal inflammation to frank corneal ulceration and perforation with eventual blindness.

GENERAL MEASURES

» Instill local anaesthetic and promptly perform copious irrigation for 15–20 minutes to dilute or remove the toxin with sodium chloride 0.9%.

» Apply chloramphenicol ointment and cover the affected eye with an eye patch.
» **Note**: Do not instill polyvalent antivenom in the eye or give systemically.

LoE:III[9]

REFERRAL
» Refer all patients to an ophthalmologist.

18.2.5 SPIDER BITES
T63.3

The vast majority of spiders are not harmful to humans.

18.2.5.1 SPIDER BITES, NEUROTOXIC (BUTTON/WIDOW SPIDERS)

DESCRIPTION
The term latrodectism is used to describe the systemic symptoms and signs following envenomation by the bite of the *Latrodectus* species (button or widow spiders). Most cases are caused by the bite of a black button spider; brown button spider bites are usually milder and characterized by local symptoms and signs.

DIAGNOSTIC CRITERIA
» Bites are felt immediately as a pinprick sensation, followed by increasing local pain that may spread to include the entire extremity.
» Typical target lesions, i.e. erythematous ring surrounding a pale center.
» Spasms in large muscle groups, abdominal pain or rigidity, progressing to generalised pain involving the trunk and abdomen have been described.
» Paraesthesia of hands and feet.
» Sweating and anxiety may occur.
» Priapism may occur, especially in children.

GENERAL AND SUPPORTIVE MEASURES
» Supportive care of airway, breathing and circulation.

MEDICINE TREATMENT
Analgesia:
- Paracetamol, oral, 15 mg/kg/dose, 6 hourly as required.

For pain and muscle cramps:
- Calcium gluconate 10%, IV, 0.5 mL/kg by slow intravenous injection.
  - Give 0.5–1 mL/minute.
  - Monitor ECG and respiration.

For severe envenomation (if systemic symptoms are present):

- *Latrodectus* spider antivenom, IV infusion, 5–10 mL diluted in sodium chloride 0.9% or dextrose 5%, 50–100 mL administered over 5–10 minutes.
- Obtainable from South African Vaccine Producers (SAVP):

SAVP For procurement of snake/spider/scorpion antivenom: Email: Benita.mouton@nhls.ac.za	Office hours: (011)386 6062/6063/6078 After hours: 071 680 9897

CAUTION
Never administer antivenom without being prepared to manage acute anaphylaxis.

18.2.5.2 SPIDER BITES, NECROTIC ARACHNIDISM

T63.3

DESCRIPTION

Violin/recluse (*Loxosceles)* spiders and sac (*Cheiracanthium*) spiders can produce local necrotic skin lesions that are mediated by enzymes.

DIAGNOSTIC CRITERIA

» Bites are initially painless.
» Skin lesions can vary from mildly erythematous lesions to severe local reactions, i.e. blistering, bluish discolouration progressing to frank necrosis.
» Systemic effects occasionally include nausea, vomiting, fever, chills, arthralgia, haemolysis, thrombocytopaenia, haemoglobinuria and renal failure.

GENERAL AND SUPPORTIVE MEASURES

» Supportive care.
» Surgical debridement may be required once clear margins around the necrotic lesions are established.

MEDICINE TREATMENT

For pain:

- Paracetamol, oral, 15 mg/kg/dose, 6 hourly as required.

Antibiotic therapy for septic lesions.
Surgical debridement may be considered for large necrotic lesions.

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CHAPTER 19

PREMATURITY AND NEONATAL CONDITIONS

Note: Always assess gestational age as accurately as possible.
Use Ballard Scoring Assessment (below).

Neuromuscular Maturity

Score	-1	0	1	2	3	4	5
Posture							
Square window (wrist)	 >90°	 90°	 60°	45°	 30°	 0°	
Arm recoil		 180°	 140°–180°	 110°–140°	 90°–110°	 <90°	
Popliteal angle	 180°	 160°	 140°	 120°	 100°	 90°	 <90°
Scarf sign							
Heel to ear							

Physical Maturity

Skin	Sticky, friable, transparent	Gelatinous, red, translucent	Smooth, pink; visible veins	Superficial peeling and/or rash; few veins	Cracking, pale areas; rare veins	Parchment, deep cracking; no vessels	Leathery, cracked wrinkled
Lanugo	None	Sparse	Abundant	Thinning	Bald areas	Mostly bald	
Plantar surface	Heel-toe 40-50 mm: –1 <40 mm: –2	>50 mm, no crease	Faint red marks	Anterior transverse crease only	Creases anterior ⅔	Creases over entire sole	
Breast	Imperceptible	Barely perceptible	Flat areola, no bud	Stippled areola, 1–2 mm bud	Raised areola, 3–4 mm bud	Full areola, 5–10 mm bud	
Eye/Ear	Lids fused loosely: –1 tightly: –2	Lids open; pinna flat; stays folded	Slightly curved pinna; soft; slow recoil	Well curved pinna; soft but ready recoil	Formed and firm, instant recoil	Thick cartilage, ear stiff	
Genitals (male)	Scrotum flat, smooth	Scrotum empty, faint rugae	Testes in upper canal, rare rugae	Testes descending, few rugae	Testes down, good rugae	Testes pendulous, deep rugae	
Genitals (female)	Clitoris prominent, labia flat	Clitoris prominent, small labia minora	Clitoris prominent, enlarging minora	Majora and minora equally prominent	Majora large, minora small	Majora cover clitoris and minora	

Maturity Rating

Score	Weeks
-10	20
-5	22
0	24
5	26
10	28
15	30
20	32
25	34
30	36
35	38
40	40
45	42
50	44

https://epomedicine.com/clinical-medicine/new-ballard-score-how-to-use-it-correctly/

19.1 RESUSCITATION OF THE NEWBORN

Be prepared!
Be at the delivery!
Check the equipment and emergency medicines!

Ask 3 questions to evaluate the infant:

1. Is there good tone?
2. Is the infant breathing adequately and not just gasping?
3. Is the heart rate above 100 beats per minute?

If the answer to all three questions is 'yes', the newborn does not need resuscitation.
If the answer to any of the three questions is 'no', the newborn needs resuscitation.

Assess the infant using the above 3 questions every 30 seconds during resuscitation. If the newborn is improving, then the intervention, e.g. bag-mask ventilation can be stopped. Only if the baby is not responding or getting worse, is further intervention needed, e.g. chest compressions (see algorithm).

Check that each step has been effectively applied before proceeding to the next step. The algorithm follows the assumption that the previous step was unsuccessful and the newborn is deteriorating.

Use the lowest inspiratory oxygen concentration to alleviate central cyanosis and restore a heart rate to above 100 beats per minute. There is evidence that resuscitation with 100% oxygen may be harmful to the baby.

- Oxygen resuscitation of newborns:
  - ≥ 32 weeks gestation: begin with 21%.
  - 28–31 weeks gestation: begin with 21–30%.
  - < 28 weeks gestation: begin with 30%.

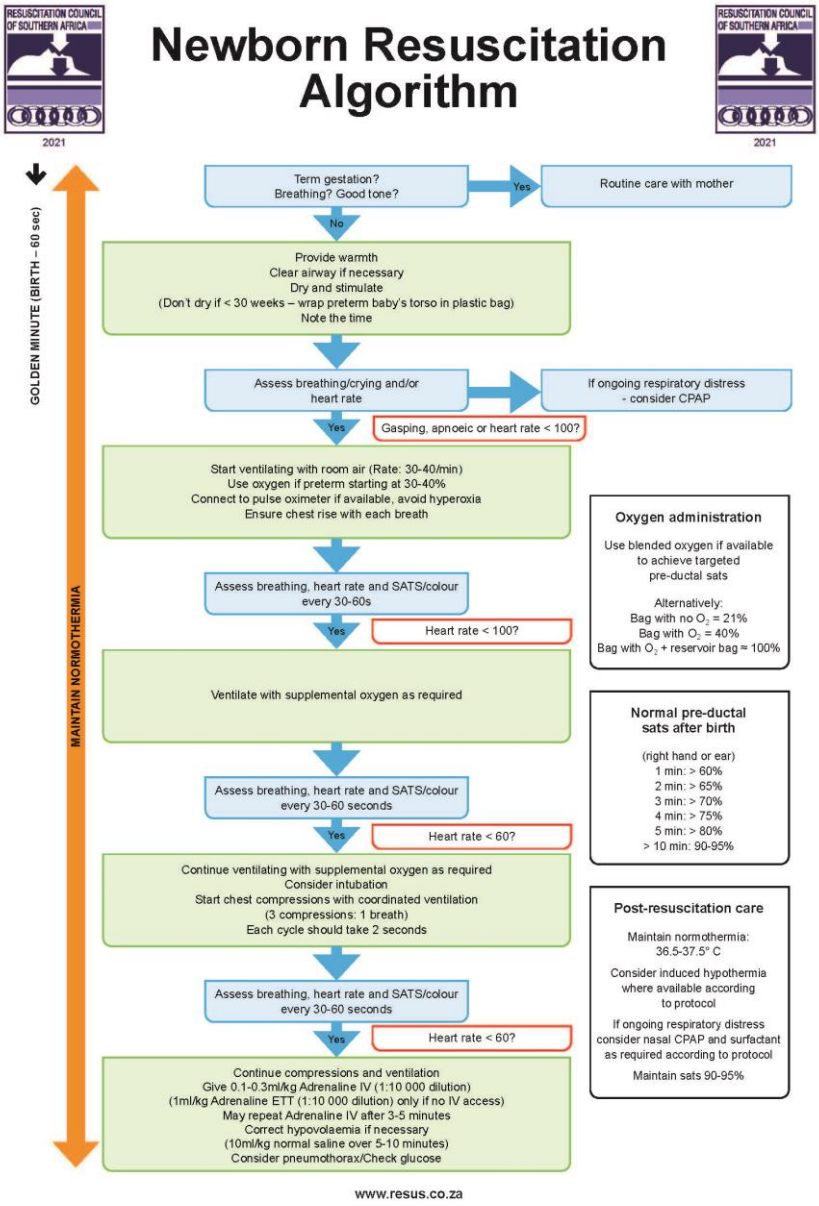
If baby is breathing but oxygen saturation is not within target range: free-flow oxygen administration may begin at 30%.
An unsatisfactory response to resuscitation includes:

» A sustained slow heart rate, usually ≤ 60/minute or a progressive decrease in heart rate until cardiac arrest occurs.
» Episodes of cardiac arrest, with a progressively weaker response to chest compressions, positive pressure ventilation and medicines.
» A decreasing blood pressure, increasing acidosis, severe hypotonia with central cyanosis or intense pallor.
» Apnoea or weak, irregular and inefficient respiratory efforts.
» Consider discontinuation of resuscitation if the unsatisfactory response to resuscitation persists for > 20 minutes and underlying conditions, e.g. pneumothorax, diaphragmatic hernia have been excluded or > 10 minutes of unresponsive cardiac arrest (asystole) and/or > 20 minutes of unsustainable respiration.

» Admit newborns with a favourable response to resuscitation to a neonatal high or intensive care unit, if available, for post-resuscitation care – see section 19.6.1: Hypoxia/Ischaemia of the newborn.
» Include analgesia for babies likely to be in pain. (See Chapter 20: Pain controlo9.)

MEDICINES USED DURING NEONATAL RESUSCITATION

Medicine	Indications	Dosage	Effect
Adrenaline (epinephrine)	Asystole Heart rate < 60/min.	IV, 0.1 mL/kg of a 1:10 000 dilution, which may be repeated up to three times. ET, 1 mL/kg of a 1:10 000 solution.	↑Heart rate ↑Myocardial contractility. ↑Arterial pressure.
Naloxone	Maternal administration of opiates + apnoeic infant.	ET/IV/SC/IM, 0.1 mg/kg.	Corrects apnoea and/or hypoventilation.
Fluids: sodium chloride 0.9%	Hypovolaemia	Slow IV, (5–10 min) 10–20 mL/kg.	↑Blood pressure and improves tissue perfusion.
Dextrose	Hypoglycaemia	IV, 250–500 mg/kg (2.5–5 mL/kg of 10% dextrose water).	Corrects hypoglycaemia.



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19.2 NEWBORN

19.2.1 JAUNDICE, NEONATAL

P58

DESCRIPTION

Yellow discolouration of the skin and mucous membranes due to hyperbilirubinaemia. Bilirubin is formed mainly from haem catabolism. Jaundice develops when there is an overproduction of bilirubin, defective bilirubin metabolism and/or defective excretion of bilirubin from the body.

DIAGNOSTIC CRITERIA

Jaundice may be physiological or pathological.

Physiological jaundice

» Seldom appears before 24–36 hours after birth.
» Rarely lasts more than 10 days in the full term infant and 14 days in the preterm infant.
» Only the unconjugated bilirubin fraction is increased.
» Total peak serum bilirubin concentration is usually below 275 µmol/L in the term infant.
» Total bilirubin concentration does not rise by more than 85 µmol/L/24 hours or 17 µmol/L/hour.
» The baby thrives and shows no signs of illness or anaemia.
» Treatment is unnecessary.

Pathological jaundice

» May appear within the first 24 hours of birth, but can occur at any time after birth.
» Persists for longer than 14 days in the full term infant or 21 days in the preterm infant.
» The unconjugated and/or conjugated fractions of bilirubin are increased.
» The conjugated bilirubin level exceeds 20% of the total bilirubin value, or the conjugated bilirubin fraction is 30 µmol/L or more.
» Total bilirubin concentration rises by more than 85 µmol/L/24 hours or 17 µmol/L/hour and the total serum bilirubin level is above physiological level.
» There are signs and symptoms of illness in the baby.
» Stools are pale in obstructive jaundice.

BREASTFEEDING ASSOCIATED JAUNDICE

Increased unconjugated bilirubin levels during the first week of life in breastfed babies is due to calorie and fluid deprivation and delayed passage of stools. It improves with increased frequency of breastfeeding.

19.2.1.1 HYPERBILIRUBINAEMIA, UNCONJUGATED

Excessive haemolysis	Defective conjugation
» ABO incompatibility	» prematurity
» rhesus disease	» infection
» enclosed haemorrhages	» hypoxia
» polycythaemia	» hypoglycaemia
» infections*	» hypothyroidism*
» spherocytosis	» breast milk jaundice*
» G6PD deficiency	

*May cause prolonged neonatal jaundice.

GENERAL AND SUPPORTIVE MEASURES

» Treat the underlying cause.
» Monitor the infant's body temperature and maintain within thermoneutral range.
» Maintain adequate nutrition and hydration.
» Correct factors known to increase the risk of brain damage in babies with jaundice, e.g.:
  > hypoxia,
  > hypoglycaemia,
  > acidosis,
  > haemolysis.
  > prematurity,
  > hypothermia,
  > hypoalbuminaemia, and

PHOTOTHERAPY

Guideline for initiating and terminating phototherapy:

» Commence phototherapy based on total serum bilirubin measurements, correlated with phototherapy graph attached. The need for phototherapy is determined by the level according to hours of life and gestation or weight.
» The skin colour of a baby receiving phototherapy does not reflect the degree of jaundice (bilirubin blood level) or the efficacy of the phototherapy.
» Undress the baby and cover the eyes with gauze pads or commercially available eye covers.
» Position the phototherapy unit (fluorescent light bulbs of 400–500 nm wavelength) not higher than 45 cm above the baby.
» Check spectral irradiance of the fluorescent lights using a radiometer after every 200–300 hours of use to ensure that they are effective.
» The spectral irradiance should be above 10 µwatt/cm^2/nm of wavelength. If spectral irradiance cannot be checked regularly, replace fluorescent light bulbs after 1 000 hours of continuous use.
» A quartz halogen light source (400–500 nm wavelength) can also be used for phototherapy.
» Phototherapy units with diodes emitting light in the blue spectrum or fibre-optic phototherapy units can be used instead of the fluorescent/quartz halogen units.
» Terminate phototherapy when the total serum bilirubin level is more than 50 µmol/L below the recommended phototherapy initiating level, and the cause of the jaundice has been determined and adequately addressed.
» A rebound increase in bilirubin may follow termination of phototherapy.

» Monitor bilirubin levels approximately 6 hourly after phototherapy has been stopped.

Guideline for exchange transfusion (see also the graphs below):

» Exchange transfusion is indicated when the risk of bilirubin encephalopathy and kernicterus is significant. Referral for exchange transfusion may be needed.

MEDICINE TREATMENT

Rh incompatibility (i.e. mother Rh-negative, baby Rh-positive).
ABO incompatibility (i.e. mother = O, baby = A, B or AB).
Once the diagnosis of Rh- or ABO-related haemolysis is confirmed, together with a positive direct Coombs test; and the serum bilirubin is rising rapidly (> 17 µmol/L/hour with intensive phototherapy) or is approaching exchange transfusion level, then administer (**in consultation with a specialist**):

- Immunoglobulin, IV, 500 mg/kg over 1 hour.
  - Can be repeated once after 6–8 hours.

Mothers of babies with Rh incompatibility should receive:

- Anti-D immunoglobulin, IM, 100 mcg as soon as possible after birth but within 72 hours of birth.

PHOTOTHERAPY

South African Neonatal Academic Hospital Guidelines: 2006

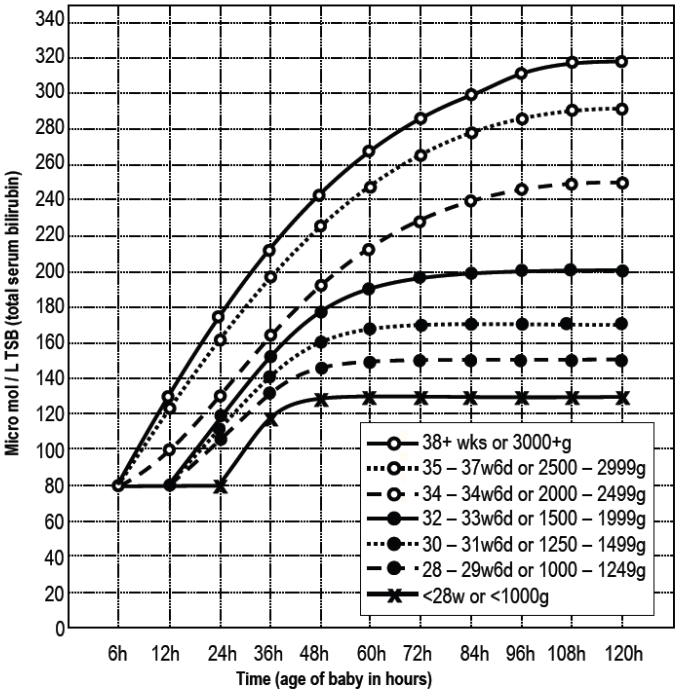
In presence of risk factors use one line lower (the gestation below) until <1000g.

If gestational age is accurate, rather use gestational age (weeks) instead of body weight

Infants > 12 hours old with TSB level below threshold, repeat TSB level as follows:
1- 20µmol/L below line:repeat TSB in 6hrs or start phototherapy and rept TSB in 12- 24hrs,
21 - 50 µmol/L below line: repeat TSB in 12 – 24hrs,
>50 µmol/L below line: rept TSB until it is falling and/or until jaundice is clinically resolving

Infants under phototherapy :
Check the TSB 12 – 24 hly but if TSB >30 µmol/L above the line , check TSB 4 – 6hly.

STOP phototherapy :
If TSB > 50 µmol/L below the line. Recheck TSB in 12 – 24hr.



Start intensive phototherapy when the TSB is ≥ the line according to gestation or weight.
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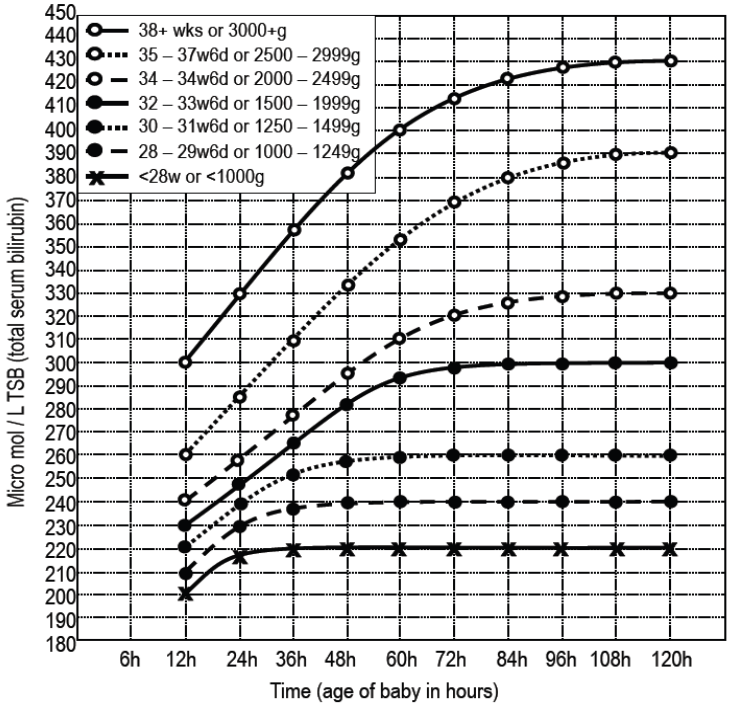
(SAMJ 2006;96:819-824)

EXCHANGE TRANSFUSION

South African Neonatal Academic Hospital Guidelines: 2006

In presence of sepsis, haemolysis, acidosis, or asphyxia,
use one line lower (gestation below) until <1000g
If gestational age is accurate, rather use gestational age (weeks) than body weight

Note: 1. Infants who present with TSB above threshold should have Exchange done if the TSB is not expected to be below the threshold after 6 hrs of intensive phototherapy.
2. Immediate Exchange is recommended if signs of bilirubin encephalopathy and usually also if TSB is >85 µmol/L above threshold at presentation
3. Exchange if TSB continues to rise >17 µmol/L/hour with intensive phototherapy



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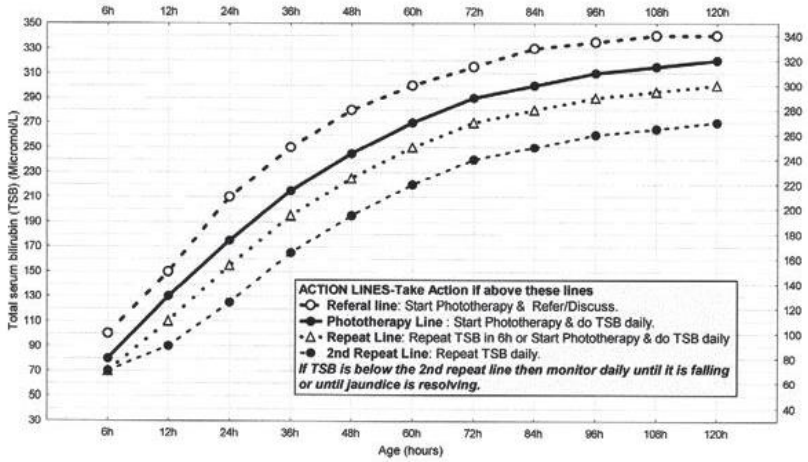
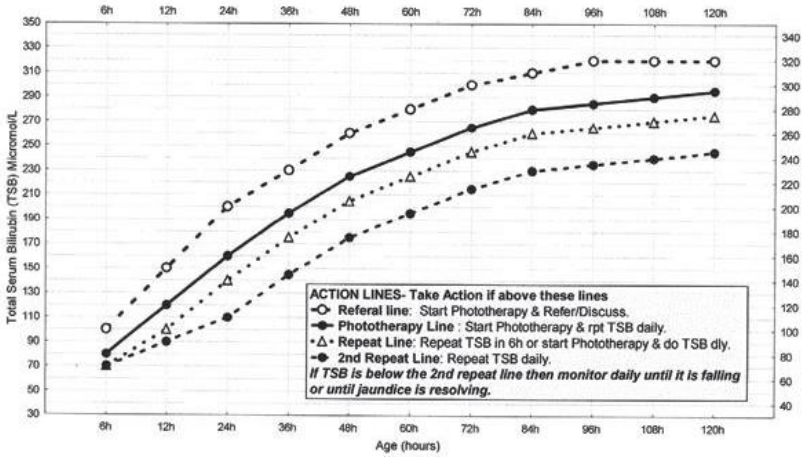
PHOTOTHERAPY AND TOTAL SERUM BILIRUBIN (TSB) MONITORING IN THE FIRST WEEK OF LIFE AT PRIMARY CARE (South African Neonatal Academic Hospitals 2006)

- Refer/Discuss all jaundiced infants who are: < 2Kg or < 35wks gestation.
- Refer all infants of mothers who have Rhesus antibodies on antenatal screening.
- Discuss ALL infants receiving phototherapy, daily, with MOU doctor (day) or referral hospital (night)
- Stop phototherapy when TSB > 50µmol/L below phototherapy line.
- If TSB continues to fall after phototherapy has been stopped, then no more TSB measurements are needed.

WELLTERM INFANTS > 3kg



WELL INFANTS 2 - 3kg *and* > 35wks



Horn et.al. SAMJ, 2006, 96 (9): 819-824

19.2.1.2 HYPERBILIRUBINAEMIA, CONJUGATED

Hepatocellular disease	Bile duct obstruction
» hepatitis* » total parenteral nutrition* » syphilis » other congenital infections » galactosaemia*	» bile duct hypoplasia/atresia* » choledochal cyst » cystic fibrosis

*May cause prolonged neonatal jaundice.

Conjugated hyperbilirubinaemia is due to intra/extrahepatic obstruction of bile ducts (cholestasis) and usually presents in the second week of life or later.
The baby has a green-yellow skin discolouration, dark bile stained urine and pale acholic stools. Hepatomegaly is commonly present and the infant often fails to thrive.

Neonatal hepatitis, prolonged TPN and biliary atresia or hypoplasia accounts for the majority of cases of conjugated hyperbilirubinaemia.

GENERAL AND SUPPORTIVE MEASURES

» Treat the underlying cause.
» Dietary modifications to counteract the malabsorption of fat and fat-soluble vitamins (A, D, E and K) that may occur in patients with a prolonged conjugated hyperbilirubinaemia.
» When galactosaemia is suspected, avoid lactose-containing feeds, i.e. breast milk and lactose-containing formula.

MEDICINE TREATMENT

All premature babies, day 15 to 1 year:

- Multivitamin drops, oral, 0.6 mL daily.

SURGICAL TREATMENT

Conditions amenable to surgery, e.g. biliary atresia.
Hepatoporto-enterostomy for biliary atresia should be done before 60 days of age for optimal outcome.

REFERRAL

» All cases of jaundice persisting more than 2 weeks with conjugated bilirubin level > 20% of total bilirubin, for diagnosis and initiation of treatment.

19.2.1.3 JAUNDICE, NEONATAL, PROLONGED

DESCRIPTION

Jaundice (static or a rising bilirubin) present for more than 14 days in a term infant and 21 days in a preterm infant. The usual causes are:
» breast milk jaundice,

» hypothyroidism,
» hepatitis,
» galactosaemia, and
» infections, e.g. UTIs.

Breast milk jaundice may be confirmed by substituting breastfeeding with formula feeds for 24–48 hours. The bilirubin level will always drop to a lower level and increase again when breastfeeding is resumed. However, the level will not rise to the original high level. Breast milk jaundice is an unconjugated hyperbilirubinaemia and the infant is always well and thriving.

Abnormal thyroid function, increased TSH and decreased T_3 and T_4, indicates hypothyroidism. The unconjugated bilirubin fraction is raised and the infant may have clinical signs of hypothyroidism, e.g.:

» lethargy,
» feeding difficulties,
» poor cry,
» nasal obstruction,
» bradycardia.
» constipation,
» hypotonia,
» umbilical hernia,
» hypothermia, and

Infants with galactosaemia usually present with:

» a conjugated hyperbilirubinaemia,
» refusal to feed,
» failure to thrive,
» encephalopathy, and
» vomiting,
» hepatomegaly,
» hypoglycaemia,
» cataracts (later).

DIAGNOSTIC CRITERIA

» Hepatitis may be confirmed by abnormal liver function tests, i.e. raised values of:
  > AST,
  > ALT,
  > GGT.
  > ALP,
  > bilirubin, mainly the conjugated fraction, and
» Hepatomegaly or hepatosplenomegaly.
» If conjugated hyperbilirubinaemia – see above.

Investigations

» Syphilis. See section 19.5.4: Syphilis, early congenital.
» Thyroid function (see Chapter 7: Endocrine System, section 7.12: Hypothyroidism, congenital).
» Urine for MCS (see Chapter 6: Nephrological/Urological Disorders, section 6.2: Urinary tract infections).
» Suspect galactosaemia if urine is positive for reducing substances but negative for glucose in a baby receiving lactose-containing feeds. A galactose-1-phosphate uridyl transferase assay will confirm the diagnosis.

GENERAL AND SUPPORTIVE MEASURES

» Monitor bilirubin levels.
» Treat the underlying cause.

» Dietary adjustment for prolonged conjugated hyperbilirubinaemia to counteract the malabsorption of fat and fat-soluble vitamins (A, D, E and K).
» Avoid lactose-containing feeds, i.e. breast milk and lactose-containing formulae, when galactosaemia is suspected.
» Regular follow-up until the underlying condition has been resolved.

MEDICINE TREATMENT

All premature babies, day 15 to 1 year:

- Multivitamin drops, oral, 0.6 mL daily.

REFERRAL

» Pathological jaundice, unconjugated and/or conjugated, where the underlying cause cannot be identified.
» Serum unconjugated bilirubin at exchange transfusion level.
» Jaundice, unconjugated and/or conjugated, not improving on adequate treatment.
» Conjugated hyperbilirubinaemia due to conditions requiring surgical intervention, e.g. biliary atresia.
» Prolonged neonatal jaundice, excluding breast milk jaundice.

19.2.2 RESPIRATORY DISTRESS IN THE NEWBORN

P22.9

DESCRIPTION

Newborn experiencing difficulty with breathing.

Causes of respiratory distress include:

Pulmonary causes	Extrapulmonary causes
» respiratory distress syndrome (surfactant deficiency), » meconium aspiration, » pneumonia, » pneumothorax, » transient tachypnoea of newborn » pulmonary haemorrhage, » pulmonary hypertension, » hypoplastic lungs, and » diaphragmatic hernia.	» sepsis, » cardiac failure irrespective of cause, » hypothermia/hyperthermia, » hypoglycaemia, » anaemia, » polycythaemia, » hypovolaemic shock, and » perinatal hypoxia.

Respiratory distress syndrome (RDS), meconium aspiration syndrome (MAS) congenital pneumonia and transient tachypnoea of the newborn (TTN) are the most common causes of respiratory distress in newborns.

DIAGNOSTIC CRITERIA

Clinical

» Pulmonary and/or extrapulmonary disorders presenting with two or more of the following signs in a newborn baby:
  > tachypnoea (≥ 60 breaths/minute),
  > expiratory grunting,
  > intercostal and sternal retractions (recession), and
  > central cyanosis while breathing room air.

Investigations

» Chest X-ray to determine the underlying pathology.
» Echocardiography, if available, to exclude cardiac causes of respiratory distress.
» Haematocrit, blood glucose and temperature.

GENERAL AND SUPPORTIVE MEASURES

» Identify and treat the underlying cause, e.g.:
  > Chest tube and underwater drainage of a pneumothorax.
» Admit to a neonatal high care/intensive care facility, if available.
» Handle the neonate as little as possible.
» Nurse a non-intubated infant in the prone position.
» Keep in a neutral thermal environment (incubator or infant crib with overhead heater). Keep the room temperature at 26–28°C, and anterior abdominal wall skin temperature at 36.5–37.5°C.
» Monitor:
  > blood pressure,
  > peripheral perfusion,
  > haematocrit,
  > blood glucose,
  > blood gases,
  > minerals and electrolytes,
  > respiratory rate,
  > heart/pulse rate,
  > acid-base status,
  > body temperature,
  > S_aO_2,
  > fluid balance.
» Nutrition:
  > Provide adequate IV dextrose to maintain blood glucose ≥ 2.6 mmol/L.
  > Commence oro/nasogastric feeding as soon as possible after birth.
  > If enteral feeding is not possible 24 hours after birth, start IV hyperalimentation.
» Ventilation (non-invasive or invasive) is needed if:
  > An oxygen saturation of at least 90% or P_aO_2 of at least 60 mmHg (8 kPA) cannot be maintained with an inspiratory oxygen concentration of ≥ 60% with or without nasal CPAP.
  > The P_aCO_2 rises to > 55 mmHg (7.5 kPa) with uncompensated respiratory acidosis (pH ≤ 7.20), irrespective of oxygen saturation or P_aO_2.

(1 kPa = 7.5 mmHg; 1 mmHg x 0.133 = 1 kPa)

MEDICINE TREATMENT

To eliminate central cyanosis and to maintain oxygen saturation of haemoglobin 90–95%:

- Oxygen, warmed and humidified via nasal cannula.

- If a pulse oximeter or facility for blood gas analysis is available, oxygen, humidified via nasal cannula to maintain oxygen tension in the blood at 60–80 mmHg.
- If a pulse oximeter or facility for blood gas analysis is not available, regulate the inspired oxygen concentration in such a way that the least amount of oxygen that will prevent central cyanosis is used.
- Keep P_aO_2 at 60–80 mmHg (8 - 10.5 kPa) and P_aCO_2 at 35–45 mmHg (4.5 – 5.5 kPa) (arterial blood gas analysis).

Nasal CPAP is needed if the neonate has a good respiratory drive with a PCO_2 of ≤ 55 mmHg but unable to maintain a S_aO_2 of 90–95% on an inspiratory oxygen concentration of ≥ 60% (F_iO_2) and pneumothorax has been excluded.
Administer nasal CPAP at 4–6 cmH_2O and monitor S_aO_2, blood gas and acid-base status.

OR

- Oxygen/air mixture, high-flow, warmed and humidified via nasal prongs. (Under specialist supervision.)
  - Do not exceed 6 L/minute. The flow/minute (L/min) approximates the pressure generated in cm of water.

Stabilise circulation and blood pressure

- Neonatal maintenance solution, IV infusion, 60–80 mL/kg/24 hours (day 1 of life) and adapt to daily maintenance requirements.

AND/OR

- Sodium chloride 0.9%, 10–20 mL/kg over 1–2 hours.
  - For preterm infants restrict to 10 mL/kg.

AND/OR

- Fresh frozen plasma, 10–20 mL/kg over 1–2 hours.

OR

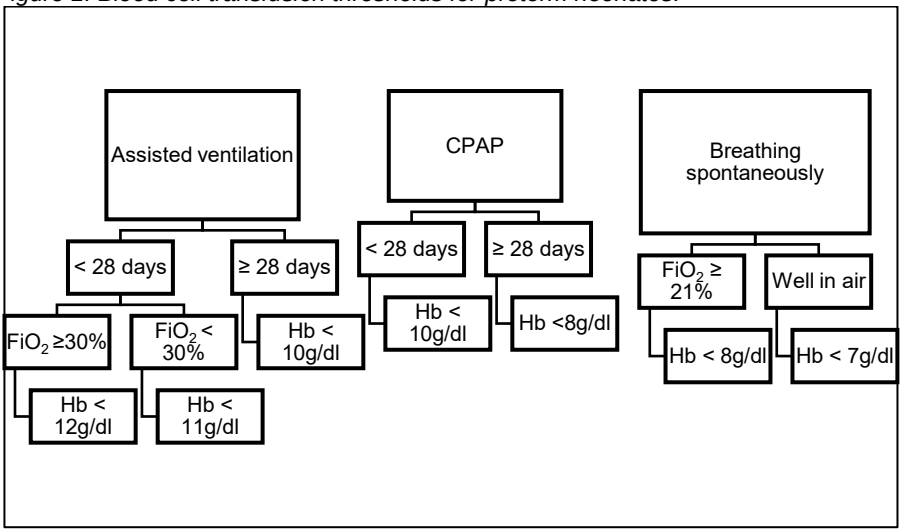
- Lyophilised plasma, 10–20 mL/kg over 1–2 hours.

Inotropic support

- Dopamine, IV, 5–15 µg/kg/minute, continued until blood pressure has stabilised.
  - Response to inotropic support will be unsatisfactory if the circulating blood volume is not corrected.

Anaemia

Figure 1: Blood cell transfusion thresholds for preterm neonates.



**Thresholds from Harrison et.al. Resource implications of adopting a restrictive neonatal blood transfusion policy, SAMJ, 2013.*

- If anaemia is present according to thresholds in figure 1 above: Packed red cells, IV, 10–15 mL/kg over 3-4 hours in haemodynamically stable patients. More rapid transfusions may be appropriate in bleeding and haemodynamically unstable patients.

Metabolic acidosis

If pH ≤ 7.0 and the metabolic acidosis does not respond to normalisation of P_aO_2, P_aCO_2, blood pressure, volume expansion (hydration) and correction of anaemia:

- Sodium bicarbonate, 4.2%, IV, administered slowly.
  - 1 mmol = 2 mL
  - HCO_3 needed (mmol) = base excess x 0.3 x body mass (kg).
  - (½ correct base deficit initially.)

CAUTION
Do not administer Ca^{++} containing infusions with sodium bicarbonate solution.

Respiratory distress syndrome (Surfactant deficiency)

In consultation with a paediatrician.

If surfactant deficiency is suspected or present, provide respiratory support.

» Mild surfactant deficiency: nasal CPAP 4–6 cmH_2O.

» Moderate surfactant deficiency: 'in-out' surfactant followed by nasal CPAP 4–6 cmH_2O. Intubate infant and administer surfactant via naso- or orotracheal tube.

Ventilate for a few minutes with a T-Piece resuscitation device or resuscitation bag with a CPAP generating device. Extubate baby and put on nasal CPAP 4–6 cmH_2O. Babies may be put on nasal CPAP directly after 'in-out' surfactant administration, omitting the ventilation step following 'in-out' surfactant.

» The LISA (Less Invasive Surfactant Administration) method may be used if the doctor is competent in the procedure. Baby is intubated with a size 8 feeding tube whilst on CPAP. The surfactant is administered through the feeding tube slowly over 5 minutes.

» Severe surfactant deficiency: intubate baby and ventilate with a ventilator. Administer surfactant via the naso- or orotracheal tube. If a ventilator is not available, then 'in-out' surfactant followed by nasal CPAP can be used.

Short-term intubation ('In-out' endotracheal surfactant administration)

» Nasal CPAP as required.

» If inadequate oxygenation on nasal CPAP, pre-oxygenate with bag-mask or T-piece ventilation to maintain preductal saturation between 90–95%.

» Intubate orally, give surfactant and follow with gentle manual ventilation or CPAP, as required, for 5 minutes:
- Surfactant, 100 mg/kg.

» Extubate and recommence nasal CPAP.

Infection

» If infection, e.g. bronchopneumonia, is present or suspected, give antibiotics after blood cultures have been taken.

» Consider the antibiotic sensitivity profile of micro-organisms in a particular hospital when prescribing antibiotics.

- Aminoglycoside, e.g.:
  - Gentamicin, IV, for 5–7 days in the first week of life.
    - If < 32 weeks gestation of age: 5 mg/kg/36 hours.
    - ≥ 32 weeks gestation of age: 5 mg/kg/24 hours.
    - After first week, 5 mg/kg/24 hours for all gestations.

  PLUS

  - Ampicillin, IV, for 5–7 days.

Gestational Age	Postnatal Age	Dose
≤ 34 weeks	≤ 7 days	50 mg/kg/dose every 12 hours
	8 to 28 days	75 mg/kg/dose every 12 hours
>34 weeks	≤ 28 days	50mg/kg/dose every 8 hours

Review after 48 hours. If infection is confirmed, or very strongly suspected, continue for 5–7 days.

Where available, gentamicin doses should be adjusted on the basis of therapeutic drug levels.

- Trough levels (taken immediately prior to next dose), target plasma level < 1 mg/L.

- Peak levels (measured 1 hour after commencement of IV infusion or IM/IV bolus dose), target plasma level > 8 mg/L.

REFERRAL
» No improvement or deterioration despite adequate treatment.
» Development of respiratory failure and need for ventilatory support.

19.3 PREMATURITY/PRETERM NEONATE
P07.3

DESCRIPTION
Neonate born before 37 completed weeks of pregnancy.

GENERAL AND SUPPORTIVE MEASURES
» Admit unwell/unstable infants to a neonatal high/intensive care facility.
» Temperature control:
  > Kangaroo mother care: Initiate if baby is well and vital signs are stable.
  > Provide a neutral thermal environment (incubator or infant crib with overhead heater) and keep ambient temperature at 26–28°C.
  > Keep infant's temperature, axilla or skin of anterior abdominal wall, at 36.5–37.5°C.

Table for neutral thermal environment for age and body mass

Neutral Thermal Environment				
Age	Temperature for body mass range			
	< 1200 g ± 0.5°C	≥ 1200–1500 g ± 0.5°C	≥ 1500–2500 g ± 1°C	≥ 2500 g ± 1.5°C
0–12 hours	35.0	34.0	33.3	32.8
12–24 hours	34.5	33.8	32.8	32.4
2–4 days	34.5	33.5	32.3	32.0
4–14 days	33.5	32.1	32.0	
2–3 weeks	33.1	31.7	30.0	
3–4 weeks	32.6	31.4		
4–5 weeks	32.0	30.9		
5–6 weeks	31.4	30.4		

» Monitor:
  > respiratory rate,
  > blood pressure,
  > blood gas,
  > acid-base status,
  > calcium, magnesium,
  > growth parameters.
  > haematocrit,
  > bilirubin,
  > blood glucose,
  > electrolytes,
  > hydration status, and

» Nutritional support:
  > Give oro/nasogastric tube feedings to infants with audible bowel sounds and no complications of prematurity.
  > Preferably use own mother's expressed breast milk, pasteurised donor breast milk or preterm formula. Give small frequent bolus feeds, 3 hourly or continuous oro/nasogastric tube feeds (alternatives: cup, dropper, spoon, syringe). Refer, if there is intolerance.
  > Monitor gastric emptying by aspirating the stomach before each feed.
  > Consider stopping enteral feeding if:
    - vomiting,
    - abdominal distension,
    - diarrhoea,
    - haematochezia, or
    - ileus.
  > IV alimentation if enteral feeds are contraindicated or not tolerated.
» IV fluids to ensure adequate hydration, electrolyte and mineral intake, and normoglycaemia (blood glucose ≥ 2.6 mmol/L) until enteral (tube or oral) intake is satisfactory.
  > Discontinue IV fluids gradually to avoid reactive hypoglycaemia.
  > Discontinue the infusion when several oral feedings have been retained.
  > If renal function is compromised, use potassium-free solution.

Fluid requirements for a healthy preterm infant	
Day of life	**mL/kg/24 hours**
1	70
2	90
3	110
4	130
5 and onwards	150

Some infants may require fluid volumes up to 180 mL/kg/24 hours after day 6.

» Hospital discharge if:
  > clinically well,
  > able to breastfeed or formula feed,
  > able to maintain body temperature, and
  > usually > 1.8 kg.
» Follow-up visits to assess growth parameters, neurodevelopment, hearing and vision.

MEDICINE TREATMENT

See figure 1: Blood cell transfusion thresholds for preterm neonates.

If anaemia is present according to thresholds in figure 1

- Packed red cells, IV, 10 mL/kg over 3 – 4 hours in haemodynamically stable patients. More rapid transfusions may be appropriate in bleeding and haemodynamically unstable patients.

To maintain oxygen tension in the blood at 60–80 mmHg:

- Oxygen, humidified via nasal cannula.
  - Oxygen therapy should be utilised to maintain oxygen saturation of haemoglobin at of 90–95%; use a pulse oximeter.

At birth

- Vitamin K, IM, 0.5–1 mg.
- Immunise according to EPI schedule according to chronological age.
- Iron and multivitamin supplementation from the third week of life.

Prophylaxis

- Iron (elemental), oral, 2–4 mg/kg/24/hours.
  - Ferrous lactate 1 mL = 25 mg elemental iron.
  - Multivitamin, oral, providing at least vitamin D, 400–800 IU and vitamin A, 1250–5000 IU per 24 hours.

Continue with iron and vitamin supplementation until the infant is on a balanced diet.

REFERRAL

Presence of one or more of the following complications that cannot be managed at the facility:

» Respiratory distress and/or apnoea attacks requiring ventilatory support.
» PDA with cardiac failure not responding to medical management.
» Necrotising enterocolitis requiring surgical intervention.
» Jaundice with serum unconjugated bilirubin level in the exchange transfusion zone.
» Septicaemic infants or infants with infections not responding to therapy.
» Pulmonary and/or intraventricular haemorrhage.
» Feeding difficulties where the underlying cause is unclear.
» Infants requiring hyperalimentation if parenteral nutrition is not available at the hospital.
» Convulsions not responding to treatment.
» Congenital abnormalities requiring surgical intervention.
» Hypoglycaemia not responding to treatment.
» For eye examination/hearing screening:
  > infants < 1.5 kg,
  > infants < 32 weeks gestation,
  > infants who received prolonged respiratory support/oxygen,
  > infants with recurrent apnoea, and
  > infants with an unstable clinical course.

19.3.1 ENTEROCOLITIS, NECROTISING (NEC)

P77

DESCRIPTION

Neonate presenting with the consequences of bowel wall injury or necrosis.

Risk factors include:

- » prematurity,
- » sepsis,
- » early formula feedings,
- » patent ductus arteriosus, and
- » hypotension/shock,
- » high feeding volumes,
- » perinatal asphyxia (hypoxia),
- » polycythaemia.

DIAGNOSTIC CRITERIA

- » Early signs are often non-specific, i.e.:
  - > feeding intolerance,
  - > significant gastric aspirates,
  - > vomiting,
  - > body temperature instability,
  - > apnoea and lethargy.
- » Non-specific signs may progress to more specific signs, including:
  - > abdominal distention with ileus,
  - > bloody stools,
  - > peritonitis,
  - > red-purple discolouration of the abdominal wall with abdominal wall cellulitis, and
  - > bowel perforation.
- » X-ray of abdomen may show:
  - > distended loops of intestines,
  - > bowel-wall thickening (oedema),
  - > pneumatosis intestinalis,
  - > hepatic portal venous gas, and
  - > free intraperitoneal air due to perforation.
- » Blood samples for culture and sensitivity testing before starting antibiotic therapy.

Modified Bell's Criteria for NEC

Stage	Systemic signs	Abdominal signs	Radiographic signs
1A Suspected	Temperature instability, apnoea, bradycardia, lethargy.	Gastric retention, abdominal distension, emesis, haeme-positive stool.	Normal or intestinal dilation, mild ileus.
1B Suspected	Same as above.	Grossly bloody stool.	Same as above.
2A Definite, mildly ill	Same as above.	Same as above, plus absent bowel sounds with or without abdominal tenderness.	Intestinal dilation, ileus, pneumatosis intestinalis.
2B Definite, moderately ill	Same as above, plus mild metabolic acidosis and thrombocytopenia.	Same as above, plus absent bowel sounds, definite tenderness, with or without abdominal cellulitis or right lower quadrant mass.	Same as above, plus ascites.

3A Advanced, severely ill, intact bowel	Same as 2B, plus hypotension, bradycardia, severe apnea, combined respiratory and metabolic acidosis, DIC, and neutropenia.	Same as above, plus signs of peritonitis, marked tenderness, and abdominal distension.	Same as 2A, plus ascites.
3B Advanced, severely ill, perforated bowel	Same as 3A.	Same as 3A.	Same as above, plus pneumoperitoneum.

https://www.researchgate.net/figure/Modified-Bell-s-Staging-Criteria-for-Necrotizing-Enterocolitis-NEC_tbl1_273870645

GENERAL AND SUPPORTIVE MEASURES

» Admit to a neonatal high-care unit or intensive care unit.
» Nurse in a neutral thermal environment.
» Insert an oro/nasogastric tube and apply free drainage.
  > Suspected cases should be nil-per-mouth for 72 hours.
  > Confirmed cases should be nil-per-mouth for at least 7 days.
» Provide adequate parenteral nutrition as soon as diagnosis is confirmed.
» Provide cardiovascular and ventilatory support, if necessary.

MEDICINE TREATMENT

Depending on age, weight and hydration status:

- Neonatal maintenance solution, IV.
  Add volume of gastric aspirates to daily maintenance fluid volume.

If coagulopathy or septic shock:

- Plasma (lyophilised or fresh frozen), IV, 20 mL/kg over 2 hours.

See figure 1: Blood cell transfusion thresholds for preterm neonates.
If anaemia is present according to thresholds in figure 1

- Packed red cells, IV, 10 mL/kg over 3 – 4 hours in haemodynamically stable patients. More rapid transfusions may be appropriate in bleeding and haemodynamically unstable patients.

Until blood pressure is stabilised:

- Dopamine, IV, 5–15 µg/kg/minute.

Empiric antibiotic therapy

- Ampicillin, IV, 50 mg/kg/dose for 7 days.

Gestational Age	Postnatal Age	Dose
≤ 34 weeks	≤ 7 days	50 mg/kg/dose every 12 hours
	8 to 28 days	75 mg/kg/dose every 12 hours
>34 weeks	≤ 28 days	50mg/kg/dose every 8 hours

PLUS

- Gentamicin, IV, 5 mg/kg once daily for 7 days.

Where available, gentamicin doses should be adjusted on the basis of therapeutic drug levels.

- Trough levels (taken immediately prior to next dose), target plasma level < 1 mg/L.
- Peak levels (measured 1 hour after commencement of IV infusion or IM/IV bolus dose), target plasma level > 8 mg/L.

PLUS

- Metronidazole, IV, for 7 days.
  - Loading dose: 15 mg/kg over 60 minutes.
  - Postnatal age < 4 weeks: 7.5 mg/kg/dose 12 hourly.
  - Postnatal age ≥ 4 weeks: 7.5 mg/kg/dose 8 hourly.

Reassess choice of antibiotics when the culture and sensitivity results become available.

Adjust antibiotic regimen according to local susceptibility patterns and suspicion of nosocomial infection, where possible in consultation with a microbiologist or infectious diseases specialist.

SURGICAL TREATMENT

Surgical intervention is required when there is progressive deterioration of the clinical condition despite maximal medical support and/or bowel necrosis with/without bowel perforation.

» Prior to transport to a tertiary hospital for definitive surgery, insert/place a peritoneal drain in babies presenting with severe abdominal distension, due to free air and/or fluid in the peritoneal cavity, compromising respiration and/or blood pressure.
» Perform the procedure in a theatre, intensive care or high care unit where facilities for monitoring vital signs, resuscitation, ventilation and temperature control of the environment are available.
» Obtain consent to perform the surgical procedure.

Method of inserting/placing a peritoneal drain

» The procedure is sterile; the doctor should be gowned and gloved.
» Clean and drape the abdomen.
» Administer an appropriate analgesic (e.g. ketamine, IV) immediately before the start of the procedure.
» Identify a site in either one of the fossae iliaca, ensuring that it is lateral to the inferior epigastric artery.
» At the intended surgical incision site, inject:
  - Lidocaine (lignocaine) 1%, SC, 0.5 mL.
» Make a small skin incision over the ‘bubble’ of lidocaine (lignocaine) (no. 11 blade).

» Use a mosquito forceps or clamp to dissect down to the peritoneum, pierce the latter with a gentle stab using the closed forceps and slightly stretch the peritoneal puncture site with the forceps.
» Note what drains from the peritoneal cavity and send a sample for microscopy and culture.
» Insert a pencil drain of ~5 mm width with the mosquito clamps or forceps into the peritoneal cavity through the peritoneal stab wound. About 1.5–2 cm of the pencil drain should be inside the peritoneal cavity.
» Fix the drain to the skin with a size 4–0 stitch (e.g. PDS).
» Cover the drain with a gauze pad or urine collecting bag.

REFERRAL
» All confirmed cases for specialist care.
» Deterioration of clinical condition, despite adequate treatment.
» Signs and symptoms of intestinal perforation and peritonitis requiring surgical intervention.
» Recurrent apnoea episodes and/or signs of respiratory failure, requiring respiratory support.

19.3.2 PATENT DUCTUS ARTERIOSUS (PDA) IN THE NEWBORN
Q25.0

DESCRIPTION
Patent ductus arteriosus (PDA) is the extra-uterine persistence of the normal foetal vessel that joins the pulmonary artery to the aorta.

DIAGNOSTIC CRITERIA
Clinical
Depending on the size of the PDA:
» A systolic or continuous murmur at the upper left sternal border.
» Hyperactive precordium with easily palpable bounding peripheral pulses.

Investigations
» Echocardiography should be done to confirm the diagnosis in all symptomatic children with a heart murmur.
» Observe and follow-up all asymptomatic patients.

Risk factors include:
» prematurity,
» hypoxia,
» fluid overload,
» anaemia, and
» pulmonary hypertension,
» sepsis,
» lung disease,
» congenital cardiac abnormalities.

Complications include cardiac failure, systemic hypotension, pulmonary haemorrhage and steal phenomena, such as a decrease in mesenteric blood flow.

GENERAL AND SUPPORTIVE MEASURES

Preterm Infants

» Identify and treat underlying risk factors.
» Restrict fluid intake to 80% of maintenance. Individualise volume to avoid over restriction of fluid and poor weight gain.
» Maintain haematocrit at ≥ 40% and Hb ≥ 13 g/dL.
» Monitor cardiac function, renal function and urinary output.
» Provide adequate nutrition.
» Nurse in a neutral thermal environment.

MEDICINE TREATMENT

In confirmed cases (in consultation with specialist):

Cardiac failure

Diuretics

- Furosemide, IV/oral, 1 mg/kg/24 hours.

Closure of PDA in preterm infants less than 14 days of age

- Ibuprofen, oral.
  First dose: 10 mg/kg. After 24 hours, follow with 2 doses of 5 mg/kg 24 hours apart.
  Contraindications to ibuprofen therapy:
  - Thrombocytopenia (< 50 000/mm^3).
  - Bleeding disorders.
  - Impaired renal function.
  - Jaundice approaching exchange transfusion levels.
  - Duct-dependant cyanotic heart disease

OR

- Paracetamol, oral.
  - Can be used when there are contraindications to Ibuprofen.
  - Dosage: 15 mg/kg every 6 hours for 5 days.
  - Contraindications to paracetamol: Liver failure.

SURGICAL TREATMENT

Consider if medicine treatment is contraindicated or fails.

REFERRAL

» Patients with complications, e.g. cardiac failure, pulmonary haemorrhage, ventilator dependence.
» PDA which remained patent despite adequate treatment.
» Term babies with symptomatic or persistent PDA.

19.3.3 RETINOPATHY OF PREMATURITY

H35.1

See Chapter 16: Eye Conditions, section 16.8: Retinopathy of Prematurity (ROP).

19.3.4 APNOEA, NEONATAL

P28.3

DESCRIPTION

A neonate presenting with episodes of cessation of breathing.
Apnoea episodes in a previously asymptomatic well neonate may be the first indication of a serious underlying disease.
Apnoea episodes in an already unwell neonate indicate deterioration in the condition of the neonate.

DIAGNOSTIC CRITERIA

» Cessation of respiration for longer than 20 seconds, with/without cyanosis, pallor or bradycardia.
» Cessation of respiration for less than 20 seconds with cyanosis, pallor and/or bradycardia (heart rate < 100 bpm).

Central apnoea

Causes include:

» *IRDS,*
» *prematurity,*
» *hypoxia/hypercarbia,*
» *sepsis,*
» *acidosis,*
» *meningitis,*
» *temperature disturbances,*
» *hypotension,*
» *pneumonia,*
» *intraventricular haemorrhage,*
» *patent ductus arteriosus,*
» *hypoglycaemia,*
» *hypermagnesaemia,*
» *atypical convulsions,*
» *anaemia,*
» *rough or excessive handling, and*
» *medicines (sedatives, anticonvulsants, analgesics).*

Obstructive apnoea

Neonates are obligatory ‘nose breathers’. Obstruction of the nares makes neonates prone to apnoea.
Causes of obstructive apnoea include:

» choanal atresia,
» micrognathia,
» gastro-oesophageal reflux,
» macroglossia,
» secretions (milk, meconium, blood, mucous) lodged in the upper airway, and,
» neck flexion or extension.

Reflex apnoea or vagally mediated apnoea

Is due to:

» endotracheal intubation,
» gastro-oesophageal reflux,
» suction of the pharynx or stomach.
» passage of a nasogastric tube,
» overfeeding, and

Mixed apnoea
Apnoea caused by a combination of the above causes.

GENERAL AND SUPPORTIVE MEASURES

For all forms of neonatal apnoea:
» Identify and treat the underlying cause.
» Frequent gentle physical stimulation, e.g. rubbing of soles of feet.
» Nurse preterm neonates in the prone position.
» Maintain ambient temperature at the lower range of neutral thermal environment.
» Maintain axillary temperature or anterior abdominal wall skin temperature at 36.2–36.8°C.
» Maintain haematocrit at 30%.
» Maintain nasal CPAP of 4–6 cmH_2O. (Nasal CPAP – not for central apnoea except for apnoea of prematurity.)
» Monitor vital signs and parameters relating to the underlying cause.

MEDICINE TREATMENT

To maintain oxygen/haemoglobin saturation of 90–95% or an oxygen tension in the blood at 60–80 mmHg:

- Oxygen via nasal cannula or mask.

Only for apnoea of prematurity (not term infants):

- Caffeine citrate, oral/IV:
  - Oral route strongly recommended (formulation can be extemporaneously compounded).
  - Loading dose: 20 mg/kg.
  - Maintenance dose: 5 mg/kg/24 hours. Start maintenance dose 24 hours after the loading dose.
    (Caffeine citrate 20 mg = caffeine base 10 mg.)

OR
(if caffeine not available)

- Aminophylline, IV/oral:
  - Loading dose: 8 mg/kg. (If IV infusion, administer over 30 minutes.)
  - Maintenance dose: 1.5–3 mg/kg/dose 8 hourly. Start maintenance dose 8 hours after loading dose.

Maintain aminophylline blood levels at 10–12 µg/mL.
If neonate responds favourably to caffeine/aminophylline, continue until neonate is apnoea free for 7 days.

REFERRAL

» Recurrent life-threatening episodes of apnoea, not responding to adequate treatment and requiring ventilation.

19.4 CARDIOVASCULAR

19.4.1 HEART FAILURE IN NEONATES

P29.0

DESCRIPTION

Clinical syndrome reflecting the inability of the myocardium to meet the oxygen, nutritional or metabolic requirements of the body. Heart failure may be acute or chronic.

The main causes of heart failure are:

» Congenital heart abnormalities:
  > Left-sided outflow obstruction, e.g. interrupted aortic arch, coarctation of the aorta and aortic valve stenosis.
  > Left to right shunts, VSD and PDA.
  > Hypoplastic left heart.
  > Complex congenital heart lesions.
» Acquired conditions:
  > fluid overload,
  > hypoglycaemia,
  > acidosis,
  > arrhythmias,
  > pneumopericardium,
  > hypertension.
  > sepsis,
  > hypoxia,
  > severe anaemia,
  > cardiomyopathy,
  > hyperthyroidism,

DIAGNOSTIC CRITERIA

Diagnosis relies on history, physical examination and a chest X-ray.

Clinical

» Acute heart failure may be associated with shock in addition to congestive symptoms and signs.
» Heart failure is usually associated with fluid retention and congestion.
» History of recent onset of:
  > poor feeding,
  > tachypnoea (> 60 breaths/minute),
  > sweating, and
  > poor or excessive weight gain in excess of 30 g/24 hours.
» Physical findings:
  > tachycardia (> 180 beats/minute),
  > gallop rhythm (with/without a cardiac murmur),
  > cardiomegaly,
  > features of cardiogenic shock, i.e. cold wet skin, weak pulses, hypotension,
  > reduced urinary output,
  > pulmonary venous congestion and fluid retention,
  > systemic venous congestion,
  > hepatomegaly, and
  > signs and symptoms of an underlying condition/disease.
» Always check the femoral pulses.

Special Investigations

» Radiology: cardiomegaly is usually present, cardiothoracic ratio > 60%. Caution – a thymic shadow may be present.
» Electrocardiogram may show evidence of hypertrophy of one or more heart chambers and/or arrhythmias.
» A comprehensive echocardiographic evaluation by an appropriately skilled individual is indicated in all neonates with heart failure.

GENERAL AND SUPPORTIVE MEASURES

» Nurse in a neutral thermal environment.
» Restrict fluids, but ensure adequate nutrition.
  > Administer 75% of estimated daily fluid requirements.
  > Use breast milk or low-salt milk formulae.
  > Tube feed.
» Treat the underlying condition, e.g. sepsis and cardiac tamponade.

MEDICINE TREATMENT

First treat shock, if present.

To prevent hypoxia:

- Oxygen via face mask, nasal cannula or head box.

Combination medicine therapy is usually indicated.

Afterload reduction: ACE inhibitor or vasodilator

Consider ACE inhibitors in persistent heart failure where left-sided outflow obstruction has been excluded, other measures have failed and only after consultation with a paediatrician or paediatric cardiologist.

Monitor blood potassium levels and stop potassium supplements while the patient is on an ACE inhibitor.
ACE inhibitors are contraindicated in renal failure, bilateral renal artery stenosis or a single functioning kidney.

- Captopril, oral, 0.2 mg/kg/dose, 8–12 hourly, initially.
  - Adjust dose and interval based on response to a maximum of 1 mg/kg/dose.
  - Administer 1 hour before feeding.
  - Continue as long as needed to control the heart failure.

Diuretics

Continue diuretic therapy as long as needed to control heart failure.
Monitor blood potassium levels.

Potassium supplements may be necessary if furosemide is used without spironolactone.

- Furosemide, IV/oral, 1–3 mg/kg/24 hours as a single daily dose, or in 3 divided oral doses.
    - Administer IV furosemide slowly over 1–2 minutes.

WITH/WITHOUT

- Spironolactone, oral, 1–3 mg/kg/dose, once daily.

Inotropic support

May help to stabilise patients with severe myocardial dysfunction, hypotension or low cardiac output.
May be lifesaving in severe myocarditis or cardiogenic shock.

- Dobutamine, IV infusion, 2.5–15 mcg/kg/minute.
    - Continue until myocardial function and blood pressure improve.
    - Ensure normovolaemia.
    - Monitor blood pressure.

Acute left-heart failure: acute pulmonary oedema or pulmonary venous congestion

- Oxygen 100%, via nasal cannula.
- Furosemide, IV, 1–3 mg/kg, immediately.

For patients not responding to furosemide:

- Morphine, IV, 0.1 mg/kg.

- Inotropic support, as above.

- Afterload reduction, as above.

To raise the alveolar pressure above pulmonary capillary pressure, intubate with intermittent positive ventilation.
Titrate oxygen according to saturation, 90–94%.

SURGICAL TREATMENT

Palliative or corrective surgery for certain congenital heart lesions.

REFERRAL

» For determination of the underlying cause, and initiation of specialised care, after stabilisation.

19.4.2 CYANOTIC HEART DISEASE IN THE NEWBORN

Q24.9

DESCRIPTION

Blue or grey discolouration of the skin and tongue in room air, with an oxygen saturation of less than 85% in the presence of a cardiac lesion (complex lesions such as common arterial trunk may be associated with saturations greater than 90%).

Note:
Strongly suspect cyanotic cardiac disease if centrally cyanosed, not in respiratory distress and normotensive.

DIAGNOSTIC CRITERIA

- Rule out non-cardiac causes of central cyanosis:
  - Respiratory conditions, e.g. respiratory distress syndrome, pneumonia and pneumothorax. Signs of respiratory distress usually improve with oxygen administration. Chest X-ray may be helpful.
  - Central nervous system involvement, e.g. sedation and asphyxia, which usually improves with oxygen administration.
  - P_aCO_2 may be increased in cyanosis due to respiratory and central nervous system causes.
  - Methaemoglobinaemia
- To confirm a cardiac cause:
  - Do a hyperoxia test.
  - Tachypnoea is present, but usually no retraction.
  - Heart murmur (may be absent).
- Hyperoxia test (Nitrogen wash out test):
  - Administer 100% oxygen via a nasal cannula for 10 minutes.
    Unnecessary if saturation is under 85% on nasal cannula delivering 100% oxygen.
  - Obtain arterial blood from the right radial artery (preductal flow).

P_aO_2 (mmHg)	P_aO_2 (kPa)	Interpretation
< 100	< 15.5	Most likely to be a cyanotic heart lesion, persistent foetal circulation or severe lung disease. P_aCO_2 will be increased with severe lung disease.
≥ 100–200	≥15.5 – 26.5	Unlikely to be a cyanotic heart lesion.
≥ 200	≥ 26.5	Excludes a cyanotic heart lesion.

- Chest X-ray may show cardiomegaly or abnormal cardiac silhouette and/or reduced pulmonary blood flow.
  - Confirm diagnosis with echocardiography.

GENERAL AND SUPPORTIVE MEASURES

» Nurse in a neutral thermal environment.
» Monitor and maintain within physiological range for age:
  - heart rate,
  - respiration,
  - blood pressure,
  - body temperature,
  - electrolytes.
  - calcium, magnesium,
  - blood glucose,
  - blood gases,
  - acid-base status, and
» Provide adequate hydration and nutrition.

MEDICINE TREATMENT

Referral is needed in all patients.

Prior to referral:
To keep ductus arteriosus open if a duct dependent cyanotic heart lesion is suspected:
Prostaglandin therapy, i.e.:

- Alprostadil, IV, (under specialist consultation):
  - Add 1 ampoule (500 mcg) to 50 mL dextrose water at 0.3–0.6 mL/hour (0.05–0.1 mcg/kg/minute).
  - Discard the solution after 24 hours.

OR

- Dinoprostone, via oro/nasogastric tube, (under specialist consultation).
  - For babies < 2.5 kg: 0.125 mg 1–2 hourly ($^1/_4$ tablet suspended in 2 mL sterile water), **or** 50 mcg/kg/dose 1–2 hourly.
  - For babies > 2.5 kg: 0.25 mg hourly (½ tablet suspended in 2 mL sterile water).

Continue with prostaglandin therapy until corrective or palliative surgery can be done or until patency of the duct is not deemed essential for survival of the infant.
If a ductal dependant lesion is suspected, maintain oxygen saturation just above 75%.

Serious side effects of prostaglandins to be aware of may include: Apnoea, fever, diarrhoea, hypotension and seizures.

If pH ≤ 7.2, correct metabolic acidosis:
» Sodium bicarbonate 4.2%, IV.
  HCO_3 needed (mmol) = base excess x 0.3 x body mass (kg).
  2 mL sodium bicarbonate 4.2% = 1 mmol HCO_3.

SURGICAL TREATMENT

» Corrective or palliative surgery.

REFERRAL

» All cyanotic infants with an underlying cardiac cause for central cyanosis.

19.5 INFECTIONS

19.5.1 MENINGITIS BACTERIAL, NEONATAL

G01

DESCRIPTION

A bacterial infection of the meninges in the first month of life.

Consider meningitis in any neonate being evaluated for sepsis or infection, as most organisms implicated in neonatal sepsis also cause neonatal meningitis. The most common causative organisms are *Group B ß-haemolytic streptococcus type III* and Gram-negative organisms such as *E. coli* with K_1 antigen. Consider *S. epidermidis* and *S. aureus* as causative organisms with central nervous system anomalies such as open defects or with indwelling devices such as VP shunts.

Consider HIV infection in neonates with meningitis.

DIAGNOSTIC CRITERIA

Clinical

» Clinical presentation is usually with one or more non-specific signs such as:
  - temperature disturbances,
  - lethargy,
  - irritability,
  - vomiting,
  - feeding problems,
  - vasomotor changes,
  - altered level of consciousness,
  - blood glucose disturbances,
  - bulging/full fontanel,
  - convulsions,
  - apnoea, and

» Complications include:
  - cerebral oedema,
  - raised intracranial pressure,
  - vasculitis, with haemorrhage,
  - ventriculitis,
  - ischaemia and infarctions of the brain,
  - inappropriate antidiuretic hormone (ADH) secretion,
  - convulsions,
  - hydrocephalus,
  - subdural effusion,
  - brain abscess,

» Late complications include:
  - neurological sequelae,
  - deafness, and
  - blindness,
  - intellectual disabilities.

SPECIAL INVESTIGATIONS

» Lumbar puncture:
  - CSF appears turbid to purulent.
  - Protein concentration is increased (> 1.0 g/L).
  - Leucocyte count is increased with a predominance of polymorphonuclear leucocytes (> 6 cells/mm^3).
  - Glucose concentration is low, < $^2/_3$ of blood glucose.

» Gram stain, microscopy, culture and sensitivity of CSF.

» Blood cultures for microscopy, culture and sensitivity.

GENERAL AND SUPPORTIVE MEASURES

» Admit to a high or intensive care unit, if available.
» Maintain a neutral thermal environment.
» Monitor, where indicated:
  > neurological status,
  > vital signs,
  > electrolytes,
  > haematocrit,
  > fluid balance (hydration),
  > calcium and magnesium,
  > acid-base status,
  > blood glucose,
  > serum and urine osmolality,
  > blood gases.
» Ensure adequate nutrition:
  > Enteral feeding where possible, use an oro/nasogastric tube, if necessary.
  > If enteral feeding is not possible, IV fluids, e.g. neonatal maintenance solution and parenteral nutrition under supervision by a paediatrician.
» Limit total daily fluid intake, IV and oral:
  > Do not exceed the daily requirements for age.
  > Prevent fluid overload.

MEDICINE TREATMENT

Antibiotics, empirical

- Cefotaxime, IV, 50 mg/kg over 30 minutes, for 21 days.

Gestational age	Postnatal age	Dose
< 32 weeks	< 14 days	50 mg/kg/dose every 12 hours
	14 to 28 days	50 mg/kg/dose every 8 hours
≥ 32 weeks	≤ 7 days	50 mg/kg/dose every 12 hours
	8 to 28 days	50 mg/kg/dose every 8 hours

PLUS

- Ampicillin, IV, for 14 days.

Gestational Age	Postnatal Age	Dose
≤ 34 weeks	≤ 7 days	50 mg/kg/dose every 12 hours
	8 to 28 days	75 mg/kg/dose every 12 hours
>34 weeks	≤ 28 days	50mg/kg/dose every 8 hours

During the course of treatment, a cranial ultrasound should be done.
Reconsider choice of antibiotic when the results of blood and CSF cultures become available or the child does not improve within 72–96 hours.

No response or intolerant to cephalosporins or ampicillin

For patients not responding to adequate antibiotic therapy where no organisms were identified or cultured, consider viruses, fungi and bacteria not usually causing meningitis.

Convulsions

See section 19.6.2: Seizures, neonate.

Raised intracranial pressure or cerebral oedema

Avoid fluid overload.

Limit total daily intake, IV and oral.
Do not exceed the total fluid maintenance requirements for age.

REFERRAL
» Meningitis not responding to adequate treatment.
» Meningitis with complications.
» Follow-up is essential for assessing neurodevelopment, hearing and vision.

19.5.2 SEPTICAEMIA OF THE NEWBORN
P36.9

DESCRIPTION
Bacterial or fungal invasion of blood before or after birth, which may spread to involve other organs/systems, e.g. meninges (meningitis), lungs (pneumonia), bone (osteomyelitis), and kidneys (pyelonephritis).

DIAGNOSTIC CRITERIA
Clinical
The baby usually presents with one or more non-specific clinical sign, e.g.:
» vasomotor changes,
» feeding problems,
» lethargy,
» jaundice,
» diarrhoea,
» tachypnoea,
» temperature disturbances,
» apnoea attacks,
» sclerema,
» acidosis,
» abdominal distension,
» tachycardia,
» organomegaly,
» petechiae,
» convulsions,
» blood glucose disturbances,
» hypotonia,
» shock,
» anaemia,
» cyanosis.

» Complications include:
> septic shock,
> hypoglycaemia,
> apnoea,
> convulsions,
> anaemia,
> meningitis,
> bronchopneumonia,
> cardiac failure,
> dehydration,
> bleeding tendency,
> DIC and/or thrombocytopenia,
> metabolic acidosis,
> osteomyelitis,
> respiratory failure,
> necrotising enterocolitis,
> ileus,
> renal failure,
> multi-organ failure.

Investigations
» Blood and cerebrospinal fluid cultures.
» Full blood count and differential count.
» C-reactive protein and procalcitonin, if available.

GENERAL AND SUPPORTIVE MEASURES

» Admit to a neonatal high or intensive care facility, if available.
» Ensure a neutral thermal environment.
» Start infusion with appropriate IV fluid, e.g. neonatal maintenance solution.
» Ensure adequate nutrition:
  > Enteral feeding where possible, via oro/nasogastric tube after ileus, obstruction, or other contraindications to enteral feeding have been excluded.
  > If enteral feeding is not possible, IV fluids, e.g. neonatal maintenance solution and parenteral nutrition under supervision by a paediatrician.
» Insert oro/nasogastric tube.
» Oxygen to maintain P_aO_2 at 60–80 mmHg or oxygen saturation of haemoglobin at 90-95%.
» Ventilatory support if P_aCO_2 exceeds 55 mmHg (7.5 kPa).
» Monitor:
  > Body temperature 36.5–37.5°C (axillary or anterior abdominal wall).
  > Maintain blood glucose level of 2.6–6.8 mmol/L.
  > Acid-base status and maintain blood pH of 7.35–7.45.
  > Maintain a haematocrit of 40%.
  > Vital signs and respiration, and maintain blood electrolytes and minerals within their normal physiological ranges.
  > Clinical progress and for the emergence of complications.

MEDICINE TREATMENT

Antibiotic therapy

Be aware of the antibiotic sensitivity/resistance profile of bacterial pathogens in your hospital/community.
Reconsider choice of antibiotic when the results of blood and CSF cultures become available or the child does not improve within 72–96 hours.

Empiric treatment (first line):

Aminoglycoside, e.g.:

- Gentamicin, IV, for 5–7 days.
  - If < 32 weeks gestation: 5 mg/kg/36 hours in the first week of life.
  - If ≥ 32 weeks gestation: 5 mg/kg/24 hours in the first week of life.
  - Monitor blood levels.

PLUS

- Ampicillin, IV, 50 mg/kg/dose for 5–7 days.

Gestational Age	Postnatal Age	Dose
≤ 34 weeks	≤ 7 days	50 mg/kg/dose every 12 hours
	8 to 28 days	75 mg/kg/dose every 12 hours
>34 weeks	≤ 28 days	50mg/kg/dose every 8 hours

If child is deteriorating on above regimen and there are no culture positive results:

Empiric treatment (second line):

- Piperacillin/tazobactam, IV, for 7 days.
  - If < 7 days of age: 50–100 mg/kg 12 hourly (1st week of life).
  - If > 7 days of age: 50–100 mg/kg 6–8 hourly.

PLUS

- Amikacin, IV, for 7 days.
  - 15 mg/kg/dose 24 hourly.
  - Therapeutic drug monitoring to be done where available.

Note: Shorter durations of therapy should be used where there is no culture confirmed infection, and the child shows clinical improvement.

Fungal infections

Where fungal septicaemia is demonstrated or suspected:

- Amphotericin B deoxycolate, IV, 1–1.5 mg/kg/day infusion in 5% dextrose water over 4 hours for 14 days.
- Monitor renal function and serum potassium.

Anaerobic infections

Where anaerobic infection is likely, e.g. after gastrointestinal surgery for sepsis, or where intra-abdominal sepsis is suspected:

- Metronidazole, oral/IV, for 10 days.
  - Loading dose, IV: 15 mg/kg administered over 60 minutes.
  - If ≤ 4 weeks of age: 7.5 mg/kg 12 hourly.
  - If > 4 weeks of age: 7.5 mg/kg 8 hourly.

Note: In patients on piperacillin/tazobactam and amikacin, no additional anaerobic cover is needed.

Inotropic support

Mean blood pressure should not be less than the gestational age (weeks) of the infant plus 5–10 mmHg.

If blood pressure is < 60/40 mmHg in term infants or < 50/35 mmHg in preterm infants:

- Dopamine, IV, 5–15 mcg/kg/minute as a continuous infusion.
  - Continue with dopamine as long as it is necessary to maintain the blood pressure.

REFERRAL

» Septicaemia with complications.
» Septicaemia not responding to treatment.

19.5.3 GROUP B STREPTOCOCCUS

DESCRIPTION

Group B streptococcus is an encapsulated Gram-positive coccus that colonises the gastrointestinal and genitourinary tracts.

Infection in the first 6 days of life is referred to as early-onset disease (EOD).
Late-onset disease (LOD) refers to infection from day 7–89 of life.

DIAGNOSTIC CRITERIA

» Infants may present in respiratory distress or with signs of septicaemia.
» Complications include meningitis, cellulitis, osteomyelitis or septic arthritis.
» A blood culture should be performed before initiation of antibiotics in infants that are at risk of sepsis, namely, maternal fever, prolonged rupture of membranes or prematurity due to an unknown cause.
» Meningitis should be excluded in all patients that have a positive blood culture for group B streptococcus.

GENERAL AND SUPPORTIVE MEASURES

Refer to section on septicaemia of the newborn, section 19.5.2.

MEDICINE TREATMENT

- Ampicillin, IV, 50 mg/kg/dose for 10 days.

Gestational Age	Postnatal Age	Dose
≤ 34 weeks	≤ 7 days	50 mg/kg/dose every 12 hours
	8 to 28 days	75 mg/kg/dose every 12 hours
>34 weeks	≤ 28 days	50mg/kg/dose every 8 hours

Uncomplicated meningitis: 14 days of ampicillin plus:

- Gentamicin, IV, for 5 days for synergy.
  - If < 32 weeks gestation: 5 mg/kg/36 hours in the first week of life.
  - If ≥ 32 weeks gestation: 5 mg/kg/24 hours in the first week of life.
  - Monitor blood levels.

REFERRAL

» For surgical complications such as hydrocephalus, septic arthritis, osteomyelitis.
» Septicaemia not responding to treatment.

19.5.4 SYPHILIS, EARLY CONGENITAL

A50.9
*Notifiable condition.

DESCRIPTION

Multi-organ infection caused by *T. pallidum* and acquired by vertical transmission via the transplacental route during pregnancy.

DIAGNOSTIC CRITERIA

Clinical

» Suspect if mother has syphilis or positive serology for syphilis and the baby a positive non-treponemal serological test at birth with a titre at least 4-fold higher than that of the mother.
» Large, pale, greasy placenta.
» The following signs may be present at birth or will develop within the first 3 months of life:
  > hydrops fetalis,
  > anaemia,
  > hepatosplenomegaly,
  > oedema,
  > condylomata,
  > hepatitis,
  > nephrosis/nephritis,
  > thrombocytopenia,
  > lymphadenopathy,
  > jaundice,
  > hypoalbuminaemia,
  > pneumonia alba,
  > meningitis,
  > interstitial keratitis, and
  > transient bullous lesions, commonly on the hands and feet with later desquamation and an erythematous appearance of palms and soles.
» A generalised, reddish, maculopapular rash that may desquamate.
» Rhinitis with mucopurulent bloodstained discharge excoriating the upper lip.
» Other mucocutaneous lesions of the mouth, anus and genitalia, healing with scars, especially the corners of the mouth and on the chin.
» Involvement of long bones with/without pseudoparalysis of one or more limbs and radiological findings.

Investigations:

If mother is positive for syphilis:

» X-ray of long bones:
  > translucent metaphyseal bands,
  > osteochondritis,
  > osteitits, and
  > metaphysitis and periostitis.
» Confirm syphilis with:
  > Non-treponemal serological tests, i.e. RPR, VDRL, in mother and baby. (Do not use umbilical cord blood at delivery for laboratory investigations.)

GENERAL AND SUPPORTIVE MEASURES

» Nurse infant in a neutral thermal environment.
» Maintain adequate nutrition and hydration.
» Monitor hepatic and renal function.

» Ensure maternal and paternal treatment if positive.

Pneumonia
To maintain oxygen saturation at 90–95% or P_aO_2 at 60–80 mmHg (8 -10.5 kPa):
- Oxygen.
  1 kPa = 7.5 mmHg
  1 mmHg x 0.133 = 1 kPa

Anaemia
If anaemia is present according to thresholds in figure 1 above:
- Packed red cells, IV, 10–15 mL/kg over 3-4 hours in haemodynamically stable patients. More rapid transfusions may be appropriate in bleeding and haemodynamically unstable patients.

MEDICINE TREATMENT

Asymptomatic, well baby
Mother seropositive or result unknown, and mother has not been treated or was only partially treated:
- Benzathine benzylpenicillin (depot formulation), IM, 50 000 units/kg as a single dose into the antero-lateral thigh.

Symptomatic baby
- Procaine penicillin, IM, 50 000 units/kg daily for 10 days (not for IV use).

OR
- Benzylpenicillin (Penicillin G), IV, 50 000 units/kg 12 hourly for 10 days.

CAUTION *Procaine penicillin and benzathine benzylpenicillin must not be given intravenously.*

Follow up children at 3 months post treatment with repeat non-treponemal serological tests, until test becomes non-reactive. Re-treat if drop in titre less than 4-fold.

Prevention
Screen pregnant women for syphilis at first visit and repeat during the second and/or third trimester.
Investigate and treat both parents, if necessary.

REFERRAL

» Symptomatic infant with complications, e.g. respiratory failure, hepatic failure, nephrotic syndrome and meningitis.

19.5.5 TETANUS, NEONATAL

A33
*Notifiable condition.

DESCRIPTION

Tetanus is an acute spastic paralytic illness caused by tetanospasmin, the neurotoxin produced by *C. tetani*. Neonatal tetanus is the most common form of the disease, usually caused by umbilical stump infections or contamination.

The disease only occurs in infants of non-immunised mothers or mothers with insufficient levels of protecting antibody to tetanus toxin.

DIAGNOSTIC CRITERIA

Clinical signs

- Presents with difficulty in sucking and swallowing due to masseter spasm, i.e. trismus, usually on day three, with associated hunger and crying.
- Temperature of 40–41°C.
- Tenseness and rigidity of all muscles, including paraspinal and abdominal muscles.
- Fists clenched and the toes fanned.
- Opisthotonic spasms and clonic jerks following sudden stimulation by touch and noise:
  - spasms are painful,
  - not true seizures,
  - there is no loss of consciousness, and
  - laryngeal spasms may result in respiratory distress.
- Umbilicus may appear normal but there may be discharge from, or dirt/dung on the umbilicus.

REFERRAL

- Seek urgent telephonic guidance prior to referral.
- All infants with suspected neonatal tetanus.

19.5.6 PREVENTION OF MOTHER TO CHILD TRANSMISSION (PMTCT)

Z20.60

See Chapter 9: HIV Infection, section 9.1.1: The HIV exposed infant.

19.5.7 NEONATES WITH EXPOSURE TO CHRONIC HEPATITIS B INFECTION

Neonatal transmission:
Babies born to mothers with acute hepatitis B infection at the time of delivery or to mothers who are HBsAg-positive or HBeAg-positive:

- Hepatitis B immunoglobulin, IM, 200 IU (2 mL) within 12 hours of delivery. (Always consult the product package insert before administering the dose for product specific dosing).

PLUS

- Hepatitis B vaccine, IM, first dose within 12 hours of delivery.
  - Continue hepatitis B immunisation according to the recommended immunisation schedule.

» Continue with routine childhood vaccine schedule thereafter.
» Measure hepatitis B surface antigen (HBsAg) and antibody (HBsAb) at 9 to 12 months. If non-immune at that time, discuss ongoing monitoring and treatment with relevant specialist.

19.6 NEUROLOGICAL

19.6.1 HYPOXIA-ISCHAEMIA OF THE NEWBORN (PERINATAL HYPOXIA/HYPOXIC-ISCHAEMIC ENCEPHALOPATHY (HIE))

P21.9

DESCRIPTION

Ischaemia and decreased oxygen delivery to the foetus/baby during the prepartum, intrapartum or immediate postpartum period, with hypoxic-ischaemic damage to the central nervous system and to other body systems.

Complications include:
» Cardiovascular: heart rate and rhythm disturbances, heart failure and hypotension.
» Pulmonary: respiratory distress/respiratory failure, pulmonary hypertension and pulmonary haemorrhage.
» Renal: renal failure, acute tubular/cortical necrosis and urinary retention.
» Gastrointestinal tract: ileus and necrotising enterocolitis.
» Central nervous system: increased intracranial pressure, cerebral oedema, encephalopathy, seizures, inappropriate antidiuretic hormone (ADH) secretion, hypotonia and apnoea.
» Metabolic: hypoglycaemia, hyperglycaemia, hypocalcaemia, hypomagnesaemia and metabolic acidosis.
» Body temperature: abnormal.
» Other: disseminated intravascular coagulation.

DIAGNOSTIC CRITERIA

To make the diagnosis of HIE, all of the following are required:

» Gestation ≥ 36 weeks (i.e. late preterm or term).
» Evidence of intrapartum asphyxia or hypoxia:
  1. Apgar < 5 at 5 and 10 minutes OR
  2. pH < 7.0 and BD ⩾ 12 mmol/l OR
  3. Ongoing resuscitation for more than 10 minutes.
» Evidence of encephalopathy:
  > Clinical examination using the modified Sarnat staging.
  OR
  > Abnormal aEEG.

Modified Sarnat staging

» Encephalopathy defined as the presence of one or more signs in at least 3 of the 6 categories:

		Moderate encephalopathy	Severe encephalopathy
1.	**Level of consciousness**	Lethargic	Stupor/coma
2.	**Spontaneous activity**	Decreased activity	No activity
3.	**Posture**	Distal flexion/complete extension	Decerebrate
4.	**Tone**	Hypotonia	Flaccid
5.	**Primitive reflexes**		
	» Suck	Weak	Absent
	» Moro	Incomplete	Absent
6.	**Autonomic nervous system**		
	» Pupils	Constricted	Deviated, dilated or non-reactive to light
	» Heart rate	Bradycardia	Variable
	» Respiration	Periodic breathing	Apnoea

Thompson Score (Long-term prognostication)

Score	1	2	3
Limb tone	Generally hypertonic	Generally hypotonic	Flaccid
LOC	Hyperalert, hyper-reactive or staring	Lethargic/Obtunded	Comatose/ Stuporous
Visible fits	Infrequent (< 3/day)	Frequent (> 2/day)	
Posture	Fisting and/or cycling	Strong distal flexion	Decerebrate
Moro	Partial	Absent	
Grasp	Poor	Absent	
Suck	Poor	Absent and/or bites	
Resp. effort	Hyperventilation	Brief apnoea	Apnoea (IPPV)
Fontanelle	Full, not tense	Tense	

Thompson, et al. The value of a scoring system for hypoxic ischaemic encephalopathy in predicting neurodevelopmental outcome. Acta Paediatr. 1997;86:757-761.

GENERAL AND SUPPORTIVE MEASURES

» Resuscitate
» Avoid hyperthermia.
» Admit to a neonatal high care or intensive care facility.
» Mild HIE: ambient temperature at the lower range of a neutral thermal environment.
» Infants ≥ 36 weeks gestation with moderate HIE (stage 2): whole body or head cooling if appropriate monitoring is available.
  > Initiate within 6 hours of birth to maintain rectal (core) temperature at 33.5–34.5ºC (whole body cryotherapy) or 34–35ºC (head cooling) for 72 hours.
  > Slowly rewarm at a rate of 0.5ºC/hour until core temperature 36.5–37.0ºC, then maintain axillary or skin temperature at 36.5–36.8ºC.

Neonates not eligible for cooling:

1. Birth weight less than 2000 g.
2. Gestational age less than 36 weeks.
3. Inability to initiate cooling by 6 hours of age.
4. Suspected coagulopathy.
5. Life-threatening abnormalities of the cardiovascular or respiratory systems such as complex congenital heart disease and persistent pulmonary hypertension of the newborn (PPHN).
6. Major congenital malformations, imperforate anus, suspected neuromuscular disorders, or presence of a known lethal chromosomal anomaly.
7. Death appears imminent.

» Ventilatory support if P_aO_2 < 60 mmHg (8 kPa) and/or P_aCO_2 > 55 mmHg (7.3 kPa) in newborns with moderate HIE (stage 2) or severe HIE (stage 3), depending on available resources.
» Maintain:
  > Blood glucose at 2.6–6 mmol/L.
  > Haematocrit at ≥ 40%.
  > Blood pressure at 70/35 mmHg in a term infant and 50/35 mmHg in a preterm infant. Mean blood pressure at least 5–10 mmHg more than the gestational age.
» IV fluids:
  > Frequent assessment of fluid balance, i.e. intake and output.
  > Restrict fluids to 40 mL/kg in the first 24–48 hours to avoid cerebral oedema.
  > Use dextrose water 10% or a neonatal maintenance solution, potassium-free, until the possibility of renal failure has been excluded.
» Maintain serum electrolytes, calcium, magnesium and acid-base status within normal physiological range.
» Nutrition:
  > No enteral feeds for at least the first 12–24 hours.
  > Enteral milk feeds (preferably breast milk) only after ileus has been excluded.

> Consider IV alimentation if enteral feeds are not possible after 24 hours.

» Monitor:
> neurological status,
> vital signs,
> acid-base status,
> blood gases,
> S_aO_2,
> blood pressure,
> brain function (aEEG), where available.
> fluid balance,
> temperature,
> blood glucose,
> electrolytes,
> calcium, magnesium,
> renal function, and

» Brain imaging – at least one cranial US during admission if available.
» Follow-up for assessment of neurodevelopment, hearing and vision.

MEDICINE TREATMENT

To keep P_aO_2 between 60 and 80 mmHg (8 and 10.5 kPa) and saturation 90–95% (normal range):

- Oxygen.

See figure 1: Blood cell transfusion thresholds for preterm neonates.
If anaemia is present according to thresholds in figure 1

- Packed red cells, IV, 10–20 mL/kg (consider pack size) over 3 – 4 hours in haemodynamically stable patients. More rapid transfusions may be appropriate in bleeding and haemodynamically unstable patients.

If infection is suspected or confirmed:
Treat as follows (if no renal dysfunction is present):

- Ampicillin, IV, 100 mg/kg/dose. Decrease the dose to 50 mg/kg/dose once meningitis has been excluded.

Gestational Age	Postnatal Age	Dose
≤ 34 weeks	≤ 7 days	50 mg/kg/dose every 12 hours
	8 to 28 days	75 mg/kg/dose every 12 hours
>34 weeks	≤ 28 days	50mg/kg/dose every 8 hours

PLUS

- Gentamicin, IV, 5 mg/kg once daily.

Where available, gentamicin doses should be adjusted based on therapeutic drug levels.

- Trough levels (taken immediately prior to next dose), target plasma level < 1 mg/L.
- Peak levels (measured 1 hour after commencement of IV infusion or IM/IV bolus dose), target plasma level > 8 mg/L.

Hypotension

- Sodium chloride 0.9%, IV, 10 mL/kg over 1 hour.

AND

- Dopamine, IV, 5–15 µg/kg/minute.

AND/OR

- Dobutamine, IV, 5–15 µg/kg/minute if cardiac dysfunction or failure is present.
  - Continue with blood pressure support until blood pressure is stabilised.

Seizure Control

Administer anticonvulsants with monitoring of cardiorespiratory function.

- Phenobarbitone, IV:
  - Loading dose: 20 mg/kg over 10 minutes.
  - Refractory seizures: Additional 10 mg/kg up to 40 mg/kg.

Maintenance:

- Phenobarbitone, IV or oral:
  - 4 mg/kg/day beginning 12–24 hours after the loading dose.

Admit neonates with seizures refractory to phenobarbitone to a high or intensive care unit.

Cardiorespiratory support is usually required in this category of infants.

For term normothermic neonates:

- Midazolam, IV.
  - Loading dose: 0.05 mg/kg IV over 10 minutes.
  - Followed by a continuous infusion of 0.03-0.3 mg/kg/hour.

OR

- Lidocaine (lignocaine), IV.
  - Loading dose: 2 mg/kg over 10 minutes.
  - Follow with a continuous infusion of:
    6 mg/kg/hour for 6 hours, then
    4 mg/kg/hour for 12 hours, followed by
    2 mg/kg/hour for 12 hours.
  - If seizures are well controlled, taper slowly over 12 hours.

For preterm neonates:

- Midazolam, IV.
  - Loading dose: 0.05 mg/kg over 10 minutes.
  - Followed by a continuous infusion of 0.03–0.3 mg/kg/hour.

OR

A safe dose of lidocaine (lignocaine) in preterm neonates has not been established but the following dosing schedule has been used.

- Lidocaine (lignocaine), IV.
  - Loading dose: 2 mg/kg over 10 minutes.
  - Follow with a continuous infusion of 3 mg/kg/hour for 3 days.
  - Taper dose gradually over the next 2 days.

CAUTION

Do not use lidocaine (lignocaine) if phenytoin was given.
Do not use lidocaine (lignocaine) for seizures in newborns with congenital heart disease, dysrhythmias, acute heart failure and shock.

» A safe lidocaine (lignocaine) dosing regimen for term infants undergoing hypothermia treatment for HIE has not been established; recommended to use half infusion dosages.
» Clearance of lidocaine (lignocaine) is slower in hypothermic preterm infants and neonates and there is a risk of accumulation.
» Start tapering earlier than 3 days if seizures are well controlled.
» Continuous monitoring of ECG, heart rate and blood pressure is mandatory if lidocaine (lignocaine) is used.
» Main adverse effects of lidocaine (lignocaine): dysrhythmias and bradycardia.
» Life threatening dysrhythmias may indicate lidocaine (lignocaine) toxicity. Treat with:
  - Lipid emulsion 20%, IV, 1.5 mg/kg over 1 minute.
    - Follow with a continuous infusion of 0.25 mL/kg/minute for 30 minutes. Refer urgently.

Cardiac failure

Restrict fluid.

- Furosemide, IV/oral/oro/nasogastric tube, 1 mg/kg/24 hours as single daily dose.
- Dobutamine IV, 5–15 µg/kg/minute.

Hypocalcaemia

Serum total calcium < 1.8 mmol/L or ionised calcium < 0.7 mmol/L.

- Calcium gluconate 10%, slow IV, 1–2 mL/kg over 15 minutes under ECG monitoring.

Hypomagnesaemia

Serum magnesium < 0.6 mmol/L:

- Magnesium sulphate 50%, IV, 0.2 mL/kg as a single dose.

Hypoglycaemia

Blood glucose < 2.6 mmol/L:

- Dextrose 10%, bolus IV, 2.5–5 mL/kg (250–500 mg/kg).
  - Dextrose 10% = 10 g dextrose in 100 mL.
  - Do not repeat dextrose bolus; titrate the glucose concentration of the IV fluid to increase glucose delivery.

Syndrome of inappropriate ADH

Moderate fluid restriction of 40 mL/kg/24 hours for the first 24–48 hours.
Raise head of cot by 10–15 cm.

Cerebral oedema/raised intracranial pressure
Moderate hyperventilation to lower P_aCO_2 to 35 mmHg (4.5 kPa), if ventilation facilities are available.

REFERRAL
» Neurological assessment of survivors at 3 months.
» Moderate HIE (gestational age ≥ 36 weeks) to reach referral hospital before 6 hours post birth.
» Lidocaine (lignocaine) toxicity.

19.6.2 SEIZURES, NEONATAL
P90

DESCRIPTION
Neonatal seizures are usually secondary to a serum biochemical disorder or an underlying brain disturbance/injury/malformation. Seizures may be subtle due to the relatively underdeveloped cortex. Seizures persist when limbs are flexed (as opposed to jitteriness).

The most likely causes are:
» perinatal asphyxia,
» birth trauma,
» intracranial haemorrhage,
» meningitis,
» narcotic or alcohol withdrawal syndrome,
» CNS developmental abnormalities.
» hypocalcaemia,
» hypomagnesaemia,
» hyponatraemia,
» hypoglycaemia,
» inborn errors of metabolism,
» pyridoxine deficiency, and

DIAGNOSTIC CRITERIA
Categories of convulsions
» Subtle seizures:
  > tonic deviation of the eyes,
  > 'swimming' movements of the arms,
  > fluttering of the eyelids,
  > 'cycling' movements of the legs,
  > sucking and chewing movements,
  > apnoea,
  > vasomotor changes.
» Tonic clonic movements.
» Focal clonic movements.
» Myoclonic movements.
» Tonic movements/posturing.

GENERAL AND SUPPORTIVE MEASURES

» Identify and treat the underlying cause, e.g. meningitis and hypoxic-ischaemic encephalopathy.
» Ensure an open airway and administer oxygen, if necessary.
» Nurse in a neutral thermal environment.
» Ensure adequate nutrition and hydration.
» Monitor and maintain within accepted physiological range:
  > respiration,
  > heart rate,
  > blood pressure,
  > blood gases,
  > S_aO_2,
  > body temperature.
  > acid-base status,
  > electrolytes,
  > minerals,
  > blood glucose,
  > haematocrit,

MEDICINE TREATMENT

Seizure Control

Administer anticonvulsants with monitoring of cardiorespiratory function.

Phenobarbitone

- Phenobarbitone, IV.
  - Loading dose: 20 mg/kg administered over 10 minutes.
  - Refractory seizures: Additional 10 mg/kg/dose up to 40 mg/kg.

Maintenance:

- Phenobarbitone, IV or oral.
  - 4 mg/kg/day beginning 12–24 hours after the loading dose.

Seizures refractory to phenobarbitone should be admitted to a high or intensive care unit.

Cardiorespiratory support is usually required in this category of infants.

For seizures refractory to phenobarbitone use:

- Midazolam, IV.
  - Loading dose: 0.05 mg/kg IV over 10 minutes.
  - Followed by a continuous infusion of 0.03-0.3 mg/kg/hour.

OR

- Lidocaine (lignocaine)

For term normothermic neonates:

- Lidocaine (lignocaine), IV.
  - Loading dose: 2 mg/kg administered over 10 minutes.
  - Follow with a continuous infusion of:
    6 mg/kg/hour for 6 hours, then,
    4 mg/kg/hour for 12 hours, then,
    2 mg/kg for 12 hours.
  - If seizures are well controlled, slowly taper lidocaine (lignocaine) over 12 hours.

For preterm neonates:

- Midazolam, IV.
  - Loading dose: 0.05 mg/kg IV over 10 minutes.
  - Followed by a continuous infusion of 0.03–0.3 mg/kg/hour.

OR

A safe dose of lidocaine (lignocaine) in preterm neonates has not been established but the following dosing schedule has been used.

- Lidocaine (lignocaine), IV.
  - Loading dose: 2 mg/kg administered over 10 minutes.
  - Follow with a continuous infusion of 3 mg/kg/hour for 3 days.
  - Gradually taper lidocaine (lignocaine) over next 2 days.

CAUTION

Do not use lidocaine (lignocaine) if phenytoin was given.
Do not use lidocaine (lignocaine) for seizures in newborns with congenital heart disease, dysrhythmias, acute heart failure and shock.

» A safe lidocaine (lignocaine) dosing regimen for term infants undergoing hypothermia treatment for hypoxic ischaemic encephalopathy has not been established.
» Clearance of lidocaine (lignocaine) is slower in hypothermic neonates and preterm infants. There is a risk of accumulation.
» Start tapering earlier than 3 days if seizures are well controlled.
» Continuous monitoring of ECG, heart rate and blood pressure is mandatory if lidocaine (lignocaine) is used.
» Dysrhythmias and bradycardia are the main side effects of lidocaine (lignocaine). Life threatening dysrhythmias may indicate lidocaine (lignocaine) toxicity.

Lidocaine (lignocaine) toxicity:

- Lipid emulsion 20%, IV, 1.5 mg/kg administered over 1 minute.
  - Follow with a continuous infusion of 0.25 mL/kg/minute for 30 minutes. (See Referral section.)

Pyridoxine deficiency:

- Pyridoxine, IV/IM, 20 mg/kg.

Maintenance anticonvulsant therapy

» Maintenance anticonvulsant therapy is usually considered for neonates with underlying brain damage due to hypoxic-ischaemic encephalopathy, meningitis, intracranial haemorrhage or birth trauma.
» Continue until neonate is seizure-free for 2 weeks, then slowly taper to stop.
» If seizures recur during tapering of anticonvulsant therapy, continue with maintenance therapy.
» Follow-up by medical practitioner or at clinic/hospital after discharge.

Note:
Patients with head or whole body cooling should have an adjustment of the anticonvulsant doses.

Hypocalcaemia
Serum total calcium ≤ 1.8 mmol/L, or ionized calcium < 0.7 mmol/L.
- Calcium gluconate 10%, IV, 100–200 mg/kg/dose administered over 10 minutes.
  - Dilute 1:4 with dextrose 5% water.
  - Administer under ECG monitoring over 5 minutes (preferred) or until seizure ceases. Repeat if necessary.
    (1 mL of 10% calcium gluconate = 100 mg calcium gluconate.)

Hypoglycaemia
Serum glucose < 2.6 mmol/L.
- Dextrose, IV as bolus, 250–500 mg/kg.
  - Follow with 6–12 mg/kg/minute or more until blood glucose is within the physiological range. (10% Dextrose = 10 g dextrose/100 mL).

Hypomagnesaemia
Serum magnesium < 0.6 mmol/L.
- Magnesium sulphate 50%, IV, 0.25 mL/kg administered slowly over 3 minutes as a single dose.

REFERRAL
» Seizures not responding to adequate therapy.
» Seizures where the underlying cause is unclear.
» Refractory cases for further treatment and aEEG monitoring.
» Lidocaine (lignocaine) toxicity.

19.7 METABOLIC

19.7.1 HYPOCALCAEMIA, NEONATAL
P71.1

DESCRIPTION
Acute symptomatic hypocalcaemia may present within the first 72 hours of birth (early hypocalcaemia) or after 72 hours of birth (late hypocalcaemia) with apnoea, irritability, seizures, jitteriness or prolonged QTc interval on ECG.

Causes of early hypocalcaemia include:
» Prematurity
» Respiratory distress syndrome.
» Asphyxia/hypoxia.
» Neonate of a diabetic mother.
» Sepsis

Causes of late hypocalcaemia include:
» Maternal hyperparathyroidism.
» Congenital hypoparathyroidism.
» Renal failure.
» Hypomagnesaemia
» High phosphate feeds.
» Vitamin D deficiency.

DIAGNOSTIC CRITERIA
» Total serum calcium < 1.8 mmol/L, or
» Ionised calcium < 0.7 mmol/L.

MEDICINE TREATMENT
Symptomatic hypocalcaemia:
- Calcium gluconate 10%, IV, 100–200 mg/kg/dose 6–8 hourly.
  1 mL of calcium gluconate 10% = 100 mg calcium gluconate
  = 10 mg elemental calcium
  = 0.23 mmol calcium

Correct hypomagnesaemia before administering 10% calcium gluconate.
- Magnesium sulphate 50%, IV, 0.25 mL/kg.
  - Monitor levels until deficits are reduced.

Acute hypocalcaemia with seizures:
- Calcium gluconate 10%, IV infusion, 100–200 mg/kg, administered over 10 minutes. Repeat in 15 minutes if necessary.
  - Dilute 1:1 with dextrose 5% or sodium chloride 0.9%.
  - Do not use calcium chloride.

Note: Rapid infusion causes bradycardia/dysrhythmias. Electrocardiographic monitoring is advised. Monitor the heart rate.

CAUTION
Do not mix calcium gluconate with bicarbonate or fluids containing phosphate, as precipitation may occur. Extravasation of calcium can cause tissue necrosis. Do not give intra-arterially or via umbilical venous catheters placed near the heart or inside the liver.

REFERRAL
» Persisting or recurrent unexplained hypocalcaemia.

19.7.2 HYPOGLYCAEMIA, NEONATAL

P70.4

DESCRIPTION

Neonate presenting with whole blood glucose below 2.6 mmol/L.

Risk factors include:

- » prematurity,
- » small for gestational age,
- » neonate of diabetic mother,
- » sepsis,
- » hypothermia/hyperthermia,
- » perinatal asphyxia,
- » hereditary defects in carbohydrate or amino acid metabolism.
- » respiratory distress,
- » rhesus iso-immunisation,
- » hyperinsulinism,
- » post maturity,
- » feeding difficulties,
- » polycythaemia,
- » large for gestational age infants,

DIAGNOSTIC CRITERIA

Clinical

Asymptomatic: Hypoglycaemia detected when screening neonates at risk.

Symptomatic:

- » lethargy,
- » hypotonia,
- » apnoea,
- » jitteriness,
- » irritability,
- » coma.
- » poor feeding,
- » respiratory distress,
- » cardiac failure,
- » convulsions,
- » metabolic acidosis, and

Investigations

» Whole blood glucose (heel prick) < 2.6 mmol/L.

Monitor the blood glucose of all neonates who are at risk of hypoglycaemia regularly, at least 2 hourly, to prevent the development of hypoglycaemia.

GENERAL AND SUPPORTIVE MEASURES

» Determine and treat the underlying cause.
» Enteral feeding, oral or via oro/nasogastric tube, after exclusion of vomiting, ileus or obstruction.

MEDICINE TREATMENT

- Dextrose 10%, bolus IV, 2.5 mL/kg (250 mg/kg).
  - Dextrose 10% = 10 g dextrose in 100 mL.
  - Do not repeat dextrose bolus.

To raise heel prick blood glucose to a level of 2.6 mmol/L or more, follow with:

- Dextrose 10%, continuous IV infusion, 6–12 mg/kg/minute or more.

$$\text{Dextrose dose (mg/kg/min)} = \frac{\text{(\% dextrose solution x rate in mL/hour)}}{\text{(weight x 6)}}$$

If heel prick blood glucose remains below 2.6 mmol/L:

- Dextrose 15%, IV via a central line, 15 mg/kg/minute or more.
  - Dextrose 15% = 15 g dextrose in 100 mL.

If heel prick blood glucose is above 2.6 mmol/L after IV infusion has been started, continue infusion at maintenance rate.

Monitor blood glucose at least 2 hourly until blood glucose level stabilises at 2.6 mmol/L or above. To avoid rebound hypoglycaemia, reduce IV dextrose infusion gradually.

Before the IV infusion is finally discontinued, the neonate should receive all milk feeds orally or via oro/nasogastric tube. If enteral feeds are not tolerated, TPN should be given.

Suspect other serious underlying metabolic or biochemical abnormality if the neonate requires > 12 mg/kg/minute of dextrose to maintain a heel prick whole blood glucose > 2.6 mmol/L.
Use a central venous line for high concentrations of dextrose.

Prior to referral, give the following, if available:

- Glucagon, IM/IV/SC, 0.2 mg/kg single dose.

REFERRAL

» Hypoglycaemia not responding to adequate treatment.
» Recurrent or persistent hypoglycaemia.
Also see Chapter 7: Endocrine System, section 7.6: Hypoglycaemia in children.

19.7.3 THE INFANT OF A DIABETIC MOTHER (IDM)

DESCRIPTION

Infants born to a mother with established or newly diagnosed diabetes mellitus. The foetus will be exposed to high levels of insulin in utero if maternal glycaemic control is not achieved, with foetal pancreatic hypertrophy as an adaptive measure. The infant of a diabetic mother is at increased risk of morbidity and mortality.

DIAGNOSTIC CRITERIA

IDM babies may show signs related to insulin and/or glucose toxicity, as well as complications of the withdrawal of insulin. As maternal diabetes may be undiagnosed, the condition should be suspected in infants with the following:

» Hypoglycaemia
» Polycythaemia
» Hyperbilirubinaemia
» Respiratory distress syndrome.
» Hypertrophic cardiomyopathy.
» Congenital malformations, especially cardiac malformations and sacral agenesis.
» Macrosomia, which predisposes to birth injuries.

GENERAL AND SUPPORTIVE MEASURES
» Strict glucose monitoring: after birth, at 30 minutes, 1 hour, 2 hours and before each feed for all LGA babies or a confirmed IDM.

MEDICINE TREATMENT
Refer to section 19.7.2: Hypoglycaemia, neonatal.

REFERRAL
» Severe, persistent hypoglycaemia requiring more than 12.5% intravenous dextrose to maintain normal glucose levels.
» Congenital malformations or birth injuries requiring specialist management.

19.8 HAEMATOLOGY

19.8.1 HAEMORRHAGIC DISEASE OF THE NEWBORN
P53

DESCRIPTION
This is due to a deficiency of vitamin K-dependent clotting factors II, VII, IX and X. All newborns who did not receive vitamin K_1 at birth, especially preterm babies and breastfed babies, are at risk.

Spontaneous bleeding may be from any site but is usually gastrointestinal, producing haematemesis or melaena. Bleeding from the umbilical stump, epistaxis and a cephalohaematoma or subgaleal haemorrhage are also relatively common.
Complications may include anaemia, hypovolaemic shock and intracranial haemorrhage with neurological damage.

There are three forms of the disorder:
Early form: Presents within 24 hours of birth in newborns of mothers on treatment with anticonvulsants, e.g. phenytoin and phenobarbitone, or oral anticoagulants.
Classical form: Presents during the first week of life, usually on the second to seventh day.
Late form: Presents during the first to fourth month of life usually with intracranial haemorrhage in exclusively breastfed babies who did not receive vitamin K prophylaxis at birth.

DIAGNOSTIC CRITERIA

Special investigations

» Prolonged prothrombin time (PT).
» Normal partial prothrombin time (PTT).
» Increased international normalised ratio (INR) with a normal platelet count.
» Normal fibrinogen levels.
» Normal thrombin time.

Note:
» Exclude other causes of bleeding in the neonate.
» Exclude swallowed blood of mother during delivery in babies with melaena. (Apt test or haemoglobin electrophoresis).

GENERAL AND SUPPORTIVE MEASURES

» Nurse in a neutral thermal environment.
» Provide adequate nutrition.
» Monitor:
  > blood pressure,
  > heart rate,
  > respiratory rate,
  > body temperature,
  > coagulation parameters.
  > hydration,
  > S_aO_2,
  > haematocrit,
  > blood glucose, and

MEDICINE TREATMENT

- Oxygen, if needed.

- Fresh frozen plasma or lyophilised plasma, IV, 20 mL/kg over 1 hour.

If anaemic (haematocrit < 40% or Hb < 13 g/dL):
- Packed red cells, IV, 10 mL/kg over 1 hour.
  - May be repeated if necessary.

- Vitamin K_1, IM, 1 mg as a single dose.

Prophylaxis

- Vitamin K_1, IM, single dose at birth.
  Full term newborns: 1 mg.
  Preterm newborns: 0.5 mg.

Prophylaxis with oral vitamin K formulation is not recommended.

REFERRAL

» Deterioration of clinical condition despite adequate treatment.
» Suspected intracranial haemorrhage.

19.9 UNDERWEIGHT FOR GESTATIONAL AGE (UGA)

DESCRIPTION

UGA is failure of an infant to achieve their genetic growth potential. This may be due to maternal, placental or foetal factors in utero.

DIAGNOSTIC CRITERIA

» The birth weight of the underweight for gestational age infant plots below the 10th centile on the Fenton chart.
» Symmetrically wasted: weight, length and head circumference is below the 10th centile. Causes include chromosomal disorders, genetic abnormalities, chronic intra-uterine infection, maternal under-nutrition, and teratogenic agents such as alcohol.
» Asymmetrically wasted: only the weight is below the 10th centile. Causes include placental insufficiency, hypertension and diabetes mellitus during pregnancy and smoking during pregnancy.

The neonate is at risk of:
» Preterm delivery.
» Birth asphyxia.
» Hypoglycaemia
» Polycythaemia
» Hypothermia
» Increased mortality.

GENERAL AND SUPPORTIVE MEASURES:

» Admit unwell/unstable infants to a neonatal high/intensive care facility.
» Temperature control:
  > Kangaroo mother care: Initiate if baby is well and vital signs are stable.
  > Keep infant's temperature, axilla or skin of anterior abdominal wall, at 36.5–37.5°C.
» Whole blood glucose (heel prick) < 2.6 mmol/L.
  > Monitor the blood glucose, at least 2 hourly, to prevent the development of hypoglycaemia.
  > See management of hypoglycaemia (section 19.7.2: Hypoglycaemia, neonatal) if the glucose < 2.6 mmol/L.
» If renal function is compromised, use a potassium-free solution.
» Hospital discharge if:
  > clinically well,
  > able to breastfeed or formula feed,
  > able to maintain body temperature, and
  > weight > 1.8 kg, and on an upward trend.
» Follow-up visits to assess growth parameters and neurodevelopment.

REFERRAL

Presence of one or more of the following complications that cannot be managed at the facility:

» Respiratory distress requiring ventilatory support.
» Feeding difficulties where the underlying cause is unclear.
» Congenital abnormalities requiring surgical intervention.
» Hypoglycaemia not responding to treatment.

19.10 NEONATAL ABSTINENCE SYNDROME (NAS)

P96.1

DESCRIPTION

Postnatal opioid (or non-opioid illicit drug) withdrawal syndrome occurring in 55–94% of newborns whose mothers were addicted to or treated with opioids or other non-opioid illicit drugs, during pregnancy.

Can result in:

» foetal malformation,
» intrauterine death,
» preterm delivery,
» growth restriction, and
» an increased risk of antepartum haemorrhage (APH).

After birth, withdrawal symptoms are most commonly associated with opiate exposure, but can occur with a wide range of substances, including SSRIs, which have a separate guideline. Babies developing Neonatal Abstinence Syndrome (NAS) risk subsequent morbidity and SIDS mortality. A multi-disciplinary approach is needed to optimise care for often, complex social, psychological and support issues.

DIAGNOSTIC CRITERIA

Mother:

» Assess the mother's drug use – especially during pregnancy.
» The mother's urine may be screened for drugs as well.

Newborn:

» Neonatal abstinence syndrome scoring system (Modified Finnegan can be used: http://www.lkpz.nl/docs/lkpz_pdf_1310485469.pdf), which assigns points based on each symptom and its severity. The infant's score can help determine treatment.
» Toxicology (drug) screen of urine and of first bowel movements (meconium).

GENERAL AND SUPPORTIVE MEASURES

» At birth, record maternal past and current drug use, dosage and route, including time of last use. Inquire about partner’s drug use – consider adding it to the Road-to-Health Chart.
» Record relatives’ awareness of maternal drug use.

» Check and document mother's viral status and offer Hepatitis B vaccine.
» Record mother's choice of feeding method, noting prior discussions and decisions.
» Breastfeeding is not contra-indicated. Mother and baby need to be monitored closely.
» Collect a urine sample from baby within 48 hours to check drug exposure – maternal consent, check antenatal record.
» Commence withdrawal observations 4 hourly/1-hour post feed times for at least 72 hours and record severity level. See the table below for guidance.

Table for timing of symptoms onset.

Typical timing of symptom onset	Substance
3–72 hours	Alcohol, heroin, morphine, buprenorphine, codeine, diazepam, SSRIs.
24 hours–21 days	Methadone, benzodiazepines, barbiturates.

MEDICINE TREATMENT

Withdrawal symptoms are reduced when drugs from the same group are re-introduced. Heroin is the most commonly abused illicit opioid in South Africa and is referred to as 'unga' or 'Thai white'. 'Sugars' is a mixture of cheap heroin and cocaine that can be cut with a variety of other substances that may even include rat poison or other household detergents. 'Nyaope' is a mixture of cheap heroin and cannabis that is commonly used is Gauteng. This mixture is also referred to as 'Pinch' in other some areas. There is debate about the exact content of the street drug, 'Woonga'. It is thought to consist of a number of different substances, that may include heroin, crystal methamphetamine as well as rat poison and antiretroviral medications, specifically efavirenz.

Medicine treatment of NAS

Problem Drug	Treatment Options
Opiate withdrawal	• Morphine sulphate o 40 µg/kg/dose 4 hourly. o Increase dose 20–40 µg/kg/dose 8 hourly until symptoms controlled. o Maximum dose: 100 µg/kg/dose. (Addition of phenobarbitone may reduce symptom severity.)
Non-opiate withdrawal	• Phenobarbitone o 20 mg/kg, orally, loading dose. o Maintenance dose 24 hours later. o 4 mg/kg daily in 2 divided doses.

Seizure management	Any seizures should be fully investigated: Refer to section 19.6.2: Seizures, neonatal.
	
	• Phenobarbitone
	  ○ 20 mg/kg, orally, loading dose.
	  ○ Maintenance dose 24 hours later.
	  ○ 4 mg/kg daily in 2 divided doses.
	
	For opioid withdrawal:
	• Morphine sulphate (for opiate withdrawal) 100 mcg/kg stat dose, oral/IV, according to clinical status.
	If on maintenance morphine sulphate, consider increasing dose.

Weaning process

» Decrease dose, NOT dose interval time.
» Discuss weaning difficulties with a specialist.

Weaning regimen

Drug	Weaning Regimen
Morphine sulphate	After 24–48 hours of symptom control, reduce dose by 10–20% each 24–48 hours as tolerated until dose of 20 mcg/kg reached. Discontinue morphine once dose is 10 mcg/kg/day and observe for 48 hours.
Phenobarbitone	After 24–48 hours of stability, reduce dose by 2 mg/kg/dose 48 hourly as tolerated.

Note:
» Continue NAS assessments for 48 hours after discontinuing medication.
» Ensure Hepatitis B immunisation is given when due.

REFERRAL

» All neonates with repeated seizures.

CHAPTER 20

PAIN CONTROL

20.1 PAIN CONTROL

R52.9

DESCRIPTION

Pain is an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage, or described in terms of such damage.

Pain is an inherent part of the pathology of most medical and surgical diseases. Children are especially vulnerable to poor pain management, largely due to underestimation of pain severity (by clinicians and parents). This frequently results in inappropriate management of pain, e.g. paracetamol only for management of moderate or severe pain, and not using opioids when indicated.

Acute pain is of sudden onset, is felt immediately following injury, is severe in intensity, but is usually short-lasting. It arises from tissue injury which stimulates nociceptors, and generally disappears when the injury heals.

Chronic pain is continuous or recurrent pain that persists beyond the expected normal time of healing. Chronic pain may begin as acute pain and persist for long periods, or may recur due to persistence of noxious stimuli or repeated exacerbation of an injury. Chronic pain may also arise and persist in the absence of identifiable pathophysiology or medical illness. Chronic pain can negatively affect all aspects of daily life, including physical activities, school attendance, sleep patterns, family interactions and social relationships and can lead to distress, anxiety, depression, insomnia, fatigue or mood changes, such as irritability and negative coping behaviour. As pain is an outcome of an interaction of many factors, a holistic approach to the child and family is required.

Good pain management involves 6 steps:

1. A high index of suspicion that pain is present.
2. Accurate pain assessment that is developmentally appropriate, using scoring tools.
3. Making an assessment of pain severity – mild, moderate or severe.
4. Initiating non-pharmacological pain management strategies.
5. Timely administration of analgesia, appropriate for the severity of pain.
6. Reassessment within an appropriate time period, and ongoing care.

Pain assessment

Evidence-based practice supports the routine use of pain scoring tools for pain assessment. These tools enable a more accurate pain diagnosis, which serves to guide appropriate pain management.

Accurate assessment of pain severity can be achieved through:

» Self-report: This is only possible for children aged 5–7 years and older.
» Behavioural tools: There are various composite tools that can be utilised for children who are preverbal, or cognitively impaired. The correct tool is one that is developmentally appropriate and can be used consistently.

Physiological variables such as heart rate, blood pressure, and respiratory rate are unreliable indicators of the presence or absence of pain.

Choose an appropriate pain assessment tool depending on the child's age and cognitive development. This facilitates the quantification of pain, which is then used to diagnose mild, moderate, or severe pain.

Neonates: Behavioural pain assessment tool (Table 1)

This tool is used in neonates and infants up to 2 months of age. The patient is observed for one minute and each parameter scored. The maximum score is 7. The score is tallied, and a diagnosis of pain severity is made (see below).

Table 1: Neonatal Infant Pain Scale (NIPS)

NEONATAL INFANT PAIN SCALE (NIPS)			
	0	**1**	**2**
Facial expression	Relaxed	Contracted	
Cry	Absent	Mumbling	Vigorous
Breathing	Relaxed	Different than basal	
Arms	Relaxed	Flexed/stretched	
Legs	Relaxed	Flexed/stretched	
Alertness	Sleeping/calm	Uncomfortable	

Infants and children (2 months to 18 years old): Behavioural pain assessment tool (Table 2)

This tool can be used in children aged 2 months to 18 years and includes descriptors for cognitively impaired children. The clinician assigns a score to each parameter, and tallies a score out of 10. The final score is used to diagnose mild, moderate, or severe pain, which must be treated accordingly (see below).

Table 2: Revised FLACC Tool (R-FLACC)

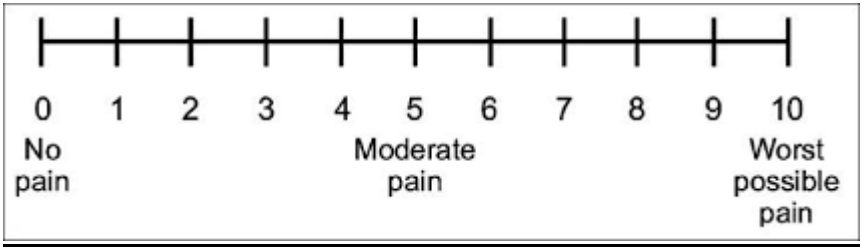
Revised FLACC Tool (R-FLACC)			
	0	**1**	**2**
Face	No particular expression/ smile.	Occasional grimace/frown; withdrawn or disinterested. Appears sad/worried.	Constant grimace/frown, quivering chin, clenched jaw. Looks distressed, expression of fright/panic.
Legs	Normal position or relaxed.	Uneasy, restless, tense. Occasional tremors.	Kicking or legs drawn up, spasticity, constant tremors, jerking.
Activity	Lying quietly, normal position, moves easily.	Squirming, shifting back and forth, tense, mildly agitated. Shallow, splinting respirations, intermittent sighs.	Arched, rigid, jerking. Severe agitation. Breath-holding, gasping, sharp intake of breath. Severe splinting.
Crying	No cry (awake/ asleep).	Moans or whimpers, occasional complaint, verbal outburst/grunt.	Crying steadily, screams, sobs. Frequent complaints/ outbursts, constant grunting.
Consolability	Content, relaxed.	Reassured by occasional touching, 'talking to', hugging. Distractible.	Difficult to console/comfort. Pushing away caregiver or comfort measures.

Self-reporting pain assessment tools: The gold standard of pain assessment is self-report. Consider using self-report tools from > 5 years. If the child is unable to self-report, use R-FLACC.

Numerical Rating Scale (Figure 1)

The Numeric Rating Scale (NRS) (Figure 1) assigns a number to their level of pain. Ask the child: 'From one to ten, if one is very little pain and ten is the worst pain you could imagine, how bad is your pain now?'

Figure 1: Numeric Rating Scale (NRS)



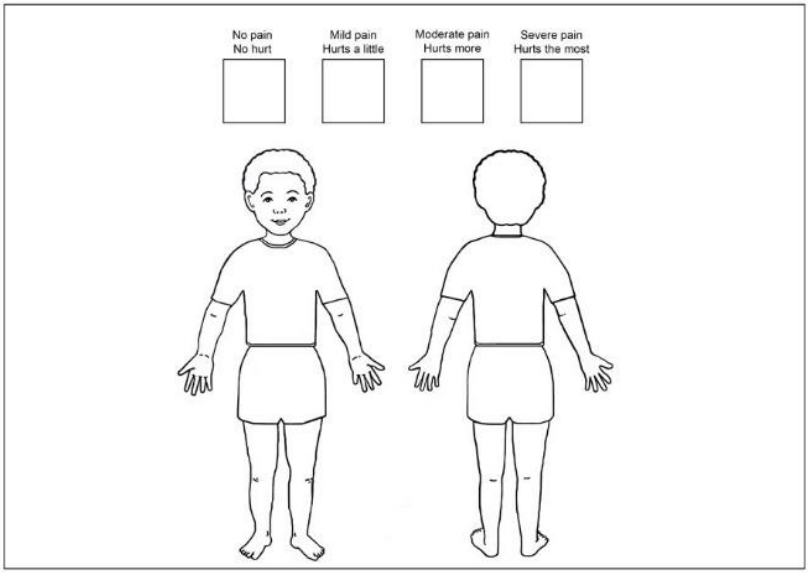
Self-reporting pain assessment tool – Eland Colour Tool (Figure 2)

After discussing with the child several things that have hurt or caused the child pain in the past:

1. Present the child with four crayons or markers of different colours.
2. Using the term that the family and child use to describe hurt or pain (the word 'pain' is used in these instructions), ask the following questions and, after the child has answered, mark the appropriate square on the tool:
   - » Of these colours, which colour is most like the worst pain you have ever had, or the worst pain anybody could ever have?
   - » Which colour is almost as much pain as the worst pain, but not quite as bad?
   - » Which colour is like a little pain?
   - » Which colour is like no pain at all?
3. Show the four colours to the child in order, from the colour chosen for the worst pain to the colour chosen for no pain.
4. Ask the child to colour within the body outlines in the places where it hurts on their own body, using the colours chosen to show how much it hurts.
5. When finished, ask if this is a picture of how it hurts now or how it hurt earlier. Be specific about what earlier means by relating the time to an event, for example, at lunch or in the playroom.

Note: Ask the child what their favourite colour is before starting and remove that one from the group of colours, as you don't want them to associate pain with this colour.

Figure 2: Eland Colour Tool



Assess pain severity

Use the pain assessment tools to make a diagnosis of no pain, mild, moderate or severe pain. For neonates/infants use the NIPS:

» 0–2 points = no pain.
» 3–4 points = moderate pain.
» > 4 points = severe pain.

For R-FLACC and NRS:

» 0 = no pain.
» 1–3 = mild pain.
» 4–7 = moderate pain.
» 8–10 = severe pain.

Once the severity of pain has been diagnosed, initiate the appropriate level of management.

PAIN MANAGEMENT

After assessing and scoring pain, proceed to pain management according to severity. Optimal pain control includes managing baseline pain (usually associated with the pathology), and pain associated with procedures. Always include non-pharmacological pain management strategies. Anxiety, fear, and pain in children are intricately linked. Addressing these is important in managing pain adequately and holistically.

Principles of pain management in children (aligned with the World Health Organization)

» Each child deserves a pain management strategy that is tailored to his/her physical, physiological, emotional and social needs.
» Give analgesia 'by the clock'. Prescribe scheduled analgesia and avoid dosing 'as necessary' or pro re nata (PRN) as far as possible. If PRN dosing is used, ensure that the caregiver remains present and is sufficiently empowered to request analgesia if in pain, and that this request will be attended to by nursing staff.
» Give analgesia by the most appropriate route. Intermittent intramuscular injections are distressing to children and are less effective in achieving pain control than other routes of administration. Their use is strongly discouraged.
» Treat pain according to severity – mild, moderate or severe. To diagnose pain severity, always use pain scoring tools. This will direct appropriate pain management.

GENERAL AND SUPPORTIVE MEASURES

» Discuss pain management with the family, including the child, as developmentally appropriate.
» Address all factors that may contribute to pain and associated symptoms, e.g. family stress, anxiety and sleep deprivation. Address parental/caregiver anxiety.
» As far as possible, minimise separation of the child from the parent/ caregiver.
» Ensure that child is comfortable, e.g. nappy is clean and dry, child is fed.

NON-MEDICINE PAIN MANAGEMENT STRATEGIES:

Type of intervention	Examples of evidence-based interventions
Contextual	Cluster procedures to reduce handling and allow rest.
Physical	Breast feed, non-nutritive sucking (dummy/pacifier), Kangaroo Mother Care/parental holding (not restraint), facilitated tucking, 24% sucrose, massage, containment, aromatherapy, keep warm. Ice for acute injuries with significant swelling. Immobilise/splint fractures. Cover burns or bleeding wounds.
Cognitive	Explain procedures, allow music, provide appropriate reassurance, educate on pain mechanisms, encourage mindfulness, distraction, imagery, favourite toy, music therapy.
Emotional	Caregiver presence, structured caregiver involvement (provide guidance), caregivers voice, clinician voice calm, soothing, positive affirmations, active reassurance. Parental involvement and interaction should be actively encouraged and should be an integral part of care.

Type of intervention	Examples of evidence-based interventions
Environmental	Reduce noise, dim lights, set monitor alarms. Use incubator covers/sheets to decrease light levels as appropriate for each baby. Create a child-friendly environment.

The oral administration of sucrose is a safe and effective form of analgesia for short-duration procedures and may be given for repeated procedures. It is effective in neonates and infants up to 18 months of age. The dose is 0.05–0.5 mL. Technique for using sucrose:

» Two minutes prior to the painful procedure or to settle the neonate in pain, administer a small amount of the dose, about one drop, onto the neonate's tongue using a pacifier or syringe. If necessary, repeat giving a drop of sucrose onto the infant's tongue during the procedure.
» Use the smallest amount of sucrose to provide pain relief, and if necessary, administer in small drops until the maximum recommended volume is achieved.
» Sucrose is more effective if given in conjunction with non-nutritive sucking using a pacifier.
» Comfort measures, such as facilitated tucking, rocking, skin-to-skin care and swaddling, may be used in conjunction with the sucrose during the procedure.

20.1.1 MANAGEMENT OF PAIN

20.1.1.1 ACUTE PAIN

R52.0

DESCRIPTION

Acute pain is pain of short duration that usually resolves as injured tissues heal.

Note:
» Do not hesitate to start with opioid analgesia in cases of severe pain.
» Always reassess the degree of response and adjust management accordingly.

MEDICINE TREATMENT

» The correct use (dose, scheduling, duration) of the correct analgesic will relieve most pain in children.
» Multimodal analgesia employs a variety of treatment strategies, both medicine and non-medicine, targeting multiple receptors involved in nociception. This facilitates improved pain control, while allowing for reduced doses of agents with unfavourable side-effect profiles (e.g.

opioids). Adjuvant agents include local anaesthetics, simple analgesics, opioids, α_2 receptor agonists (clonidine), NMDA receptor antagonists (ketamine, magnesium sulphate), and anxiolytics.

Simple analgesics

This includes paracetamol, NSAIDs and local anaesthetic agents. They are generally safe, provided dosing instructions and other cautions are adhered to, with favourable side-effect profiles. These agents should be considered as part of any analgesic strategy. They reduce the amount of opioid needed to achieve equivalent levels of analgesia.

- Paracetamol:
  - Oral paracetamol is the preferred route of administration. It is cheap and effective, and considers the placebo effect.
  - IV paracetamol should be reserved for patients who cannot receive oral paracetamol, i.e. those with gastrointestinal pathology causing poor absorption or not allowing for feeding.
  - Rectal route can be considered in patients who are unable to take oral medicines, where IV access is not available. Administration via the rectal route should be avoided in children with neutropenia.

Note: Suppositories should not be cut into pieces, as the amount of paracetamol in each portion may not be consistent.

Route	Loading dose	Maintenance dose				
		Preterm neonates < 32 weeks	Neonates	Infants 30 days to 3 months	3 months to 12 years	Maximum daily dose
Oral	20 mg/kg	10 mg/kg 12 hourly (Maximum 30 mg/kg/day)	10 mg/kg 6 to 8 hourly	10 mg/kg 6 hourly	15 mg/kg 6 hourly	Neonates: 60 mg/kg/day Children over 1 month: 90 mg/kg/day (Maximum 4 g/day)
Intravenous	20 mg/kg	10 mg/kg 12 hourly (Maximum 30 mg/kg/day)	10 mg/kg 6 to 8 hourly	10 mg/kg 6 hourly	15 mg/kg 6 hourly	Neonates: 60 mg/kg/day Children over 1 month: 90 mg/kg/day (Maximum 4 g/day)
Rectal	40 mg/kg	Not recommended	30 mg/kg/dose 6 hourly			Maximum5 g /day

» Avoid prolonged use of paracetamol.
» Caution and dose reduction needs to be considered when administering paracetamol to chronically sick or malnourished children.

Non-steroidal anti-inflammatory drugs (NSAIDS)
These should be considered as part of any analgesic strategy. Serious adverse events after NSAIDs are rare in children aged ≥ 6 months of age. Children over 3 months of age can safely receive ibuprofen. Due to the risk of Reye Syndrome, aspirin should be avoided.

- Ibuprofen, oral, 5–10 mg/kg/dose 6–8 hourly with meals.
  - Maximum daily dose is 40 mg/kg/day.
  - Can be used in combination with paracetamol and opioids.

Opioid therapies
Opioid medicines are essential in the management of moderate and severe pain. Unfortunately, fear and lack of knowledge about the use of opioids in children are often barriers to effective relief of pain and suffering.

Opioids
- Morphine, oral [Immediate release morphine (liquid)]:
  If 0–1 month of age: 0.05 mg/kg 6 hourly.
  If > 1–12 months of age: 0.1 mg/kg/dose 4–6 hourly.
  If > 12 months of age: 0.2–0.4 mg/kg/dose 4–6 hourly.
  - Onset of action: 20–40 minutes.
  - Time to peak action: 60–90 minutes.
  - Duration of action: 3–6 hours.
  - Neonates and patients with hepatic and renal dysfunction may require dose modification – specialist consultation.

- Morphine, IV:
  - IV morphine is indicated if pain is severe, or the patient is unable to take oral morphine. Titrate morphine slowly to achieve pain control and avoid side effects. Give small doses at 5–10 minute intervals, with frequent reassessment.
  - Time to peak action: 20–40 minutes.
  - Duration of action: 4–6 hours.
  - For infusions: Morphine 0.5 mg/kg diluted up to 50 mL with dextrose 5% or sodium chloride 0.9%. 1 mL = 10 mcg/kg.
  - Give morphine bolus slowly over 3–5 minutes.

Table: Dosing guide for IV morphine

Age	4 hourly bolus dosing (mg/kg)	Infusion dose (mcg/kg/hour)	mL/hour*
Neonate	0.025–0.05	5–10	0.5–1
1–6 months	0.05	10–30	1–3
6 months–1 year	0.05–0.2	20–30	2–3
1–12 years	0.1–0.2	20–30	2–3

- Fentanyl, IV:
  - Fentanyl is a strong opioid, 100 times more potent than morphine. IV fentanyl is the preferred agent in severe renal dysfunction or renal failure, and can also be used in patients with liver failure. Titrate fentanyl to achieve pain control and avoid side effects. Start at the lower dosing range in opioid naïve patients.
  - Bolus dose: 0.5–2 mcg/kg, repeated at 30–60 minutes. Give bolus slowly over 3–5 minutes.
  - Infusion dose: Give bolus dose, then commence infusion at 1 mcg/kg/hour.
  - Onset of action: 1 minute.
  - Time to peak action: 5.8 minutes.
  - Duration of action: 30–60 minutes.
  - For infusions:
    - Neonates: 200 mcg/kg in 20 mL 5% dextrose: 0.1 mL/hour = 1 mcg/kg/hour.
    - > 1 month: 20 mL neat fentanyl (50 mcg/mL). 0.1 mL/kg/hour = 5 mcg/kg/hour.

Managing opioid-related side effects:
Some side-effects are common and require prophylactic management. Fortunately, life-threatening side effects are uncommon, provided recommended dosing is adhered to. It is inappropriate to deny children appropriate opioid analgesia where indicated, due to fear of side-effects.

Constipation	• Lactulose, oral, 0.5 mL/kg 12 hourly. ○ Also see Chapter 21: Palliative Care, section 2.1.1.4: Constipation.
Nausea/vomiting	• Ondansetron, IV, 0.15 mg/kg 8 hourly.

Management of opioid-induced respiratory depression
Also see Chapter 18: Poisoning, section 18.1.10: Opioid poisoning.
	This is uncommon if safe prescription is adhered to – correct route/dose/scheduling.
	• Stop the opioid.
	• Stimulate the patient – gently rouse, call and ask to breathe.
	• Give oxygen.
	• Give naloxone if indicated.
	
	Indications for Naloxone:
	• Significant sedation – arousable only with deep or significant physical stimulation, or un-arousable.
	Instructions for administration:
	• Dose: 10 mcg/kg slowly (over 2 minutes) IV/IM/SC. Repeat if necessary.
	• For ease of dosing and administration:
	  ○ Naloxone: 0.4 mg diluted to 10 mL with 0.9% sodium chloride.
	  ○ Give 0.25 mL/kg/dose IV/IM/SC.
	• Repeat every 2 minutes IV, or every 15 minutes IM/SC, x 4 doses as needed.
	• If no IV access: Give intranasally (IN): 1 mg per nostril (NOT per kilogram). Repeat as needed after 3–5 minutes.

<u>Monitoring in patients receiving opioids (in ward/high care/ICU):</u>
A suitably trained nurse must be available to monitor, initiate management, and escalate care, or call a doctor when necessary. Resuscitation equipment must be readily available, checked, and in working order. Naloxone must be immediately available.

All patients receiving opioids should have the following monitored and documented:
» Heart rate.
» Oxygen saturation via continuous saturation monitoring for the first 15 minutes.
» Respiratory rate.
» Level of consciousness.
» Pain scores.

Frequency of monitoring:
» Observe closely for 15 minutes after administering the first opioid dose.
» Then do observations every 30 minutes for the first hour.
» Thereafter, observations must be documented 4 hourly.

Weaning from opioids
This must be done for any child who has received morphine for more than 5–7 days. Wean by decreasing the daily dose by one third for 3 days.

Note: Children receiving properly titrated doses of analgesics, including opioids, are unlikely to become dependent. There is a difference between tolerance, which is a need for escalating doses to achieve the same therapeutic effect, and addiction.

Adjuvant medicines used in pain management:
An adjuvant (or co-analgesic) is a drug that in its pharmacological characteristic is not necessarily primarily identified as an analgesic in nature but that has been found in clinical practice to have either an independent analgesic effect or additive analgesic properties when used with opioids.

Ketamine
Ketamine is an NMDA receptor antagonist known for its haemodynamic and respiratory stability. This agent should be considered for patients with high opioid requirements or opioid tolerance, or where there is a significant component of neuropathic pain (e.g. amputation, neurosurgical procedures with nerve injury, burns, mucositis, or severe surgical pain).

- Ketamine, oral:
  - 4–6 mg/kg 4–6 hourly.
  - Injectable formulation can be used, (concentration 100 mg/mL). It is bitter tasting, and should be mixed with a sweet-tasting substance e.g. paracetamol or ibuprofen.
  - Onset of action: > 5 minutes.
  - Time to peak action: 30 minutes.
  - Duration of action: 4–6 hours.

- Ketamine, IV:
  - 0.2–0.3 mg/kg/hour, IV, (2–3 mL/hour).
  - Infusion: Mix 5 mg/kg of ketamine diluted to 50 mL with sodium chloride 0.9%. 1 mL = 0.1 mg/kg.
  - Low dose ketamine delivered by IV infusion is safe and effective. It does not cause sedation, or any psychotropic effects.
  - Onset of action: < 1 minute.
  - Time to peak effect: 3–5 minutes.

Recommended multimodal pain management directed by pain severity (see pain assessment above):

Pain severity	Analgesia	Comments
Mild	Paracetamol ± NSAIDs	
Moderate	Paracetamol ± NSAIDs + Opioid: • Morphine, oral	
Severe	Paracetamol ± NSAIDs + Opioid: • Morphine, oral or IV. **OR** • Fentanyl, IV.	Titrate IV opioids for safety.
Adjuvant agents	Ketamine	Can be used with any pain severity. Re-commended for moderate/severe pain.
Interventional modalities	Regional anaesthesia. *See Chapter 22: Anaesthesia, section 22.1.1: Local and regional anaesthesia.*	Consider indwelling catheters.

Pain in children with severe neurological impairment (SNI):
Pain is a frequent problem in children with neurological impairment (from any cause), with the highest frequency and severity occurring in children with the greatest impairment. These patients are vulnerable to under-recognition and under-treatment of pain. Barriers to treatment include uncertainty in identifying pain, limited experience, and fear with the use of analgesics. A systematic approach to identifying a source of pain is suggested. The R-FLACC tool has been validated in this patient population for assessment of pain severity, but clinicians must note that this tool (and others) can underestimate pain in these patients.

Patients with SNI may suffer from neuro-irritability, which can be associated with pain. In a child with recurrent pain behaviour episodes (3 or more prolonged episodes per week or a monthly cycle of frequent episodes for 1–2 weeks each month), initiate:

- Clonidine, oral, 1–3 mcg/kg 6–8 hourly.
- Amitriptyline, oral, 0.5–1 mg/kg 8 hourly.
  - Maximum: 25 mg/dose.

Pain in children with burn injury:
Burn injury is often associated with severe pain. Pain severity is directly correlated with the extent of burn injury. In addition, anxiety and post-traumatic

stress disorder can contribute to the pain experience. These should be actively managed with non-medicine therapies and medicine therapies where necessary.

Manage baseline pain according to severity – see pain assessment and recommended multimodal pain management (above). Patients with significant burns often develop tolerance to opioids, and often require higher doses of opioids in addition to adjuvant medicines. Procedural sedation and analgesia (PSA) should be optimised to minimise further anxiety, pain and distress, and is indicated for IV access and dressing changes. Dressing changes involving a large total body surface area (TBSA), or patients who have failed previous attempts at PSA should undergo procedures under general anaesthesia.

Neuropathic pain: medicine management

If a child reports features suggestive of neuropathic pain – i.e. pain that is sharp/stabbing/burning in nature, or paraesthesia – or the mechanism of injury or pathology is in keeping with nerve injury or neuropathic pain, a trial of amitriptyline can be considered.

- Amitriptyline, oral, 0.1–1 mg/kg 8 hourly.
  - Start on a low dose and titrate up according to symptoms.
  - Maximum: 25 mg/dose.

20.1.1.2 PERSISTENT/CHRONIC PAIN (NON-CANCER PAIN)

R52.2

Persistent/chronic pain is pain that lasts longer than the expected time for healing, and does not always have an obvious physical cause. Best practices for the management of chronic pain in children as recommended by the World Health Organization include:

» Use a comprehensive biopsychosocial assessment to inform pain management and planning. Screen for and monitor pain intensity and its impact on the quality of life of the child and family.
» Evaluation of underlying conditions with access to appropriate treatment, in addition to appropriate interventions for the management of pain.
» Assessment by healthcare providers, skilled and experienced in the evaluation, diagnosis and management of chronic pain.
» Adopting an interdisciplinary, multimodal approach tailored to the needs and desires of the child, family and caregivers, and to available resources. This includes psychology/psychiatry, social worker, physiotherapy, and other providers of non-pharmacological pain management strategies, e.g. aromatherapy, acupuncture.
» Goals of care: return to function, attaining good quality of life, minimising absenteeism from school, and engagement with peers.

» There is insufficient evidence to support the use of medicines for the management of chronic pain, unless pain is associated with underlying pathology, e.g. rheumatological disease, nerve injury.

REFERRAL

» In patients with acute pain, adequate analgesia and application of relevant, developmentally appropriate non-medicine strategies will control pain in most cases.
» Patients with resistant chronic pain should be discussed or referred to specialist centres experienced in paediatric chronic pain management.

20.1.1.3 CANCER PAIN

G89.3

DESCRIPTION

Pain in children with cancer is common and can be divided into four categories:

1. Pain as a result of the disease.
2. Pain secondary to treatment of the disease (chemo and radiotherapy).
3. Procedural pain (especially from bone marrow aspirations and LPs).
4. Pain from other causes as experienced by children in general.

» Pain caused by malignancy may be acute or chronic, acute-on-chronic or recurrent. It may be nociceptive or neuropathic or a combination of both. Sympathetic pain may occur with tumour infiltration of the sympathetic nervous system.
» Assessment of cancer pain follows the same general principles for pain assessment. The Eland Body Tool is particularly useful as a tool to identify multiple pain sites.
» General pain management also follows the basic principles of pain management with some extra considerations.
» Avoid NSAIDs in children with low platelets, renal dysfunction and dyspepsia.
» Procedural pain is common in children with cancer and may be more severe than pain related to the disease.
» Severe procedural pain is generally managed in oncology units with conscious sedation or general anaesthesia.
» Pain may have particular significance to the child and his/her parent or caregiver especially when it is the presenting feature of relapse.
» Children with cancer may under-report their pain for fear of further treatments.
» Pain is a common end-of-life symptom in terminally ill children that often requires escalating doses of opiates or opiate rotation to control it.

Pain type	Clinical presentation	Causes/ Mechanisms	Treatment
Bone pain.	Aching to sharp, severe pain, more pronounced with movement. Point tenderness common.	Primary and secondary (metastases). Strong neuropathic component (periosteum, Haversian canals).	• NSAIDs • Corticosteroids • Opioids • Adjuvants: Amitriptyline
Neuropathic pain.	Pain described as tingling, burning or stabbing. Dysesthesia: Allodynia and hyperalgaesia, Sometimes numbness, formication.	Nerve invasion by tumour. Chemotherapy side effects (vincristine, cisplatin, paclitaxel). Nerve entrapment. Phantom pain post amputation.	• Seek specialist advice. • Treat underlying cause – consider radiation. • Start NSAID if no contra-indications. • Opioids (morphine). • Add: Amitriptyline
Visceral pain. Pain arising from organs. Tumours of bowel ± obstruction. Retroperitoneal tumours.	Poorly localized pain. Varies in intensity. Deep aching pain.	Tumour infiltration. Serosal stretch. Obstruction	• Consider hyoscine butylbromide for cramps. • Low dose morphine.
Mucositis	Oral pain. Odynophagia Mucosal ulceration. Drooling	Post chemotherapy. Radiotherapy	See Chapter 21: Palliative care, section 21.1.1.1 odynophagia
Post-surgical	Pain related to tissue trauma post-surgery.		See post-op pain management.

REFERRAL

» All patients.

20.1.2 PROCEDURAL SEDATION AND ANALGESIA

Children in hospital are exposed to a variety of painful diagnostic and therapeutic procedures. The aim of procedural pain management is to minimise physical discomfort, pain, movement, and psychological disturbance, without compromising patient safety. Failure to provide adequate preventative pain measures increases anxiety in both the child and parent/caregiver, making repeat procedures more challenging.

GOALS OF PROCEDURAL SEDATION AND ANALGESIA

» Provide a safe environment for the patient.
» Effectively control pain, anxiety and movement.
» Decreased awareness and amnesia are also advantageous.

GENERAL AND SUPPORTIVE MEASURES

Non-medication measures are as important as medication measures in the management of procedural pain. These include adequate preparation /explanation to the child and parent/caregiver, correct positioning, and the use of distraction. For a comprehensive list see above.*

Note:

» It is the sedation team's responsibility to familiarise themselves with local guidelines for procedural sedation and analgesia. Important safety aspects must be adhered to including fasting, availability of equipment and the appropriate monitoring recommendations followed. All clinicians providing sedation need to have the necessary skills to manage a compromised airway, and haemodynamic compromise that may occur.
» Each case should be individualised. This table does not supersede clinical judgement.
» Timing of medications in relation to the procedure is essential.
» Always use simple analgesia in combination with other agents.

MEDICINE TREATMENT

Selection of medication and routes of administration should be guided by:

» Drug choice – specifically onset/peak and duration of action, and side effect profile.
» Child's age and level of cognitive development.
» Child's condition, comorbid diseases.
» Severity of pain associated with the procedure.
» Duration of the procedure.
» Level of immobility required to complete the procedure.

Providing safe and effective procedural sedation and analgesia can be a challenging undertaking, particularly in inexperienced hands. Some children are difficult to sedate with recommended dosing, and may require multiple agents or general anaesthesia to facilitate successful completion of the procedure. If so, refer the child to an experienced seditionist, or for general anaesthesia. Do not cause the child undue distress and emotional trauma.
Some children are at higher risk for morbidity (and even mortality), and should also be referred to an experienced seditionist, or for general anaesthesia. This includes children with severe systemic illness, life-threatening conditions, raised intracranial pressure, anticipated difficult airway, obesity, congenital syndromes, advanced respiratory disease, cardiac dysfunction, and a depressed level of consciousness. Refer to Chapter 22: Anaesthetics for recommendations.

The intranasal route of administration is a relatively painless, fast-acting, effective means of providing analgosedation. To maximise delivery, maximise concentration and minimise the volume. To further minimise the volume per nostril, divide the dose in half, and each half is administered into each nostril.

- Fentanyl:

Fentanyl provides analgesia and sedation. It should never be used as a sole agent. Combine with paracetamol ± NSAID. If used in combination with other respiratory depressant medicines, use lower doses and titrate to effect. The most frequent side effects include an itchy nose and dizziness.

	Route	Dose (mcg/kg)	Onset (minutes)	Peak (minutes)	Duration (minutes)
Fentanyl	Intranasal*	1–2	10	15	60–120
	IV	0.25	1	5–6	30

*Intranasal route is preferred.

LoE III[1]

A 'top up' dose can be considered if satisfactory analgesia is not reached with the initial dose.

- Ketamine:

Ketamine provides analgesia, anxiolysis and sedation. It is bitter tasting, and should be mixed with a sweet-tasting substance, e.g. paracetamol or ibuprofen. It may burn when given via the intranasal (IN) route. To decrease burning, administer 0.25 mL of 2% lignocaine prior to medication.
The most frequent side effects include nausea and dizziness.
For children who are hypotensive or in situations where opioids should be avoided for airway concerns, IN ketamine could be an alternative option.

	Route	Dose (mg/kg)	Onset (minutes)	Peak (minutes)	Duration
Ketamine	Oral	6–10	> 5	30	4–6 hours
	Intranasal	5	5–10	20	20–120 minutes
	IV (bolus)	0.25–1	< 1	3–5	10–15 minutes
	IV (infusion)	0.5–1 mg/kg/hr	< 1	3–5	10–15 minutes
	Intramuscular*	2–4	2–5	20	30–120 minutes

*IM injections are painful and distressing, and should not be utilised as a first option.

LoE III

- Midazolam:

Midazolam provides anxiolysis and sedation ONLY. It does not have any analgesic effect. It is bitter tasting, and should be mixed with a sweet-tasting substance, e.g. sucrose, paracetamol or ibuprofen.

	Route	Dose (mg/kg)	Max. dose	Peak (minutes)	Duration (minutes)
Midazolam	Oral	0.25–0.5	15 mg	10–30	60
	Sublingual	0.25–0.3	0.3mg/kg	10–15	20–60
	Intranasal	0.2–0.3	0.3mg/kg	10–15	60–120
	IV	0.025–0.1	1 mg	3–5	20–60

Table: Procedural Sedation and Analgesia

	Procedures associated with mild pain	Procedures associated with moderate to severe pain
Examples	Blood taking. Heel prick. IM injection. Nasogastric tube insertion. Urethral catheterisation. Peripheral cannulation.	Arterial line, central venous catheter. Simple laceration. Intercostal drain insertion/removal. Dressing change for burns. Lumbar puncture. Fracture reduction/manipulation. Bone marrow aspirate and trephine.
ANALGESIA		
Local anaes-thesia*	• Topical lidocaine (lignocaine)/prilocaine 1 hour before procedure) covered with occlusive dressing. • Lidocaine (lignocaine) infiltration 0.5, 1 or 2% (lower concentrations burn less). • Consider regional anaesthesia (e.g. digit blocks, wrist block).	
Systemic	• Sucrose 24% solution (up to 12 months). • Breastfeed • Paracetamol • ± Ibuprofen	• Paracetamol ± ibuprofen **AND** **<u>one</u>** of the following medicines: • Ketamine **OR** • Fentanyl

**Local anaesthetics are used in combination with systemic agents corresponding with the severity of pain associated with the procedure.*

References

[1] South African Society of Anaesthesiologists (SASA) Paediatric Sedation Guidelines for Procedural Sedation and Analgesia. South Afr J Anaesth Analg. 2016, 22(1) (supplementary 5). https://painsa.org.za/wp-content/uploads/2020/03/Untitled-attachment-00037.pdf

CHAPTER 21

PALLIATIVE CARE

21.1 SYMPTOM CONTROL

Z51.5

DESCRIPTION

The World Health Organisation (WHO) defines paediatric palliative care as the active total care of the child's body, mind and spirit that also involves giving support to the family. Palliative care should begin when illness is diagnosed and continue regardless of whether or not a child receives treatment directed at the disease. Healthcare providers must evaluate and alleviate a child's physical, psychological, and social distress. Effective palliative care requires a broad multidisciplinary approach that includes the family and makes use of available community resources; it can be successfully implemented even if resources are limited. It can be provided in tertiary care facilities, in community health centres and even in children's homes.

A key component to relieving suffering is the management of distressing symptoms that include both pain and non-pain symptoms (e.g. nausea, anxiety, etc.). There are certain key principles that should be applied when managing these symptoms, i.e.:

» Determine and treat underlying causes of the symptom, including non-physical causes.
» Relieve the symptom without creating new symptoms or unwanted side effects.
» Consider different types of interventions: drug and non-drug interventions.
» Consider whether the treatment is of benefit to the individual patient.

PRINCIPLES FOR THE SAFE AND EFFECTIVE PRESCRIBING OF MEDICINES IN PAEDIATRIC PALLIATIVE CARE

When prescribing medicines for children in need of palliative care the following needs to be considered:

» Children with advanced illness may have organ dysfunction (esp. renal and liver) and/or be malnourished which may alter their drug handling capabilities, often necessitating the use of lower doses of medications or increased dosing intervals.
» Children with complex medical conditions may already be on several medications to manage their underlying condition – always consider the dangers of polypharmacy and drug interactions.
» Although growing, the evidence base for prescribing in paediatric palliative care is still limited given the ethical challenges of doing research

in this population. For this reason, several medications commonly used in paediatric palliative care are prescribed 'off-licence'. The benefit of prescribing to relieve suffering needs to be weighed against potential harm or drug side effects.

» As children enter the terminal stages of their illness, they may lose their ability to swallow medications or gaining intravenous access may be increasingly difficult. Palliative care practitioners have devised several alternative routes of drug administration to decrease unnecessary procedural pain and enable families to care for their child at home. These should only be utilized by practitioners who have been trained in their use (see section 21.3: End of life and Terminal care).

This chapter provides an approach to the management of several non-pain symptoms commonly encountered in paediatric palliative care. Also see Chapter 20: Pain.

Where these symptoms are already addressed in other chapters, a referral to the relevant sections has been added. It is important to note, however, that when an underlying disease cannot be cured or controlled, these chronic distressing symptoms may need to be managed using medications that would not ordinarily be used in children with acute symptoms that usually resolve with treatment of the underlying disease. Where symptoms are persistent, cause distress, impact on sleep and ability to function resulting in poor quality of life, they need to be addressed through the use of both pharmacological and non-pharmacological means.

21.1.1 GASTRO-INTESTINAL SYMPTOMS

21.1.1.1 ODYNOPHAGIA

R13

DESCRIPTION

Pain that arises from the oropharynx and/or pain with swallowing. Not only does it lead to irritability and discomfort but can affect intake of feeds and medication. May be an unrecognised source of pain in neurologically impaired non-verbal children.

GENERAL AND SUPPORTIVE MEASURES

Perform a thorough examination to determine and treat the underlying cause where possible:

» Uncomplicated gingivitis (see Chapter 2: Alimentary Tract, section 2.1.1).
» Necrotising periodontitis (see Chapter 2: Alimentary Tract, section 2.1.3).
» Aphthous ulcers (see Chapter 2: Alimentary Tract, section 2.1.5).
» Herpes gingivostomatitis (see Chapter 2: Alimentary Tract, section 2.1.6).
» Stevens-Johnson Syndrome (see Chapter 5: Dermatology, section 5.2.2).
» Candidiasis oral (See Chapter 8: Infective/Infectious Diseases, section 8.6).
» Mucositis (secondary to chemo or radiotherapy).

Xerostomia (dry mouth) is also common in palliative care patients and can cause significant discomfort. This is especially prevalent in children who are not taking in orally, are being fed via NGT or feeding gastrostomy, cannot close their mouths and/or are receiving anti-cholinergic medications. Xerostomia is common in children with prolonged hospitalisation with poor attention to oral hygiene. In severe cases the tongue may stick to the roof of the mouth causing pain and bleeding when pried away.

Prevent xerostomia with good oral nursing care and brushing of teeth with a soft toothbrush and fluoride containing toothpaste.

Place ice-chips in mouth to prevent xerostomia and keep lips moist with white soft paraffin.

In children who are feeding orally but where pain is preventing sufficient oral intake, rehydration and/or temporary feeding via naso-gastric tube may be needed (if appropriate: see section 21.3: End of life and Terminal care) while oral lesions heal.

Avoid hot, spicy or acidic food and carbonated drinks in older children still able to swallow and change to soft or puréed diet until condition improves.

Drink through a straw to bypass the mouth.

MEDICATION AND TREATMENT

- Regular washes (2–4 times a day) with chlorhexidine 0.2% mouthwash.
- Paracetamol oral (or per NGT) or PR 15 mg/kg/dose 6 hourly.
- In severe cases of mucositis, oral or even IV morphine may be necessary. (See Chapter 22: Pain Control.)

21.1.1.2 NAUSEA AND VOMITING

R11

DESCRIPTION

Nausea is an unpleasant sensation vaguely referred to the epigastrium and abdomen that often but not always culminates in vomiting. Vomiting is the forcible expulsion of the contents of the stomach through the mouth. It should be distinguished from passive regurgitation and reflux.

In acute illnesses, these presenting symptoms usually resolve with the treatment of the underlying disease and treatment is not indicated. In chronic conditions, especially where there is no cure (e.g. chronic renal failure), this symptom may persist and warrant targeted drug treatment. Untreated nausea and vomiting may contribute to anorexia and weight loss which can accelerate disease progression.

GENERAL AND SUPPORTIVE MEASURES

» Avoid foods/smells that aggravate nausea and vomiting, especially spicy, very sweet or fatty foods.
» Offer foods that are bland and dry until symptoms improve.
» Be careful of wearing strong-smelling perfumes around patients.
» Provide psychological support as anxiety and emotional distress can aggravate nausea and vomiting.
» Maintain hydration by giving small amounts or oral rehydration solution.
» Review medications that may be causing nausea and vomiting, discontinue or change where possible and/or space these out across the day if necessary.
» Nausea is a possible early side effect of opioids that can be managed with short-term anti-emetics. Tolerance usually develops to this side effect within 5–7 days.

MEDICATION AND TREATMENT

Targeted anti-emetic therapy is best to treat the specific underlying cause.

Knowledge of the neuronal pathways, sites of action and receptors involved in nausea and vomiting as well as the sites of action of the anti-emetics are essential to provide targeted therapy.

Targeted anti-emetic therapy in palliative care patients:

Cause	Site	Anti-emetic of choice
Anxiety, fear	Cortex	Lorazepam
Chemotherapy or medications (esp. opioids) or Metabolic (increased urea, calcium)	Chemoreceptor trigger zone	Ondansetron Metoclopramide Haloperidol

Cause	Site	Anti-emetic of choice
Vomiting centre	Viscera (GIT obstruction) Raised intracranial pressure	Hyoscine butylbromide Betamethasone
Obstruction, spasm	Gastric outlet	Metoclopramide
GI inflammation	Oesophagus: GORD Stomach: gastritis	Proton pump inhibitor: e.g.: omeprazole

- Lorazepam, oral:
  - Child < 2 years: 25 mcg/kg 8–12 hourly.
  - Child 2–5 years: 500 mcg 8–12 hourly.
  - Child 6–10 years: 750 mcg 8 hourly.
  - Child 11–14 years: 1 mg 8 hourly.
  - Child > 15 years: 1–2 mg 8 hourly.

- Ondansetron:
  - Oral, 0.1–0.2 mg/kg 12 hourly.

  If oral route cannot be used:
  - Ondansetron, IV, 0.1 mg/kg immediately and every 8–12 hours, thereafter, given over 2–5 minutes. Maximum: 4 mg/day.

- Metoclopramide, oral or IV:
  - Neonates: 100 mcg/kg 6–8 hourly.
  - 1–11 months (up to 10 kg): 100 mcg/kg 12 hourly. Maximum: 1000 mcg/dose (1 mg/dose).
  - 1–18 years: 100–150 mcg/kg 8 hourly. Maximum: 10 mg/dose.

Use with caution as extrapyramidal side effects may occur (especially at higher doses).

- Haloperidol, oral:
  - 1 month to 11 years: 0.01–0.1 mg/kg 12–24 hourly.
  - 12–17 years: 1.5 mg at night, increase to 1.5 mg 12 hourly. Maximum: 5 mg 12 hourly.

- Hyoscine butylbromide, oral, IM or IV:
  - 1 month to 4 years: 300–500 mcg/kg 6–8 hourly. Maximum: 5000 mcg/dose (5 mg/dose).
  - 5–11 years: 5–10 mg 6–8 hourly.
  - 12–17 years: 10–20 mg 6–8 hourly.

- Betamethasone, oral:
  - Child < 1 year: 250 mcg 8 hourly. Maximum: 1000 mcg (1 mg) 8 hourly.
  - Child 1–5 years: 1 mg 8 hourly increased to a maximum of 2 mg 8 hourly.

- Child 6–11 years: 2 mg 8 hourly up to 4 mg 8 hourly.
- Child 12–17 years: 4 mg 8 hourly.

Better to give as intermittent short courses (5 days) rather than for protracted periods of time.
Need to wean if given for > 2 weeks, over a number of weeks.

21.1.1.3 INTRACTABLE DIARRHOEA

R19.7

DESCRIPTION

See guidelines for Persistent and Chronic Diarrhoea (including Non-infectious) in Chapter 2: Alimentary Tract, sections 2.2.5 and 2.2.6 respectively.

Although uncommon, intractable diarrhoea not amenable to any treatment may be encountered in paediatric palliative care. Examples of causes include:

» Short bowel syndrome in neonatal survivors of NEC (< 50 cm, no ileo-caecal valve).
» Severe burns.
» Unmanaged HIV.
» Uncontrolled inflammatory bowel disease.
» Degenerative leiomyopathy.
» Graft vs Host disease.
» Bowel failure.

GENERAL AND SUPPORTIVE MEASURES

» Whilst many of these children may be initially treated at tertiary level, they may be down referred to district or regional hospitals, especially if ongoing treatment is futile.
» Address the underlying cause in as much as this is possible.
» Feed for comfort for as long as possible and whilst child is hungry but do not prolong dying if pre-terminal and not candidates for TPN, see section 21.3: End of life and Terminal care.
» Pay close attention to perineal and peri-anal excoriation that can cause much discomfort.
» Manage abdominal cramps.

MEDICINE TREATMENT

- Loperamide: 0.1 mg/kg 6 hourly increasing up to 2 mg/kg/day.

For acute hypocalcaemia associated with tetany:

- Calcium gluconate:
  - Loading intravenous bolus: 10% calcium gluconate 0.5 mL/kg (0.11 mmol/kg) to a maximum of 20 mL over 10 minutes (maximum rate 0.5 mmol/minute) followed by a continuous intravenous infusion over 24 hours of 0.5–1.0 mmol/kg (maximum 8.8 mmol).

Spasmodic abdominal pain:

- Hyoscine butylbromide, oral, IM or IV:
  - 1 month to 4 years: 300–500 mcg/kg 6–8 hourly. Maximum: 5000 mcg/dose (5 mg/dose).
  - 5–11 years: 5–10 mg 6–8 hourly.
  - 12–17 years: 10–20 mg 6–8 hourly.

REFERRAL

» Refer for trial of TPN in cases where underlying disease is under control.

LoE III[1]

21.1.1.4 CONSTIPATION

K59.0

DESCRIPTION

The infrequent passage of hard stools. See Chapter 2: Alimentary Tract, section 2.2.2. Constipation/Faecal loading.
In palliative care, the most frequent causes are drug related (especially opioids), pain, immobility and neurological impairment (e.g. cerebral palsy).

GENERAL AND SUPPORTIVE MEASURES

» Review medications causing constipation.
» Ensure adequate intake of fluids and fibre when dietary measures are appropriate.
» Mobilize where possible.
» Consider abdominal massage in bed-bound patients: massage in small clockwise circles in the periumbilical area for small bowel and in U-shaped pattern following the direction of stool in colon.

MEDICINE TREATMENT

See Chapter 2: Alimentary Tract, section 2.2.2: Constipation/Faecal loading.

Laxatives should be used prophylactically in all older children receiving morphine. This is not usually needed in infants and younger children.

In bed-bound patients, sometimes disimpaction is needed with the help of a glycerine suppository or enema. **Do not use the rectal route in paediatric oncology patients with neutropenia or thrombocytopenia.**

Be wary of peristalsis-inducing laxatives in children, especially those with neurological conditions: this may cause cramping pain and irritability.

- Lactulose**,** oral, 2.5–10 mL 12 hourly.

OR

- Sorbitol:
  - Children 2–11 years: 2 mL/kg, oral, (70% solution) once.
  - Children 12 years and older: 30–150 mL, oral, (70% solution) once.

Severe constipation in patients unable to swallow:

- Glycerine (glycerol) suppositories:
  - 2 to less than 6 years: 0.891 mL/1.26 g suppository when necessary.
  - 6 years and older: 1.698 mL/2.4 g suppository when necessary.

OR

- Phosphate enema (sodium phosphate 6 g, sodium biphosphate 16 g/100 mL):
  - 2–5 years: 32 mL.
  - 5–11 years: 64 mL.
  - Repeat once, if necessary.

OR

- Polyethylene glycol 59 g/L solution with sodium sulphate and electrolytes, oral/naso-gastric tube, 10–25 mL/kg/hour until clear fluid is passed rectally.

Note: No additional ingredient should be added to the solution, e.g. flavourings or sugar containing cold drinks.

21.1.2 RESPIRATORY SYMPTOMS

21.1.2.1 DYSPNOEA

R06.0

DESCRIPTION

A subjective feeling of breathlessness, when breathing becomes unpleasant, difficult and tiresome.

GENERAL AND SUPPORTIVE MEASURES

» Find the position in which the patient is most comfortable: upright, semi-fowlers or prone. In patients with large effusions: position with the bad lung down to allow for maximum aeration of the good lung.

» Treat the underlying cause where appropriate:
  > Pneumonia is a common end of life event in many palliative care patients, with recurrent infections. Discuss with family when it may be appropriate to withhold or withdraw antibiotics.
  > Consider burden versus benefit of repeat drainage of malignant effusions that re-accumulate.
  > Blood transfusions for anaemia, especially at the end of life, have limited benefit.
  > Diuresis for patients with heart or renal failure may provide transient relief.

» Provide supplemental oxygen if beneficial in patients with end-stage disease. Manage the patient and not the saturation monitor. If dyspnoea

is not relieved, then discontinue oxygen especially if this keeps patients in hospital.
» Reduce anxiety by addressing psychosocial factors, e.g. parental separation.
» Non-pharmacological interventions such as mindfulness, relaxation techniques, music and controlled breathing exercises can be beneficial.
» Blowing cool air onto the face with a fan or open window may also help relieve dyspnoea.
» Warm the air in the room using a humidifier.
» Keep mouth and lips moist in open mouth breathers.
» Manage secretions:
  > If thick, try loosen with saline nebulisation.
  > Physiotherapy and postural drainage where appropriate.
  > Suction as needed but avoid excessive suctioning.
  > See medication for excessive secretions.

MEDICINE TREATMENT

Morphine

Many fear using morphine for dyspnoea because of its potential to suppress respiration. If used at dyspnoea doses and titrated upwards against dyspnoea and/or pain, this is not a concern and should not be withheld even if the child is not for ventilation.

- Morphine, oral [Immediate release morphine (liquid)].
  - Dyspnoea starting dose for opioid naïve patients is 50% of the pain dose.
  - For patients already on morphine (e.g. for pain) increase their current dose by 30–50%.
  - For moderate dyspnoea, oral:
    - If 0–1 month: 25 mcg/kg/dose 6 hourly.
    - If > 1–12 months: 50 mcg/kg/dose 4 hourly.
    - If > 12 months: 100–200 mcg/kg/dose 4 hourly.
  - For severe dyspnoea, IV or SC:
    - If 0–1 month: 0.01 mg/kg/dose immediately.
    - If > 1–12 months: 0.025 mg/kg/dose immediately.
    - If > 12 months: 0.05–0.1 mg/kg/dose immediately.
    - Repeat in 25 minutes if given IV or 30 minutes if given SC and then start continuous IV or SC infusion.
    - IV/SC infusion starting dose: 10 mcg/kg/hour and titrate upwards in increments of 30 to 50% against dyspnoea.

Midazolam

Route	Dose
Oral	• 125–250 mcg/kg [maximum: 20 000 mcg (20 mg)] as a single dose.
Buccal/ Intranasal	• 6 months to 9 years: 50–150 mcg/kg [maximum: 5 mg (5000 mcg)] as a single dose. • 10 to 17 years: 1.5–3.5 mg as a single dose.
IV or SC injection	• 1 month to 5 years: Initially 6.25–25 mcg/kg, to be administered over 2–3 minutes; dose can be increased if necessary in small steps to maximum total dose of 3000 mcg/dose (3 mg/dose). • 6–11 years: Initially 6.25–25 mcg/kg, to be administered over 2–3 minutes; dose can be increased if necessary in small steps to a maximum total of 3750 mcg (3.75 mg). • 12–17 years: Initially 6.25–25 mcg/kg, to be administered over 2–3 minutes; dose can be increased if necessary in small steps to a maximum of 5000 mcg (5 mg).
IV or SC infusion	• 250–1500 mcg/kg/24 hours as starting dose titrating upwards against symptoms and sedation. (Equates to: 10–60 mg/kg/hour.)

For excessive secretions

- Atropine ophthalmic solution 1%:
  - Starting dose (all ages): 1 drop, sublingual every 6 hours.
  - Increase to 2 drops, sublingual every 6 hours.
  - Stop if mouth becomes too dry.
  - **Note**: Following systemic absorption, mydriasis may occur.
  - Ensure this agent is discontinued when evaluating patients for brain death with brain stem testing.

- Hyoscine butylbromide, SC/IV:
  - 1 month to 4 years: 300–500 mcg/kg (maximum: 5 mg/dose) 6–8 hourly.
  - 4–11 years: 5–10 mg 6–8 hourly.
  - 12–17 years: 10–20 mg 6–8 hourly.
  - Continuous SC infusion:
    - 1 month to 4 years: 1.5 mg/kg/24 hours (maximum: 15 mg/day).
    - 5–11 years: 30 mg over 24 hours.
    - 12–17 years: Up to 60–80 mg over 24 hours.
    - Higher doses may be needed: doses used in adults range from 10–120 mg/24 hours (maximum: 300 mg/day).

21.1.2.2 CHRONIC COUGH

R05

DESCRIPTION

Involuntary cough lasting more than 3 weeks caused by chronic stimulation of cough receptors impairing sleep, communication and feeding.

GENERAL AND SUPPORTIVE MEASURES

» Determine and treat the underlying cause where possible.
» Exclude undiagnosed GORD and bronchospasm.
» If caused by ACE inhibitor, consider changing meds.
» Try simple linctus to soothe throat.
» Alternatively, a homemade solution of hot water with a squeeze of lemon and teaspoon of honey.

MEDICATION AND TREATMENT

- Severe and disturbing cough that impacts negatively on sleep and quality of life warrants suppression.
- Codeine is no longer recommended given issues with metabolism (non-metabolizers or ultra-rapid metabolizers).
- Use morphine at dyspnoea doses (see Dyspnoea, section 21.1.2.1).
- If already on morphine for pain, increase dose by 30–50%.

21.1.3 NEUROPSYCHIATRIC SYMPTOMS

21.1.3.1 ANXIETY

F41.9

DESCRIPTION

Anxiety is common in children with life-threatening and life-limiting illnesses and often exacerbates other symptoms (e.g. dyspnoea and insomnia).

Anxiety in this population may be:
1. Transitory – often triggered by certain situations or procedures.
2. Formal generalized anxiety disorder.
3. ‘Death anxiety.’

GENERAL AND SUPPORTIVE TREATMENT

» Anxiety is often triggered by other co-existent symptoms such as breathlessness and unaddressed pain.
» Manage procedure related pain and anxiety (see Chapter 20: Pain).
» Avoid separation from parents or caregivers where possible.
» Communicate openly with children with life-threatening and life-limiting illnesses: especially those that are dying.
» Use cognitive behavioural therapy to desensitize to anxiety provoking situations (e.g. needle phobia).

» Provide opportunities for self-expression and stress release.
» Teach children coping strategies.
» Address and treat insomnia.

MEDICINE TREATMENT

Transitory anxiety
Use short-acting benzodiazepines for procedure related anxiety or panic attacks. (See Chapter 20: Pain, section 20.1.2: Procedural sedation and analgesia.)
However; increase utilisation of non-pharmacological strategies to manage procedural pain to decrease recurrent experience of sedation that becomes disorientating and removes sense of control.
Short-term use of hypnotics for anxiety-induced insomnia may be useful but avoid longer-term use as this disrupts sleep-architecture.

Formal Generalized Anxiety Disorder
See Chapter 14: Paediatric Psychiatry, section 14.5.1: Generalised anxiety disorder.

- Fluoxetine, oral, 0.5 mg/kg/day.
  - Dose range: 20–40 mg daily.
  - Recommended average dose: 20 mg/day.
  - Consider citalopram if fluoxetine is not tolerated or is ineffective.

- Citalopram, oral, 0.4 mg/kg/day.
  - Dose range: 5–40 mg daily.
  - Recommended average dose: 10–20 mg/day.

Death anxiety
Best managed with open communication, however, with fear of sleeping, short-term use of benzodiazepines at night may be warranted.

- Benzodiazepine, e.g.:
  - Diazepam, oral, 8 hourly.
    - If > 2–12 years: 2–3 mg.
    - If > 12–18 years: 2–10 mg.

21.1.3.2 DEPRESSION
F32-34

DESCRIPTION
Low mood in children and adolescents who become aware of their impending death is often congruent and appropriate and does not always warrant treatment. However, around 10 to 30% of chronically ill children are depressed. DSM 5 criteria instruct clinicians to exclude “symptoms that are

clearly due to a general medical condition" BUT this may lead to an under diagnosis of depression in this population.

GENERAL AND SUPPORTIVE TREATMENT

» Exclude and treat unaddressed pain.
» Communicate openly about diagnosis and prognosis.
» Address commonly occurring non-illness stressors (educational, familial, social and financial).
» Provide supportive counselling: opportunities for open communication about fears and worries.
» Cognitive behavioural therapy plus peer group support.
» Provide creative outlets: music, art and writing.
» Legacy work (memory making) in children nearing end of life.

MEDICATION AND TREATMENT

Mild or congruent depression does not always need to be medicated and is best addressed with non-pharmacological measures as above.
Moderate to severe depression may need to be treated. Medication should never be prescribed alone without counselling interventions.
SSRIs are generally the mainstay of treatment of depression in this population.

See Chapter 14: Paediatric Psychiatry, section 14.4.1: Depression in childhood and adolescence.

Although fluoxetine is usually first-line treatment for depression in children without other medical illnesses, citalopram may be safer in palliative care patients as it has fewer interactions (esp. involving cytochrome p450 enzyme) with other drugs (including chemotherapy). Citalopram also has the added benefit of being helpful if there is co-existent anxiety. Note that it takes 4 to 6 weeks for SSRIs to achieve therapeutic effect.

- Citalopram, oral, 0.4 mg/kg/day.
  - Dose range: 5–40 mg daily.
  - Recommended average dose: 10–20 mg/day.

21.1.3.3 DYSTONIA/MUSCLE SPASMS/SPASTICITY

DESCRIPTION

Dystonia

A movement disorder caused by diseases of the basal ganglia, in which involuntary sustained or intermittent muscle contractions cause twisting and repetitive movements as well as abnormal posturing that is often painful.
Dystonia can be a primary disorder (e.g. brain tumours, metabolic conditions, neurodegenerative disorders and demyelinating diseases or, secondary to

diseases (e.g. TB meningitis) and injury (e.g. hypoxic or traumatic brain injury) of the CNS. Acute dystonia may also be drug induced.

Muscle spasms and Spasticity

Spasticity is velocity-dependent increased resistance to stretch observed in upper motor neuron damage. The increased tone can cause muscle injury resulting in pain secondary to inflammation. Intermittent muscle spasms may also occur secondary to pain, acute illness, positioning or constipation.

GENERAL AND SUPPORTIVE TREATMENT

» Prevent secondary trauma that can be caused by the child hurting herself during dystonic movements – this can be achieved by padding cot sides or nursing on the floor.
» Do not restrain the child with dystonia.
» A weighted blanket may help.
» If feeding is problematic and there is a risk for aspiration, consider naso-gastric or feeding gastrostomy.
» Physiotherapy and massage.
» A warm bath may help unlock spasms.
» Supportive counselling for parents and caregivers as this can be very distressing for them, especially if it is difficult to control.
» Identify and treat triggers for muscle spasticity, especially pain.
» Involve physiotherapists and occupational therapists for exercises, splints and positioning to prevent contractures.

MEDICATION AND TREATMENT

If drug dystonia suspected, discontinue offending medication.

- Diazepam, oral, 12 hourly.
  - Child 1–11 months: Initial dose of 250 mcg/kg twice a day.
  - Child 1–4 years: Initial dose of 2.5 mg twice a day.
  - Child 5–11 years: Initial dose of 5 mg twice a day.
  - Child 12–17 years: Initial dose of 10 mg twice a day. Maximum total daily dose of 40 mg.

For pain:

- Ibuprofen, oral, 5–10 mg/kg 8 hourly.

If severe, use morphine short-term:

- Morphine, oral [Immediate release morphine (liquid).]
  - Starting dose:
    - If 0–1 month: 50 mcg/kg/dose 6 hourly.
    - If > 1–12 months: 100 mcg/kg/dose 4 hourly.
    - If > 12 months: 200–400 mcg/kg/dose 4 hourly.

Neuropathic pain and/or neuro-irritability is common in ‘evolving cerebral palsy’, refer to tertiary level for consideration of a gabapentinoid.

REFERRAL

» To Paediatric Neurology where dystonia is difficult to manage to consider use of other dystonia medications (such as carbidopa/levodopa) and to pain specialists for unresolved neuro-irritability (to consider gabapentin). Also see Chapter 20: Pain Control.

21.1.3.4 INTRACTABLE SEIZURES

G41

For status epilepticus, see Chapter 13: Central Nervous System, section 13.3.

DESCRIPTION

Intractable seizures in palliative care refer to seizures that do not respond to treatment and often occur at the end of life in children with severe CNS pathology who are not candidates for ventilation. These may range from repetitive self-limiting seizures that do not cause distress to constant fitting not responsive to treatment. Causes include brain tumours, neuro-degenerative diseases, inborn errors of metabolism, severe congenital structural malformations including migrational disorders, and brain damage secondary to trauma or hypoxia.

GENERAL AND SUPPORTIVE TREATMENT

» Counselling support for parents, caregivers and professional care-giving staff.
» Reassurance if seizures are brief and not causing any obvious distress.
» Prevent secondary trauma by padding the side of the bed/cot or nursing on the floor.
» Do not restrain the patient as it may make seizures worse.
» Nurse on the side to minimize aspiration.
» If at end of life, stop feeds and follow guidance as per section 21.3: End of life and Terminal care.

MEDICINE TREATMENT

These children have often already been treated as per status epilepticus protocols but have not responded to standard treatment.
In children at the end of life or with poor prognosis, where admission to ICU for thiopentone infusion is not recommended, the mainstay of treatment is midazolam infusion to provide terminal sedation. (Consider subcutaneous infusion if no IV access is available.)

- Midazolam by SC or IV infusion over 24 hours for seizure control at end of life:
  - Neonate to 18 years: Initial dose: 1–3 mg/kg/24 hours increasing up to 7 mg/kg/24 hours (maximum 60 mg/24 hours or 150 mg/24 hours in specialist units for patients with refractory epilepsy).

- Morphine SC or IV infusion at 10–20 mcg/kg/hour titrated upwards in 30% increments against pain.

REFERRAL

» Seek specialist advice and consider addition of other agents.

21.1.4 DERMATOLOGICAL SYMPTOMS

21.1.4.1 PRURITUS

R29.9

DESCRIPTION

An unpleasant cutaneous sensation that provokes the desire to scratch. Can interfere with sleep and activities of daily living. Scratch marks may lead to skin excoriation and secondary infections. May be difficult to control with incurable conditions. Commonly seen in cholestasis, renal failure, burns, Hodgkin's lymphoma and occasionally as a side effect of opioids.

GENERAL AND SUPPORTIVE CARE

» Keep nails short and cover fingers with mittens but do not restrain.
» Keep skin moist with aqueous cream and emollients.

MEDICINE TREATMENT

Treatment depends on the underlying cause:

Cause	Mechanisms	Treatment
Opioid related	Stimulation of mu opioid receptors. NOT histamine mediated.	• Opioid switch if possible. • Ondansetron
Uraemia (Chronic renal failure)	Several factors including dry skin, uraemic toxin accumulation, neuropathy.	• Non-sedating antihistamines have NOT been shown to be effective. • Refer to tertiary level for consideration of a gabapentinoid.
Cholestasis	Bile acids in skin.	• Phenobarbitone
Burn wounds	Post burn during healing phase: caused by peripheral sensitisation.	• Refer to tertiary level for consideration of a gabapentinoid. • Sedating antihistamines. • Non-sedating antihistamines (cetirizine). • Ondansetron

LoE II[2]

Corticosteroid creams should not be used for generalized pruritus unless associated with inflammatory conditions (e.g. atopic eczema) as they will result in skin thinning and damage.

REFERRAL

» Severe pruritus not responding to standard treatment.

21.1.4.2 MALODOROUS FUNGATING WOUNDS/TUMOURS

DESCRIPTION

Non-healing fungating tumours that are often secondarily infected and smelly causing social ostracization and distress to child and family. Examples include exophytic retinoblastoma, infected bedsores, rhabdomyosarcoma, osteosarcoma or Kaposi's sarcoma.

GENERAL AND SUPPORTIVE MEASURES

» Supportive counselling.
» Set realistic goals: may not include wound healing but could include odour eradication.
» Regular wound cleaning and dressing changes.
» Adequate ventilation.
» Disguise smell by placing a bowl of vanilla essence in the room, burn incense or place kitty litter under the bed to absorb smell.
» Air-fresheners and perfumes do not work.
» Change bedding and clothing regularly.

MEDICINE TREATMENT

- Provide good procedural pain management (see Chapter 20: Pain Control) and use distraction/relaxation techniques before and during dressing changes.
- Irrigate wounds with warmed normal saline. Gentle debridement with gloved hand, not sharp instruments.
- Consider formal surgical debridement in a patient who still has some life expectancy.
- Topical metronidazole:
  - Irrigation and cleaning of wound: 2 L of saline combined with 13 crushed metronidazole 400 mg tablets (2 L 0.9% sodium chloride: 5200 mg metronidazole).
  - Metronidazole crushed tablet topical: Crushed metronidazole tablet 400 mg per 35 cm^2 area twice daily to ameliorate malodour.
- Activated charcoal dressings also help to absorb odours.
- For wound pain consider using topical anaesthetics such as lidocaine/prilocaine.

21.2 PAEDIATRIC PALLIATIVE CARE EMERGENCIES

21.2.1 MUCOSAL BLEEDS

DESCRIPTION

Massive bleeds at the end of life, although rare, can occur in several conditions and include:

» Haematemesis (e.g. bleeding varices, fulminant liver failure).
» Epistaxis (in haematological malignancies).
» Haemoptysis (rare in children).
» Tumour related erosion of blood vessels (less common in children).

GENERAL AND SUPPORTIVE CARE

» If a major bleed is anticipated it is best to be prepared, warn the family about the possibility that this may happen and ensure that they have what they need to manage an emergency: consider providing emergency home packs.
» Major bleeds are often preceded by smaller bleeds.
» In haematological causes associated with thrombocytopenia, platelet transfusions may be used to prevent bleeds up to a point where these no longer work, have to be given frequently or are in short supply. Repeat red blood cell transfusions at the end of life are costly, may not improve quality of life and could postpone dying.
» Have aprons and gloves ready.
» Use dark towels or green surgical sheets to reduce the visual impact of the blood.

MEDICINE TREATMENT

See Chapter 17: Ear, Nose and Throat, section 17.4: Epistaxis.
See Chapter 2: Alimentary Tract, section 2.3.3.1: Bleeding oesophageal varices.

For small mucosal bleeds:

- Topical treatment: crushed tranexamic acid tablets or gauze soaked in 100 mg/mL solution for injection.

Bleeding wounds:

- Use topical adrenalin 1:1000 mL on gauze and apply directly to the wound.

In massive bleeds associated with hypotensive shock, consciousness is lost and family/caregiver distress becomes the focus of attention.
With slower but large distressing bleeds occurring at the end of life, rapid sedation with benzodiazepines may be required using available routes including IV, SC and rectal (see terminal sedation under end of life care).

21.2.2 SPINAL CORD COMPRESSION

DESCRIPTION

Loss of neurological function in limbs (usually lower) caused by spinal compression from tumour or other disease process. Should be managed as an emergency in an attempt to delay complete loss of function for as long as possible.

Caused in children by intramedullary or intradural metastases or extradural compression (e.g. vertebral collapse).

Early signs:

» Change in nature of long-standing pain.
» Neuropathic pain radiating down legs.
» Positive Lhermitte's sign: electric shock-like pain on neck flexion.

Late signs:

» Limb weakness, sensory deficits – level detected, decreased to absent reflexes, paraplegia.

GENERAL AND SUPPORTIVE MEASURES

» Early detection in high-risk patients.
» Once established manage as per paraplegia with careful attention to pressure support as well as bowel and bladder care (intermittent catheterisation).

MEDICINE TREATMENT

Commence high dose dexamethasone:

- Dexamethasone, IV:
  - Loading dose of 1–2 mg/kg followed by 0.25–0.5 mg/kg every 6 hours has been suggested.

REFERRAL

» Palliative radiotherapy.

21.2.3 RESPIRATORY PANIC

DESCRIPTION

Sudden onset of severe respiratory distress sometimes experienced with an end of life event such as pulmonary embolus, pneumothorax, pulmonary oedema, SVC syndrome, upper airway obstruction, and bleed into CNS tumour.

GENERAL AND SUPPORTIVE CARE

» Remain calm and provide reassurance.

» Position in semi-fowlers position.
» Gentle suctioning.
» Supplemental oxygen.

MEDICINE TREATMENT

If no IV line, use buccal midazolam and morphine:

- Midazolam: 500 mcg/kg and morphine 100 mcg/kg repeating every 10–30 minutes as needed until child settles or subcutaneous infusion is commenced.

21.3 END OF LIFE AND TERMINAL CARE

Z51.1

DESCRIPTION

The end of life phase is defined as that stage where it is recognized that the child's health is in a state of steady decline, whereas the terminal stage is the last few hours of life.

Although prognostication is more difficult in children compared to adults especially when it comes to non-malignant conditions, the following may serve as indicators that prognosis is becoming more limited:

» Increasing frequency or duration of hospitalisations.
» More severe disease-related complications with downward drifting baseline.
» Decreasing response to disease modifying treatments.
» Decreased duration of benefits of transfusions (especially when these benefits are shorter than the expected lifespan of the blood product).
» Increasing fatigue and prolonged periods of sleep.
» Anorexia and cachexia.
» Decreasing urine and stool output.
» Child less interactive, becoming increasingly withdrawn and less interested in surroundings.
» Deteriorating physiological parameters.
» Increasing anxiety or agitation or in some children increasing peace and serenity and actively seeking out of opportunities for legacy making.

GENERAL AND SUPPORTIVE MEASURES

» Advance care planning:
  > Is a process of discussions between families and healthcare providers about preferences for care (including place), treatments and goals in the context of the child's current and anticipated future goals.
  > Should include information on resuscitation status and documentation of decisions on limitations of interventions.
  > Should outline plans for anticipated complications/end of life events

before they arise.

» Symptoms often intensify at the end of life and treatment should be continued and intensified as needed. Alternative routes for administering medications should be sought in children who lose the capacity to swallow: these include the buccal and rectal routes, naso-gastric tubes, transdermal patches and the subcutaneous route.
» Parents, caregivers and siblings should be actively counselled and prepared for the child's death.
» Try limit hospital admissions or reduce the duration of hospital stays where family have the capacity to care for their child at home.

21.3.1 TERMINAL CARE

Indications for inpatient hospital or hospice inpatient terminal care:

» Hypoxia and respiratory distress where oxygen therapy provides relief and not already available at home.
» IV/naso-gastric fluid requirements or medication administration needed to relieve suffering.
» Carer/s unable to cope at home.
» Symptom control needing to be intensified or provided intravenously.

Feeds and fluids at the end of life:

» Anorexia and refusal of feeds/fluids in dying patients is a normal phenomenon and not an indication for naso-gastric feeds or intravenous fluids as these may prolong dying.
» Encourage the family to 'feed for comfort only' and reassure them that the dying child is not hungry.
» Decreasing fluid intake is helpful for the dying process: decreases excessive secretions, urination, pulmonary and cerebral oedema.
» Ketosis is also beneficial in that is suppresses appetite and also aids release of endorphins (natural pain killers).

Investigations at the end of life:

» Investigations should be kept to a minimum and only done if it is believed that doing these will shorten the duration of hospital stay or in some way contribute to the child's comfort.
»

MEDICINE TREATMENT

Antibiotics at the end of life:

- Oral antibiotic therapy may be started, where it is thought that a course of antibiotics could shorten the duration of discomfort or hospital stay.
- Non-treatment of a terminal pneumonia (a common end of life event) is an acceptable palliative care practice.

Medication at the end of life:

- Stop all unnecessary medications (e.g. multivitamins, TB treatment, ART) that are not contributing towards symptom control and adding to pill burden in an actively dying child.
- Continue medications that if discontinued could cause distressing symptoms (e.g. calcium, anti-failure medications).
- Consider use of alternative routes of administration of symptom control if not able to take orally.

Management of terminal agitation or restlessness:

» Exclude unmanaged pain.
» Exclude urinary retention.
» Check pressure sites for bedsores.

- Midazolam
  - By IV/SC infusion: 250–1500 mcg/kg/24 hours as starting dose, titrating upwards against symptoms and sedation, 10–60 mcg/kg/hour.

REFERRAL

Discuss with a specialist:

» Children with symptoms not described here.
» Children not responding to management.

References

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CHAPTER 22

ANAESTHETICS

Healthcare professionals engaged in intensive care and delivery of anaesthesia must undergo appropriate training.

22.1 ANAESTHETIC AND POST-ANAESTHETIC CARE OF CHILDREN

22.1.1 LOCAL AND REGIONAL ANAESTHESIA

DESCRIPTION

Local anaesthesia is accomplished by either local infiltration of soft tissue or the instillation of local anaesthetic into potential or existing body spaces such as the epidural space, sub-arachnoid spinal spaces or around major nerves or plexuses.

Appropriate care is always used to limit overdose and avoid toxicity. Use appropriate agents, avoid adrenaline (epinephrine) where end-artery blood supply exists and ensure the agents are in the correct sites. This should be learnt under appropriate learning conditions.

MEDICINE TREATMENT

Choice of local anaesthetic agent should be guided by desired onset and duration of action. Bupivacaine is the local anaesthetic agent of choice due to duration of action. These agents, particularly bupivacaine, are cardiotoxic – every effort must be made to prevent intravascular injection. The use of ultrasound is strongly advised. Maximum doses must be strictly adhered to.

Table 1: Local anaesthetic agents

Local anaesthetic	Onset of action	Duration of action	Maximum dose with adrenaline (epinephrine)	Maximum dose without adrenaline (epinephrine)
Lidocaine	2–5 minutes	1–2 hours	7 mg/kg (0.3 mL/kg of 2% solution)	3 mg/kg (0.15 mL/kg of 2% solution)
Bupivacaine	10–40 minutes	4–6 hours	2–3 mg/kg (0.4–0.6 mL/kg of 0.5% solution)	2–3 mg/kg* (0.4–0.6 mL/kg of 0.5% solution)

*In infants under 12 months, overweight children, or children with liver dysfunction (where levels of α-acid glycoprotein are likely to be low), use a maximum dose of 2 mg/kg.
*If using continuous regional anaesthesia technique (e.g. via indwelling catheter), use 2 mg/kg as maximum dose over a 4–6 hour period.

Note: Lipid emulsion 20% must be readily available where these techniques are performed, in the event of inadvertent intravascular injection or drug error leading to overdose and Local Anaesthetic Systemic Toxicity (LAST). For management of LAST, see below.
Note: Do not use adrenaline (epinephrine) containing local anaesthetic solutions in sites where vascular (end-artery) compromise may result from vasoconstrictor use, i.e. fingers, toes, penis and eyes.

Caudal anaesthesia
Caudal anaesthesia is a commonly utilised technique in children and provides good analgesia for common procedures. This technique must be learnt in an appropriate learning situation, as it has the potential to cause serious harm.

- Calculate the maximum dose of bupivacaine allowed for patient weight.
- Dilute with 0.9% sodium chloride (ONLY) to the desired volume.
- Adjuncts can be used to prolong and improve the quality of the block:
  - Dexamethasone 0.1–0.5 mg/kg given IV prolongs the duration of analgesia provided by the caudal anaesthesia.

Note: Only medicines with proven safety should be injected into the caudal space due to the potential for neurotoxicity and other adverse effects.

Table 2: Recommended volumes for caudal anaesthesia

Level of analgesia required	Volume of local anaesthetic required
Low thoracic level	1.25–1.5 mL/kg
High lumbar level	1–1.25 mL/kg
Sacral level	0.5–1 mL/kg

Other regional anaesthetic techniques
These techniques should be learnt in an appropriate learning situation. The use of ultrasound is strongly recommended to improve safety. Always adhere to maximum allowable local anaesthetic doses.

Epidural volumes should take into consideration the dermatomal and visceral cover required. Generally allow 0.5 – 1 mL/dermatome, staying within the toxic dose range.

For wound infusion catheters infusions of bupivacaine:

- If < 4 months or < 5 kg: use 0.1% bupivacaine at 0.2 ml/kg/hour
- If > 4 months or > 5 kg: use 0.2% bupivacaine at 0.2 ml/kg/hour

Procedure	Regional nerve block options	Dosing* (volume)
Umbilical herniorrhaphy	Rectus sheath	0.2 – 0.3 mL/kg/side
Inguinal herniorrhaphy	Caudal	1 – 1.25 mL/kg
	Ilio-inguinal/iliohypogastric nn.	0.15–0.2 mL/kg/side
Orchidopexy	Caudal	1 – 1.25 mL/kg
	Ilio-inguinal/iliohypogastric nn.	0.2–0.3 mL/kg/side
Circumcision	Dorsal penile nerve	0.5 - 1 mL/kg
	Caudal	1 mL/kg
	Pudendal nerve	1 mL/kg
Laparotomy (supra-umbilical)	Thoracic paravertebral	0.5 mL/kg/side
	Subcostal transversus abdominus plane**	0.3–0.5 mL/kg/side
	Epidural with catheter	
	Wound infusion catheter	
Laparotomy (infra-umbilical)	Caudal	(see table above)
	Epidural + catheter	
	Quadratus lumborum	0.5 mL/kg/side
	Lumbar paravertebral plane	0.5 mL/kg/side
	Transversus abdominus plane**	0.3–0.5 mL/kg/side
	Wound infusion catheter	
Laparotomy (midline)	Rectus sheath block**	0.1–0.3 mL/kg/side
	Caudal (only blocks lower midline)	1.25–1.5 mL/kg
	Epidural with catheter	
	Wound infusion catheter	
Thoracotomy	Thoracic paravertebral	0.5 mL/kg/side
	Intercostal nerves	0.5 - 2 mL per nerve

Procedure	Regional nerve block options	Dosing* (volume)
	Epidural with catheter Wound infusion catheter	
Appendicectomy (laparoscopic)	Transversus abdominus plane** Quadratus lumborum	0.3–0.5 mL/kg/side 0.5 mL/kg/side
Femur fracture/ Osteotomy	Fascia iliaca Femoral nerve +/- sciatic nerve Caudal Epidural with catheter	0.2 - 0.5 mL/kg 0.2 – 0.4 mL/kg 0.3 – 0.5 mL/kg (see table above)

**Provides somatic analgesia only.

22.1.2 GENERAL ANAESTHESIA

22.1.2.1 PREPARATION

DESCRIPTION

All patients should be starved before general anaesthesia to prevent regurgitation and aspiration of gastric contents. The preoperative starvation period is:

» clear fluid: 1 hour,
» breast milk: 4 hours, and
» solids, breast milk substitutes, non-human milk: 6 hours.

Clear fluids include water, clear juices without pulp and tea without milk.

Premedication of children for anaesthesia is largely a sedative/anxiolytic intervention.
The goal of anxiolytic premedication is to minimise emotional distress and facilitate mask acceptance for induction of anaesthesia.
The choice of agent should be guided by the child's condition (previous experiences, comorbidities, severity of anxiety).
Children who are distressed on induction of anaesthesia are more likely to develop distress in the early post-operative period. An active approach to reducing emotional distress with non-medicine and medicine measures is advised.

Avoid sedative premedication in children less than 6 months, children with evidence of airway compromise, obstructive sleep apnoea (OSA) or hypotonia.

GENERAL AND SUPPORTIVE MEASURES

» Distraction techniques, e.g. videos, games, reading, music.
» Caregiver presence is strongly encouraged. Counsel appropriately as to what is expected.
» Medical play is a useful technique that helps address anxiety.

MEDICINE TREATMENT

Premedication

Midazolam and ketamine are bitter tasting. To facilitate acceptance, mix with the recommended dose of paracetamol syrup/ibuprofen syrup or something sweet tasting such as apple juice.

Agent	Route	Dose	Time to peak effect (minutes)
Midazolam	Oral Intranasal** Intravenous	0.25–0.5 mg/kg (max. 15 mg) 0.3 mg/kg 0.025–0.1 mg/kg*	10–30 10–15 3–5
Clonidine	Oral	3–5 mcg/kg	60–90
Ketamine	Oral Intranasal** Intramuscular	6–10 mg/kg 1–5 mg/kg 2–4 mg/kg	30 20 20

*Titrate to effect. Repeat dose at 5 minute intervals until desired level of sedation is achieve.
**Off-label route sometimes employed in practice.

Midazolam:

- This is a commonly used premedication agent that is generally well tolerated.
- Can be safely used in most children, but caution is advised in children with:
  - Risk factors for paradoxical excitation, e.g. children under 3 years, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD).
  - Avoid in patients with obstructive sleep apnoea (OSA), as can cause respiratory depression.

OR

Clonidine:

- Preferred agent in children with:
  - Behavioural disorders such as ADHD, and children with ASD.
  - Obstructive sleep apnoea.
- Does not cause respiratory depression.

- Can cause bradycardia, which is clinically insignificant.
- Provides analgesia in addition to anxiolysis and sedation.
- Is tasteless and well tolerated. Even smaller children will swallow the tablets, but they can also be crushed and added to juice or water.

LoE II[1]

Alternative in certain circumstance

Ketamine:

- Is cardio stable and does not cause respiratory depression.
- Provides analgesia in addition to anxiolysis and sedation.
- In exceptional circumstances, can be used IM, e.g. when dealing with a combative child who is unable to understand what is needed and will not accept other routes of administration.

Intranasal administration of medicines can be administered with the patient reclining (or held) at 45 degrees, preferably using a mucosal atomiser device. The syringe is held horizontally and applied to the nare, and the contents expelled in one rapid dose. Use undiluted medicines to minimise the volume of drug. Doses of 1 mL or more should be divided between two nares.

22.1.2.2 INDUCTION OF ANAESTHESIA

Induction should be learnt in an appropriate learning situation.

DESCRIPTION

Anaesthesia should only be administered by medical practitioners with appropriate training in anaesthesia. Induction of anaesthesia is the critical part of the transition from consciousness to general anaesthesia. This is a period which requires highly skilled and attentive care. Depression of the respiratory and cardiovascular systems often occur. The degree of depression depends on the agents used and the patient's condition.

The following monitors are mandatory to ensure the delivery of safe anaesthesia:

» Clinical observation – a dedicated medical doctor is mandatory.
» 3-lead ECG with heart rate display.
» Automated blood pressure.
» Pulse oximeter.
» Capnograph, displaying end-tidal CO_2 in mmHg, kPa or % and capnogram.
» Temperature

MEDICINE TREATMENT FOR INDUCTION OF ANAESTHESIA

Inhalational agents

Non-irritant inhalational agents, delivered with oxygen with/without medical air/nitrous oxide, are used for induction of anaesthesia. Nitrous oxide can be used to increase the onset of anaesthesia by its 'second gas effect', but should be limited to use with a minimum oxygen concentration of 30%, with oxygen analysis, by an experienced user. The following agents are used for gas induction of anaesthesia:

- Sevoflurane (preferred)
- Halothane

LoE III[2]

Intravenous agents (Use reduced doses if inhalational agents also used).

- Propofol, IV, titrate up to 3.5 mg/kg. Titrate as necessary to achieve required sedation. (Acts within 30 seconds. Effect lasts 3–10 minutes).

OR

- Ketamine, IV, 1–2 mg/kg. (Acts within 60 seconds. Effect lasts 5–10 minutes).

OR

- Etomidate, IV 0.3 mg/kg. Give slowly. This is regarded as being more 'cardio stable' and is generally reserved for patients who are at risk of cardiovascular collapse, but must be used with caution even in these patients. A single dose can cause adrenal suppression.

Muscle relaxant during induction for intubation

Note: These agents cause muscle paralysis and apnoea. It is good practice to use a nerve stimulator when non-depolarising muscle relaxants are used to monitor the degree of paralysis/weakness.

Ventilate all patients receiving muscle relaxants.

- Suxamethonium, IV, 1–2 mg/kg. Onset of action: 30–60 seconds. Duration of action: 5–10 minutes.
  - **Note**: Avoid suxamethonium in patients with or at risk of hyperkalaemia, scoline apnoea, certain neuromuscular diseases and a family history of malignant hyperthermia.

OR

- Rocuronium bromide, IV, 0.3–1 mg/kg. Onset and duration of action is dose dependent. Onset of action: 1–3 minutes. Duration of action: 30–60 minutes.

OR

- Vecuronium, IV, 0.1 mg/kg. Onset of action: 2–3 minutes. Duration of action: 30–40 minutes.

OR

- Cisatracurium, IV, 0.1–0.15 mg/kg. Onset of action: 3 minutes. Duration of action: 30–45 minutes. This is the agent of choice in patients with renal dysfunction.

Endotracheal intubation

Caution
This procedure should be learnt under supervision.

The condition of the patient and the surgical requirements dictate the choice of airway management – face mask, supraglottic airway device or endotracheal tube (ETT). Traditionally, uncuffed endotracheal tubes were preferred in children. More recently, cuffed endotracheal tubes have been demonstrated to be safe and may offer several advantages over uncuffed tubes. Care must be taken not to overinflate the cuff as this can lead to ischaemia of the tracheal wall and the development of severe complications like sub-glottic stenosis. It is advisable to check cuff pressures with a manometer 4-hourly, and to limit pressures to 15–20 cmH_20. Use the smallest volume of air to maintain an adequate seal.

To estimate the correct ETT size, the table below can be used as a guide. Alternatively, formulas can be used:
ETT size (ID (mm)): Age (years)/4 + 3.5 (cuffed ETT)
Age (years)/4 + 4 (uncuffed ETT)

Confirm clinically with auscultation that air entry is heard bilaterally, and observe airway pressures.

Table 3: A guide to endotracheal tube sizes and lengths in children with head in the neutral position

Age	Weight (kg)	ETT*	Oral (measurement at lips, cm)	Nasal (measurement at nostril, cm)
Preterm	1	2.5	7	8.5
Preterm	2	2.5–3	8	9.5
Term	3	3–3.5	9.5	11.5
2 months	4.5	3.5	11	12.5
1 year	10	4	12	14
18 months	12	4.5	13	15
2 years	15	5	14	16
4 years	17	5.5	15	17
6 years	21	6	16	19
8 years	25	6.5	17	20
10 years	31	7	18	21

*If using a cuffed endotracheal tube, use a half-size smaller.

22.1.2.3 MAINTENANCE OF ANAESTHESIA

DESCRIPTION

After induction, the focus shifts to the maintenance of an adequate level of hypnosis, immobility and analgesia. Anaesthetic goals include maintaining normothermia and normoglycaemia, maintenance of cardiovascular stability, prevention of hypoxia and hyper/hypocapnia, providing appropriate analgesia, and the prevention of post-operative complications.

MEDICINE TREATMENT DURING MAINTENANCE OF ANAESTHESIA

Inhalational (volatile) anaesthesia

These are delivered with a combination of oxygen and medical air/nitrous oxide. The recommendation is to use a combination of oxygen and air, especially if unable to monitor inhaled oxygen concentration. The use of nitrous oxide risks hypoxia, and offers little benefit intraoperatively. The use of nitrous oxide should be limited to use with a minimum oxygen concentration of 30%, with oxygen analysis. The use of nitrous oxide to provide analgesia is variable depending on altitude and is discouraged, as this effect is limited to the period of its use, with no provision for post-operative analgesia.

The Minimum Alveolar Concentration (MAC) defines the anaesthetic depth for inhaled agents at which 50% of patients respond to a painful stimulus with movement.

Table 4: Age-related MAC values

Age (months)	Isoflurane	Sevoflurane
1	1.6	3.2–3.3
2	1.9	3.2–3.3
14	1.8	2.5
44	1.6	2.5

Intravenous anaesthetic agents

These agents can be delivered by continuous infusions where volatile agents are contraindicated.

- Propofol, IVI, 7.5–15 mg/kg/hr. Infusions of more than 4 mg/kg/hr for more than 24 hours should be avoided due to the risk of propofol infusion syndrome.
- Ketamine, IVI, 10–40 mcg/kg/min. Excessive salivation can be managed with an anti-sialogogue such as glycopyrrolate.

Analgesia

- Multimodal analgesia (the use of multiple pharmacological agents in combination) is strongly advised to facilitate optimal pain management through synergy of various agents, and to minimise the dose of opiates

required for effective analgesia. This allows for avoidance of the unwanted side effects typically associated with opioids, e.g. respiratory depression, nausea, hypotension, sedation.

Simple analgesia

- Oral paracetamol is cost effective and has excellent bioavailability. Oral paracetamol can be administered when patients are being kept NPO for general anaesthesia. (See Table 5 for dosing.)

- Ibuprofen syrup, 5–10 mg/kg orally (can be given preoperatively).

Table 5: Paracetamol doses in children

Route	Loading Dose	Maintenance dose			Maximum daily dose
		Neonates	Infants 30 days to 3 months	3 months to 12 years	
Oral	20 mg/kg	5 – 10 mg/kg 6 to 8 hourly	10 mg/kg 6 hourly	15 mg/kg 6 hourly	90 mg/kg/day Neonates: 60 mg/kg/day
Intravenous	20 mg/kg	5 – 10 mg/kg 6 to 8 hourly	10 mg/kg 6 hourly	15 mg/kg 6 hourly	90 mg/kg/day Neonates: 60 mg/kg/day
Rectal	40 mg/kg	30 mg/kg/dose 6-hourly			5 g/day

Opiate Analgesia

For most cases, unless a regional technique has been employed, a combination of a short and longer acting opioid are used. Fentanyl is a short-acting opioid used to provide intraoperative analgesia, and morphine is a long-acting opioid used for both intraoperative and post-operative analgesia.

- Fentanyl, IV, 0.5–2 mcg/kg boluses as required, titrated to indicators of pain – patient movement, heart rate, BP and respiratory rate (where patient is breathing spontaneously). Note that these parameters are non-specific indicators for pain. Correlate with painful stimuli and expected procedure-specific pain severity. Fentanyl is a potent opioid with a rapid onset and short duration of action. Bradycardia may occur, but blood pressure is usually preserved. Apnoea can occur. Respiratory support may be required.

- Morphine, IV, 0.05–0.2 mg/kg boluses as required. Morphine is a delayed onset, long-acting opioid. Respiratory depression (decreased minute ventilation or apnoea) precedes analgesic effect. Respiratory support may be required. Can cause bradycardia and hypotension, especially in patients who are hypovolaemic or unstable. Note that there is no ceiling dose for morphine – children who have developed opioid

tolerance or with severe pain may need higher doses. Titration is an important aspect of safety.

Drug	Onset of action	Duration of action	Dose
Fentanyl	1–5 minutes	30–60 minutes	0.5–2 mcg/kg
Morphine	20–50 minutes	4–6 hours	0.05–0.2 mg/kg

- Ketamine, IV, 0.3 mg/kg stat. Consider using to decrease opioid requirements and address elements of neuropathic surgical pain.
- Local anaesthetic infiltration of the wound by the surgeon with bupivacaine +/- adrenaline (see maximum allowable dose) or regional anaesthesia technique.

Muscle relaxant during maintenance phase

- Rocuronium bromide, IV:
  - Maintenance doses: IV, 0.3–1 mg/kg, as needed (may be guided by nerve stimulator). Note that repeated doses may lead to prolonged muscle relaxation.

OR

- Vecuronium, IV:
  - Maintenance doses: IV, 0.1 mg/kg, as needed (may be guided by nerve stimulator).

OR

- Cisatracurium, IV. Preferred in patients with renal impairment:
  - Maintenance doses: IV, 0.1–0.2 mg/kg.

Reversal of muscle relaxant

Always reverse non-depolarising muscle relaxants. A combination of an acetylcholinesterase inhibitor and either glycopyrrolate OR atropine to counteract the excess acetylcholine which will produce muscarinic side effects. Glycopyrrolate is preferred as it has a slower onset of action, producing less tachycardia and less central nervous system effects with a longer duration of action.

- Acetylcholinesterase inhibitor: Neostigmine, IV, 50 mcg/kg.

PLUS

- Glycopyrrolate, IV, 10 mcg/kg **OR** atropine, IV, 20 mcg/kg.
  For convenience, can be dosed as follows:
  - 1 mL of neostigmine 2.5 mg/mL **plus** 2 mL glycopyrrolate 0.2 mg/mL **plus** 7 mL sodium chloride 0.9%. Give 1 mL/5 kg of this solution IV.

To reduce secretions, only if required (especially if ketamine is given):

- Glycopyrrolate, IV, 5–10 mcg/kg (preferred).
  OR
- Atropine, IV, 20 mcg/kg.

Prophylaxis for Post-Operative Nausea and Vomiting (PONV)
A risk assessment should be conducted for every child.
The postoperative vomiting in children score (POVOC) can be used:

1. Duration of surgery > 30 minutes.
2. Age > 3 years.
3. Strabismus surgery.
4. Personal or direct family history of PONV.

Table 6: POVOC score

Number of risk factors	Incidence of postoperative vomiting (%)	Recommended Intervention
1	10	Dexamethasone, IV, 0.15 mg/kg
2	30	Dexamethasone, IV, 0.15 mg/kg + Ondansetron, IV, 0.15 mg/kg
3–4	55–70	Dexamethasone, IV, 0.15 mg/kg + Ondansetron, IV, 0.15 mg/kg + Intra-operative fluid administration up to 30 mL/kg

Other strategies to decrease PONV are encouraged and include avoidance of nitrous oxide, multi-modal analgesia to reduce opioid requirements, and the consideration of a total intravenous anaesthesia technique.
The risk for PONV increases significantly peri-adolescence. During this time, girls are at higher risk when compared to boys.

Hypotension under General Anaesthesia
An appreciation of normal values for age for blood pressure are essential for the safe conduct of anaesthesia in children. Most cases of hypotension in children are due to hypovolaemia, and a bolus of 5 – 10 mL/kg of isotonic fluid should be given, and the response assessed. With persistent hypotension, a cause needs to be sought and addressed. For the diagnosis of hypotensive states or shock, and appropriate management, please refer to Intensive Care Chapter: section 23.8. Inotropes and vasopressors

22.1.3 POST OPERATIVE CARE

Vital signs should be monitored more frequently in the immediate post-operative period after discharge from the recovery area. Inadequately treated pain has adverse effects on multiple organ systems. Pain management should be individualised for each patient – according to the expected severity and type of pain. Analgesia should be prescribed regularly if pain is expected to be moderate to severe.

MEDICINE TREATMENT

Analgesia should be prescribed according to the predicted severity of pain. Procedures associated with mild pain include incision and drainage of an abscess, manipulation of a mildly displaced fracture, and inguinal hernia repair. Procedures associated with moderate–severe pain include tonsillectomy, laparotomy, appendicectomy, testicular torsion, and severely displaced fractures.

Avoid 'as necessary' or 'pro re nata' (PRN) dosing. Scheduled analgesia is essential in managing moderate and severe pain.

Table 7: Recommended post-operative analgesia

Predicted pain severity	Principles of management	Suggested regimen
Mild pain	Simple analgesia should suffice.	Paracetamol ± Ibuprofen
Moderate pain	Simple analgesia + opioid Dose regularly.	Paracetamol + Ibuprofen + Morphine PO
Severe pain	Simple analgesia + strong opioid. Dose regularly.	Paracetamol + Ibuprofen + Morphine IV
Adjuncts		Ketamine

Simple analgesia: Paracetamol

- See doses above

Simple analgesia: Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)

- Ibuprofen, oral, 5–10 mg/kg/dose 8 hourly

Opioid analgesia

- Strong opioid: Morphine, oral:
  - 0–1 month of age: 0.05 mg/kg 6 hourly.
  - 1–12 months of age: 0.05–0.2 mg/kg/dose 4–6 hourly.
  - > 12 months of age: 0.2–0.4 mg/kg/dose 4–6 hourly.

- Strong opioid: Morphine, IV. Morphine infusion for older child (more than 3 months of age):
  - Ventilated: Morphine, IV, 20–40 mcg/kg/hour infusion.
    - i.e. Morphine 1 mg/kg mixed with 50 mL dextrose 5% or sodium chloride 0.9% at 1–2 mL/hour.
  - Unventilated: Morphine 5–20 mcg/kg/hour infusion.
    - i.e. Morphine 1 mg/kg mixed with 50 mL dextrose 5% or sodium chloride 0.9% at 0.25–1 mL/hour.

Adjuncts

- Ketamine, IV, 0.2–0.5 mg/kg/hour.
  - i.e. Ketamine 5 mg/kg mixed up to 50 mL sodium chloride 0.9% at 2–5 mL/hour.

Ketamine is a safe and effective analgesic adjunct, with significant opioid sparing effect, even at low doses. This dosing regimen will not result in haemodynamic changes, or unwanted psychotropic effects.

Note:
Patients on morphine infusions should have continuous oxygen saturation monitored and adequate nursing care. Label syringes appropriately.

REFERRAL

» Inability to provide appropriate care.

22.1.4 MANAGEMENT OF ANAESTHETIC AND POST-ANAESTHETIC COMPLICATIONS

DESCRIPTION

Various events may occur during and after anaesthesia, which require management.

MEDICINE TREATMENT

Laryngospasm

1. Maintain a good seal and attempt bag-mask ventilation, maintaining continuous positive pressure.
2. Deepen the level of anaesthesia with a volatile anaesthetic agent (if laryngospasm is partial) – may overcome laryngospasm without the need for suxamethonium.
3. If laryngospasm is complete (no movement of air) and the patient starts to desaturate, act quickly and consider:
   - Propofol, IV, 1–2 mg/kg.
     AND/OR
   - Lidocaine, IV, 1–2 mg/kg.
   - Suxamethonium, IV, 1–2 mg/kg. If no IV access: Suxamethonium 3–4 mg/kg IM into the tongue (intralingually) with massage (submental route is preferred, see diagram below). Massage speeds onset of action significantly. (Produces 5–10 minutes of neuromuscular blockade within 30–60 seconds). Causes paralysis and apnoea.

Note: Do not wait for patient to become significantly hypoxic and bradycardic. Call for help early.

Note: Avoid suxamethonium in patients with or at risk of hyperkalaemia, scoline apnoea, certain neuromuscular diseases and a family history of malignant hyperthermia.

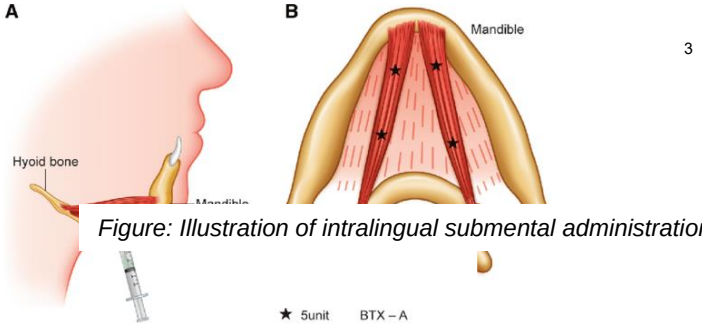

Figure: Illustration of intralingual submental administration.

Route of administration	Quadriceps	Intralingual submental	Intralingual submental with massage
Time to 90% twitch suppression	295 seconds	265 seconds	133 seconds

Bronchospasm

Intraoperatively, exclude precipitating factors, e.g. ET tube at carina or mainstem bronchus intubation, blocked tubing or equipment, light anaesthesia, secretions, aspiration, allergic reactions.

Management

- Increase FiO_2.
- Increase volatile agent (except desflurane; if using, change to different agent).
- β_2-agonists can be delivered via different routes:
  - Nebulised fenoterol via in-line nebuliser (need independent oxygen source). Attach onto the circuit at the patient-end of HME and ventilate. Note that capnography will be inaccurate.
  - Salbutamol, IV, 15 mcg/kg over 10 minutes.
- Magnesium sulphate, IV, 30–50 mg/kg (maximum 2 g) slowly over 20 minutes.

If no response, consider:

- Ketamine, IV bolus, 0.5 mg/kg or consider infusion at 1–3 mg/kg/hr (may increase secretions).
- Adrenaline, IV, 0.1–1 mcg/kg or infusion at 0.05–1 mcg/kg/min.
- Hydrocortisone, IV, 1–2 mg/kg stat.

Opioid-induced respiratory depression

- For reversal of apnoea/respiratory depression: Naloxone, IV, 0.01 mg/kg, repeated every 2 minutes, if required, up to 4 times. Maximum dose: 0.4 mg.
- For reversal of post-operative sedation: Naloxone, IV, 0.002 mg/kg/dose, repeated every 2 minutes, as required, up to 4 times.

Note: All patients need to be kept under direct observation until the effect of the opiates has completely worn off. Further doses of naloxone may be needed as naloxone has a shorter duration of action than most opiates (e.g. morphine). Because naloxone antagonises opiates at the mu receptor, the analgesic effect will also be reversed. This occurs at higher doses of naloxone, hence the need for titration. The lowest dose of naloxone to reverse respiratory depression should be used.

Post operative nausea and vomiting

Use an agent of a different class if prophylaxis given.

- Ondansetron, slow IV, 0.15 mg/kg. (No benefit if already used as prophylaxis). Maximum dose: 4 mg. *LoE III[4]*

Malignant hyperthermia

Malignant hyperthermia is a life-threatening anaesthetic emergency triggered by exposure to volatile anaesthetic agents and suxamethonium. Management involves supportive and specific therapies, which centre on the administration of dantrolene. For a comprehensive management guideline, refer to the Association of Anaesthetists of Great Britain and Ireland's (AAGBI):

https://anaesthetists.org/Portals/0/PDFs/Guidelines%20PDFs/New%20archived/Guideline_malignant_hyperthermia_laminate_2011_archive%20version.pdf?ver=2021-01-13-160622-273

- Stop the triggering agent.
- Stop surgery or provide an alternate method of hypnosis intravenously (e.g. ketamine, propofol).
- Give dantrolene, IV, 2.5 mg/kg immediately. This is followed by 1 mg/kg IV boluses to a maximum cumulative dose of 10 mg/kg.

Local Anaesthetic Systemic Toxicity (LAST):

This is a life-threatening emergency caused by inadvertent intravascular injection or overdose of local anaesthetic agents. LAST is comprised of neurological and cardiovascular features with eventual cardiovascular collapse and cardiac arrest if high plasma concentrations are reached. The management is supportive and specific. For a comprehensive management guideline, refer to the Association of Anaesthetists of Great Britain and Ireland's (AAGBI) guideline:

(https://www.aagbi.org/sites/default/files/la_toxicity_2010_0.pdf)

- Stop injecting the local anaesthetic.
- Early administration of lipid emulsion 20% is a priority. Provide cardiovascular and respiratory support while awaiting lipid emulsion and until return of spontaneous circulation. Apply Advanced Paediatric Life Support algorithms should cardiac arrest occur. Good cardiopulmonary resuscitation is of paramount importance to ensure a good outcome. Treat arrythmias, but do not use lignocaine.
- Start lipid emulsion, IV, 1.5 mL/kg **AND** start infusion of 15 mg/kg/hr. The bolus of 1.5 mL/kg can be repeated after 5 minutes if the patient remains unstable. The maximum dose of lipid emulsion is 12 mg/kg. Propofol is not a suitable replacement.
- Treat seizures

Dysrhythmias

See Chapter 4: Cardiovascular System, section 4.1: Cardiac dysrhythmias.

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CHAPTER 23

PAEDIATRIC INTENSIVE CARE

Healthcare professionals engaged in intensive care must undergo appropriate training, with junior doctors working under appropriate supervision. Endotracheal intubation should usually be performed using the rapid sequence technique and must be undertaken by the most experienced clinician during emergencies.

For Neonatal Care see:
Chapter 19: Prematurity and Neonatal Conditions.

23.1 RAPID SEQUENCE INTUBATION (RSI)

DESCRIPTION

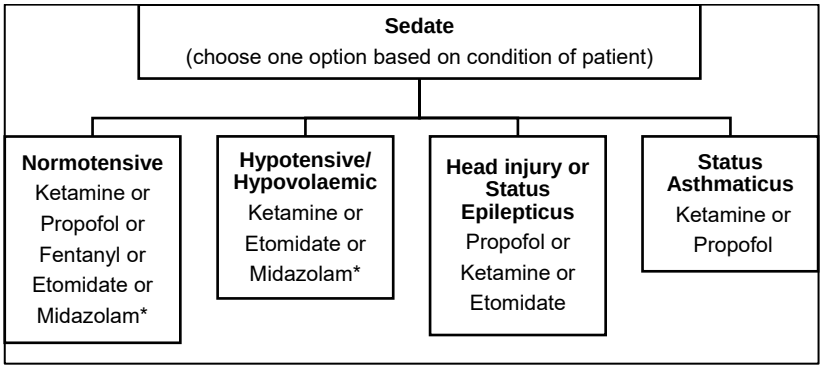
Rapid Sequence Intubation (RSI) is a coordinated, sequential approach to emergency endotracheal intubation designed to optimise success and safety. This technique is recommended for most scenarios necessitating endotracheal intubation. The sequential steps involved in RSI are (The 7 'P's):

1. **Preparation** (10 minutes pre-intubation) – best achieved with the use of a checklist. Focussed history and examination to assess for presence of a difficult airway and conditions which will influence choice of drugs for the procedure. All necessary equipment must be present and checked prior to the administration of any sedatives. A plan for what to do should intubation be unsuccessful is mandatory.
2. **Pre-oxygenation** (5 minutes pre-intubation) – 100% oxygen (or highest concentration available) should be started as soon as the decision to intubate is taken. A minimum of 3 minutes is needed to increase the time to desaturation during intubation.
3. **Pre-treatment** (3 minutes pre-intubation) – **optional**. Atropine may be beneficial to counteract bradycardia during intubation for the following: if suxamethonium is going to be used; for infants and in children with septic or late-stage hypovolaemic shock.
4. **Paralysis post sedation** (Induction) – Sedation must be administered prior to the paralytic agent. The choice of agents will be determined by the clinical characteristics of the patient.
5. **Protection and Positioning** (30 seconds post induction) – cricoid pressure is not recommended for airway protection. External laryngeal manipulation may be utilised to improve the view of the anatomy during intubation.

6. **Placement with confirmation** (45 seconds post induction) – end-tidal CO_2 detection is strongly recommended, in addition to auscultation and visualisation of symmetrical chest rise.
7. **Post intubation management** (60 seconds post induction) – secure the endotracheal tube appropriately and obtain a chest X-ray. Commence ongoing analgosedation.

NOTES:

» If intravenous (IV) access is not available, intraosseous (IO) is preferred to intramuscular (IM) administration.
» Pre-treatment (see table below) is no longer routinely recommended as there is limited evidence of routine benefit.
» Factors influencing choice of sedative:
  > Haemodynamically stable – propofol or ketamine or etomidate.
  > Haemodynamically unstable – ketamine or fentanyl or etomidate.
  > Status asthmaticus – ketamine or etomidate.
  > Status epilepticus – propofol or midazolam. If hypotensive – ketamine or etomidate.
» With respect to paralytic agents, suxamethonium (unless contraindicated) remains the agent of choice. Among the non-depolarizing agents, rocuronium is preferred to vecuronium.
» While etomidate does cause adrenal suppression, it remains an efficacious induction agent for most indications with the potential exception of sepsis.
» Fentanyl can be used in patients with haemodynamic instability, but at a lower starting dose and then titrated to effect (1 mcg/kg vs 3 mcg/kg in haemodynamically stable patients). It is a good option in patients with either suspected myocardial ischaemia or catecholamine depletion. Fentanyl must be administered slowly (30–60 seconds).
» **While midazolam remains a very popular induction agent, it is not recommended for routine use unless it is the only agent available**.



**Midazolam only to be used if no other agent available.*

Suxamethonium contraindications:

» Absolute:
  > Chronic myopathy or denervating neuromuscular disease.
  > 48 to 72 hours post burns, polytrauma, or an acute denervating event.
  > Extensive rhabdomyolysis.
  > Pre-existing hyperkalaemia.
  > Personal or family history of malignant hyperthermia.
» Relative:
  > Renal dysfunction with normal serum potassium.
  > Organophosphate poisoning or any other known pseudo-cholinesterase deficiency.

MEDICINE TREATMENT

Pre-treatment

Drug	IV Dose	Indication
Atropine or Glycopyrrolate	0.02 mg/kg Minimum: 0.1 mg Maximum: 0.5 mg (1 mg adolescents) 0.01–0.08 mg/kg	For patients at increased risk of bradycardia (vagally induced, reflex, succinylcholine). Prior to ketamine administration. As per atropine.
Lidocaine	1–2 mg/kg Maximum: 200 mg	Consider in patients with suspected raised ICP.
Fentanyl	2–3 mcg/kg	Consider in patients with suspected raised ICP.

Sedatives (Induction)

Drug	IV Dose	Time to Effect	Duration of Effect
Ketamine	1–2 mg/kg	60 seconds	5–10 minutes
Propofol	1–3.5 mg/kg	30 seconds	3–10 minutes
Fentanyl	1–5 mcg/kg	1–2 minutes	30–40 minutes
Etomidate	0.3 mg/kg Maximum: 20 mg	15–45 seconds	10–12 minutes
Midazolam	0.2–0.3 mg/kg Maximum: 10 mg	2–3 minutes	30–45 minutes

Paralytic Agents (Neuromuscular Blockers)

Drug	IV Dose	Time to Effect	Duration of Effect
Suxamethonium	1–2 mg/kg	30–60 seconds	5–10 minutes
Rocuronium	1 mg/kg	1–3 minutes	60–90 minutes
Vecuronium	0.1 mg/kg	2–3 minutes	30–40 minutes
Cisatracurium	0.1–0.15 mg/kg	3 minutes	30–45 minutes

Options if no IV or IO access available

Drug	IM Dose	Onset	Comments
Atropine	0.02–0.03 mg/kg	4–8 minutes	Not routinely recommended.
Ketamine	6–10 mg/kg	3–4 minutes	Peak effect after 10–30 minutes.
Midazolam	0.25–0.5 mg/kg Maximum: 10 mg	5– 10 minutes	Peak effect after 10–30 minutes.

Drug	IM Dose	Onset	Comments
Suxamethonium	4 mg/kg Maximum: 150 mg	3–6 minutes	Commonly results in significant local muscle pain.
Rocuronium	1–1.8 mg/kg	5–9 minutes	1 mg/kg for infants, 1.8 mg/kg for children > 1 year.

23.2 ANALGOSEDATION

DESCRIPTION

With respect to the comfort of critically ill children, the first priority is ensuring adequate analgesia, best assessed by validated pain assessment scales such as the revised FLACC (R-FLACC), Wong-Baker Faces, Numeric Pain Rating etc. However, sedation is routinely required to minimise anxiety and facilitate both the delivery of therapies, and performance of various invasive procedures associated with intensive care of children. To optimise the use of sedatives, it is essential to utilise age-appropriate sedation scales, e.g. COMFORT-B Scale or Richmond Agitation Sedation Scale, regularly (4–8 hourly). Please note that many sedatives may decrease blood pressure and prolonged usage is associated with delirium and other adverse outcomes.

DIAGNOSTIC CRITERIA

COMFORT-B Scale Score

Alertness	**1** – Deeply asleep (eyes closed, no response to changes in environment). **2** – Lightly asleep (eyes mostly closed, occasional responses) **3** – Drowsy **4** – Awake & alert. **5** – Awake & hyper-alert.	How responsive is the patient to the ambient light, sound and activity around them? Monitors, phones, talking.
Calm/ Agitation	**1** – Calm **2** – Slightly anxious. **3** – Anxious **4** – Very anxious. **5** – Panicky	How would you rate the patient's level of anxiety?
Respiratory response *(intubated & ventilated)*	**1** – No spontaneous respiration, no cough. **2** – Spontaneous breathing no resistance to ventilator. **3** – Occasional cough or resistance to ventilator. **4** – Actively breathes against ventilator or coughs. **5** – Fights ventilator coughing or choking.	How comfortable and compliant is the patient with ventilation via ET tube?
Respiratory response *(crying & self-ventilated)*	**1** – Quiet breathing, no crying sound. **2** – Occasional sobbing or moaning. **3** – Whining or monotonous sound. **4** – Crying **5** – Screaming or shrieking.	How would you score the intensity of verbal response? (*Significance should be given to the characteristics of the cry, not to the presence of tears.)*

Physical Movement	**1** – No movement. **2** – Occasional (3 or fewer) slight movements. **3** – Frequent, (> 3) slight movements. **4** – Vigorous movements limited to extremities. **5** – Vigorous movements include torso & head.	What is the intensity & frequency of the patient's movements?
Muscle Tone	**1** – Muscles totally relaxed; no muscle tone. **2** – Reduced muscle tone; less than normal. **3** – Normal muscle tone. **4** – Increased muscle tone, increased flexion of fingers & toes. **5** – Extreme muscle rigidity & flexion of fingers & toes. *In cases of complex needs/CP/underlying neuromuscular condition, assess with a parent for the 1st assessment.*	How does the patient's muscle tone compare to a normal awake & alert child of the same age/stage of development? Flex/extend limb. (*Assess this section last.)*
Facial Muscles	**1** – Facial muscles totally relaxed. **2** – Normal facial tone. **3** –Tension evident in some muscles (not sustained). **4** – Tension evident throughout muscles (sustained). **5** – Facial muscles contorted and grimacing.	How does the patient's facial movement/tension compare to that of an awake & alert child of the same age/stage of development

Score uses 6 components; use only 1 respiratory score depending on whether the patient is intubated or not.

GENERAL AND SUPPORTIVE MEASURES

Pharmacotherapy is just part of the overall strategy to decrease the distress of critically ill children. It is crucial to also employ non-pharmacological strategies such as parental presence, calming music, distraction therapy, reduction of unnecessary alarms and environmental noise. Bundling of procedures also limits exposure to distressing situations.

MEDICINE TREATMENT

<u>During continuous mechanical ventilation</u>

	IV Bolus Dose	IV Infusion Dose	Comments
Analgesic			
Morphine	0.05–0.3 mg/kg	20–80 mcg/kg/hour	Significant vasodilator. Needs dose adjustment for renal failure.
Fentanyl	1–5 mcg/kg	1–4 mcg/kg/hour	Easier to titrate due to faster onset of action, but higher risk of tolerance/ tachyphylaxis.
Sedative			

	IV Bolus Dose	IV Infusion Dose	Comments
Midazolam	0.05–0.2 mg/kg	50– 200 mcg/kg/hour	Significant vasodilator. Needs dose adjustment for renal failure.
Lorazepam	0.05–0.1 mg/kg	0.05– 0.15 mg/kg/hour	Maximum daily dose 2 mg/kg or 100 mg. Useful for anticipated longer term sedation, t½ 10–20 hours.
Propofol	0.5–1 mg/kg	1.5–4 mg/kg/hour	For maximum of 48 hours continuously, significant vasodilator.
Ketamine	1–2 mg/kg	5–40 mcg/kg/min	Currently recommended as an adjunctive sedative.

Procedural Sedation

Take standard precautions for respiratory arrest.

Drug	Dose	Comments
Ketamine	0.25–1 mg/kg, IV 2–4 mg/kg, IM 6–10 mg/kg, oral	Both sedative and analgesic. Also results in a dissociative state. Oral dose must be administered 30 minutes before procedure.
Midazolam	0.025–0.1 mg/kg, IV 0.1–0.2 mg/kg, IM 0.25–0.5 mg/kg, oral 0.2–0.3 mg/kg, IN 0.3–0.5 mg/kg, PR	Purely sedative, therefore, will need to combine with an analgesic (opioid) for painful procedures. When combining with an opioid, reduce the dose by 30–50%. Time prior to procedure that dose should be administered: IM – 10 to 20 minutes, oral – 30 to 45 minutes, PR – 30 to 45 minutes.
Fentanyl	0.25 mcg/kg, IV 1–2 mcg/kg, IN	For painful procedures. Administer slowly to reduce risk of chest wall rigidity.

23.3 NUTRITIONAL CARE IN THE ICU

Malnutrition is common (25%) among critically ill children and is associated with increased morbidity, delayed recovery and increased mortality.

Nutritional goals in PICU include:
» Prevention and/or treatment of malnutrition – both macro and micronutrient deficiencies as well as overfeeding.
» Maintenance of gut integrity with enteral nutrition.
» Optimization of organ function.

23.3.1 PARENTERAL NUTRITION

» **Parenteral nutrition (PN) should be prescribed and administered under the supervision of a medical specialist and dietician.**
» PN should be used only when it is not possible to meet nutritional requirements enterally or when there is gastrointestinal dysfunction resulting in inability to tolerate enteral nutrition for a prolonged time: > 5 to 7 days.
» PN is the intravenous administration of amino acids (proteins), lipids, carbohydrates, electrolytes, minerals, vitamins, and trace elements necessary for metabolic requirements and growth.
» PN may be total parenteral nutrition (TPN) where all nutrients are administered, usually via a central venous line, until the child is able to tolerate enteral feeds.
» PN may also be partial parenteral nutrition (PPN) where it is used to supplement enteral feeds in children who cannot yet tolerate their full complement of enteral feeds.
» Whenever possible, the enteral route should still be used to deliver small volumes of feed, in order to protect the integrity of the gut mucosal barrier and preserve mechanical function of the gut. This is known as trophic feeding.
» Administer PN preferably via a central venous catheter (CVC), especially when it is expected that the child will require TPN for more than 7 days. A peripheral venous catheter may only be used for anticipated short term (< 7 days) partial parenteral nutrition. Only PN solutions with an osmolarity < 800 mOsm/L (non-lipid containing) and < 1000 mOsm/L (lipid containing) can be safely administered via a peripheral vein.
» Check peripheral vein infusion sites and patency of the catheter regularly for tissue infiltration.
» Transport and store PN solutions at 2–8 ºC. Start administration of the PN solutions within one hour after removal from the refrigerator.
» Do not make additions to a PN bag or decant contents as the stability and/or the sterility may be compromised.
» Do not use the PN catheter/lumen to collect blood samples.
» Administer PN through a dedicated catheter/lumen and do not administer medications, blood, etc. through the PN catheter/lumen.
» Use a 1.2 micron in-line filter for lipid containing PN solutions and a 0.2 micron filter for lipid-free PN solutions.
» Adhere to a strict aseptic technique when administering PN solutions. Check integrity of packaging before starting the infusion.
» PN bags must not be used beyond 24 hours after starting the infusion.

COMPLICATIONS OF PN

» Central or peripheral venous catheter complications, e.g., extravasation, blockage, infection and venous thrombosis.
» Metabolic complications, e.g., hyperglycaemia, hypoglycaemia, electrolyte and mineral disturbances, micronutrient deficiencies and hyperlipidaemia.

» Metabolic bone disease and growth impairment.
» Cholestatic hepatitis and liver failure.

Monitor:
» Vital signs and hydration.
» Blood glucose 12 hourly; maintain blood glucose at 4.0–10 mmol/L.
» Electrolytes, minerals, and acid-base on a daily basis or more regularly if necessary.
» Growth parameters and weight, twice weekly.
» Liver enzymes, bilirubin, lipids, urea and creatinine once weekly or more frequently, as indicated by the condition of the child.
» Regular screening for the presence of infection.

DOSE AND DURATION OF PN INFUSION
The maximum volume of TPN for a child depends on the age, weight and underlying disease and is based on the total daily fluid requirements.

AVERAGE DAILY PARENTERAL REQUIREMENTS

	Birth–3 months	> 3 months –1 year	> 1–3 years	> 3–6 years	> 6–12 years
Fluid (mL/kg)	100–120	80–100	70–80	60–70	40–60
Energy (kcal/kg)	90–100	90–100	75–90	75–90	60–75
Protein (g/kg)	1.5–3	1.5–2.5	1.5–2.5	1.5	1.5
CHO (g/kg)	16-18	16–18	12–14	10–12	< 12
Lipid (g/kg)	3–4	3–4	2–3	2–3	2–3

The daily nutritional requirements are influenced by age, physical activity and underlying diseases/disorders, e.g., burns, liver failure, etc.

23.4 POST CARDIAC-ARREST SYNDROME

See Chapter 11: Emergencies and Trauma, section 1.1.5: Post resuscitation care.

23.5 FLUIDS IN ICU

- Fluids should be thought of as any other drug/medication in ICU; an under-resuscitated child as well as an overloaded child both have deleterious effects.
- Therefore, fluid therapy prescriptions must be tailored and appropriate for each child's clinical condition.
- Fluids need to be considered under:
  - Resuscitation – need for bolus therapy: 10–20 mL/kg, rapid administration, isotonic crystalloids.
  - Rehydration – slower administration with regular re-evaluation, decreasing infusion as the child improves.
  - Maintenance – restricted due to general lower requirements when in ICU.
  - Ongoing losses – the need to add additional specific fluids, e.g.: burns, DKA, cerebral salt wasting, dehydrating diarrhoeas, bowel fistulae etc.
- As soon as a child is able to feed enterally, a de-escalation approach to stopping all IV fluids as soon as possible and aiming for all fluids and feeds to be given enterally (orally or via gastric tubes).
- Critically ill children have important considerations specific to fluid prescriptions:
  - Sedated and ventilated.
  - Humidified ventilator circuits.
  - Increased ADH production (SIADH).
  - Overhead warmers for small infants.
  - Decreased energy expenditure.
  - Oliguria and anuria.
- These result in fewer insensible losses compared to normal children.
- In particular groups, i.e. head injuries, those with increased ADH (pneumonia, intracranial infection), and post-operative patients, this may be 60–80% of the maintenance volume outlined by the formulae below.
- Fluids should, therefore, be adjusted accordingly, on a patient-by-patient basis.
- **There must be a very good reason why you are giving crystalloid instead of nutritive enteral feeds to any paediatric ICU patient.**
- **Maintenance fluids must be isotonic crystalloids, (balanced solutions or 0.9% saline) with added dextrose.**
- **Note**: **The ideal maintenance fluid is enteral feed.**

Maintenance fluid requirements in ill children:

Age	Fluid requirements
1–3 months	100–120 mL/kg/day
3–12 months	80–100 mL/kg/day
1–5 years	70–80 mL/kg/day
5–12 years	40–70 mL/kg/day

Alternatively, for critically ill children: fluid dosage needs to be 80% of the below 4/2/1 rule.

1st 10 kg	100 mL/kg/24 hours	4 mL/kg/hour
2nd 10 kg	50 mL/kg/24 hours	2 mL/kg/hour
Each next 1 kg	20 mL/kg/24 hours	1 mL/kg/hour

Composition of commonly used crystalloid (mmol/L):

	Ringers Lactate	NaCl (0.9%)	RHS (0.45%NaCl/5% dextrose)	0.45% NaCl
Na	130	154	77	77
Cl	109	154	77	77
K	4	0	0	0
Mg	0	0	0	0
Bicarb.	0	0	0	0
Lactate	28	0	0	0
Glucose	0	0	5 g	0
Ca	0	0	0	0
Osmol.	272	308	406	154
Tonicity (approx. 275–295)	272 Isotonic	308 Isotonic	154 **Hypotonic**	154 **Hypotonic**

23.6 ELECTROLYTE ABNORMALITIES

23.6.1 DYSNATRAEMIAS IN ICU

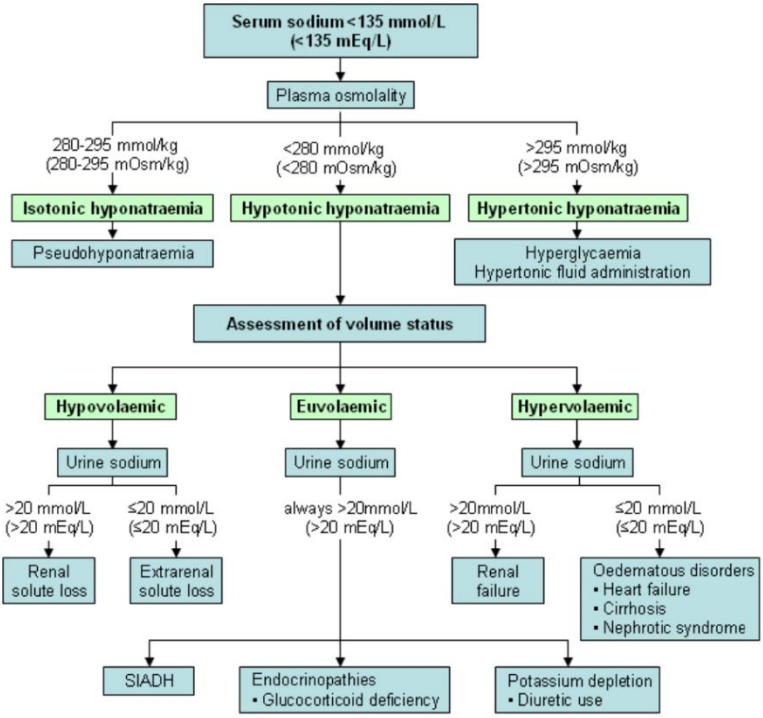
» Rapid changes in serum sodium are more likely to be symptomatic.
» Slow changes should be corrected slowly:
  > Hypernatremia – risk of cerebral oedema.
  > Hyponatremia – risk of central pontine myelinolysis.

Hyponatraemia
Defined as serum Na < 135 mmol/L

» Disorder of water balance, excess total body water relative to electrolytes.
» Caused by increased renal water reabsorption in response to ADH, along with water intake.
» Loss of sodium is minor compared to gain in water in most types of hyponatraemia.
» Hypotonic hyponatraemia is the commonest type.

Hyponatraemia may be classified according to the serum tonicity as being hypertonic, isotonic, or hypotonic:

» **Hypertonic hyponatraemia,** also known as redistributive hyponatraemia, occurs when the presence of excess levels of an osmolyte such as glucose or mannitol causes water to shift from the intracellular to the extracellular compartment, diluting extracellular sodium.
» **Isotonic hyponatraemia,** is an artefact caused by high lipid or protein levels and is usually called pseudohyponatraemia.
» **Hypotonic hyponatraemia,** encompasses all other causes of hyponatraemia and is classified as hypovolaemic, euvolaemic, or hypervolaemic.



** Aetiological diagnosis algorithm of hyponatraemia.*[1]

Hypovolaemic hypotonic hyponatraemia

» U_{Na} > 20 mmol/L: Renal salt losses occur due to diuretics (especially thiazides), salt wasting nephropathy, cerebral salt wasting syndrome and mineralocorticoid deficiency.
» U_{Na} < 20 mmol/L: Non-renal salt losses, usually GIT losses, e.g., vomiting and diarrhoea, burns, pancreatitis and severe hypoalbuminaemia resulting in third spacing of fluid.

Euvolaemic hypotonic hyponatraemia

» U_{Na} > 20 mmol/L: High fluid intake, primary polydipsia, intense exercise, iatrogenic.
» SIADH: Malignancy, CNS disorders and pulmonary disease.
» Urine osmolality > 300 mmol/kg.

Hypervolaemic hypotonic hyponatraemia

» Cardiac failure, cirrhotic liver, nephrotic syndrome.

Corrected sodium = measured sodium + (0.3 x (glucose - 5.6)) [all units in mmol/L]

Criteria for Diagnosing SIADH:

1. No drugs being administered which may mimic the condition.
2. Normal endocrine function (thyroid, adrenal).
3. No volume overload
4. Hyponatremia
5. Low serum osmolality (< 270 mosm/kg).
6. Inappropriately concentrated urine (> 150 mosm/kg).
7. Urine Na > 20 mmol/L.
8. Corrects with fluid restriction.

Management of hyponatremia:

Also see Chapter 2: Alimentary Tract, section 2.2.4: Diarrhoea, acute: metabolic disturbances.

1. Depends on the cause (see algorithm below).
2. Pseudohyponatraemia does not need treatment.
3. SIADH should be fluid restricted.
4. Sodium deficit requires replacement (e.g. renal/cerebral salt wasting, vomiting/diarrhoea).

Calculating sodium deficit:

(Na desired - Na actual) x weight x 0.6 = mmol Na required.

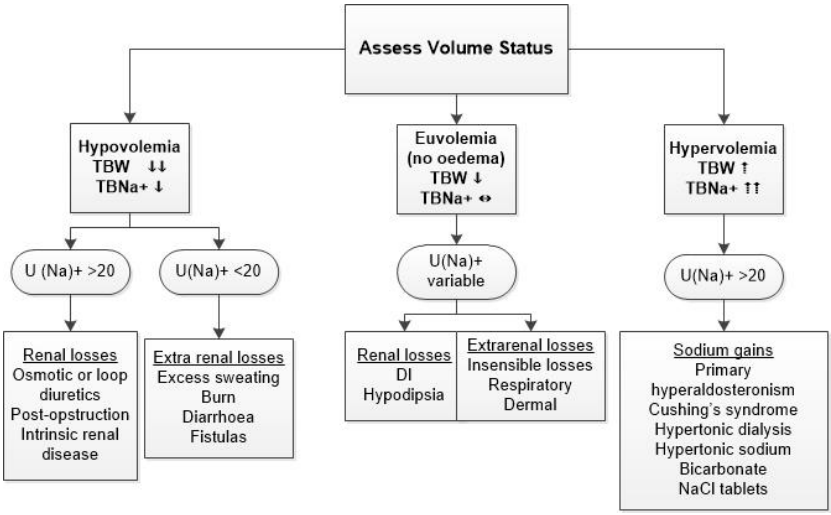
Serum sodium should not increase by greater than 10–12 mmol/L in a 24 hour period.

8.5% $NaHCO_3$: 1 mmol Na/mL
5% NaCl: 0.85 mmol Na/mL
3% NaCl: 0.5 mmol Na/mL
0.9% NaCl: 0.15 mmol Na/mL

Hypernatraemia

Defined as serum Na > 145 mmol/L.

See Chapter 2: Alimentary Tract, section 2.2.4: Diarrhoea, acute: metabolic disturbances.



Hypervolaemic hypernatraemia

» Administration of bicarbonate, hypertonic saline and other fluids containing excess solute relative to free-water.

Hypovolaemic hypernatraemia

» Conditions that cause excessive amounts of free-water losses via the kidneys include central and nephrogenic diabetes insipidus (chronic kidney disease and nephrogenic diabetes insipidus (NDI), respectively).
» Acquired causes of NDI include amphotericin, lithium, hypokalaemia and hypercalcaemia. Mannitol and hyperglycaemia – osmotic diuresis.
» Non-renal free-water losses – from the GIT via suctioning, diarrhoea, vomiting; skin (drains, burns, hyperthermia), and from the respiratory tract in intubated patients.

Management of hypernatraemia:
In children, the two most common aetiologies are diabetes insipidus and hypernatraemic gastroenteritis.

1. Diabetes insipidus requires extra fluid and desmopressin (if central). See Chapter 7: Endocrine System, section 7.4: Diabetes insipidus.
2. Hypernatraemic dehydration treatment:
   a. Calculate free-water deficit and replace, aiming to decrease sodium slowly (maximum 10–15 mmol/L/24 hours). May, therefore, need to administer free-water deficit over 24 to 72 hours (depending on severity).
   b. Oral 'tap water' preferable, otherwise D5W, IV, (taking note of increased glucose delivery).
3. Stop offending drugs.
4. Replace excessive volume losses with fluid containing equivalent electrolyte concentrations (drains, fistulae, renal).

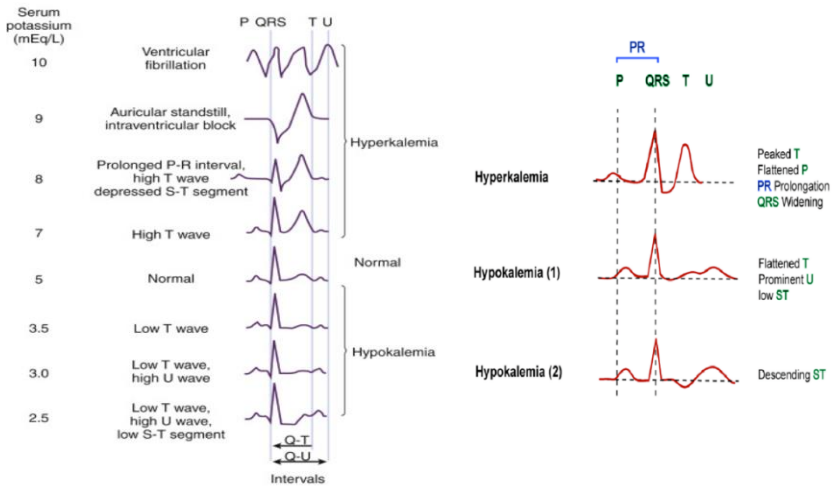
Water deficit calculation:

Water deficit = (current Na/140 -1) x 0.6 x weight (kg) = total litres of water required to normalize sodium.

Amount to be administered per 24 hours is total water deficit divided by planned duration of correction (in days).

23.6.2 POTASSIUM ABNORMALITIES IN ICU

Rapid changes in serum potassium result in the critical clinical features, mainly cardiac and therefore, absolute values may not reflect commonly described clinical changes associated with absolute levels, e.g.: children with chronic renal failure may tolerate very high levels of potassium with little clinical effect.



Hypokalaemia:
See Chapter 2: Alimentary Tract, section 2.2.4: Diarrhoea, acute: metabolic disturbances.

Normal potassium = 3.5–4.5 mmol/L.
Replacement of potassium in ICU:
If potassium 2.5–3.4 mmol/L – replace orally – 1 mmol/kg per dose.

- Potassium chloride tablets (600 mg) = 8 mmol.
- Mist. potassium citrate 30% suspension = 2.8 mmol/mL.

If potassium **< 2.5 mmol/L**, will need intravenous replacement.

»	IV potassium only to be used where appropriate monitoring is available which must include continuous ECG and bedside serum potassium/blood gas analysis.
»	Ensure slow administration, over 4 hours.

Always discuss with a specialist first before commencing any IV potassium.

- Replacement dose = 1–2 mmol/kg (given slowly over 4 hours).
- Maximum rate of replacement = 0.5 mmol/kg/hour.
- **Recommended dose = 1.2 mmol/kg = 0.3 mmol/kg/hour for 4 hours.**
- 15% KPO_4 and 15% KCL both contain 2 mmol/mL of potassium.
- ECG monitoring is strongly recommended during IV potassium replacement.

Example of IV replacement in a 10 kg child:
Dose = 1.2 mmol x 10 kg = 12 mmol of potassium.
= 6 mL of 15% potassium solution.
Recommended: Add the 6 mL of potassium (either KCl or KPO_4 - depending on the patient's clinical characteristics) to 14 mL of 0.9% saline, to create a 20 mL solution. Then administer the solution at 5 mL/hour over 4 hours.

Please note that this only holds true for a child who is not receiving any additional potassium intravenously.

Note: In stable patients with severe hypokalaemia, slow correction with oral potassium supplementation can be considered in non-ICU environments.

Acute hyperkalaemia in ICU:
Hyperkalaemia: K > 5.5 mmol/L.
Moderate hyperkalaemia: K > 6 mmol/L.
Severe hyperkalaemia: K > 7 mmol/L.

Management of hyperkalaemia:
» Stop any potassium containing fluids/supplemental potassium.
» Treat the cause.
» Treatment of hyperkalaemia:
- Calcium gluconate 0.6 mL/kg diluted 1:4, IV, slowly.

OR if life threatening hyperkalaemia, consider:
- Calcium chloride (10%) 0.2 mL/kg (maximum 10 mL) diluted 1:4 with sterile water, IV, slowly over 10 minutes **(must be administered via a CVC line)**.
- Salbutamol nebulisation or salbutamol 4 mcg/kg, IV, over 20 minutes. (Note – ineffective in severe metabolic acidosis.)
- Sodium bicarbonate 8.5% 1 mL/kg diluted 1:1 with sterile water, IV. (Note – more effective with severe acidosis of pH < 7.15.)
- Dextrose/insulin: 1 mL/kg of 50% dextrose + 1 mL/kg of sterile water + 0.1 units/kg rapid acting insulin. (this concentration is only suitable for administration via a central line, use a 10% solution via peripheral lines)

23.6.3 MAGNESIUM ABNORMALITIES IN ICU

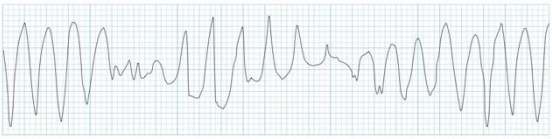
40–60% of ICU patients have hypomagnesaemia.

Hypomagnesaemia:
Clinical effects of hypomagnesaemia:
» Electrolyte abnormalities:
> Hypokalaemia
> Hypocalcaemia

- Hypophosphataemia

» Arrhythmias:
- Prolonged QT interval.
- Polymorphic VT – Torsade de pointes.

» Neurologic:
- Altered mentation, generalized seizures, tremors, hyper-reflexia, weakness.



Torsade de pointes

Magnesium supplementation:
IV: Ampoules of 2 g in 1 mL (50% magnesium sulphate solution).

Replacement dose:
- Magnesium sulphate, 25–50 mg/kg, IV.
  - Maximum rate of IV administration: 1 g/7 minutes.

Life threatening hypomagnesaemia – Torsade de pointes:
1. Infuse 50 mg/kg $MgSO_4$, IV, over 2 to 5 minutes.
2. Follow with 25–50 mg/kg $MgSO_4$ in 250–500 mL N/S over the next 6 hours (maximum 5 g).
3. Continue with 25–50 mg/kg $MgSO_4$ every 12 hourly for 5 days (Note – to replenish total body stores).

Hypermagnesaemia:
» Serum magnesium > 2 mEq/L.
» Usually in patients with renal insufficiency and haemolysis, closely associated with increased potassium and low calcium.

Clinical effects of hypermagnesaemia:
Serious effects of hypomagnesaemia are due to calcium antagonism in the cardiovascular system:
» Weakness/hyporeflexia/paralysis > 4 mEq/L.
» 1st degree AV block > 5 mEq/L.
» Complete heart block > 10 mEq/L.
» Cardiac arrest > 13 mEq/L.

Treatment of hypermagnesaemia:
» Stop extra oral/IV intake.
» In patients with normal renal function, will correct once supplemental intake is stopped.

- IV calcium gluconate (0.6 mL/kg over 2–3 minutes) can be used for hypotension and respiratory depression (only transient effect).

» Haemodialysis for severe cases with significant cardiac signs.

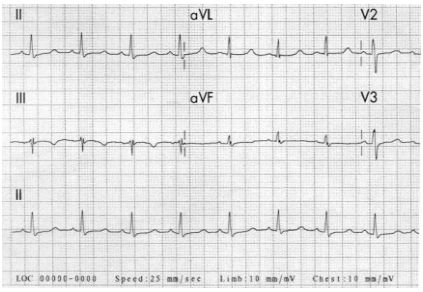
23.6.4 CALCIUM ABNORMALITIES IN ICU

Effects of albumin and pH
Alkalosis results in increased bound calcium – and decreased ionized calcium.
In hypoalbuminaemia, total serum calcium measurement may be falsely low.

Corrected calcium = measured calcium + (40 - albumin) x 0.025.

Hypocalcaemia:
See Chapter 7: Endocrine System, section 7.8: Hypocalcaemia in children.

In ICU, the focus is on low ionized calcium concentrations (< 1.0 mmol/L).
Clinical effects of hypocalcaemia:
» Tetany
» Seizures, confusion.
» Laryngospasm
» Cardiac arrhythmias (heart block and ventricular tachycardia).
» Prolonged QTc interval.



Management of hypocalcaemia in ICU:
1. Check magnesium, replace if low.
2. Replace calcium, IV:
   - 10% calcium gluconate 0.5 mL/kg/dose.
   - 10% calcium chloride 0.2 mL/kg/dose (must use a central line).
3. IV replacement targeted to the ionized calcium value on blood gas – > 1.2 mmol/L.

Intravenous calcium replacement in ICU:
» Replacement dose = 0.1 mmol/kg/dose (for seizures/arrhythmias – infusion 0.1 mmol/kg/hour after initial IV slow bolus).

- Calcium gluconate 10%:
  - 1 ampoule (10 mL) = 1 g = 2.2 mmol = 0.22 mmol/mL.
  - 0.6 mL/kg/dose (maximum 10 mL).
  - Mix 1:4 with sterile water and inject IV, slowly over 10 minutes.

OR if severe or refractory:
- Calcium chloride10%:
  - 1 ampoule (10 mL) = 1 g = 7 mmol = 0.7 mmol/mL.
  - 0.2 mL/kg/dose (maximum 10 mL).
  - Mix 1:4 with sterile water and inject IV, slowly over 10 minutes.
  - **Must be administered via a CVC**

Note:
Monitor IV sites for extravasation, never mix with fluids containing bicarbonate or phosphate, never give IM or SC.

Hypercalcaemia:
» Key principle: Effective management of hypercalcaemia begins with adequate rehydration and treating the underlying cause.
» Refer to a specialist for consideration of furosemide and/or haemodialysis in the setting of severe renal failure.

23.6.5 PHOSPHATE ABNORMALITIES IN ICU

Hypophosphataemia:
» Incidence is 60–80% of septic ICU patients.
» Mortality increases 30% in patients with severe hypophosphataemia (< 0.32 mmol/L).

Clinical presentation of hypophosphataemia can include:
» Confusion, coma, seizure.
» CCF
» Respiratory failure.
» Shift of Hb-dissociation curve left (hypoxia).
» Haemolysis, rhabdomyolysis.

Treatment of hypophosphataemia:
Intravenous replacement is recommended for severe hypophosphataemia.

- Potassium phosphate: 1 mmol/mL phosphate and 2 mmol/mL potassium.
  - 0.15–0.6 mmol/kg/day, IV, over 6 hours.
  - Dilute to ratio 1:4 (potassium phosphate: 0.9% sodium chloride).
  - Repeat at 6 hourly intervals until phosphate > 0.6 mmol/L.

Note:
Rate limiting fact will usually be potassium concentration/rate.

  - Example: 20 kg child:

0.15 x 20 kg = 3 mmol/day = 3 mL $KP0_4$.
i.e. add 3 mL $KP0_4$ to 12 mL normal saline over 6 hours (3 mL/hour).
= 0.05 mmol/kg/hour potassium.
= 0.025 mmol/kg/hour phosphate.

Hyperphosphataemia:

Clinical presentation of hyperphosphataemia:
» Decreased mental status.
» Seizures (secondary to hypocalcaemia).
» Weakness, tetany (secondary to hypocalcaemia).
» ECG changes: prolonged QT, polymorphic VT, Torsade de pointes (secondary to hypocalcaemia).
» Anorexia, nausea, vomiting.
» Soft tissue deposition of calcium-phosphate product – renal dysfunction.
» Metabolic acidosis, hypomagnesaemia.

Management of hyperphosphataemia:
1. Treat the underlying cause.
2. Fluid administration (rhabdomyolysis/tumor lysis).
3. Reduce phosphate intake.
4. Phosphate binders (calcium carbonate).
5. Refer and consult with specialist for consideration for haemodialysis.

23.6.6 HYPERGLYCAEMIA

R73.9

DESCRIPTION

Critical illness is a state of metabolic stress associated with elevated serum catecholamines and is often associated with the use of continuous feeding. Hence the target blood glucose is 4–10 mmol/L. Serum glucose > 10 mmol/L is common, occurring in up to 20% of critically ill children.

Clinical significance

» Increased morbidity and mortality.
» Osmotic diuresis – fluid and electrolyte abnormalities.
» Increased infections and sepsis.
» Poorer neurological outcomes.

Monitoring

» Routine blood glucose monitoring: 4 to 6 hourly.
» Urine dipstix to check for glycosuria.
» If the patient is requiring insulin then hourly monitoring until blood glucose < 10 mmol/L.

Management

» Tight glycaemic control (maintenance of blood glucose between 4.4–6.1 mmol/L) is NOT recommended.
» Look for and treat any potential underlying cause, e.g. sepsis, pain, steroid treatment etc.
» If HGT is > 10 mmol/L for 2 consecutive readings (60 minutes apart) or for 1 reading in the presence of glycosuria, then give a stat dose of IV short acting insulin 0.05 units/kg.
» Calculate glucose delivery. If glucose delivery > age-appropriate range, reduce glucose delivery to within normal range and monitor HGTs.
» If a second dose of IV insulin is required within a 4-hour period, then seek advice from a paediatric endocrinologist.
» Insulin infusions are not routinely recommended.

23.6.7 HYPOGLYCAEMIA

The target blood glucose of critically ill children is 4–10 mmol/L. It is essential to check the blood glucose of all critically ill children as hypoglycaemia (< 3.5 mmol/L) is an emergency. Immediate treatment is with an IV glucose bolus and depends on the nature of the available IV access.

- Peripheral line: 5 mL/kg of a 10% dextrose solution.
- Central line: 2 mL/kg of a 25% dextrose solution.

The bolus will need to be repeated until the blood glucose ≥ 4.0 mmol/L.

For additional information see Chapter 7: Endocrine System, section 7.6: Hypoglycaemia in children.

23.6.8 DIABETIC KETOACIDOSIS

See Chapter 7: Endocrine System, section 7.5.2.2: Diabetic ketoacidosis

23.7 TRAUMATIC BRAIN INJURY (TBI) AND NEURO-PROTECTION IN THE ICU

S06.2

DEFINITION

Traumatic brain injury (TBI) is a form of Acquired Brain Injury. It is a non-degenerative, non-congenital insult to the brain from an external mechanical force, possibly leading to permanent or temporary impairment of cognitive, physical, and psychosocial functions, with an associated diminished or altered state of consciousness. Severity of the initial insult is based clinically on the Glascow Coma Scale (GCS): Severe = GCS < 9.

Patients should be referred and managed in a specialised centre.

Summarized therapeutic goals – strict avoidance of the 5 'H's.

» Hypoxaemia
» Hypotension
» Hyperthermia
» Hypoglycaemia
» Hypercarbia

MEDICINE TREATMENT

Principles for neuroprotection in 1st 24–48 hours.

1. Airway & Ventilation

1. Secure the airway.
2. Optimise oxygenation – Sats > 94% but < 100%.
3. Use PEEP cautiously – keep PEEP < 10 cmH_2O to prevent inhibited venous return – individualise according to patient response. NB: Hypoxia kills neurons.
4. P_aCO_2 manipulation
   » Target P_aCO_2 35–40 mmHg (4.7-6 kPa).
   » Avoid prophylactic hyperventilation P_aCO_2 < 35 mmHg.

2. Haemodynamics

Prevent hypotension

1. Ensure adequate Cerebral Perfusion Pressure (CPP).
2. CPP = MAP - ICP
   a. Therefore, placing an ICP monitoring catheter is mandatory, if available.
   b. ICP directed therapy – target MAP to a CPP of 40–50 mmHg.
3. If no ICP catheter – target MAP = 65 + 1.5 x age (years).
4. The use of inotropes and vasopressors should be considered early if needed to achieve the target CPP level.

Fluids

1. Optimal fluid resuscitation to ensure normal circulating blood volume.
2. Use isotonic fluids in patients with raised ICP for fluid resuscitation, e.g. Ringers lactate, normal saline.
3. Avoid hypo-osmolar and dextrose containing IV fluids, e.g. 5% dextrose water, ½ normal saline, in the resuscitation phase of care (see fluid contents table).

Corticosteroids

- Available evidence does not support the use of corticosteroid.

3. Ongoing management

Analgosedation

Goal is to avoid ICP spikes from restlessness and irritability, especially if ventilated; avoid ventilator/patient dyssynchrony.

Objective measures for analgesia and sedation should be used, e.g.: RASS and Comfort score targets.

» Provide adequate sedation and optimal pain relief to avoid anxiety and pain – helps decrease ICP. See Chapter 20: Pain Control.
» Morphine/fentanyl and midazolam are the mainstay in the first 24 hours.
» Titrations or infusions are acceptable.
» Paracetamol decreases the need for opioids by 30% and is recommended as initial therapy.
» Avoid NSAID in the 1st 24–48 hours – impaired platelet function may aggravate intracranial bleeding.
» If above steps are inadequate, consider ketamine and propofol (note – haemodynamic instability may occur and require vasopressor support).
» Neuromuscular blocking agents are not indicated as routine therapy.

Seizure Prophylaxis

Phenytoin can be considered in patients with severe TBI to reduce the incidence of early onset (< 7 days) post traumatic seizures.

- Phenytoin, IV, 20 mg/kg over 20 minutes (loading dose) followed by 5–10 mg/kg/day in 3 divided doses (maintenance).

Positioning and care

1. Optimise venous drainage from the brain:
   » Keep head in neutral position with neck in mid-line.
   » Elevated head of bed – 30 degrees.
   » Remove cervical collars as soon as possible, current prehospital guidelines – hard cervical collar usage is contraindicated.
2. Limit handling when possible.
3. Tracheal suctioning:

- » Protection of the brain takes precedence over protection of the lungs.
- » Avoid routine suctioning – a potent elevator of ICP.
- » Suction only if secretions are visible and causing ventilation problems.
- » Do not insert the catheter beyond the end of the ETT or tracheostomy tube.
- » Provide analgosedation and consider neuromuscular blockade with a non-depolarising agent (cisatracurium, vecuronium or rocuronium) when suctioning patients with increased ICP.

4. Relieve Abdominal Compartment Syndrome (ACS) if present, as abdominal hypertension increases ICP.

Temperature

» Maintain normothermia – 36.0–37.5 °C.
» Hyperthermia > 38 °C must be avoided.
» Hypothermia – cooling reduces the cerebral metabolic rate of oxygen consumption but published data are controversial.
Targeted temperature management is recommended after prolonged cardiac arrest followed by return of spontaneous circulation.

Feeds

» Patients with TBI are frequently hyper-metabolic and hyper-catabolic.
» Initiation of early enteral nutrition within 72 hours from time of injury is indicated. Build feeds slowly as tolerated to achieve full enteral nutrition. Avoid nasogastric tubes if a base of skull fracture is suspected.

Stress-ulcer prophylaxis

» Patients with raised ICP are at high risk for stress ulceration.
» Consider prophylaxis with a proton pump inhibitor.
» Stop prophylaxis once feeds have been established.

Glucose

» Aim for glucose levels 4–10 mmol/L.

Family Information

» Allow family contact as this helps calm and reassure the patient.
» Prepare family with advice on infection control and ICU practices.
» Commence counseling early in the patient's stay – regarding high risk of short-term adverse outcomes in patients with TBI and raised ICP requiring ICU, and the likelihood of protracted recovery and permanent disability even in survivors of initial ICU stay.

4. Acute management of raised ICP

» Controlled hyperventilation ($PaCO_2$ no less than 30 mmHg – risk cerebral vasoconstriction and induced ischaemia) only transiently for management of very acute and serious elevation of intracranial pressure.
» Osmotic therapy for children with suspected raised ICP (avoid use if sodium > 160 mmol/L).

Hypertonic saline should be considered for acute treatment of TBI with raised ICP (> 20 mmHg).

- Sodium chloride 5%, IV, 3 mL/kg as a stat dose over 20 minutes.
- Continuous infusion of sodium chloride 3%, IV, 0.1–1 mL/kg/hour, titrated to maintain ICP < 20 mmHg).

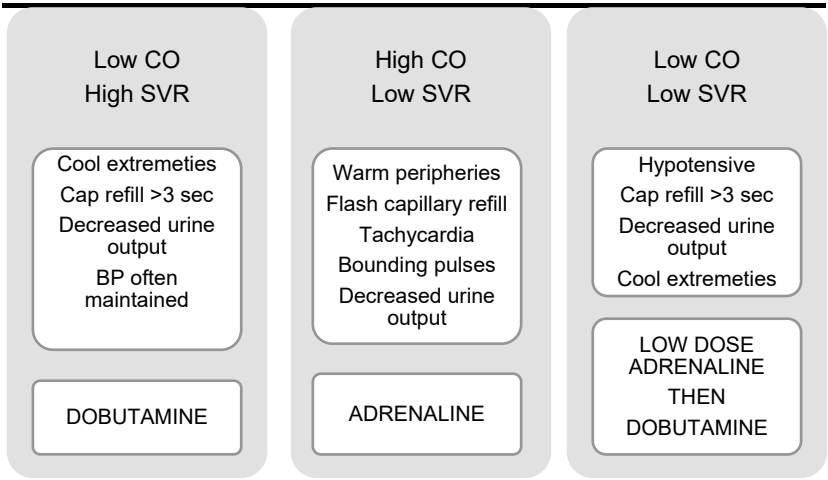
Mannitol can also be used for the treatment of raised ICP, although hypertonic saline has a better efficacy and side effect profile.

- Mannitol, IV, 0.5–1 g/kg over 10 minutes, may be repeated 6 hourly.

» Urgent neurosurgical consultation if raised ICP is refractory to medical management.
» High dose barbiturate therapy in refractory intracranial hypertension.

23.8 INOTROPES AND VASOPRESSORS

» Choice depends on desired effect.
» There is no 'one size fits all' strategy for inotrope/vasopressor choice.
» Each agent has dose-dependent effects on inotrope (improved contractility) or vasopressor effect (increasing the SVR).
» Important components of the cardiovascular system:
  > Preload – is the child pre-load replete (not overfilled and not under-filled) – fluid therapy.
  > Contractility – does the heart need support to pump effectively – inotropic support.
  > Afterload – how vasoconstricted or vasodilated is the child – need for vasopressor or vasodilator support.
» Septic shock patients may present in any of the following ways, and may change clinical appearance from hour to hour:



Paediatric cardiovascular considerations:

» Reduced myocardial mass means that the myocardium is limited in its ability to increase size and contractility, therefore, the main way that children are able to increase CO is by increasing HR, not SV.
» Children start at higher baseline heart rates, therefore, they are limited by how much they are able to increase HR and, therefore, CO.
» Children maintain blood pressure by increasing SVR (systemic vascular resistance). A drop in blood pressure is a late sign in shocked children.
» Vagal parasympathetic tone is most prominent, therefore, they are more prone to bradycardia.

Drug	Dosage	A1	B1	B2	DOPA	Side effects	Indications
Adrenaline	0.01–1 mcg/kg/min	++ ++ +	+++ +	+++	N/A	Ventricular arrhythmias -Cardiac ischaemia -Hyper-tension -Sudden cardiac death -Lactic acidosis -Tissue ischaemia	-Shock (vasodilatory, cardiogenic) Note: Broncho-spasm – SC adrenaline Anaphylaxis – IM adrenaline initially: (0.15 mg < 6 years, 0.3 mg > 6 years)
Dopamine	2–20 mcg/kg/min	++ +	+++ +	++	+++ ++	-Hyper-tension -Ventricular arrhythmia	-Cardiogenic shock -Heart failure

						-Cardiac ischaemia -Tissue ischaemia/ gangrene	-Symptomatic bradycardia unresponsive to atropine
Dobutamine	2–20 mcg/kg/min	+	+++ ++	+++	N/A	-Tachy-cardia -Ventricular arrhythmia -Cardiac ischaemia -Hyper-tension -Hypo-tension	-Low CO, shock -Symptomatic bradycardia unresponsive to atropine
Phenylephrine	0.4–9 mcg/kg/min	++ ++ +	0	0	N/A	-Reflex bradycardia -Hyper-tension -Peripheral vaso-constriction -Tissue necrosis	-Hypotension (vagally mediated) -Increase afterload in Tetralogy of Fallot -Decrease LVOT gradient in HCM -Increase MAP in AS with hypo-tension - Hypotension in spinal shock (**Not for use in septic shock)**

Concentrations and formula

Vasopressors and Inotropes	Recommended concentration	Formula to calculate rate (mL/hour)
Adrenaline	100 mcg/mL (5 mg in 50 mL normal saline)	$\frac{\text{mcg/kg/min x weight x 60}}{100}$
Dobutamine	2500 mcg/mL (125 mg in 50 mL normal saline)	$\frac{\text{mcg/kg/min x weight x 60}}{2500}$
Dopamine	1000 mcg/mL (50 mg in 500 mL normal saline)	$\frac{\text{mcg/kg/min x weight x 60}}{1000}$
Phenylephrine	100 mcg/mL (5 mg in 50 mL normal saline)	$\frac{\text{mcg/kg/min x weight x 60}}{100}$

5% Dextrose water to be considered for use in patients where sodium needs to be avoided (e.g. nephrotic syndrome).

Additional medicine therapies:

- Corticosteroids:
  - Limit adrenoceptor down-regulation.
  - The role of adjunctive hydrocortisone in catecholamine refractory septic shock is unclear. Use is currently not supported by high-level evidence.
- Calcium:
  - Use in the setting of hypocalcaemia and hypotension.
  - Side effects: cardiac myocyte apoptosis, over constriction, arrhythmias.
    - Infusion dose: 0.5–2.0 mmol/kg/day = 0.02–0.08 mmol/kg/hour. Mix 2 mmol/kg of 10% calcium chloride to make a total volume of 100 mL to run at 1–4 mL/hour (0.02–0.08 mmol/kg/hour).

    Example: 8 kg child: 2 mmol/kg = 2 mmol x 8 = 16 mmol.
    10% calcium chloride is 7 mmol/10 mL.
    16 mmol, therefore = 22.8 mL of 10% calcium chloride.
    Mix this with 77 mL of normal saline to make a total volume of 100 mL.
    Run at 1–4 mL/hour (0.02–0.08 mmol/kg/hour).

Pearls:

» There is more to fixing shock than fixing the blood pressure.
» All catecholamines alter immune response.
» All catecholamines have short half-lives, therefore, achieve your goal quickly at the bedside and titrate to targeted goals.
» Steady state is achieved after 5–10 minutes.
» **Start** administering inotrope/vasopressor through a peripheral line but **switching to a central venous line** is paramount as soon as possible.
» Cardiac output monitoring is the most accurate way to assess the cardiovascular system. Consider in the patient with refractory shock – therefore, the need for possible referral to a tertiary ICU.
» Make sure your patient is adequately 'filled' before starting a vasopressor.
» Do not leave the bedside until the patient has improved perfusion markers – improved LOC, adequate urine output, improved skin perfusion, HR normalizing and appropriate BP.

23.9 VENOUS THROMBO-EMBOLISM (VTE)

23.9.1 THROMBOPROPHYLAXIS IN ICU

The incidence of venous thrombosis is likely underappreciated in critically ill children. All children with at least one organ failure and central venous access likely require pharmacological prophylaxis against venous thrombo-embolism.

Drug	Dose	Comments
Low molecular weight heparin (LMWH), e.g. enoxaparin.	< 2 months of age: 0.75 mg/kg/dose, SC, 12 hourly. > 2 months of age: 0.5 mg/kg/dose, SC, 12 hourly.	Avoid with renal insufficiency. Monitoring: 0.2–0.4 anti-Xa U/mL (sample must be drawn in a non-heparinised syringe, 3–4 hours post dose).
Unfractionated heparin (UFH).	10 units/kg/hour, IV, as a continuous infusion.	Not for routine use. Can be used in children with renal insufficiency, those requiring surgery or if they have a high risk of bleeding.

LoE III[2]

23.9.2 TREATMENT OF VTE

The duration of treatment (anticoagulation) depends on the cause of VTE: 3 months for CVC-related or secondary VTE and 6 months for idiopathic or recurrent VTE. Initial anticoagulation with LMWH or UFH for 5–10 days followed by maintenance warfarin or LMWH. Routine use of thrombolytic therapy is not recommended unless there is a major vessel occlusion. Protamine sulphate can be used to reverse the effects of both LMWH and UFH.

Drug	Dose	Comments
Low Molecular Weight Heparin (LMWH), e.g. enoxaparin.	< 2 months of age: 1.5 mg/kg/dose, SC, 12 hourly. > 2 months of age: 1 mg/kg/dose, SC, 12 hourly.	Avoid with renal insufficiency. Monitoring: 0.5–1.0 anti-Xa U/mL (sample must be drawn in a non-heparinised syringe, 3–4 hours post dose).
Unfractionated Heparin (UFH).	Bolus: 75–100 units/kg, IV, followed by 20 units/kg/hour, IV, as a continuous infusion.	Monitoring: PTT 2–3 times baseline value (60–85 seconds). Check platelet count (heparin induced thrombocytopenia is an infrequent complication).
Warfarin	0.1 mg/kg (maximum 10 mg on day 1).	Must follow treatment with a heparin. Dose can be increased by 0.5 mg per dose, in response to INR (target 2.0–3.0). Heparin is discontinued when warfarin produces target INR for 2

		consecutive days. Monitoring: INR at least 2–4 weekly.

23.10 ICU MEDICATIONS

Drugs given in ICU are often diluted and given as an infusion. It is essential that one considers intravenous fluids to be drugs and as such need to consider compatibility with other medications, role of ambient light, temperature and stability of drugs once diluted, characteristics of diluents and the physical characteristics of the infusion set.

Agent	Compos-sition	Pharmaco-logical action/ Indications	Route of admin.	Dose	Compatible fluids	Incompatible fluids/drugs
Adrenaline (epinephrine)	1 mg/mL ampule, clear fluid.	Vasopressor, inotrope, shock, anaphylaxis, cardiac arrest, upper airway obstruction.	Continuous IV infusion via a central line; IM, for ana-phylaxis; nebulized for upper airway obstruction.	0.05–1 mcg/kg/min, IV, (titrated to effect). 0.01 mg/kg, IV, for cardiac arrest. 0.01 mg/kg (maximum 0.5 mg), IM, for anaphylaxis. 2–5 mL (1 mg/mL) for nebulization.	Normal saline 0.9%, 5% dextrose saline, 5% dextrose water.	
Amiodarone	150 mg/ 3 mL (50 mg/mL), clear pale yellow fluid.	Specific tachy-dysrhythmias (refractory SVTs and VTs).	IV infusion, preferably via a central line	Emergency (VT/VF): 5 mg/kg, IV, bolus over 3 minutes (maximum 300 mg bolus dose). Other arrhythmias: Initial dose: 5 mg/kg (150 mg + 7 mL of 5% dextrose water = 10 mL, so 15 mg/mL) over 20–60 minutes; maximum 300 mg. Infusion: 10 mg/kg over 24 hours with maximum daily dose of 15 mg/kg over 24 hours.	5% dextrose water only.	Normal saline, sodium bicarbonate.

Agent	Compos-sition	Pharmaco-logical action/ Indications	Route of admin.	Dose	Compatible fluids	Incompatible fluids/drugs
Atropine	0.5 mg/mL; 1 mg/mL.	Cholinergic causes of bradycardias, organo-phosphate/ carbonate poisoning.	IV infusion, IV bolus.	Bolus: 0.02 mg/kg Infusions: 1 mg into 9 mL of normal saline giving a concentration of 0.1 mg/mL and the rediluted 1 mL of this solution into 9 mL normal saline giving a concentration of 0.02 mg/mL and give at a rate of 0.012–0.1 mg/kg/hour.		
Dexametha-sone	4 mg/1 mL vial	Allergic and anti-inflammatory conditions. Croup/ Airway oedema. Note: Long-acting steroid (half-life up to 54 hours), 30 x more potent than hydrocortisone.	IV bolus.	0.6 mg/kg, stat. May be followed by 0.15 mg/kg 6 hourly in airway oedema.		
Dobutamine	250 mg/20 m L ampoule, clear fluid.	Inotrope vasodilator (< 7.5 mcg/kg/min) Vasopressor (> 10 mcg/kg/min)	Continuous IV infusion via a central line.	5–20 mcg/kg/min titrated to effect.	Normal saline 0.9%, 5% dextrose water, 5% dextrose saline.	Sodium bicarb, furosemide, heparin, hydrocortisone, penicillin, cefazolin.

Agent	Compos-sition	Pharmaco-logical action/ Indications	Route of admin.	Dose	Compatible fluids	Incompatible fluids/drugs
Furosemide	10 mg/mL in 2 mL/20 mg ampoules or 5 mL/50 mg ampules.	Fluid overload.	IV infusion, IV bolus (Note: IV boluses are associated with hearing loss).	Bolus 0.5–1.5 mg/kg slowly Infusions: 0.05–0.2 mg/kg/hour (higher doses to be used only in consultation with specialists).	Normal saline 0.9%, 5% dextrose saline 5% dextrose water, Ringers lactate.	
Glycopyrrolate	0.2 mg/mL in a 1 mL or 2 mL vial.	Organo-phosphate poisoning in the absence of neurological involvement due to the organo-phosphate (off-label).	IV infusion, IV bolus.	0.01 mg/kg2 mg into 9 mL normal saline resulting in a concentration of 0.02 mg/mL.		
Hydrocortisone	100 mg/ 2 mL (powder). Add 2 mL WFI or normal saline.	Adrenal corticosteroid, Anti-inflammatory agent (glucocorticoid). Refractory septic shock. Adrenal insufficiency. Status asthmaticus. anaphylaxis	IV bolus.	5 mg/kg in acute asthma and anaphylaxis. 50 mg/m^2/day in divided doses for catecholamine refractory septic shock.		

Agent	Compos-sition	Pharmaco-logical action/ Indications	Route of admin.	Dose	Compatible fluids	Incompatible fluids/drugs
IVIG Intravenous polyvalent human immune-globulin.	3 g powder in 100 mL normal saline, 6 g powder in 200 mL normal saline and 12 g powder in 400 mL normal saline (packaged with diluent).	Autoimmune and inflammatory disorders (GBS, Kawasaki, MIS-C, TTP).	IV infusion.	2 g/kg (in total) given over 2–5 days. Depending on indication, seek specialised advice in toxic shock.		
Labetalol	5 mg/mL in 20 mL ampules, clear liquid.	Hypertensive emergency.	IV infusion.	200 mg (2 amps) in 200 mL normal saline = 1 mg/mL.	Normal saline 0.9%, 5% dextrose saline.	Bolus: 0.2–1 mg/kg, IV, maximum 40 mg Infusion: 0.25–3 mg/kg/hour.
Lidocaine (Lignocaine)	10 mg/mL (1%), 20 mg/mL (2%) clear colourless fluid.	Specific ventricular dysrhythmias. Alternative to amiodarone in VF/VT refractory cardiac arrest.	IV bolus or IV infusion.	Bolus:1 mg/kg, with a maximum of 100 mg/dose. Dilute to 1 mg/mL solution and inject at a rate of 25–50 mg/minute. Can be repeated at 5 to 10 minute intervals with a maximum of 3 mg/kg or 300 mg. Infusions: 20–50 mcg/kg/min. If have liver dysfunction, renal dysfunction or persistent poor	Normal saline 0.9%, 5% dextrose. water, 5% dextrose saline.	Normal saline, sodium bicarbonate.

Agent	Compos-sition	Pharmaco-logical action/ Indications	Route of admin.	Dose	Compatible fluids	Incompatible fluids/drugs
				cardiac output, do not exceed 20 mcg/kg/minute.		
Magnesium sulphate	1 g in 2 mL plastic ampoules (2mmol/ml = 4mmol per 2 ml ampoule)	Bronchodilation Hypo-magnesaemia, cardiac arrest from Torsades de pointes, digoxin toxicity. Pre-eclampsia, eclampsia.	Intravenous infusion, intravenous bolus.	Bolus: 20–40 mg/kg, over 20 minutes. Infusions: 10–50 mg/kg/hour. Asthma/Digoxin tachycardia/Pulmonary HT – 50 mg/kg, over 20 min. Polymorphic VT 25–50 mg/kg, over 3–5 min. Magnesium deficiency 100 mg/kg, IV, over 4–6 hours 12 hourly.		
Salbutamol	0.5 mg/mL (500 mcg/ mL)	Hyperkalaemia Bronchodilator	IV bolus, IV infusion,	Bolus: 2–4 mcg/kg over 20 min. Infusion: Dilute 500 mcg into 49 mL of normal saline giving a concentration of 10 mcg/mL. 1–2 mcg/kg/min. Higher doses only in consultation with a specialist.		

References

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CHAPTER 24

ADOLESCENCE

Adolescence is a period of significant physical, emotional, and cognitive change. The development of independence from family and the pressure to conform to peers can impose challenges in the management of chronic disease. However, adolescents with chronic illnesses require more support from family and caregivers.

Adolescence spans the period of pubertal development, which manifests with physical changes which reflect maturation of the gonads and hypothalamic-pituitary-gonadal axis. The generally accepted age for adolescence includes 10 to 19 years, but the adolescent/youth period may extend to 24 years. Irresponsible behaviour and a tendency towards risk-taking are features in adolescence that are related to the hormonal changes in puberty.

Distinct psychosocial features characterise early, mid- and late adolescence; these stages affect adherence. In early adolescence, the individual is unable to think abstractly or plan ahead; in middle adolescence, concrete thinking in times of stress develops; in late adolescence, abstract thinking and the ability to anticipate the future and plan develops.

CHILD RIGHTS (Children's ACT 38 of 2005)

https://www.gov.za/documents/childrens-act

A child is defined by the Bill of Rights and the Children's Act as "a person under the age of 18 years".[1]

Access to information and confidentiality

Every child has a right to access to information and confidentiality regarding his/her health status and treatment, except when this confidentiality is not in the best interests of the child. Consent to disclose that a child is HIV positive may be given by the child if (s)he is 12 years or older, or of sufficient maturity to understand the implications of such disclosure. In younger children, the consent may be given by the parent/caregiver, or person in charge of a hospital (if the child is hospitalised).

Consent to medical and surgical treatment

A child may consent to his/her own medical treatment and surgical operation if (s)he is over 12 years and has the mental capacity to understand the implications of the treatment/procedure. For a surgical operation the child must be duly assisted by his/her parent or guardian. The person in charge of a hospital may consent to the medical treatment or surgical operation if this is necessary to save the life of the child or save the child from serious injury or disability or if the need for the operation is urgent.

Contraceptives

Condoms may not be withheld from children older than 12 years if they request them. Contraceptives other than condoms may be given to children older than 12 years without the consent of the parent/guardian provided that proper medical counselling has been given to the child and that the child has been examined to exclude contraindications to giving specific contraceptives.

Termination of pregnancy (Choice on Termination of Pregnancy Act 92 of 1996)

If a pregnant minor requests termination of pregnancy she should be advised to discuss it with her parents/guardians but their consent is not required.

Sexual assault (Criminal law (Sexual Offenses and Related Matters) Act 32 of 2007)

While a person younger than 18 years is considered a child in South Africa, the act does allow consensual sex for people who are between 16 and 18 years. It is illegal for any person younger than 16 years to consent to or to be involved in any sexual act. It should be noted that consensual sex where both parties are 12 to 15 years is no longer a sexual offence. Consensual sex between an adolescent younger than 16 years and a partner who is not more than 2 years older is legal.

A healthcare worker may prescribe contraception to children under the age of 16 years without obtaining parental/caregiver consent.

Healthcare workers are reminded of their obligation to report sexual assault.
Refer to Sexual Offenses and Related Matters Act 32 of 2007 and the Constitutional Court ruling Case CCT [2013] ZACC 35 for further guidance.

24.1 ADOLESCENT CHRONIC DISEASE: TRANSITION OF CARE

Z00.3

DESCRIPTION

Transition of care in adolescence is described as the purposeful, planned movement of a person with chronic medical conditions from a child-centred to an adult-orientated healthcare service.

Specialised programmes for transition improve adherence and outcomes. Careful assessment of growth and development may determine an individualised approach to transition. Chronic disease during this period impacts on growth and development.

GENERAL AND SUPPORTIVE MEASURES

» Promote adherence to medicine and follow-up.
» Counselling and support.
» Manage and co-ordinate treatment through a multidisciplinary team, including physicians and paediatricians.

MEDICINE TREATMENT USING TANNER STAGING

The Tanner staging is used to assess pubertal development and medication doses may be adjusted according to Tanner staging rather than strictly on the basis of age.

TANNER STAGING OF PUBERTAL DEVELOPMENT

Tanner stage	Pubic hair	Breast development	Testicular and Scrotal development	Penis
1.	No hair	Pre-adolescent	Pre-adolescent	Pre-adolescent
2.	Sparse, downy hair at base of symphysis pubis	Breast bud	Enlargement of scrotum and testes Skin of scrotum reddens, changes in texture	Little or no penis enlargement
3.	Sparse, coarse hair across symphysis pubis	Continued growth of breast	Further growth of testes and scrotum	Enlargement of penis, mainly in length
4.	Adult hair quality, fills in pubic triangle, no spread to thighs	Areolar and papillae form secondary mound	Testes and scrotum larger; scrotal skin darkened	Increased size with growth in breadth and development of glans
5.	Adult quality and distribution of hair including spread to medial thighs	Mature female breast	Adult size and shape	Adult size and shape

Note: Deviation from normal pubertal development may be primarily a disorder of the endocrine system and may reflect the impact of another disease process on the endocrine system.

In 50% of children, breast Tanner stage 2 develops at 10 years, pubic hair Tanner stage 3 at 11.5 years and menarche at 12.5 years.

Titrate doses according to Tanner staging rather than strictly on the basis of age.

» Tanner stage 1 or 2 or 3 (early to mid-puberty): use paediatric schedules.
» Tanner stage 4–5 (late puberty): use adult schedules.
» Puberty may be delayed in children with chronic disease, adding to discrepancies between Tanner stage-based dosing and age-based dosing (consult relevant package inserts for guidance of dosage).
» Optimise therapy of certain medicines by monitoring drug levels, and by adjusting doses during puberty and with weight gain.
» Consider medicine interactions, e.g. induction of oral contraceptive metabolism by rifampicin and changes of drug disposition during puberty and use convenient medicine formulations and devices that contribute to better treatment adherence.
» Minimise the adverse impact of medicines on cognition and brain development.

REFERRAL

» Refer patients with cognitive impairment and mental health problems to a psychiatrist.
» Refer adolescents with chronic disease for assessment by a psychologist and mental health specialist for recognition of anxiety, depression, attention-deficit disorder and post-traumatic stress disorder.

24.2 CONTRACEPTION, TEENAGE PREGNANCY AND TERATOGENICITY RISKS

Z30.9

DESCRIPTION

Adolescents are at risk for both sexually transmitted diseases and unintended pregnancy. Healthcare workers need to be supportive of adolescents regardless of whether they are abstinent or sexually active.

The foetus may be at risk for teratogenic effects of chronic medications taken by a pregnant adolescent. Examples of potential teratogenic medicines include some members of the following classes, e.g. anticonvulsants, antiretrovirals, anticoagulants, antithyroids, chemotherapy, and radiation.

GENERAL AND SUPPORTIVE MEASURES

» Offer sex education (risk of pregnancy and sexually transmitted infections) early and at every opportunity in adolescence.
» Counsel pregnant adolescent females about the risks of teratogenicity.
» Offer psychosocial support through a multidisciplinary team to pregnant teenagers.

MEDICINE TREATMENT

For contraception, refer to the Standard Treatment Guidelines and Essential Medicines List for Primary Healthcare 2020, Chapter 7: Family Planning. Where necessary, adolescents should have access to the full range of contraception options.

Seek expert advice for pregnant teenagers on potential teratogenic medicine.

REFERRAL

» All pregnant teenagers with significant disease requiring chronic medicine.
» Refer a pregnant adolescent at risk for teratogenicity for early foetal ultrasonography.

References

[1] Constitution of the Republic of South Africa, Act 108 of 1996. Section 28(3). Children's Act 38 of 2005. Section 1.

CHAPTER 25
DRUG ALLERGIES

25.1 DRUG ALLERGIES
T88.7

DESCRIPTION
Drug allergy is an immune-mediated reaction to the drug. Reactions are idiosyncratic and, unlike side effects, cannot be predicted by physiological action of the pharmaceutical agent. Common drugs involved include penicillin, sulphonamides, non-steroidal anti-inflammatory drugs, anticonvulsants, and chemotherapeutic agents.

CLASSIFICATION
Drug hypersensitivity reactions are simply classified as:
» immediate (≤ 1 hour after exposure): anaphylaxis, urticaria, angioedema; or
» delayed (≥ 6 hours): often involving rash with or without systemic symptoms.

DIAGNOSIS
Drug allergies are diagnosed clinically, based on symptoms and signs, and their timing relative to drug exposure, as well as exclusion of other potential causes.

In the acute setting, laboratory tests help to confirm the diagnosis and to determine the extent of systemic involvement (e.g. eosinophil counts, liver or renal function tests).

Tryptase measurement
An elevated serum tryptase concentration can help to confirm the diagnosis of anaphylaxis in cases where this is in doubt, but normal measurements do not necessarily exclude it. Serial tryptase measurements are the most helpful, with sampling at 1–2 hours, 4–6 hours, and 24 hours after the start of the reaction.

No serum biomarkers are currently available to identify delayed hypersensitivity reactions.

Specific diagnostic testing to identify the causative drug
Do tests to confirm the causative drug only if the benefit to the patient outweighs the risk, and only in consultation with a specialist.
» Skin tests: Includes subcutaneous skin prick tests, intradermal tests, and patch tests:

- > Should be performed in specialised units. Safety equipment is required as significant reactions can occur.
- > Have variable sensitivity and specificity depending on the drug.

» Serum specific IgE against the suspected drug:
- > Available for a few drugs only.
- > The majority have low sensitivity but high specificity.

» Cellular antigen stimulation tests for selected drugs:
- > Useful for non-IgE mediated reactions.
- > Either measures basophil activation markers (via flow cytometry) or sulpholeukotrienes (via ELISA).

Drug provocation testing

» Is the gold standard to identify the causative drug and is often required for a number of drugs due to the limited diagnostic accuracy of *in vitro* and *in vivo* testing.

» Perform only in specialised units. Safety equipment must be available as they can provoke significant reactions.

25.2 IMMEDIATE HYPERSENSITIVITY REACTIONS

25.2.1 DRUG RELATED ANAPHYLAXIS

T88.6

See Chapter 1: Emergencies and Trauma, section 1.1.3: Anaphylaxis/ anaphylactic reactions.

25.2.2 DRUG RELATED URTICARIA

L50.9

See Chapter 5: Dermatology, section 5.3.7: Urticaria.

25.2.3 DRUG RELATED ANGIOEDEMA

T78.3

DESCRIPTION

Local swelling of skin and/or mucosal tissue. May occur in isolation or together with urticaria or anaphylaxis. It must be distinguished from recurrent non-pruritic angioedema which has a hereditary component and does not respond to the treatment below. Complement C4 and C1 esterase inhibitor levels are used to help to distinguish the two entities.

GENERAL AND SUPPORTIVE MEASURES

» Stop potentially causative drug(s).

» Monitor the airway closely and intubate early if necessary.

MEDICINE TREATMENT

If symptoms and signs of anaphylaxis: treat as for anaphylaxis, see Chapter 1: Emergencies and Trauma, section 1.1.3: Anaphylaxis /anaphylactic reactions.

If angioedema in isolation:

- Chlorphenamine, oral, 0.1 mg/kg/dose 6 hourly.

AND

- Prednisone, oral, 1–2 mg/kg daily for 1 week.

OR

If unable to take orally and ≥ 2 years:

- Promethazine, IM, 0.5 mg/kg immediately, followed by above oral therapy.

LoE III[1]

REFERRAL

» All cases after stabilisation for confirmation of diagnosis and long-term management.
» Recurrent non-pruritic angioedema.

25.3 DELAYED HYPERSENSITIVITY REACTIONS

See Chapter 5: Dermatology, sections 5.2.1: Erythema multiforme, 5.2.2: Stevens-Johnson syndrome, and 5.3.1: Drug reactions.

DESCRIPTION

Broad spectrum of clinical manifestations involving different organs, including liver, kidneys and skin. Cutaneous reactions are most prevalent and range from maculopapular or morbilliform rashes (most common presentation), to life-threatening cutaneous reactions such as Stevens-Johnson syndrome/toxic epidermal necrolysis (SJS/TEN). Common drugs associated are antiretrovirals (efavirenz or nevirapine), anticonvulsants, anti-tuberculous therapy, penicillins and co-trimoxazole.

GENERAL AND SUPPORTIVE MEASURES

Stop the suspected causative medicine(s) immediately. Use an alternative class of agent if required.
If there are compelling reasons to continue with the suspected medicine, seek expert advice.

Severe cutaneous reactions will usually require admission and intensive supportive therapies. See Chapter 5: Dermatology, sections 5.2.1: Erythema Multiforme and 5.2.2: Stevens-Johnson syndrome.

MEDICINE TREATMENT

Mild reactions without systemic or mucosal involvement may be treated symptomatically:

- Chlorphenamine, oral, 0.1 mg/kg/dose 6 hourly.

If child is asthmatic, see Chapter 15: Respiratory System, section 15.4: Conditions with predominant wheeze.

REFERRAL

» SJS/TEN for management in a specialist centre with experience or a unit familiar with managing burns.

25.4 SPECIFIC ALLERGIES

25.4.1 ALLERGIES TO PENICILLINS

Z88.0

DESCRIPTION

Patients may present with immediate (e.g. anaphylaxis, bronchospasm, angioedema) or delayed reactions (most commonly maculopapular rash without systemic involvement; rarely SJS/TEN or other systemic reactions).

GENERAL AND SUPPORTIVE MEASURES

Stop penicillin.

MEDICINE TREATMENT

If an antibiotic is still required, treat with a suitable alternative antibiotic class according to the condition.

Milder infections

E.g. upper respiratory tract infections:

- Azithromycin, oral, 10 mg/kg/day for 3 days.

OR

E.g. impetigo, mild cellulitis:

- Clindamycin, oral, 6 mg/kg/dose 6 hourly for 3 days.

Severe infections e.g. osteomyelitis, pneumonia:

- Third generation cephalosporin, provided there is no history of immediate hypersensitivity (see below, cross-reactivity of other β-lactams).

Alternative antibiotics for gram-positive infections:

- Clindamycin, oral, 6 mg/kg/dose 6 hourly.

OR

- Vancomycin, IV, 15 mg/kg 8 hourly.

Urinary tract infection

- Neonates: Ciprofloxacin, oral, 6 mg/kg/dose 12 hourly.
- Infants: Ciprofloxacin, oral, 6 mg/kg/dose 8 hourly.
- > 1 year of age: Ciprofloxacin, oral, 10 mg/kg/dose 12 hourly.

Prophylaxis in rheumatic heart disease or post splenectomy, consider**:**

- Macrolide, e.g.
  - < 11 years: Azithromycin, oral, 10 mg/kg/day, 3 times weekly.
  - ≥ 11 years: Azithromycin, oral 250 mg daily.

LoEIII[2]

Cross-reactivity of other β-lactams in patients with penicillin allergy

The risk of cross-reactivity to cephalosporins in penicillin allergic patients is low. Consequently, only avoid oral cephalosporins in patients with a history of anaphylaxis to penicillin.

In hospitalised patients, and in those with mild reactions such as rash to aminopenicillin, cephalosporins should not be avoided if indicated for infection. If concerned, discuss with expert and/or consider a test dose.

Risk of cross-reactivity is very low with carbapenems, and these agents can be used without allergy assessment in penicillin allergic patients.

If no alternative antibiotic is available, consider desensitisation after consultation with a specialist. Desensitisation to be done by a specialist, in a tertiary facility.

REFERRAL

» In cases where desensitisation is considered.
» Consult a specialist for alternative antibiotics in all patients with severe, immediate reactions.

25.4.2 ALLERGIES TO SULPHONAMIDES

Z88.2

DESCRIPTION

The commonest sulphonamide allergies are related to co-trimoxazole, especially when used in HIV-infected patients for *P. jirovecii* treatment and/or prophylaxis.

Patients may present with:

» a morbilliform or maculopapular rash only, usually within a few days of starting treatment (most common presentation),
» a rash with fever, which may progress to,
» a drug-induced rash with eosinophilia and systemic symptoms (DRESS) usually with hepatitis (usually within 1–2 weeks of treatment commencement),

» SJS/TEN, or
» an immediate hypersensitivity reaction (rare).

GENERAL AND SUPPORTIVE MEASURES

Stop the sulphonamide-containing drug. Severe cutaneous drug reactions with or without organ involvement require admission and specialist review to optimise supportive management. See Chapter 5: Dermatology, section 5.2.2: SJS/TEN.

MEDICINE TREATMENT

Options for HIV-infected patients requiring treatment for *P. jirovecii* pneumonia with a history of a mild reaction, e.g. rash to prior co-trimoxazole exposure.

P. jirovecii pneumonia treatment:

» There is no clear alternative recommendation to co-trimoxazole in this setting and thus a general alternative recommendation cannot be made. In these cases, management will need to be carefully considered with a specialist.

P. jirovecii pneumonia prophylaxis:

- Dapsone, oral, 2 mg/kg daily.
  - Maximum dose: 100 mg (1 tablet) daily.
  - **Note**: Dapsone is a sulphone, not a sulphonamide; but there are cases of cross-reactivity with sulphonamide allergy, however, reactions are usually mild. Avoid dapsone if there is a history of anaphylaxis, SJS/TEN, or rash with systemic involvement.

If no alternative antibiotic is available, consider desensitisation after consultation with a specialist. Desensitisation to be done by a specialist in a tertiary facility.

REFERRAL

» In cases where desensitisation is considered. Consult a specialist.
» For alternative antibiotics in all patients with severe immediate reactions.

References

[1] Promethazine: South African Medicines Formulary. 11th Edition. Division of Clinical Pharmacology. University of Cape Town. 2014.
[2] Azithromycin: Gerber MA, Baltimore RS, Eaton, CB, Gewitz M, Rowley AH, Shulman ST, Taubert KA. Prevention of Rheumatic Fever and Diagnosis and Treatment of Acute Streptococcal Pharyngitis. Circulation. 2009; 119:1541-1551.

Annexure 1

AMOXICILLIN/CLAVULANIC ACID
Weight Band Dosing Table

Amoxicillin/Clavulanic Acid (14:1 Ratio) 600mg/42.9mg/5 ml

- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose of amoxicillin component, 12 hourly.
    - Maximum dose of amoxicillin component: 1.5 g 12 hourly.

Weight *kg*	Dose (amoxicillin component) *mg*	600mg/42.9/5ml Solution (14:1)		875mg/125mg Capsule	Age
>2–2.5 kg	96 mg	**0.8**	**mL**	–	>34–36 weeks
>2.5–3.5 kg	120 mg	**1**	**mL**	–	>36 weeks–1 month
>3.5–5 kg	180 mg	**1.5**	**mL**	–	>1–3 months
>5–7 kg	240 mg	**2**	**mL**	–	>3–6 months
>7–11 kg	360 mg	**3**	**mL**	–	>6–18 months
>11–14 kg	480 mg	**4**	**mL**	–	>18 months–3 years
>14-17.5 kg	720 mg	**6**	**mL**	**1**	>3–5 years
>17.5–25 kg	900 mg	**7.5**	**mL**	**1**	>5–7 years
>25 -30 kg	1200 mg	**10**	**mL**	**1**	>7–10 years
>30 kg	1500 mg	**12.5**	**mL**	**2**	>10 years

GUIDELINES FOR THE MOTIVATION OF A NEW MEDICINE ON THE NATIONAL ESSENTIAL MEDICINE LIST

Section 1: Medication details

» Generic name
A fundamental principle of the Essential Drug Programme is that of generic prescribing. Most clinical trials are conducted using the generic name.

» Proposed indication
There will usually be many registered indications for the medication. However, this section should be limited to the main indication, which is supported by the evidence provided in section 2.

» Prevalence of the condition in South Africa
This information is not always readily available. However, it is an important consideration in the review of a proposed essential medicine.

» Prescriber level
Here the proposed prescriber level should be included. If more than one level is proposed each relevant box should be ticked.

Section 2: Evidence and motivation

» Estimated benefit:

- Effect measure: this is the clinical outcome that was reported in the clinical trial such as BP, FEV, CD_4, VL etc.
- Risk benefit: this should be reported in the clinical trial and, in most cases, includes the 95% confidence level (95% CI). Absolute risk reduction, also termed risk difference, is the difference between the absolute risk of an event in the intervention group and the absolute risk in the control group.
- Number Need to Treat (NNT): gives the number of patients who need to be treated for a certain period of time to prevent one event. It is the reciprocal of the absolute risk or can be calculated using the formula below.

Calculations

	Bad outcome	Good outcome	Total patients
Intervention group	a	c	a + c
Control group	b	d	b + d

Measure	Equation
Absolute risk:	$[b/(b+d)] - [a/(a+c)]$
Number needed to treat	$\frac{1}{[b/(b+d)] - [a/(a+c)]}$
Relative risk	$[a/(a+c)] \div [b/(b+d)]$
Odds Ratio	$\frac{[a/(a+c)] \div [c/(a+c)]}{[b/(b+d)] \div [d/(b+d)]} = (a/c) \div (b/d)$

Reference - Aust Prescr 2008;31:12–16

» Motivating information **(Level of evidence based on the SORT system)**

The National Essential Drug List Committee has endorsed the adoption of the SORT system[1] for categorising levels of evidence. This system contains only three levels:

Level I	Good quality evidence	Systematic review of RCTs with consistent findings High quality individual RCT
Level II	Limited quality patient orientated evidence	Systematic review of lower quality studies or studies with inconsistent findings Low quality clinical trial Cohort studies Case-control studies
Level III	Other	Consensus guidelines, extrapolations from bench research, usual practice, opinion, disease-oriented evidence (intermediate or physiologic outcomes only), or case series

A: Newer product: for most newer products, level I evidence such as high quality systematic reviews or peer-reviewed high quality randomised controlled trials should be identified and referenced in the space provided. B: Older products: many of these products were developed prior to the wide use of randomised controlled trials. However, there may be level I evidence where the product was used as the control arm for a newer product. If no level 1 evidence can be identified, then level II data from poorer quality controlled trials or high quality observational studies should be referenced in the space provided.

» Cost considerations

Where a published reference supporting the review of cost is available comments should be made regarding its applicability to the South African public sector environment.

Possible unpublished information that can be included:

- Cost per daily dose or course of therapy – for long term or chronic therapy such as hypertension the usual daily dose should be calculated (Dose x number of times a day) and converted into the number of dosing units e.g. tablets. This is then used to calculate the cost per day. For medications used in a course of therapy such as antibiotics this is then multiplied by the number of days in the course of therapy.
- Cost minimisation is used where there is evidence to support equivalence and aims to identify the least costly treatment by identifying all the relevant costs associated with the treatment.
- Cost-effectiveness analysis is used to compare treatment alternatives that differ in the degree of success in terms of the therapeutic or clinical outcome. By calculating a summary measurement of efficiency (a cost-effectiveness ratio), alternatives with different costs, efficacy rates, and safety rates can be fairly compared along a level playing field.

Where any of these have been performed tick the relevant block and send as an attachment with all the calculations. If possible, the spread sheet should be supplied electronically.

Section 3: Motivator's Details

The receipt of all submission will be acknowledged. In addition, all decisions with supporting arguments will be communicated where appropriate. This section therefore forms a vital link between the motivator and the decision making process.

[1] Ebell MH, Siwek J, Weiss BD, et al. Strength of recommendation taxonomy (SORT): a patient-centered approach to grading evidence in the medical literature. Am Fam Physician. 2004;69:550-6.

DEPARTMENT OF HEALTH
Republic of South Africa

Motivation form for the inclusion of a new medication on the National Essential Medicines List

Section 1: Medication details			
Generic name (or International Non-proprietary Name):			
Proposed indication:			
Prevalence of condition (based on epidemiological data, if any):			
Prescriber level			
Primary Health Care 1	Medical Officer 2	Specialist 3	Designated Specialist 4

Section 2: Evidence and motivation			
2.1 Estimated benefit			
Effect measure			
Risk difference (95% CI)			
NNT			
2.2: Motivating information (Level of evidence based on the SORT system)			
A. Newer product: High quality systematic reviews or peer-reviewed high quality randomised controlled trials (Level I)			
Author	Title	Journal ref	
B. Older product with weaker evidence base: Poorer quality controlled trials or high quality observational studies (Level II)			
Author	Title	Journal ref	
2.3: Cost-considerations			
Have you worked up the cost?	YES		NO
	Daily cost	Cost minimisation	Cost-effectiveness analysis
Other relevant cost information if available:			
Author	Title	Journal ref	
2.4: Additional motivating comments.			

Section 3: Motivator's Details	
PTC Title:	**Date submitted:**

National Pharmacovigilance Programme

The South African Health Products Regulatory Authority (SAHPRA) has a responsibility to ensure the safety, efficacy and quality of all medicines used by the South African public. The National Pharmacovigilance Programme is coordinated by the SAHPRA and has a dedicated Unit, The National Adverse Drug Event Monitoring Centre (NADEMC), in Cape Town, which monitors the safety of all registered medicines in South Africa.

What is Pharmacovigilance?

The World Health Organization defines pharmacovigilance as the science and activities relating to the detection, assessment, understanding and prevention of suspected adverse effects or any other-related problems. The ultimate goal of this activity is to improve the safe and rational use of medicines, thereby improving patient care and public health.

What is an Adverse Drug Reaction (ADR)?

An ADR is defined as a noxious and unintended response to a medicine, including lack of efficacy, and which occurs at doses normally used in man and which can also result from overdose, misuse or abuse of a medicine.

Who should report Adverse Drug Reactions?

All healthcare professionals, including doctors, dentists, pharmacists, nurses and other healthcare professionals, patients, caregivers and representatives of the patient (e.g., lawyer) are encouraged to report all suspected adverse reactions to medicines (including vaccines, X-ray contrast media, traditional and herbal remedies), especially when the reaction is not in the package insert, potentially serious or clinically significant.

What happens to a report?

All ADR reports are entered into a national ADR database. Each report is evaluated to assess the causal relationship between the event and the medicine. A well-completed adverse drug reaction/product quality form submitted could result in any of the following:

» additional investigations into the use of the medicine in South Africa;
» educational initiatives to improve the safe use of the medicine;
» appropriate package insert changes to include the potential for the reaction, and
» changes in the scheduling or manufacture of the medicine to make it safer.

The purpose of ADR reporting is to reduce the risks associated with the use of medicines and to ultimately improve patient care.

Will reporting have any negative consequences on the healthcare professional or the patient?

An adverse drug reaction report does not constitute an admission of liability or that the healthcare professional contributed to the event in any way. The outcome of a report, together with any important or relevant information relating to the reaction, will be sent back to the reporter as appropriate. The details of a report are stored in a confidential database. The names of the reporter or any other healthcare professionals named on a report and that of the patient will be removed before any details about a specific adverse drug reaction are used or communicated to others. The information is only meant to improve the understanding of the medicines used in the country.

Is the event possibly an ADR?

The following factors should be considered when an adverse drug reaction is suspected:

1. What exactly is the nature of the reaction? *(Describe the reaction as clearly as possible and* where *possible provide an accurate diagnosis.)*
2. Did the reaction occur within a reasonable time relationship to starting treatment with the suspected medicine? *(Some reactions occur immediately after administration of a medicine while others take time to develop.)*
3. Is the reaction known to occur with the particular medicine as stated in the package insert or other reference? *(If the reaction is not documented in the package insert, it does not mean that the reaction cannot occur with that particular medicine.)*
4. Did the patient recover when the suspected medicine was stopped? *(Some reactions can cause permanent damage, but most reactions are reversible if the medication is stopped.)*
5. Did the patient take the medicine again after the reaction abated (i.e. rechallenge). If so, did the same reaction occur again? *(In most situations it is not possible or ethical* to *rechallenge the patient with the same medicine. If such information is available* or *if such* a *rechallenge is necessary, recurrence of the event is a strong indicator that the medicine may be responsible.)*
6. Can this reaction be explained by other causes (e.g. underlying disease/s; other medicine/s; toxins or foods)? *(It is essential that the patient is thoroughly investigated* to *decide what the actual cause* of *any new medical problem is. A medicine-related cause should be considered, when other causes* do *not explain the patient's condition.)*

What types of reactions should be reported?

- All ADRs to newly marketed drugs or new drugs added to the EDL
- All serious reactions and interactions
- ADRs that are not clearly stated in the professional information.
- All adverse reactions or poisonings to traditional or herbal remedies

Report even if you are not certain that the medicine caused the event

What Product Quality Problems should be reported?

- suspected contamination;
- questionable stability;
- defective components;
- poor packaging or labeling;
- therapeutic failures.

How can ADRs be prevented from occurring?

Some ADRs are unavoidable and cannot be prevented. However, most ADRs can be prevented by following the basic principles of rational use of medicines.

How are adverse drug reactions reported?

An adverse drug reactions (ADRs), or product quality issues (including batch details) should be reported by completing the ADR reporting form accessible via the SAHPRA website; and email it to adr@sahpra.org.za.

Reporters may also use eReporting link available on SAHPRA website (www.sahpra.org.za) to submit ADR report. Additionally, reporting can be done via Med Safety Application.

Submissions of adverse drug reaction and quality reporting may also be submitted using any of the following channels:

1. **eReporting link**
   https://primaryreporting.who-umc.org/Reporting/Reporter?OrganizationID=ZA

2. **SAHPRA - Pharmacovigilance**
   Submission to:
   ADR reports in an e2b in an xml format: e2b@sahpra.org.za
   Other ADR reports: adr@sahpra.org.za

3. **MedSafety Application**
   The application can be downloaded onto a smart mobile phone directory from the SAHPRA website, http://medsafety.sahpra.org.za, or via Google play or App store.

For more reporting channels visit to the SAHPRA website: http://www.sahpra.org.za

For more information on ADR reporting of products, contact the SAHPRA Vigilance unit at pvqueries@sahpra.org.za.

NOTIFIABLE MEDICAL CONDITIONS

The International Health Regulations, 2005 (IHR) and the National Health Act, 61 of 2003 in South Africa require the rapid detection, notification and prompt risk assessment of public health risk to enable timely an targeted public health response to contain and prevent outbreaks.

Notifications provide empirical data required to monitor disease distribution and trends and identify populations at risk, and for policy decisions.

Who should notify

The first health care professional to come into contact with a patient presenting with one of the prescribed Notifiable Medical Conditions (NMC) is required by law to notify. This may include clinic personnel, infection control nurses, other hospital staff or private medical practitioners. In the event of deaths (or cases) in the community, a member of the community is obliged to notify the event.

Which diseases to notify

Notifiable medical conditions have been sub-divided into two categories according to type of disease:

» ***Category 1 NMC:*** Required to be reported immediately using the most rapid means upon clinical or laboratory diagnosis followed by a written or electronic notification within 24 hours of diagnosis.

» ***Category 2 NMC:*** Required to be reported through a written or electronic notification, within 7 days of clinical or laboratory diagnosis but preferably as soon as possible following diagnosis.

Reporting a Notifiable Disease during an outbreak

During an outbreak of a notifiable disease, report all cases electronically or by phone, email or fax. Daily reporting by health facilities should be maintained through an Outbreak Case Line Listing Form as well through the notification form (GW17/5) to the local health authority that must report to the provincial health officials and the National Department of Health.

How to notify

» *Electronically:*

1. Capture the NMC case details onto the NMC electronic system. https://www.nicd.ac.za/nmc-overview/notification-process/

» *Paper-based:*

1. Complete the NMC Case Notification Form. https://www.nicd.ac.za/nmc-overview/notification-forms/
2. Send the NMC Case Notification Form to NMCsurveillanceReport@nicd.ac.za or fax to **086 639 1638**
3. Send a copy to the NMC focal person at Sub-District/District.

Any person contracting notifiable disease and then dies from the disease should be notified twice: first as a "CASE" and then later as a "DEATH". This will ensure that when estimating the "Case Fatality Rate (CFR%), all deaths in the numerator are also included in the denominator.

List of Notifiable Medical Conditions

Category 1

Acute flaccid paralysis
Acute rheumatic fever
Anthrax
Botulism
Cholera
Coronavirus disease-2019 (COVID-19)
Diphtheria
Enteric fever (typhoid or paratyphoid)
Food borne illness outbreak
Haemolytic uraemic syndrome (HUS)
Listeriosis
Malaria
Measles
Meningococcal disease
Multisystem inflammatory syndrome (MIS-C)
Pertussis
Plague
Poliomyelitis
Rabies (human)
Respiratory disease caused by a novel respiratory pathogen
Rift valley fever (human)
Smallpox
Viral haemorrhagic fever diseases
Yellow fever

Category 2

Agricultural or stock remedy poisoning
Bilharzia (schistosomiasis)
Brucellosis
Congenital rubella syndrome
Congenital syphilis
Haemophilus Influenza type B
Hepatitis A
Hepatitis B
Hepatitis C
Hepatitis E
Lead poisoning
Legionellosis
Leprosy
Maternal death (pregnancy, childbirth and puerperium)
Mercury poisoning
Pertussis
Soil-transmitted helminth (Ascaris Lumbricoides, Trichuris trichiuria, Ancylostoma dudenale, Necator americanus)
Tetanus
Tuberculosis: pulmonary
Tuberculosis: extra-pulmonary
Tuberculosis: multidrug-resistant (MDR-TB)
Tuberculosis: extensively drug -resistant (XDR-TB)

USING THE ROAD TO HEALTH BOOKLET

Check and update the Road to Health booklet at each consultation and on each admission and discharge.

The South African Road to Health Booklet is an extremely important document for the child and family.

It is designed to support and integrate the various child health strategies such as IMCI, EPI, TB and HIV care and the Integrated Nutrition Programme. It reminds health care workers to look for, respond to, and record important events and care given to the child.

OWNERSHIP OF THE BOOKLET

The Road to Health Booklet is the exclusive property of the parent (primary caregiver) and the child. This is important as the booklet contains information on the child's health, and if the booklet is used for other purposes, mothers may hide the booklet or refuse to allow important information to be recorded in it. This can result in the child receiving less than optimal care.

USE OF THE ROAD TO HEALTH BOOKLET

Issuing the Road to Health Booklet

At birth, all children should be issued with a Road to Health Booklet – in which all vital information is recorded including:

» Name and date of birth
» Details of child and family
» Neonatal information
» Immunisations at birth
» PMTCT/HIV information

Use at health service contacts

The cover the booklet states:

"IMPORTANT: always bring this booklet when you visit any clinic, doctor or hospital"

Key focus areas of the booklet are described as:

1. Good nutrition
2. Love, playing and talking
3. Protection from disease an injury
4. Health care when children are sick or injured
5. Extra care and support if an when needed

To use the booklet effectively the attending nurse or doctor should ask, at each attendance, to see the Road to Health booklet both due to its intrinsic value as part of a child health consultation and to emphasize the importance of the booklet and its use to the mother. All mothers should be introduced to the booklet during antenatal care.

During the health visit certain care given will depend on whether this is a scheduled well child visit, a follow-up visit, or a first attendance for a new illness.

Well child visit	Sick child consultation	Follow up
Greet mother and child		
Ask why she has come and whether she has any concerns.	Ask why she has come and what her concerns are.	Ask how the child is and whether any further concerns have arisen.
Ask for Road to Health Booklet and use it.		
If the child has an illness, proceed to sick child consultation (IMCI) in addition to the well child consultation.	Proceed to sick child consultation (IMCI). Ensure that promotive aspects of IMCI (nutrition, immunisations, HIV and TB status) are covered.	Carry out the follow-up process from IMCI, but also check the well child consultation.
Check and record all due visit items- see above.		
Carry out and record the well child visit. Note and respond to any other problems Identified.	Manage the child according to IMCI classification. Follow up as required. Carry out and record the well child visit. Note and respond to any other problems Identified.	
Tell mother what has been done, what was found and what this means. Ensure the mother knows when to follow up for the next well child visit, and when to come if the child is ill or for other scheduled follow up.		

Well child (routine or promotive care) includes checking, recording and responding to:

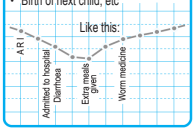
- Immunisations status.
- Weight for age, length/height for age and weight for length/height charts
- Vitamin A and deworming status.
- The HIV status of the mother and child (if HIV-exposed).
- TB screening

Boy's Weight-for-Age Chart

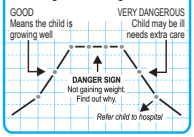
Write on the chart

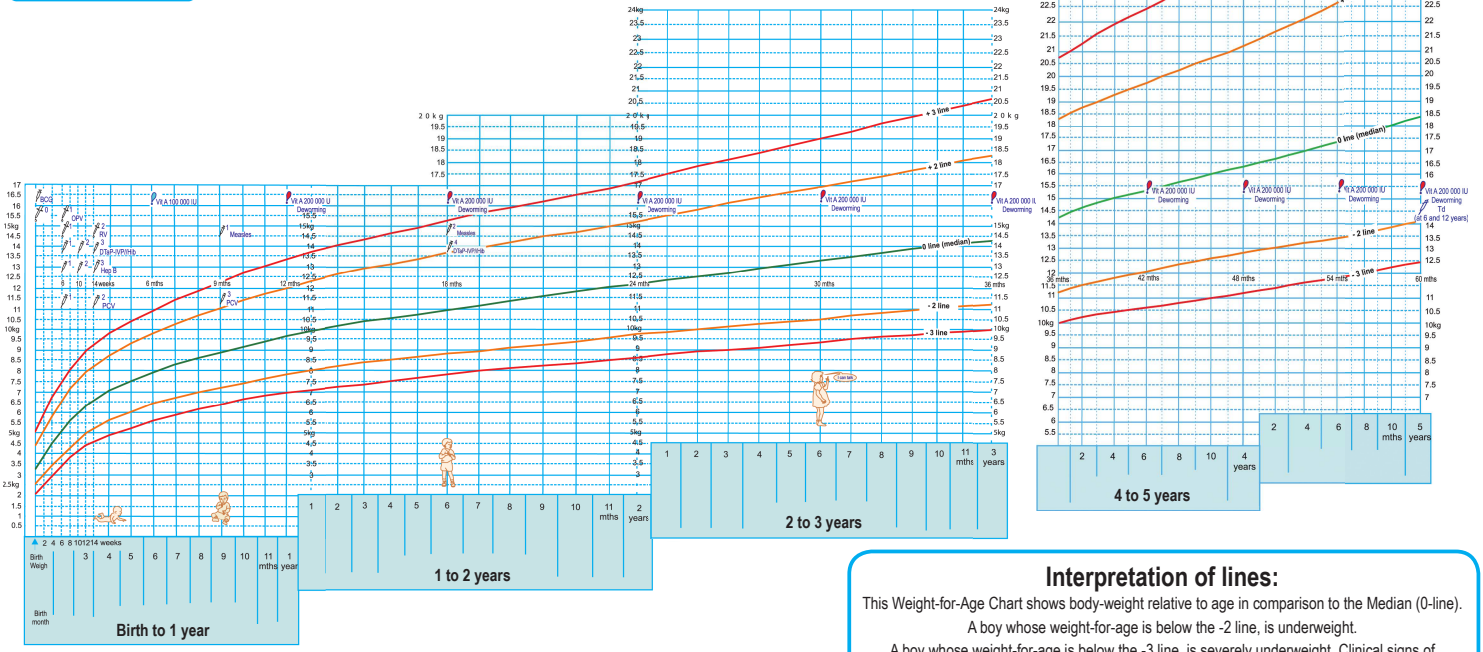
- Any illness e.g. diarrhoea, ARI etc.
- Admission to hospital
- Solids introduced
- Breastfeeding stopped
- Birth of next child, etc

Like this:



Watch the direction of the curve showing the child's growth:





Interpretation of lines:

This Weight-for-Age Chart shows body-weight relative to age in comparison to the Median (0-line).

A boy whose weight-for-age is below the -2 line, is underweight.

A boy whose weight-for-age is below the -3 line, is severely underweight. Clinical signs of Marasmus or Kwashiokor may be observed.

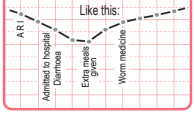
If his line crosses a z-score line and the shift is away from the median, this may indicate a problem or risk of a problem.

If his line stays close to the median, occasionally crossing above or below it, this is fine.

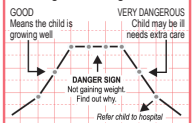
Girl's Weight-for-Age Chart

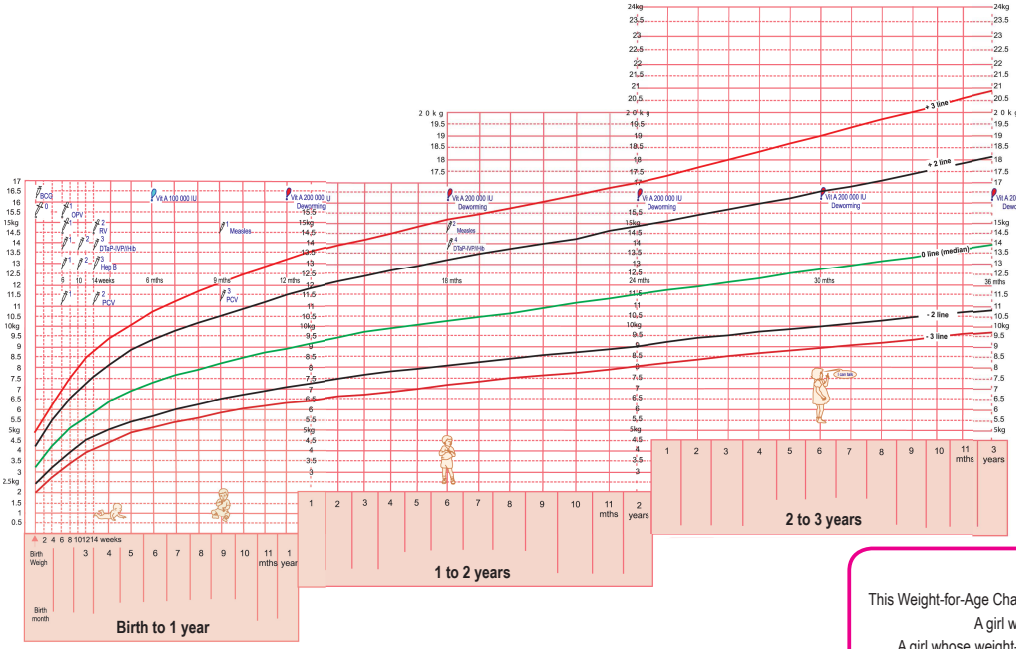
Write on the chart

- Any illness e.g. diarrhoea, ARI etc.
- Admission to hospital
- Solids introduced
- Breastfeeding stopped
- Birth of next child, etc



Watch the direction of the curve showing the child's growth:





Interpretation of lines:

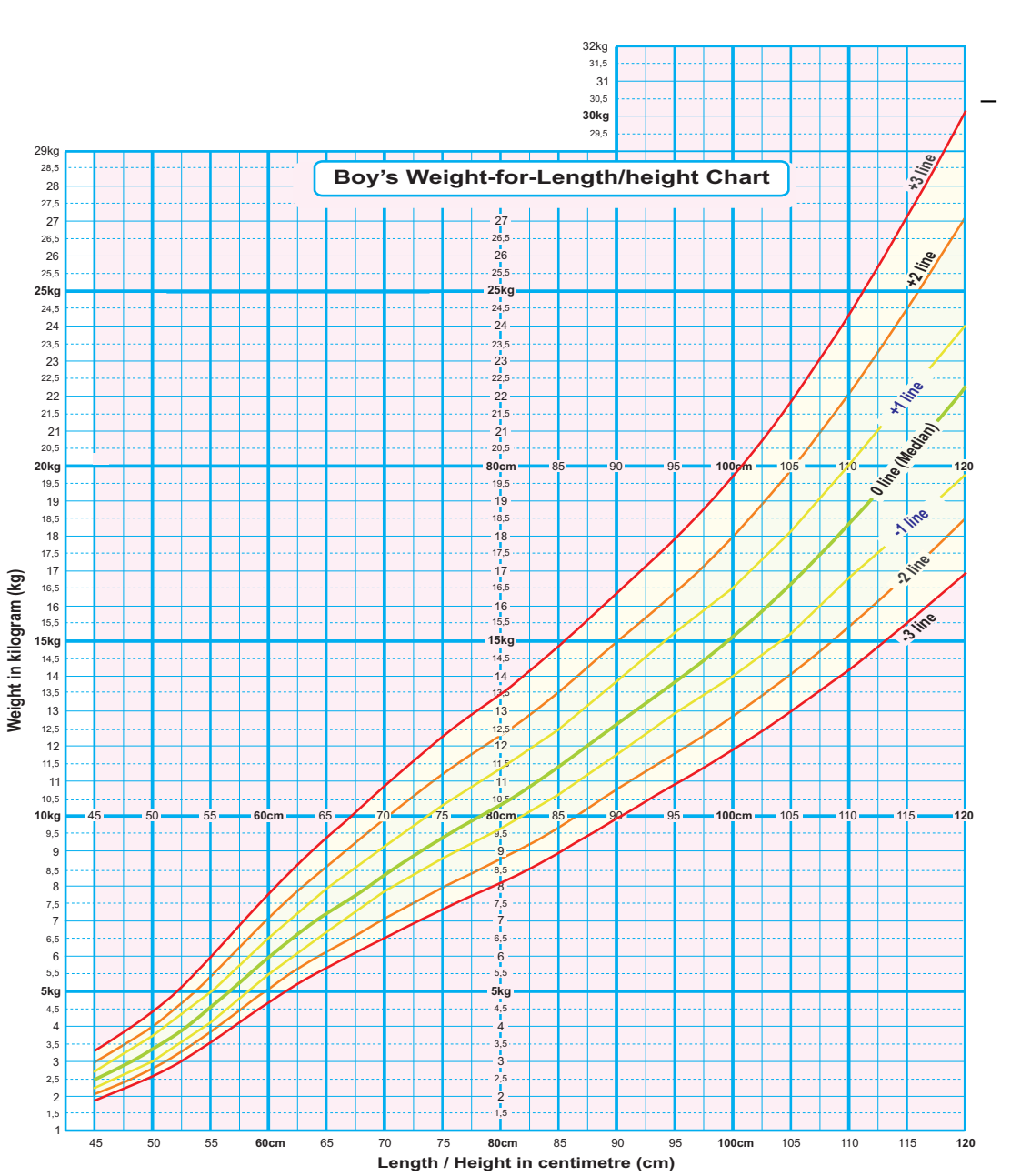
This Weight-for-Age Chart shows body-weight relative to age in comparison to the Median (0-line).

A girl whose weight-for-age is below the -2 line, is underweight.

A girl whose weight-for-age is below the -3 line, is severely underweight. Clinical signs of Marasmus or Kwashiokor may be observed.

If her line crosses a z-score line and the shift is away from the median, this may indicate a problem or risk of a problem.

If her line stays close to the median, occasionally crossing above or below it, this is fine.



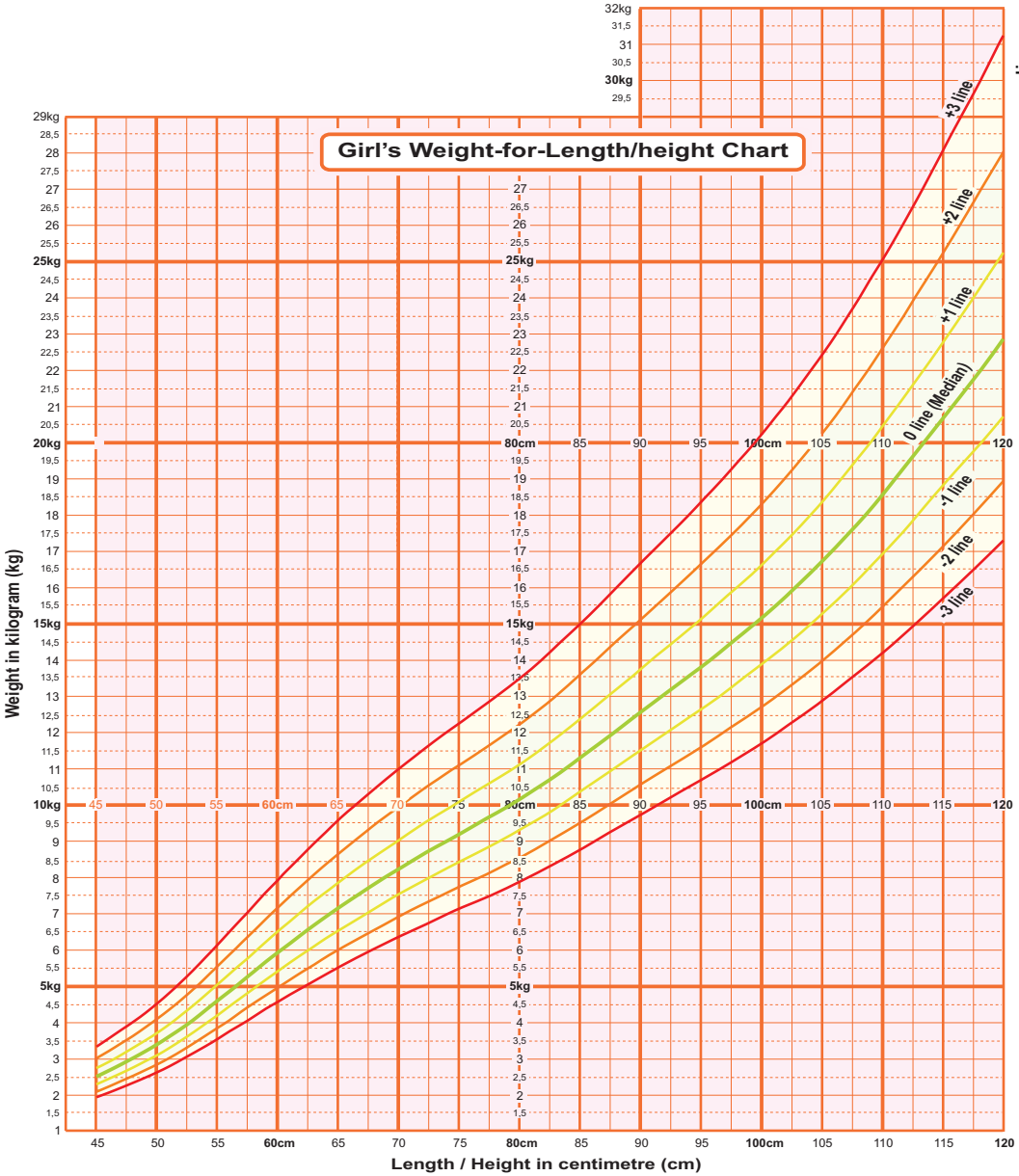
This **Weight-for-Length/height Chart** shows body-weight relative to length/height in comparison to the Median (the 0 z-score line).

A boy whose weight-for-length/height is above the +3 line, is **obese.**

A boy whose weight-for-length/height is above the +2 line, is **overweight.**

A boy whose weight-for-length/height is below the -2 line, is **wasted.**

A boy whose weight-for-length/height is below the -3 line, is **severely wasted. Refer for urgent specialised care.**



This **Weight-for-Length/height Chart** shows body-weight relative to length/height in comparison to the Median (the 0 z-score line).

A girl whose weight-for-length/height is above the +3 line, is **obese.**

A girl whose weight-for-length/height is above the +2 line, is **overweight.**

A girl whose weight-for-length/height is above the +1 line, shows possible risk of **overweight.**

A girl whose weight-for-length/height is below the -2 line, is **wasted.**

A girl whose weight-for-length/height is below the -3 line, is **severely wasted. Refer for urgent specialised care.**

BALLARD SCORING
Maturational Assessment of Gestational Age

NEUROMUSCULAR MATURITY

NEUROMUSCULAR MATURITY SIGN	SCORE -1	0	1	2	3	4	5	RECORD SCORE HERE
POSTURE								
SQUARE WINDOW (Wrist)	 >90°	 90°	 60°	 45°	 30°	 0°		
ARM RECOIL		 180°	 140 –180°	 110 –140°	 90 –110°	 <90°		
POPLITEAL ANGLE	 180°	 160°	 140°	 120°	 100°	 90°	 <90°	
SCARF SIGN								
HEEL TO EAR								
							TOTAL NEUROMUSCULAR MATURITY SCORE	

PHYSICAL MATURITY

PHYSICAL MATURITY SIGN	SCORE -1	0	1	2	3	4	5	RECORD SCORE HERE
SKIN	sticky friable transparent	gelatinous red translucent	smooth pink visible veins	superficial peeling & / or rash, few veins	cracking pale areas rare veins	parchment deep cracking no vessels	leathery cracked wrinkled	
LANUGO	none	sparse	abundant	thinning	bald areas	mostly bald		
PLANTAR SURFACE	heel-toe 40–50 mm: -1 < 40 mm: -2	>50 mm no crease	faint red marks	anterior transverse crease only	creases ant. 2/3	creases over entire sole		
BREAST	imperceptible	barely perceptible	flat areola no bud	stippled areola 1–2 mm bud	raised areola 3–4 mm bud	full areola 5–10 mm bud		
EYE / EAR	lids fused loosely: -1 tightly: -2	lids open pinna flat stays folded	sl. curved pinna; soft; slow recoil	well-curved pinna; soft but ready recoil	formed & firm instant recoil	thick cartilage ear stiff		
GENITALS (Male)	scrotum flat, smooth	scrotum empty faint rugae	testes in upper canal rare rugae	testes descending few rugae	testes down good rugae	testes pendulous deep rugae		
GENITALS (Female)	clitoris prominent & labia flat	prominent clitoris & small labia minora	prominent clitoris & enlarging minora	majora & minora equally prominent	majora large minora small	majora cover clitoris & minora		
							TOTAL PHYSICAL MATURITY SCORE	

Reference
Ballard JL, Khoury JC, Wedig K, et al: New Ballard Score, expanded to include extremely premature infants. J Pediatr 1991; 119:417–423.

SCORE

Neuromuscular _____
Physical _____
Total _____

MATURITY RATING

SCORE	WEEKS
-10	20
-5	22
0	24
5	26
10	28
15	30
20	32
25	34
30	36
35	38
40	40
45	42
50	44

GESTATIONAL AGE (weeks)

By dates
By ultrasound
By exam _____

INDEX OF CONDITIONS

INDEX OF MEDICINES

ABBREVIATIONS

3RH	rifampicin/isoniazid daily for 3 months
3TC	lamivudine
6H	isoniazid daily for 6 months
ABC	abacavir
ABCDE	airways, breathing, circulation, disability, exposure
ABRS	acute bacterial rhinosinusitis
ACS	abdominal compartment syndrome
ACTH	adrenocorticoid hormone
ADA	adenosine deaminase
ADEM	acute disseminated encephalomyelitis
ADH	antidiuretic hormone
ADHD	attention deficit hyperactivity disorder
ADR	adverse drug reaction
AED	antiepileptic drug
AFP	acute flaccid paralysis
AI	aortic incompetence
AIDP	acute inflammatory demyelinating polyradiculoneuropathy
AIDS	acquired immune deficiency syndrome
AKI	acute kidney injury
ALP	alkaline phosphatase
ALT	alanine aminotransferase
AMAN	acute motor axonal neuropathy
AMSAN	acute motor-sensory axonal neuropathy
ANA	anti-nuclear antibody
AOM	acute otitis media
AP	anteroposterior
APH	antepartum haemorrahge
APSGN	acute poststreptococcal glomerulonephritis
ARDS	acute respiratory distress syndrome
ART	antiretroviral therapy

ARV	antiretroviral
ASA	American Society of Anaesthesiology
ASD	atrial septal defect
ASO	antistreptolysin O
ASOT	antistreptolysin O titre
AST	aspartate aminotransferase
ATV	atazanavir
ATV/r	atazanavir/ritonavir
AVSD	atrioventricular septal defect
AZT	zidovudine
BCG	Bacille Calmette-Guérin
BD	twice daily
BHCG	beta-human chorionic gonadotropin
BIPP	bismuth iodoform paraffin paste
BMI	body mass index
BP	blood pressure
BSA	body surface area
CA-MRSA	community acquired methicillin-resistant Staphylococcus aureus
cART	combination antiretroviral therapy
CBT	cognitive behavioural therapy
CCF	congestive cardiac failure
CD4	cluster of differentiation 4
CDC	Centers for Disease Control and Prevention
CHD	congenital heart disease
CIDP	chronic inflammatory demyelinating polyradiculoneuropathy
CKD	chronic kidney disease
CMP	comprehensive metabolic panel
CMV	cytomegalovirus
CNS	central nervous system
COCs	combined oral contraceptives
COVID-19	coronavirus disease 2019

CP	cerebral palsy
CPAP	continuous positive airway pressure
CPP	cerebral perfusion pressure
CPR	cardiopulmonary resuscitation
CRF	chronic renal failure
CRP	C-reactive protein
CRT	capillary refilling time
CSF	cerebrospinal fluid
CT	computerized tomography
CVC	central venous catheter
CVP	central venous pressure
CVT	cerebral venous thrombosis
DAT	diphtheria antitoxin treatment
DC	direct current
DEET	diethyltoluamide
DIC	disseminated intravascular coagulation
DKA	diabetic ketoacidosis
dL	decilitre
DMARDs	disease modifying antirheumatic drugs
DMD	duchenne muscular dystrophy
DMDD	disruptive mood dysregulation disorder
DNA	deoxyribonucleic acid
DOT	directly observed therapy
DPT	diphtheria, pertussis, tetanus
DR	drug resistance
DR-TB	drug resistant TB
DRESS	drug-induced rash with eosinophilia and systemic symptoms
DS	drug sensitive
DSD	disorders of sexual development
DSM	diagnostic and statistical manual
DST	drug susceptibility testing
DT	dispersible tablet

DTG	dolutegravir
E	ethambutol
ECG	electrocardiogram
eCrCl	estimated creatinine clearance
EEG	electroencephalogram
EFV	efavirenz
eGFR	estimated glomerular filtration rate
ELISA	enzyme linked immunosorbent assay
EMB	ethambutol
ENT	ear, nose and throat
EOS	early onset schizophrenia
EPI	expanded programme on immunisation
ESBL	extended spectrum beta lactamase
ESPE	extrapyramidal side effects
ESPGHAN	European Society for Paediatric Gastroenterology Hepatology and Nutrition
ESR	erythrocyte sedimentation rate
ESRF	end stage renal failure
ET	endotracheal
ETAT	emergency triage assessment and treatment
Eto	ethionamide
ETT	endotracheal tube
FBC	full blood count
FC	film coated
FDA	Food and Drug Administration
FDC	fixed dose combination
FDP	freeze dried plasma
FEV	forced expiratory volume
FEV1	forced expiratory volume in 1 second
FFP	fresh frozen plasma
FiO2	fraction of inspired oxygen
FLACC	face, legs, activity, cry, consolability
FSGS	focal segmental glomerulosclerosis

FTC	emtricitabine
FVC	forced vital capacity
g	gram
g	gram
G6PD	glucose-6-phosphate dehydrogenase
GABA	gamma aminobutyric acid
GAD	generalised anxiety disorder
GBS	Guillain-Barre' syndrome
GCS	glasgow coma scale
GEFS+	genetic epilepsy with febrile seizures plus
GFR	glomerular filtration rate
GGT	gamma-glutamyl transferase
GIT	gastrointestinal tract
GMFCS	gross motor function classification system
GMP	Good Manufacturing Practice
GORD	gastro-oesophageal reflux disease
GTCS	generalised tonic-clonic seizures
H	isoniazid
Hb	haemoglobin
HbA1C	glycosylated haemoglobin, type A1C
HBeAg	hepatitis B e antigen
HBsAg	hepatitis B surface antigen
HBV	hepatitis B virus
HCV	hepatitis C virus
HCV	head circumference
HGT	haemo glucose test
Hib	haemophilus influenza type B
HIE	hypoxic-ischaemic encephalopathy
HIV	human immunodeficiency virus
HLA	human leukocyte antigen
HMD	hyaline membrane disease
HSP	Henoch-Schönlein purpura

HSV	herpes simplex virus
HT	hypertension
IAS	intra-articular steroids
ICHD	International Classification of Headache Disorders
ICP	intracranial pressure
ICU	intensive care unit
IDM	infant of a diabetic mother
IE	infective endocarditis
IgE	Immunoglobulin E
IgG	immunoglobulin G
IgM	immunoglobulin M
ILAE	International League against Epilepsy
IM	intramuscular
IMCI	Integrated Management of Childhood Illness
IMI	intramuscular injection
INH	isoniazid
INR	international normalised ratio
InSTI	integrase strand transfer inhibitors
IO	intraosseous
IPPV	intermittent positive-pressure ventilation
IPT	isoniazid prevention therapy
IRDS	infant respiratory distress syndrome
IRIS	immune reconstitution inflammatory syndrome
ITP	immune thrombocytopaenic purpura
IU	international unit
IUCDs	intra-uterine contraceptive device
IV	intravenous
IVIG	intravenous immunoglobulin
J	joule
JIA	juvenile idiopathic arthritis
JVP	jugular venous pressure
KCl	potassium chloride

KDQOI	Kidney Disease Outcomes Quality Initiative
kg	kilogram
kJ	kilojoule
L	litre
LABA	long-acting beta agonist
LAST	local anaesthetic systemic toxicity
LDH	lactate dehydrogenase
LDL	low-density lipoprotein
LDL-C	low-density-lipoprotein cholesterol
LFTs	liver function tests
LGA	large for gestational age
LGE	lineal gingival erythema
LGS	Lennox-Gastaut syndrome
LIP	lymphoid interstitial pneumonitis
LMWH	low molecular weight heparin
LOC	loss of consciousness
LOD	late-onset disease
LoE	level of evidence
LP	lumbar puncture
LPV/r	lopinavir/ritonavir
LTB	laryngotracheobronchitis
MAC	mycobacterium avium complex
MAP	mean arterial pressure
MAS	meconium aspiration syndrome
MC	myasthenic crisis
mcg	microgram
MCNS	minimal change nephrotic syndrome
MCS	microscopy, culture, sensitivity
MCUG	micturating cystourethrogram
MCV	meningococcal conjugate vaccine
MDD	major depressive disorder
MDI	metered-dose inhaler

MDR	multi-drug resistant
mg	milligram
MI	mitral incompetence
MIS-C	multisystem inflammatory syndrome in children
mL	millilitre
mmol	millimole
MRI	magnetic resonance imaging
MRSA	methicillin-resistant Staphylococcus aureus
MTB	mycobacterium tuberculosis
MTP	massive transfusion protocol
MUAC	mid upper arm circumference
Na	sodium
NAC	N-acetyl cysteine
NAS	neonatal abstinence syndrome
NDI	nephrogenic diabetes insipidus
NDoH	National Department of Health
NEC	necrotising enterocolitis
NGAs	nasogastric aspirates
NGT	nasogastric tube
NHLS	National Health Laboratory Service
NICD	National Institute for Communicable Diseases
NIMART	nurse-initiated and managed antiretroviral therapy
NIPS	neonatal infant pain scale
NMS	neuroleptic malignant syndrome
NNRTIs	non-nucleoside reverse transcriptase inhibitors
NRS	numeric rating scale
NRTIs	nucleoside reverse transcriptase inhibitors
NS	nephrotic syndrome
NSAIDs	nonsteroidal anti-inflammatory drugs
NTS	non-typhoid salmonella
NVP	nevirapine
OCD	obsessive compulsive disorder

ODD	oppositional defiant disorder
OME	otitis media with effusion
ORS	oral rehydration solution
OT	occupational therapy
OTC	over-the-counter
PA	posteroanterior
PA	pulmonary atresia
PaCO2	partial pressures of carbon dioxide
PAIR	percutaneous puncture aspiration injection
PANDAS	paediatric autoimmune neuropsychiatric disorders associated with streptococcal infections
PCR	polymerase chain reaction
PCV	pneumococcus conjugate vaccine
PDA	patent duct arteriosus
PEA	pulseless electrical activity
PEF	peak expiratory flow
PEFR	peak expiratory flow rate
PGL	persistent generalised lymphadenopathy
PHC	primary healthcare
PI	protease inhibitor
PICU	paediatric intensive care unit
PJP	pneumocystis jiroveci pneumonia
PML	progressive multifocal leukoencephalopathy
PMTCT	prevention of mother to child transmission
PN	parenteral nutrition
PONV	post-operative nausea and vomiting
POVOC	post-operative vomiting in children score
PPE	personal protective equipment
PPHN	persistent pulmonary hypertension of the newborn
PPN	partial parenteral nutrition
PPV	pneumococcus polysaccharide vaccine
PR	per rectum
PRN	pro re nata (as necessary)

PT	prothrombin time
PTB	pulmonary tuberculosis
PTSD	post traumatic stress disorder
PTT	partial thromboplastin time
PUV	posterior urethral valve
PZA	pyrazinamide
R	rifampicin
RBC	red blood cell
RDS	respiratory distress syndrome
RF	rheumatoid factor
R-FLACC	revised FLACC (face, legs, activity, cry, consolability)
RH	rifampicin/isoniazid
rHuEPO	recombinant human erythropoietin
RHZE	rifampicin/isoniazid/pyrazinamide/ethambutol
RIG	rabies immunoglobulin
RNA	ribonucleic acid
ROP	retinopathy of prematurity
RPR	rapid plasma reagin
RSI	rapid sequence intubation
RSTI	repeated supratherapeutic ingestion
RUTF	ready to use therapeutic food
RTV	ritonavir
SAM	severe acute malnutrition
SANCA	South African National Council on Alcoholism and Drug Dependence
SaO2	Oxygen saturation
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
SC	subcutaneous
SD	standard deviation
SE	status epilepticus
SIADH	syndrome of inappropriate antidiuretic hormone secretion
SIDS	sudden infant death syndrome

SJS	Stevens-Johnson Syndrome
SLE	systemic lupus erythematosus
SMEI	severe myoclonic epilepsy of infancy
SSRI	selective serotonin re-uptake inhibitors
SSS	sugar and salt solution
STI	sexually transmitted infection
SUD	substance use disorders
SVT	supraventricular tachycardia
TA	tricuspid atresia
TAPVD	total anomalous pulmonary venous drainage
TB	tuberculosis
TBI	traumatic brain injury
TBM	tuberculous meningitis
TBW	total body water
TC	total cholesterol
TCA	tricyclic antidepressants
Td	tenus, diphtheria
TDD	total daily dose
TDF	tenofovir
TEG	thromboelastogam
TEN	toxic epidermal necrosis
TG	triglycerides
TGA	transposition of great arteries (TGA)
TIG	tetanus immunoglobulin
TLART	third-line antiretroviral therapy
TLD	tenofovir, lamivudine, dolutegravir
TOF	tetralogy of fallot
TPN	total parenteral nutrition
TPT	TB preventive therapy
TSB	total serum bilirubin
TSH	thyroid-stimulating hormone
TST	tuberculin skin test

TT	tetanus toxoid
TTN	transient tachypnoea of the newborn
TTP	thrombotic thrombocytopenia purpura
U&E	urea and electrolytes
UCT	University of Cape Town
UFH	unfractioned heparin
UGA	underweight for gestational age
URTI	upper respiratory tract infection
UTI	urinary tract infection
VBG	venuos blood gas
VEOS	very early onset schizophrenia
VF	ventricular fibrillation
VL	viral load
VLDL	very low-density lipoprotein
VP	ventriculoperitoneal
VSD	ventricular septal defect
VT	ventricular tachycardia
VTE	venous thrombo-embolism
VTP	vertical transmission prevention
WHO	World Health Organization
Wt	weight
XDR	extensively drug-resistant
Z	pyrazinamide