Take control of your own learning in this innovative new book for nurses and doctors. You'll be taught to solve practical problems and to take a simple, logical approach to common paediatric disorders.

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Theoretical knowledge is presented in an easy, problem-solving way.

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This balanced and up-to-date guide to common and important clinical conditions can be used as a training course or as a reference manual for professionals and students.

Based on the highly successful Perinatal Education Programme, which has brought effective continuing training to thousands of midwives, neonatal nurses and doctors.
Child Healthcare

A learning programme for professionals

Prof. David Woods

www.ebwhealthcare.com
VERY IMPORTANT

We have taken every care to ensure that drug dosages and related medical advice in this book are accurate. However, drug dosages can change and are updated often, so always double-check dosages and procedures against a reliable, up-to-date formulary and the given drug's documentation before administering it.
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Royalties from the sale of this book will go to Eduhealthcare, a not-for-profit organisation which has the goal of improving the healthcare of children, especially in poor countries, through the education of nurses and doctors.

Prof David Woods
ABOUT THE EBW HEALTHCARE SERIES

EBW Healthcare publishes an innovative series of distance-learning books for healthcare professionals, developed by the Perinatal Education Trust, Eduhealthcare, the Desmond Tutu HIV Foundation and the Desmond Tutu TB Centre, with contributions from numerous experts.

Our aim is to provide appropriate, affordable and up-to-date learning material for healthcare workers in under-resourced areas, so that they can manage their own continuing education courses which will enable them to learn, practise and deliver skillful, efficient patient care.

The EBW Healthcare series is built on the experience of the Perinatal Education Programme (PEP), which has provided learning opportunities to over 60 000 nurses and doctors in South Africa since 1992. Many of the educational methods developed by PEP are now being adopted by the World Health Organisation (WHO).

WHY DECENTRALISED LEARNING?

Continuing education for healthcare workers traditionally consists of courses and workshops run by formal trainers at large central hospitals. These teaching courses are expensive to attend, often far away from the healthcare workers' families and places of work, and the content frequently fails to address the real healthcare requirements of the poor, rural communities who face the biggest healthcare challenges.

To help solve these many problems, a self-help decentralised learning method has been developed which addresses the needs of professional healthcare workers, especially those in poor, rural communities.

BOOKS IN THE EBW HEALTHCARE SERIES

Maternal Care addresses all the common and important problems that occur during pregnancy, labour, delivery and the puerperium. It covers the antenatal and postnatal care of healthy women with normal pregnancies, monitoring and managing the progress of labour, specific medical problems during pregnancy, labour and the puerperium, family planning and regionalised perinatal care. Skills workshops teach clinical examination in pregnancy and labour, routine screening tests, the use of an antenatal card and partogram, measuring blood pressure, detecting proteinuria and performing and repairing an episiotomy.

Maternal Care is aimed at healthcare workers in level 1 hospitals or clinics.
**Primary Maternal Care** addresses the needs of healthcare workers who provide antenatal and postnatal care, but do not conduct deliveries. It is adapted from theory chapters and skills workshops from *Maternal Care*. This book is ideal for midwives and doctors providing primary maternal care in level 1 district hospitals and clinics, and complements the national protocol of antenatal care in South Africa.

**Intrapartum Care** was developed for doctors and advanced midwives who care for women who deliver in district hospitals. It contains theory chapters and skills workshops adapted from the labour chapters of *Maternal Care*. Particular attention is given to the care of the mother, the management of labour and monitoring the wellbeing of the fetus. **Intrapartum Care** was written to support and complement the national protocol of intrapartum care in South Africa.

**Newborn Care** was written for healthcare workers providing special care for newborn infants in regional hospitals. It covers resuscitation at birth, assessing infant size and gestational age, routine care and feeding of both normal and high-risk infants, the prevention, diagnosis and management of hypothermia, hypoglycaemia, jaundice, respiratory distress, infection, trauma, bleeding and congenital abnormalities, as well as communication with parents. Skills workshops address resuscitation, size measurement, history, examination and clinical notes, nasogastric feeds, intravenous infusions, use of incubators, measuring blood glucose concentration, insertion of an umbilical vein catheter, phototherapy, apnoea monitors and oxygen therapy.

**Primary Newborn Care** was written specifically for nurses and doctors who provide primary care for newborn infants in level 1 clinics and hospitals. **Primary Newborn Care** addresses the care of infants at birth, care of normal infants, care of low-birth-weight infants, neonatal emergencies, and common minor problems in newborn infants.

**Mother and Baby Friendly Care** describes gentler, kinder, evidence-based ways of caring for women during pregnancy, labour and delivery. It also presents improved methods of providing infant care with an emphasis on kangaroo mother care and exclusive breastfeeding.

**Saving Mothers and Babies** was developed in response to the high maternal and perinatal mortality rates found in most developing countries. Learning material used in this book is based on the results of the annual confidential enquiries into maternal deaths and the Saving Mothers and Saving Babies reports published in South Africa. It addresses the basic principles of mortality audit, maternal mortality, perinatal mortality, managing mortality meetings and ways of reducing maternal and perinatal mortality rates. This book should be used together with the Perinatal Problem Identification Programme (PPIP).

**Birth Defects** was written for healthcare workers who look after individuals with birth defects, their families, and women who are at increased risk of giving birth to an infant with a birth defect. Special attention is given to modes of inheritance, medical genetic counselling, and birth defects due to chromosomal abnormalities, single gene defects, teratogens and multifactorial inheritance. This book is being used in the Genetics Education Programme which trains healthcare workers in genetic counselling in South Africa.

**Perinatal HIV** enables midwives, nurses and doctors to care for pregnant women and their infants in communities where HIV infection is common. Special emphasis has been placed on the prevention of mother-to-infant transmission of HIV. It covers the basics of HIV infection and screening, antenatal and intrapartum care of women with HIV infection, care of HIV-exposed newborn infants, and parent counselling.

**Childhood HIV** enables nurses and doctors to care for children with HIV infection. It addresses an introduction to HIV in children,
the clinical and immunological diagnosis of HIV infection, management of children with and without antiretroviral treatment, antiretroviral drugs, opportunistic infections and end-of-life care.

*Childhood TB* was written to enable healthcare workers to learn about the primary care of children with tuberculosis. The book covers an introduction to TB infection, and the clinical presentation, diagnosis, management and prevention of tuberculosis in children and HIV/TB co-infection. *Childhood TB* was developed by paediatricians with wide experience in the care of children with tuberculosis, under the auspices of the Desmond Tutu Tuberculosis Centre at the University of Stellenbosch.

*Child Healthcare* addresses all the common and important clinical problems in children, including immunisation, history and examination, growth and nutrition, acute and chronic infections, parasites, skin conditions, and difficulties in the home and society. *Child Healthcare* was developed for use in primary care settings.

*Adult HIV* covers an introduction to HIV infection, management of HIV-infected adults at primary-care clinics, preparing patients for antiretroviral (ARV) treatment, ARV drugs, starting and maintaining patients on ARV treatment and an approach to opportunistic infections. *Adult HIV* was developed by doctors and nurses with wide experience in the care of adults with HIV, under the auspices of the Desmond Tutu HIV Foundation at the University of Cape Town.

## FORMAT OF THE COURSES

### 1. Objectives
The learning objectives are clearly stated at the start of each chapter. They help the participant to identify and understand the important lessons to be learned.

### 2. Pre- and post-tests
There is a multiple-choice test of 20 questions for each chapter at the end of the book. Participants are encouraged to take a pre-test before starting each chapter, to benchmark their current knowledge, and a post-test after each chapter, to assess what they have learned. Self-assessment allows participants to monitor their own progress through the course.

### 3. Question-and-answer format
Theoretical knowledge is presented in a question-and-answer format, which encourages the learner to actively participate in the learning process. In this way, the participant is led step by step through the definitions, causes, diagnosis, prevention, dangers and management of a particular problem. Participants should cover the answer for a few minutes with a piece of paper while thinking about the correct reply to each question. This method helps learning. Simplified flow diagrams are also used, where necessary, to indicate the correct approach to diagnosing or managing a particular problem.

Each question is written in bold, like this, and is identified with the number of the chapter, followed by the number of the question, e.g. 5-23.

### 4. Important lessons

```
Important practical lessons are emphasised by placing them in a box like this.
```

### 5. Notes

*NOTE* Additional, non-essential information is provided for interest and given in notes like this. These facts are not used in the case studies or included in the multiple-choice questions.

### 6. Case studies
Each chapter closes with a few case studies which encourage the participant...
to consolidate and apply what was learned earlier in the chapter. These studies give the participant an opportunity to see the problem as it usually presents itself in the clinic or hospital. The participant should attempt to answer each question in the case study before reading the correct answer.

7. Practical training

Certain chapters contain skills workshops, which need to be practised by the participants (preferably in groups). The skills workshops, which are often illustrated with line drawings, list essential equipment and present step-by-step instructions on how to perform each task. If participants aren’t familiar with a practical skill, they are encouraged to ask an appropriate medical or nursing colleague to demonstrate the clinical skill to them. In this way, senior personnel are encouraged to share their skills with their colleagues.

8. Final examination

On completion of each course, participants can take a 75-question multiple-choice examination on the EBW Healthcare website, when they are ready to.

All the exam questions will be taken from the multiple-choice tests from the book. The content of the skills workshops will not be included in the examination.

Participants need to achieve at least 80% in the examination in order to successfully complete the course. Successful candidates will be emailed a certificate which states that they have successfully completed that course. EBW Healthcare courses are not yet accredited for nurses, but South African doctors can earn CPD points on the successful completion of an examination.

Please contact info@ebwhealthcare.com or +27 021 44 88 336 when you are ready to take the exam.

CONTRIBUTORS

The developers of our learning materials are a multi-disciplinary team of nurses, midwives, obstetricians, neonatologists, and general paediatricians. The development and review of all course material is overseen by the Editor-in-Chief, emeritus Professor Dave Woods, a previous head of neonatal medicine at the University of Cape Town who now consults to UNICEF and the WHO.

Perinatal Education Trust

Books developed by the Perinatal Education Programme are provided as cheaply as possible. Writing and updating the programme is both funded and managed on a non-profit basis by the Perinatal Education Trust.

Eduhealthcare

Eduhealthcare is a non-profit organisation based in South Africa. It aims to improve health and wellbeing, especially in poor communities, through affordable education for healthcare workers. To this end it provides financial support for the development and publishing of the EBW Healthcare series.

The Desmond Tutu HIV Foundation

The Desmond Tutu HIV Foundation at the University of Cape Town, South Africa, is a centre of excellence in HIV medicine, building capacity through training and enhancing knowledge through research.

The Desmond Tutu Tuberculosis Centre

The Desmond Tutu Tuberculosis Centre at Stellenbosch University, South Africa, strives to improve the health of vulnerable groups through the education of healthcare workers and community members, and by influencing policy based on research into the epidemiology of childhood tuberculosis, multi-drug-resistant tuberculosis, HIV/TB co-infection and preventing the spread of TB and HIV in southern Africa.
UPDATING THE COURSE MATERIAL

EBW Healthcare learning materials are regularly updated to keep up with developments and changes in healthcare protocols. Course participants can make important contributions to the continual improvement of EBW Healthcare books by reporting factual or language errors, by identifying sections that are difficult to understand, and by suggesting additions or improvements to the contents. Details of alternative or better forms of management would be particularly appreciated. Please send any comments or suggestions to the Editor-in-Chief, Professor Dave Woods.

CONTACT INFORMATION

EBW Healthcare
Website: www.ebwhealthcare.com
Email: info@ebwhealthcare.com
Telephone: +27 021 44 88 336
Fax: +27 088 021 44 88 336
Post: 87 Station Road, Observatory, 7925, Cape Town, South Africa

Editor-in-Chief: Professor Dave Woods
Website: www.pepcourse.co.za
Email: pepcourse@mweb.co.za
Telephone: +27 021 786 5369
Fax: +27 021 671 8030
Post: Perinatal Education Programme, PO Box 34502, Groote Schuur, Observatory, 7937, South Africa
Objectives

When you have completed this unit you should be able to:

- Introduce yourself to a mother and child.
- Take a full history.
- Perform a physical examination.
- Make a clinical assessment.
- Draw up a problem list.
- Decide on a plan of action.
- Write good clinical notes.

The four main steps in the examination are the story, the observation, the assessment of the problems, and the management plan.

INTRODUCTION

1-1 What are the steps in the general examination of a child?

- The introduction to the child
- The review of any referral information
- Recording basic observations
- Taking a history
- The physical examination
- Special investigations
- Drawing up a problem list and making a diagnosis if possible
- Planning any intervention that is needed

The letters ‘SOAP’ remind us of the 4 main steps of a general examination:

1. Story (the history or subjective information)
2. Observation (what you observe during the physical examination, the objective information)
3. Assessment (the list of problems and diagnosis)
4. Plan of action (what needs to be done)

THE FIRST MEETING

1-2 Why is the introduction important?

The first step of the general examination is to introduce yourself to the child and his or her mother, father or caregiver (guardian). At the start, find out whether the child is a boy or girl. Always make sure that you know the gender of the child. If you get that wrong the parent may not trust you with your medical management. Never refer to a child as ‘it’. Always greet the child and parents with respect. This first meeting establishes the relationship between the caregiver (doctor or nurse) and the child and parents. The rest of the general examination and management
of the child depend on a good, trusting relationship. A friendly, caring approach builds trust and confidence. Often in a busy clinic, the introduction is unfortunately bypassed. Always take time to ‘make friends’ with the child first before starting the examination. Avoid strong eye contact with toddlers until you have ‘made friends’. 

It is very important to take time to establish a good relationship with the child and mother at the start of the general examination.

1-3 How should you address a child?
Always introduce yourself by name. Find out what the child's name is and use it throughout the examination. Some children prefer to be addressed by their pet name ('nickname') e.g. 'Bobby' rather than 'Robert.' Never refer to the child as 'the kid' or any other term of disrespect. Do not pretend that the child is not present when speaking to the mother.

1-4 Why is it important to listen to mothers?
One of the most dangerous mistakes to make when examining a child is not listening to what the mother (or caregiver) has to say. She usually knows the child best and the opinions and insights of mothers are often right. Always allow the mother time to give her story and ask questions.

Always pay careful attention to what the mother says about the child.

1-5 Why is it important to keep the language simple?
One of the main complaints by patients is that doctors and nurses do not use simple language. Avoid technical terms, complicated words and medical jargon. Make sure that you and the patient understand one another at all times. Sometimes a simple drawing may help to obtain an accurate history or give a clear explanation. Taking a clear history is often difficult when the patient comes from a different cultural or social background.

THE REVIEW OF ANY REFERRAL INFORMATION

1-6 What is the value of a referral letter?
The child may arrive with a referral letter from a colleague, crèche or school. The referral letter is important because it draws attention to the problem. It is important to read any referral information carefully. Always reply to a referral letter.

1-7 What is the value of the Road-to-Health Card?
It is always very important to ask for and review the child's Road-to-Health Card as it provides much useful information about the child's past medical history, immunisation record, growth pattern and wellbeing. If the Road-to-Health Card is lost or not available, ask why. A lost or forgotten Card may be due to a family or social problem. The crèche, school, clinic or hospital must not keep this patient-carried card.

Always look carefully at the Road-to-Health Card before examining a child.

BASIC INFORMATION

1-8 What basic information is needed?
Before the history and examination, some basic information is often taken and recorded by the staff that meet the mother and child when they arrive at the clinic or hospital. This basic information usually includes the following:

1. The age and gender of the child
2. The child's size
3. The child's temperature
1-9 Why are the age and gender important?

Age is needed to plot the infant’s size on the growth chart of the Road-to-Health Card and to assess whether the child’s development is normal. Boys are usually slightly bigger than girls at any given age, while girls tend to be slightly more advanced in their development.

1-10 How should the child’s size be recorded?

The infant’s size measurements (weight, head circumference and standing height or lying length) must be accurately measured and noted. The measurements must then be carefully plotted on the growth chart of the Road-to-Health Card.

Weight is a very good measure of the child’s general health and must be measured and recorded at every visit.

The head circumference is important, especially in the first year of life, as it is a measure of brain growth.

If the child can stand, the standing height (stature) should be recorded, as it is the best measure of growth. In younger children, the lying length should be recorded. While weight is a good measure of growth in an infant, height is the best measure of growth in older children.

Details of the measurement and plotting of an infant’s size are discussed in Unit 3.

The child’s weight must be measured and plotted on the Road-to-Health Card at every visit.

1-11 How should you measure the child’s temperature?

Body temperature is measured with a digital or mercury thermometer. In younger children...
the axillary temperature must be recorded. In older children the oral temperature can be measured under the tongue. Rectal temperatures should not be taken.

If a mercury thermometer is used, always shake the mercury down before measuring a temperature. Leave the thermometer in the axilla for 1 to 2 minutes, with the arm held against the body, before reading the temperature. The normal axillary body temperature is 36.5 to 37 °C. If the axillary temperature is higher than 37 °C, the child has a fever. The normal oral temperature is slightly higher than the axillary temperature, with a normal range up to 37.5 °C. Always clean the thermometer before taking a child’s temperature.

If no thermometer is available, feel the child with your hand and assess whether they are normal, cold or hot.

**NOTE** Due to the small risk of mercury pollution or poisoning, a digital thermometer is preferred.

### THE HISTORY

#### 1-12 How do you start taking a history?

It is best to begin by simply asking the mother (or child) what is worrying them. Make sure that you understand what the complaint is. Ask ‘What is worrying you?’

#### 1-13 Why is it important to obtain a good history?

The history (the story) is often the most important part of the general examination. Most problems can be identified and diagnoses can be made on a good history. Every effort must, therefore, be made to obtain a clear and detailed history.

**A carefully taken history will provide the information needed to make the correct diagnosis.**

#### 1-14 Who should give the history?

It is best if the history can be obtained from the child. However, in small children this is not possible and the history is usually given by the mother or someone else (the caregiver) who knows the child. Sometimes it is helpful to get the history from both the child and mother as each may emphasize different parts of the history. Some patients may need help to describe and explain their symptoms. Adolescents may wish to be seen without a parent present.

The history not only provides information about the present illness but can also give important details about the child’s past health, social and home environment.

#### 1-15 What are the main parts of the history?

The main parts are:

1. The present history and presenting complaints
2. The past history
3. Immunisations
4. The social history (home, family and school)
5. Special questions

#### 1-16 What is important to ask about in the present history?

It is best to start by asking why they have come to see the doctor or nurse. What is worrying them? First let the child or mother tell their story. Give them time to speak without interrupting. In getting an accurate present history make sure that you obtain the following information:

1. When was the child last completely well?
2. What are the present complaints (symptoms)?
3. What are the problems which made you bring the child today?
4. When and how did they start?
5. Are they getting worse?
6. Does anything make the complaints better or worse?
7. Is any treatment being used?
8. Are there any other symptoms (what the child feels) or signs (what you can see)?
9. Has the child been in contact with other children with similar problems? Many childhood illnesses are infectious.

It is important to make an assessment about whether you think the information is reliable or trustworthy. Sometimes it can be very difficult to understand what the complaints are.

**Note** A symptom is something that a patient complains of. It is usually a feeling like pain, discomfort, nausea or fear. In contrast, a sign is something that can be seen, felt or heard by someone else, such as a rash, lump or heart murmur. Small infants usually only have signs and not symptoms as they cannot speak yet.

1-17 What is important in the past history?

It is important to note:

1. Any problems during the pregnancy, labour and delivery
2. Gestational age and birth weight (If not known, was the infant small? How long was the hospital stay?)
3. Any problems during the first few days of life
4. Diet and feeding
5. Growth and development
6. Any previous illness or problems before the start of the present complaints
7. If the present complaints have ever occurred before
8. Any previous or present medication
9. Any operations or hospital admissions
10. Any allergies

It is most important to determine whether the present complaints can be related to anything in the past history.

1-18 What is needed in the immunisation history?

It is important at every visit to review the child’s immunisation record. Children may present with an infectious disease because they have not been fully immunised against that infection. An incomplete immunisation schedule may suggest social problems. All missing immunisations must be given.

1-19 Why may the social (home, family, school, economic) history be important?

Children are greatly influenced by their environment and by those around them. Many childhood problems are caused by problems at home (poverty, malnutrition, abuse, neglect, poor housing, unemployment) or at school (discipline, fear, bullying). The presenting complaint may be a warning of deeper social problems. Poverty and poor maternal education are the cause of many childhood problems. Some mothers bring their child to a clinic because they have a problem themselves. This may not always be obvious. Therefore, a social history must always be taken. Suspect abuse if the history does not explain any sign of injury.

Useful questions to ask are:

1. Who looks after the child?
2. Who are the other family members and are they healthy? Is there anyone with TB?
3. Who looks after the child during the day?
4. What is the family income?
5. What is the mother’s (or caregiver’s) level of education?
6. Are there problems in the home which may affect the child’s wellbeing (e.g. alcohol, violence, abuse)?
7. What type of housing exists? Is there water, sanitation, electricity?
8. Is the child receiving child support or a care dependency grant?
9. Are there problems at school or crèche?

1-20 What question in the social history should not be forgotten?

It is difficult but important to ask the mother whether she knows her HIV status. HIV infection is the cause of many illnesses in children today. Most of these children are born to HIV-positive mothers and infected by mother-to-child transmission.
1-21 What special questions should be asked?

Special questions should be asked about each system e.g. respiratory, gastrointestinal or cardiovascular system. Questions are mainly limited to the body system involved in the present history. For example, if the presenting complaint is abdominal pain it would be important to ask about appetite, vomiting, diarrhoea or constipation, worms, blood in the stool and weight loss. If the right questions are not asked, you will not be able to get the correct answers.

1-22 When can an interpreter help in taking a history?

Many mothers and children do not speak the same home language as the doctor or nurse. Even if you are able to understand each other a little, it is very difficult to take a detailed history without a good understanding of each other’s language and traditions. Here a translator is very helpful. Unfortunately, skilled translators are often not available and local nurses or cleaning staff have to help. Always express your concern and willingness to help the child, and make sure you understand what the main problem is.

1-23 Why is confidentiality important in history taking?

Often the history has to be taken in a busy clinic or ward with many other people around. Always be aware that the mother and child may be embarrassed or unwilling to discuss the details of their problem in front of others. This is particularly important if the mother is afraid that her child may have AIDS. If at all possible, try to arrange that histories can be taken in a quiet, comfortable, private area.

1-24 What can be learned by observing the mother and child during history taking?

Much can be learned by observing the child and mother. Watch their facial expressions, hand movements and body language. These give clues about anxiety, guilt, embarrassment or lack of interest. Observe what kind of clothes they wear.

THE PHYSICAL EXAMINATION

1-25 What are the steps in the physical examination?

The steps are:
1. General and regional inspection
2. Systematic examination
3. Special examination

1-26 In what order should the steps of the examination be done?

Usually the general and regional inspection are done first and then followed by the systematic (systems) examination. A special examination (e.g. rectal examination) is only done if there is a good indication.

It is important to do the physical examination in a fixed order. Otherwise, parts of the examination may be forgotten. However, the steps are flexible and in younger children parts of the examination that may hurt or frighten the child or require an instrument (e.g. examining the throat) are often left for last. Most mistakes in diagnosis come from incomplete examination.

1-27 What are the components of each step of the physical examination?

1. Inspection (look and see)
2. Palpation (feel)
3. Percussion (feel and listen)
4. Auscultation (listen with a stethoscope)
In a brief examination, percussion is often left out unless particularly indicated. Always inspect (look) before palpating (touching). Palpate before auscultating (listening). In a small child who is likely to cry, it may be better to listen before palpating. Children are less threatened if you start by examining their limbs first, before examining their chest and abdomen. It is important to make the examination as non-threatening and comfortable as possible. With young children it often helps to turn the examination into a game.

Always observe first.

1-28 What is the most important component of the examination?

All components are important. However, it is particularly important to look and see. Inspection is the best means of telling whether a child is well or sick. It also helps to decide whether a child is anxious, frightened or embarrassed. Many diagnoses can be made by careful inspection alone. As children often cannot tell you how they are feeling, you need to obtain this information by observing them.

Always be gentle and friendly. Never rush or move suddenly.

1-30 Should the child be undressed for the examination?

If possible, all the infant’s clothes should be removed slowly and gently. Toys or sweets may help to distract the child during undressing and examination. Never touch a child with cold hands. Most children do not mind being undressed provided due respect is paid to their feelings. Older children may be sensitive and embarrassed about getting undressed in front of strangers.

If a child is very distressed by being completely undressed, it may be better to undress and examine one part of the body at a time. If a child is shy, it is best to leave the underpants on for most of the examination. However, the genitalia should be inspected. A soft blanket can be used to cover parts of the body while they are not being examined.

The examination room should be warm, quiet and interesting to the child. Always keep the mother close by.

Always have warm hands when examining a child.

1-31 What is the best approach to the general and regional inspection?

1. First stand back (at the end of the bed) and have a good look at the whole child (general inspection):
   - Does the child appear well or ill, distressed, toxic or shocked?
   - Does the child look strange, with an appearance suggesting a syndrome (dysmorphic)?
   - Is the child fully conscious and co-operative?
   - Does the child look thin or fat? What is the nutritional status? Is the child wasted?
   - Is the child afraid, tearful, angry or embarrassed?
• Is the child pale, jaundiced or cyanosed?
• Does the child have a rash?
• Does the child appear well cared for?
• Does the child appear dehydrated?

2. Secondly, inspect each part of the body (region) starting with the head and ending with legs (regional inspection):
   • Head – size, appearance, hair, fontanelle
   • Ears – appearance, exudate
   • Eyes – appearance, conjunctivitis, jaundice, squint
   • Nose – discharge, flaring
   • Mouth – appearance, stomatitis, thrush, pallor or cyanosis, cleft palate
   • Neck – enlarged thyroid or lymph nodes
   • Arms – lymph nodes, rickets, palmar creases, clubbing, pallor or cyanosis
   • Chest and abdomen – appearance, dehydration, rash, scars, hernias
   • Spine – scoliosis
   • Genitalia – appearance, undescended testes, hernias
   • Legs – lymph nodes, rickets, oedema, clubbed feet

Usually the general and regional inspection is followed by an examination of the main body systems. The general and regional inspection often indicates what system needs special attention during the systematic examination.

**Always look carefully first before touching the child.**

### 1-32 How are the body systems examined?

During the systematic examination, each system is examined separately by inspection (looking), palpation (feeling), percussion (tapping) and auscultation (listening with a stethoscope):

1. Respiratory system:
   • Count the respiratory rate.
   • Listen for cough, wheezing or stridor.
   • Look for signs of respiratory distress (recession, grunting).

2. Cardiovascular system:
   • Count the pulse and note the nature of the pulse (easy or difficult to feel?)
   • Take the blood pressure (not always needed in infants).
   • Look at the shape of chest.
   • Palpate (feel) for the position of the apex beat.
   • Auscultate the heart for heart sounds and murmurs.

3. Gastrointestinal system:
   • Look for abdominal distension.
   • Look and feel for hernias.
   • Feel for abdominal tenderness.
   • Feel for enlarged organs (liver, spleen, kidneys) or other masses.
   • Listen for bowel sounds.

4. Genitourinary system:
   • Is the child obviously a boy or girl?
   • If a boy, are the testes descended?

5. Central nervous system:
   • Assess whether the child is alert and fully conscious. Any convulsions (fits)?
   • Determine the developmental milestones.
   • Can the child see and hear normally?
   • Can the child smile and close eyes tightly?
   • Assess for neck stiffness (meningism).
   • Assess whether the child is able to move all limbs normally.
   • Observe whether the child walks normally (if old enough).

6. Muscular skeletal system:
   • Look whether the back is straight.

7. Ears, nose and throat:
   • Examine mouth and throat.
   • Examine ears.

The order of the examination is flexible. Usually the examination of the mouth, throat and ears is done last as it is unpleasant for a young child. Sometimes the heart is examined first so that the heart sounds can be heard before the child becomes upset and cries.

**NOTE** Only the most important aspects of the physical examination are given here. For a more
detailed examination see a standard textbook on paediatrics such as *Paediatric Primary Health Care* by Ireland, Power, Woods and Desai (Oxford University Press, Cape Town 2006).

1-33 What are important danger signs?  
Danger signs warn that the child may have a serious illness. During the general inspection, it is important to look for danger signs such as:

- Physical or mental distress. Always look for respiratory distress.
- Dehydration or continuous vomiting
- Depressed level of consciousness
- Convulsion

1-34 What are the early signs of dehydration?  
A child is dehydrated when:

1. There is decreased skin turgor (the skin is pinched and then released, but does not return to its previous shape immediately).
2. The fontanelle is sunken.
3. The eyes are sunken.

The signs of dehydration are discussed in Unit 5.

1-35 What special examination may be needed?  
Sometimes it may be necessary to perform a rectal or vaginal examination, or examine the fundi of the eyes. These may need to be done under general anaesthesia in a small child.

1-36 What are the 10 common errors in the general examination of a child?  
The 10 common errors are:

1. Not taking time to introduce yourself to the mother and child
2. Not listening to what the mother says
3. Not taking a full history
4. Not checking the immunisation status
5. Not weighing the child and plotting the weight correctly on the Road-to-Health Card
6. Not looking at the child carefully (inadequate general inspection)

7. Not assessing the developmental milestones
8. Not recording the blood pressure in older children
9. Not examining the child’s gait (walk)
10. Not writing SOAP notes with a problem list, assessment and plan

**SPECIAL INVESTIGATIONS**

1-37 What special investigations are usually needed?  
The most important special investigations are:

1. Urinalysis with a urine dipstick to detect urinary tract disease or diabetes. It is particularly important to test the urine in a child with fever.
2. Haemoglobin concentration.

These are often done routinely in ill children.

Other special investigations, which are often asked for in hospital, are a full blood count (FBC), erythrocyte sedimentation rate (ESR), chest X-ray, urine and stool microscopy and culture, and Mantoux skin test. These tests may not be available in many clinics.

1-38 What additional investigations may be needed?  
These will be determined by the findings of the history and the physical examination. Any investigations should only be done if they are indicated.

**THE ASSESSMENT**

1-39 What is the assessment?  
Once the history has been taken and the examination completed, it is very important to make an assessment of your findings and write careful notes. You need to note the patient’s main complaints and draw up a list of problems. If possible, make a diagnosis. If
this is not possible yet, it is most helpful to complete a detailed problem list.

1-40 What is a problem list?

This is a precise list of the patient’s current unsolved problems (i.e. problems which are still active and need to be addressed). The problems may be medical as well as social or economic. A carefully drawn-up problem list is one of the most important parts of the whole examination and makes sure that no problem is forgotten. Do not include problems which have already been resolved. As soon as a problem has been solved it should be removed from the problem list. From the problem list, an attempt should be made to reach one or more diagnoses. A diagnosis may be included as a problem.

The following is a typical problem list:

1. Poverty, with poor housing
2. Failing to thrive, with weight below the 3rd centile
3. Incomplete immunisation
4. Pneumonia
5. Dental caries

A problem list is a precise list of the patient’s current unsolved problems.

NOTE The problem-orientated medical record has been a major advance in improving patient care and is widely accepted as the best method of keeping records.

1-41 How do you make a diagnosis?

Many childhood diseases have similar signs and symptoms but only a few of these diseases are common. The steps in making a diagnosis are:

1. Gather all the abnormal findings found in the history, examination and any special tests.
2. Compare these findings to those found in common childhood diseases. It is usually quite easy to find one which best fits the findings.
3. Carefully compare the clinical findings to the signs and symptoms typical of the chosen diagnosis and see if they truly fit.
4. If they do not fit, reconsider your diagnosis and think of another possible diagnosis.
5. Watch the child’s response to the treatment for that diagnosis.

If you are unable to make a diagnosis or if you diagnose a serious disease, the child must be referred to hospital or a special clinic for further management.

A PLAN OF ACTION

1-42 What is a plan of action?

This is a careful plan of how each identified problem is going to be investigated and managed. It is of little help to complete a full general examination, make a careful problem list and possible diagnosis, but then fail to take any action. Each item of the problem list must be considered and a plan of action decided upon and documented for that problem. The plan of action must be clearly written in the patient’s record (if in hospital or at a clinic) as well as in the Road-to-Health Card.

When writing out the plan of action, it is useful to list each problem in turn and then note what action is needed for that specific problem. This helps to keep track of the various actions which are needed for the whole problem list. What is not wanted is a long, confused list of actions where it is uncertain which problems are being addressed by each action.

The clinical findings, assessment and plan of action must be simply and clearly explained to the parents. The patient and parents should be allowed to ask questions and discuss the important points. Always be patient, polite and caring. A translator may be needed.

The following is a typical plan of action:

1. Poverty: Refer to social worker to consider a grant.
2. Underweight for age: Provide food supplements and monitor weight gain.
3. Incomplete immunisation: Arrange for missing immunisations to be given.
4. Pneumonia: Start oral amoxycillin, check oxygen saturation, provide oxygen if needed, refer to hospital.
5. Dental caries: Book dental appointment and discuss dental hygiene with mother.

WRITING GOOD CLINICAL NOTES

1-43 What is the importance of good clinical notes?
It is extremely important to always write good clinical notes.

- The patient’s notes are the best way of reminding yourself at the next visit what the problems were, what was found and decided upon, and what investigations and management were planned.
- Good notes are the best way of communicating this information to other members of the health team who may see this child at future visits.
- Writing good notes helps one to think and develop a clear idea of the child’s problems and the required management. By looking at other colleagues’ notes it is easy to determine whether they had a clear idea of the problems and course of action needed.
- The patient’s notes are the official record of the patient’s care. They are the medico-legal record of the interaction between the patient and the health service.
- Keeping good notes helps to develop and maintain a high level of care and pride in the service.

It is essential that clinical notes can be easily read and understood. It is a waste of time and dangerous practice to make notes which others are unable to read.

1-44 How detailed should your notes be?
This depends on whether you are seeing the patient for the first time or at a follow-up clinic. It also depends on the amount of time you have to examine the infant and write notes. Notes must be written at every visit. The aim is to produce the best notes possible under the circumstances.

Usually, detailed notes are written at the first consultation. Thereafter, a brief note should be made about each problem on the problem list at every visit. Do not lose a problem from the list until it has been fully attended to. Always make a note of any problems in the Road-to-Health Card.

1-45 How should the notes of the first visit be laid out?
Use the SOAP system to lay out your initial notes.

1. Start with the history (story or what is said):
   - The reason for referral should be noted together with the child’s age and gender. It is important to begin with the presenting complaints and the detailed history relating to each of them. This will form the present history.
   - Any important points from the past history should be recorded.
   - Any outstanding immunisations must be recorded.
   - Important facts from the social history should be noted.
   - Each section of the history (present, past, immunisation and social history) is given a separate heading to make it easier to read.

2. Important positive and negative aspects of the special questions are usually written under a separate Special Questions heading. This completes the history section of the notes.

3. The physical examination follows next. This usually is written under the following headings:
   - Weight (and sometimes head circumference and length or height)
- Temperature
- The general appearance of the child (including nutritional state and hydration)
- Specific general signs (such as pallor, cyanosis, jaundice and oedema)
- Important positive or negative signs from each body part (e.g. head) or organ system (e.g. cardiovascular system)

4. List special investigations asked for, note the date of the investigation and record any results available.
5. Make an assessment by drawing up a problem list with diagnoses where possible.
6. Write a plan of action for each problem.

All notes must clearly state the date and your name.

**1-46 How should progress notes be written?**

Every time the patient is examined, a careful progress note must be made in the patient record or on the Road-to-Health Card. Continue using the SOAP system. Each item on the problem list must be considered in turn. The history, clinical findings, any special investigations, and plan of action must be recorded for each problem. Only record what is important. One of the greatest mistakes made in writing continuation (follow-up) notes is that they are too long and detailed. Notes must be kept short and simple. No one will read pages and pages of unnecessary writing.

The following is a typical example of progress notes using a problem list and SOAP method:

**PROBLEMS**

1. **Scabies:**
   - **S**: Itching is much better, especially at night.
   - **O**: Rash improving. No secondary infection.
   - **A**: Scabies has responded to treatment with Ascabiol.
   - **P**: Give mother Ascabiol to treat whole family.

2. **Iron deficiency anaemia:**
   - **S**: More energy. Good appetite.
   - **O**: No longer pale.
   - **A**: Good response.
   - **P**: Check Hb. Continue oral iron for 3 months.

1-47 **Should notes always be made in the Road-to-Health Card?**

If the child presents at either a clinic or hospital, a note should always be written in the Card. A brief summary of the problems, assessment and plan of action should be made even if fuller notes are made in the patient’s hospital or clinic record. As the child may be seen at a number of different facilities over months or years, the patient-carried Road-to-Health Card is the one place where all the visits should be recorded.

**Progress notes should be short and simple and address each unresolved problem.**

Once a problem on the list is solved, that problem can be dropped and need no longer be included in the problem list. Any new problem should be added to the list.

In this way, each active problem (i.e. still on the list) should be considered at each examination. This provides a simple, clear and systematic record of the patient’s clinical progress. Any other nurse or doctor can quickly understand the patient’s problems and progress by reading good notes.

**Always make a note in the Road-to-Health Card.**

**CASE STUDY 1**

A doctor is asked to see an ill 9-year-old child in a hospital outpatient department. He ignores the child and asks her mother what the problem is. She gives him the referral letter, which he does not read. Before she can give her story he has already started to examine the child. The child is not weighed. He tells her that the child has rheumatic fever, and should
stay in bed and take the prescribed tablets three times a day. He then rushes out without any further explanation.

1. **What is the first mistake the doctor makes?**

He ignores the patient. A 9-year-old child should be able to tell the doctor about the presenting complaints. He also does not introduce himself to both mother and child. This is not only bad medicine but it is also foolish and rude.

2. **Is this the correct method of taking a history?**

No. He does not pay attention to the mother and starts examining the child before she has had a chance to tell her full story. Never ignore what a mother has to say, as she knows her child best.

3. **In a hospital, is it important to read referral letters?**

Yes. Always read the referral letter as it draws attention to the clinical problem and often provides important information. The doctor should have replied to the letter.

4. **Is measuring weight part of the general examination?**

All children (and adults) should be weighed as part of a general examination. The child's weight should have been plotted on a weight-for-age chart.

5. **What do you think of the way he told the mother the diagnosis and prescribed treatment?**

He failed to explain what the problem was and what the diagnosis means. She should have had the management explained to her. The mother needs to know when to return for the next appointment. Even if the diagnosis and treatment were correct, the history and examination were inadequate.

### CASE STUDY 2

A general practitioner asks about the presenting complaints and takes a present but no other history from a mother and her 10-year-old daughter. The child has a fever and a rash. After a quick general inspection, he lifts the child’s shirt and looks at the rash. After writing a brief note in the hospital folder he tells the mother that the child has measles.

1. **What mistake has the doctor made in taking a history?**

Only a present history was taken. It is important always to take a past, social and immunisation history as well.

2. **Why is an immunisation history important?**

It is important to know whether this child has been fully immunised, especially against measles and rubella.

3. **What was wrong with the physical examination?**

The doctor only did a general inspection. Each organ system was not examined. The doctor also did not palpate or auscultate. Important clinical signs, such as lymphadeopathy, splenomegaly and signs of measles in the child’s mouth (Koplik’s spots) may have been missed.

4. **What routine basic information would have been useful?**

The child's temperature and weight. Always record and plot weight to screen for malnutrition.

5. **Is a ‘brief note’ in the hospital folder adequate?**

No. As this is the initial consultation he should have written full notes (basic information, history, special questions, physical examination and any investigations).
**CASE STUDY 3**

An infant is seen by a nurse at a follow-up appointment at a local clinic. She is unable to read the long and confused notes made at the previous visit and does not ask the mother for the Road-to-Health Card. The mother cannot help her, as she was not told what the problem was. She thinks the child has a heart problem. During the examination the infant cries because the nurse’s hands are cold. As a result she cannot hear the heart sounds and refers the child to hospital.

1. **Why is she unable to read and make sense of the patient’s notes?**

   Because they were not written clearly in a logical order. This is a very common finding. With good notes she should be able to quickly find out what the previous problems and management were.

2. **Why should she have asked for the Road-to-Health Card?**

   There may be a summary of the previous visit in the Card. The Card would also indicate how the child has been growing, whether the immunisation schedule is up to date and what previous health problems have occurred. It is a serious error not to review the Card at each visit.

3. **Why was the mother not told what the problems were?**

   There was poor communication between the health professional and the patient. This is a common problem. This can be partially addressed by making a note in the Road-to-Health Card. The parents and the child should always be fully informed after a consultation.

4. **What mistake did the nurse make with the examination?**

   She did not warm her hands first. Cold hands and a cold stethoscope are a common mistake. As a result she could not listen to the heart.

5. **What are the 3 steps in the physical examination?**

   1. General and regional inspection
   2. Systematic examination
   3. Special examination

6. **In what order should each of the most important 3 steps be done?**

   1. Inspection
   2. Palpation
   3. Auscultation

**CASE STUDY 4**

A child from a very poor home presents with scabies at a clinic. His weight is below the 3rd centile. The mother also says that he has coughed for the past month. The nurse takes a full history and completes a physical examination. She writes SOAP notes in the patient folder and also writes a summary in the Road-to-Health Card.

1. **What are SOAP notes?**

   This is a system of writing clinical notes, which includes the story (history), observations (physical examination), assessment and plan of action. All initial or follow-up examinations should be recorded this way.

2. **Is it necessary to write notes in both the clinic folder and Road-to-Health Card?**

   Yes. The clinic folder should hold the detailed notes while a summary should be written in the Road-to-Health Card.

3. **What is a problem list?**

   This is a clear, simple list of the patient’s problems. The problem list is drawn up during the assessment at the end of the complete examination. The problem list is the most important part of summarizing the findings of the history, physical examination and investigations. A problem list must always be made even if the diagnosis is not known.
4. What would be the problem list for this child?

1. Poor social circumstances
2. Failure to thrive, with a weight below the 3rd centile
3. Scabies
4. Chronic cough

An action plan is needed for each of the problems. Some problems, like scabies, needs treatment while others, like the chronic cough, need investigation. It is important that social problems are also recorded and addressed.
Objectives

When you have completed this unit you should be able to:
• Define immunisation.
• Write the immunisation schedule.
• Understand the advantages of immunisation.
• List the contraindications and complications of immunisation.
• Give immunisations safely.
• Store vaccines safely in a clinic or hospital.

INTRODUCTION

2-1 What is immunity?
Children may become infected with many bacteria or viruses, which can cause illness. Some of these organisms may also produce toxins, which can result in serious damage. Following most infections the body develops protection (resistance) against further infections by the same organism or against the toxins which these organisms produce. The body is now said to be immune to (protected against) that specific organism or toxin. This protection is called immunity. The body produces immunoglobulins (antibodies) and white cells to provide immunity (protection). Immunity can follow a natural infection or be induced by immunisation.

Immunity is the protection which the body develops against further damage by an organism or toxin.

2-2 What is immunisation?
Immunisation is a method of artificially stimulating the immune system to provide protection against specific serious infections. This is done by giving a vaccine. A vaccine may be any one of the following:
• A live, but specially weakened (attenuated), organism such as oral polio vaccine.
• A dead organism such as intramuscular polio vaccine.
• An inactivated substance (a toxoid) produced by an organism such as diphtheria vaccine.
• Part of an organism such as hepatitis B vaccine.

Immunisation is a method of preventing some serious infectious diseases.

NOTE It is best not to use the word ‘vaccination’ as it means to immunise with vaccinia (cowpox) to protect against smallpox. However, the word
2-3 What are the advantages of immunisation?

Immunisation is strongly recommended as it can prevent many serious infections. The introduction of immunisation for all children has been one of the most important advances in modern medicine and saves the lives of millions of children throughout the world each year. It is far better to prevent an infectious illness than to treat the illness and its complications. Immunisation is therefore very cost effective. Immunisation has greatly reduced the mortality rate of children in many countries.

2-4 What immunisations should be given to young children?

All children should be routinely immunised against the following eight important infections:

1. Tuberculosis
2. Polio (poliomyelitis)
3. Diphtheria
4. Whooping cough (pertussis)
5. Tetanus
6. Hepatitis B
7. Measles
8. Haemophilus influenzae

In South Africa, children are immunised against these eight infections as part of the State immunisation programme. As a result, many of these infections (polio, diphtheria, tetanus, measles) have become uncommon. In future, additional immunisations are likely to be added.

Some additional immunisations may be given to specific children when indicated, e.g. viral influenza, polyvalent pneumococcal, meningoccal and yellow fever vaccine.

2-5 What is the expanded programme on immunisation

The Expanded Programme on Immunisation (EPI) of the World Health Organisation recommends that all children be immunised against these infections. It aims to provide free immunisation for children against the important childhood infections.

NOTE EPI was started in 1974. It was called ‘expanded’ as measles and polio vaccines were added to BCG and DPT, and the number of children immunised in developing countries was greatly increased. The purpose of EPI is to prevent the childhood diseases for which vaccines exist, to provide high quality vaccines, and surveillance of these diseases.

2-6 How are immunisations given?

They may be given as drops by mouth, as with polio immunisation, or by intramuscular injection, as with hepatitis B. BCG immunisation is injected into the skin.

2-7 Which vaccines are used in South Africa?

- BCG is used to immunise against tuberculosis, especially tuberculous meningitis and miliary tuberculosis in children, which are two of the most severe forms of tuberculosis.
- A live polio virus vaccine is used to protect children against poliomyelitis, which is a viral infection that can cause permanent paralysis.
- Diphtheria toxoid and tetanus toxoid are used to protect against the effects of diphtheria and tetanus infections. Diphtheria infection can cause airway obstruction and damage to the heart and nerves. Tetanus infection causes convulsions and muscle spasms.
- Pertussis vaccine protects against the infection which causes whooping cough. It is usually given together with diphtheria and tetanus toxoid (DPT).
- A live measles vaccine is used to protect children against measles.
- Hepatitis B vaccine is used to protect against hepatitis B.
• *Haemophilus influenzae* B vaccine (Hib), which is the latest vaccine to be added to the South African expanded programme on immunisation, protects against serious infections, such as meningitis, caused by *Haemophilus influenzae* type B.

**Note**: Some vaccines are alive (BCG, oral polio, measles) while others are dead (diphtheria, tetanus, pertussis, hepatitis B and *Haemophilus influenzae* B). A toxoid is an inactivated toxin.

In future, MMR (measles, mumps and rubella) vaccine will replace measles immunisation alone, while hepatitis A, pneumococcal and chickenpox (varicella) immunisations should be added to the routine immunisations. Yellow fever immunisation is routinely given in countries where yellow fever occurs. New vaccines, such as the Rota virus vaccine, could be very important, but are expensive.

It is easier to give combined vaccines such as DPT plus Hib as less injections are needed. In future more combination vaccines will be used.

### 2-8 When should immunisations be given?

The recommended schedule for immunisation lists the age at which specific immunisations should be given. Some immunisations need only be given once while others have to be repeated a number of times.

The schedule for the immunisation of children in South Africa (Table 2.1) is as follows:

- Polio 0 is the dose of polio vaccine at birth
- DPT 1 is the first dose of DPT
- Hepatitis B 2 is second dose of hepatitis B vaccine
- Hib 3 is the third dose of Hib vaccine, etc.

The primary immunisations are given between birth and 9 months. The immunisations given at 18 months and 5 years (polio, measles, diphtheria and tetanus) are often called ‘boosters’ as they help to improve the immune response produced by the initial course of immunisation.

<table>
<thead>
<tr>
<th>When</th>
<th>Vaccines</th>
</tr>
</thead>
<tbody>
<tr>
<td>At birth</td>
<td>BCG</td>
</tr>
<tr>
<td></td>
<td>Oral polio 0 (OPV 0)</td>
</tr>
<tr>
<td>At 6 weeks</td>
<td>Oral polio 1 (OPV 1)</td>
</tr>
<tr>
<td></td>
<td>DPT 1 (diphtheria, pertussis, tetanus)</td>
</tr>
<tr>
<td></td>
<td>Hepatitis B 1</td>
</tr>
<tr>
<td></td>
<td>Hib 1</td>
</tr>
<tr>
<td>At 10 weeks</td>
<td>Oral polio 2 (OPV 2)</td>
</tr>
<tr>
<td></td>
<td>DPT 2</td>
</tr>
<tr>
<td></td>
<td>Hepatitis B 2</td>
</tr>
<tr>
<td></td>
<td>Hib 2</td>
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<tr>
<td>At 14 weeks</td>
<td>Oral polio 3 (OPV 3)</td>
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<td></td>
<td>DPT 3</td>
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<tr>
<td></td>
<td>Hepatitis B 3</td>
</tr>
<tr>
<td></td>
<td>Hib 3</td>
</tr>
<tr>
<td>At 9 months</td>
<td>Measles 1</td>
</tr>
<tr>
<td>At 18 months</td>
<td>Oral polio 4 (OPV4)</td>
</tr>
<tr>
<td></td>
<td>DPT 4</td>
</tr>
<tr>
<td></td>
<td>Measles 2 or MMR (measles, mumps, rubella)</td>
</tr>
<tr>
<td>At 5 years</td>
<td>Oral polio 5 (OPV 5)</td>
</tr>
<tr>
<td></td>
<td>DT 5 (diphtheria, tetanus)</td>
</tr>
</tbody>
</table>

**Table 2.1: The schedule for the immunisation of children in South Africa**

### 2-9 Why is it important to give immunisations at the recommended time?

1. If an immunisation is given too early (e.g. if measles immunisation is given at 3 months), the infant may not develop the expected resistance to the illness due to the immune system still being too immature to respond fully.
2. If an immunisation is given too late (e.g. not giving measles immunisation at 9 months), the infant may develop that illness before the immunisation can be given.
3. If immunisations are given too soon after the previous immunisation (e.g. if DPT immunisations are given a week apart), the infant may not develop the expected resistance to the illness.
All the most important immunisations should be given by the time the child reaches 9 months of age.

**It is important to give immunisations at the recommended time according to the immunisation schedule.**

2-10 What should be done if immunisations are missed or never started?

This depends on how old the child is and what immunisations have been missed.

If the immunisation schedule was not started when it should have been, immunisations can be started immediately with the normal time intervals between immunisations, e.g. the second DPT would follow 4 weeks after the first.

However, some immunisations may not be given as they are no longer needed or they are not safe in an older child:

- Pertussis vaccine is not given after 18 months.
- Hib and BCG are not given over 1 year.
- Measles need not be repeated if it is given after 18 months.

If immunisations were started correctly, but later immunisations were missed, these can be given using the normal time intervals between immunisations. If the immunisation schedule is interrupted it need not be started again from the beginning.

2-11 Why are immunisations opportunities often missed?

Many opportunities to immunise children are missed. This is a serious mistake as the child may become ill, or even die, from a preventable disease. Children often visit doctors or attend clinics or hospitals without being immunised because of stock shortages, because the child’s immunisation status is not checked on the Card or because it is too much trouble to give the correct immunisations.

Whenever a child visits a doctor or clinic, the opportunity must be used to detect and give missing immunisations. In addition, a visit to a doctor or nurse often exposes an unimmunised child to other children with preventable infections such as measles. It is important to look at the infant’s immunisation record in the Road-to-Health Card at every visit to a clinic or hospital and to make sure that all the recommended immunisations have been given. Outstanding immunisations must be given immediately before the child goes home.

Opportunities for immunisation are also lost when health facilities do not offer immunisation services every day. Therefore, this essential service should be made available on a daily basis at all clinics and hospitals where children are managed.

A child may develop a serious infection as the result of a missed immunisation.

2-12 How should immunisations be recorded?

It is very important that all immunisations are carefully recorded on the infant’s Road-to-Health Card. Both the type and the date of the immunisation must be recorded. It is an essential and important part of primary health care to record all immunisations carefully. Even though DPT and Hib are given as a single injection, they must be recorded separately on the card. The Road-to-Health Card is the official immunisation record needed for clinic visits, hospital admission and attendance at crèche and school.

2-13 What should be done if the Road-to-Health Card is lost?

All mothers have the right to carry a Road-to-Health Card. If the card is lost or destroyed, the mother should be given a new card, clearly marked as a duplicate. All available information must be entered. The mother should be asked whether the infant has been immunised and which immunisations have been given. If she can give a good account
of her child’s immunisations or if they are recorded in the clinic records, these should be entered in the new card and do not need to be repeated. If she is uncertain of the child’s immunisation history, the missing immunisations should be repeated. It is not dangerous to repeat an immunisation, provided that the child is not too old.

2-14 Should infants born to HIV-positive women be immunised?

Yes. It is particularly important that these infants are immunised as they are at high risk of infections if they later develop AIDS. The immune system of infants born to HIV-positive women is usually normal in the first few months after delivery. This provides an opportunity for routine immunisations to be given, even to those children who have been exposed or infected with HIV. However, most infants born to HIV-positive women are not infected with HIV. All immunisations can be given according to the normal schedule to HIV-exposed infants provided they have no clinical signs of HIV infection.

2-15 Should infants with HIV infection be immunised?

Infants who are known to be infected with HIV but have no clinical signs of HIV infection (and a normal CD4 count) should be immunised. There is no danger giving them most live vaccines such as polio and measles as their immune system is still functioning normally. However, BCG should not be given.

In contrast, infants with clinical signs of HIV infection should not be given any live virus vaccines, such as BCG, oral polio and measles, but should receive the other routine immunisations. Giving BCG to infants with HIV infection may result in a generalised infection with BCG as their immune system is damaged and not able to control the spread of BCG. Children with AIDS on antiretroviral therapy may benefit from waiting until the CD4 count is normal before giving measles and OPV immunisations.

NOTE Infants with immunosuppression due to other causes, such as leukaemia or cytotoxic drugs or large doses of steroids should not be given live vaccines (e.g., polio and measles). They must be protected from exposure to these illnesses.

Infants who are exposed to HIV but are otherwise well should receive routine immunisations.

2-16 Should malnourished infants be immunised?

Yes. Malnutrition (undernutrition) is not a contraindication to immunisation. Even children with severe malnutrition (kwashiorkor or marasmus) should be given the routine immunisations. Measles immunisation can be given when these children are admitted for care. The rest of the immunisation schedule must be started before discharge home. It is important to make sure that they will receive all the routine immunisations.

2-17 Should small or sick newborn infants be immunised?

Low birth weight (less than 2500 g) or sick newborn infants should be given BCG and polio vaccine when they are well enough to be discharged home from hospital. By this time some preterm infants may already be a few months old. After discharge they can follow the routine immunisation schedule. If a preterm infant is older than 6 weeks when it is discharged home, the routine 6 week immunisations can be given at discharge and then repeated at 4 week intervals. It is rare that preterm infants need immunisation before they are ready for discharge.

2-18 Should routine immunisations be given to a sick child?

There are very few general contraindications to immunisation. Infants with a skin rash or minor illness such as a ‘cold,’ cough or mild fever below 38 °C should be immunised. If the infant has diarrhoea when OPV is due, give
OPV but ask the mother to bring the child back for an extra dose of polio drops when the infant is again well. Mark on the card that an extra dose of OPV is needed due to diarrhoea. It is important to immunise sick and malnourished children to protect them against these illnesses. If a child is not immunised because of a minor illness, they may not be brought back later and the opportunity to immunise is lost.

Minor illnesses and malnutrition are not a contraindications to immunisation.

2-19 Can immunisations be safely given to an allergic child?

Yes. Allergic reactions to immunisations are rare, even in children with signs of allergy (e.g. eczema).

2-20 When are immunisations contraindicated?

There are very few contraindications to immunisations and serious thought must be given before deciding not to give a scheduled immunisation. Mild illness is not a contraindication. Neither is a skin rash or eczema. Antibiotics or allergic illnesses are also not contraindications. If an ill or malnourished child is well enough to go home, he/she can be immunised before going home.

An infant who is well enough to go home is well enough to be immunised.

Contraindications are:

1. A seriously ill child who needs hospitalisation can be given measles immunisation on admission. The other immunisations can be postponed and given when the child has recovered, but before discharge from hospital.
2. Live viruses (polio, measles and BCG) should not be given in infants with clinical signs of HIV infection (or a low CD4 count). However, all scheduled immunisations can be given if the infant is HIV positive without signs of HIV infection (and a normal CD4 count).
3. Live viruses should not be given to children with immunosuppression such as children with leukaemia or receiving cytotoxic drugs. Kwashiorkor, marasmus and low dose or inhaled steroid treatment are not contraindications.
4. DPT vaccine should not be given to infants with:
   • A high temperature (38 °C or above).
   • Fits or collapse within 3 days of a previous DPT immunisation
   • A serious progressive neurological abnormality such as repeated fits.
In these situations DT should be used instead of DPT.

2-21 Is immunisation safe?

Yes. Serious complications of immunisation are rare. However, mild fever and irritability are common, especially 6 to 12 hours after DPT immunisation. A mild fever, irritability and slight rash are common about a week after measles and MMR immunisation. These mild side effects can be treated with paracetamol (Panado) 6 hourly for 4 doses if needed (2.5 ml if under 1 year and 5 ml if 1 to 5 years). The benefits of immunisation are far greater than the risks. Therefore, as many infants as possible should be fully immunised.

Note: There is no evidence that immunisation increases the risk of cot death.

BCG IMMUNISATION

2-22 What is BCG?

BCG (Bacille Calmette Guerin) is a freeze-dried, live but weakened (attenuated) form of Mycobacteria, the bacteria which causes tuberculosis (TB). BCG reduces the risk of TB meningitis and disseminated (miliary) TB in young children. Unfortunately it is less effective in preventing pulmonary TB,
especially in malnourished children. It also gives less protection in adults.

**NOTE** In South Africa the Danish strain of BCG is being used.

### 2-23 How should BCG be stored and mixed?

BCG vaccine should be stored in a refrigerator (fridge) between 2 and 8 °C and must not be frozen. Keep it and the diluent on the middle shelf. It must also be kept out of direct sunlight. To prepare the vaccine for administration the vial of diluent should be added to the vial of dried vaccine. Do not use alcohol or ether to clean the top of the vial as it may kill the BCG. After making up the vaccine it will last for 6 hours if kept in a refrigerator or cool box.

### 2-24 When should BCG be given?

BCG should be given to well infants at birth and on the day of discharge from hospital or clinic to infants who have been ill or are low birth weight. If there is any doubt about whether BCG was given after birth, it should be given at 6 weeks with the first polio, DPT and hepatitis B vaccines. BCG is not usually given to children older than 1 year.

### 2-25 How is BCG given?

BCG is given by intradermal injection on the right upper arm as follows:

1. Inject 1 ml of diluent into the vial (brown) containing BCG. Gently turn the vial upside down at least five times until fully mixed. Do not shake.
2. The reconstituted BCG vaccine can be stored up to 6 hours in a refrigerator between 2 and 8 °C.
3. Draw up 0.05 ml of BCG vaccine in a sterile syringe (a special syringe to measure 0.05 ml accurately).
4. Clean an area of skin over the right deltoid muscle (upper arm) with soap and water.
5. Stretch the skin over the right deltoid muscle with your thumb and forefinger. Slowly insert the needle intradermally (bevel facing up). Insert the needle for less than 2 mm into the skin. The needle can be seen through the skin.
6. Inject the 0.05 ml of vaccine. A weal (raised lump) indicates that the intradermal injection has been given successfully. The most common error is to inject under the skin when no weal will be seen. With no weal, start again at a different site and inject into the skin.

### 2-26 What are the side effects of BCG immunisation?

In the majority of infants a raised nodule develops at the site of the immunisation after 2 to 4 weeks. A small crust may develop or it may ulcerate. The nodule will heal by itself and no dressing should be applied. After 8 weeks the nodule starts to decrease in size and by 6 months a small flat scar will form. The lymph nodes in the axilla on that side may enlarge slightly, which is normal. BCG immunisation does not always leave a scar in an infant. It is not necessary to repeat the BCG immunisation if no scar is seen.

The most common side effects are local pain and ulceration at the site of the immunisation and enlarged lymph nodes in the axilla and sometimes the neck.

Serious side effects which require referral are very rare. They include:

- An abscess may form at the site of the immunisation.
- Axillary lymph nodes may enlarge rapidly to more than 3 cm.

**NOTE** BCG lymphadenitis or local abscess must be reported to the local health authorities. Rarely suppurative adenitis may require needle drainage or a sinus may form. Antituberculous treatment is seldom needed (usually in immunocompromised children only).

### 2-27 What are the contraindications to BCG immunisation?

BCG can be given to HIV-exposed infants but not infants with HIV infection, especially if clinical signs of HIV infection are present. It is not used over one year of age.
POLIO IMMUNISATION

2-28 Which polio vaccine is used?
Both live, oral (Sabin) and killed, intramuscular (Salk) vaccines can be used to protect against polio. In South Africa the trivalent live oral polio vaccine is used. It has been weakened (attenuated) to give immunity (against all 3 strains of polio virus) without causing clinical infection. The killed vaccine is equally effective as the live vaccine. Only the oral vaccine is used in South Africa. It is hoped that universal immunisation will eradicate polio as has happened to smallpox.

NOTE Live (oral) attenuated polio vaccine was introduced in 1962. It is excreted in the stool and can infect others asymptptomatically and thereby boost the immunity of the whole community. It is best used in communities where wild polio virus may still occur. With the elimination of clinical polio, the inactivated (intramuscular) Salk vaccine can be used instead as part of a single combination vaccine (e.g. DPT/ Hib/ inactivated polio). The Salk vaccine avoids the rare cases of oral polio vaccine induced paralysis.

2-29 How should polio vaccine be stored?
Live polio vaccine must always be kept cold to avoid heat killing the virus. In a standard clinic or hospital refrigerator it should be stored at 2 to 8 °C. Direct sunlight kills the vaccine. Keep the vial of vaccine cool in a home refrigerator or cool bag while it is being used. It can be safely kept in this way for up to 30 days.

NOTE Polio vaccine can be stored for years at –20 °C or for one year at –10 °C.

2-30 How is live polio vaccine given?
Two drops are given directly into the infant’s mouth from the plastic dropper bottle. If the drops are spat out or vomited the dose should be immediately repeated. It is not necessary to avoid either a bottle or breastfeed before or after giving the vaccine.

NOTE Usually, the trivalent vaccine, which includes types 1, 2 and 3 polio virus is used. Live Sabin vaccine should not be given to immunosuppressed children, e.g. children with AIDS.

Usually, a single dose of polio vaccine is given at the same time as BCG after delivery and then a further 3 doses are given with DPT vaccine at 6, 10 and 14 weeks. Follow up doses (boosters) are given at 18 months and 5 years.

2-31 Should oral polio immunisation be given to a breastfeeding infant?
Breastfeeding is not a contraindication to immunisation. There is no need to avoid a breastfeed before or after giving oral polio immunisation.

Breastfed infants can be given oral polio immunisations.

2-32 What are the contraindications to polio immunisation?
Only the killed (Salk) vaccine can safely be used in children with symptomatic HIV infection. However, the live vaccine is safe in infants who are HIV infected but well.

Polio vaccine can be given to children with diarrhoea and vomiting but an extra dose should later be given as the diarrhoea or vomiting may prevent successful immunisation.

NOTE Very rarely (1 in 500 000), paralysis can follow use of oral Sabin polio vaccine. This does not occur with the killed Salk vaccine. All cases of acute flaccid paralysis must be notified to determine whether polio has been eradicated.

IMMUNISATION AGAINST DIPHTHERIA, PERTUSSIS AND TETANUS (DPT)

2-33 What is DPT vaccine?
It is a combined vaccine against diphtheria, pertussis and tetanus. Pertussis is another name for whooping cough. The vaccine contains both
diphtheria and tetanus toxoids, as well as killed pertussis (whooping cough) bacteria.

Toxoids are inactivated toxins. Toxins are produced by the diphtheria and tetanus bacteria and cause most of the clinical signs in these infections. Toxoids stimulate the body to produce immunity to these toxins.

2-34 How should DPT vaccine be stored?

In a refrigerator or cold box at 2 to 8 °C. Do not freeze DPT vaccine as this damages the vaccine. Avoid direct sunlight as this may also damage the vaccine. It is best to keep DPT on the middle shelf of a fridge.

Do not freeze DPT as this damages the vaccine.

2-35 How is DPT vaccine given?

1. The 10 ml vial of DPT vaccine is ready to use. Shake the vial well and draw 0.5 ml of the vaccine into a syringe. Use a new 23 gauge needle for each child. Never use the same needle for more than one child.
2. Clean an area over the skin on the outer side of the left thigh (upper leg) with an alcohol swab (NOT buttocks).
3. Inject 0.5 ml of the vaccine intramuscularly.

Three doses of DPT vaccine are given together with polio vaccine at 6, 10 and 14 weeks. A follow up (booster) dose is given with polio vaccine at 18 months.

2-36 What are the side effects of DPT immunisation?

- Mild redness, tenderness and swelling at the site of the injection for a few days.
- A mild fever and irritability for a few days is common.
- Rarely serious side effects may occur to the pertussis vaccine.

Minor side effects to DPT immunisation are common and are not a contraindication to further immunisations.

If infants are not fully immunised with DPT because of minor side effects, they may later develop diphtheria, whooping cough or tetanus which remain very serious illnesses.

The side effects can usually be managed with paracetamol 6 hourly for 2 days.

2-37 What are the possible serious reactions to pertussis immunisation?

Very rarely, fever above 40.5 °C, fits, collapse and shock, severe irritability with persistent crying and screaming attacks or drowsiness, confusion and brain damage (encephalopathy) may follow pertussis immunisation. The risk of fever and fits is one in a thousand infants immunised with pertussis vaccine while the risk of encephalopathy is one in a million. If a serious reaction occurs, pertussis vaccine must not be given again.

A new, safer, cell-free pertussis vaccine, with fewer local and systemic side effects, is now available. However, parents have to pay for this as it is expensive.

Note: Fever above 40.5 °C within 2 days, fits within 3 days or encephalopathy within 7 days of DPT immunisation must be reported to the local health authorities.

2-38 When should pertussis vaccine not be given?

Pertussis immunisation should not be given to the following infants:

- A progressive central nervous system disease such as uncontrolled epilepsy. Children with mental retardation or cerebral palsy can be given routine immunisations including DPT as these are not progressive condition.
- Infants who have had a severe reaction or clinical signs of encephalopathy within 7 days of a previous DPT immunisation, e.g. persistent screaming, collapse, drowsiness, confusion, fits or a fever over 40.5 °C.
- Usually, pertussis vaccine is not given to children over the age of 18 months as the risk of severe reactions to pertussis vaccine...
increases with age. These infants should be given DT vaccine instead.

Mild fever and redness with some pain is common with DPT immunisation and are not contraindications to future immunisations. A family history of convulsions is also not a contraindication. Neither are cerebral palsy and Down Syndrome.

Pertussis vaccine should not be given if the child had a severe reaction to a previous DPT immunisation.

2-39 What is DT vaccine?
DT vaccine contains a reduced dose of tetanus and diphtheria vaccine and no pertussis vaccine. It is given together with polio vaccine at 5 years. The method of storing and giving DT vaccine is the same as that for DPT vaccine. The dose is 0.5 ml intramuscularly. Tetanus immunisation should also be given after an injury, especially if the wound is contaminated with soil. Usually, this is not needed if tetanus immunisation has been given within the past 5 years.

**NOTE** It is important that all pregnant women have received tetanus immunisation as this protects newborn infants against neonatal tetanus. If not, they should be immunised during the pregnancy with pure tetanus toxoid (TT), 3 doses given one month apart. In areas where neonatal tetanus still occurs, women who have been previously immunised against tetanus should be given a single booster dose of tetanus vaccine during pregnancy. Tetanus immunisation is safe during pregnancy as it is a toxoid and not a live vaccine.

2-40 Why is pertussis vaccine not given after 18 months?
Because whooping cough is a far less serious illness in older children and the risk of side effects increases after 18 months.
Unfortunately, infants often get infected with measles when they come into contact with other children at health clinics, outpatient departments or in hospital wards. Any infant of 9 months or more who visits a clinic or hospital and does not have measles immunisation documented on their Road-to-Health Card should immediately be given a dose of measles vaccine.

**NOTE** During an epidemic of measles, if many young infants are contracting the infection, measles immunisation is sometimes given at 6 months and then repeated at 9 months to offer some protection to infants between 6 and 9 months. Measles immunisation is usually ineffective before 6 months.

**2-45 What are the complications of measles immunisation?**

A mild fever about 7 days after the immunisation occurs in up to 25% of children. Less commonly a faint rash may occur.

**2-46 What are the contraindications to measles immunisation?**

It should not be given to children with untreated tuberculosis. These children can receive measles immunisation once the TB treatment has been started. Mild fever, ‘colds’ or influenza, otitis media, bronchitis or diarrhoea are not contraindications to measles immunisation.

**NOTE** A previous anaphylactic reaction to measles or MMR immunisation may be due to egg allergy. This is a contraindication to further immunisation with measles or MMR vaccine.

**2-47 What is MMR vaccine?**

Often vaccines against measles, mumps and rubella are given together (MMR vaccine) at 18 months instead of measles vaccine alone. Although more expensive than measles vaccine, MMR offers important protection against meningitis, which may complicate mumps, and serious congenital abnormalities in the fetus, which may complicate maternal rubella during pregnancy.

Although not yet part of the EPI policy, children who received MMR at 18 months should be given a second dose of MMR when they start school (however the parents will have to pay). MMR vaccine needs to be kept cold during storage in the same way as measles vaccine. The dose and method of administration is the same as measles vaccine.

**NOTE** Children who are immunised twice with MMR will have lifelong immunity against rubella and, thereby, avoid the risk of congenital rubella in their infants. Likewise, MMR gives protection against mumps, which avoids the risk of orchitis and resultant sterility in boys in later life.

**IMMUNISATION AGAINST HEPATITIS B**

**2-48 What is hepatitis B?**

Acute infectious hepatitis (infection of the liver) is caused by a number of different viruses. The hepatitis B virus may cause a severe form of hepatitis, which can result in liver failure. This virus may also cause chronic liver infection resulting in cirrhosis or cancer of the liver years after the person becomes infected. Following hepatitis B the person may remain infectious for many years and spread the infection to their children and other family members (i.e. they are a hepatitis B virus ‘carrier’). Hepatitis B is common in poor countries. Although the vaccine is expensive, immunisation against hepatitis B is, therefore, important in developing countries.

**NOTE** Hepatitis B immunisation has already resulted in a falling rate of liver cancer in some countries.

**2-49 When and how is hepatitis B vaccine given?**

Hepatitis B vaccine (HepB) 0.5 ml is given by intramuscular injection into the right thigh in 3 doses at 6, 10 and 14 weeks at the same time as polio and DPT immunisations. HepB vaccine must be stored in a fridge.
2-50 What are the side effects of hepatitis B vaccine?
These include mild fever, pain and local swelling but are very uncommon.

2-51 What is the management of an infant born to a mother who is infected with hepatitis B?
People with either acute or chronic hepatitis B virus infection have pieces of viral protein, called hepatitis B surface antigen (HbSAg), circulating in their blood stream. These people often excrete the virus and may spread the infection to others. Infants are at high risk of infection during a vaginal delivery if the mother is excreting the virus. Therefore, infants born to women who have hepatitis B during pregnancy or are HbSAg positive (i.e. have a chronic viral infection) need special management at delivery to protect them against infection. These infants should receive 0.5 ml of hyperimmune hepatitis B immunoglobulin by intramuscular injection with 72 hours of delivery. They should also receive a dose of hepatitis B vaccine. This should be followed by the standard schedule of hepatitis B immunisation at 6, 10 and 14 weeks.

IMMUNISATION AGAINST HAEMOPHILUS INFLUENZAE

2-52 What is Haemophilus influenzae?
*Haemophilus influenzae* B (Hib) is a bacterium which can cause serious and often fatal infections in childhood, especially meningitis, pneumonia and epiglottitis (a severe infection of the throat and epiglottis which often obstructs the upper airway). Children under 2 years are most at risk.

2-53 What is Hib vaccine?
An effective vaccine against Haemophilus is now available (the Hib vaccine) and is part of the South African national immunisation schedule. Unfortunately it is expensive and, therefore, has still not been included into the immunisation schedules of some poor countries. In South Africa, DPT and Hib vaccines are available as a combined vaccine. Hib vaccine has few side effects.

2-54 How is Hib vaccine stored?
In a refrigerator at 2 to 8 °C. A cold box can be used to move vaccines to a clinic.

2-55 When and how is Hib vaccine given?
Hib vaccine 0.5 ml is given by intramuscular injection into the outer part of the left thigh in 3 doses 4 weeks apart. It is most convenient to give it together with polio and DPT vaccines at 6, 10 and 14 weeks. In South Africa it is combined with DPT and given as a single injection.

2-56 Which other immunisations are available?
Other immunisations are available but are not given routinely. For example, influenza vaccine should be offered to children with serious chronic lung diseases. Influenza vaccine must not be confused with Hib vaccine.

**NOTE** Pneumococcal, varicella (chicken pox) and hepatitis A vaccines may be included in the immunisation schedule in future. Yellow fever vaccine is needed for international travel while rabies vaccine is given to children exposed to a bite from a rabid animal. To protect children, who have been exposed to serious infections, specific immunoglobulin is sometimes used. For example, hyperimmune immunoglobulin can be offered to children exposed to hepatitis B virus. The use of immunoglobulin is not as effective as immunisation as the protection is short-lived.

2-57 Why is a booster dose of vaccine given?
Some vaccines (polio, DPT and measles) are repeated at 18 months as a follow up or booster immunisation. This makes sure that the body develops immunity against these important infections. At 5 years children are given a further booster dose of polio and DT (but not pertussis) before they start school.
2-58 Why are some immunisations given on the left and others on the right side of the body?

By convention, BCG is given into the skin over the right deltoid. This helps to find the scar.

DTP and Hib are given into the left thigh or into the left deltoid in older children. The vaccines can be combined and given together as they do not interfere with each others’ action.

Hepatitis B is given into the right thigh as it is best not given at the same site as Hib.

Measles is usually given into right thigh or right deltoid in older children.

New, special vaccines consisting of combinations DPT, Hib, HepB and killed polio can be given together. Single vaccines must not be combined in the same syringe (except DPT and Hib).

2-59 What equipment is used to give intramuscular immunisations?

Usually, a 1 ml syringe is used with a 23-gauge needle to give immunisations into the deltoid or thigh muscles. Injections are never given into the buttocks of infants. Never re-use syringes or needles.

2-60 What is ‘herd immunity’?

If enough children in a community are immunised against an infection, that infection will no longer be passed from one child to another. The few non-immunised children are then partially protected as they are unlikely to be exposed to that infection. As a result, the whole community (herd) is protected against that infection (herd immunity). It is, therefore, of benefit to the whole community when a child is immunised. Due to the high immunisation rate, some infections such as smallpox have disappeared. The goal in South Africa is to have 90% of all children fully immunised.

2-61 Which infectious diseases in children are notifiable?

In South Africa all the childhood diseases, for which vaccines are routinely given, are notifiable. This helps to monitor the number of cases still occurring and also enables the health authorities to control any outbreaks with mass immunisation. This is particularly important for any case of suspected polio.

Cases of measles, polio, neonatal tetanus and diphtheria are now rare in South Africa while smallpox was eradicated worldwide in 1975.

2-62 What are mass immunisation campaigns?

These are arranged separately to the routine immunisations programme, and are once-off events to increase the number of immunised children in a region and, thereby, help to eradicate the disease. They are used in regions or whole countries where the immunisation rates are low and also to control unexpected outbreaks of one of the important infectious diseases. Mass immunisation campaigns have been very effective against measles and polio.

2-63 What is important about storing and handling vaccines?

All live vaccines (BCG, polio, measles, MMR vaccines) must be kept correctly stored or they will be damaged. Sunlight, the incorrect temperature and antiseptics damage vaccines. In a clinic, all should be stored in a refrigerator between 2 and 8 °C (not in the freezer compartment) and kept in a cool bag during handling. Only polio vaccine can be safely kept frozen during storage for long periods. Freezing damages other vaccines.

Live vaccines, which have been frozen in error, have a granular appearance with a deposit on standing, and must be discarded.
Avoid direct sunlight and do not use alcohol or ether to clean vials of live vaccines or the skin as this may kill the vaccine. If necessary, the skin can be cleaned with soap and water. Only draw up the vaccine into the syringe when you are ready to give it. The vaccines often come in brown vials to protect them from the light. All vaccines have an expiry date, and must not be used after the expiry date.

Polio vaccine has a heat sensitive spot on each vial. Normally the dot is white but it darkens if the vaccine is not kept cool correctly. If the dot is the colour of the surrounding circle, or darker, it is damaged and must not be used.

2-64 What is ‘the cold chain’?

Not only do vaccines need to be kept cold during storage but they must also be kept cold during handling. When live vaccines are moved from the central cold store to a clinic or hospital they should be moved in a cool box. They should also be kept in a cool box in the clinic after the vial has been opened. Vaccines must be kept cool continuously at 2–8 °C. Measles and MMR are commonly inactivated by not being kept cool continuously. From the time the vaccine is produced to the time it is given it must be kept cold. The chain of travel from factory to store to health clinic to patient is called the cold chain. If possible, vaccines should be kept in a separate vaccine fridge at the health facilities. There must be a temperature chart on the vaccine fridge and the fridge temperature should be recorded twice a day. Where gas fridges are used a spare gas tank must be at hand. The expiratory date on vaccines is only valid if they have been kept cool during transport and storage.

2-65 What is the correct use of a vaccine fridge?

A dedicated fridge (the same type as that used in the home) with a freezer compartment and 3 shelves must be made available at every site where immunisations are given. The main section of the fridge must be kept at 2–8 °C while the freezer compartment will be below 0 °C. This fridge must be used for vaccines only. Medicines, drugs, formula feeds and food must not also be kept in the vaccine fridge as repeated opening and closing of the fridge door raises the fridge temperature and this may damage the vaccines.

The coolest part of the fridge that does not freeze is the top shelf (below the freezer compartment). This is the best place to store polio and measles vaccines. Other vaccines (BCG, Hib, DPT, DT, TT, HepB and diluents) are best stored on the middle shelf. A fridge thermometer must be kept on the middle shelf and the temperature measured and recorded daily. The thermostat of the fridge must be adjusted to keep the temperature between 2 and 8 °C. If the fridge is warmer or freezes, vaccines may be damaged.

Bottles of water should be stored on the bottom shelf as this helps to maintain the correct temperature in the fridge if there is a power failure. The freezer compartment can be used to freeze and store ice packs and ice cubes for use in cool boxes. The door must be kept closed at all times except when removing or replacing vaccines.

2-66 What is a cool box?

Keeping vaccines cold in rural regions and during transport is particularly difficult when a fridge is not available. Under these circumstances, a cool box is very useful. Usually, a cool box consists of a closable
polystyrene container. Frozen ice packs (they should rattle when shaken) are placed inside the cool box on the bottom and sides as well as under the lid.

Measles and polio vaccines should be placed at the bottom where it is coldest. The other vaccines can then be placed above them. Vaccines must never be allowed to freeze. Keep the top firmly on to protect the vaccines from sunlight.

2.67 What is an opened multidose vial policy?

To make sure that vaccines remain effective with as little wastage as possible, a policy of managing opened vials is needed. Opened vials can be used to withdraw a number of doses if they are stored correctly.

Open vials of DPT, DT, TT, HepB and OPV may be stored for up to 1 month provided the expiry date is not past, cold chain conditions have been maintained, and aseptic technique is used to withdraw doses.

Open vials of combined DPT and Hib vaccine can be kept for 7 days if the above conditions are met and the vaccine vial monitor has not reached discard point.

Open vials of measles and BCG must not be kept for more than 6 hours.

All opened vials must be discarded immediately if the aseptic procedures have not been followed or there is any suspicion that the vial is contaminated (a change in the normal appearance of the vaccine).

See the summary of the scheduled vaccines at the end of this unit.

CASE STUDY 1

During a woman's pregnancy, she and her husband ask the doctor whether it will be necessary for their infant to be immunised. They also want to know which immunisations are given straight after delivery and whether they would still be given if the infant were born prematurely and is breastfed. The mother mentions that she had hepatitis years ago and is known to be hepatitis B positive.

1. Why should the infant receive routine immunisations?

It is very important that all infants be immunised unless there is a medical reason not to do so. Immunisation protects the infant against many dangerous infections. Immunising children also helps to decrease the spread of that infection in the community.

2. What immunisations are given after delivery?

It is routine to give BCG and polio drops in the first few days after delivery. These immunisations should be given before an infant is discharged from the hospital or clinic.

3. Are immunisations given to preterm infants?

It is very important to give all routine immunisations to preterm infants. Usually, the BCG and first polio immunisations are given when the infant is ready for discharge from hospital. After discharge the routine immunisation schedule is followed.

4. Should breastfed infants be given oral polio drops?

Yes. Breast milk does not inactivate the live polio virus in the oral drops.

5. Would loose stools be a contraindication to polio immunisation?

No. However, the drops should be given again when the infant is well.

6. What should be done, as the mother is hepatitis B-positive?

As there is a high risk that the infant will be infected with the hepatitis B virus at or soon after delivery, the infant must be given 0.5 ml of hyperimmune hepatitis B immunoglobulin
by intramuscular injection within 72 hours after birth. In addition, the infant should be given a dose of hepatitis B vaccine after birth to be followed by the routine hepatitis B immunisations starting at 6 weeks.

**CASE STUDY 2**

A mother who is known to be HIV-positive delivers a clinically well infant at term. The staff tells her that her infant should not be immunised as it may already be infected with HIV. This will make immunisation dangerous.

1. **Should routine immunisations be given to infants born to HIV-positive mothers?**

Yes. It is particularly important that these infants are immunised as they are at high risk of infections if they later develop AIDS. The immune system of infants born to HIV-positive women is usually normal in the first few months after delivery, which gives an opportunity to safely give the routine immunisations. Most infants born to HIV-positive mothers are not HIV infected themselves.

2. **Should routine immunisations be given to healthy infants with HIV infection?**

Yes. These infants without clinical signs of HIV infection still have an intact immune system and should be given routine immunisations except BCG.

3. **Should infants with clinical signs of HIV infection be given routine immunisations?**

As these infants have a damaged immune system, they should not be given live vaccines such as BCG, oral polio and measles.

4. **What is the danger of giving BCG to an infant with symptomatic HIV infection?**

As these infants have a damaged immune system, they may develop a generalised infection with BCG.

**CASE STUDY 3**

A healthy 6-week-old infant is given her first DPT immunisation. The day after the immunisation the infant has a mild fever and is slightly irritable. She also has some pain and swelling at the site of the injection. The mother gives a history of febrile convulsions when she was a child. She also heard on the radio that DPT immunisation could cause mental retardation. Because of this mild reaction and the mother’s anxiety, the staff advises that no further DPT immunisations should be given.

1. **What does DPT stand for?**

Diphtheria, pertussis (whooping cough) and tetanus.

2. **At which site should the DPT injection be given?**

DPT should be given by intramuscular injection into the left thigh. In older children it can be given into the left deltoid muscle. *Never* give a child an injection into the buttock, because young children have little muscle over the buttock, and important nerves and blood vessels lie close under the skin and may be damaged.

3. **Are side effects common after DPT immunisation?**

Many infants have mild local tenderness and swelling at the site of the immunisation for a few days. Mild fever and some irritability are also common. If necessary the infant can be treated with paracetamol syrup 2.5 ml 6 hourly.

4. **Can DPT cause dangerous complications?**

Very rarely, DPT can cause a high fever (above 40 °C), severe irritability with screaming attacks, drowsiness, convulsions and mental retardation. The risk of severe complications is only 1 per million children.
5. **Should the second dose of DPT be given if the infant has mild side effects after the first dose?**

Yes. The second dose of DPT should be given at 10 weeks. If the infant has had a severe complication to the first dose of DPT, only DT should be given at 10 and 14 weeks and at 18 months.

6. **Should DPT be given if the mother had febrile convulsions as a child?**

It is important that DPT immunisation is still given. A family history of fits is not a contraindication to DPT immunisation.

7. **Is it recommended that DPT be given routinely at 5 years?**

No. At 5 years only DT should be given, as the chance of complications with pertussis vaccine is higher in older children (above 18 months).

**CASE STUDY 4**

A week after the second routine immunisation with measles at 18 months, an infant develops a mild fever and a fine pink rash, which lasts for 2 days. As the infant had a slight cough at the time of the immunisation, the mother is worried that the fever and rash may be dangerous.

1. **Is the mild fever and rash dangerous?**

About 25% of infants develop a mild fever after measles immunisations. A rash is less common. Both are not dangerous and resolve in a few days.

2. **What combined immunisation instead of measles alone can be given at 18 months?**

Measles, mumps and rubella (MMR vaccine). MMR vaccine should be repeated at 5 years.

3. **When should measles immunisation not be given?**

Measles immunisation should be delayed in children with untreated tuberculosis. Malnourished infants can safely be given measles immunisations. This is particularly important, as measles can be a fatal infection in malnourished children.

4. **Should the measles immunisation have been given to this infant with a mild cough?**

A mild illness, such as loose stools, cold or cough, is not a contraindication to immunisation. Infants who are well enough to go home are well enough to be immunised.

5. **Why is it important to record measles immunisation on the Road-to-Health Card?**

It is very important to note all immunisations on the Road-to-Health Card, as this is the official record of the child’s immunisation status. This is needed when the child is taken to another clinic or hospital and when the child is admitted to a crèche or play school.

**CASE STUDY 5**

A doctor notices that the fridge, which stores the vaccines in a clinic, is not working and that the vaccines are warm. He therefore cools the vaccines by placing them in the freezer compartment. He also notices that the expiratory date on some of the vaccines has been reached.

1. **Does it matter if vaccines are not kept cool?**

It is very important that all vaccines are kept cool, between 2 and 8 °C. Otherwise they will be damaged and possibly killed. The commonest cause of failure of immunisation to protect an infant is the incorrect storage of vaccine.
2. **Is it dangerous to freeze vaccines?**

With the exception of polio vaccine, freezing damages or kills vaccines. Exposure to sunlight also damages vaccines.

3. **What should be done with the vaccines, which were allowed to warm and were then frozen?**

They must be discarded. Vaccines should also be discarded if the expiratory date has been passed.

4. **What is meant by the ‘cold chain’?**

This is the method that keeps vaccines cold from the time of manufacture until they are given to the patient. The cold chain makes sure that the vaccines are not damaged by becoming warm. A vaccine, especially measles vaccine, may not be effective if the cold chain has been broken.

5. **What can be done to keep vaccines cool if the clinic cannot afford a fridge?**

A cool bag or cool box can be used to keep vaccines cool for a few hours. When used for an immunisation clinic, this is adequate.

**IMMUNISATION REFERENCES**

See the following pages for:

- A summary of immunisations routinely used
- An immunisation record
<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Description</th>
<th>Storage</th>
<th>Administration</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BCG</strong></td>
<td>Live attenuated Bacillus Calmette Guerin</td>
<td>2–8 °C Store on middle shelf</td>
<td>0.05 ml intradermal Right upper arm</td>
<td>Should not be given in children over 1 year. Do not give if symptomatic HIV. Small ulcer after a few weeks common</td>
</tr>
<tr>
<td>DPT</td>
<td>Diphtheria Pertussis Tetanus</td>
<td>2–8 °C Store on middle shelf</td>
<td>0.5 ml intramuscular Left thigh up until 1 year Left upper arm if over 1 year</td>
<td>Mild fever, pain, local swelling common Not used after 18 months</td>
</tr>
<tr>
<td><strong>DT</strong></td>
<td>Diphtheria Tetanus</td>
<td>2–8 °C Store on middle shelf</td>
<td>0.5 ml intramuscular Left thigh up till 1 year Left upper arm if over 1 year</td>
<td>Mild fever, pain, local swelling common</td>
</tr>
<tr>
<td><strong>HepB</strong></td>
<td>Hepatitis B</td>
<td>2–8 °C Store on middle shelf</td>
<td>0.5 ml intramuscular Right thigh up until 1 year Right upper arm if over 1 year</td>
<td>Mild fever, pain and local swelling occasionally</td>
</tr>
<tr>
<td>Hib</td>
<td>Haemophilus influenza B</td>
<td>2–8 °C Store on middle shelf</td>
<td>0.5 ml intramuscular Left thigh – usually as combined DPT Hib Vaccine</td>
<td>Usually, no side effects</td>
</tr>
<tr>
<td><strong>Polio (OPV)</strong></td>
<td>Oral Polio Vaccine</td>
<td>2–8 °C Store on top shelf Can use if inner square lighter than outer circle</td>
<td>Two drops by mouth If vomited or spat out can repeat immediately If diarrhoea repeat dose when diarrhoea settled</td>
<td>Mild flu like illness or mild diarrhoea may occur</td>
</tr>
<tr>
<td><strong>Measles</strong></td>
<td>Measles vaccine</td>
<td>2–8 °C Store on top shelf Discard open vial after 6 hours</td>
<td>0.5 ml intramuscular Right thigh up until 1 year Right upper arm if over 1 year</td>
<td>Mild fever or transient red rash are not uncommon 6–11 days post immunisation High fever is uncommon Encephalitis is extremely rare</td>
</tr>
</tbody>
</table>
Growth and development

Objectives

When you have completed this unit you should be able to:

• Measure the size of a child to assess growth.
• Know the value of growth monitoring.
• Use centile charts and growth curves.
• Understand different growth patterns.
• Identify obese children.
• Use the growth chart on the Road-to-Health Card.
• Assess neurodevelopment.

INTRODUCTION

3-1 What is growth?

Growth is the increase in body size over a period of time. In order to assess growth, some measure of body size has to be accurately measured on two or more occasions.

Growth is the increase of body size over a period of time.

Growth is best assessed by determining the child's:

• Size compared to other children of the same age
• Growth curve
• Growth pattern

MEASURING BODY SIZE

3-2 How is body size determined in children?

The following 3 measurements of body size are commonly used in children:

1. Weight: This is the most commonly used measure of body size as it is easy and accurate to weigh a child.
2. Height or length: This is a very useful measure of size, especially in older children. However, it is more difficult to measure accurately. Height is measured with the child standing. In infants the measurement is taken lying down and is then called length. A child's length and height are the same.
3. Head circumference: This is also a useful measure of size but must be measured correctly.

Weight is the most common way of assessing body size in children.
3-3 How is weight measured?

Young children are weighed when lying on a scale. Wait until the child lies still before recording the weight to the nearest 10 g. Always weigh the child undressed or wearing only a vest. Always remove the nappy before weighing.

Older children are weighed standing up. Record the weight to the nearest 100 g (0.1 kg). Remove all the child’s clothes, except the underpants, before weighing.

Before weighing a child, always check that the scale reads zero. Scales should be calibrated weekly.

Note: When weighing an infant on a spring scale, or an older child on a bathroom scale, you are measuring weight. A balance scale measures mass. Both are equal and expressed in kilograms.

3-4 How are height and length measured?

Height must be measured with the child standing barefoot. Keep both heels on the floor with the child’s back pressed against a wall. The child should stretch as tall as possible with the arms kept at the side while looking straight ahead. Move a square block of wood or a book down against the wall until it touches the top of the child’s head. Then measure the distance from the floor to the block of wood, to the nearest 1 mm, to get the correct height. Ideally, a special measuring device should be used, with a fixed tape or ruler on the wall and a sliding head board.

Under 2 years: It is difficult to measure an infant’s standing height. Therefore, the lying length is measured. If possible, a measuring board should be used. The infant is laid down on his/her back with legs fully extended. One person holds the infant’s head against the top board while another person gently stretches the infant’s legs, keeping the knees flat and pressing the heels of the infant’s feet against the bottom board. Measuring the distance, to the nearest 1 mm, between the boards gives the length of the infant. It is inaccurate to simply measure length with a tape measure.

For convenience, height is used in this unit. However, whatever is said about the height of older children, applies equally to the length of infants and young children.

3-5 How should head circumference be measured?

It can be difficult to measure head circumference accurately. Use a measuring tape and record to the nearest 1 mm. Measure the largest circumference of the head (occipito-frontal circumference) with the tape across the forehead and then around to the back of the head (occiput).

3-6 How often should the size of children be measured?

Weight should be measured and recorded every month for the first year of life, as young children grow fast.

- Children should be weighed every 6 months between 1 and 5 years.
- Height should be measured every year.
- Head circumference is not routinely measured unless there is a good reason.

In addition, a child’s weight should also be measured and recorded every time the child is seen at a clinic, hospital or by a general practitioner.

3-7 How is a child’s size used to assess growth?

The best method to assess growth is to measure the child’s size (e.g. weight) and then to repeat the measurements a few months later. The increase in size is due to growth. The greater the increase, the faster the child is growing. If there is no increase, the child is not growing. For this reason it is important to record a child’s size and plot the measurements on a growth chart at every clinic visit.
THE IMPORTANCE OF GROWTH MONITORING

3-8 What is growth monitoring?

Growth monitoring is the regular measurement of a child’s size in order to document growth. The child’s size measurements must then be plotted on a growth chart. This is extremely important as it can detect early changes in a child’s growth. Both growing too slowly or too fast may indicate a nutritional or other health problem. Therefore, growth monitoring is an essential part of primary health care in children. Measuring a child’s size is of very little value unless it is used for growth monitoring.

3-9 What is the value of weight in growth monitoring?

Weight-for-age is usually used to monitor growth. It is particularly useful in small infants who normally gain weight fast. Normal weight gain suggests that the infant is healthy and growing normally. Failure to gain weight normally is often the earliest sign of illness or malnutrition (i.e. undernutrition). Therefore, a child’s weight should be measured at every clinic visit in order to monitor growth.

3-10 What is the value of measuring height and head circumference?

These are also important measurements of growth. Height is the best method of measuring linear growth (stature) as height reflects growth over a longer period than does weight. Measuring height is therefore important in older children.

Head circumference can be used to assess brain growth in children under 2 years. During this period brain growth is fast and, therefore, head circumference increases rapidly. A small head (microcephaly) suggests a small brain, while a large head suggests hydrocephaly. Head circumference is less accurate in assessing brain growth over 2 years of age.

Therefore, measuring head circumference is most useful in young children, and height in older children.

If a child’s weight gain is normal, the height and head circumference is usually also normal. However, it is particularly important to measure height and head circumference in children who are not gaining weight normally.

3-11 Can an infant’s growth be determined at a single clinic visit?

No, as the definition of growth is a change in body size over a period of time. Therefore, some other form of assessment of growth is needed when you cannot wait a few weeks or months to decide whether the child is growing normally or not. An assessment of growth can be made if the size of a child is compared to the size of other children of the same age. In order to do this, the normal (i.e. average size) range of children of that age is needed. If the child’s size is the same as most other children of the same age, then the child is probably growing normally. The most commonly used growth charts are centile charts.
CENTILE CHARTS

3-12 What is a centile chart?
A centile chart is a size-for-age chart that is used to decide whether the size of a child falls within the normal (average) range or whether the child is larger or smaller than normal. The size of a healthy child will increase normally with age. Without knowing a child’s age, one cannot decide whether the size is normal or not. Therefore, accurate ages are needed when using a centile chart.

A centile chart is based on the size measurements of thousands of healthy children recorded at different ages. A centile chart is made up of lines called centiles. The growth of healthy children usually follows the centile lines.

NOTE With increasing age, the centiles move further and further apart, as some normal children grow faster and others slower than the average. As a result, the normal range becomes wider. Boys are slightly larger than girls. However, the same charts are often used for both boys and girls when routinely plotting size-for-age.

3-13 What are the important centiles on a centile chart?
Most centile charts have 7 centile lines on them, i.e. the 3rd, 10th, 25th, 50th, 75th, 90th and 97th centiles. Ninety seven percent of healthy children will fall below the 97th centile. Similarly 50% of healthy children will fall below the 50th centile and 3% below the 3rd centile. Therefore, each centile indicates what percentage of healthy children should have a size that falls below that line. This method enables one to compare the size of any child with the expected size of children of the same age.

NOTE If 100 healthy children of the same age were lined up from the tallest to the shortest, the height of the tallest child would be the 100th centile, that of the second tallest the 99th centile, and so on. The height of the child at the centre of the row would be the 50th centile. It is called a centile chart as it reflects the relative size of 100 normal children, and ‘centum’ is the Latin word for a hundred. International centile charts are used in all countries.

3-14 What is the normal size for children of a given age?
The size of most children (94%) falls between the 3rd and the 97th centiles. These children are regarded as having a normal (average or appropriate) size for their age and are growing well. Centile charts, therefore, indicate the range of normal growth.

The range of size between the 97th and 3rd centiles is regarded as normal.

NOTE The size range for older children is different to that in newborn infants when the 10th and 90th centiles are used to define appropriate size for gestational age.

3-15 What size measurements are usually plotted on a centile chart?
Weight, height (or length), head circumference and weight-for-height can all be plotted on a centile chart. Weight is the measurement most commonly plotted on a centile chart. International centile charts are shown at the end of this unit.

3-16 When is a child larger than normal?
When the infant’s size measurement falls above the 97th centile. Children are heavier than normal if their weight is above the 97th centile. Similarly, they are taller (longer) than normal if their height (length) falls above the 97th centile. They have bigger heads than normal if their head circumference falls above the 97th centile.

3-17 When is a child smaller than normal?
When the infant’s size measurement falls below the 3rd centile. Children are underweight if their weight is below the 3rd
centile. Similarly, children are shorter than normal if their height (length) falls below the 3rd centile. They have smaller heads than normal if their head circumference falls below the 3rd centile.

**Note** 3% of normal children fall above the 97th centile and 3% below the 3rd centile. Therefore, the size of 6% of children falls outside the normal (i.e. average) range, i.e. above the 97th or below the 3rd centiles. Note that ‘normal’ refers to the average range of size for age. Therefore, some perfectly healthy children might fall outside the 3rd and 97th centiles.

Recently Z-scores (standard deviations from the mean) have also been used to assess a child’s size. A Z-score of –2 is equivalent to the 3rd centile.

**Figure 3.1: Plotting a child’s weight on a centile chart**

3-18 How should you plot a child’s weight on a centile chart?

1. Make a mark along the bottom of the chart opposite the age of the child. Now draw an imaginary vertical line up from the mark.
2. Similarly, make a mark opposite the child’s weight along the left or right hand side of the chart. Now draw an imaginary horizontal line from that mark.
3. Make a dot at the point on the chart where the two imaginary lines meet. This is called plotting the weight. It will give the child’s weight for its age.

The same method is used to plot the infant’s height (or length) and head circumference on centile charts.

At the first visit it is helpful to fill in the calendar months along the bottom of the chart.
centile chart, starting with the month in which the child was born. This is done so that further growth is easily plotted.

3-19 Can length and height both be plotted on the same chart?

Yes. As a child gets older height can be plotted on the chart used before to plot length. For practical purposes, the measurement of length is the same as height.

3-20 What is the value of knowing a child’s weight-for-height?

The weight-for-height gives an idea of how fat or thin a child is. Thin children have a low weight for their height while fat children have a high weight-for-height. Often the body mass index (weight in kg divided by height in metres) is used to determine fatness or thinness.

GROWTH CURVES

3-21 What is a growth curve?

A growth curve (or growth line) illustrates the way a child is growing over a period of time. A growth curve can be determined when a child’s size measurements have been made on two or more visits and have been plotted as dots on a centile chart. If these dots are now joined together with a line, you will have a growth curve. Therefore, the best way to assess growth is to look at the growth curve over the past few months and compare the growth curve to the centiles.

Figure 3.2: A normal growth curve plotted on a centile chart
A growth curve is a line linking size measurements recorded over time.

3-22 What is the value of a growth curve?
A growth curve shows not only whether the child’s size is normal or not, but also whether the child is growing normally, faster or slower than expected. Therefore, a growth curve is a far better method of assessing growth than using size measurements taken on one occasion only as it reflects the child’s growth rate.

3-23 What is the normal growth rate?
If the child’s growth rate is normal, the growth curve will closely follow along (be parallel to) the centile lines and not cross more than one centile.

A normal growth curve follows the centile lines.

3-24 How fast should most children grow?
Most children double their weight from birth to 6 months and treble (increase by three times) their birth weight by one year. The increase in weight and height is fastest in the first year of life and then slows down until puberty when growth is again fast for a short while. Growth in head size is almost complete by 2 years.

3-25 Is weight or height the better measure of growth?
In younger children, weight is the most sensitive index of growth and poor weight gain is usually the first sign of malnutrition. In older children, height is the better index of growth.

Height is the best index of growth in older children.

3-26 Is it important if a child is heavier than normal?
Some children who are heavier than normal are perfectly healthy. They are simply bigger for their age than most children. Other children are heavier than normal because they are obese (too fat).

3-27 Is it important if a child is lighter than normal?
This is a very important observation. Some children who weigh less than normal are healthy and simply smaller for their age than most children. However, in a poor community, most children who weigh less than normal are malnourished (undernourished) or have an illness.

3-28 What should you do if a child is heavier or lighter than normal?
Determine the child’s growth pattern.

3-29 What is a growth pattern?
The position of the child’s weight, height, head circumference on the centile lines, and the growth curves for all these measurements, determines the child’s growth pattern. Therefore, more than one measurement of size (e.g. weight and height) is needed to establish the growth pattern.

Most normal healthy children have a weight, height and head circumference within the
normal range and the growth curves for all these measurements are normal. Therefore, all measurements of size fall between the 97th and 3rd centiles and the growth curves have followed and not crossed more than one centile. This is the most common growth pattern.

3-30 What other growth patterns are common?

- Large-for-age
- Overweight-for-age
- Wasted
- Growth faltering
- Stunted

These growth patterns indicate that the child may have a medical, nutritional or social problem. It is, therefore, very important that all children who do not have a normal growth pattern are identified as soon as possible in order that they can be carefully examined. Some of these children will be healthy even if their growth pattern differs from the average.

3-31 How can you recognise a large-for-age child?

These children appear healthy but are symmetrically large. Their weight, height and head circumference are all equally above the 97th centile. Their growth curves run parallel above the 97th centile. Most of these children have tall parents and are genetically large. Some may have been large at birth with a high birth weight. They are normal on general examination and can be managed as normal children. They often have an earlier puberty than most children.

3-32 Which children weigh too much?

These children can often be recognised by simple inspection. Their weight falls above the 97th centile (overweight-for-age) while their height and head circumference usually fall in the normal range. Their growth curve for weight often shows a weight gain faster than normal. They are too fat.

A weight above the 97th centile with a height below the 50th centile suggests a hormonal problem, which needs to be investigated.

NOTE Some children grow faster than normal and their size measurements cross centiles. This growth pattern is seen normally at puberty and in some children after an illness or period of malnutrition (catch up growth). Rapid gain in weight only is also seen with obesity, some endocrine disorders and generalized oedema.

3-33 What is a wasted child?

Wasting is a danger sign and suggests malnutrition or illness. These children usually look very thin and have a weight that falls below the 3rd centile while their height and head circumference often fall within the normal range. These children also have a body mass index below the 3rd centile, i.e. they are underweight for their height. Special weight for height charts are available. Their growth curve may show weight faltering.

NOTE Mid-arm circumference and triceps skin-fold thickness can also be measured and plotted on centiles to identify thin children and fat children. Special arm tapes are used to detect wasted children. Abdominal circumference is another measure that can be used to detect fatness in children.

3-34 What is growth faltering?

Infants with growth faltering (failure to thrive or slow growth) have not been gaining weight normally. Their weight may be static (remaining the same) or may even be dropping. Their height and head circumference may also not be increasing normally. This is a very important growth pattern to recognise as most of these children have a medical, nutritional or social problem, which needs to be urgently diagnosed and managed. Faltering weight gain must be detected as soon as possible so that the cause can be corrected. Growth faltering may be the first sign of HIV infection.
Slow growth or growth faltering are important signs that the child may be ill or not getting enough food.

**3-35 How can you recognise stunting?**

Stunted children are shorter than normal for their age. As they are often symmetrically small and do not look thin, their stunting is often missed. Usually their growth curves have followed the centiles although their weight, height and head circumference all fall below the 3rd centile. Stunting usually occurs before 3 years of life.

The most common cause of stunting is chronic malnutrition during the first years of life. However, some healthy short children are genetically small, and look like their parents. Being born very pre-term or growth-restricted can also result in stunting. Some important medical disorders, such as Foetal Alcohol Syndrome, can cause stunting.

**It is very important to identify all children with a height below the 3rd centile.**

**NOTE** Children who are symmetrically small (stunted) often have a normal growth rate. They are simply growing parallel to, but below, the 3rd centile.
3-36 What is the long term effect of stunting?

Short children usually become short adults as catch-up growth is difficult to achieve. Severe stunting due to malnutrition before 2 years of age is associated with schooling difficulties later.

3-37 What is the common growth pattern in poor communities?

A very common pattern of growth in poor communities throughout the world is normal weight gain for the first 6 months while the infant is being breastfed. Then, between 6 months and a year, there is faltering of both weight and length as the child receives inadequate food. By a year the child is stunted, with a weight and length below the 3rd centile. After a year, the weight may slowly increase to slightly above the 3rd centile but height remains below the 3rd centile. This pattern of low weight and height often continues into adulthood and reflects chronic malnutrition.

3-38 When does the puberty growth spurt occur?

Puberty is a time of rapid growth. It occurs earlier in girls than in boys. Puberty also occurs earlier in well-nourished children than in malnourished (undernourished) children. The puberty growth spurt usually lasts 2 years, starting at about 11 years in girls and 13 years in boys.

3-39 What is the effect of emotion on growth?

Love and emotional security are needed for normal growth. Stressed and emotionally deprived children grow slower that normal and may become stunted.

NOTE Growth hormone is not secreted normally in emotionally deprived children. This has been well-documented in some children in orphanages.

OVERWEIGHT AND OBESITY

3-40 How do you decide whether a child is overweight?

It is better not to use weight alone to decide whether a child is overweight as some children are heavy because they are simply big while others are heavy because they are fat. Usually the body mass index for age (i.e. weight in kg/height in m²) is used to decide whether a child is overweight due to excess fat. Special charts are used to define the normal body mass index for age. A body mass index for age between the 5th and 85th centiles is usually regarded as normal.

NOTE Even body mass index cannot always differentiate between obesity and a high lean mass.

3-41 When is a child overweight?

Children are usually considered overweight if their body mass index is between the 85th and 97th centile. These children also look fat. A child is not considered overweight if the weight for age is above the 97th centile but the body mass index is normal. These children are simply big for their age.

NOTE The definition of overweight remains very controversial and a number of different definitions are used. Overweight (which refers to the BMI) must not be confused with overweight-for-age.

3-42 What is obesity?

There is still no internationally accepted method of defining obesity in childhood. However, the clinical diagnosis can usually be made on simple inspection of the child as these children appear very fat. A body mass index for age above the 97th centile is regarded as obesity in older children and adolescents.

The diagnosis of obesity can usually be made by simple inspection.
Obesity is a common childhood problem in affluent countries and over the past 20 years has reached epidemic proportions in some communities, especially with girls. Obese children have excessive fat stores due to a high energy intake and inadequate exercise. The cause is almost always due to the child’s lifestyle. Fast foods, soft (fizzy) drinks and hours of watching TV each day are associated with obesity, as is rapid weight gain in infancy. Genetic factors are not as important as diet. However, many obese children have obese parents. Obese children have difficulty with sports and often have emotional problems due to a poor body image and lack of self confidence. They are miserable and unhappy with their weight and shape. Obese children, and especially obese adolescents, are at increased risk of growing up to be obese adults with a high risk of chronic illnesses in adulthood (hypertension, type II diabetes and heart disease).

**NOTE** A high skin-fold thickness can also be used to define obesity. Waist circumference may also be useful. Short, fat children need investigation for endocrine abnormalities.

3-43 How do you manage childhood obesity?

This is very difficult and often not successful. Management consists of a low-calorie diet, increased exercise and family therapy. The whole family needs to be educated about healthy eating and lifestyle behaviour. The goal is to lose weight and then maintain a normal weight. A motivated child and parents are essential if the management is to be successful. The help of a dietician is valuable in drawing up a balanced diet that is practical, affordable and not too high in energy. Bad eating habits of the whole community should be addressed. Soft drinks and refined foods should be avoided and time watching TV limited. Emotional support and psychological counseling are often needed. Good eating habits for the family should prevent obesity.

### THE ROAD-TO-HEALTH CARD

3-44 What is the Road-to-Health Card?

The patient-held Road-to-Health Card is the child’s formal medical record. It gives the child’s medical history, immunisation record, developmental milestones and growth record. Growth is plotted on a weight-for-age chart (growth chart) which is part of the Road-to-Health Card.

*A blank Road-to-Health Card growth chart is given at the end of this unit.*

3-45 What is the importance of the growth chart?

The weight-for-age chart is an essential part of the Road-to-Health Card. The area between the 3rd and 97th centiles is shaded in. It is important that the infant’s weight remains within this shaded area and increases parallel to the centiles. If the infant’s weight keeps within this normal weight-for-age range, it is following the ‘road to health’ along which the child should steadily walk. Normal growth suggests good nutrition.

Monitoring weight gain or loss on the Road-to-Health Card is one of the most important methods of identifying children at risk of malnutrition. This is a major part of primary health care. It is important that each mother understands and takes an interest in her child’s Road-to-Health Card.

*The growth chart is an extremely important method of screening children for malnutrition.*
3-46 When should the Road-to-Health Card be used?

It is important that the Road-to-Health Card be presented by the mother every time the child attends a clinic or hospital or visits a private doctor. Each child must be weighed at every visit and the weight must be plotted accurately on the card. The pattern of weight gain must always be examined and the growth curve explained to the mother or caregiver. The type of feeding should be recorded on the card. If necessary, counseling or advice on feeding must be given. There is important information about the child on the card and this must be updated at each clinic visit.

3-47 What is growth promotion?

Once the child’s growth has been assessed, advice and counseling should be given to the mother to promote normal growth and nutrition. It is of little value to assess growth without taking active steps to promote good growth.

3-48 When and where should children with growth problems be referred?

If failure to gain weight adequately does not respond to management at a primary care clinic, the child must be referred for further assessment and management. This is particularly important in children with a weight that falls or crosses centiles.

Sometimes these children are referred to a special nutritional clinic where the following steps should be followed:

1. Exclude any chronic illness such as tuberculosis or HIV infection.
2. A dietician or nutritional counselor should educate the mother or caregiver.
3. A social worker should interview the mother or caregiver and assist where help is needed.
4. If the child is still not improving, refer to a paediatrician.

3-49 How is neurodevelopment monitored?

Developmental milestones are used to monitor neurodevelopment in childhood. These are easily observable developmental achievements such as smiling, sitting and walking. Milestones are assessed by both history and examination. The neurodevelopmental monitoring of milestones must be part of the routine growth and developmental screening of all children.

Milestones are used to assess neurodevelopment in childhood.

NOTE The formal assessment of neurodevelopment is often divided into:

• Gross motor development (locomotion)
• Fine motor development (manipulation of objects)
• Language and communication (using sounds and words)
• Personal and social development (relating to family and society)

3-50 What are normal milestones?

Neurodevelopmental milestones are largely predictable as children get older although there is a range between different normal children. Delayed milestones are warning signs...
that neurodevelopment may be abnormal. Children with delayed milestones should be referred for formal neurodevelopmental assessment.

The following milestones should be achieved:

1. Smile at mother: 8 weeks
2. Good head control: 6 months
3. Sit unsupported: 9 months
4. Crawl well: 12 months
5. Make babbling noises (‘baby sounds’): 12 months
6. Stand without help: 15 months
7. Walk without help: 18 months
8. Understand simple commands: 24 months
9. Use one or two words: 36 months

Normally developing children should reach these milestones before (often long before) these cut-off ages.

**NOTE** A number of formal screening tools are used to monitor neurodevelopment. The Denver Developmental Screening Test is commonly used in children from birth to 6 years of age. Language and cognitive development is often screened at school, e.g. ‘IQ’ testing.

### CASE STUDY 1

A 12-week-old infant is seen at a routine visit for immunisation. The infant’s weight is measured and found to fall below the 3rd centile. The birth weight was normal (3000 g) at term. The child appears well. The mother has stopped breastfeeding.

1. **What does this child’s weight at 6 weeks suggest?**

   This child is not thriving, either due to inadequate feeds or illness. The problem is probably that the mother has stopped breastfeeding. She needs nutritional advice and the infant must be closely followed up.

2. **What is the value of using a weight-for-age chart to assess a child’s weight?**

   Plotting weight for age on a Road-to-Health Card is an excellent way of deciding whether an infant’s weight falls within the average range. It is only of limited value knowing the weight if it is not compared to the weight of other healthy children of the same age.

3. **What does the 3rd centile mean?**

   It means that only 3% of healthy children of that age will weigh less. The 3rd centile is usually used as the bottom of the normal range.
4. What is a growth curve?
A growth curve is obtained by joining measurements plotted on a centile chart (growth chart) over a period of time. Knowing this child’s weight at birth and at 6 weeks allows you to draw a growth curve. His growth curve will be falling rather than following parallel to the centile lines. This indicates that the child is not thriving.

5. What other measurement could be recorded?
It would be useful to measure and plot the circumference of the child’s head on a centile chart to see if the head size is still in the normal range.

6. When does a child weigh more than normal?
When the weight falls above the 97th centile.

CASE STUDY 2

A 4-year-old child gained weight normally until a few months ago when she had measles. Since then her weight has dropped from the 50th to the 10th centile. The mother is concerned that she has almost dropped off the road to health (i.e. no longer following the centile line).

1. Is the mother correct to be worried?
Yes. This pattern of weight loss (growth faltering) suggests that there is a medical problem. The child may have a complication of measles such as diarrhoea or tuberculosis.

2. What is the value of monitoring growth?
This child is a very good example of how valuable routine growth monitoring is to identify problems. The cause of her weight loss can now be investigated and corrected before her weight drops below the normal range.

3. How often should a child’s weight be routinely measured to monitor growth?
Monthly, until the child is 1-year-old, and then every 6 months until they are 5. Weight should also be monitored at every visit to the clinic, hospital or general practitioner.

4. How valuable is height for monitoring growth?
Height is a good measure of growth over a long period of time. Therefore, height should be measured every year from 1 year. Length (usually measured while the child is under 1 year) and head circumference are not routinely measured unless there is a good indication. Weight is the best measure of growth over a short period such as the time between visits to the clinic.

5. How can you detect wasting?
A wasted child is very thin. Weight usually falls well below the height on the centiles. The body mass index will also be low. Wasting is an important sign of malnutrition due to starvation or illness. These children usually have lost a lot of weight recently. This needs urgent investigation.

CASE STUDY 3

A 5-year-old child is examined at a preschool. Both her weight and height fall equally below the 3rd centile. She does not appear to be thin and looks generally well. She has attended the local clinic regularly and her size has been well documented as following the centiles on her Road-to-Health Card since birth. At birth she weighed 2000 g at term.

1. What is the growth pattern of his child?
This child is stunted. Plotting her weight and height for age shows that she is symmetrically small as both weight and height are equally low on the centiles.
2. What is the common cause of this growth pattern?
Usually chronic malnutrition (undernutrition) is the cause of slow growth in poor communities. However the size of this child has followed the centiles from birth. She was underweight for her gestational age at birth. This is the probable cause of her stunting. Always examine the child well as she may have a medical cause of slow growth, such as Foetal Alcohol Syndrome.

3. How should she be managed?
Her mother should be given dietary advice and reassured. It would be important to follow this child's growth.

4. What are the effects of emotion on growth?
Emotional stress and insecurity prevent normal growth. Therefore stunting can also be the result of emotional as well as nutritional deprivation.

5. Can poor growth affect the timing of puberty?
Yes. Puberty occurs earlier in well nourished children than children who are growing slowly because of malnutrition.

CASE STUDY 4
A mother is worried that her daughter is overweight. Her weight falls above the 97th centile while her height is on the 75th centile. The mother also looks overweight.

1. Can you use weight for age to tell if a child is too fat?
Any child with a weight above the 97th centile weighs more than normal. However, if her height is similarly over the 97th centile, she is probably just a big child for her age. Therefore, a high weight for age alone does necessarily mean the child is too fat.

2. Which children are overweight?
The term ‘overweight’ is used to mean that the child is too fat. As this child is very heavy for her age with a normal height, she probably is overweight.

3. How can you confirm that this child is overweight?
Her weight and height should be used to calculate the body mass index for age (weight/height²).

The definition of overweight is a body mass index between the 85th and 95th centile, while obese children have a body mass index above the 97th centile.

4. Is being overweight an inherited problem?
Overweight children often have overweight parents. While genetic factors are important, most overweight children eat too much and have too little exercise.

5. What are the complications of being overweight or obese?
Overweight and obese children often have difficulty with sports and may have emotional problems due to a poor body image. Obese children often grow up to be obese adults with an increased risk of hypertension, diabetes and heart disease.

6. How should overweight children be managed?
It is difficult to get an overweight child to lose weight. The whole family has to be educated and involved in a weight loss programme. A dietician may be helpful in drawing up a well-balanced diet that is practical, affordable and not too high in energy. Time spent watching TV must be limited and exercise encouraged.
Figure 3.4: The Growth Monitoring Chart on the Road-to-Health Card

- **Growth and Development**
- **Age in Months**
- **Birth to 1 Year**
- **Birth to 2 Years**
- **Birth to 3 Years**
- **Weight in kg**
- **Height in cm**
- **Health Parameters**
  - **BCG**
  - Measles
  - Polio
  - DPT
  - Hib, DTP & Hep B
- **Immunizations**
- **Admission to hospital**
- **Oral rehydration solution**
- **Breastfeeding**
- **Diarrhoea**
- **A RI**
- **Dates for next visit**
- **Child’s name**
- **Date for next visit**
  - Any illness e.g. diarrhoea, A RI, etc.
  - Admission to hospital, solids introduced, breastfeeding stopped, birth of next child, etc.
  - Chart revised: August 2003

- **GOOD**
  - Means the child is growing well.
- **DANGER SIGN**
  - VERY DANGEROUS
  - Child may be ill, needs extra care.
  - Extra meals given

- **IMMUNISATIONS**
  - 60% of 50th centile

- **DISCUSS**
  - Breastfeeding
  - Child spacing
  - Food intake
  - Oral rehydration solution

- **Figure 3.4**
- The Growth Monitoring Chart on the Road-to-Health Card

- **Child’s name**: [Insert name]
- **Date for next visit**: [Insert date]
**Weight-for-age percentiles: Boys, birth to 36 months**

Published May 30, 2000.

**SOURCE:** Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).

*Figure 3.5: Weight-for-age percentiles: Boys, birth to 36 months*
Figure 3.6: Weight-for-age percentiles: Girls, birth to 36 months
Figure 3.7: Length-for-age percentiles: Boys, birth to 36 months
Length-for-age percentiles: Girls, birth to 36 months

Figure 3.8: Length-for-age percentiles: Girls, birth to 36 months
Head circumference-for-age percentiles: Boys, birth to 36 months

Published May 30, 2000.
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).

Figure 3.9: Head circumference-for-age percentiles: Boys, birth to 36 months
Figure 3.10: Head circumference-for-age percentiles: Girls, birth to 36 months

Published May 30, 2000.
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
Figure 3.11: Weight-for-age percentiles: Boys, 2 to 20 years
Figure 3.12: Weight-for-age percentiles: Girls, 2 to 20 years
Figure 3.15: Stature-for-age percentiles: Boys, 2 to 20 years
Figure 3.16: Stature-for-age percentiles: Girls, 2 to 20 years

Published May 30, 2000.
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
Body mass index-for-age percentiles: Boys, 2 to 20 years

Figure 3.17: Body mass index-for-age percentiles: Boys, 2 to 20 years
Figure 3.18: Body mass index-for-age percentiles: Girls, 2 to 20 years
When you have completed this unit you should be able to:
- Define normal nutrition and malnutrition.
- List the main food groups.
- List the important forms of malnutrition.
- Diagnose and manage protein-energy malnutrition.
- Diagnose and manage vitamin deficiencies.
- Diagnose and manage iron deficiency.
- List the common causes of anaemia.

4-1 What is nutrition?
Nutrition is the food (diet) that a child eats and drinks.

4-2 What is the nutritional state?
The nutritional state (or the state of nutrition) is the child’s physical appearance which indicates whether he/she is well nourished or poorly nourished. The nutritional state can also be affected by medical conditions such as chronic diarrhoea or tuberculosis.

The nutritional state is evaluated by clinical examination to determine whether the child is underweight or overweight, stunted, wasted or obese, or shows any signs of nutritional deficiency. Therefore, the nutritional state is an indirect measure of the child’s diet.

Nutrition is what we eat, while our nutritional state is what we look like. Good nutrition in a healthy child results in a normal nutritional state and normal growth.

4-3 What is normal nutrition?
Children with normal nutrition receive the correct amount of all the essential types of food necessary for normal growth and good health. They have a diet which contains the correct amount of each nutrient (food type).

Although the type of food varies with age, it is important that all children have an adequate diet which contains all the main nutrients in the correct proportion. If the amount of one or more of the nutrients is inadequate, the result is malnutrition. Excessive nutrients can also cause problems, especially obesity.

Good nutrition is a diet which contains the correct amount of all the main nutrients.
4-4 What are the main nutrients in the diet?

The major nutrients (food groups) are:

- Energy foods
- Protein foods
- Micronutrients
- Water

4-5 What are energy foods?

- Carbohydrates
- Fats and oils

Both carbohydrates and fats are important because they provide the body with energy. Too much energy food causes obesity while too little results in failure to thrive or even weight loss.

4-6 Which foods are carbohydrates?

Sugars (simple carbohydrates) and starches (complex carbohydrates). Household sugar is an important source of carbohydrates while syrup, honey and fruit juice are rich in sugars. Common foods that are rich in starches are bread, porridge, potatoes, maize and rice.

4-7 Which foods are rich in fats and oils?

Fats are present in food from animals while oils are found in vegetable foods and fish. Both fats (solids) and oils (liquids) are high in energy. Vegetable oils are better for good health than animal fats.

Foods rich in fat include meat and dairy products (milk, cream, butter).

Foods rich in oils include maize, sunflower oil, margarine, peanuts and fish.

4-8 Which foods are rich in protein?

Many animal and vegetable foods contain proteins. Proteins are made up of amino acids. Unfortunately, many animal sources of protein are expensive.

Animal sources of protein include meat, eggs and dairy products.

Vegetable sources of protein include legumes (beans, peas, lentils), nuts, millet (sorghum) and, to a lesser degree, maize.


4-9 What are micronutrients?

- Minerals and electrolytes such as sodium, potassium, calcium, chloride and bicarbonate
- Trace elements such as copper, zinc, iodine and selenium
- Vitamins such as fat soluble vitamins (A, D and E) and water soluble vitamins (B and C)
- Iron

4-10 What is a well-balanced diet?

A well-balanced diet contains adequate amounts of all the major food groups. A diet that contains too much or too little of one or more food groups is not balanced. Ideally each meal should contain fat, carbohydrate, protein and all the essential micronutrients.

Many foods are made up of more than one food group, e.g. nuts contain carbohydrates, oils and proteins. Mixing foods can give a balanced meal, e.g. maize for energy with beans for protein or milk for protein and porridge for energy.

A well-balanced diet contains adequate amounts of all the major food groups.

4-11 What foods are needed by children?

All children need a balanced diet, but a child’s age, maturity and physical size determines how this is best achieved. Young children have relatively bigger nutritional requirements per kg than adults because of their need to grow.

Infants under 6 months need a liquid diet because chewing and swallowing must still develop and mature. Breast milk alone is the ideal diet (designed by nature) for these infants. It meets the nutritional needs and is a balanced diet. Breastfeeding avoids the risks attached to unsafe handling and contamination of alternative feeds. If breast milk is not available,
formula feeds should be given. If a formula has to be chosen, select a suitable commercial starter formula feed and follow the mixing instructions and recommended volumes as given on the tin. Usually one scoop (provided by the manufacturer) of milk powder is added to 25 ml water.

Beyond 6 months of age the infant’s nutritional needs can no longer be met completely by breast milk or formula alone. Solids must be introduced. Breast milk or formula feeds should, however, still form an important part of the diet. Soft family foods such as porridge, mashed vegetables or fruit should be started. By 8 months children can chew and ‘finger foods’ can be started. Solids should be given 3 times a day to infants that are still breastfeed or are formula fed.

By one year of age most children can be given family foods 5 times a day. Small children have small stomachs and therefore need more frequent meals than adults to achieve an adequate total nutritional intake. Breastfeed as often as the child wants. If possible, breastfeeding should be continued until at least 2 years of age. Most children will tolerate cow’s milk from 1 year of age. After 1 year of age, a normal child who is not breastfed should not receive more than about 500 ml milk per day.

Complementary foods are given to fill the gap between the total nutritional needs of the infant and the nutrition provided by breast milk or formula feeds. Complementary foods are usually not needed before 6 months.

**NOTE** The advantages and risks of breastfeeding must be carefully considered in infants born to HIV positive women.

### MALNUTRITION

#### 4-12 What is malnutrition?

An abnormal nutritional state can be caused by too little or too much of one or more of the important food groups in the diet. Abnormal nutrition leads to a number of different nutritional problems. While obesity is also a form of abnormal nutrition, the term malnutrition is usually used to refer to children with undernutrition.

**Children with malnutrition are not receiving adequate amounts of one or more important nutrient.**

**NOTE** In wealthy countries, obesity is the commonest form of abnormal nutrition.

#### 4-13 How is malnutrition recognised clinically?

Most children with malnutrition are underweight, stunted or thin. Therefore, a child’s size for age can be used to help diagnose malnutrition. These children usually are deficient in a number of different nutrients. However, some children may be deficient in only a single nutrient, e.g. a vitamin deficiency.

#### 4-14 Which children are underweight?

These are children who have a body weight for their age that is below the 3rd centile. Therefore, they weigh less than the normal range for their age. Many have been underweight for months or years while others have only recently lost weight. Malnutrition should be considered in all underweight children. There are, however, many causes of being underweight other than malnutrition (e.g. being born preterm).

**Malnutrition must be considered in all underweight children.**

#### 4-15 Which children are stunted?

These children have a height less than the 3rd centile. They are, therefore, shorter than normal. Stunting suggests slow growth for a long time. Most stunted children are also underweight but often do not appear wasted. As a result their poor growth is often not recognised if they are not measured.
Malnutrition or a chronic illness should be considered in all stunted children.

**Stunting always suggests a chronic health problem or malnutrition.**

4-16 Which children are wasted?

A wasted child has lost weight with a weight for height below the 3rd centile. Wasting can be diagnosed by clinically examining the child. These children have very little subcutaneous fat and muscle. Their arms and legs are particularly thin and they have loose skin and soft tissue around the upper arms and thighs. Wasting is an important sign and must always be taken seriously. It indicates a recent serious loss of weight. Wasting in children indicates either fairly recent onset of malnutrition or they have a serious illness such as malabsorption, malignancy or chronic infection (such as tuberculosis or HIV).

**Wasting is an important sign of malnutrition.**

Assessing weight, height and weight for height by the correct use of centile charts is discussed in Unit 3.

*NOTE* Measuring the mid upper arm circumference is a good screening test for wasting. These children will also have a low body mass index.

4-17 Why is malnutrition important?

Because malnutrition is common, especially in poor countries. It is directly or indirectly responsible for half of all deaths worldwide in children under 5 years of age. Unless managed correctly, the mortality rate from severe malnutrition can be as high as 50%.

Malnutrition is closely linked with both poverty and ignorance. Preventing malnutrition is one of the main goals of programmes that address poverty.

**Malnutrition is a common cause of childhood death, especially in poor countries.**

4-18 How is a clinical diagnosis of malnutrition confirmed?

By taking a careful dietary history. You must ask about the type of food, amount of food and frequency of feeds. If the diet appears to be good according to the mother's history, consider a disease such as chronic diarrhoea or infection as the cause of the child's poor nutritional state. Many illnesses can lead to malnutrition, e.g. measles. Sometimes, only a response to a good diet confirms the diagnosis of malnutrition due to a poor diet.

**The diagnosis of malnutrition is confirmed by taking a careful dietary history.**

4-19 What are the common forms of malnutrition?

- Protein-energy malnutrition
- Vitamin deficiencies
- Trace element deficiency

**PROTEIN ENERGY MALNUTRITION**

4-20 What is protein-energy malnutrition?

Protein-energy malnutrition (PEM) consists of a range of clinical conditions caused by a lack of both protein and energy in the diet (i.e. general undernutrition). PEM ranges from mild to severe and the clinical presentation depends on the degree of deficiency and precipitating factors such as infection. Most children with PEM have both weight and height below the normal range, i.e. they are stunted.

4-21 What are the forms of protein-energy malnutrition?

- Underweight for age (UWFA)
- Marasmus
- Kwashiorkor
- Marasmic kwashiorkor

Children with marasmus, kwashiorkor or marasmic kwashiorkor have severe malnutrition. These different forms of severe malnutrition are often considered together as their causes are similar and they are managed in the same way.

**Children with severe malnutrition have signs of marasmus or kwashiorkor or both.**

These different forms of malnutrition are identified by the child's weight for age, the degree of wasting, and by the presence or absence of oedema of the feet. In addition to examining and measuring these children, it is important to also obtain as detailed a dietary history as possible.

**4-22 Which children are underweight-for-age?**

Underweight-for-age (or 'low weight') is defined as a weight for age that falls below the 3rd centile. This means that they weigh less than the normal range. Many of these children are 'failing to thrive'. They appear clinically well and do not look undernourished. They do not have oedema. Unless they are weighed, and their weight is plotted on a centile chart, the diagnosis is frequently missed. Underweight-for-age is the commonest form of malnutrition.

**Being underweight-for-age is the commonest form of malnutrition.**

**NOTE** Using the Wellcome classification of PEM, children who are UWFA have a weight which is between 60 and 80% of the median (50th centile).

**4-23 Why is it important to detect underweight-for-age children?**

Marasmus and kwashiorkor are always preceded by 'underweight-for-age'. Therefore, it is important to identify these children and address their nutritional problems before they become worse.

**4-24 What is marasmus?**

This is the commonest form of severe malnutrition. The child's weight is far below the 3rd centile and lies below 60% of the 50th centile (the 'marasmus line'). These children usually appear very thin (severely wasted) and are often ill. They do not have oedema. Marasmus is usually due to starvation or severe illness such as malabsorption or AIDS.

**Children with marasmus are severely underweight for their age.**

**NOTE** Children with marasmus have a weight-for-height less than 60% of expected (under 3 SD below the mean). Some serious medical conditions (e.g. malabsorption) can also result in marasmus.

The severe wasting is best seen on the buttocks, thighs and upper arms where the skin hangs in folds. The ribs and shoulder blades stick out and the abdomen is usually distended due to decreased muscle tone. They are anxious, irritable, cry easily and look like an old person.

**NOTE** Anorexia nervosa causes marasmus in older children and adolescents.

**4-25 What is kwashiorkor?**

This is another severe form of protein-energy malnutrition. These children present with a characteristic syndrome which always includes oedema, especially of both feet and legs. Kwashiorkor usually occurs in children between 6 months and 2 years of age. It is an acute problem which is often precipitated by an infection such as gastroenteritis in a child who is already underweight for age. These children have a typical appearance:

- They are miserable, with a poor appetite.
- They have oedema of their legs and their face looks swollen with fat cheeks. Pressing on the back of each foot for a few seconds will show the pitting of oedema. Due to the
facial oedema they may appear ‘chubby’ and their wasting is often missed.

- Their hair is sparse, fine and may have a reddish colour.
- They have areas of increased or decreased skin pigmentation with scaling, especially in the nappy area (flaky-paint rash). There may also be areas of skin which are wet and look like burns. The skin is easily damaged and may be ulcerated. Secondary bacterial skin infection is common.
- They have a distended abdomen and an enlarged liver.
- Angular stomatitis is common with painful cracking at the angles of the mouth.
- Their nails are pale.
- Their weight usually falls below the 3rd centile but above 60% of the 50th centile. Some infants have a normal weight because of their oedema.
- They often have signs of anaemia and vitamin deficiency.

**note** While the underlying cause of PEM is an intake of protein and energy that is insufficient to maintain health, not all children with severe malnutrition develop kwashiorkor. The clinical disease is precipitated by an additional stress such as infection.

**note** Using the Wellcome classification of PEM, children with kwashiorkor have a weight which is usually below the 3rd centile together with nutritional oedema.

### 4-26 What is marasmic kwashiorkor?

These severely malnourished children have clinical features of both marasmus and kwashiorkor. They are severely underweight (below 60% of the 50th centile) but also have oedema. Children with marasmus may rapidly deteriorate, especially if they develop an infection, and present with oedema to become marasmic kwashiorkor.

**note** Using the Wellcome classification of PEM, children who have marasmic kwashiorkor have a weight which is below 60% of the median (50th centile) and also have oedema.

### 4-27 How can you determine whether a child has malnutrition?

1. Take a careful dietary and family history.
2. Examine the child fully.

### 4-28 How can the history help in the diagnosis of malnutrition?

The following needs to be known:

1. Is the child still breastfed?
2. What is the usual diet (type, amount and frequency of feeds or meals)?
3. What is the child’s appetite like?
4. Are there any signs of illness, e.g. diarrhoea, vomiting or cough?
5. The family background (income, parents, carers, abuse)

### 4-29 How can a general examination help in the diagnosis of malnutrition?

The weight and length must be measured and plotted on a growth chart.

A full general examination must be done, looking particularly for signs of:

- Severe malnutrition (e.g. oedema and wasting)
- Vitamin deficiencies
- Dehydration
- Pallor (due to anaemia)
- Illness, e.g. diarrhoea, tuberculosis or AIDS

Most children with severe malnutrition will have other signs of kwashiorkor or marasmus. They may also have signs of vitamin or trace element deficiencies. Severe malnutrition is, therefore, a clinical diagnosis which can be made by examining the child and plotting the child’s weight and height.

**Malnutrition is a clinical diagnosis based on history and examination.**

### 4-30 How common is protein-energy malnutrition?

This is very common in poor countries. It is estimated that 170 million children in the world suffer from severe protein-energy
malnutrition while a third of all the world’s children are undernourished (30% of all children are underweight and 37% stunted).

**NOTE** In South Africa 10% of children are underweight and 25% stunted. Less than 5% are wasted. Therefore, chronic malnutrition is common.

### 4-31 What factors are commonly associated with malnutrition?

Malnutrition is usually due to an inadequate diet. However, the cause is often complex and related to poverty. Common associated factors are:

- Poverty
- Ignorance
- Parental neglect and deprivation
- Poor health services
- Frequent infections, especially diarrhoea and measles
- AIDS
- Displaced families, drought, famine and war

Poor education of women, unemployment, young mothers, poor social support in the community, war and violence, neglect and abuse, no breastfeeding, and low birth weight are all common in communities with a high prevalence of malnutrition. Failing to breastfeed in poor, rural communities will almost certainly lead to malnutrition.

In some children, malnutrition is not caused by a poor diet but is due to an illness which prevents the body from using food that is eaten. Chronic diseases and malabsorption may result in malnutrition in spite of a normal diet.

### 4-32 What are the complications of severe malnutrition?

These are usually seen in kwashiorkor and marasmic kwashiorkor:

- Serious infections, especially septicaemia or pneumonia. Gastroenteritis, tuberculosis, measles and AIDS often precipitate kwashiorkor.
- Hypoglycaemia due to loss of energy stores
- Hypothermia
- Heart failure due to a small, weak heart
- Bleeding, usually purpura
- Anaemia due to protein and iron deficiency
- Electrolyte imbalances, especially potassium deficiency
- Malabsorption
- Tremors (‘kwashi shakes’)
- Sudden death

About 25% of children with kwashiorkor die despite treatment. The long-term effect of severe malnutrition on growth and mental development remain uncertain as these children are also affected by a deprived environment.

**Hypoglycaemia, hypothermia, infection and heart failure are the main causes of death in severe malnutrition.**

**NOTE** Children with kwashiorkor have a low serum albumin, potassium, magnesium, sodium, copper and zinc. Also low glucose, transferrin and clotting factors.

### 4-33 How are malnutrition and infection related?

Severe malnutrition weakens the immune system and makes the child more susceptible to infections such as gastroenteritis, measles, tuberculosis and AIDS. In turn infection (especially diarrhoea) often precipitates severe malnutrition in a child who is underweight-for-age.

### 4-34 Is malnutrition always due to a poor diet?

No. Some children who fail to thrive are receiving a good diet. They usually have a severe, chronic illness, such as tuberculosis, AIDS, malignancy, bowel or liver disease, or cerebral palsy. AIDS is a common cause of failure to thrive in Africa.
Some stunted children are not malnourished but have a medical condition or had a very low birth weight. Chronic emotional stress can also cause stunting.

4-35 What is the management of an underweight-for-age child?

1. A careful history, physical examination and review of the weight and height (and head circumference in infants) growth curves is essential to establish the pattern of growth and the underlying cause of the failure to thrive. Treat any medical problem.

2. The child should be given a normal, well-balanced diet (a trial of feeding) if malnutrition is diagnosed. Frequent small feeds increase the total food intake and should be given at least 5 times per day. Peanut butter, vegetable oil or sugar added to the staple diet can be used to increase energy intake. Cheap forms of protein (milk powder, peas, beans) must be encouraged. Food supplements are available at clinics and hospitals under the state’s nutrition programme for qualifying families.

3. The child must be closely followed for 2 weeks. If there is no weight gain, the child must be admitted to hospital for a controlled trial of feeding and possibly further investigation.

4. If there is weight gain, the child must be carefully followed with repeat weight checks to ensure that weight gain continues. Height will only be gained after a few months of satisfactory weight gain.

5. The underlying cause of the poor feeding must be addressed or the problem will simply recur. Nutritional education of the mother is essential. Financial aid may be needed.

6. It is best to deworm the child and give vitamin A according to the national vitamin A policy as many underweight for age children have worms and are likely to have mild vitamin A deficiency. Multivitamin syrup is needed during the phase of catch-up growth and also if the usual diet is deficient in fresh vegetables or fruit.

7. Measure the haemoglobin concentration and treat anaemia with oral iron.

**Good nutrition will correct growth in most children that are underweight.**

4-36 What is the management of severe malnutrition?

The management of children with marasmus, kwashiorkor and marasmic kwashiorkor (i.e. severe malnutrition) is very similar and, therefore, can be considered together.

These children are seriously ill and all must be urgently admitted to hospital. The management consists of:

1. Initial resuscitation
2. Nutritional rehabilitation
3. Follow up

4-37 What resuscitation is needed?

Infants presenting with severe malnutrition (especially kwashiorkor) are very sick and a number will die within a week of starting treatment. They must all be hospitalised immediately. This phase of treatment usually lasts about a week:

1. Correct and avoid hypoglycaemia, hypothermia or dehydration. Check the blood glucose 6 hourly for the first few days and whenever the child’s temperature falls below 35.5 °C. A feed of 50 ml of 10% glucose orally should correct hypoglycaemia. Correct any dehydration slowly with oral fluids. Avoid intravenous fluids if possible. Do not use diuretics to reduce the oedema.

2. Give broad spectrum antibiotics (ampicillin and gentamicin if clinically septic or co-trimoxazole if there is no obvious site of infection) to all children for a week. Assume that all children with severe malnutrition have a bacterial infection.

3. Start with oral or nasogastric feeds every 3 hours, both day and night, as soon as possible. Usually a starter formula or, if diarrhoea is present, a lactose-free
formula 100 ml/kg/24 hours is used for the first week. High volume feeds may cause heart failure.

4. Give oral potassium chloride 0.5 g/kg/day (4 to 6 mmol/kg/day) as these children are severely potassium depleted, especially children with kwashiorkor. Also give extra magnesium, 0.4 to 0.6 mmol/kg/day, as well as zinc 2 mg/kg/day, folic acid 5 mg per day, multivitamin syrup 10 ml per day and vitamin A 50 000 to 100 000 units on day 1.

5. Do not give oral iron yet. Iron can be very dangerous as these children do not have enough protein to carry iron safely in the blood stream.

NOTE: A blood transfusion is only used for severe anaemia with associated cardiac failure. Extra magnesium is often added to feeds.

4-38 What nutritional rehabilitation is required?

This phase of treatment starts when the appetite improves and the child is looking better:

1. Once the appetite has returned and any oedema has improved, a weaning (follow-on) formula with a higher protein content can be started in infants. As the older child improves, porridge and mixed foods, especially maize, beans and dried peas, can be started. Vegetable oils can be added for energy. A high energy and protein diet is needed. Start introducing solid foods slowly. During this phase, children are often very hungry and take a lot of food. The first sign of recovery is when the child starts to smile.

2. Continue folic acid 5 mg daily for 5 days.

3. Continue multivitamin syrup 10 ml daily.

4. Treat for worms with mebendazole 100 mg twice daily for 3 days and metronidazole (Flagyl) 7.5 mg/kg 8 hourly for 7 days for Giardia.

5. Oral iron 6 mg elemental iron/kg/day for 12 weeks, starting ONLY when the child is gaining weight and any oedema has disappeared.

6. Monitor daily weight gain.

4-39 How can you prevent malnutrition recurring?

1. The mother or caregiver must be given the education and financial support to provide a good diet.

2. Regular follow up with weighing is essential.

There is a real risk that malnutrition will recur in a previously malnourished child as it is very difficult to correct social and economic problems in a family and community.

4-40 How should you address the underlying causes of malnutrition?

An aggressive attempt must be made to break the cycle of ignorance, poverty, malnutrition and emotional deprivation. Socio-economic factors are most important. The answers lie in the family and community rather than in the primary health care system. Employment, education, social upliftment, pride and responsibility are vitally important. The level of childhood malnutrition is a good measure of the health and wellbeing of the community.

The sources of inexpensive protein, such as beans, must be stressed.

4-41 What can be done to prevent malnutrition in poor communities?

- Breastfeeding to 6 months of age or longer
- Complementary feeding from 6 to 24 months (breast milk plus solids)
- Prevent infections, especially diarrhoea
- Routine weighing, immunisation and use of the chart in the Road-to-Health Card
- Social support for mothers
- School feeding projects
4-42 What is the effect of severe malnutrition on a child’s mental development?

Severe malnutrition results in poor growth and wasting of the brain. These children are lethargic, not interested in their surroundings, irritable and unhappy. Often they are not given the stimulation and love needed for normal mental and behavioural development.

Once they start recovering and smiling, they need to be stimulated and given a lot of loving attention. The hospital ward should provide a happy, stimulating environment with play and physical contact. With good nutrition, loving care and stimulation, many children will recover physically and intellectually.

4-43 What are micronutrients?

In contrast to the major components of the diet (proteins, carbohydrates and fats), micronutrients are needed in much smaller amounts. Micronutrients can be divided into:

- Vitamins
- Trace elements (minerals)
- Iron

VITAMIN DEFICIENCIES

4-44 What are vitamins?

Vitamins are essential items in the diet, which are needed for healthy growth and normal metabolism. A deficiency of one or more vitamins (hypovitaminosis) causes nutritional illness.

4-45 What are the common vitamin deficiencies in children?

- Vitamin A deficiency
- Vitamin B group deficiencies (e.g. pellagra)
- Vitamin C deficiency (scurvy)
- Vitamin D deficiency (rickets)
- Vitamin K deficiency (haemorrhagic disease in newborn infants)

**NOTE** In South Africa maize meal is now fortified with folic acid. Many bakeries also fortify their wheat flour used for bread with folic acid. It is planned to fortify both maize flour and bread with folate, vitamin A and vitamin B complex.

4-46 Which children are at greatest risk of vitamin A deficiency?

- Infants who are not breastfed
- Low birth weight infants
- Underweight infants on a poor diet
- Infants with diarrhoea, measles, tuberculosis or AIDS

Vitamin A deficiency is particularly important as it is common in most poor countries and contributes to the death of many children. It is estimated that as many as 25% of young children in South Africa are deficient in vitamin A, especially in rural areas.

4-47 How does vitamin A deficiency present?

Mild vitamin A deficiency usually does not present with any gross clinical signs. Yet it is very important because it is associated with loss of appetite, poor growth and severe infections (especially gastroenteritis and measles) and increased mortality.

**Vitamin A deficiency is common in South Africa, especially in poor rural communities.**

4-48 Which children are at greatest risk of vitamin A deficiency?

- Infants who are not breastfed
- Low birth weight infants
- Underweight infants on a poor diet
- Infants with diarrhoea, measles, tuberculosis or AIDS

Vitamin A deficiency is particularly important as it is common in most poor countries and contributes to the death of many children. It is estimated that as many as 25% of young children in South Africa are deficient in vitamin A, especially in rural areas.

**Vitamin A deficiency results in an increased risk of severe infections.**

Severe vitamin A deficiency causes eye problems and presents with photophobia (keep eyes closed in bright light), night blindness (unable to see in poor light) and xerophthalmia (dry eyes). It also causes corneal clouding, ulcers and softening (keratomalacia) which can lead to corneal scarring and blindness. Severe vitamin A deficiency is the commonest preventable cause of blindness in children in poor countries.

**NOTE** A patch of dry, raised conjunctiva (appears foamy) over the sclera is called a Bitot’s spot. Vitamin A deficiency causes blindness in half a million children worldwide annually.
4-48 How is vitamin A deficiency prevented?

One of the major challenges to health care of children in the world today is to get vitamin A supplementation or fortification into common foods. Vitamin A supplementation significantly reduces children's risk of dying from infectious diseases.

One method of supplementing vitamin A is to give a single 50 000 unit dose of oral vitamin A to all children at 6 weeks as part of the routine immunisation schedule. This is followed by 100 000 units at 9 months and then 200 000 units at 12 months and every 6 months thereafter until 5 years. All children with measles should be given 200 000 units of vitamin A orally daily for 2 days.

The body can make vitamin A from carotene which is present in yellow fruits and vegetables (e.g. mangoes, pawpaws, carrots, pumpkin, butternut, sweet potatoes) as well as green leafy vegetables (e.g. spinach). Vitamin A is present in breast milk, liver, butter and margarine. Vitamin A fortification of basic foods is another method of ensuring adequate amounts of vitamin A in the diet.

4-49 How is vitamin A deficiency treated?

Children with signs of severe vitamin A deficiency (eye signs) are treated with 100 000 units of oral vitamin A daily for 2 days followed by a third dose at 6 weeks. Children with mild signs only should receive 100 000 units once if they are one year or less, and 100 000 units daily for two days if they are over one year.

4-50 What are the B group vitamins?

These are a group of water-soluble vitamins that are not stored in the body and therefore have to be present in the diet on a continuous basis. While folic acid deficiency may be seen with severe malnutrition and intestinal parasites, only niacin deficiency is common in some areas in South Africa. Deficiencies of the other group B vitamins are rare.

4-51 What is pellagra?

This is a condition caused by niacin deficiency. It is seen in communities who depend on a maize diet. In children, pellagra presents with a skin rash on areas exposed to the sun (face, neck and chest in a necklace distribution, arms and legs). The rash is erythematous (red) or pigmented and may be scaly.

Pellagra is treated with nicotinic acid 100 mg orally, every 4 hours for 3 days. Advise on a balanced diet with beans and peas added to maize. Pellagra patients are usually also generally malnourished.

4-52 What is scurvy?

Scurvy is caused by a lack of vitamin C, which is found in fruits and vegetables. It is uncommon in older children but sometimes is seen in infants on a poor diet without breast milk (which is rich in vitamin C). Scurvy causes painful, tender bones (due to bleeding under the periosteum) which presents in infants with irritability and crying when handled. They do not like moving their legs and may be misdiagnosed as osteitis, paralysis or battering. Bleeding gums are rare as they only occur in children old enough to have teeth. An X-ray of the long bones shows diagnostic lifting of the periosteum.

Scurvy is treated with 250 mg vitamin C orally 4 times a day for 5 days. Correct the diet.

NOTE The other group B vitamins are thiamine, riboflavin, B12 and pyridoxine. Folate can be added to basic foods to reduce the prevalence of neural tube defect in newborn infants.

NOTE The prevention of scurvy, through the provision of fruit and vegetables, on the long sea voyage from Europe to the spice islands of Indonesia and Malaysia, was the reason for the colonisation of the Cape by the Dutch in 1652.
4-53 What is rickets?

Rickets is a clinical syndrome of deformities of growing bones and delayed physical milestones usually caused by a lack of vitamin D. Vitamin D is present in a mixed diet and can be made in the skin if the child is exposed to sunlight. In South Africa nutritional rickets is usually seen in preterm infants who are exclusively breastfed and not exposed to sunlight. Breast milk contains little vitamin D. Infant formulas are supplemented with vitamin D. Once infants start walking, they usually have adequate sun exposure to make their own vitamin D.

Rickets in infants presents with soft, deformed bones, resulting in:

- A ‘rickety rosary’ with swelling of the ribs where bone meets cartilage
- A chest deformity with a horizontal groove overlying the diaphragm attachment to the ribs (Harrison’s sulcus)
- Craniotabes with a softened ‘ping-pong’ skull above the ears
- Thickened wrists and ankles
- Decreased muscle tone, giving a distended abdomen
- Delayed physical milestones
- An increased risk of pneumonia

Treatment consists of 1000 units of oral vitamin D daily for a month by which time there should be radiological confirmation of healing. Increase exposure to sunlight for 30 minutes a week. For prevention vitamin D 400 units daily (in 0.6 ml of multivitamin drops or 5 ml vitamin syrup) should be given to preterm infants for 6 months as they are at high risk of developing rickets.

**Note**: Rickets due to calcium deficiency can occur in older children on a diet which has adequate vitamin D but is low in calcium (e.g. maize without milk). There are also rare renal and metabolic causes of rickets in children who do not respond to the standard treatment. Vitamin D deficiency in adolescents (osteomalacia) presents with bone pain, muscle weakness and hypotonia. Hypovitaminosis D can be confirmed by finding a low concentration of serum 25 hydroxycholecalciferol.

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**TRACE ELEMENT AND MINERAL DEFICIENCIES**

4-54 What are trace element and mineral deficiencies?

The important trace elements are iodine, fluoride and zinc, while the common minerals are sodium, potassium, calcium, magnesium, phosphate and iron.

- Iodine deficiency causes thyroid enlargement (goitre) and hypothyroidism (with retarded mental development). This is uncommon in South Africa due to iodine being added to table salt. However, it is still seen in mountainous regions where rock salt or non-iodated salt is used.
- Fluoride deficiency is common in some regions of South Africa and results in dental caries. It is prevented by fluoridation of drinking water.
- Zinc deficiency may result in growth failure and an increased risk of infections. Weekly zinc supplements decrease the incidence and severity of both pneumonia and diarrhoea. Zinc fortification of food is an important method of providing adequate amounts of zinc in the diet.
- Calcium and phosphate deficiency may cause rickets and increase the risk of osteoporosis in adult life. It is prevented by including milk in the diet.

Trace element and mineral deficiency is best avoided by taking a well-balanced diet.

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**IRON DEFICIENCY**

4-55 How common is iron deficiency?

Iron deficiency is common in South Africa and many poor countries. It is usually seen in young children, especially between the ages of 6 months and 2 years when breastfeeding has been stopped.
Iron deficiency is common in South Africa.

4-56 What are the common causes of iron deficiency in children?

1. Iron deficiency is usually due to inadequate amounts of iron in the diet. However it is often made worse by chronic bleeding from the gut due to intestinal parasites.
2. Cow’s milk contains little iron. Fortunately, most formula feeds contain additional iron which has reduced the incidence of iron deficiency in most formula-fed infants.
3. Immediate clamping of the umbilical cord at birth deprives the newborn infant of much iron, while preterm infants have low iron stores.

Iron deficiency in children is usually due to a poor diet and worms.

4-57 What are the clinical signs of iron deficiency?

Iron deficiency results in lethargy, poor appetite, eating soil (pica) and poor school performance. If the iron deficiency is severe enough, anaemia will develop as the result of inadequate amounts of iron to produce normal red cells. Therefore, anaemia is the commonest clinical presentation of iron deficiency. However, children with mild iron deficiency may not yet be anaemic and the diagnosis of iron deficiency is often missed.

Mild iron deficiency, (i.e. without anaemia), is usually managed by improving the diet to make sure the child receives adequate amounts of iron. Meat, eggs and green vegetables are rich in iron.

4-58 How is the diagnosis of iron deficiency confirmed?

With iron deficiency, the red cells usually appear small and pale on a blood smear (microcytic and hypochromic red cells). Therefore, this finding strongly suggests iron deficiency even if anaemia is not yet present.

Examining a blood smear is a useful way of screening for iron deficiency. Children with iron deficiency also have a low serum concentration of ferritin. This will prove the diagnosis. With severe iron deficiency the child will develop anaemia. The haemoglobin concentration is usually normal with mild iron deficiency.

4-59 How can iron deficiency be prevented?

1. By giving a good, balanced diet
2. By regularly deworming children
3. By waiting until the infant cries before clamping the umbilical cord after birth
4. Children at high risk of iron deficiency, such as preterm infants, should be given prophylactic oral iron. Once discharged home, preterm infants should receive ferrous lactate drops 0.6 ml (e.g. Ferrodrops) daily until 6 months of age.

Always store iron drops, syrup and tablets away safely where children cannot get them.

NOTE The prophylactic dose of iron is 1 mg of elemental iron/kg/day while the therapeutic dose is 1–2 mg of elemental iron/kg 3 times a day.

4-60 What is anaemia?

Anaemia is a haemoglobin concentration below the normal range for the age of the child. Children with anaemia also have a low packed cell volume. The haemoglobin concentration (Hb) normally falls for the first 3 months of life and then rises again at puberty. The normal Hb in children is about 11 g/dl with a lower limit of 9 g/dl. Children with a Hb below 9 g/dl are therefore anaemic.

Anaemia is not a disease but the result of many nutritional and medical problems. Iron deficiency is not the only cause of anaemia.

Children with a haemoglobin concentration below 9 g/dl are anaemic.
4-61 What are the presenting symptoms and signs of anaemia?

- Tiredness and general apathy
- Pallor of the nails and mucus membranes (i.e. pale)
- Heart failure, with shortness of breath on effort, in severe anaemia

Anaemia plus bruising or purpura, hepatosplenomegaly, bone tenderness or jaundice, suggest a serious illness and are indications for urgent referral to hospital.

4-62 What are the common causes of anaemia in children?

- Iron deficiency:
  - Early clamping of the umbilical cord at birth (reduces the newborn infant’s iron stores)
  - Preterm birth (preterm infants have low iron stores)
  - A diet deficient in iron
- Intestinal parasites
- Repeated nose bleeds
- Haemolysis, due to:
  - Malaria
  - Inherited blood disorders (e.g. spherocytosis, thalassaemia or sickle cell disease)
- Chronic illness, such as tuberculosis and AIDS
- Severe malnutrition (due to lack of protein to produce haemoglobin)

**NOTE** Less common causes include malignancies, bleeding disorders, folate deficiency, drug side effects and stomach ulcers.

Iron deficiency is by far the commonest cause of anaemia of children in South Africa and most poor societies.

**Iron deficiency is the commonest cause of anaemia in children in South Africa.**

4-63 What is the simplest method of confirming anaemia due to iron deficiency?

1. Showing that the Hb is low (below 9 g/dl). This can be done with a haemoglobinometer but is more accurately measured with a full blood count.
2. Examination of a peripheral blood smear to show small, pale red cells
3. A trial of iron treatment

**NOTE** Finding a low mean red cell size and haemoglobin concentration on a full blood count will confirm the finding of microcytosis and hypochromia on a peripheral smear.

4-64 What is the treatment of iron deficiency anaemia?

Oral iron should be given for 4 weeks and the Hb should then be checked. If the Hb has improved, the oral iron should be continued for another 2 months to replace the iron stores. Therefore, full treatment is oral iron for 3 months. If the Hb has not increased by 4 weeks the child must be referred for further investigations.

Iron deficiency anaemia is treated with ferrous gluconate (or sulphate) syrup 0.25 ml/kg 3 times a day. Always deworm the child with mebendazole or albendazole.

All anaemic children with signs of heart failure must be urgently referred to hospital as they may need a blood transfusion.

The commonest mistake in treating iron deficient anaemia is stopping the oral iron too soon.

**CASE STUDY 1**

A 5-year-old child attends a clinic where he is weighed. The weight is then plotted on the weight-for-age chart in his Road-to-Health Card. His weight falls just below the 3rd centile. He appears generally well but thin. The mother is out of work and has no financial support.

1. Does this child have malnutrition?

Yes. He probably has mild protein-energy malnutrition. He is underweight-for-age as his weight falls just below the 3rd centile. There is no evidence on the history that there is a
medical reason for being underweight-for-age. The family history suggests that there is not enough money for an adequate balanced diet.

2. How would you confirm the diagnosis?

Firstly, by taking a dietary history and confirming that he receives a poor diet. Secondly, by demonstrating weight gain when his diet is improved.

3. What is the danger of being underweight-for-age?

Children who are underweight-for-age are at high risk of developing a more severe form of protein-energy malnutrition if their diet becomes worse or they have an infection such as diarrhoea or measles. Children who are underweight-for-age have a weakened (suppressed) immune system and, therefore, are also at increased risk of a serious infection such as tuberculosis.

4. What is the value of examining this child's growth curve and growth pattern?

The growth curve will show whether he has been underweight-for-age for a long time or has only recently lost weight. The growth pattern would also be helpful as a height below the normal range will indicate stunting while a normal height will suggest recent weight loss. Recent weight loss may suggest an infection such as AIDS.

5. What are energy foods?

- Carbohydrates such as bread, maize, potatoes, rice, porridge and sugar.
- Fats, such as dairy products, or vegetable and fish oils.

6. What dietary management does this child need?

He needs enough of a balanced diet. His mother needs to be told what cheap foods are high in protein and energy (maize together with beans or milk mixed with porridge). She also needs social and financial assistance. It is important to watch this child's weight over the next few months to make sure that he is gaining weight adequately. It would be wise to give him 200,000 units of oral vitamin A as he is probably deficient in vitamin A.

CASE STUDY 2

An 18 month old child is seen at a local hospital. The child is very thin and wasted. Her weight falls well below the 3rd centile (also below 60% of the 50th centile). There is no rash or oedema. She is pale and has thickening of her wrists and ankles. The mother was drunk when she brought the child to hospital.

1. What is your diagnosis?

Marasmus. The weight falls far below the 3rd centile (below 60% of the 50th centile). The cause is almost certainly starvation and neglect.

2. What should be the initial treatment?

Admit the child immediately to hospital for resuscitation. Look for and treat any hypothermia, dehydration or hypoglycaemia. Small oral or nasogastric feeds should be started. If possible, do not start an intravenous infusion. Start antibiotics even if there is no obvious infection. Her social circumstances will have to be investigated and managed.

3. Why is the child pale?

She probably has iron deficiency anaemia due to a poor diet and possibly because of chronic infection. Only once she is taking feeds well and looking better should oral iron be started.

4. What additional diagnosis is suggested by the swelling of her wrists and ankles?

Rickets, due to a deficiency of vitamin D in her poor diet. She has probably also had very little exposure to sunlight. The treatment would be 1000 units vitamin D daily for a month. She almost certainly needs a multivitamin syrup as she is probably deficient in other vitamins as well.
5. How could the marasmus be prevented?
If she had been taken to the local clinic for routine weighing every month her failure to thrive would have been detected before she reached the stage of severe malnutrition. Steps could then have been taken to manage the nutritional and social problems.

CASE STUDY 3

A very miserable child is seen at an urban clinic after he had been brought from a poor rural district by his grandmother. He appears swollen, with oedema of the face and legs. There is a pigmented, scaly rash on the trunk and legs. His weight is plotted on the 3rd centile but this falls to below the 3rd centile during his first week in hospital. His hair is very thin and he has a bad cough.

1. What is wrong with this child?
He has all the clinical signs of kwashiorkor: misery, oedema, thin hair and a rash. Often children with kwashiorkor are not very underweight when they present as they are oedematous. Their weight often falls markedly when they lose their oedema.

2. Why is this child severely malnourished?
Probably as the result of poverty. There may be a drought in the rural area. Sometimes only maize meal is available (which is low in protein).

3. What diagnosis could the cough suggest?
He may have tuberculosis. This will need to be investigated.

4. Is kwashiorkor a fatal illness?
Up to 25% of children with kwashiorkor will die despite treatment.

5. What feeds should be given to this child?
Children with severe malnutrition are usually started on lactose-free feeds. Small feeds are given at first as a high volume intake can cause heart failure. Potassium is added to their feeds as they are severely potassium depleted. Once he is improving he can be given follow-on formula.

6. What cheap food gives high quality protein?
Breast milk, provided the mother can be traced and convinced to restart breastfeeding. Otherwise, milk powder or beans can be added to the diet to increase the amount of protein.

7. What other form of malnutrition can cause a pigmented, scaly rash?
Pellagra, due to niacin deficiency. The rash usually occurs on the face, neck and chest in a necklace distribution, arms and legs (i.e. exposed areas).

CASE STUDY 4

An 18 month old girl presents with a history of poor feeding and eating sand. On examination she has a normal weight for age and appears generally well. However her nails and tongue are pale. The mother says that she drinks a lot of cow’s milk and does not want to eat solid foods.

1. Why is this child pale?
She is probably anaemic.

2. How would you confirm this diagnosis?
By measuring her haemoglobin concentration which should be about 11 g/dl. A concentration below 9 g/dl at her age would indicate anaemia.

3. What do you think is the most likely cause of her anaemia?
Iron deficiency. Eating sand (pica) and a poor appetite are common in children with iron
deficiency. Cow’s milk is a poor source of iron. She may also have intestinal parasites.

4. What is a simple method of confirming iron deficiency anaemia?

By measuring the haemoglobin concentration and then examining a peripheral blood smear. Small pale red cells strongly suggest iron deficiency. The presence of iron deficiency can be proved by a low serum ferritin concentration. Therefore, a Hb below 9 g/dl plus a typical smear or low serum ferritin would confirm the diagnosis of iron deficiency. The diagnosis would be supported if the Hb increased with a month of iron treatment.

5. What is the management of iron deficiency anaemia?

Ferrous gluconate (or sulphate) syrup 0.25 ml/kg 3 times a day for 3 months. She should also be ‘dewormed.’
When you have completed this unit you should be able to:

- Define and diagnose diarrhoea.
- Understand the importance and danger of diarrhoea.
- List the causes and complications of diarrhoea.
- Diagnose and grade the severity of dehydration.
- Manage diarrhoea.
- Treat dehydration.
- Prevent diarrhoea.

### 5-1 What is diarrhoea?

Diarrhoea (or diarrhoeal disease) is defined as the passage of frequent, loose, watery stools at least 3 times a day. Diarrhoea is not a single condition but simply a clinical sign, which has many different causes. With diarrhoea excessive amounts of water and electrolytes (salts such as sodium and potassium) are lost into the stool.

### 5-2 Is diarrhoea common?

Yes, it is one of the commonest problems in childhood throughout the world.

### 5-3 Can diarrhoea be dangerous?

Yes. Diarrhoea can be life threatening if it is severe. Diarrhoea causes a loss of fluid and electrolytes in the stool, which can result in dehydration and electrolyte imbalance. The correct management of diarrhoea is important as diarrhoea is one of the leading causes of death in children, especially in poor countries. Each year about 4 million children worldwide die of diarrhoea.

### 5-4 What are the common causes of diarrhoea?

The 2 commonest causes of diarrhoea are:

1. Gastroentestinal infections
2. Food allergy or intolerance

**Note** Less common causes of diarrhoea include food poisoning (bacterial toxins), a side effect of antibiotics (bacterial overgrowth), some drugs which increase gut motility, coeliac disease and cystic fibrosis (malabsorption).
5-5 What infections cause diarrhoea?

1. Infections of the bowel:
   - Viruses, such as Rota virus and measles. Rota virus is the commonest cause of diarrhoea in children.
   - Bacteria, such as E. coli (Eschericia coli), Shigella, Salmonella, Campylobacter and Cholera.
   - Protozoa (small one-celled organisms), such as Giardia, Amoeba and Cryptosporidium.

2. Infections outside the bowel:
   - Children with bacterial infections, such as otitis media, septicaemia and urinary tract infection may also have diarrhoea.
   - In some children who present with diarrhoea, the infection is not in the bowel but elsewhere (parenteral diarrhoea).

Rota virus infection of the bowel is the commonest cause of diarrhoea in children.

5-6 What food intolerances cause diarrhoea?

1. Carbohydrate intolerance especially lactose intolerance.
2. Protein intolerance especially cow's milk protein intolerance.

Both lactose intolerance and cow's milk protein intolerance usually cause persistent diarrhoea following earlier damage to the bowel caused by gastroenteritis.

Note: Diarrhoea due to carbohydrate induced intolerance may be caused by the excessive intake of fruit juice especially apple juice (fructose intolerance).

5-7 What is gastroenteritis?

Gastroenteritis (or acute diarrhoeal disease) is an acute infection of the bowel resulting in watery diarrhoea without visible blood or mucus in the stool. It is caused by a wide range of organisms which interfere with the normal functioning of the cells that line the bowel wall, resulting in loss of water and electrolytes into the stool. It is the commonest form of diarrhoea in childhood. Vomiting and abdominal cramps in older children are common with gastroenteritis but pyrexia is absent or only mild.

Gastroenteritis is usually caused by Rota virus or E. coli. Rota virus is highly infectious and seen in both poor and wealthy communities especially in children less than 1 year old. The infection is usually spread from the stool of the infected person by unwashed hands or contaminated water or food (the faecal–oral route). Poor hygiene or sanitation may result in outbreaks of gastroenteritis. Gastroenteritis usually presents as acute diarrhoea. However, if the bowel mucosa is damaged by the infection, gastroenteritis may also result in persistent diarrhoea.

Gastroenteritis is an acute infection of the bowel, causing diarrhoea.

Note: Rota virus causes direct bowel mucosal damage while most types of E. coli produce toxins which interfere with the normal function of the bowel wall leading to excess water and electrolyte loss.

5-8 What is acute diarrhoea?

Acute diarrhoea is watery diarrhoea which lasts less than 2 weeks (14 days). Acute diarrhoea is usually due to gastroenteritis (an acute infection of the bowel).

Note: Often the term gastroenteritis and acute diarrhoea are used interchangeably. However, acute diarrhoea is not always caused by an infection of the bowel but can also result from an infection elsewhere in the body or food intolerance.

5-9 What is persistent diarrhoea?

Diarrhoea usually recovers within 7 days. However, if diarrhoea does not recover by 2 weeks (14 days), it is called persistent (prolonged or chronic) diarrhoea. Persistent diarrhoea is common in malnourished children and children with HIV infection.
Diarrhoea for more than 14 days is persistent diarrhoea.

5-10 What is the relationship between diarrhoea and malnutrition?

Diarrhoea is commoner and more severe in children with malnutrition (i.e. undernutrition). Therefore malnourished children often have persistent or repeated diarrhoea. In addition, malnourished children are more likely to develop severe diarrhoea and die from it. There is therefore a close relationship between diarrhoea and malnutrition.

Diarrhoea is both common and more severe in children with malnutrition.

Persistent or repeated diarrhoea may result in weight loss and malnutrition in children who were previously well nourished. Diarrhoea, especially persistent diarrhoea, often precipitates marasmus or kwashiorkor in children who already are mildly malnourished. Therefore, both malnutrition and diarrhoea often occur in the same children. The one condition often makes the other condition worse.

Diarrhoea may precipitate or aggravate malnutrition.

5-11 Is diarrhoea common in children with HIV infection?

Yes, diarrhoea is common and may be the presenting sign in children with HIV infection. In children with HIV infection, diarrhoea is not only more frequent but also more severe and takes longer to recover. Diarrhoea is often persistent in children with HIV infection and is a common cause of death.

5-12 Which infants are at greatest risk of dying from diarrhoea?

- Infants under 6 months of age
- Malnourished infants
- Children with AIDS

5-13 What is cholera?

Cholera is a severe, highly infectious form of watery diarrhoea which is common in undeveloped countries. Cholera occurs in epidemics as has happened in some areas of South Africa in recent years. It is caused by a bowel infection with *Vibrio cholerae*. The stools in cholera as typically watery with small pieces (flecks) of mucus (‘rice water stools’). Cholera can rapidly lead to dehydration and death, even in adults. Always think of cholera if there is a local epidemic, especially with severe dehydration in an older child.

5-14 What is dysentery?

Dysentery is a form of diarrhoea where the stool is not simply watery, but also contains visible blood and mucus. Dysentery is usually caused by organisms which invade and damage the bowel wall. These children usually look ill (toxic) and have a high temperature. Dysentery is usually caused by Shigella, Salmonella, Campylobacter, Amoeba and some types of *E. coli*. The commonest cause of dysentery is Shigella. Dysentery is severe if there are signs of dehydration.

Dysentery is diarrhoea containing blood and mucus.

**Note** With dysentery, the organisms invade and damage the bowel wall, causing bleeding and the secretion of mucus.

5-15 What is typhoid?

Some bacteria which cause diarrhoea, can invade the bowel wall and spread into the blood stream resulting in septicaemia. Septicaemia usually complicates diarrhoea with infections caused by Salmonella, Shigella and Campylobacter. Septicaemia is commoner in dysentery than in watery diarrhoea.

Typhoid is a septicaemia caused by a bowel infection with *Salmonella typhi*. These children are very ill and may die if not treated early with antibiotics.
Children with typhoid may appear severely ill and toxic with only mild diarrhoea or no diarrhoea at all.

5-16 What are the complications of acute diarrhoea?

- Dehydration
- Shock
- Acidosis
- Electrolyte loss
- Ileus
- Hypoglycaemia
- Septicaemia
- Malnutrition

Severe dehydration is the commonest cause of death in infants with diarrhoea and by far the most important complication.

**Dehydration is the most important complication and the commonest cause of death in infants with diarrhoea.**

5-17 How can you recognise dehydration?

Dehydration develops when excessive amounts of fluid are lost from the body. Diarrhoea can rapidly lead to dehydration, especially if vomiting is also present. Both the history and the clinical examination are important in assessing whether a child is dehydrated.

In all children with diarrhoea the following signs must be looked for:

- Offer the child a drink. Is the child able to drink? Is there increased thirst or a refusal to drink? Does the child vomit after drinking?
- Is the child restless and irritable or lethargic or unconscious?
- Are the eyes sunken?
- Is the skin turgor (elasticity) decreased?
- Is the infant’s fontanelle sunken?
- Has there been a sudden weight loss?

5-18 How can you recognise loss of skin turgor?

The normal skin turgor is the elasticity (stretch) which enables skin to rapidly return to its previous position after it is gently pinched into a tent shape for 2 seconds. Normally skin returns to its position immediately after being pinched and then released. With decreased skin turgor, the skin takes longer than normal to return to its previous position. Decreased skin turgor is caused by a loss of fluid from the skin. The greater the loss of skin turgor, the longer it takes for the skin to go back to the normal position.

Skin turgor is best tested over the abdomen. Using the thumb and first finger, a fold of skin on one side of the umbilicus is lifted and gently squeezed for 2 seconds and then released. Observe how quickly or slowly the skin returns to its normal position.

**NOTE** Wasted newborn infants and marasmic children may have decreased skin turgor without being dehydrated (lack of subcutaneous fat) while decreased skin turgor can be difficult to detect in fat children who are dehydrated.

5-19 How can the degree of dehydration be assessed?

All children with diarrhoea must be examined for signs of dehydration. The degree of dehydration can be roughly assessed clinically into ‘no visible’ dehydration, ‘some’ dehydration or ‘severe’ dehydration. This is important as it is essential to identify children with severe dehydration.

1. ‘No visible’ dehydration: The child has no signs of dehydration or not enough signs to be classified as ‘some dehydration’. However, many children with ‘no visible dehydration’ have still lost more fluid than normal. They often are thirsty and pass little urine.
2. ‘Some’ dehydration: They have 2 or more of the following signs:
   - Very thirsty and drinks eagerly
   - Restless and irritable
   - Sunken eyes
   - Moderate degree of decreased skin turgor. When pinched, the skin takes longer than usual, but less than 2 seconds, to return to normal.

3. ‘Severe’ dehydration: They have 2 or more of the following signs:
   - Not able to drink or drinks very poorly
   - Lethargic or unconscious
   - Eyes very sunken.
   - Severe decrease in skin turgor. When pinched, the skin takes 2 seconds or more to return to normal.
   - Shock with delayed capillary filling time

Severe dehydration leads to shock, acidosis, electrolyte loss, an ileus and hypoglycaemia.

Always start by first looking for signs of severe dehydration. If the child has 2 or more signs of severe dehydration, then the child is classified as severe dehydration. If the child does not have 2 or more signs of severe dehydration, then look for signs of some dehydration. If there are 2 or more signs of some dehydration, the child is classified as some dehydration. If there are no signs or only 1 sign of some dehydration present the child is classified as no visible dehydration.

**The degree of dehydration must always be assessed in children with diarrhoea.**

**NOTE** Children with ‘some’ dehydration often also have a dry mouth, poor urine output and do not look well. Children with ‘severe’ dehydration appear severely ill and are hypotensive, with a rapid, weak pulse, cold peripheries, and have acidotic breathing.

5-20 How can weight loss help to decide the degree of dehydration?

Weight loss is the best measure of the degree of dehydration. Unfortunately the child’s weight at the onset of the diarrhoea is often not known. Therefore, this method of assessing the degree of dehydration is only of limited use. With ‘some’ dehydration, less than 10% of body weight is lost while 10% or more of body weight is lost with ‘severe’ dehydration. A child may lose up to 5% of body weight (and body fluid) before the signs of dehydration can be recognized.

**NOTE** If a child is 10% dehydrated, 10% of the body weight will have been lost as fluid in the stool or vomitus (i.e. 100 ml/kg as 1 ml of body fluid weighs 1 g).

5-21 What is shock?

Shock (hypovolaemic shock in dehydration) is the failure of the heart to maintain adequate circulation due to the loss of fluid. With excessive fluid loss in the stools, the volume of fluid in the circulation falls and there is not enough fluid to allow normal blood flow to the small capillaries of the body. As a result, blood flow slows down or stops in the capillaries and the body cells do not receive enough oxygen and food. Shock presents with:

- A delayed capillary filling time
- Tachycardia (a fast heart rate)
- A weak radial pulse which is difficult to feel
- Hypothermia (low body temperature) especially cold hands and feet (cold peripheries)
- A depressed level of consciousness (lethargy and drowsiness)
- Hypotension (low blood pressure) with weak or impalpable peripheral pulses

The blood pressure may still be normal in the early stages of shock. Shock is a very serious sign and indicates that the child will probably die unless immediate treatment is started.

**Shock is the failure of the peripheral circulation due to the loss of fluid.**

5-22 How is a delayed capillary filling time measured?

The most important sign of shock is a delayed capillary filling time of more than 3 seconds. The capillary filling time is measured by
pressing on the sole of the child's foot or palm of the hand, then releasing the pressure and counting how many seconds it takes for the pale area to regain its pink colour. Pressing on the nail of the middle finger can also be used to measure the capillary filling time. In order to count in seconds, and not too fast or too slow, it is useful to count 'one crocodile, two crocodiles, three crocodiles, etc'. The return of colour to the pale area is due to the capillaries filling once more with blood. Therefore, this is a good way of assessing the state of the peripheral circulation (the blood flow through the capillaries). Slow filling of the capillaries shows that the blood is not circulating properly.

Children with diarrhoea lose excessive amounts of fluid and electrolytes in the stool.

An electrolyte imbalance (too much or too little of one or more of the electrolytes) may be caused by dehydration or using an incorrect rehydration fluid. Electrolyte imbalance presents as floppiness (hypotonia), drowsiness or fits.

5-23 What causes acidosis in children with diarrhoea?

With poor peripheral perfusion due to shock, many cells in the body no longer receive enough oxygen and, therefore, are no longer able to produce energy by fully breaking down carbohydrates and fats. This failure of metabolism results in the formation and accumulation of lactic acid, which causes metabolic acidosis. Metabolic acidosis is made worse in diarrhoea by the loss of bicarbonate in the stool. The use of aspirin (salicylates) may also make the acidosis worse.

Children with a metabolic acidosis develop rapid sighing (deep) breathing. The clinical diagnosis of acidosis can be confirmed by blood gas analysis.

5-24 Why do children with diarrhoea lose electrolytes?

Children with diarrhoea lose both fluid and electrolytes in the stool. Important electrolytes which are lost include sodium, potassium, calcium, magnesium, chloride, phosphate, and bicarbonate. Electrolytes are also lost with excessive vomiting.

5-25 What is ileus?

Ileus is distension of the abdomen due to a decrease or absence of the bowel movements (peristalsis). No bowel sounds can be heard. This lack of peristalsis is due to infection and loss of potassium. Ileus usually does not cause abdominal pain or bile stained vomiting.

5-26 What is the danger of hypoglycaemia?

Hypoglycaemia in children is defined as a blood glucose concentration of less than 3 mmol/l. Severe diarrhoea, especially in malnourished children who refuse feeds or have severe vomiting, may cause hypoglycaemia. This can result in loss of consciousness or convulsions. Hypoglycaemia must always be suspected in children with diarrhoea who have fits or a decreased level of consciousness.

Hypoglycaemia is a very serious complication that requires urgent diagnosis and immediate treatment with intravenous glucose. Hypoglycaemia can be confirmed by measuring the blood glucose concentration with a reagent strip.

5-27 How is septicaemia recognised?

Some infants with diarrhoea appear very ill and have bacteria circulating in their blood.
This is called septicaemia. Septicaemia should be suspected if the child has a high temperature (pyrexia) or appears a lot sicker that you would expect for the degree of dehydration or does not improve after the dehydration is corrected. Septicaemia is commoner in infants below 3 months, in malnourished children and in children with dysentery. Associated HIV infection makes septicaemia more likely, more serious and more dangerous.

5-28 What signs suggest that the diarrhoea may have a surgical cause?
- Repeated, severe vomiting
- A markedly distended abdomen
- Bile stained vomiting
- Passing a lot of blood and mucus with little stool
- Severe, continuing abdominal pain (not just intermittent cramping pains)

These children must be referred to hospital urgently for further investigation.

TREATMENT OF DIARRHOEA

5-29 What is the management of a child with acute diarrhoea?
1. The most important aspect of management is to start oral rehydration therapy as early as possible to prevent dehydration from occurring. Oral rehydration solution should be used. With frequent, small drinks most children with mild diarrhoea can be adequately managed without developing dehydration.
2. Breastfeeding, formula or solid feeds should be continued unless the child has severe vomiting.
3. The clinical condition of the child must be continually assessed for signs of complications, especially dehydration.
4. Treat the complications if they occur.

Treatment must be started early and every effort must be made to prevent dehydration by replacing the fluid losses. It is important to teach mothers that acute diarrhoea is treated with oral rehydration solution and not with medicines. Thirst is often a good guide to the need for oral rehydration solution. The management of most children with acute diarrhoea is both simple and cheap. Intravenous fluid (‘a drip’) is usually not necessary. There is no need for routine stool cultures in acute diarrhoea.

5-30 Will milk feeds make acute diarrhoea worse?
Although continuing milk feeds in infants may appear to make the diarrhoea worse, it is important to continue feeds as it helps to provide energy and replace fluid and electrolyte losses. Infants recover from diarrhoea faster if milk feeds are continued. Breastfeeding or full-strength formula should be used. There is no need to dilute feeds. The aim of feeding during diarrhoea is to maintain nutrition. Rehydration solution should be given in addition and not be used to replace feeds.

Milk feeds must not be stopped in infants with acute diarrhoea.

5-31 Can children with acute diarrhoea continue to be fed solid food?
If the child is already receiving solid food, this should be continued unless the child is vomiting a lot. Small feeds should be given frequently (at least every 4 hours). This is particularly important in children who are malnourished as diarrhoea can make the malnutrition rapidly worse. Extra feeds should be given while the child is recovering from the diarrhoea to improve weight gain. Feeding during diarrhoea does not increase the number of stools.
5-32 Should anti-diarrhoeal medication be used to treat acute diarrhoea?

Medicine is usually not necessary and may even be dangerous in small children. Anti-diarrhoeal medication such as codeine, Imodium (loperamide) and Lomotil (diphenoxylate) decrease peristalsis and may cause ileus. They improve cramps in older children but do not prevent the loss of fluid and electrolytes from the gut. Medications which absorb water like pectin and kaolin have no role in the management of children with diarrhoea. Antiemetics (to reduce vomiting) are also not used. Traditional medicine, especially enemas, must not be given.

5-33 Should antibiotics be routinely given to children with acute diarrhoea?

Most cases of acute diarrhoea are caused by a virus and do not respond to antibiotics. Indication for antibiotics are:

- Suspected septicaemia (very ill with a high fever)
- Small infants (under 1 month)
- Severely malnourished children
- Dysentery (blood in the stools)
- Suspected cholera

Infants who are sick enough to receive antibiotics should be referred to hospital for management.

Routine antibiotics should not be used to treat acute diarrhoea.

**NOTE** Ill infants with suspected septicaemia must receive systemic antibiotics. Dysentery (often due to Shigella) is usually treated with oral nalidixic acid (12.5 mg/kg/dose 6 hourly for 5 days) while persistent diarrhoea (often due to *Amoebae* or *Giardia*) is treated with metronidazole (Flagyl).

5-34 What should you do if the child vomits a lot?

Infants with acute diarrhoea may vomit. However, the vomiting usually stops once the dehydration is corrected. If the oral rehydration solution is vomited, a smaller amount should be given slowly about 10 minutes later. The best way to avoid vomiting is to give small sips of fluid frequently by cup. If severe vomiting continues, a serious cause of the diarrhoea should be looked for, and continuous nasogastric or intravenous fluid must be started.

There is no role for antiemetics (drugs which stop vomiting) in the management of vomiting in children with acute diarrhoea. They can have serious side effects.

5-35 Can a child with acute diarrhoea be treated at home?

Children with mild diarrhoea and no visible signs of dehydration can be treated at home with continuing feeds and oral rehydration solution. If the diarrhoea becomes worse or does not recover in 2 days the child must be seen at a clinic. Children who refuse to drink or who vomit repeatedly must be taken to a clinic immediately as they are at great risk of dehydration. Counsel the mother to seek help if the infant’s eyes or fontanelle appear sunken. Most children with diarrhoea can be managed at home. The mother must know how to give rehydration solution correctly and when to bring the child back to clinic.

**Children with mild diarrhoea can be treated at home with feeds and oral rehydration solution.**

The guidelines for managing acute diarrhoea at home are:

1. Give extra fluids.
2. Continue feeding.
3. Know when to take the child to the clinic or hospital.

5-36 What is oral rehydration therapy?

Oral rehydration therapy (ORT) is the most important part of managing acute diarrhoea and saves the lives of millions of children worldwide each year. ORT consists of giving oral rehydration solution by mouth early in
acute diarrhoea to prevent or treat dehydration. Give frequent small sips from a cup.

**Oral rehydration therapy saves million of lives every year.**

5-37 What is oral rehydration solution?
Oral rehydration solution (ORS) is a mixture of water, electrolytes (salts) and glucose which is given by mouth to provide energy and replace the fluid and electrolytes which have been lost. Oral rehydration solution can be:

- Bought commercially.
- Made up in the home as a sugar and salt solution.

5-38 What is commercial oral rehydration solution?
There are a number of different brands of commercially available oral rehydration solution (e.g. Sorol). They all contain a balanced mixture of electrolytes and water together with glucose. They are usually sold in the form of a powder which is packaged in a sachet (small packet). One sachet of powder should be mixed in one litre of water. The cleanest available water must be used. Sterile or boiled water (which has been allowed to cool) is best. Commercial oral rehydration solution powder should be kept in as many homes with children as possible.

**NOTE** Standard ORS contains 90 mmol/l of sodium and 111 mmol/l of glucose. However, WHO and UNICEF have recently advised that a solution of 75 mmol/l of both sodium and glucose is preferable as it gives an effective ORS with a lower osmolality.

5-39 How can a sugar and salt solution be made at home?
Home made sugar and salt solution (SSS) is not quite as good as commercial oral rehydration solution as it does not contain potassium. However, it is immediately available and often lifesaving. The commonest recipe for a sugar and salt solution is:

1. 1 litre of clean water.
2. 8 level teaspoons of sugar.
3. ½ of a level teaspoon of table salt.

One litre of water can be measured with a measuring jug or a one litre cool drink bottle. The sugar and salt must be added to the litre of clean water and mixed well. It is very important not to add too much salt. If possible, the sugar and salt solution should be given by cup or by spoon as this avoids using dirty bottles. It is dangerous to add a sachet of rehydration powder to the sugar and salt solution as this will make the solution too concentrated.

**A sugar and salt solution for oral rehydration can be easily made up at home.**

5-40 Who should know how to make up sugar and salt solution for oral rehydration?
Every mother or caretaker should know how to make up a sugar and salt solution and have the necessary ingredients at home. The recipe for making sugar and salt solution is given in some Road-to-Health Cards.

5-41 When should oral rehydration therapy be started?
As soon as the diarrhoea is noticed. It is very important to start oral rehydration therapy as early as possible to prevent dehydration. The earlier it is started the quicker the child will get better. It is important to start oral rehydration therapy before taking the child to a doctor or nurse.

**Oral rehydration therapy at home should be started as soon as possible, to prevent dehydration.**

5-42 How much oral rehydration solution should be given?
It is best to give the oral rehydration solution frequently and in small volumes. Too much fluid at one time may cause vomiting. Give as much fluid as the child will take. Most children with no or only some dehydration
will drink as much oral rehydration fluid as they need to replace the fluid lost. Children with some dehydration are usually very thirsty. However, children with severe dehydration are very ill and may refuse to drink. Usually 25 ml (5 teaspoons) can be given every 10 minutes. If the child vomits, try again in another 10 minutes. If the child refuses the fluid or continues to vomit the fluid, nasogastric or intravenous therapy may be needed. This is particularly important if a vomiting child appears to be dehydrated.

5-43 Which children with acute diarrhoea should be referred to hospital?

Most children with acute diarrhoea can be managed at home or at a primary care clinic. However, the following children should be referred to hospital for further management:

- Children with signs of severe dehydration or shock
- Children who have lost more than 10% of their body weight
- Children who continue to vomit despite being given oral rehydration solution
- Children with a fever or other signs of infection
- Children who have had a convulsion (fit) or are very irritable

5-44 What is the management of persistent diarrhoea?

Children with persistent diarrhoea should be referred to hospital for investigation and further management. Correct dehydration if present. Offer oral rehydration solution even if the child is not visibly dehydrated. Consider HIV in any child with persistent diarrhoea.

**NOTE** The stool should be cultured and examined under a microscope in an attempt to identify the cause. Secondary lactose intolerance is common. Often a lactose free formula (Isomil, Infasoy) is given for a few weeks.

5-45 What is the management of dysentery?

These children should be referred to hospital for investigation and treatment. Correct dehydration. An antibiotic is needed. Usually, nalidixic acid is given 6 hourly for 5 days (2.5 ml if 12 to 24 months; 5 ml if 2 to 5 years; 7.5 ml if older than 5 years).

**NOTE** Dysentry is usually due to Shigella, which has become resistant over the years to many antibiotics. Ciprofloxacin may be required.

**MANAGEMENT OF DEHYDRATION**

5-46 What is the management of a child with diarrhoea but no visible dehydration?

These children are losing excessive amounts of fluid and electrolytes in their stools and therefore must still be given extra fluid and electrolytes to prevent signs of dehydration from appearing.

1. These children should be managed at home or at a clinic using commercial oral rehydration solution or sugar and salt solution to replace fluid losses. Give as much fluid as the child will take. Continue with extra fluids until the diarrhoea stops.
2. Normal feeds should be continued. Breastfeeding mothers should continue to give breastfeeds.
3. The child should be closely observed for continuing loose stools or vomiting. Signs of dehydration must also be looked for.
4. The mother should bring the child to the clinic immediately if the child becomes more sick, develops signs of dehydration, refuses feeds or vomits a lot.
5. Children with diarrhoea but no visible dehydration, who are managed at home, should return to the clinic in 5 days if the diarrhoea has not stopped.

The aim of early home care is to prevent dehydration and continue feeding. The mother must know what fluids to use and how much
to give. She must also know when to return to the clinic.

**Home care with oral rehydration solution can usually prevent dehydration.**

**NOTE** Children with ‘no visible’ dehydration who do not meet the criteria needed to be classified as ‘some’ dehydration may still have lost about 5% of their body fluid (about 5% loss in body weight and therefore need extra fluids).

5-47 What is the treatment of a child with some dehydration?

These children with 2 or more clinical signs of ‘some’ dehydration should initially be managed in a clinic or hospital if possible as they can progress to ‘severe’ dehydration:

1. They can be treated with oral rehydration solution with a close watch for repeated vomiting or a refusal to drink. It is best if the oral rehydration solution is given by cup and/or spoon.
2. 80 ml/kg of oral rehydration solution should be given over 4 hours, i.e. about 20 ml/kg each hour. More can be given if the child wants to drink more. It is best if the child has frequent, small sips. If the child vomits, wait for 10 minutes and then try again more slowly.
3. The degree of dehydration must be assessed after 4 hours.
4. If the child takes the oral rehydration solution well, is not vomiting and there are no longer signs of dehydration (and the child has gained weight) after 4 hours, the child can be sent home and return to be assessed the next day. At home the child should be managed with oral rehydration solution (as for diarrhoea with ‘no visible’ dehydration). The decision to send the child home will depend on the home circumstances. The mother must bring the child back immediately if the diarrhoea gets worse, the child vomits everything or signs of dehydration appear.
5. It is important that the child continues to receive regular feeds (especially breastfeeds) plus oral rehydration solution until the diarrhoea stops. Oral rehydration solution does not cause the fluid loss in the stools to increase.
6. The mother must know how to make up the rehydration solution correctly and how much to give.

If the infant refuses to drink fluids or vomits repeatedly after drinking, a continuous nasogastric drip should be started. If there are still signs of ‘some’ dehydration after 4 hours, continue with the oral or nasogastric rehydration solution and assess again after a further 4 hours. If signs of severe dehydration develop, manage the child for ‘severe’ dehydration.

The lives of most children with diarrhoea can be saved by the simple, cheap use of oral rehydration therapy at home or in a local primary care clinic.

**Children with some dehydration are treated at a clinic or hospital with extra fluids in addition to continuing normal feeds.**

**NOTE** The WHO recommends 75 ml/kg of oral rehydration solution over 4 hours.

5-48 What is the treatment of a child with severe dehydration?

The management of children with severe diarrhoea leading to severe dehydration is a medical emergency. Look carefully for shock in all children with severe dehydration and treat immediately:

1. Immediately start an intravenous infusion with Ringer’s lactate (or half normal saline or half strength Darrows/dextrose solution).
2. Give 30 ml/kg over the first half hour (30 minutes). Then give 70 ml/kg over 2 ½ hours (i.e. about 30 ml/kg per hour). Most infants are therefore rehydrated with 100 ml/kg over 3 hours.
3. The child must be closely observed and reassessed every half hour. If the clinical signs of dehydration have not improved after an hour, fluid should be given faster.
Careful assessment after 3 hours is needed to decide whether further management should be for 'no visible', 'some' or 'severe' dehydration.

4. If an intravenous infusion cannot be started, pass a nasogastric tube and give 20 ml/kg/hour over 6 hours (i.e. 120 ml/kg). Nasogastric rehydration is slower than intravenous rehydration as it takes time for the fluid to be absorbed. If there is repeated vomiting or abdominal distension, give the nasogastric fluid slower or try again to start an intravenous infusion.

5. Only once intravenous or nasogastric rehydration has been started, should the child be moved urgently to hospital. Always start replacing fluid before moving the child. One of the commonest mistakes made is to rush the child to hospital before starting intravenous or nasogastric fluid. If no equipment is available to give fluid fast, try to get the child to drink while being urgently transported to hospital.

6. Oral rehydration solution should be started when the child is able to drink.

Never rehydrate an infant or child with 5% or 10% dextrose only as they need electrolytes as well as fluid and glucose. Rehydration fluids must always contain some glucose (dextrose).

5-49 What is the treatment of dehydration resulting in shock?

Give intravenous Ringer's lactate or normal saline 20 ml/kg as fast as possible. Continue to give fluid at this fast rate until the signs of shock have disappeared. An easily felt radial pulse and normal capillary filling time are very reassuring signs of a good response to management. Once shock has been corrected, Ringer's lactate, half normal saline or half Darrows/dextrose solution is then given at the standard rate for severe dehydration (i.e. 30 ml/kg per hour).

20 ml/kg of intravenous fluid is given as fast as possible if shock is present.

If it is not possible to start an intravenous line, the intraosseous route can be used in young children if the health worker is trained in this technique. A nasogastric drip can be used if neither intravenous or intraosseous routes are available. Haemacel, fresh frozen plasma or stabilized human serum (SHS) can also be used to treat shock. Using the intraosseous route in children under six years of age can be a life-saving procedure.

In an emergency with ongoing shock, where several attempts to place an intravenous line have failed, use the intraosseous route. The most suitable site is 2 cm below the tibial tuberosity on the flat surface of the tibia (shin bone). A wide-bore needle (15–18 gauge) can be used if a needle with stylet is not available. In children under 18 months, an 18 × 1.5 or 20 × 1.5 lumbar puncture needle is suitable. Hold the needle perpendicular to the skin and with a twisting movement push it into the flat part of the tibia until a ‘give’ is felt; the needle is now in the bone marrow. Do not advance it any further. In a shocked patient, fluid must be introduced under pressure (use a 20 ml syringe as a ‘push-in’ or a sphygmomanometer cuff wrapped around a collapsible IV plastic fluid container). The dosage and volume of drugs and fluid are the same as for direct IV infusion.

Children with severe dehydration should be rehydrated with 100 ml/kg of fluid intravenously over 3 hours.

**NOTE** In infants under one year it is best to give 30 ml/kg for the first hour while the remaining 70 ml/kg is given slower over a further five hours. Therefore, small infants are rehydrated slower with 100 ml/kg over 6 hours.

The amount and rate of fluid needed to correct severe dehydration has been controversial for many years. The Red Cross Children's Hospital in Cape Town, South Africa, recommends 20 ml/kg over the first 30 minutes followed by 100 ml/kg over the next 4 hours. This regimen avoids the dangers of rehydrating a child too fast.
5-50 What fluids should be given once dehydration has been corrected?

Once dehydration has been corrected, the total amount of fluid needed is normal maintenance requirements plus any ongoing fluid losses. The normal fluid needs of most infants are about 100 ml/kg daily. If possible this fluid should be given orally as rehydration solution or milk. Thirst is usually a good guide to the infant’s fluid needs.

5-51 What is the value of zinc supplements in managing a child with diarrhoea?

Zinc is an important trace element which can speed up the recovery from diarrhoea and help to prevent further diarrhoea. Once the child is taking feeds well, one tablet of zinc (20 mg) should be given daily for 10 days. Children under 6 months should have half a tablet daily.

**PREVENTION OF DIARRHOEA**

5-52 Is acute diarrhoea preventable?

Yes. The viruses and bacteria that usually cause acute diarrhoea spread easily from person to person. Acute diarrhoea is an infectious disease. With simple interventions, most cases of acute diarrhoea can be prevented.

5-53 Why do children commonly get diarrhoea?

Because they are exposed to the viruses and bacteria which cause diarrhoea. Their food and water may also be contaminated by these organisms. Infections which cause diarrhoea are particularly common:

- In infants who are bottle-fed rather than breastfed
- Where there is not a supply of clean water to mix formula
- When feeding bottles and teats cannot be properly cleaned
- In communities without adequate toilet facilities
- When flies are common
- When personal hygiene is poor, especially no handwashing before eating

**Diarrhoea is usually due to contaminated food or water.**

**NOTE** Faeces left on the open ground or washed into the water supply by rain, pit toilets that overflow, and vegetables ‘freshened’ with contaminated water are all common sources of infection. Infected food (e.g. eggs and shellfish) can also result in diarrhoea.

5-54 How can the risk of diarrhoea be reduced?

Diarrhoea is far less common with:

- Breastfeeding to 6 months and longer if possible
- A supply of clean water
- Adequate sanitation (the safe disposal of faeces)
- Cup-feeding rather than bottle-feeding if formula is used
- Good personal hygiene, especially hand-washing before meals or handling food
- Protecting food from flies

Breastfeeding, a clean safe water supply, appropriate hand-washing and good sanitation will prevent most cases of diarrhoea. Well nourished children are less likely to get severe diarrhoea than malnourished children. Breast milk contains many substances (antibodies and immune cells) which protect the gut from infection and it thereby protects the infant from diarrhoea caused by infection.

**Breastfeeding is an important way of preventing diarrhoea in young infants.**
**NOTE** Recent research shows that probiotics, such as bifidobacteria, added to formula feeds can reduce the risk of gastroenteritis.

**5-55 How can a safe water supply be obtained?**

1. Chlorinated tap water must be provided wherever possible.
2. Water can be sterilized by boiling or adding chlorine tablets.
3. If none of the above is available, water can be made safer by putting it into a clear, plastic bottle or bag and leaving it in the sun for a few hours. The ultraviolet light will kill most viruses or bacteria in the water.

If the water is cloudy or dirty it should be filtered or be allowed to stand until the clear water at the top can be gently poured off. The clear water must then be sterilized.

**NOTE** A simple water filter can be made in a container with holes in the bottom. At the base of the container place a few centimetres of small pebbles. Cover these with a few centimetres of sand (not clay). Place the container on top of a second container in order to catch the drops of filtered water. The dirty water can now be poured into the top container to filter down into the second container.

**5-56 How can sanitation be improved?**

There are a number of simple ways to improve sanitation and reduce the risk of children getting diarrhoea. All stools must be passed or deposited into a flush, chemical or pit toilet:

- A simple pit toilet: The pit must be dug less than a metre wide and at least 1 to 2 metres deep, 20 metres or more away from houses or water sources. The deeper the pit the better. The pit must be covered with a slab or platform, having a single round hole which must be covered with a lid to keep out flies and keep in the smell. Throwing in lime, ash or soil after each use will help control flies and smell.
- A Ventilated Improved Toilet (VIP Toilet): The pit should be covered by a slab with two holes. An outhouse should be built over the larger, central hole while a ventilation pipe should be placed in the second smaller hole which is at one end of the slab. The top of the ventilation pipe must be covered with a fly screen. The door of the toilet should face into the wind. The outhouse should be dark inside with no cover over the seat. Air flow in the pit is down the large hole and up the small hole. Smell and flies escape up the pipe where the flies are trapped.

**Effective, cheap sanitation can be provided with a pit or VIP toilet.**

Where affordable, a chemical or flush toilet should be used. If no toilet is available, all stools must be buried immediately.

**5-57 Why is cup-feeding safer than bottle-feeding?**

If a mother is unable to safely clean dirty bottles and teats, it is better to feed the infant by cup. Unlike a bottle, a cup can easily be cleaned with soap and water. The inside surfaces of a cup are smooth and easily reached by finger. Unlike a feeding bottle, there are no corners for milk and bacteria to lodge in.

**Cup-feeding is safer than bottle-feeding.**

**5-58 How can hygiene be improved?**

- Wash hands after going to the toilet or handling a soiled nappy.
- Wash hands before preparing food or eating.
- Wash fruit and vegetables with clean water.
- Cover food to keep flies away.
- Store food in a fridge (refrigerator) or cool place.
- Bury or burn all food waste.

**CASE STUDY 1**

A mother brings her 9 month old child to a local clinic. The child has had loose stools for 2 days. The mother has stopped bottle feeds of formula and given sugar and salt solution
as advised by a general practitioner. Oral antibiotics and an anti-diarrhoea medication were started. On examination the child has no signs of dehydration. Other than the loose, watery stools, the child appears healthy. The older sibling had loose stools the week before.

1. **What is the diagnosis?**

The child has acute diarrhoea with no visible dehydration. The diarrhoea is probably due to a bowel infection with Rota virus. The infection probably spread from the sibling.

2. **What could have been done to prevent the diarrhoea?**

Good hygiene with hand-washing after going to the toilet and before meals. Breastfeeding rather than formula feeds also reduces the risk of diarrhoea. Formula feeds are best given by cup rather than bottle.

3. **Do you agree with the use of a sugar and salt solution?**

Yes. Oral rehydration solution or a home made sugar and salt solution is the correct management of diarrhoea.

4. **Should feeds be stopped when children have diarrhoea?**

No. It is very important that feeds are continued. Stopping feeds does not improve the diarrhoea and may lead to malnutrition.

5. **Would you have prescribed an antibiotic?**

There is no need for an antibiotic in acute diarrhoea unless the diarrhoea is caused by an infection outside the bowel, such as an acute otitis media (ear infection). Neither is there an indication for anti-diarrhoeal or antiemetic medications.

6. **Does this child need to be kept at the clinic or admitted to hospital?**

No. A child with no visible dehydration can be managed at home. The child should be brought back to the clinic in 5 days, or sooner if the diarrhoea becomes worse or the child's general condition deteriorates. The child should be observed for continuing loose stools or vomiting. The aim of early home care is to prevent dehydration and continue feeding. The mother must know what fluids to use and how much to give. She must also know when to return to the clinic.

**CASE STUDY 2**

An ill 9 month old child with diarrhoea and signs of severe dehydration is brought to a local hospital. He is shocked and breathing fast. The mother says he has had watery stools all day and vomits all feeds. The family live in a poor area with no formal toilets. Drinking water is collected from a stream. When compared to the weight recorded in the child's Road-to-Health Card two weeks before, 15% body weight has been lost.

1. **What are the signs of severe dehydation?**

- The child is not able to drink or drinks very poorly.
- The child is lethargic or unconscious.
- The eyes are very sunken.
- There is decrease in skin turgor. When pinched, the skin takes two seconds or more to return to normal.
- The child is shocked.

If 2 or more of these signs are positive, a diagnosis of severe dehydration is made. The weight loss of more than 10% also suggests severe dehydration.

2. **What are the signs of shock?**

- A delayed capillary filling time
- Tachycardia (a fast heart rate)
- Hypothermia (low body temperature) especially cold hands and feet (cold peripheries)
- A depressed level of consciousness (lethargy and drowsiness)
- Hypotension (low blood pressure) with weak or absent peripheral pulses
3. Why is this child breathing fast?
He is probably acidotic. However, he may also have pneumonia.

4. How should shock due to dehydration be treated?
It is very important that the child is given intravenous fluid immediately and fast. Usually Ringer’s lactate or half Darrows/dextrose is used, starting with 20 ml/kg. The signs of shock must be carefully observed. If the child is still shocked after the first 20 ml/kg, repeat this amount fast. If it is not possible to start an intravenous infusion, the fluid should be given via an intraosseous route or a nasogastric tube if this is not possible. The child should be transferred immediately to hospital.

5. How is severe dehydration corrected?
Once the shock is corrected, the child should receive Ringer’s lactate or Darrows/dextrose intravenously (or via a nasogastric tube) to treat the severe dehydration. Usually 30 ml/kg is given over 30 minutes followed by 70 ml/kg over 2 ½ hours. Start oral rehydration solution once the child is fully conscious and able to take fluids.

6. Why does this child have diarrhoea?
Probably because there are no toilets or clean drinking water. If clean tap water is not available, water can be sterilized by boiling or adding chlorine tablets. If this cannot be done, water can be made safer by putting it into a clear, plastic bottle or bag and leaving it in the sun for a few hours. The ultraviolet light will kill most viruses or bacteria in the water.

7. What can be done if no toilet is available?
A simple pit toilet can be made. A Ventilated Improved Toilet (VIP Toilet) would be even better. Some plan must always be made to get rid of waste safely.

CASE STUDY 3
A child of 2 years has a one-month history of loose stools. The child has some dehydration. The weight falls below the third centile. It is noticed that the child has generalised lymphadenopathy. The grandmother says that the child’s mother died a few months before.

1. What is your diagnosis?
This child has persistent diarrhoea as the loose stools have been present for more than 14 days.

2. How is ‘some’ dehydration recognized?
The child does not have severe dehydration but 2 or more of the following signs:
- Very thirsty and drinks eagerly
- Restless and irritable
- Sunken eyes
- Moderate degree of decreased skin turgor
  When pinched, the skin takes longer than usual, but less than two seconds, to return to normal.

3. What is the correct treatment of ‘some’ dehydration?
These children should be treated at a clinic or in hospital. Usually oral rehydration solution is given with a close watch for repeated vomiting or a refusal to drink. It is best if the oral rehydration solution is given by cup. 80 ml/kg of oral rehydration solution should be given over 4 hours, i.e. about 20 ml/kg each hour. More can be given if the child wants to drink more. Usually the fluid is given by cup or spoon. It is best if the child has frequent, small sips. If the child vomits, wait for 10 minutes and then try again more slowly. The degree of dehydration must be assessed after 4 hours.

4. When can this child be sent home?
Children with acute diarrhoea and ‘some’ dehydration can be sent home if they take the oral rehydration solution well, are not vomiting and there are no signs of dehydration after 4 hours. It is important that the child
continues to receive regular feeds. The decision to send the child home will depend on the home circumstances. The child must continue to be offered rehydration solution frequently and return to be assessed the next day. The mother must bring the child back immediately if the diarrhoea gets worse, the child vomits everything or signs of dehydration appear. However, as this child has persistent diarrhoea, she must be admitted to hospital for investigation and further management.

5. What is the relationship between diarrhoea and malnutrition?
Diarrhoea, especially persistent diarrhoea, can lead to malnutrition while children with malnutrition are at high risk of getting severe diarrhoea. Therefore, the one often leads to the other.

6. What illness must be suspected in this child?
AIDS. HIV infection often presents clinically with persistent or recurrent diarrhoea. The generalized lymphadenopathy suggests HIV infection. This child’s mother may have died of AIDS.

CASE STUDY 4

An 8-year-old child presents with a week’s history of loose stools containing both blood and mucus. The child has a temperature and looks ill. There are no signs of dehydration.

1. What is the importance of blood in this child’s stool?
It indicates that he has dysentery.

2. What may the cause be?
As the child is ill with a temperature, typhoid (Salmonella) or Shigella or amoebic dysentry must be suspected. The commonest cause of dysentery is Shigella.

3. How should this child be managed?
Children with dysentery should be referred to hospital for investigation and treatment. An antibiotic, usually nalidixic acid, is given 6 hourly (7.5 ml as the child is older than 5 years). Oral rehydration solution should be given.

4. What simple steps can reduce the risk of diarrhoea and dysentery?
Making sure that there is:

- Breastfeeding to 6 months and longer if possible
- A supply of clean water
- Adequate sanitation (the safe disposal of faeces)
- Cup-feeding rather than bottle-feeding if formula is used
- Good personal hygiene, especially hand-washing before meals or handling food

5. How can a safe water supply be obtained?

- Chlorinated tap water must be provided wherever possible.
- Water can be sterilized by boiling or adding chlorine tablets.
- If these are not available, water can be made safer by putting it into a clear, plastic bottle or bag and leaving it in the sun for a few hours.

6. What trace element may help the recovery from diarrhoea?
Zinc. One dissolved tablet should be taken daily for 10 days.
Objectives

When you have completed this unit you should be able to:

- List both the common and dangerous upper respiratory tract conditions.
- Recognise these clinical conditions.
- Understand the causes of these conditions.
- Provide primary care management for these conditions.
- Refer children with these conditions appropriately.

INTRODUCTION

6-1 What is the upper respiratory tract?
The upper respiratory tract (URT) consists of:

- The nose, sinuses and adenoids
- The throat, pharynx and tonsils
- The middle ear and eustachian tubes

Therefore, the respiratory tract above the larynx is called the upper respiratory tract.

6-2 What is the lower respiratory tract?
The lower respiratory tract consists of:

- The larynx
- The trachea and large bronchi
- The small bronchi (bronchioles)
- The alveoli.

Therefore, the respiratory tract from the larynx down is called the lower respiratory tract.

COMMON COLD

6-3 What is a common cold?
The common cold (coryza or acute viral rhinitis) is an acute viral infection of the nasal passages. It is the commonest infection in childhood. The throat, middle ear and sinuses may also be involved. Many children have five or more common colds a year.

6-4 What is the cause of a common cold?
Usually a rhinovirus. However, many other viruses can also cause the common cold. Children get repeated common colds as immunity to one virus does not give protection against other viruses. The viruses causing the common cold are infectious and can be passed from person to person by sneezing and coughing (droplet spread). The virus is then inhaled and infects the lining of the nasal
upper respiratory tract infections

The virus can also be spread by hand to hand contact. One person coughs into their hand, and later hold hands with someone else who then rubs their nose. In this way the virus is spread from the nose of one person to another. The common cold is particularly frequent in young children who attend a crèche or play group, nursery school or school for the first time. Here children are exposed to viruses they have not met before. The patient is often infectious for a day or two before the signs and symptoms of a common cold appear.

**NOTE** As there are more than a hundred subtypes of rhinovirus, one child can repeatedly catch a common cold.

### 6-5 What are the signs and symptoms of the common cold?

- A blocked or runny nose
- Sneezing
- Watery eyes
- Mild fever
- Mild cough

Usually the common cold presents with a runny nose, nasal discharge and sneezing. The eyes become watery and a mild fever is common. Initially the nasal discharge is clear and watery but later becomes thicker and white or yellow. After a few days the nose becomes blocked and nasal breathing may be difficult, especially at night or while breastfeeding. Sleep is commonly interrupted. A mild cough is common and caused by mucous running down the back of the throat (post-nasal drip). The symptoms and signs of a common cold clear up in a week. Usually there are no complications of a common cold.

A very sore throat suggests pharyngitis or tonsillitis while high fever, muscle pains and feeling very unwell suggest influenza rather than a common cold.

A blocked nose with a green (purulent) discharge on one side in a generally well child suggests a foreign body.

### 6-6 What are the complications of a common cold?

The viral infection may spread to:

- The sinuses
- The middle ear
- The throat
- The lower respiratory tract, causing bronchitis, bronchiolitis or pneumonia

The viral infection may become complicated by a bacterial infection. Then the clear nasal discharge will become purulent (green).

The viral infection may also trigger an asthma attack in children who suffer from asthma.

Viral complications are most common in infants as they have an immature immune system with little resistance to many viruses.

### 6-7 How can the common cold be prevented?

There are no practical methods of avoiding the common cold other than trying to avoid contact with other people suffering from a common cold. It is best if children with a common cold be kept at home for a few days to recover and avoid infecting others.

### 6-8 What is the management of a common cold?

Usually no treatment is needed. Make sure the child drinks enough fluid. Frequent, small feeds are best. Appetite is often poor for a few days. Older children can blow their nose, but saline nose drops help to clear the nose in infants and young children. Keeping the room warm and raising the head with pillows may help at night. Paracetamol syrup will lower fever. Aspirin should not be used in children.

Decongestant nose drops for a few days or an oral decongestant (e.g. Actifed) are only practical to help a blocked nose in older children. Antibiotics are not indicated unless there is a secondary bacterial infection. Suspect a complication if the child develops a high fever, severe cough or breathes fast.
Antibiotics are not indicated for a common cold.

ACUTE SINUSITIS

6-9 What is acute sinusitis?
This is an infection of the lining of one or more of the air sinuses that develop around the nasal cavity in older children (especially the maxillary sinuses). Sinusitis is usually caused by a bacterial infection, which complicates a common cold. The common cold virus causes swelling of the mucus membranes lining the sinuses. As a result, mucous in the sinuses cannot drain normally and secondary bacterial infection starts a few days after the signs of the common cold.

Acute sinusitis is uncommon in preschool children as their facial sinuses are not yet fully formed. Sinusitis is usually acute but can become chronic. Less commonly sinusitis may complicate allergy.

6-10 What are the symptoms and signs of sinusitis?
- A green (purulent) nasal discharge
- A feeling of fullness or pain over one or more of the sinuses (to the side and above the nose)
- Headache and tenderness over the infected sinus
- Post-nasal drip with a cough. Secretions drain from the sinuses when the child lies down. This irritates the throat and bronchi causing a cough, especially when the child lies down to sleep.

6-11 What is the treatment of sinusitis?
1. Oral antibiotics for 10 days. Amoxycillin is usually used
2. Paracetamol for pain and discomfort
3. Steam inhalation by breathing in warm, moist air in a warm shower or over a bowl of hot water. Do not use boiling water or steam as the child may be burned.
4. Nasal decongestant drops or spray

If the sinusitis does not disappear in 10 days or becomes recurrent, refer the patient to an ENT specialist/clinic. Repeated sinusitis suggests an allergy. Chronic sinusitis is not common in children.

ALLERGIC RHINITIS

6-12 What is allergic rhinitis?
Allergic rhinitis is an allergy of the lining (mucosa) of the nose and may present like a common cold. There are two forms of allergic rhinitis:

1. Seasonal allergic rhinitis (hay fever). This is only present during part of the year, e.g. spring and early summer.
2. Persistent allergic rhinitis. This is occurs all year round.

6-13 What are the symptoms and signs of allergic rhinitis?
Both forms of allergic rhinitis present with:
- Repeated sneezing
- A blocked nose with a watery nasal discharge
- Red, swollen eyes (allergic conjunctivitis)

Seasonal rhinitis also has itching of the nose, eyes, ears and soft palate. Itching is uncommon in persistent rhinitis.

Children with persistent allergic rhinitis usually have a pale face with blue colouration of the lower eyelids. Due to upward rubbing of the nose they often have a crease at the base of the nose.

6-14 What is the cause of allergic rhinitis?
Usually pollens or fungal spores inhaled from the atmosphere in seasonal allergic rhinitis. Pets or house dust mite which are present all year usually cause persistent allergic rhinitis.
Commonly there is a family history of allergies (rhinitis, asthma and eczema).

There is usually a family history of allergy in allergic rhinitis.

**NOTE** Skin prick testing and IgE blood tests (RAST test) are used to identify the allergen causing the rhinitis.

6-15 What is the management of allergic rhinitis?

1. Try to identify and avoid any likely cause (allergens).
2. Use newer non-sedating oral antihistamine drugs (e.g. Zyrtec).
3. Avoid decongestant nose drops.
4. Steroid nasal spray is very effective, especially in persistent allergic rhinitis.

**NOTE** Desensitisation is very effective if the allergic rhinitis is due to a single cause, e.g. grass pollen or house dust mite.

6-16 What is pharyngitis?

Infection and inflammation of the pharynx (throat). This is a common condition.

6-17 What are the causes of pharyngitis?

Usually a virus (about 90% of cases). Pharyngitis may also be caused by a bacteria such as Group A Streptococcus. It is not possible to clinically differentiate between a viral and streptococcal pharyngitis.

**NOTE** Infectious mononucleosis due to infection with the Epstein-Barr virus may also cause a pharyngitis, often with a membrane. Diphtheria is a rare cause of membranous pharyngitis. Bacterial infection can be diagnosed if a throat swab is taken for culture.

6-18 What are the symptoms and signs of pharyngitis?

Pharyngitis presents with:

- A sore throat. This is the main symptom.
- Pain on swallowing. Young children may refuse to eat.
- Fever
- Enlarged, tender cervical lymph nodes
- Abdominal pain is common in young children
- Mild cough

The symptoms usually disappear within 5 days.

On examination the throat is very red (inflamed). The mucus membrane of the back of the throat appears swollen and granular.

Often it is difficult to differentiate between pharyngitis and a common cold as the symptoms overlap. However, a sore throat without a blocked or runny nose suggests a pharyngitis.

**NOTE** A membrane on the pharyngeal mucosa suggests diphtheria. This is a rare infection as most children are immunised with DPT. Children with diphtheria are usually severely ill. Children with glandular fever may also have a membrane.

6-19 What are the complications of pharyngitis?

- Tonsillitis
- Spread of the infection to the middle ear or the lower respiratory tract (bronchitis, bronchiolitis or pneumonia)
- Streptococcal pharyngitis may cause acute glomerulonephritis and acute rheumatic fever.

**NOTE** A Group A beta haemolytic Streptococcal infection of the pharynx is an important cause of acute glomerulonephritis and rheumatic fever, especially in poor communities. The clinical diagnosis of a Streptococcal pharyngitis can be difficult without a bacterial culture.
6-20 What is the management of pharyngitis?

1. Make sure that the child has an adequate fluid intake.
2. Paracetamol syrup for pain and fever.
3. Antibiotics are not indicated unless there is severe pharyngitis (very sore throat) without signs of a common cold. Oral penicillin, amoxycillin or erythromycin for 5 days is usually preferred.

6-21 What is tonsillitis?

If a child with enlarged tonsils gets pharyngitis, the tonsils also become inflamed. This is called tonsillitis. Tonsillitis is usually seen in children between the age of 2 and 10 years. It may be caused by either a viral or bacterial (Streptococcal) infection.

6-22 What are the signs of tonsillitis?

The same as pharyngitis. However, both tonsils are swollen and red. There may be yellow spots (follicles) or an exudate (yellow mucoid covering) on the tonsils. With very swollen and inflamed tonsils, the airway may become narrow.

The tonsils normally grow and enlarge in young infants as part of the development of their immune system. Normally the size of the tonsils decreases by 10 years of age. Tonsillitis is more common in children with large tonsils. However, many children have enlarged tonsils without repeated attacks of tonsillitis.

Usually tonsillitis recovers within a week. However, tonsillitis may become recurrent or chronic.

1. Repeated severe tonsillitis
2. Tonsillar abscess
3. Severe airway obstruction

Unless there is severe airway obstruction, enlarged tonsils alone is usually not an indication for tonsillectomy.

Tonsillectomy for repeated attacks of tonsillitis remains controversial. While occasional tonsillitis is not an indication for tonsillectomy, it has been suggested that more than 5 attacks of tonsillitis per year is a reasonable indication for tonsillectomy.

6-23 What is the management of tonsillitis?

1. Paracetamol syrup for pain and fever
2. Penicillin, amoxycillin or erythromycin for 10 days

The indications for tonsillectomy are:

1. Repeated severe tonsillitis
2. Tonsillar abscess
3. Severe airway obstruction

6-24 What are the signs and management of enlarged adenoids?

Adenoids are situated at the back of the nose and cannot be seen without special instruments. They enlarge up to the age of about 7 years and then spontaneously become smaller. Enlarged adenoids may obstruct the nasal airway. This causes snoring, frequent waking at night, mouth breathing, nasal speech, and chronic secretory otitis media. Poor sleep may affect schooling. Mild enlargement of the adenoids requires no treatment but adenoidectomy (removing the adenoids) is indicated for signs of severe upper airway obstruction, especially snoring and sleep apnoea (stopping breathing during sleep).

**NOTE** Large adenoids can be diagnosed on a lateral X-ray of the neck. Sleep apnoea due to enlarged adenoids is an important condition, as it causes nocturnal hypoxia, and must be urgently treated by adenoidectomy.

**Snoring and sleep apnoea are important reasons for adenoidectomy.**

6-25 What is otitis media?

It is an infection and inflammation of the middle ear. Usually otitis media is acute but it can become chronic. Otitis media is more common in bottle-fed infants, especially with
‘bottle-propping’, when milk can run into the eustachian tube (the narrow tube connecting the middle ear to the pharynx).

Acute otitis media is caused by viruses and bacteria that reach the middle ear from the pharynx via the eustachian tube. The important bacteria are Pneumococcus, Haemophilus, Moraxella and Streptococcus. With a common cold, swelling of the mucosa may block the eustachian tube and cause a build up of fluid in the middle ear where bacteria can thrive.

6-26 What are the symptoms and signs of acute otitis media?

This is a common infection in children, especially children under 5 years of age. Acute otitis media presents with:

- Sudden onset of severe pain in the ear (earache). Infants become irritable, cry and may pull at the affected ear.
- Fever, often above 39 °C.
- On examination, the eardrum is red and bulges with loss of the normal light reflex. The pain is not made worse if the pinna (external ear) is pulled.
- The eardrum may perforate (rupture) resulting in pus pouring into the external ear canal (otorrhoea). The pain is often relieved when the drum bursts.
- Otitis media often presents a few days after the onset of a common cold or pharyngitis.

Acute otitis media presents with sudden, severe earache and fever.

6-27 What is the management of acute otitis media?

1. Paracetamol for pain and fever.
2. Oral antibiotics for 10 days. Usually amoxycillin is used.
3. If there is no decrease in pain and no drop in fever after 24 hours of antibiotics, the child should be referred to an ENT (ear, nose and throat) clinic.
4. Follow up to make sure that the otitis media has fully recovered.
5. Ear drops and oral decongestants do not help.

With correct treatment, perforation of the eardrum should heal within 2 weeks. Failure or incorrect treatment may lead to chronic suppurative or secretory otitis media.

NOTE In older children, acute otitis media will often recover without antibiotics. If severe otitis media does not respond to antibiotics, surgical drainage of the middle ear may be required. Children under 2 years should always be given antibiotics.

6-28 What is chronic suppurative otitis media?

Chronic suppurative otitis media is diagnosed if pus has been draining from a perforation in the eardrum for more than 2 weeks. The hole in the eardrum is now unlikely to heal on its own. Complications of chronic suppurative otitis media include destruction of the bones in the middle ear leading to conductive deafness, mastoiditis and bacterial meningitis or brain abscess.

It is very important to prevent chronic suppurative otitis media by the correct management of children with acute otitis media. Always be alert for signs of mastoiditis (swelling and tenderness over the bone behind the ear), especially in older children. Mastoiditis (infection of the mastoid bone) is a dangerous condition which needs urgent referral to hospital for antibiotics and possible surgical drainage.

6-29 What is the management of chronic suppurative otitis media?

The aim is to treat the infection and keep the ear dry so that the perforation in the eardrum can heal:
1. Oral antibiotics, usually amoxycillin or co-trimoxazole for 10 days.
2. Clean the external canal at least twice a day with a cotton bud to keep it dry. Using a cotton wick to dry the external canal is very useful (wicking).
3. Avoid swimming or showering.
4. Ear drops are of little help.

Refer to an ENT specialist/clinic if the ear continues to drain after 2 weeks of treatment, if the condition recurs or if you suspect a complication.

### Chronic suppurative otitis media may result in serious complications.

6-30 What is chronic secretory otitis media?

Chronic secretory otitis media or ‘glue ear’ is a common and important cause of deafness in young children. Chronic infection in the middle ear and enlarged adenoids can lead to obstruction of the eustachian tube with the collection of a thick, sticky effusion in the middle ear. This results in the eardrum being sucked inwards due to the absorption of the air in the middle ear. The thick fluid prevents the bones in the middle ear from vibrating normally. This interferes with normal hearing. Chronic secretory otitis media can delay speech development and result in learning difficulties at school. On examination, the eardrum is dull and retracted. Either one or both ears may be affected. Pain is uncommon. Chronic secretory otitis media is uncommon over the age of 10 years as the eustachian tube becomes wider with improved drainage of the middle ear with increasing age.

### Chronic secretory otitis media is a common cause of deafness in young children.

6-31 What is the management of chronic secretory otitis media?

1. A 10 day course of oral antibiotic to clear any remaining infection.

2. If there is no improvement after 3 months, refer the child to an ENT specialist.

**Note** An audiogram to assess for hearing loss is important, especially if the hearing is abnormal in both ears. An ENT specialist may insert a grommet (small plastic tube) into the eardrum to allow the fluid to drain. With correct treatment normal hearing returns.

6-32 What is otitis externa?

Otitis externa is an infection of the external ear canal (not a true upper respiratory tract infection). It may be caused by a viral, bacterial or fungal infection, a complication of a skin condition (e.g. eczema) or a foreign body. Otitis externa may complicate chronic suppurative otitis externa as the draining pus irritates the skin of the external canal.

- With mild otitis externa the ear is itchy but the external canal appears normal.
- With moderate otitis externa the ear is painful with a purulent, smelly discharge. The pain is worse if the pinna (external ear) is pulled. On examination the external canal is red and contains debris. Partial obstruction of the external ear canal may cause mild deafness.
- With severe otitis externa the ear is very painful with deafness due to complete obstruction of the canal. On examination the external canal is red and swollen.

A boil in the external canal or mumps may also present with earache.

6-33 What is the treatment of otitis externa?

1. Mild and moderate otitis external can be treated locally with ear drops for 10 days. Combined steroid and antibiotic drops give the best results (e.g. Sofradex). Any debris should be removed with a cotton bud or syringing (water at body temperature) before instilling the ear drops. Locacorten-Vioform drops can also be used. The infection is usually cured by one week. Oral antibiotics are usually not needed. Swimming and showering should be
avoided to keep the canal dry. Recurrence is common.
2. With severe otitis externa the canal should be packed with a cotton wick soaked in ichthammol and glycerine to reduce the swelling. Then the infection can be treated as above.
3. A boil in the external canal can be very painful and should be treated with oral flucloxacillin.

**EPIGLOTTITIS**

6-34 What is the epiglottis?
The epiglottis is positioned at the opening of the larynx to prevent the inhalation of fluids and solids when swallowing. It lies at the meeting point of the upper and lower respiratory tract.

6-35 What is epiglottitis?
An acute infection of the epiglottis, is usually caused by *Haemophilus influenzae*. The epiglottis becomes very swollen and may obstruct the airway. This is a rare but very serious condition which may rapidly cause death unless correctly diagnosed and rapidly treated. Children with acute epiglottitis also have a *Haemophilus influenzae* septicaemia. Acute epiglottitis due to *Haemophilus influenzae* can be prevented by Hib immunisation of all children. Do not confuse *Haemophilus influenzae* (a bacteria) with the influenza virus.

**Acute epiglottitis is an extremely serious condition which can be prevented with Hib immunisation.**

6-36 How is acute epiglottitis recognised?
It usually occurs in children between two and 5 years of age. The onset is sudden with:
- High fever. These children appear very sick and may be shocked due to the septicaemia.
- Drooling. They have a very sore throat and are unable to swallow or even open their mouth. This is a very important sign. They usually are unable to speak, cry, cough or drink.
- They have progressive airway obstruction. Characteristically, the children sit up, leaning forward with the neck extended to keep the airway open.
- Changing their body position or trying to examine the throat may cause total airway obstruction.

**Acute epiglottitis is the one upper respiratory tract condition that can present with respiratory distress due to airways narrowing.**

6-37 How must acute epiglottitis be managed?
1. Allow the child to adopt a position that he prefers to keep the airway open.
2. Move the child urgently to a facility where intubation or tracheotomy under general anaesthetic is possible. Thereafter, intensive care is needed to make sure the artificial airway remains open.
3. Intravenous chloramphenicol or cefotaxime to treat the epiglottitis and septicaemia.

With the correct antibiotics, the swelling of the epiglottis decreases and the child can usually be extubated after 48 hours.

**Acute epiglottitis is a medical emergency.**

**INFLUENZA**

6-38 What is influenza?
Influenza, or ‘flu’, is a common upper respiratory tract infection caused by the influenza virus. However, many other viruses can present with similar symptoms and signs of a ‘flu-like’ illness. Influenza usually occurs in epidemics. These may be very serious and
cause many deaths. Like the common cold, the influenza virus is spread by coughing, sneezing and direct hand-to-hand contact. Influenza usually presents 1 to 3 days after infection.

**NOTE** As is difficult to clinically tell whether a patient is infected with the influenza virus or another virus, such as rhinovirus, it is better to speak of a flu-like illness unless there is a proven epidemic of influenza infections at the time.

**6-39 What are the symptoms and signs of influenza?**

The onset is usually sudden, with:

- Fever
- A blocked nose and sore throat
- Tiredness, weakness and a general feeling of being unwell
- Headache
- Muscle ache
- Cough

The symptoms are worse for the first 5 days and usually recover by 10 days. Complications of influenza include otitis media, bronchitis and pneumonia. Children may develop convulsions caused by the high fever (pyrexial fits).

**6-40 What is the management of influenza?**

Influenza can be prevented by a recent influenza immunisation (especially if given just before the winter months).

1. Bed rest.
2. Make sure the child has an adequate amount to drink.
3. Paracetamol for fever, headache and muscle pains.
4. Antibiotics are only indicated if a secondary bacterial infection is suspected, e.g. pneumonia.

**NOTE** As the influenza virus continually changes, one can have repeated attacks of influenza. It is also important to have immunisation which covers the virus that is current that year. Immunisation is particularly important in children with chronic lung disease, e.g. asthma and cystic fibrosis.

**6-41 How can acute respiratory conditions be prevented?**

A number of important steps can be taken to both prevent and reduce the severity of acute upper and lower respiratory tract infections:

- Reduce environmental smoke. The source may be active or passive cigarette smoking or the smoke of indoor fires in poorly ventilated homes.
- Immunise against measles, diphtheria, whooping cough and *Haemophilus influenzae* in all children. Also immunise selected children with influenza and pneumococcal vaccines.
- Decrease overcrowding in homes and schools. This will lessen the exposure to many acute respiratory tract infections.
- Promote breastfeeding as exclusive breastfeeding, prevents and reduces the severity of respiratory infections.
- Give vitamin A as a depot injection or as an oral supplement.
- Improve the nutritional status of all children.
- Educate the public, especially parents, to recognise the signs of severe respiratory tract conditions so that these children can be given early, correct management.

**CASE STUDY 1**

A 4-year-old child is taken to a family doctor. The mother says he has had a blocked nose, is eating poorly and sleeping badly for the past 2 days. On examination he has a mild fever and is generally unwell. There are no signs of pneumonia or otitis media. He attends a crèche where a number of children have been sick.

1. **What is the most likely diagnosis?**
   A common cold

2. **What is the probable cause?**
   A rhinovirus
3. What is the likely source of the infection?
Other children at the crèche. Many children have at least 5 common colds a year.

4. Should this child be given an antibiotic?
No. There is no indication that the child has a bacterial infection.

5. What management is needed?
Paracetamol for fever. Make sure he has enough to drink. Keeping the room warm and raising to head of the bed may reduce nasal obstruction at night. Most colds get better in a few days. Nose drops, other than saline drops, and oral decongestants are usually not helpful in young children.

6. What is the likely diagnosis if a child is partially deaf after a common cold?
Secretory otitis media, with a collection of fluid behind the ear drum.

**CASE STUDY 2**

A 5-year-old boy presents with fever and a very sore throat. On examination his tonsils are enlarged and swollen. The mother reports that this is the second sore throat he has had in 6 months and asks that his tonsils be removed.

1. What is your diagnosis?
Acute tonsillitis.

2. What is the cause?
Probably a viral or bacterial infection. However, as there is no history of a common cold, the tonsillitis may be due to a bacterial (Streptococcal) infection.

3. Should the child be given a course of antibiotics?
It is very difficult clinically to differentiate between a viral and bacterial infection of the pharynx and tonsils. Therefore, many doctors would give an antibiotic.

4. What are the serious complications of a bacterial pharyngitis or tonsillitis?
Acute glomerulonephritis and acute rheumatic fever. Tonsillitis can also result in a tonsillar abscess.

5. Should his tonsils be removed?
Probably not. The indications for tonsillectomy are severe airway obstruction, tonsillar abscess and repeated tonsillitis (more than 5 attacks a year).

6. What should you think of if a child with a very sore throat has difficulty swallowing and appears severely ill?
Acute epiglottitis. They have a high fever, often drool and keep their head in a fixed position. This is an acute emergency as they may totally obstruct their airway.

7. What treatment is needed?
Emergency referral for intubation or tracheotomy under general anaesthetic. Allow the child to hold his head in any position that he prefers. Start intravenous antibiotics.

**CASE STUDY 3**

Following a runny nose for 3 days, a young infant develops a high fever and severe pain in one ear. The next day the child seems better and pus is seen in the external canal of that ear.

1. Why did the child have severe earache?
Due to acute otitis media.

2. Why did the pain suddenly improve?
The ear drum ruptured.
3. Why did this child develop acute otitis media?
As a complication of a common cold. Bacteria can reach the middle ear via the eustachian tube. Blockage of the eustachian tube during a common cold causes an ideal environment for bacteria to grow in the middle ear.

4. What treatment should the child have been given?
A course of antibiotics. This probably would have avoided the ruptured ear drum.

5. What will happen to the hole in the child’s eardrum?
With antibiotic treatment it should heal within 2 weeks. If not, the child must be referred. If the hole in the ear drum does not heal, the child will have chronic suppurative otitis media. This may lead to deafness with destruction of the bones in the middle ear.

6. What dangerous complication may follow chronic suppurative otitis media?
Mastoiditis. This presents with tenderness over the mastoid bone behind the ear. Mastoiditis is dangerous as it may result in a brain abscess or bacterial meningitis.

CASE STUDY 4
A 10-year-old child has been ill for 4 days with a high temperature, headache, blocked nose and muscle pains. His younger brother had a similar illness the week before.

1. What do you think is the problem?
Influenza.

2. What is the cause?
The influenza virus.

3. Why is this not a common cold?
Because the child has a high fever, headache and muscle pains.

4. How is the illness spread?
By coughing and sneezing (droplet spread). It may also be spread by hand to hand contact. One person coughs into their hand, and later hold hands with someone else who then rubs their nose. In this way the virus is spread from the nose of one person to another. The influenza virus almost certainly was spread from the younger brother.

5. What is the correct treatment of influenza?
Bed rest, plenty of fluids and paracetamol. Usually an antibiotic is not needed unless a complication develops such as pneumonia.

6. Can influenza be prevented?
Influenza immunisation in autumn greatly reduces the risk of infection.

7. What complications may young children have with a high fever due to an upper respiratory tract infection?
Febrile convulsions (pyrexial fits).
7

Lower respiratory tract conditions

Objectives
When you have completed this unit you should be able to:
• Give the signs of breathing difficulty and respiratory distress.
• List the important lower respiratory tract conditions.
• Diagnose these conditions.
• Understand the causes and possible prevention of these conditions.
• Provide primary management of these conditions.
• Describe a syndromic approach to a child with a cough.

INTRODUCTION

7-1 What is the lower respiratory tract?
The lower respiratory tract consists of:
• Larynx and trachea
• Bronchi
• Bronchioles
• Alveoli (lungs)

Therefore, the respiratory tract from the larynx down is called the lower respiratory tract while the respiratory tract above the larynx is called the upper respiratory tract. Disorders of the lower respiratory tract usually present with one or more signs of breathing difficulty.

7-2 What are the signs of breathing difficulty?
The major signs are:
• stridor
• indrawing of the lower chest wall (recession)
• wheeze
• fast breathing (tachypnoea)
• shortness of breath with grunting, nasal flaring, head nodding and refusal to feed.

These signs of breathing difficulty suggest that the child’s breathing difficulty is becoming progressively more severe and could lead to respiratory distress.

7-3 What are the signs of respiratory distress?
Respiratory distress is the clinical condition where the respiratory difficulty has become so severe that the child is likely to die unless given respiratory support (e.g. oxygen or ventilation).
• Central cyanosis (or a low oxygen saturation)
• Drowsiness, lethargy or unconsciousness
- Restlessness
- Apnoea

7-4 What is stridor?
Stridor is a crowing sound made in the throat, most commonly during inspiration. Any narrowing of the airway in the region of the larynx may result in stridor. Narrowing of the airway above (e.g. epiglottis) or below (e.g. trachea) the larynx may also cause stridor.

7-5 What is chest indrawing?
With chest indrawing, the lower ribs on both sides of the chest are pulled in when the child breathes in. This is very abnormal as the lower chest normally moves out when a child breathes in. When resting, children should never have chest indrawing.

7-6 What is a wheeze?
This is a noise made during expiration due to narrowing of the lower airways.

7-7 How can you tell when a child is breathing too fast?
Rapid respiration (tachypnoea) is one of the most important signs of pneumonia. A child at rest is breathing too fast when the following rates are exceeded:
- 60 breaths or more per minute in an infant of 2 months or less
- 50 breaths or more per minute in children 2 months to 1 year
- 40 breaths or more per minute in children older than 1 year

The normal respiratory rate decreases with age. By the age of 12 years healthy children should not breathe faster than 20 breaths per minute.

7-8 What is central cyanosis?
A blue colour of the tongue. The lips may also appear blue instead of the normal pink. Central cyanosis is a very important and dangerous sign which indicates that the cells are not receiving enough oxygen. Cold hands and feet may show peripheral cyanosis.

Always look for central cyanosis if a child has peripheral cyanosis.

Pulse oximetry is a very useful method of assessing the oxygen saturation (the amount of oxygen being carried in the red cells of the blood). The normal oxygen saturation is above 95% (above 92% in newborn infants). An oxygen saturation below 90% is abnormal and an indicator for oxygen therapy. A pulse oximeter (or oxygen saturation monitor) is used for measuring the oxygen saturation. The probe is clipped onto the child’s finger, hand or foot and the device displays the heart rate and oxygen saturation.

As central cyanosis is an important sign of respiratory failure, measuring the oxygen saturation is very useful.

VIRAL CROUP

7-9 What is viral croup?
This is an acute viral infection of the larynx, trachea and bronchi (acute viral laryngotraceobronchitis). With croup the area around the vocal cords is swollen as is the area just below the cords. Viral croup typically presents in children around 2 years of age (between 6 months and 6 years), especially in autumn. Viral croup is usually mild and the signs of croup usually clear in a few days but may recur. Some children develop viral croup whenever they have a common cold or pharyngitis.

The most common cause of viral croup is an infection with parainfluenza virus.

NOTE Other viruses, such as the respiratory syncytial virus, metapneumovirus, measles, adenovirus and Herpes simplex, can also cause croup.

7-10 What are the presenting signs of viral croup?
The characteristic signs of viral croup are:
- The infection often starts with a common cold or pharyngitis.
- A mild fever
- A typical ‘barking’ cough
- Inspiratory stridor is often, but not always, present. It is usually worse at night and then much better in the morning.
- Hoarseness of the voice is a less common sign in viral croup.

Viral croup typically presents at night with inspiratory stridor and a barking cough.

**Note:** Stridor can also be caused by an inhaled foreign body, retropharyngeal abscess, epiglottitis or, rarely, by diphtheria.

### 7-11 How is the degree of stridor assessed?

The degree of respiratory obstruction is difficult to assess as it may vary from moment to moment. Stridor usually becomes worse if the child cries or becomes agitated. Therefore stridor in a quiet child should be regarded as severe.

1. Inspiratory stridor only, without lower chest wall indrawing (recession or retraction) suggests mild airway obstruction. These children usually only have stridor when they are upset or crying. There is no stridor when they are sleeping or at rest.
2. The addition of lower chest wall indrawing or stridor during both inspiration and expiration are very important clinical signs as they indicate worsening airways obstruction. Therefore, expiratory stridor is a sign of severe airway obstruction. Stridor at rest in a quiet child also suggests severe stridor.
3. The obvious use of chest and abdominal muscles during expiration (active expiration, restlessness or fast breathing (tachypnea) are signs of dangerous airway obstruction.

**Expiratory stridor is a sign of worsening airway obstruction.**

**Note:** Disappearance or weakening of the peripheral pulse on light palpation during inspiration (pulsus paradoxus), marked recession, apathy and cyanosis are signs of severe airway obstruction. Stridor becomes softer with severe obstruction.

### 7-12 What is the correct management of viral croup?

1. The degree of airways obstruction must be continually observed.
2. Keep the child comfortable and calm as crying worsens the airways obstruction.
3. Keeping the room warm helps. Humidifying the air may also help. Do not accidentally burn the child with steam from a kettle. Cold mist does not help.
4. If the child has fever above 38 °C give paracetamol.
5. Continue to give frequent, small amounts of oral fluid unless the airway obstruction is severe. Continue breastfeeding if the child is not distressed.
6. The child can be closely observed at home if the airways obstruction is mild and the home circumstances are adequate. Communication and transport to the nearest health facility are needed if the child is to be managed at home.
7. Oral dexamethasone 0.5 mg/kg as a single dose (not if measles or herpes is the cause of the stridor). If no improvement, repeat after 24 hours. Steroids are the most important treatment in severe viral croup.
8. There is no indication for antibiotics or bronchodilators in viral croup.
9. Move to hospital if the airways obstruction becomes worse, especially if there is both inspiratory and expiratory stridor. It is best to move the child to hospital if there is stridor when the child is at rest. If possible, give oxygen during transport.
10. Nebulised adrenaline (1:1000 solution) in hospital is the treatment of choice for worsening or severe airways obstruction. It will often provide temporary relief. If the child responds to the nebulised adrenaline admit the child to hospital for 24 hours to observe for rebound airway obstruction as the effect of adrenaline usually last only about 2 hours.
11. Intubation or tracheotomy under general anaesthetic is only needed if respiratory
failure develops (cyanosis, restlessness, severe chest wall indrawing or inadequate oxygen saturation in room air). Intubation must be seriously considered if the child has expiratory stridor and uses the chest and abdominal muscles during expiration.

12. Oxygen should only be given in cases of severe airway obstruction as the method of delivering (e.g. nasal prongs) could make the child frightened and agitated and worsen the airway obstruction.

NOTE Mix 1 ml of 1:1000 adrenaline with 1 ml saline. Nebulise the entire volume with oxygen. Repeat every 15 minutes until the expiratory obstruction has resolved. Observe the child very carefully for signs of deterioration. Laryngoscopy to look for other causes of stridor is important in children who require intubation.

BRONCHITIS

7-13 What is bronchitis?

Bronchitis is an inflammation of the lining on the large airways of the lung (the large bronchi). The inflammation is usually due to a viral infection, but there may also be a secondary bacterial infection. Bronchitis usually follows an upper respiratory infection (common cold, pharyngitis or influenza). With inflammation of the bronchi, the glands in the walls of the large airways produce excessive secretions (mucus or phlegm) with a ‘productive cough’. These secretions may partially block the airways. Children with bronchitis do not have breathing difficulties (the only lower respiratory tract infection that does not cause breathing difficulties in children). Bronchitis in children is usually acute and recovers in 1 to 2 weeks. Bronchitis is more common in a smoky environment (cigarette smoke or an open fire in the home) and is usually seen in older children.

7-14 What are the symptoms and signs of acute bronchitis?

- A persistent cough. At first the cough is dry, but it may later become loose and produce clear, sticky secretions. Yellow-green secretions indicates a secondary bacterial infection.
- There may be chest pain with excessive coughing.
- Mild fever
- Wheezing may occasionally occur in an older child. This should always suggest asthma.

Acute bronchitis in children is very different from chronic bronchitis in adults.

NOTE Loose crackles are heard, especially on auscultation (with a stethoscope). These noises clear with coughing.

7-15 What is the management of acute bronchitis?

1. Make sure the child drinks enough fluid. Often there is a loss of appetite.
2. Inhaling warm, moist air may relieve the cough. Warm drinks may also help.
3. Cough mixtures are of little help, but salbutamol syrup may relieve the cough.
4. Give paracetamol for the fever.
5. Oral antibiotics should only be given if the mucus becomes yellow-green.

It is important to observe for signs of pneumonia, especially in small children. A wheeze suggests asthma or bronchiolitis. Bouts of severe coughing with an inspiratory whoop, apnoea or vomiting suggest whooping cough.

BRONCHIOLITIS

7-16 What is bronchiolitis?

Bronchiolitis is an acute viral infection of the small airways of the lungs (the bronchioles). It typically presents with airways obstruction. Bronchiolitis is usually caused by the respiratory syncytial virus (RSV) and occurs commonly in children under one year of age. When severe it can be life threatening. Bronchiolitis usually occurs in winter and follows a few days after the onset of a common cold. The small airways become
inflamed and narrowed. Secondary bacterial infection may occur.

**Bronchiolitis causes serious narrowing of the small airways in young infants.**

**7-17 What are the signs of bronchiolitis?**

- Recession (indrawing of the lower chest) and a hyperinflated chest (over expanded due to air trapping).
- Wheezing is usually present and is not relieved by an inhaled bronchodilator. Occasionally wheeze may be absent.
- Rapid breathing and breathlessness (difficulty breathing)
- Prolonged expiration
- A dry coughing
- Reluctance or difficulty in feeding
- Mild fever

Cyanosis, decreased level of consciousness, inability to feed or persistent vomiting and a marked tachycardia (fast heart rate) are all dangerous signs and indicates respiratory failure. Apnoea is common in infants less than 3 months. Bronchiolitis takes about a week to recover.

Repeated bronchiolitis, especially in an older child, suggest asthma.

**NOTE** There is poor air entry over both lungs on auscultation. Fine crackles may be present. A chest X-ray shows air trapping due to small airway narrowing without signs of consolidation (pneumonia). Pneumothorax is an uncommon complication of bronchiolitis.

**7-18 What is the correct management of bronchiolitis?**

1. Children with mild bronchiolitis may be managed at home provided they are carefully observed, they take adequate fluids, the home circumstances are good and that communication and transport are available if needed.
2. All other children with bronchiolitis must be admitted to hospital, especially if they are under 3 months, or if there is an inability to feed, tachycardia or low oxygen saturation.
3. Oxygen therapy with nasal prongs (flow 1 to 2 litres/minute) is indicated if there are signs of respiratory distress or the oxygen saturation is low (below 90%).
4. Bronchodilators usually do not help in bronchiolitis.
5. Steroids are of little help.
6. Ensure an adequate fluid intake. If the child will not drink give nasogastric fluid. Intravenous fluid should only be given with great caution as overhydration is dangerous.
7. Antibiotics are usually not given unless there are also signs of pneumonia or the child is less than 3 months. If pneumonia is suspected give amoxycillin.
8. If the child has a fever give paracetamol.
9. Physiotherapy is contraindicated and can be dangerous.
10. Careful observation is important for signs of respiratory failure or apnoea.
11. Intubation and ventilation for respiratory failure

**Oxygen is the treatment for severe bronchiolitis.**

**NOTE** Bronchodilators by nebulisation, e.g. salbutamol, are sometimes used in severe bronchiolitis with variable results. Children with a history of 2 or more attacks of bronchiolitis and respond to inhaled bronchodilators probably have early asthma. Do not use aminophylline as it is dangerous.

**7-19 When should children with bronchiolitis be referred to hospital?**

Bronchiolitis is a serious condition which can suddenly deteriorate. Therefore, only the mildest cases should be managed at home or at a primary care clinic. The following children should be referred to hospital:

- Children with signs of respiratory failure (e.g. cyanosis or depressed level of consciousness)
- If there is no improvement
- Signs of pneumonia
• Oxygen saturation below 90% with oximetry (saturation monitor)

**PNEUMONIA**

7-20 What is pneumonia?
Pneumonia is an inflammation of the small air sacs of the lungs (alveoli), usually due to a viral or bacterial infection. Pneumonia is often a complication of an upper respiratory tract infection. It may involve only part of one lung or be more extensive and even involve both lungs. The common causes of pneumonia depend on the child’s age. Breastfeeding and avoiding cigarette smoke helps to prevent pneumonia.

7-21 What are the causes of pneumonia?

- Pneumonia in newborn infants is usually due to a bacterial infection such as Group B Streptococcus and Gram negative bacilli (e.g. *Klebsiella*).
- Viruses especially the respiratory syncytial virus, cause most pneumonias in infancy.
- In young children Mycoplasma is a common cause of pneumonia.
- Pneumonia in older children is usually due to bacteria such as Pneumococcus, *Haemophilus* and *Staphylococcus*. Pneumococcus is the most common cause of community-acquired pneumonia in children.
- Tuberculosis is an important cause of pneumonia in poor communities.
- Pneumocystis is an important cause of pneumonia in HIV infected infants between 2 and 6 months of age. This is a very unusual cause of pneumonia in children who do not have AIDS.
- Gram negative organisms such as *Klebsiella* and *E. coli* are also an important cause of severe pneumonia in children with HIV infection.

**Note** Chlamydia can cause pneumonia in infants.

It is difficult to decide whether the pneumonia is due to a virus, bacteria or TB on both clinical examination and chest X-ray. Often pneumonia is due to bacteria complicating a viral infection.

7-22 What are the symptoms and signs of pneumonia?

- The child is generally unwell.
- Fever, often high fever
- Cough
- Breathlessness (difficulty breathing). The breathing is usually fast and shallow.
- Chest wall indrawing (recession or retraction)
- Refusal to eat or drink due to shortness of breath
- The infant may become cyanosed (with a low oxygen saturation).
- Chest pain may be present.

**Fast breathing is the most important sign of pneumonia.**

There are some causes of fast breathing, other than lung conditions, such as a high fever or a metabolic acidosis (seen in diarrhoea with severe dehydration). It is best to look for fast breathing when the child is calm and the fever has been lowered.

**A normal breathing rate usually excludes pneumonia.**

**Note** Nothing abnormal may be heard on auscultation with a stethoscope as the classical chest signs of pneumonia (dullness, bronchial breathing, crepitations) are often not present in children with pneumonia.

7-23 Should all children with pneumonia have chest X-rays?

A routine chest X-ray need not be taken in all children suspected of having pneumonia. However, if facilities are available, it should be done where:

- Complications are expected (e.g. pneumothorax).
- The diagnosis of tuberculosis is suspected.
The pneumonia is severe or does not respond to treatment after 2 days.

The diagnosis of pneumonia in a child is usually made on general examination rather than by listening to the chest.

**NOTE** Bronchopneumonia is common in small children while lobar pneumonia is often seen in older children. Always look for a pleural effusion or other signs of tuberculosis.

7-24 Is pneumonia a serious infection?
Yes. Pneumonia is a common reason for hospital admission and a major cause of death in children, especially in developing countries, such as South Africa, and in children with AIDS. Pneumonia acquired in hospital is particularly dangerous.

7-25 How can you recognise severe pneumonia?
Any of the following clinical signs suggest that the child has severe pneumonia:

- Chest wall indrawing (recession)
- Cyanosis (needs oxygen to keep the oxygen saturation above 90%)
- Depressed level of consciousness
- Refusal to eat or drink due to shortness of breath

These are danger signs which mean that the child needs urgent treatment and then referral to hospital.

7-26 What is the correct management of pneumonia?
1. If possible, all children with pneumonia should be admitted to hospital. Only mild cases should be managed at home or in a primary care clinic.
2. Observe the child carefully. Monitoring the oxygen saturation is very important. Look for signs of severe pneumonia.
3. Give oxygen by nasal prongs (or catheter) or face mask for severe pneumonia. Monitor with the use of a saturation monitor and give oxygen if saturations are below 90%.
4. Give an appropriate antibiotic. While oral antibiotics can be used with mild pneumonia, intramuscular or intravenous antibiotics must be used with more severe cases. All children with pneumonia must receive an antibiotic as it is difficult to tell whether the pneumonia is due to a virus or bacteria.
5. If a wheeze is present give an inhaled bronchodilator.
6. Give paracetamol to lower the fever.
7. Remove thick secretion from the nose by gentle suctioning.
8. Encourage breastfeeding. If the child does not take fluids by mouth, give nasogastric feeds or start an intravenous infusion.
9. Physiotherapy may be helpful.
10. All children with signs of severe pneumonia must be urgently referred to hospital. Give the first dose of antibiotic before referring the child.
11. In very severe cases of pneumonia, intubation and ventilation may be needed.

**Oxygen and antibiotics are the main form of treatment for pneumonia.**

7-27 What antibiotics are used in pneumonia?
1. Amoxycillin 30 mg/kg orally 3 times a day for 5 days in children with mild community-acquired pneumonia that is treated at home.
2. Intramuscular ampicillin 20 mg/kg before referring a child with severe pneumonia. In hospital, ampicillin and gentamicin, or cefotaxime (or ceftriaxone) are usually used. The choice of antibiotic may change when the sputum and blood cultures and sensitivities are received.
3. Cloxacillin 50 mg/kg/dose orally 6 hourly is given if Staphylococcus is suspected.
4. Hospital-acquired pneumonia may be due to organisms resistant to many antibiotics.
5. Search for tuberculosis if there is no response to antibiotics.

Note: Erythromycin or co-trimoxazole are the antibiotics of choice if Mycoplasma pneumonia is suspected in older children (5 years or older). Additional co-trimoxazole 6 hourly in high doses is used to treat suspected Pneumocystis pneumonia in HIV infected children.

**ASTHMA**

**7-28 What is asthma?**

Asthma is a chronic inflammatory condition with repeated episodes (or attacks) of reversible narrowing of the small airways (bronchi) of the lung that respond to bronchodilators. Children with asthma have ‘hyperactive airways’, i.e. their small airways become narrow in response to a number of factors. Asthma usually presents as repeated acute attacks. Each attack lasts hours to days. While some children only have a few attacks a year others are rarely free from asthma. If acute asthma is not controlled, the asthma may become persistent.

**7-29 How common is asthma?**

Asthma occurs in about 10% of children in South Africa, especially children living in towns and cities. Asthma is becoming more common as more rural families move into town.

**7-30 What are the symptoms of asthma?**

Children with asthma complain of:

- Expiratory wheezing
- Cough

- Difficulty breathing (breathlessness or shortness of breath or a ‘tight chest’)

Most, but not all, children with asthma have wheezing. Some children present with coughing only, especially at night. Both the wheezing and coughing are worse at night and often wake the child. Asthma is usually seen in children of one year or older.

Always think of asthma when a child presents with wheezing.

**7-31 What are the clinical signs of asthma?**

The clinical signs of asthma on examination are:

- A generalised, expiratory wheeze, especially on forced expiration.
- The chest may appear full (hyperexpanded due to air trapping) with prolonged expiration.
- There may be lower chest wall indrawing.
- The use of muscles in the abdomen or neck during expiration suggests severe airways obstruction.
- Cyanosis, drowsiness or panic are signs of respiratory failure.
- Usually there is no fever.
- Long standing, poorly controlled asthma may result in chest deformity and poor growth.
- Between acute attacks the chest examination is usually normal.

The sudden onset of wheezing during play in a well child with no history of asthma suggests the inhalation of a foreign body.

**7-32 What is the cause of asthma?**

Asthma results from a combination of inherited and trigger factors which cause inflammation of the bronchi. Most, but not all, children with asthma have a family history of allergic conditions (asthma, eczema, or allergic rhinitis). Children with asthma often have other allergic conditions.

Inflammation of the bronchi results in:
1. Mucosal oedema (swelling of the linings of the bronchi)
2. Bronchospasm (contraction of the smooth muscle in the bronchi)
3. Increased secretion of sticky mucus

These factors cause narrowing of the bronchi, especially in small children who normally have narrower bronchi than do older children.

**NOTE** The causes of asthma are multifactorial and result in airway hyperresponsiveness.

**7-33 How do inherited factors increase the risk of asthma?**

There may be a history of asthma on either the mother’s or father’s side of the family. Often a parent or sibling has an allergic condition. The tendency to have asthma is, therefore, passed from one generation to the next and close family members with asthma are an important risk factor for children to develop the condition.

Children with asthma usually have a family history of allergies.

**NOTE** A high risk of allergic conditions is inherited as an autosomal dominant with variable inheritance.

**7-34 What is allergy?**

Allergy (or atopy) is an abnormal or exaggerated reaction by the body to certain foreign proteins. In these allergic people the body produces an inflammatory response to these proteins which are called allergens. This abnormal inflammatory response is present in all common allergic conditions. Allergens do not produce an inflammatory response in people who are not allergic.

Common allergens are:

- House dust mite
- Foods, e.g. cows milk protein, eggs, wheat, peanuts, fish and soya
- Pollens, e.g. grass or tree pollen
- Dog and cat hair
- Fungus (mould) spores

**NOTE** In allergic people the body responds abnormally to foreign proteins by producing IgE rather than IgG (atopy).

**7-35 What trigger factors may start an attack of asthma?**

A wide range of trigger factors may start an acute attack of asthma. They include:

- Upper respiratory tract infections
- Allergens in the environment
- Active or passive smoking
- Exercise, especially running
- A sudden drop in environmental temperature (cold air)
- Emotion (sadness, anger or excitement)
- Irritants in the environment, e.g. paint fumes

**7-36 How is asthma diagnosed?**

Asthma is mainly a clinical diagnosis based on a history of repeated acute attacks of wheezing, coughing and breathlessness, often with a positive family history of allergy.

The most useful special investigations are:

1. **Lung function tests:** Children over the age of 5 years can use a peak flow meter to measure their peak expiratory flow rate. They take a deep breath and then blow as hard as they can into the peak flow meter, which measures how fast they can blow air out of their lungs (like blowing out a candle). Children with asthma have a lower peak flow rate than normal due to their narrow airways.

2. **Skin tests:** Skin tests are done by placing a drop of a specific allergen on the child’s forearms. The underlying skin is then pricked with a special lancet through the drop of allergic testing solution. The test site is examined after 15 minutes. A swelling (wheal) at the test site indicates that the person is allergic to that allergen. Skin tests are simple to perform, cheap
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and accurate. A blood test (RAST) can also be used to identify a response to specific allergens. The child should not be on an antihistamine for 48 hours before performing a skin prick test. Skin tests are used as supportive evidence for asthma as they diagnose allergies only.

3. **Response to a short acting bronchodilator:** A good clinical and peak flow rate response to a dose of inhaled bronchodilator is the best way to confirm the clinical diagnosis of acute asthma. In preschool children the diagnosis usually depends on a clinical response to treatment while in older children an improvement in the peak flow is important.

**Asthma presents with repeated episodes of wheezing, coughing or shortness of breath that respond to bronchodilators.**

**7-37 How is the severity of asthma graded?**

With intermittent asthma there are only occasional episodes of wheezing or coughing (less than once a month). Most children with asthma only have intermittent asthma. The symptoms of intermittent asthma are usually easily controlled and do not affect the quality of life.

With persistent asthma the episodes are more frequent (at least once a month). Persistent asthma may be:

- **Mild:** Episodes of coughing or wheezing occur once or twice a week
- **Moderate:** Episodes of coughing or wheezing at least 4 times a week
- **Severe:** They have daily symptoms which interfere with sleep and schooling

**NOTE:** With intermittent or mild persistent asthma the peak expiratory flow is usually 80% or more of predicted. This falls to 60–80% with moderate and less than 60% with severe asthma.

**7-38 What is the correct management of asthma?**

1. Assess the severity of the asthma
2. Control the acute attack
3. Prevent recurrent attacks
4. Avoid trigger factors
5. Education and support

**7-39 How is the severity of acute asthma assessed?**

The following are features of severe asthma:

- Previous history of severe acute asthma indicates that any further attack should be regarded as severe.
- Lack of response to bronchodilator therapy
- Inability to speak or cry or feed due to severe respiratory distress
- Cyanosis
- Oxygen saturation below 90%

**NOTE:** A silent chest when examined with a stethoscope or peak expiratory flow rate below 60% indicates severe asthma.

**7-40 How should acute asthma be treated?**

The aim of treating acute asthma (whether intermittent or persistent) is to relieve the airway narrowing (bronchospasm) as soon as possible and make sure that the patient is getting adequate oxygen.

1. Nebulised or inhaled short acting bronchodilators (beta 2 agonists), e.g. salbutamol (Ventolin) or fenoterol (Berotec). Oral short acting bronchodilators are rarely used as the inhaled drugs are better and safer.
2. Antibiotics are usually not needed.
3. Sedatives and antihistamines must be avoided.
4. Oral theophylline is only rarely used. Rectal and intravenous theophylline, and subcutaneous adrenaline, are dangerous and should not be used.

Acute intermittent asthma is usually mild and can be treated at home. ‘Reliever’ treatment can be given at home with inhaled short acting bronchodilators using a spacer (e.g. 1 or 2 puffs of salbutamol or fenoterol, i.e. 100–200 µg). This can be repeated after an hour if needed. The child must be carefully observed and moved to hospital if the wheeze gets...
worse. An inhaled short acting bronchodilator can also be taken before exercise to prevent wheezing or cough.

**7-41 What should you do if there is no response?**

If there is no clinical response within 20 minutes of giving an inhaled bronchodilator, repeat the dose, give a dose of oral steroids and refer the child to hospital for further treatment. Also consider transfer to hospital if the child refuses fluids, becomes restless or lethargic, or becomes cyanosed. Give oxygen during transfer.

The management of acute asthma in hospital consists of:

1. Nebulised or inhaled bronchodilators every hour.
2. A short course of oral steroids for 7 days (e.g. oral prednisone 2 mg/kg daily).
3. Reassess hourly. If no response consider admission for intensive care.

**7-42 How should inhaled and nebulised drugs be given?**

Inhaled medication (e.g. bronchodilators and anti-inflammatory drugs) are safer and more effective than oral drugs. They are best given to children using a spacer. A spacer is a container that is placed between the metered dose inhaler (MDI or ‘puffer’) and the patient’s mouth. This allows the drug to mix well with the air in the container before it is inhaled. In this way the drugs are better absorbed through the linings of the airway.

The inhaler is pushed through a hole made in the bottom end of a 500 ml cooldrink bottle while a face mask is attached to the mouth of the bottle. This home-made spacer works well and is much better than a small plastic or polystyrene cup.

For older children the child places her mouth directly over the top of the bottle rather than using a face mask. The child then breathes normally into the bottle. Specially designed commercial spacers are available but they are expensive. A face mask is needed in young children. Older children should use a mouthpiece.

Metered dose inhalers can be used in children of 8 years or more when they are able to cooperate and use the inhalers correctly. Spacers are used for younger children.

Nebulisers can be used in hospital to very efficiently give inhaled drugs. The drug in liquid form is added to the nebuliser which produces a fine mist. The dose is usually 1 ml of drug with 1 ml of saline.

**7-43 How can repeated attacks of asthma be prevented?**

If the child has persistent asthma (more than one episode a month) or severe attacks of asthma (requiring admission to hospital) the aim of management should be to prevent these acute attacks. These children should be referred to an asthma clinic for chronic maintenance management if possible. The aim of treatment is to allow the child to have a good quality of life, i.e. play sport, attend school normally and sleep well. Treatment requires the use of both anti-inflammatory and bronchodilator drugs.

The treatment of persistent asthma:

1. In mild persistent asthma (with repeated mild episodes of cough and wheezing which occur once or twice a week) a low daily dose of inhaled corticosteroid (‘prevention’ therapy e.g. beclomethasone 100–200 µg) should be given in addition to the short acting bronchodilator. Inhaled steroids are very effective and safer than oral steroids. Inhaled steroids should be used with a spacer. Rinse out the mouth after inhaling the steroid to avoid excessive absorption.
2. Moderate persistent asthma requires higher doses of daily inhaled steroids (e.g. beclomethasone 200–400 µg).
3. In severe persistent asthma, oral steroids may be needed. These patients should be management by an asthma clinic at a regional or tertiary health centre.
4. Short acting inhaled bronchodilators are needed in all patients with asthma and should be used when necessary. Use a spacer whenever possible.

Exercise-induced asthma can be prevented by inhaling a short acting bronchodilator 10 minutes before starting the exercise.

In severe or repeated attacks of asthma, daily treatment is needed to give the child as normal a quality of life as possible.

**NOTE** A long acting bronchodilator (beta 2 agonist) such as salmeterol, or sustained release oral theophylline, or a leukotriene antagonist may be added as a steroid sparing agent.

7-44 How can trigger factors be avoided?

1. No one should smoke in the house.
2. Avoid contact with people who have upper respiratory tract infections, especially common colds.
3. Avoid cats and dogs if allergic to them. Ban pets from the bedroom.
4. Reduce house dust mites, especially in the child’s bedroom. Cover the pillow and mattress with plastic sheeting, vacuum the carpet daily, wash the sheets and covers frequently in hot water and dry them in the sun. Synthetic bedding is best.

7-45 What education and support is useful in asthma?

Asthma is frightening to the child and parents. They should understand the causes, symptoms and treatment of the condition. Children should be encouraged to manage their own use of bronchodilators.

Parents can be reassured that asthma tends to improve with age.

7-46 What is the syndromic approach to acute respiratory tract disorders?

This is a simple way of using important clinical signs to classify and manage acute respiratory tract disorders. It is based on what you and the mother observe (see and hear) in the child. In the older child, the history (symptoms) given by the child is also important. This is the method used by IMCI (Integrated Management of Childhood Illness) for primary care management.

The two main signs of lower respiratory tract disorders are:

- Cough
- Difficulty breathing

7-47 What are the important causes of a cough?

Most children become ill and cough a number of times a year:

1. Usually a cough is due to a mild upper respiratory tract infection (cold, pharyngitis or sinusitis) due to a virus and does not last more than 3 weeks.
2. A cough may be due to a lower respiratory tract infection (pneumonia, croup, bronchitis, bronchiolitis and asthma). It is, therefore, important to look for signs of these conditions.
3. A cough lasting more than 3 weeks (21 days) may be a sign of tuberculosis (TB).
4. Think of whooping cough if a bout of coughing leads to vomiting.
5. Think of asthma if the cough is worse at night or after exercise. In bronchiolitis the cough is also worse at night. Asthmatics usually have a recurrent wheezy cough.
6. A cough that starts soon after lying down suggests a post-nasal drip in acute sinusitis.
The sudden onset of coughing after a choking episode suggests an inhaled foreign body.

A barking cough is suggestive of croup.

**7-48 What is the management of a cough?**

1. If the child has a cough but no signs of breathing difficulty, the cause is usually an upper respiratory tract viral infection. They do not need an antibiotic but something to soothe the throat (warm water or tea with honey or sugar). Cough mixtures usually only help by soothing the throat. Therefore, use a simple cough linctus.

2. The cough should get better by 3 weeks. If not, think of TB, asthma or whooping cough. These children should be referred for further investigation and management. Always think of tuberculosis in a child with a chronic cough and weight loss.

3. If the child has signs of breathing difficulty, refer for management of the underlying condition.

**Note:** There is no scientific evidence that cough suppressants, expectorants or mucolytics are effective for an acute cough cause by a viral infection.

**7-49 What signs of breathing difficulty suggest specific diagnoses?**

These signs must be assessed when the child is calm and not crying:

1. Stridor is usually due to viral croup.
2. Indrawing of the lower chest wall may occur with most severe lower respiratory tract problems, i.e. pneumonia, stridor, bronchiolitis or asthma.
3. Wheezing suggests bronchiolitis (in an infant) or asthma (in an older child).
4. Fast breathing suggests pneumonia, bronchiolitis or asthma.

Older children with a severe lower respiratory tract problem may complain of shortness of breath. Always look for danger signs in any child with breathing difficulty.

The sudden onset of stridor or wheeze in a well child suggests a foreign body.

If any of these signs are present, the child should be carefully examined and considered for urgent transfer to hospital.

**7-50 When and how should oxygen be given?**

Children with rapid breathing, indrawing of the chest, expiratory stridor or cyanosis, restless and saturations less than 90% should be given oxygen. Usually 1 to 2 litres per minute of 100% oxygen is given by nasal prongs or 3 to 4 litres via face mask. Measuring the oxygen saturation is very helpful.

**CASE STUDY 1**

During the early evening a 2-year-old child develops a strange cough and a crowing noise when she breathes in. She had a mild fever and a runny nose during the day. When the child cries, the noise during inspiration becomes worse. The mother became anxious and brought the child to the casualty department of the local hospital.

1. What is the crowing sound during inspiration called?

Stridor. The sound is caused by breathing in through swollen vocal cords. Mild stridor only occurs during inspiration and is usually only heard when the child cries.

2. What is the most likely cause?

Viral croup. This is an acute viral infection of the larynx, trachea and bronchi (laryngotracheobronchitis). It usually follows the start of a common cold or pharyngitis.

3. What other sign is common with this condition?

A ‘barking’ cough.
4. What signs would suggest that the stridor is becoming worse?

Both inspiratory and expiratory stridor, especially if present at rest, and indrawing of the lower ribs during inspiration. The obvious use of chest and abdominal muscles during expiration, restlessness or fast breathing are signs of dangerous airway obstruction.

5. What is the main treatment of severe stridor?

Nebulised adrenaline. A single dose of steroids helps. There is no indication for bronchodilators or antibiotics. If respiratory failure develops, intubation or a tracheotomy may be needed to bypass the laryngeal narrowing.

6. What diagnosis should you consider with the sudden onset of stridor in a well child?

An inhaled foreign body.

CASE STUDY 2

An infant of 6 months develops fast breathing and recession 3 days after the start of a common cold. On inspection the chest appears over expanded and a wheeze is heard. There is a mild fever and the child does not appear seriously ill. He takes his bottle well and has no cyanosis. There is no family history of asthma and this is the first time the child has been ill.

1. What is the most likely diagnosis?

Bronchiolitis. This is an acute inflammation and narrowing of the small airways of the lungs.

2. Why is this unlikely to be asthma?

The infant is young for asthma, this is the first episode of wheezing and there is no family history of asthma. No other features of allergy are mentioned.

CASE STUDY 3

A 5-year-old child develops a cough and blocked nose. The next day his mother notices that he is breathing fast and has a fever. On examination he has a respiratory rate of 45 with chest indrawing. He refuses to drink and has mild central cyanosis.

1. Why is this child breathing fast?

He probably has pneumonia.

2. What is the definition of fast breathing?

It depends on the child’s age as younger children normally breathe faster than older children. A respiratory rate above 40 breaths per minute is abnormally fast in any child older than one year.

3. What is the likely cause?

Probably viral as he has an upper respiratory tract infection. However the cause of the pneumonia may be bacterial.
4. What is chest indrawing?
Chest indrawing (recession or retractions) is a clinical sign where there is indrawing of the lower chest when the child breathes in. It is seen with pneumonia as well as a number of other lower respiratory tract conditions.

5. How severe is the pneumonia in this child?
It is severe as he has 3 signs of severe pneumonia (chest indrawing, refusal to drink and cyanosis). These are danger signs.

6. What management is needed?
1. Give oxygen to keep the child pink.
2. Start antibiotics.
3. Try to get the child to take oral fluids. Otherwise start an intravenous infusion.
4. Urgently transfer the child to hospital.

7. What antibiotic would you choose?
Intramuscular ampicillin. It can be given intravenously if an intravenous infusion (a drip) is started. In hospital gentamicin may be added.

8. What is the value of measuring the oxygen saturation?
This is a very useful method of assessing whether there is enough oxygen in the blood.

CASE STUDY 4
A 7-year-old child has a history of repeated attacks of coughing and wheezing, especially at night and during sport at school. He now has wheezing for the past few hours, complicating a common cold. There is a strong family history of allergies.

1. Why is this child coughing and wheezing?
He has an acute attack of asthma.

2. What is this clinical condition?
Asthma is a chronic condition that presents with repeated attacks of airway narrowing.

3. What is the cause?
Asthma is caused by a combination of an inherited factor (i.e. allergy) plus trigger factors.

4. What are common trigger factors?
Viral infections, exercise, exposure to allergens or irritants (e.g. smoke), cold air and emotion. In this child the trigger factor was a viral upper respiratory airway infection.

5. Can you name a few common allergens?
House dust mite, pollens, cat or dog hair, some foods and fungus spores.

6. How is a clinical diagnosis of asthma confirmed?
By lung function tests for airway narrowing and response to an inhaled bronchodilator. A skin prick test provides supportive evidence for allergies.

7. How should his acute attack be treated?
He will probably respond well to an inhaled short acting bronchodilator. If not, he should be referred to hospital for assessment and further treatment

8. Can acute attacks be prevented?
Yes. Every attempt should be made to prevent acute attacks by identifying and removing trigger factors. In children with persistent asthma, steroids should be added to the regular use of an inhaled bronchodilator.
8

Tuberculosis

Objectives

When you have completed this unit you should be able to:

- Give reasons why tuberculosis is an important and dangerous disease.
- Describe primary tuberculous infection of the lung.
- List the complications of primary tuberculous infection.
- Diagnose tuberculosis.
- Perform and interpret a Mantoux skin test.
- Treat tuberculosis.
- List ways to prevent tuberculosis.

INTRODUCTION

8-1 What is tuberculosis?

Tuberculosis is a chronic infectious disease. Tuberculosis is often referred to as TB and may involve most organs of the body, but especially the lungs.

8-2 What causes tuberculosis?

Tuberculosis is caused by a bacillus called Mycobacterium tuberculosis. The TB bacillus (tuberculous bacillus) is a long, thin bacteria.

NOTE Mycobacterium tuberculosis was first described by Robert Koch in 1882.

8-3 How is tuberculosis spread from person to person?

Tuberculosis is usually spread when an infected person talks, coughs, spits, laughs, shouts, sings or sneezes. This sends a spray of very small droplets into the air (i.e. airborne droplet spread). Live TB bacilli (plural of bacillus) from the patient’s lungs then float in the air and may be breathed in by other people. The inhaled TB bacilli can cause an infection of the lung. Tuberculosis is usually spread from adults with untreated tuberculosis of the lungs (pulmonary tuberculosis). Therefore, a child (the contact) with tuberculosis almost always has been in close contact with an adult with pulmonary tuberculosis (the source). It is less common for a child to catch tuberculosis from another child as children usually do not cough up TB bacilli in such large numbers. Adults with untreated tuberculosis are a danger to children in the family.

NOTE TB bacilli in unpasteurised cow’s milk can be drunk and cause infection of the tonsils or gut, but this is very uncommon in South Africa.

Tuberculosis in children is usually spread from an adult with untreated pulmonary tuberculosis.
8-4 Do all children infected with Mycobacterium tuberculosis develop tuberculosis?

No. Most children infected with TB bacilli (i.e. Mycobacterium tuberculosis) do not develop tuberculosis (TB disease) because their immune system is able to control the infection and kill most of the TB bacilli. Therefore, the natural immune response protects most children with TB infection from developing tuberculosis.

**Note** Young children infected before 3 years of age and immunocompromised children have a much greater chance (20–50%) of developing tuberculosis after infection with TB bacilli.

Fortunately, most children infected with tuberculous bacilli (TB infection) do not develop tuberculosis (TB disease).

8-5 Is tuberculosis common?

Infection with TB bacilli is very common, and it is estimated that almost 50% of South Africans have been infected. Most infections take place during childhood. However, only about 10% of all people with TB infection progress to tuberculosis (TB disease) during their lifetime. Therefore, TB infection is far more common than tuberculosis.

Tuberculosis is uncommon in most developed countries. However, tuberculosis is common in developing countries such as South Africa where the incidence has increased rapidly in the last few years. Tuberculosis is particularly common in the Western Cape and KwaZulu-Natal.

**Note** It is estimated that 10 million new cases of tuberculosis occur worldwide each year with 3 million deaths due to TB. About 40 South Africans die of TB each day. With the AIDS epidemic this figure is rising rapidly.

8-6 In which communities is tuberculosis common?

In poor, disadvantaged communities where overcrowding, undernutrition and HIV infection are common. Tuberculosis is a disease of poverty. Tuberculosis may be spread in any overcrowded spaces such as homes, schools, churches, buses, clinics and trains. TB infection is usually caught from a family member, friend or neighbour.

**Tuberculosis is usually seen in poor communities.**

**Note** About 95% of new TB cases and 99% of TB deaths worldwide are in developing countries. In developed countries TB is virtually confined to poor, overcrowded environments and ethnic minorities.

8-7 Why is tuberculosis an important disease?

Because it is an important cause of illness and death in many poor countries.

8-8 Which infected children are at greatest risk of developing tuberculosis?

A child can only develop tuberculosis if the child is exposed to TB bacilli. Therefore, the more tuberculosis there is in the community, the higher is the risk that children will become infected. However, some children are at a particularly high risk of developing tuberculosis if they become infected with TB bacilli:

- **Children exposed to large numbers of TB bacilli:** Children living in poor, overcrowded, poorly ventilated conditions are at great risk of becoming infected. They are often exposed to large numbers of TB bacilli due to many adults with untreated pulmonary tuberculosis.
- **Children with a weak immune system:** In these children infection with TB bacilli may progress to tuberculosis because they have an inadequate immune system which is unable to control the infection.
Therefore, tuberculosis is most common when a child with a weak immune system is exposed to a large number of TB bacilli.

**Children who have a weak immune system and are exposed to large numbers of TB bacilli have the greatest risk of tuberculosis.**

8-9 Which children have a weak immune system?

Young children under 3 years have an immature (weak) immune system which is unable to control severe infections. The younger the child, the less mature the immune system.

Some older children have an immune system which has been weakened by illness, malnutrition or drugs:

- Children with HIV infection
- Children recovering from measles or whooping cough
- Malnourished children
- Children on large doses of steroids

Severe tuberculosis itself weakens the immune system.

**Children with a weak immune system are at high risk of tuberculosis.**

8-10 What is primary tuberculosis of the lung?

Tuberculous infection usually starts when TB bacilli are inhaled into the lung. During the first 6 weeks of infection the immune system is unable to control the TB bacilli, which multiply and cause a small, local area of inflammation in the lung. From here TB bacilli also spread along the lymphatics to the local lymph nodes (hilar nodes) at the place where the main bronchi divide into branches. After 6 weeks the immune system usually becomes active and kills most of the TB bacilli. As a result, the primary infection is asymptomatic in most children and does not cause clinical illness. Primary tuberculosis is common.

**Inhaling tuberculous bacilli into the lung results in a primary infection.**

8-11 Can the primary infection cause illness due to spread of the infection within the lung?

Unfortunately, yes. Tuberculosis is a very unpredictable disease as there are a number of different ways that the primary infection can spread in the lungs:

1. Usually the primary infection heals and does not spread, as the TB bacilli have been contained by the natural immunity. These children do not develop tuberculosis.
2. In some children, especially those with a weak immune system, the body is unable to control the primary infection. The TB bacilli at the site of the primary infection multiply and spread to cause progressive lung infection (tuberculous pneumonia).
3. TB bacilli may multiply in the regional lymph nodes, causing them to rapidly enlarge and compress the bronchus or trachea. Clinically this may present as wheezing or stridor with either collapse or hyperinflation of a lobe or the whole lung.

**NOTE** The primary infection in the lung, together with the infected regional lymph nodes, is called the primary complex (Ghon complex). Often primary infection of the lung can only be recognised by the presence of a positive skin test. Mild flu-like symptoms may sometimes occur.

4. The TB bacilli often remain dormant (inactive or ‘sleeping’) for many months or even years after the primary infection. The body has been able to control but not kill all the TB bacilli. If the child’s immune system later becomes weakened by malnutrition or another infection, such as HIV or measles, the TB bacilli may reactivate (multiply) and a local area of tuberculosis pneumonia will develop. Pulmonary tuberculosis due to reactivation of dormant TB bacilli may only present years after the primary infection. This is in contrast to progressive tuberculosis, which usually develops within the first year after the primary infection.
5. ‘Adult type’ TB is usually seen in older children, especially adolescents. The area of tuberculous pneumonia may ‘break down’ and rupture into a bronchus. An infected lymph node can also erode into a bronchus. The TB bacilli can now spread along the bronchi to other parts of the lung. This occurs most commonly in the upper parts of the lung and results in an air-filled cavity (a hole) containing caseous (dead) tissue which contains huge numbers of TB bacilli. This adult form of pulmonary tuberculosis (‘open tuberculosis’) is very infectious as many TB bacilli enter the airways. From here they are then coughed into the air where they may be breathed in and infect the lungs of other people. Adult pulmonary TB is usually the source of TB infection in children.

6. Damage to the large airways by tuberculosis can result in bronchiectasis.

7. Tuberculous infection may also spread into the pleura causing an effusion.

8. Once the TB bacilli have spread beyond the primary infection (spread into the lung or enlarged lymph nodes) the child will become ill. Prompt diagnosis and urgent treatment is very important in these children with pulmonary tuberculosis.

8-12 Can one have a tuberculous infection more than once?

Yes. Unlike some other infections, such as measles and mumps, a TB infection does not necessarily give immunity to further TB infections. A child with a healed primary infection can months or years later have another, new, primary infection. Therefore, pulmonary tuberculosis may be due to immediate spread from the original primary infection, reactivation of an old primary infection which had not healed, or spread from a further primary infection.

8-13 Can tuberculous infection spread from the lung to other parts of the body?

- Yes. Infection with TB bacilli can spread from the lung, via the bloodstream (TB bacteremia,) to most organs of the body (extrapulmonary tuberculosis). The TB bacilli usually spread at the time of the primary lung infection. Sometimes tuberculosis of other organs presents soon after the primary lung infection. However, the TB bacilli often remain dormant in these organs for many months or years before they start to multiply and cause local tuberculosis. This reactivation of TB bacilli is usually due to weakening of the immune system.

- TB bacilli can also spread to other organs via the lymphatics. Spread from the hilar lymph nodes is usually up to the cervical lymph nodes or down to the abdominal lymph nodes. Lymph nodes in the axilla or groin may also be involved. Tuberculosis of organs other than the lungs is not infectious to other people.

8-14 Which other organs can be involved in tuberculosis?

Although the lung is the most common organ to be infected by TB bacilli, tuberculosis can involve any other organ of the body (extrapulmonary tuberculosis). The organs which are most commonly infected via the bloodstream in children are:

- The meninges (tuberculous meningitis)
- Bones, especially the spine (tuberculous osteitis)
- Joints, especially the hip joint (tuberculous arthritis)

**Note** The abdomen, skin, tonsils, pericardium, bone marrow, middle ear and genitalia are less common sites of tuberculosis in children. Tuberculosis of the kidney usually only follows...
5 or more years after the primary infection and therefore is uncommon in childhood.

8-15 What are the most common complications of primary tuberculosis in children?
The most common complications of primary tuberculous infection in children are:

- Pulmonary spread (tuberculous pneumonia)
- Airway compression by hilar or mediastinal lymph nodes
- Pleural effusion
- Tuberculosis of the cervical lymph nodes
- Tuberculous meningitis
- Miliary tuberculosis

**NOTE** Fifty percent of children with miliary TB are under 2 years of age and 80% are under 5 years. Thirty percent of these children will also have meningeal involvement.

8-16 How is tuberculosis diagnosed?
The suspected diagnosis of tuberculosis is often difficult to prove. The following are used clinically to diagnose tuberculosis in children:

1. There is often a history of an adult in the home with infectious pulmonary tuberculosis in the last 6 months (a history of contact).
2. The child often comes from a poor, overcrowded environment and has a weak immune system (young, undernourished or infected with HIV or measles).
3. There are clinical signs and symptoms of tuberculosis.
4. The tuberculin skin test is usually positive (but often negative in children with malnutrition or HIV infection).
5. The chest X-ray is usually abnormal.
6. TB bacilli (*Mycobacterium tuberculosis*) may be found in the sputum, gastric aspirate or other body fluids
7. A high index of suspicion is very important in the early diagnosis of tuberculosis, as tuberculosis may present in many different ways.

8. Identifying the person who is the source of tuberculosis is also important.

**The diagnosis of tuberculosis in children usually depends on a history of contact, clinical signs, tuberculin skin test and chest X-ray.**

**NOTE** A number of new methods, such as PCR for *Mycobacterium*, promise quick, sensitive and accurate methods of diagnosing tuberculosis.

8-17 What are the clinical signs and symptoms of tuberculosis?
The early signs and symptoms of tuberculosis are often vague and non-specific making the diagnosis difficult. These general signs and symptoms are caused by tuberculosis at any site in the body:

- Failure to thrive with poor weight gain or weight loss. This may be first noticed when the child’s weight is plotted on the Road-to-Health Card.
- Feeling generally unwell with loss of appetite, apathy and fatigue (feeling weak and tired).
- A fever for more then 2 weeks, often with sweating, especially at night.
- Lymphadenopathy, especially in the neck. There may also be an enlarged liver and spleen.

The later signs of tuberculosis usually depend on which organ or organs are infected (e.g. meningitis or abdominal distension).

**Suspecting tuberculosis is the first step in making the diagnosis.**

**NOTE** Lymphadenopathy usually consists of a number of mildly tender or non-tender nodes stuck together (matted).

Phlyctenular conjunctivitis (a patch of conjunctivitis at the junction of the sclera and cornea) and erythema nodosum (raised, tender, purple patches on the shin) should always suggest TB.
8-18 What are the signs and symptoms of pulmonary tuberculosis?

- In addition to the early, general signs and symptoms, the most important sign of pulmonary tuberculosis is a persistent, cough lasting 3 weeks or more. The cough may be dry or productive. Shortness of breath, fast breathing and chest pain (usually older children) may also be present. Unlike adults, blood stained sputum is uncommon in children with pulmonary tuberculosis.
- The enlarged hilar nodes may press on a bronchus causing wheezing, coughing or stridor. The wheeze does not respond to inhaled bronchodilators.

A persistent cough lasting longer than 3 weeks is an important symptom of pulmonary tuberculosis.

8-19 How can a clinical diagnosis of pulmonary tuberculosis be confirmed?

A chest X-ray is very important in confirming a clinical suspicion or diagnosis of pulmonary tuberculosis. In children, tuberculosis is often diagnosed on a chest X-ray.

A chest X-ray is an important way of diagnosing pulmonary tuberculosis.

NOTE In children with HIV infection, other HIV related lung conditions may present with a similar X-ray appearance. This makes interpretation more difficult. If pneumonia does not respond to a weeks course of antibiotics, always suspect TB.

8-20 What are the signs of tuberculosis on a chest X-ray?

In children the following are the most common chest X-ray (radiographic) features:

- The site of the primary infection in the lung cannot usually be seen on a chest X-ray. However, the associated hilar lymphadenopathy (enlarged lymph nodes where the main bronchi enter the lung) is seen, often with widening of the mediastinum. A lateral chest X-ray will make it easier to see hilar adenopathy.
- The enlarged hilar lymph nodes may partially or completely compress a bronchus resulting in an area of over-expansion (air trapping), collapse or consolidation.
- Miliary tuberculosis presents with multiple small spots (nodular pattern) evenly spread through both lungs.
- A pleural effusion, especially in older children.
- A cavity may form within the area of pneumonia, especially in adolescents. This is usually seen in the upper lobes of the lungs.

In young children the interpretation of a chest X-ray may be difficult. A good chest X-ray is important to both diagnose tuberculosis and monitor the response to treatment. Some children with tuberculosis may have a normal chest X-ray, e.g. infants with tuberculous meningitis, bone tuberculosis or any other form of extrapulmonary tuberculosis.

8-21 What is a tuberculin skin test?

This is a skin test done with tuberculin which contains protein from TB bacilli. Usually PPD (i.e. Purified Protein Derivative) is the form of tuberculin which is used. It does not contain live TB bacilli. The most accurate method of tuberculin skin testing is the Mantoux test, when a small amount of PPD is injected into the skin (intradermally). If a large area of swelling (induration) develops after 2 to 3 days at the injection site, the test is said to be positive. A positive skin test indicates that the child is infected, or has previously been infected with the TB bacillus, or been given BCG. As a result the child has now developed a sensitivity (an ‘allergy’) to the PPD.

The Tine test is also used but is not as accurate as a Mantoux test.

NOTE The induration at the site of the skin test is due to delayed sensitivity to the PPD, which develops at the time of the primary infection or the BCG immunisation. This indicates a good cellular immune response. The effect of BCG
on the tuberculin skin test, however, does not last more than 2 years. Other signs of more marked sensitivity to *Mycobacterium tuberculosis* include phlyctenular conjunctivitis and erythema nodosum.

**8-22 How is the Mantoux skin test done?**

A 1 ml syringe and size 26 needle are used to inject 0.1 ml of tuberculin (PPD) into the skin (*intradermally*) over the inner side of the left forearm. It is very important that the tuberculin is injected into the skin and not under the skin (subcutaneously). If the tuberculin is correctly injected into the skin a raised, pale weal of 5 to 10 mm is formed. If no weal is raised, the tuberculin has been injected too deep in error.

Incorrect injection under the skin may make the result difficult to interpret.

**8-23 How should you read a Mantoux skin test?**

The Mantoux skin test must be read 2 to 3 days (48 to 72 hours) after it is done. The widest transverse diameter (across the arm) of induration (raised, swollen, thickened area of skin) is measured. It is important that the induration and not the area of redness is measured. The diameter of the induration is best measured with a ruler. The result should be reported in millimeters and not simply as positive or negative. The interpretation is as follows:

1. If the diameter of induration is 0 to 4 mm the test is negative.
2. A diameter of induration of 5 to 9 mm is intermediate and may be due to BCG or TB infection. In a healthy HIV negative child this usually indicates that BCG has been given. However, in HIV infected or severely malnourished children, it may indicate tuberculosis.
3. A diameter of induration of 10 mm or more is positive and indicates infection with TB bacilli.

A Mantoux skin test of 10 mm or more indicates tuberculous infection. However, an induration between 5 and 9 mm cannot differentiate between children who have a tuberculous infection and those who have had BCG in the past 2 years. Furthermore, a result of 10 mm or more cannot differentiate between a recent healed TB infection and active tuberculosis. It is unfortunate that BCG may confuse the interpretation of the Mantoux skin test in the first 2 years. It is important to understand that a positive Mantoux test suggest tuberculous infection but does not necessarily mean that the child has tuberculosis.

**A positive Mantoux skin test indicates tuberculous infection but not necessarily tuberculosis.**

*NOTE* An area of induration of 5 to 9 mm may also indicate infection with a non-tuberculous *Mycobacterium*.

**8-24 Does a negative Mantoux test exclude infection with tuberculous bacilli?**

No. Although a negative Mantoux test suggests that there is no tuberculosis, the test may be negative (less than 5 mm induration) in spite of active infection with TB bacilli if the child’s immune system is not reacting to the tuberculin. Therefore, the test may be falsely negative, even though the child has tuberculosis, in:

- Early tuberculous infection (the Mantoux skin test becomes positive only 6 weeks to 3 months after the TB infection)
- Very young children
- Children with severe malnutrition
- HIV infection and AIDS
- After measles infection (for about 6 weeks)
- Children with severe tuberculous disease

*NOTE* The test may also be falsely negative if the PPD is old or inactive, or if poor technique was used in doing the test.

**The Mantoux test may be falsely negative in children with severe malnutrition, HIV infection, severe tuberculosis or after measles.**
New blood tests may help to differentiate between TB and BCG infections.

8-25 How can tuberculosis bacilli be identified?

The most accurate way of diagnosing tuberculosis is to identify TB bacilli. Unfortunately this is not always possible in a child and the diagnosis often has to be made on the history, clinical examination, chest X-ray and Mantoux skin test alone. TB bacilli may be identified by either:

- Seeing TB bacilli
- Growing TB bacilli

In adults, TB bacilli are usually identified in a stained sample (smear and direct microscopy) of sputum (not saliva). A special stain is used to identify the bacteria as TB bacilli. The sputum is collected at a TB clinic and the test done at the nearest laboratory. The result can be obtained in a few hours. Patients who have TB bacilli identified by a ‘positive TB stain’ on a smear of their sputum are called ‘smear positive’.

When staining for TB bacilli with Ziehl-Nielsen stain, the stained bacilli are said to be ‘acid-fast.’ Therefore, TB bacilli are often called ‘acid-fast bacilli’ or ‘AFBs.’ The greater the concentration of AFBs in the sputum, the greater is the infectious risk to others. Sometimes TB bacilli can also be seen in other body fluids such as CSF or a pleural aspirate, in fine needle aspirates of a lymph node, or in histological specimens obtained through open biopsy.

TB bacilli can also be grown (cultured). Unfortunately this is more difficult and expensive and may take many weeks. Therefore, in most poor countries tuberculosis in adults is confirmed with a sputum smear. TB culture and sensitivity testing is important in communities where multidrug resistance is common.

A definite diagnosis of pulmonary tuberculosis in adults is usually made by identifying TB bacilli in their sputum.

8-26 Which adults with tuberculosis are most infectious?

Patients with untreated pulmonary tuberculosis (‘cavitary’ or ‘open TB’). These patients are highly infectious to others as they cough up large numbers of TB bacilli.

8-27 How can a sample of sputum be obtained in a child?

In older children and adults the patient can be asked to cough up a sample of sputum. However, younger children under 6 years of age are usually unable to caugh up sputum to examine, as sputum is swallowed. If a sputum sample is needed in a child, it is easier to take a sample of gastric fluid which contains swallowed sputum. The gastric aspirate is best collected early in the morning before the first feed, the child having been nil per mouth for 6 hours. As gastric fluid is highly acid, 4% sodium bicarbonate in an equal volume to the gastric aspirate should be added to the specimen to neutralize the acid. Otherwise the TB bacilli will be killed before they can be cultured.

As children usually cough up or swallow far fewer TB bacilli than adults do, positive cultures are less common in children. Therefore, diagnosing tuberculosis in children is often done without obtaining a sputum sample.

A useful method of promoting coughing and sputum collection in a child can be performed before a meal. A puff of inhaled bronchodilator is given using a spacer followed 10 minutes later by 5 ml hypertonic saline (5% saline) also by nebuliser. This is followed by chest physiotherapy to loosen the mucus and promote coughing.

8-28 What is miliary tuberculosis?

If the primary tuberculous infection spreads (disseminates or seeds) into the bloodstream, TB bacilli can be carried to many organs other than the lungs. Tuberculosis affecting many different organs at the same time is called miliary tuberculosis.
8-29 How is miliary tuberculosis diagnosed?

Miliary tuberculosis is usually seen in young children under 2 years of age or children with a weak immune system due to HIV infection or severe malnutrition. Miliary tuberculosis presents with the general signs and symptoms of tuberculosis (fever, lethargy, weakness and weight loss). In addition these children often have an enlarged liver and spleen. Miliary tuberculosis usually develops soon after the primary infection when TB bacilli ‘seed’ to many organs. The chest X-ray shows many small spots of pneumonia (‘a snow storm’ appearance).

8-30 What are the signs and symptoms of tuberculous meningitis?

Tuberculous meningitis usually occurs a few months after the primary TB infection, especially in small children below 3 years of age. It is the most dangerous complication of pulmonary tuberculosis. The TB bacilli reach the meninges via the blood stream, usually from the lungs. Most children with tuberculous meningitis have a positive Mantoux skin test, an abnormal chest X-ray and a history of contact with an adult suffering from pulmonary tuberculosis, but all of these could be absent.

For the first few days and weeks the child is generally unwell with fever and lethargy. Then signs of meningitis appear (headache, irritability, vomiting and neck stiffness) followed by confusion, a depressed level of consciousness, convulsions and neurological signs (weakness or paralysis). The classical signs of meningitis are often not present for the first few days. The risk of permanent brain damage (hydrocephalus, paralysis, deafness, blindness, convulsions and mental retardation) or death is high, especially if the diagnosis is made late. However, recovery can be complete with early treatment.

Examination of the cerebrospinal fluid (CSF) obtained by lumbar puncture is helpful in making the clinical diagnosis. The diagnosis is only confirmed by finding TB bacilli (by staining or culture) in the CSF.

**NOTE** In TB meningitis the CSF typically has a markedly raised protein, low sugar and low chloride, with a dominance of lymphocytes and total cell count usually below 500/ul. In early TB meningitis the CSF may be normal. The Gram stain is negative. Unfortunately TB bacilli are rarely seen while the culture takes a few months.

All children with suspected tuberculous meningitis must be referred urgently to hospital for investigation and treatment (and treatment preferably started immediately).

8-31 What are the signs and symptoms of abdominal tuberculosis?

Abdominal tuberculosis usually results from spread of TB bacilli via the lymphatics from the chest. TB infection from the abdominal lymph nodes can then spread to the omentum, peritoneum, liver and other abdominal organs. These children present with the general signs of tuberculosis, i.e. fever, lethargy and weight loss. They may also have diarrhoea, abdominal pain and a distended (swollen) abdomen due to ascites or enlarged abdominal lymph nodes.

**NOTE** *Mycobacterium bovis* may also cause abdominal TB due to drinking unpasteurised milk from a cow with tuberculosis. This causes a primary TB infection of the gut. It also gives a positive Mantoux skin test.

8-32 What are the signs of tuberculous infection of the peripheral lymph nodes?

Peripheral lymphadenopathy (enlarged lymph nodes) is common in tuberculosis. Enlarged TB lymph nodes in the neck (cervical, submandibular) are usually due to spread of infection via the lymphatics from the chest. Axillary and inguinal lymph nodes are less commonly affected.

Peripheral TB lymph nodes are typically non tender (unless secondarily infected) and often matted (stuck together). In the neck the lymph nodes enlarge and fuse together becoming stuck to the skin. They may become fluctuant or even ulcerate through the skin to form a chronic sinus.
Rarely human or bovine TB may cause a primary infection of the tonsil with enlarged cervical nodes. TB adenitis with ulceration through the skin is called scrofula.

Enlarged lymph nodes in the neck may be caused by tuberculosis.

8-33 How is tuberculosis affected by HIV infection and AIDS?

- Increasing numbers of adults and children have both HIV infection and untreated tuberculosis. As adults are highly infectious, more infants (both HIV positive and negative) are becoming infected with TB bacilli.
- HIV infection weakens the immune system. This increases the risk that the child will develop severe tuberculosis. Previous asymptomatic primary tuberculous infection may become reactivated resulting in tuberculosis. With damage to the immune system by HIV, previously well controlled TB bacilli can become active and multiply rapidly.
- Tuberculosis may be the first serious infection in an HIV infected child and be the first indication that the child is HIV infected.

HIV infection makes the diagnosis of TB more difficult. The Mantoux skin test may be falsely negative and the chest X-ray confusing. While a smear may be negative, TB bacilli can still be grown in the sputum.

Tuberculosis is a very common complication and cause of death in children and adults with HIV infection.

8-34 How does tuberculosis affect HIV infection and AIDS?

Tuberculosis weakens the patient’s immune system and enables HIV infection to progress more rapidly to AIDS.

Every child with tuberculosis should be screened for HIV infection.

8-35 How can tuberculosis be prevented?

1. By improving the standard of living and preventing overcrowding
2. By diagnosing and treating adults with pulmonary tuberculosis
3. By immunising all newborn infants with BCG
4. By keeping children away from adults with untreated tuberculosis
5. By screening children who have come into close contact with an adult with pulmonary tuberculosis and giving chemoprophylaxis to all TB exposed children under 5 years of age
6. By monitoring weight gain (Road-to-Health Card) to identify children with failure to thrive. Preventing malnutrition and giving routine vitamin A helps prevent the progression of TB infection to tuberculosis (TB disease).
7. By preventing the spread of HIV infection and TB (TB and HIV) is a major problem in South Africa.
- Most children with both HIV and tuberculous infections will respond as well to the standard antituberculosis treatment as children who are not infected with HIV.

Due to their weak immune system, tuberculosis of organs other than the lungs is more common in children with HIV infection, e.g. miliary tuberculosis or tuberculous meningitis and even chronic otitis media due to TB bacilli.

The recent increase in deaths due to tuberculosis in many developing countries is largely due to the spread of HIV infection. Tuberculosis is a very common complication of HIV infection and many children with HIV infection will develop pulmonary tuberculosis. Co-infection (TB and HIV) is a major problem in South Africa.

HIV infection weakens the immune system and allows previously dormant tuberculosis bacilli to become active, resulting in tuberculosis.
8-36 What is the value of BCG immunisation?

Immunisation with BCG gives some protection against infection with wild TB bacilli. BCG gives good protection against miliary tuberculosis and tuberculous meningitis, especially in well nourished children. Unfortunately, BCG immunisation does not give total protection against tuberculosis. BCG should be given to all infants at birth.

BCG should still be given to newborn infants who have HIV positive mothers. However, BCG should not be given to children with clinical signs of HIV infection. Side effects from BCG are more common in HIV infected children.

Immunisation against measles and diphtheria also helps reduce the risk of tuberculosis.

8-37 How is the diagnosis of tuberculosis classified in children?

2. Probable tuberculosis: The chest X-ray suggests tuberculosis in a child who is failing to thrive, has a chronic cough, has a positive Mantoux skin test and/or has a history of contact with an adult suffering from untreated tuberculosis.
3. Confirmed tuberculosis: In addition to the above, TB bacilli are seen or grown from the sputum or any other body fluid.

Unfortunately the diagnosis of tuberculosis is often only suspected or probable and cannot be confirmed. These infants need to be treated as if they had confirmed tuberculosis.

8-38 What is the management of tuberculosis?

1. Multi-drug treatment with 3 or 4 drugs is essential to make sure that the tuberculosis is cured and that resistance to the anti-TB drugs does not develop.
2. The most important aspect of treating a child with tuberculosis is to ensure that the medicine is taken correctly and regularly. This is often difficult as the treatment takes many months. It is essential that the health care workers at the clinic develop a good working relationship with the mother and child.
3. While ill children need hospitalisation, most children with tuberculosis can be treated from a clinic.
4. The child's general nutritional status must be improved as most children with tuberculosis are underweight for age. The Road-to-Health Card is a valuable way of monitoring the child's weight gain.
5. If children are infected with both HIV and TB, both infections should be treated. These children have a damaged immune system and their HIV infection should be correctly managed with prophylactic co-trimoxazole and antiretroviral therapy if they qualify.

Multi-drug treatment for many months is essential to cure tuberculosis.

**NOTE** Because of severe drug interactions between anti-TB and antiretroviral drugs, similar adverse drug reactions in the 2 groups of drugs, and possible immune reconstitution inflammatory syndrome, it is recommended to delay antiretroviral treatment until after the TB treatment is completed or to postpone antiretroviral treatment until 2 months of TB treatment has been completed.

8-39 What drugs are used to treat tuberculosis in children?

Because the TB bacillus rapidly becomes resistant to 1 antituberculous drug if it is given on its own, multiple drug therapy is used. Usually 3 or more drugs are given together. The drug combination usually given consists of:

- Rifampicin
- Isoniazid (INH)
- Pyrazinamide (PZA)

All 3 drugs are usually given together before breakfast. It is very important that the drugs are taken regularly and correctly. Hospitalisation and bed rest are usually not needed. With
correct treatment more than 90% of children with tuberculosis can be cured.

Children with miliary TB or TB meningitis must be hospitalised. A fourth antituberculous drug is added (preferably ethionamide, otherwise ethambutol or streptomycin). These drugs are given at higher doses in TB meningitis and miliary TB.

**Note** Usually added pyridoxine is not needed.

8-40 What is short course treatment of tuberculosis?

The cure rate of tuberculosis has improved with shorter, well monitored courses of anti-TB drugs. This method is better than previous longer courses where compliance was poor and many patients did not take their medication regularly or stopped treatment too soon. Short course treatment is more cost effective with better patient compliance. However it must be well managed.

With short course treatment from a clinic, the anti-TB drugs are usually given on 5 days of the week only (Monday to Friday). Most children can be treated with combination tablets (rifampicin, INH and pyrazinamide or rifampicin and INH alone). Usually all 3 drugs are given for 2 months (the initial phase) and then only rifampicin and isoniazid are taken for a further 4 months (continuation phase). See Table 8.1 for the usual 6 month treatment regimen.

<table>
<thead>
<tr>
<th>Pretreatment body weight</th>
<th>2 months</th>
<th>4 months</th>
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<tbody>
<tr>
<td></td>
<td>5 times per week</td>
<td>5 times per week</td>
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<td></td>
<td>Initial phase: RHZ 60/30/150 mg</td>
<td>Continuation phase: RH 60/30 mg</td>
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<td>3–4 kg</td>
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<td>8–9 kg</td>
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<td>25–29 kg</td>
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<tr>
<td>30–35 kg</td>
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**Table 8.1:** The usual 6-month treatment regimen for tuberculosis. R = Rifampicin; H = INH; Z = Pyrazinamide.

Children older than 8 years or children weighing more than 35 kg are treated with 4 drugs (ethambutol added) in the initial phase as with the adult anti-TB treatment regimen.

**Note** Corticosteroids are indicated in addition to anti-TB treatment in children with severe bronchial compression by enlarged lymph nodes and in tuberculous meningitis.

8-41 How is the response to treatment monitored?

Once the child has been on triple drug treatment for a few weeks the signs and symptoms of TB should gradually improve and the child should start to gain weight. A definite improvement in the chest X-ray may be seen in early infections after a month. However, the X-ray changes may take months to improve in extensive pulmonary TB.

**Note** The results of sensitivity tests are usually available by the end of the initial 2 month period of treatment.

8-42 What are the side effects of anti-tuberculous drugs?

Unfortunately, all anti-TB drugs have side effects. In children these are fortunately not as severe as in adults. The organ most commonly
affected by anti-TB drugs is the liver. Nausea and skin rashes may occur. The urine is often stained orange when rifampicin is given.

**NOTE** All 3 antituberculous drugs (RMP, INH and PZA) may cause a drug induced hepatitis. INH may cause a peripheral neuropathy, but this is very uncommon in children.

### 8-43 What is the most common cause of failure to cure tuberculosis?

Failure to take the anti-TB drugs correctly as prescribed (non-compliance). If doses of the drugs are missed repeatedly, the tuberculosis will not be cured and drug resistance may develop. Resistance to both INH and rifampicin is called multidrug resistant (MDR) TB. This is very difficult to treat. In multidrug resistance, the TB bacilli continue to multiply and are not killed by the usual combination of anti-TB drugs. Multidrug resistant TB develops because of incorrect treatment or poor adherence. Multidrug resistant TB can be transmitted to close contacts, including children and is becoming a major problem in some regions.

**NOTE** Resistance to 3 or more antituberculous drugs is called extreme drug resistant (EDR) TB. It is usually fatal.

If the treatment is stopped too soon the tuberculosis can also return (relapse). In many poor countries it is common for TB patients not to complete their full course of treatment. Once they feel well again they stop their treatment. As a result, relapse of TB occurs and many people die of TB.

**Treatment of tuberculosis is difficult as it is lengthy and requires good compliance.**

Adults with tuberculosis have a responsibility, not only to themselves, but also to their household and community to complete their treatment correctly.

### 8-44 What is the DOTS strategy?

‘DOTS’ stands for Directly Observed Treatment – Short course. With the DOTS strategy the patient is given the anti-TB drugs by some responsible person in the community who observes the patient swallowing every dose of the medication. The treatment supporter does not have to be a health professional. With adults, it is best if the treatment supporter is not a family member. This ensures good compliance without the patient having to go to the clinic for every dose. If DOTS is correctly used, the failure rate of treatment is greatly reduced and over 85% of patients should be cured. The general public can play an important role in the control of TB by supporting DOTS (i.e. DOTS supporters). The cure rate for TB without DOTS in poor countries may be as low as 40%.

**NOTE** The DOTS strategy consists of 5 main points: Government commitment to sustained TB control activities; case detection by sputum smear microscopy among symptomatic patients; self-reporting to health services; standardized treatment regimens of 6 to 8 months for at least all confirmed sputum smear positive cases, with directly observed treatment (DOT) for at least the initial 2 months; a regular, uninterrupted supply of all essential anti-TB drugs; and a standardized recording and reporting system that allows assessment of treatment results for each patient and of the TB control programme overall. DOTS was introduced to South Africa in 1996.

**With DOTS a responsible person must see the patient take the tablets.**

### 8-45 When are anti-tuberculous drugs given prophylactically to young children?

The following children should be given prophylactic (preventative) treatment:

- Clinically well, asymptomatic children under 5 years of age who have been in the same home as someone who has smear-positive pulmonary TB. These young children are at very high risk of developing TB themselves as they have an immature immune system.
- Children under 5 years who have a positive Mantoux skin test (10 mm or more), who
are clinically well and have not recently been treated for TB.
- HIV positive children who are in contact with adults with smear-positive tuberculosis.

Currently, prophylaxis consists of INH for 6 months. The treatment is given daily for 5 days a week using the same dose as for short course treatment. Children of 5 and older, who have been in close contact with an adult with untreated pulmonary TB, or have a positive Mantoux, are not given prophylaxis, as they are at far less risk of developing tuberculosis. However, they should be followed and treated if they develop any early signs of TB.

8-46 What is the management of a newborn infant if the mother has tuberculosis?

1. If the mother has untreated pulmonary tuberculosis, or has not been on treatment for at least 4 weeks before delivery, the infant should have prophylactic treatment. The same will apply if another family member has active pulmonary tuberculosis. Usually INH 5 mg/kg/day is given. Some services use INH plus rifampicin.
2. The mother should be allowed to care for and breastfeed her infant. The infant need not be isolated but can stay with the mother. The mother must receive a full course of treatment.
3. BCG should not be given at birth (as the BCG bacillus could be killed by the anti-TB drugs).
4. At 3 months, a Mantoux skin test must be done:
   - If the infant is thriving and the skin test is negative, the infant has not been infected with TB bacilli. BCG should now be given after the prophylactic treatment has been stopped for 3 days. No further treatment is needed.

   - A Mantoux skin test of 5 mm or more indicates that the infant has been infected by TB bacilli despite the prophylactic treatment. Do not give BCG but treat the child for tuberculosis.

**NOTE** Prophylactic treatment of newborn infants remains controversial. The choice of 1 or more drugs and the duration of treatment is still debatable. Therefore, some authorities use both INH and rifampicin for 3 months.

8-47 Is tuberculosis a notifiable disease?

Yes. All cases of tuberculosis must be notified to the local health authority. The health care worker who makes the diagnosis is responsible for the notification. The local health authority should now look for the person who is the source of the infection and also screen contacts for tuberculosis.

8-48 Should adults with tuberculosis be isolated?

After 2 weeks of the correct treatment, patients with pulmonary tuberculosis are no longer infectious to others even though TB bacilli may still be seen on a smear. Isolation of patients with tuberculosis is, therefore, usually not necessary. Younger children usually do not develop ‘adult type tuberculosis’ with cavities and, therefore, are less infectious to others. As a result, most children with tuberculosis do not need to be isolated.

8-49 How can tuberculosis be controlled in a community?

1. By the early identification, referral and correct treatment of adults with tuberculosis (especially if smear-positive).
2. By looking for family members, friends or care givers with untreated tuberculosis (TB contacts) when a child is diagnosed with tuberculosis. It is important to look for the source of infection.
3. By bringing any child who has been in contact with a smear-positive tuberculosis to clinic for assessment and possible prophylactic treatment. This is particularly
important in children under 5 years of age and those with HIV infection.
4. By improving general nutrition and preventing overcrowding (good housing)
5. By immunising all infants with BCG, measles and pertussis vaccine
6. By routinely monitoring weight gain in children with the Road-to-Health Card
7. By using the DOTS strategy
8. By reducing the transmission of HIV to children and correctly treating children with symptomatic HIV infection
9. By notifying all cases of tuberculosis

8-50 What are the main responsibilities of the staff in a primary care TB clinic?
1. Identifying adults and children with tuberculosis or at high risk of having tuberculosis
2. Referring them for correct diagnosis
3. Making sure that patients take their treatment correctly
4. Looking for other cases of tuberculosis in the home
5. Finding children under 5 years who need prophylactic treatment
6. Supporting the family of a patient with tuberculosis

CASE STUDY 1

A 7-year-old child presents at a local clinic with a history of a persistent, dry cough for the past month. He has a poor appetite, has lost weight recently and reports that he sweats a lot at night. Examination reveals a thin child with an expiratory wheeze. A BCG scar is noted over his right upper arm. His mother says she and her 5 children live with her father in a 2 roomed house. The grandfather is also unwell and has been coughing and complaining of chest pain for the past few months. She is unemployed and the whole family live on the grandfather's pension. The child is sent for a chest X-ray and Mantoux skin test.

1. Why should you suspect that this child has pulmonary tuberculosis?

The symptoms of chronic cough for a month, poor appetite, weight loss and night sweats are strongly suggestive of tuberculosis. They live in poor, overcrowded conditions and the grandfather's history also suggests tuberculosis. The child has probably been infected by the grandfather who could have smear-positive pulmonary tuberculosis.

2. Would BCG immunisation not protect this child from tuberculosis?

BCG immunisation gives partial protection against tuberculosis, especially tuberculous meningitis and miliary tuberculosis. However, an immunised child can still become infected particularly if they are undernourished or exposed to large numbers of TB bacilli. Therefore, this child may have tuberculosis even though he has been immunized with BCG.

3. How can the suspected diagnosis of tuberculosis be confirmed in this child?

A chest X-ray should be taken and a Mantoux skin test performed. The grandfather should also be investigated for tuberculosis.

4. What are the typical chest X-ray findings of tuberculosis in a child?

Usually an area of pneumonia (consolidation) is seen together with a widened mediastinum due to enlarged hilar and mediastinal lymph nodes.

5. What is the probable cause of the wheeze?

Either a wheeze or stridor can be caused by pressure of enlarged lymph nodes on the airway. This is common in children with pulmonary tuberculosis. The wheeze seldom responds to inhaled bronchodilators.
6. How would you interpret a Mantoux skin test with an area of induration of more than 15 mm across?

A test of 10 mm or more would indicate tuberculosis, even if the child had received BCG.

7. What other diagnostic investigations should be done on the child?

The child should be able to cough up a sample of sputum. This should be stained and then examined for TB bacilli.

8. What medication should be given to this child to treat his tuberculosis?

Rifampicin, isoniazid and pyrazinamide are used for the first 2 months then only rifampicin and isoniazid continued for another 4 months. With short course treatment the drugs are given 5 times a week. It is very important that the drugs are given regularly and that doses are not missed.

9. Is tuberculosis a notifiable disease?

Yes. All forms of tuberculosis are notifiable in South Africa. This enables the local health authority to look for the person who is the source of the infection and to screen contacts for tuberculosis.

**CASE STUDY 2**

An 18 month old infant is brought to hospital with a 1 week history of fever and irritability. For the last 2 days the infant has been very drowsy, refuses feeds and does not want to play with her siblings. She has also vomited a few times. The mother reports that the child has not been immunized as she was born at home and lives far from the nearest clinic. The child has received no treatment or traditional medicine. A chest X-ray done at the clinic is normal.

1. What diagnosis should be suspected?

Tuberculous meningitis.

2. How can this diagnosis be confirmed?

By examining a sample of cerebrospinal fluid (CSF) obtained by lumbar puncture. If the child has tuberculous meningitis the fluid will be abnormal. Children with TB meningitis often have a normal chest X-ray. The typical signs of meningitis are often not present during the first few days of illness.

3. Which children are at most risk of tuberculous meningitis?

Children under 3 years of age who have not been immunized with BCG and are exposed to large numbers of TB bacilli. It would be important to ask if there is an adult in the home who may have untreated tuberculosis.

4. What are the dangers of tuberculous meningitis?

The child may die or suffer permanent brain damage. Hydrocephalus, paralysis, deafness, blindness, convulsions or mental retardation may result, especially if the diagnosis is only made when the child already has neurological signs. If diagnosed and treated early, the child may fully recover. The clinical presentation in this child suggests an early diagnosis.

5. How should this child be managed?

The child must be urgently referred to hospital for investigation and treatment. Treatment with anti-TB drugs will be needed for 6 months.

6. What other organs can be infected with the tuberculosis bacilli?

The lungs are the most common organs to be infected with tuberculosis. In children, tuberculous meningitis, abdominal tuberculosis, tuberculosis of the bones or joints, and tuberculous infection of the lymph nodes are less common. Almost any organ can be infected with tuberculosis.
**CASE STUDY 3**

A 16-year-old adolescent gives a history of feeling unwell and losing weight for the past 2 months. She also complains of a chronic loose cough and blood stained sputum. Her older brother was treated for tuberculosis for 2 months but stopped when the medicine ran out. He remained well for a while but is now coughing again. She has a younger brother who is well. The nurse at the clinic refers the patient to hospital for a chest X-ray as she suspects that she has tuberculosis.

1. **How is tuberculosis spread?**

Usually by breathing in TB bacilli that have been coughed into the air by an adult with untreated pulmonary tuberculosis.

2. **What viral infections may weaken the immune system and increase the risk of tuberculosis?**

HIV infection is a very important cause of damage to the immune system. Therefore children with HIV infection are at high risk of developing tuberculosis. A recent infection with measles can also damage the immune system.

3. **What would you expect to see on this patient’s chest X-ray?**

She probably has adult type pulmonary tuberculosis with cavities in an upper lobe. Patients with this type of tuberculosis are highly infectious as they cough up large numbers of TB bacilli. A stain of her sputum will probably be full of TB bacilli.

4. **When was this child probably infected with the TB bacilli?**

She could have had an asymptomatic primary tuberculosis infection a number of years ago, but recent infection transmitted from her older brother is more likely. If her tuberculosis was the result of reactivation from previous infection, it was because her immune system was able to stop the TB bacilli from multiplying at the time of the previous infection but it was not able to kill them. A few years later the TB bacilli started to multiply again causing pulmonary tuberculosis. This resulted in her becoming ill.

5. **What is the best method to make sure that she takes her anti-tuberculosis treatment correctly?**

DOTS (Directly Observed Treatment – Short course). It is best if every dose of medication is carefully supervised by a responsible person. It is not necessary to admit her to hospital for treatment. With DOTS she also need not visit the local clinic daily for her treatment.

6. **How should the younger brother be managed?**

The younger brother should be screened for tuberculosis. Any child in the home who is under 5 years of age and does not have tuberculosis should receive prophylactic treatment.

**CASE STUDY 4**

A 1-year-old child is seen by a general practitioner with a short history of fever and being generally unwell. On examination the child is obviously ill with an enlarged liver and spleen. The mother is also unwell with weight loss and chronic diarrhoea.

1. **What is the probable diagnosis in this child?**

Although a number of different infections can present in this way, miliary tuberculosis must be suspected.

2. **What would be the appearance of a chest X-ray in miliary tuberculosis?**

With miliary tuberculosis the chest X-ray shows numerous small spots throughout both lungs indicating a widespread pneumonia.
3. Would you expect the Mantoux skin test to be positive?

The Mantoux skin test may be positive. However, with miliary tuberculosis the Mantoux could be negative, as the severe infection weakens the immune system.

4. How did this child probably become infected with TB?

The mother probably has tuberculosis. The story of chronic diarrhoea suggests that she may also have AIDS. Tuberculosis and HIV infection often occur together.

5. How can a newborn infant be protected against infection if the mother has tuberculosis?

The infant should be started on prophylactic anti-TB treatment (usually INH alone or INH plus rifampicin) as soon as possible after delivery. Immunisation with BCG should be delayed until the treatment is completed.

6. Should a mother with tuberculosis be allowed to breastfeed her infant?

Yes, provided the infant is given prophylactic treatment. The mother must take her anti-TB medication correctly and need not be separated from her infant.
**Objectives**

When you have completed this unit you should be able to:

- Define HIV infection and AIDS.
- Describe how children may become infected with HIV.
- Reduce the risk of mother-to-child transmission of HIV.
- Recognise the clinical signs and symptoms of HIV infection.
- Confirm the diagnosis of HIV infection.
- Manage a child with HIV infection.
- Counsel parents of a child with HIV infection.

**INTRODUCTION**

**9-1 What is HIV?**

HIV stands for the Human Immunodeficiency Virus. The virus is infectious and can be spread from one person to another and is found in most body fluids, e.g. blood, semen, vaginal secretions and breast milk.

**HIV is the Human Immunodeficiency Virus.**

**NOTE** HIV is a new human virus which was first identified in Paris in 1983. It was probably transmitted to humans from monkeys in central Africa in the 1950s. From here it rapidly spread to all parts of the world, especially the USA, Europe, Asia and other parts of Africa.

**9-2 Are there different types of HIV?**

Two types of HIV are recognized: HIV 1 and HIV 2. Most infections in Southern Africa are caused by HIV 1 which has many subtypes (clades). The important subtype in Africa is subtype C while subtype B is the most common subtype in the developed world.

**9-3 What is HIV infection?**

HIV infects the CD4 lymphocytes of the immune system. The CD4 lymphocytes are a special group of white cell which play an important role in protecting the body from infections. HIV introduces its own genes into the nucleus of the CD4 lymphocytes giving instructions to produce millions of new HIV. These HIV are then released into the blood stream where they infect and kill other CD4 lymphocytes. When HIV causes illness it is called symptomatic HIV infection or HIV disease.

HIV belongs to a group of viruses known as retroviruses. Retroviruses usually cause long periods of silent infection before symptoms and signs of disease appear.
Retroviruses contain a RNA genetic code. The viral enzyme reverse transcriptase allows HIV to make DNA copies of its RNA. The DNA copy is then inserted into the nuclear DNA of CD4 lymphocytes. The addition of this new information enables the virus to take over control of the CD4 lymphocytes and instruct them to produce huge numbers of new HIV. Only retroviruses have this ability to make a cellular DNA copy of their viral RNA code.

**9-4 What is AIDS?**

AIDS is the Acquired Immune Deficiency Syndrome. This is an advanced stage of HIV infection presenting with serious clinical illness. It presents in both adults and children in many different ways. The main feature of AIDS is severe damage to the immune system leading to many viral, bacterial and fungal infections, many of which do not usually occur in people with a healthy immune system. These are called HIV associated infections or opportunistic infections. They take the ‘opportunity’ of infecting people with poor immune function (immune deficiency). At present AIDS can be controlled but cannot be cured. If not treated with antiretroviral drugs, AIDS is a fatal condition.

**AIDS is a serious illness caused by the Human Immunodeficiency Virus (HIV).**

**NOTE** AIDS was first recognized among homosexual males and intravenous drug abusers in the USA in 1981. The next year it was diagnosed in heterosexual men and women in Africa and also recognized in infants born to drug addicted mothers.

**9-5 Can a person have HIV infection but remain well?**

Yes. Adults are usually infected with HIV for years while remaining clinically well (asymptomatic HIV infection). Only after this long latent period do the clinical signs of HIV infection develop (symptomatic HIV infection). In children the latent period may be as short as a few months. HIV infection is only called AIDS when the patient becomes seriously ill due to HIV related infections. Therefore, AIDS is the most advanced and serious form of HIV infection.

**AIDS is the most advanced and serious stage of HIV infection.**

HIV is frequently transmitted by people who appear to be clinically well and do not know that they are infected with HIV.

**9-6 How common is HIV infection?**

Most cases of HIV infection occur in Africa where the spread of the HIV epidemic is greatest in Southern Africa. Over 40 million people world-wide have HIV infection. South Africa has one of the fastest growing HIV epidemics with 1000 to 2000 people infected every day. Between 12 and 15% of all South Africans are currently infected with HIV. Approximately 30% of pregnant women in South Africa are HIV-positive (i.e. infected with HIV) and over 100 000 infants are infected annually.

**Symptomatic HIV infection is causing a widespread epidemic in Africa.**

HIV infection is having a devastating effect on the health of children and many of the gains made in child survival during recent years are now being reversed. In many hospitals in Southern Africa, most paediatric beds are now filled with children suffering from HIV infection.

**TRANSMISSION OF HIV TO CHILDREN**

**9-7 How can a person become infected with HIV?**

HIV may be transmitted from one person to another by:
HIV infection

- Unprotected heterosexual or homosexual intercourse (horizontal transmission). This includes rape or sexual assault.
- Crossing from a mother to her fetus or newborn infant (vertical transmission).
- Using syringes, needles or blades which are soiled with HIV-infected blood. This includes syringes and needles shared by intravenous drug abusers.
- Accidental injuries in health care workers (a needle, lancet or blade contaminated with HIV-infected blood). HIV may also be able to enter via a skin lesion (cut or open wound).
- A blood transfusion with HIV-infected blood or other HIV-infected blood products such as factor VIII in haemophiliacs. This is very rare in South Africa as all blood products are screened for HIV.

There is no evidence that HIV can be spread by mosquitoes, lice or bed bugs. HIV infection is not spread by kissing, holding hands or sharing cups or eating utensils. In Africa HIV is most commonly spread between adults by heterosexual intercourse.

In adults HIV is usually spread by sexual intercourse.

9-8 How are children usually infected with HIV?

In children HIV is usually spread from a mother to her fetus or young infant. This is called mother-to-child transmission or MTCT. An HIV-infected mother may pass the virus to her child by the following routes:

1. HIV may cross the placenta from the mother to her fetus during pregnancy.
2. The infant may be infected with HIV by contact with vaginal secretions and blood during labour and delivery.
3. HIV may cross to the infant in breast milk.
4. Young children may also be infected with HIV during rape or sexual assault while adolescents may be infected during consenting intercourse.
5. Children may be infected when sharp instruments are used in ritual scratching or scarification or circumcision if the instrument is contaminated with blood containing HIV from another person.

9-9 What is the risk of a child becoming infected with HIV by mother-to-child transmission?

If a mother is infected with HIV and is not being given antiretroviral prophylaxis:

1. There is a 5% risk that HIV will cross the placenta from a mother to her fetus during pregnancy. The risk is increased further if the woman has an amniocentesis, external cephalic version, becomes infected with HIV during the pregnancy or has AIDS.
2. There is a 15% risk of the infant becoming infected with HIV during labour and a vaginal delivery. The risk is increased if the mother has pre-term labour, chorioamnionitis, rupture of membranes for more than 4 hours, an episiotomy or assisted delivery (vacuum or forceps delivery), a scalp clip for foetal heart rate monitoring or foetal scalp blood sampling for pH. Elective caesarean section removes the risk of HIV transmission during labour and vaginal delivery.
3. There is an additional 15% risk of HIV transmission after delivery if the mother practices mixed breastfeeding (breast milk plus other fluids and foods) for up to 18 months.

Therefore, without antiretroviral prophylaxis, the risk of HIV transmission with vaginal delivery and no breastfeeding is 20% (i.e. 5% plus 15%). With mixed breastfeeding the risk increases to 35% (i.e. 5% plus 15% plus 15%). It is important to know that at least 65% or more of infants born to HIV-infected mothers are not infected with HIV.

Most infants born to HIV-infected mothers are not infected with HIV.
9-10 How can the risk of mother-to-child transmission be reduced?

1. If possible, all women should be screened for HIV infection early in pregnancy so that HIV-exposed infants can be identified before delivery. Antiretroviral prophylaxis should be offered to all HIV-infected mothers during pregnancy and delivery, and to the newborn infant to reduce the risk of mother-to-child transmission of HIV.

2. The management of pregnancy, labour and delivery should be altered to reduce the risk of exposing the fetus and infant to HIV. Avoid early rupture of the membranes, instrument delivery and episiotomy if possible. An elective caesarean section is an option, especially in communities that can afford it.

3. Women should avoid becoming infected with HIV during pregnancy and breastfeeding by practising safe sex.

4. The choice of infant feeding should be discussed with the mother.

9-11 What factors influence the risk of HIV transmission in breast milk?

HIV is present in breast milk and HIV can be transmitted in the mother’s milk to the breastfeeding infant. The risk is greatest if the mother both breastfeeds and gives other foods, such as water, fruit juice, formula feeds and solids (i.e. mixed breastfeeding). With mixed breastfeeding the risk of passing HIV to the infant is:

1. 5% in the first 6 months
2. 5% from 6 to 12 months
3. 5% from 12 to 18 months

The risk of HIV transmission with breastfeeding is further increased if:

- The mother becomes infected with HIV during the time that she is breastfeeding.
- The mother has AIDS.
- The mother has cracked nipples, mastitis or a breast abscess.
- The infant has oral thrush.

**Note** The risk of transmission is determined by the amount of HIV in the breast milk. This is very high soon after infection with HIV and again with symptomatic HIV infection.

9-12 How can the risk of HIV transmission in breast milk be reduced?

- By giving formula feeds only and no breast milk (exclusive formula feeding)
- By giving breast milk only and no other liquids or solids (exclusive breastfeeding)
- By preventing HIV infection of the mother (safe sex) during the breastfeeding period
- By good breastfeeding management to avoid mastitis or breast abscess
- By treating oral thrush correctly in the infant
- By pasteurising breast milk. This is very helpful with pre-term infants in hospital
- By giving antiretroviral treatment to HIV-positive mothers who elect to breastfeeding

With exclusive breastfeeding, for the first 6 months, the risk of HIV transmission appears to be small. Further research is still needed to document the risk of HIV transmission with exclusive breastfeeding.

**Note** In the Durban study, which compared exclusive-breast- and exclusive-formula-feeding in HIV-positive women, the risk of HIV infection in the infant at birth and 3 months was 6% and 15% respectively in both groups. In the Harare study the risk of HIV transmission with exclusive breastfeeding between 6 weeks and 6 months after delivery was about 1%.

9-13 When is it best not to breastfeed?

The best feeding choice must be made by the mother herself after counselling to enable her to understand the risks and advantages of both forms of feeding. Formula feeding is usually only advised if all the following conditions can be met:

1. Formula is available and affordable.
2. Clean water is available and feeding cups or bottles can be sterilised.
3. The mother can mix the feeds correctly.
4. It is acceptable to her family and society to formula feed.
5. Primary health facilities are available to monitor the child’s growth.

If any of these conditions cannot be met, which is common when mothers are living in or returning to rural areas, then exclusive breastfeeding for 4 to 6 months followed by rapid weaning off the breast is probably safest. In these infants, the risk of death due to gastroenteritis and malnutrition if formula fed is often higher than the risk of HIV infection via breastfeeding.

**Note**: WHO uses the acronym AFSS for acceptable, feasible, affordable, sustainable and safe.

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**DIAGNOSING HIV INFECTION IN A CHILD**

**9-14 How is HIV infection diagnosed?**

In older children (and adults) the ELISA or rapid screening tests are used to confirm the diagnosis of HIV infection. These tests detect antibodies against HIV in the blood and usually become positive between 2 to 6 weeks after the infection (i.e. after the window period for the screening tests). As maternal HIV antibodies cross the placenta to the infant, and can remain in the infant’s blood for up to 18 months after delivery, the screening tests can only diagnose HIV infection in an infant if the test remains positive after 18 months of age. A positive screening test in the infant before 18 months may simply indicate that there are still maternal antibodies to HIV in an infant who is not infected (i.e. HIV-exposed but not infected).

A positive ELISA or rapid test in a child younger than 18 months does not necessarily mean the child has HIV infection.

A PCR test (polymerase chain reaction) detects HIV DNA (part of the genetic code of HIV). If the PCR blood test is positive the infant is infected with HIV. As the PCR test may take up to 6 weeks after the time of infection to become positive (the window period for the PCR test), an HIV-infected infant may have a negative test during this time (a false negative test).

If the mother is HIV-positive and does not breastfeed, the PCR test should be done on the infant 6 weeks after delivery (at the time of the first immunisation). If the mother breastfeeds, the test should only be done 6 weeks after the last breastfeed. It is a great advantage to establish whether an HIV-exposed child is infected with HIV or not.

**Note**: The vast majority of infants (more than 98%) infected with HIV before or during delivery will have a positive PCR test by 6 weeks. The remainder will be positive by 3 months.

A positive PCR test indicates that the child has HIV infection.

**Note**: The ultrasensitive p24 antigen test is as reliable as the PCR at 6 weeks but is not widely available yet. The PCR HIV RNA test is also probably an accurate method of identifying HIV infection in children under 18 months.

**9-15 What are the advantages of diagnosing HIV infection early?**

There are many advantages of diagnosing HIV infection early in infants. If the infant has not been breastfed, PCR testing can screen the infant for HIV infection at 6 weeks after delivery. Most infants will be negative and their parents can be reassured. These infants do not need the routine care offered to HIV-exposed infants from 6 weeks and can be followed at a well baby clinic. Infants with a positive PCR test should be closely followed up as they need additional care and monitoring. Breastfed infants should only be rescreened later after they have received no breast milk for 6 weeks. As HIV can cause severe illness and even death in the first few months of life, it is important to make the diagnosis as early as possible so that treatment can be started.

HIV-exposed infants should be screened for HIV infection at 6 weeks of age.
9-16 How does HIV infection present clinically in children?

HIV infection can present in many different ways in children and, as a result, may present with a wide range of signs and symptoms. This makes the clinical diagnosis of HIV infection difficult at times. Clinical signs usually slowly develop over a number of months but can present earlier in some infants. The clinical presentation of HIV infection depends on which stage has been reached.

9-17 What are the clinical stages of HIV infection?

HIV infection in children is divided into 4 stages:

1. During stage 1 the child is generally well (asymptomatic).
2. During stage 2 the child has skin rashes and minor infections.
3. During stage 3 the child becomes ill with more serious infections.
4. During stage 4 the child becomes infected with unusual organisms which are very uncommon in healthy children. Stage 4 is also known as AIDS.

Some previously-well infants can present with stage 4 disease without first progressing through the other stages.

NOTE This is the WHO classification. It has replaced the CDC classification which only used 3 stages and did not adequately address many common conditions in Africa such as pulmonary tuberculosis, malnutrition and chronic lung disease.

9-18 How is symptomatic HIV infection diagnosed?

A definite diagnosis of symptomatic HIV infection (i.e. HIV infection causing disease) can be made if both of the following are present:

1. Confirmation of HIV infection by ELISA or PCR testing
2. Clinical signs and symptoms common in HIV infection (Remember that young infants do not have symptoms as they cannot give a history.)

Additional blood tests showing a weakened or damaged immune system help to confirm the diagnosis of symptomatic HIV infection but are not essential. Therefore, when laboratory tests of immune function are not available, a diagnosis of illness due to HIV infection can still be made on clinical signs and symptoms together with blood tests confirming HIV infection.

9-19 What are the signs of stage 1 HIV infection?

These children are generally well (asymptomatic) but may have persistent generalised lymphadenopathy.

9-20 What are the clinical signs of stage 2 HIV infection?

Stage 2 HIV infection presents with any of the following:

- An enlarged liver (hepatomegaly) and spleen (splenomegaly), i.e. hepatosplenomegaly
- Bilateral enlargement of the parotid glands
- Mild skin rashes, especially itchy papules, warts or molluscum
- Recurrent mouth ulcers
- Chronic or recurrent upper respiratory infections especially otitis media

9-21 What are the signs of stage 3 HIV infection?

Stage 3 HIV infection is recognised by:

- Moderate unexplained weight loss or failure to thrive. These children are usually chronically unwell with a poor appetite. Their weight is 60 to 80% of that expected for their age.
- Unexplained fever
• Unexplained persistent diarrhoea for more than 14 days
• Oral candidiasis (thrush) after the newborn period. The candidiasis is often severe, recurrent and responds poorly to topical treatment.
• Pulmonary tuberculosis
• Severe recurrent presumed bacterial pneumonia
• Herpes zoster or severe herpes simplex infection
• Symptomatic lymphoid interstitial pneumonia (LIP)
• Unexplained anaemia, neutropaenia (low white blood cell count) or thrombocytopaenia (low platelet count)
• Gingivitis (gum infections and bleeding)

9-22 What are the signs of stage 4 HIV infection?
Stage 4 HIV infection is recognised by:
• Severe failure to thrive or weight loss with a weight less than 60% of that expected for age
• Oesophageal candidiasis
• Pneumocystis pneumonia
• Disseminated tuberculosis or extrapulmonary tuberculosis
• HIV encephalopathy
• Many other severe opportunistic infections
• Malignancy

The main feature of stage 4 HIV infection is severe opportunistic infection such as Pneumocystis pneumonia. Unlike adults, children with HIV infection rarely present with malignancies.

9-23 How is damage to the immune system documented in children?
HIV infects and damages the CD4 lymphocytes. These are important cells that control the whole immune system. HIV results in a fall in the number of CD4 cells in the blood (immunosuppression) which weakens or damages the function of the immune system (immunodeficiency).

The concentration or percentage of CD4 lymphocytes is used to measure the degree of immune damage. In children the number of CD4 cells is higher than in adults and normally reduces with age. Therefore, in young children (under 5 years) the number of CD4 cells is best expressed as a percentage:

1. The normal range of CD4 lymphocytes in children is 25% or above.
2. With mild immunosuppression the CD4 percentage may still be normal.
3. With moderate immunosuppression the range of CD4 lymphocytes is 15 to 24%.
4. With severe immunosuppression the range of CD4 lymphocytes falls below 15%.

The lower the CD4 percentage the greater is the damage to the immune system and, therefore, the higher the risk of serious HIV-related infections.

The absolute CD4 count is used in children aged 5 years and more. Healthy HIV-negative children of 5 years or above have a CD4 count above 500 cells/μL. A CD4 count below 200 cells/μL indicates severe immune suppression.

NOTE A low total lymphocyte count suggests a low CD4 percentage or count.

9-24 How is the clinical severity of HIV infection classified in children?
This depends on both:
1. The severity of the clinical signs of HIV infection (i.e. the clinical stage)
2. The severity of the immunosuppression
9-25 How should an infant born to an HIV-infected woman be managed after delivery?

1. All the routine care should be given. It is safe to give intramuscular vitamin K.
2. Infants should be dried well immediately after delivery to remove blood and amniotic fluid.
3. Whenever possible the decision to breastfeed or not should be made well before delivery.
4. HIV prophylaxis should be given to the mother and newborn infant to reduce the risk of mother-to-child transmission.

9-26 How should HIV prophylaxis be given to the newborn infant to reduce the risk of HIV infection during labour and delivery?

All pregnant women should be screened for HIV infection when they book for antenatal care. HIV-positive women must have their CD4 count measured and be offered HIV prophylaxis before delivery. Usually AZT 300 mg orally twice daily is given from 28 weeks gestation followed by a 300 mg oral dose 3-hourly during labour. In addition, oral Nevirapine 200 mg should be given to the mother at the onset of labour. After delivery the infant should be given both:

- AZT syrup 12 mg (1.2 ml) twice daily for 7 days, or 4 mg/kg (0.4 ml/kg) if the birth weight is less than 2 kg
- Nevirapine syrup within 72 hours of delivery as a single dose of 6 mg (0.6 ml), or 2 mg/kg (0.2 ml/kg) if birth weight is less than 2 kg

HAART (Highly Active Antiretroviral Treatment) with 3 antiretroviral drugs should be given to HIV-infected pregnant women with a CD4 count below 200 cells/μL. This will reduce the risk of HIV transmission to the fetus if it is started before 28 weeks.

9-27 What is the management of HIV-exposed infants during the first year of life?

All HIV-exposed infants should be managed as follows unless appropriate PCR testing excludes HIV infection:

1. All the routine immunisations should be given.
2. Growth should be assessed by regularly plotting the infant’s weight on a Road-to-Health Card. The early detection of poor weight gain is especially important.
3. Ensure that the infant is receiving an adequate diet. Provide vitamins, especially vitamin A. This is best given as a multivitamin syrup.
4. Co-trimoxazole should be started at 6 weeks.
5. Signs of HIV infection should be looked for at each clinic visit. The early diagnosis and effective treatment of opportunistic infections can give these children longer and better lives.
6. The correct use of antiretroviral therapy is most important in children with AIDS.
7. It is very important to also provide the correct HIV management to the mother and other infected members of the family.

There are great advantages in identifying HIV-infected infants as soon as possible with PCR testing. Infants who are not infected with HIV can be followed at a well baby clinic.

9-28 Is it safe to give immunisations to infants who may be infected with HIV?

It is safe to give all routine immunisations to infants in the first months of life, provided they do not have signs of symptomatic HIV infection. Infants with HIV infection should not be given BCG.
9-29 What is the role of good nutrition in children with HIV infection?

Good nutrition plays an important role in helping to maintain the normal functioning of the immune system. Malnutrition (undernutrition) weakens the immune system, especially in HIV-infected children. Good weight gain on the Road-to-Health Card is the best indicator that the child is well nourished. A careful nutritional history must be taken in children who fail to thrive or lose weight. If necessary, supplementary feeds should be given. It is also important to regularly deworm children.

Vitamin A is important in maintaining a healthy immune system. To prevent vitamin A deficiency, children at risk of HIV infection should be given a multivitamin supplement 0.6 ml daily. This can be stopped if the child is found to be not infected with HIV. If multivitamin supplements are not available, give 50 000 iu of vitamin A orally once if under 6 months (best at 6 weeks). Then give 100 000 iu once at 6 months and 200 000 at 12 months and every 6 months thereafter to HIV-infected children.

Adequate nutrition is an important part of managing children with HIV infection.

9-30 How and when should prophylactic co-trimoxazole be given?

All infants born to HIV-positive women should be given prophylactic co-trimoxazole from 6 weeks until one year or until HIV infection in the child has been excluded by PCR testing. Prophylaxis should be continued beyond one year in any child with clinical signs of HIV infection. Prophylactic co-trimoxazole syrup is usually given daily for 5 days a week (Monday to Friday). The dose depends on the child’s weight:

<table>
<thead>
<tr>
<th>Weight</th>
<th>Daily dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5 kg</td>
<td>2.5 ml paediatric suspension</td>
</tr>
<tr>
<td>5–9 kg</td>
<td>5 ml paediatric suspension</td>
</tr>
</tbody>
</table>

**NOTE** Co-trimoxazole can also be given 3 times a week (e.g. Monday, Wednesday and Friday)

Prophylactic co-trimoxazole decreases the risk of pneumonia caused by Pneumocystis. It also reduces the risk of other bacterial infections and diarrhoea due to some opportunistic infections.

Side effects to co-trimoxazole are uncommon in children. However, co-trimoxazole must be stopped immediately and the child referred if a maculopapular rash (red and easily palpable) develops as this may be the first sign of severe allergy to the drug.

**Prophylactic co-trimoxazole reduces the risk of pneumocystis pneumonia.**

9-31 What is the value of antiretroviral therapy in children?

- When started early it can prevent severe damage to the immune system and thereby prevent severe, recurrent opportunistic infections.
- If the immune system is already damaged, it allows partial recovery and lessens the risk of opportunistic infections.
- With an improvement in the functioning of the immune system, the child will start to thrive and feel much better.
- In the future, it is hoped that new developments in antiretroviral therapy may be able to cure HIV infection.
- With antiretroviral therapy AIDS is a chronic, manageable disease.

**Early, correct treatment of HIV infection can enable children to enjoy a good quality of life for many years.**
9-32 What is the expected outcome for children with HIV infection?

Although HIV infection is believed to eventually have a fatal outcome, much can still be done to improve the quality and length of these children’s lives.

Because young children, especially those born pre-term, have an immature immune system, the course of the disease is more rapid than in adults.

The earlier the onset of symptomatic HIV infection, the poorer the expected outcome. Infants who are infected before delivery probably present early while infants infected via breast milk probably present late.

The clinical categories and immunological status (CD4 percentage) can be used to give an idea of the expected outcome. Children with asymptomatic HIV infection and an intact immune system (normal CD4 percentage) do best while the children with stage 3 or 4 HIV infection and a damaged immune system have the worst outlook.

Children with AIDS who do not receive antiretroviral therapy die much sooner than those who receive full treatment.

The progress in HIV-infected children can be roughly divided into 3 groups:

1. About a third of children present with clinical signs of HIV infection within the first year of life. Without antiretroviral therapy they have a rapid progression of their disease and usually die before 2 years of age (‘fast progressors’).
2. Another third of children present later, between the ages of 1 and 5 years. Their disease runs a slower course.
3. The remaining third present after the age of 5 (‘slow progressors’). They have the best outlook and may live for 10 years or more (similar to adults) even without antiretroviral therapy.

9-33 What factors other than age determine how fast HIV infection will progress?

- The amount of virus present (the viral load). A lot of virus leads to rapid progression of the disease.
- The amount of damage to the immune system (the degree of immunosuppression). The greater the damage (the lower the CD4 percentage), the faster the disease progresses.
- The nutritional status of the child. Poor nutrition results in a worse outcome as it lowers the number of CD4 cells.
- The number of HIV related infections. These co-infections (e.g. TB) may further depress the immune system and accelerate the course of HIV infection.
- Access to health care. Children die sooner if they do not have access to good health care as early diagnosis and treatment of infections is essential.
- The amount of organ damage done before antiretroviral treatment is started.

NOTE The genetic make up of the child and the type of the virus are probably also important. The viral load during the asymptomatic phase of HIV infection (viral set point) determines how fast the HIV infection will progress.

9-34 What are important respiratory problems in children with HIV infection?

- Severe, recurrent or chronic pneumonia caused by bacteria that also cause pneumonia in children who do not have HIV infection, e.g. Streptococcal pneumonia (Pneumococcus) and Haemophilus influenzae B
- Pneumocystis pneumonia
- Viral pneumonia and bronchiolitis
- Tuberculosis
- Bacterial ear infections (otitis media), bronchitis and sinusitis
- Lymphoid interstitial pneumonitis (LIP)
- Chronic lung disease especially bronchiectasis
Pneumocystis pneumonia and lymphoid interstitial pneumonitis are seen very rarely in HIV-negative children.

**9-35 What is pneumocystis pneumonia?**

Pneumocystis pneumonia is a severe opportunistic infection caused by a fungus called *Pneumocystis jiroveci*. This fungus does not cause pneumonia in healthy children. Therefore, a diagnosis of Pneumocystis pneumonia usually indicates that the child has AIDS. Pneumocystis pneumonia commonly presents in the first year of life with high fever, a cough and marked respiratory distress.

The risk of Pneumocystis pneumonia can be greatly reduced with co-trimoxazole prophylaxis from 6 weeks in all HIV-exposed infants (i.e. infants born to HIV-positive women).

Infants with suspected Pneumocystis pneumonia must be urgently referred to hospital for treatment with intravenous co-trimoxazole.

**NOTE** The diagnosis can be confirmed by finding cysts of Pneumocystis in the sputum using a special stain. Pneumocystis pneumonia is one of the AIDS defining illnesses (i.e. stage 4 HIV infection).

**9-36 Is tuberculosis common in children with HIV infection?**

Yes. Tuberculosis is one of the commonest serious bacterial infections seen in children with HIV infection.

**9-37 What forms of tuberculosis are common in children with HIV infection?**

Pulmonary TB due to *Mycobacterium tuberculosis* is the commonest form of TB in both HIV-infected and non-infected children. However, tuberculosis of other organs (extrapulmonary TB) is far more common in children who are infected with HIV.

A combination of HIV and TB infection leads to rapid immunosuppression with progression of both diseases. As a result, TB is more severe in children with HIV infection.

TB in HIV-infected children usually responds well to treatment. However, multiple drug resistant TB is becoming a problem with HIV-infected children. It is the result of inadequate or incomplete treatment.

**NOTE** Infection with *Mycobacterium avium* complex (MAC) is rare in children with AIDS.

See unit 8 for details on tuberculosis.

**9-38 What gastrointestinal problems are common in children with HIV infection?**

- **Oral candidiasis (moniliasis or thrush):** This may be severe, persistent or recurrent. Oral candidiasis after 2 months of age is uncommon in children who are not HIV-infected.
- **Oesophageal candidiasis:** Infants who have severe oral candidiasis and have difficulty swallowing and drool probably have oesophageal candidiasis as well. This serious complication rapidly results in dehydration.
- **Herpes stomatitis:** This is often severe in children with HIV infection, resulting in dehydration. Aphthous ulcers and gum infections are also common. Severe herpes stomatitis should be treated with acyclovir.
- **Acute diarrhoea:** This is usually due to bacteria and viruses which also cause diarrhoea in children who are not infected with HIV.
- **Chronic diarrhoea:** This may complicate acute diarrhoea or be due to opportunistic infections such as Cryptosporidium.
• Lactose intolerance: This may complicate chronic diarrhoea.

Except for children with mild, acute diarrhoea, all these children should be referred to hospital for further investigation and management. Oral candidiasis can usually be treated with local mycostatin or miconazole at a primary care clinic.

9-39 What skin conditions are common in children with HIV infection?

Many common skin conditions occur in children who are HIV-infected. However, they are more severe, and often take longer to respond to treatment, than in children who are not immunosuppressed. Common skin conditions in children with HIV infection are:

- Pruritic papular urticaria (‘itchy bump disease’)
- Severe molluscum contagiosum
- Severe candidiasis nappy rash, which may ulcerate
- Widespread warts
- Severe chicken pox or shingles due to Varicella zoster virus
- Severe scabies, which may involve the whole body
- Severe tinea capitis (ringworm of the scalp)
- Severe impetigo
- Severe seborrhoeic dermatitis

Any of these severe skin conditions, especially shingles, suggests that the child is infected with HIV. Molluscum contagiosum and warts are often extensive and do not recover spontaneously. Severe tinea capitis and impetigo often need systemic therapy and do not respond to local treatment.

Skin conditions and their management are discussed in unit 12.

9-40 What is the effect of HIV infection on neurodevelopment?

The neurodevelopment of children with HIV infection is often retarded. They may even lose developmental milestones that have earlier been achieved. Slow development may be due to chronic illness, hospitalisation, lack of stimulation at home or depression. However, HIV may infect the brain causing an encephalopathy. Children with HIV infection are also at increased risk of bacterial and tuberculous meningitis.

NOTE: Cryptococcal meningitis is an uncommon opportunistic infection in children.

MANAGEMENT OF CHILDREN WITH SYMPTOMATIC HIV INFECTION

9-41 What are the major components of management?

1. Nutritional support
2. Preventing and treating opportunistic infections
3. Antiretroviral therapy
4. Emotional and family support
5. Palliative and terminal care

9-42 How important is nutrition support?

Very important. Children with HIV infection should receive an adequate balanced diet and a multivitamin supplement. Many children feel much better and become hungry once antiretroviral therapy is started. Therefore they may need financial support or free food supplements.

9-43 How should opportunistic infections be managed?

It is very important that opportunistic infections (HIV-associated infections which occur because the immune system has been weakened) are treated early and aggressively. If possible, tuberculosis should be well controlled before antiretroviral therapy is started. The use of prophylaxis with co-trimoxazole in children with immune suppression is important. INH prevention (prophylaxis) must be given to young children...
who have household contact with adults suffering from pulmonary tuberculosis.

9-44 What are the goals of antiretroviral therapy?

1. To stop or reverse the progress of AIDS
2. To return growth and development to normal
3. To prolong and improve the quality of the child's life

With antiretroviral therapy, the aim should be to return the child to normal health, growth and development and maintain this for as long as possible. Antiretroviral therapy has changed AIDS from a rapidly fatal to a chronic, manageable illness.

Antiretroviral therapy prolongs and improves the quality of life.

9-45 When should antiretroviral treatment be started?

There remains a lot of debate as to when treatment should be started and guidelines are changing rapidly as more information becomes available. In South Africa, treatment is started when either:

1. The child is graded as having stage 3 or 4 HIV infection (i.e. moderate or severe clinical signs of HIV infection).
2. The CD4 percentage falls below 20% in asymptomatic children less than 18 months and below 15% if 18 months and older, or a CD4 count below 350 cells/μL in children of 5 years or more.

The clinical staging and CD4 percentage are used as indications for antiretroviral therapy.

The mother or carer must also be ready to accept the diagnosis and make a commitment to treatment (‘treatment-ready’).

9-46 What are the guidelines for antiretroviral therapy?

1. Usually, 3 drugs are used together (multi-drug therapy).
2. The drugs must be given regularly and correctly, at the same time every day (good adherence or compliance).
3. Once or twice daily drugs that taste pleasant and can be given as a liquid are ideal.
4. The dose is calculated for body weight (or body surface area). The most common mistake is not to increase the dosage as the child grows.
5. Someone must take responsibility for the medication. There must be firm parental commitment to life-long treatment.
6. Educating the parents and child about correct medication is essential.
7. Treatment should be started and monitored for the first 6 months by an infectious disease clinic (AIDS clinic). Follow-up can then be done at a primary care clinic.

It is most important that antiretroviral therapy is given correctly every day.

9-47 What drugs are used for antiretroviral therapy?

The first line choice of antiretroviral treatment with highly-active antiretroviral therapy (HAART) in South Africa is a combination of:

1. Two nucleoside reverse transcriptase inhibitors (‘nucs’), usually stavudine (d4T) and lamivudine (3TC)
2. One protease inhibitor in younger children, usually Kaletra (lopinavir with ritonavir), or one non-nucleoside reverse transcriptase inhibitor (‘non-nuc’) in older children, usually nevirapine or efavirenz

If there are serious side effects to one or more drugs, or if the patient fails to respond, a second line of treatment with a different combination of drugs will be necessary. These decisions will be made at an infectious disease clinic.
Highly-active antiretroviral therapy (HAART) is given with a combination of 3 drugs.

9-48 What side effects are seen with antiretroviral drugs?

All antiretroviral drugs have side effects. Most are mild, especially in children. However some can be severe and even fatal in rare cases. Nausea, vomiting, headache, fatigue and mild rashes are common. Rash, raised liver enzymes, peripheral neuropathy and anaemia must be looked for. Most serious side effects occur within one month of starting treatment.

Poor drug compliance (not taking the medication on time every day) may lead to drug resistance and treatment failure.

**NOTE** Immune reconstitution inflammatory syndrome (IRIS) may present soon after antiretroviral therapy has started. An inflammatory response may develop as the immune system starts to recover. During this period severe bacterial, viral or opportunistic infects may present or become worse, especially TB.

9-49 What monitoring is need with antiretroviral therapy?

All children on antiretroviral therapy must be monitored:

1. Check compliance.
2. Growth should be monitored using the Road-to-Health Card.
3. The CD4 percentage and viral load should be measured every 6 months.
4. Full blood count, liver enzymes and/or fasting lipids according to the specific antiretroviral treatment regimen.

9-50 Is there a vaccine against HIV infection?

Unfortunately, there is not. However, an enormous amount of research is being done to develop an HIV vaccine. This holds the most promise of stopping the spread of the HIV epidemic.

9-51 How can emotional and family support be provided?

HIV affects the whole family. Counselling is needed when the diagnosis is made and for some time afterwards until the family comes to both accept and disclose the diagnosis. HIV counselling is usually provided by lay counselors. The support of the community is also very important.

Families with AIDS are often very poor with little or no income. The bread winners are often ill or have died. A child may be head of the family. Many children with AIDS, and children from families with AIDS, become orphans. Social services and community organizations need to be involved in the management of children with AIDS. Financial grants may also be needed.

Almost all children with AIDS have parents who are HIV-infected. It is important that the whole family receives good care. In poor communities, the death of a mother often results in the death of her children, even if they are not HIV-infected.

9-52 What is palliative and terminal care?

Palliative care is the care given to patients who cannot be cured of their illness. It addresses the physical, emotional and psychological needs of the child and family. Because HIV infection is incurable, palliative care starts when HIV infection is first diagnosed and continues for the duration of the illness. Emotional and spiritual support is also important. The aim of palliative care in children is to achieve the best quality of life for the child and family.

Terminal care is the care given to children in the last stages of AIDS. Pain management is an essential part of terminal care. Terminal care is best provided at home (home-based care) by a multi-disciplinary team of nurses, doctors, social workers and members of the community.
It should be compassionate and patient-centred (what is best for the patient). The Hospice movement has greatly improved the quality of terminal care both at home and in institutions.

Palliative care includes terminal care. During the final stages of the disease the aim shifts to keeping the patient comfortable with love and dignity, relieving distress, limiting or reducing the duration of any hospital admissions, and providing the family with additional support.

Palliative care starts when HIV infection is first diagnosed and continues for the duration of the illness.

**CASE STUDY 1**

A young woman is counselled and screened during pregnancy and found to be HIV-positive. She delivers at home and takes her infant to the clinic 3 days later. She breastfeeds for 24 months and introduces formula and solids from one month after delivery. The clinic refuses to give the routine immunisations because the child is positive for HIV on an ELISA screening test.

1. **What is the risk of HIV transmission to this child before and during labour and delivery?**

There is a 5% risk of HIV transmission during pregnancy plus a 15% risk during labour and vaginal delivery, giving a combined risk of 20%.

2. **How could the risk of mother-to-child transmission of HIV at birth have been reduced in this child?**

By giving both the mother and newborn infant prophylactic antiretroviral drugs.

3. **What is the risk of HIV transmission to this child during the first years of life?**

About 15% as mixed breastfeeds (breast milk plus other foods) were given for 2 years.

Therefore the total risk of mother-to-child transmission of HIV is 35% (5% + 15% + 15%).

**CASE STUDY 2**

A 4-year-old child presents at a local clinic with loose stools for 6 weeks and a sore mouth. The Road-to-Health Card shows failure to thrive for the past 3 months. On examination the child is generally unwell and thin, has oral thrush, a rash and generalized lymphadenopathy. After counselling the mother, an HIV screening test (rapid test) is done. This is positive. The CD4 percentage is 20%.

1. **Why would you suspect on the history alone that this child has HIV infection?**

Because failure to thrive with chronic diarrhoea and a sore mouth are common presenting signs of HIV infection.
2. Are the findings on clinical examination suggestive of HIV infection?

Yes. Wasting, oral thrush (candidiasis), a rash and generalized lymphadopathy are typical of symptomatic HIV infection.

3. How would you grade the clinical severity?

Stage 3 as the child is generally unwell with chronic diarrhoea and oral candidiasis.

4. Does the positive screening test confirm the diagnosis of HIV infection?

Yes, as the child is older than 18 months.

5. What does the CD4 percentage indicate?

It shows that the child’s immune system has been weakened (normal above 25%).

6. How should this child be managed?

The child should be referred to an HIV clinic where he can be evaluated for antiretroviral therapy. His oral thrush must be treated. Co-trimoxazole prophylaxis should be started. He needs an adequate balanced diet and the parents must to be counselled. They may also need emotional and financial support.

CASE STUDY 3

A 1-year-old child presents with severe pneumonia. The mother is know to be HIV-positive. On examination the child also has extensive scabies and chronic otitis media. The infant has not started to crawl yet.

1. Do you think this child has symptomatic HIV infection?

Yes. With extensive scabies, you should always think of HIV infection. The pneumonia and chronic ear infection also suggests that this child has a suppressed immune system. Knowing that the mother is HIV-positive makes the diagnosis very likely.

2. What are the probable causes of the pneumonia?

Probably bacterial pneumonia, pulmonary tuberculosis or Pneumocyctis pneumonia. This child needs urgent referral for investigation and treatment. A chest X-ray may show the typical appearance of pneumocystis pneumonia.

3. How can Pneumocyctis pneumonia be prevented in an HIV-infected infant?

Prophylactic co-trimoxazole from 6 weeks is very effective in preventing Pneumocystis pneumonia in HIV-infected infants. It will also reduce the risk of other bacterial infections such as otitis media. There is no history that this child received prophylaxis.

4. Do children with HIV infection often have retarded development?

Yes. Retarded development is common in children with symptomatic HIV infection. It may be one of the first clinical signs of HIV encephalopathy, indicating stage 4 disease.

5. What is this child’s prognosis?

He has stage 4 HIV infections (i.e. AIDS) with severe immunosuppression. Without correct treatment, including antiretroviral therapy, he will probably die within months.

CASE STUDY 4

A 5-year-old girl, who was infected with HIV following a sexual assault, has been followed for 2 years at an HIV clinic. She has remained well until now when she presents with tuberculosis. On examination it is noted that she has bilateral parotid enlargement and an itchy papular rash. Her CD4 percentage is less than 15%. She is started on TB treatment, followed 2 months later by antiretroviral therapy. Soon after beginning the antiretroviral therapy she feels nauseous and has headaches.
1. What is the importance of bilateral parotid enlargement?
This is a very common early sign of HIV infection, as is an itchy papular rash.

2. Is tuberculosis common in children with HIV infection?
Yes. HIV infection should be suspected in all children and adults with TB.

3. Should antiretroviral treatment not be started before the tuberculosis?
No. If possible the TB should be controlled first before the antiretroviral therapy is started.

4. How many drugs are used to treat AIDS?
Antiretroviral therapy (HAART) should always be started with 3 drugs (multi-drug therapy). This lessens the risk of drug resistance and treatment failure.

5. What drugs are usually started as first-line treatment of AIDS?
In South Africa the first-line treatment regime is d4T and 3TC (both nucleoside reverse transcriptase inhibitors) together with Kaletra (a protease inhibitor) in young children and nevirapene or efavirenz (a non-nucleoside reverse transcriptase inhibitor) in older children.

6. Do antiretroviral drugs have side effects?
Yes. These are usually mild, especially in children. Nausea, vomiting, headache, fatigue and mild rashes are common and improve with time. Severe side effects can occur, but they are rare.
REFERENCE: THE 4 STAGES OF HIV INFECTION

Stage 1
- Asymptomatic
- Generalised persistent lymphadenopathy

Stage 2
- Hepatosplenomegaly (enlarged liver and spleen)
- Chronically enlarged painful parotid glands
- Repeated or chronic upper respiratory tract infections (e.g. otitis media, pharyngitis and sinusitis)
- Skin rashes (‘itchy bump disease’, extensive warts or molluscum) and fungal nail infections
- Recurrent mouth ulcers (aphthous ulcers) and inflamed gums
- Angular chelitis (cracks on the lips at the angles of the mouth)
- Herpes zoster

Stage 3
- Unexplained moderate malnutrition with no response to feeding
- Unexplained persistent fever for longer than 1 month
- Unexplained persistent diarrhoea for 14 days or more

Stage 4
- Oral candidiasis (thrush) after 2 months of age
- Oral hairy leukoplakia (white lines on the edge of the tongue)
- Severe ulceration and bleeding of the gums
- Pulmonary tuberculosis (TB) or lymph node TB
- Severe, recurrent pneumonia
- Symptomatic lymphoid interstitial pneumonitis (LIP)
- Chronic lung disease including bronchiectasis
- Unexplained anaemia, neutropenia (low white cells) or thrombocytopenia (low platelets)
10
Childhood infections

Objectives
When you have completed this unit you should be able to:
• Diagnose and manage children with measles, chickenpox and mumps.
• Diagnose and manage children with herpes stomatitis.
• Diagnose and manage children with viral hepatitis.
• Diagnose and manage children with tickbite fever.
• Diagnose and treat children with acute conjunctivitis.

INTRODUCTION

10-1 Which are the common childhood infections?
• Measles
• Chickenpox
• Mumps
• Herpes stomatitis
• Viral hepatitis
• Tickbite fever
• Conjunctivitis

Some infections, such as measles, mumps and viral hepatitis, are becoming uncommon in communities where vaccines against these viral illness are routinely given.

MEASLES

10-2 What is the cause of measles?
Measles is caused by a virus. It is an acute, very infectious (contagious) illness and is transmitted from person to person when the measles virus is breathed, coughed or sneezed into the air and then inhaled by another person who becomes infected by droplet spread. Measles often occurs in epidemics and is an important cause of childhood death in poor, unimmunised communities.

Measles is a highly infectious and serious disease.

10-3 What are the signs and symptoms of measles?
Measles has an incubation period of about 10 days (the delay between infection and the start of the illness).

At first the child develops a fever, runny nose, conjunctivitis and cough, and is generally unwell.

Two days after the start of the illness, Koplik spots appear. These are numerous small white
spots on a granular red base inside the cheeks, opposite the back teeth.

After a further 2 days the typical pink or red blotchy maculopapular (both seen and felt) rash appears, starting on the face and neck and slowly spreading down to the hands and feet. The rash therefore appears 4 days after the child first becomes unwell.

The fever increases and the child becomes increasingly ill with the onset of the rash. Over a few days the rash fades, the temperature drops and the child feels better.

Skin pigmentation (brown) and peeling may follow the rash (post-measles staining).

**Note** The diagnosis is usually clinical but it can be confirmed by serum antibody tests.

**10-4 What are the complications of measles?**

- Otitis media
- Laryngotraceobronchitis with a severe cough and stridor (measles croup)
- Pneumonia. This may be viral (measles, herpes or adenovirus) or bacterial
- Gastroenteritis
- Oral herpes or candidiasis (thrush)
- Keratitis (infection of the cornea) with possible corneal ulcers due to measles or herpes virus
- Encephalitis (rare but serious)
- Reactivation of tuberculosis
- Immunosuppression

Measles depresses the immune system resulting in other infections such as herpes stomatitis and adenoviral pneumonia. HIV infection may rapidly progress to AIDS while tuberculosis is often reactivated following measles. The Mantoux skin test may be negative despite active tuberculosis for a few months after measles.

**Measles complications may be severe and result in death.**

**10-5 What is the relationship between measles and malnutrition?**

There is a close and important relationship between measles and malnutrition (i.e. undernutrition).

Measles is far more severe in children who are malnourished, especially if they are also vitamin A deficient. In addition, complications are more common and more serious in malnourished children.

Measles, especially with complications such as diarrhoea, often results in failure to thrive. Measles may lead to kwashiorkor or marasmus in children who are underweight at the time that they get measles. Therefore, measles may result in, or aggravate, malnutrition.

**Measles is more severe in malnourished children and may make the existing malnutrition worse.**

**10-6 How can measles be prevented?**

By immunising all children with measles vaccine. This is usually given at 9 months and again at 18 months. Measles vaccine is a highly effective and has resulted in the disappearance of measles in many communities. Measles, mumps and rubella vaccines (MMR) are often combined and given together.

**Note** Clinical measles can be prevented in an unimmunised child if measles vaccine is given within 12 hours of exposure to a child with measles.

**10-7 What is the management of a child with measles?**

1. The child should be kept away from other children until 5 days after the rash first appears. By this time the child is no longer infectious to others. Measles is most infectious during the 4 days of illness before the rash appears.
2. Paracetamol for fever
3. Adequate oral fluids to prevent dehydration
4. Vitamin A for all children with measles: 100,000 IU orally daily for 2 days (50,000 IU daily for 2 days in children under 1 year)
5. Look out for and treat complications (acyclovir for herpes stomatitis and stridor; antibiotics for otitis media and pneumonia).
6. Measles is a notifiable disease in South Africa.

Note: Other viral infections may have a rash similar to measles: rubella (German measles), erythema infectiosum (slapped cheek disease) due to parvovirus, roseola infantum ('baby measles') due to herpes virus 6, infectious mononucleosis (glandular fever) due to Epstein-Barr virus and common viral infections of the bowel, e.g. coxsackie and ECHO.

CHICKENPOX

10-8 What is the cause of chickenpox?

Chickenpox is caused by the Varicella zoster virus. Like measles, it is very infectious and transmitted from person to person by droplet spread. Chickenpox is most infectious at the time that the rash starts. Following chickenpox, the same virus may remain silent (dormant) in the body for many years before being reactivated to result in shingles (acute pain and vesicular rash affecting only part of the body). Children can therefore also be infected and get chickenpox from an adult with shingles.

10-9 What are the signs and symptoms of chickenpox?

The incubation period of chickenpox is long at 2 to 3 weeks. The child becomes pyrexial and feels generally unwell. Within hours the rash appears on the face, scalp, chest, back and abdomen.

The rash starts as a pink macule (spot) which soon becomes a papule (palpable) and then a vesicle (with clear fluid) which progresses to a pustule (containing pus) and finally a scab. The progression takes 1–2 days and the rash, which is very itchy, appears in crops for about 5 days. The rash also appears in the mouth as multiple small ulcers. Unless there is secondary infection (impetigo), the rash does not leave scars.

The diagnosis can almost always be made by finding the typical rash. Usually the illness is mild and is not complicated.

Note: Rarely pneumonia or encephalitis may complicate chickenpox.

10-10 How is a child with chickenpox managed?

1. They should not come into contact with other children or adults who have not had chickenpox until there are no more crops of new rash and all the rash has formed scabs.
2. Paracetamol for fever
3. Try to prevent secondary bacterial infection following scratching. Baby powder often helps reduce the itching. Antibiotics may be needed for impetigo.
4. Ensure an adequate fluid intake, especially if the child has a sore mouth.
5. A new vaccine, recently available, is very effective in preventing chickenpox and shingles.
6. Hyperimmune immunoglobulin should be given prophylactically to high-risk children (leukaemia, AIDS, newborns) who are exposed to chickenpox.

Note: Acyclovir is indicated for pneumonia or encephalitis or severe rash or in immunocompromised children.

MUMPS

10-11 What are the clinical features of mumps?

Mumps is an acute illness which presents with fever as well as swelling and tenderness of one or both parotid glands. The enlarged parotid glands lift the lower part of the ear. Chewing may be painful due to the swollen glands. Sometimes the submandibular glands (below the jaw) may be involved.
Mumps is infectious and is caused by the droplet spread of mumps virus. Like chickenpox, the incubation period is 2 to 3 weeks. The parotid swelling has usually resolved by 10 days.

**NOTE** The virus can be cultured, and serum antibodies and mumps DNA detected, if the clinical diagnosis needs to be confirmed. This is uncommon. Mumps infection may be asymptomatic. Painless chronic parotid enlargement unrelated to mumps is common with AIDS.

10-12 What are the complications of mumps?

Mumps usually has no complications and recovery takes about 1 to 2 weeks. However, mumps may cause very painful orchitis (inflammation of the testes) in postpubertal males. Mumps may also cause a viral meningitis.

10-13 What is the management of children with mumps?

1. Mumps is infectious until the parotid swelling disappears.
2. Paracetamol for fever and discomfort is usually all the treatment that is needed.
3. Ensure adequate fluid intake.
4. Good mouth hygiene with antiseptic mouthwashes

Mumps is becoming uncommon in many communities as the very effective mumps vaccine is often given together with measles and rubella vaccine (MMR).

**HERPES STOMATITIS**

10-14 What is herpes stomatitis?

Herpes stomatitis (or oral herpes) is an acute infection of the mouth cause by the herpes simplex virus. The infection is common and often asymptomatic. However, some children get numerous small, shallow ulcers on the tongue, gums and mucosa inside the cheeks. As the ulcers are very painful the child salivates and often refuses to eat or drink. The child is also pyrexial and generally unwell. The stomatitis slowly resolves by 10 days. An important complication of herpes stomatitis is dehydration.

Undernourished children with measles, and children with AIDS, are at high risk of severe herpes stomatitis. Children may also have severe stomatitis due to oral candidiasis.

**NOTE** Most stomatitis in children is caused by the type I Herpes simplex virus. The type II virus is more common in sexually-transmitted genital infection in adults (genital herpes).

10-15 What is the management of a child with herpes stomatitis?

1. Paracetamol for pain and fever
2. Good mouth hygiene with Glyco Thymol mouthwashes
3. Ensure adequate hydration. A nasogastric tube may be needed if the child refuses to drink or swallow.
4. Acyclovir in severe stomatitis, especially children with HIV infection. These children need hospitalisation.

**Children with severe herpes stomatitis should be referred to hospital.**

10-16 What are fever blisters?

The herpes simplex virus can remain hidden (dormant) and then become reactivated to cause fever blisters on the lips. This is similar to the varicella virus in chickenpox which can live on in the body for years before becoming reactivated to cause shingles. The onset of fever blisters may be started by other viral illnesses with fever or excessive exposure to sunlight.

Fever blisters present as a few very painful vesicles on the lips which soon form ulcers and then scabs. They can be treated with acyclovir cream if the treatment is started as soon as the discomfort begins. Herpes virus is present in fever blisters and can be spread to others by direct contact such as kissing. Therefore, adults with fever blisters should never kiss a child.
Unlike fever blisters, which occur on the lip, painful aphthous ulcers occur repeatedly on the mucosa of the mouth. The cause of aphthous ulcers is still unknown.

**ACUTE VIRAL HEPATITIS**

10-17 What is hepatitis?

Hepatitis is an inflammation of the liver. Although there are many causes of hepatitis, the main cause in children is viral.

During the early stages of hepatitis both bilirubin and urobilin are present in the urine when tested with reagent strips. This is a useful way of confirming the diagnosis of hepatitis.

**Note** With hepatitis there is an increase in the serum concentration of the liver enzymes. The bilirubin concentration may also be raised.

10-18 What are the common causes of acute viral hepatitis?

There are 2 common causes of acute viral hepatitis in children:

- **Hepatitis A virus**: This has a shorter incubation period (15–50 days) and is spread by swallowing the virus in contaminated food or water. Hepatitis A is the most common type of hepatitis in children.
- **Hepatitis B virus**: This has a longer incubation period (5–150 days) and in children is usually spread from a mother to her newborn infant at or soon after delivery. However it may also be spread orally like hepatitis A or by an unscreened blood transfusion or traditional scratching or cutting. In adults it is spread by sexual contact.

**Note** Antibodies to hepatitis A or B can be used to identify each virus. Hepatitis surface antigen (HBsAg) or e antigen (HBeAg) indicate persistent infection and probable viral shedding with hepatitis B.

10-19 What is the clinical presentation of acute viral hepatitis?

Acute viral hepatitis in children is often asymptomatic or presents with loose stools and a general feeling of being unwell. Clinical hepatitis may develop with loss of appetite, nausea and vomiting and pain over the liver. The liver is enlarged and tender. Some children have jaundice with dark urine and pale stools. Acute hepatitis is the most common cause of jaundice in children. The clinical symptoms and signs usually resolve over 2–4 weeks.

**Acute viral hepatitis is the most common cause of jaundice in children.**

Hepatitis A virus only causes acute hepatitis but hepatitis B virus may also cause chronic hepatitis.

10-20 What are the complications of acute viral hepatitis?

- Liver failure with acute viral hepatitis is uncommon. Liver failure presents with drowsiness and confusion or severe vomiting. These children need urgent referral to hospital. Some of these children die.
- Chronic hepatitis due to the hepatitis B virus may lead to cirrhosis and liver cancer in adulthood. Therefore, it is important to prevent hepatitis due to the hepatitis B virus.

**Note** In acute liver failure there is usually hypoglycaemia, low clotting factors and raised serum ammonia. Chronic (active) hepatitis is recognised by persistent raised liver enzymes.

10-21 How can viral hepatitis be prevented?

**Hepatitis A**:

- This virus is spread by the virus in stool-contaminated food or water, which is then eaten or drunk by someone else (the faeco-oral route). Good sanitation, clean water, hand-washing before meals and the
hygienic preparation of food are therefore important to prevent the spread of the virus.

- A very effective vaccine to prevent Hepatitis A is now available. Hopefully it will be added to the routine programme of immunisation in children.

Hepatitis B:

- As children usually acquire this virus from their mother who has the virus in her stool, it is important to identify women who have hepatitis before or during pregnancy. Their infants should be given hyperimmune immunoglobulin for hepatitis B after delivery when the first dose of hepatitis B vaccine should also be given.
- A very effective vaccine to prevent hepatitis B is available and has been included in the routine programme of immunisation in South Africa.

10-22 What is the management of a child with acute viral hepatitis?

1. Allow the child to eat whatever is wanted. A high energy diet with a lot of carbohydrate is best tolerated. Keep the child at home if possible.
2. Good hygiene prevents other children getting hepatitis. Hepatitis A is most infectious in the days just before the onset of jaundice.
3. Look out for danger signs of depressed level of consciousness, severe vomiting, and jaundice that does not clear by 4 weeks. Monitor blood glucose concentration in severely ill children.

**Note** Pooled immunoglobulin should be given to hepatitis A contacts and hyperimmune gamma globulin to hepatitis B contacts if affordable and available.

**ACUTE CONJUNCTIVITIS**

10-25 What are the common causes of acute conjunctivitis?

Acute conjunctivitis is common and highly infectious. Usually it is caused by a virus (e.g. adenovirus) but it may be bacterial (e.g. Staphylococcus). Acute conjunctivitis may
occur in outbreaks in schools. Measles, tickbite fever and tuberculosis may also cause acute conjunctivitis.

Conjunctivitis due to allergy may be recurrent or chronic, and is usually associated with other allergies.

10-26 What are the clinical features of acute conjunctivitis?

It may involve one or both eyes. The conjunctivae become red and swollen. With viral conjunctivitis there is a watery discharge. With bacterial conjunctivitis the discharge may become purulent (yellow pus) and the eyelashes stick together. Allergic conjunctivitis is very itchy. Sudden onset of pain and redness of the conjunctiva in one eye suggests a foreign body.

Very localised swelling of an eyelid is usually due to a stye (infection of a hair follicle). Local antibiotics, removal of the eyelash and warm compresses to open the obstructed hair follicle are needed.

10-27 What is the treatment of acute conjunctivitis?

Topical antibiotic drops or ointment (e.g. chloromycetin) or povidone-iodine drops are used for a few days. If there is marked swelling of the eyelids, give intramuscular ceftriaxone daily for 3 days.

**NOTE** 1% chloromycetin eye ointment, 1% tetracycline eye ointment or 2.5% povidone-iodine aqueous solution are used to treat bacterial conjunctivitis. Tetracycline and povidone-iodine can also be used to treat conjunctivitis due to Chlamydia.

10-28 What are the less common childhood illnesses?

Some childhood illnesses have almost disappeared due to routine immunisation:

- Poliomyelitis (polio)
- Whooping cough
- Diphtheria

Other infections are more common in adolescents and young adults:

- Infectious mononucleosis (Glandular fever)
- Rubella (German measles)

**CASE STUDY 1**

A 6-year-old child comes home from school feeling generally unwell. She has a temperature, cough and mild conjunctivitis. When a doctor is called 2 days later he notices Koplik spots and diagnoses measles. After another 2 days she develops a typical measles rash. Another child at school had measles recently.

1. **What are Koplik spots?**

Small white spots seen on a red, granular mucosa inside the cheeks opposite the back teeth. Only measles displays Koplik spots.

2. **What is the incubation period for measles?**

10 days from exposure to an infected child until the onset of feeling unwell with fever, cough and conjunctivitis. Another 2 days until the Koplik spots appear and then a further 2 days for the rash to start. Therefore, 14 days from infection to the rash.

3. **Describe the typical rash of measles.**

A pink or red blotchy maculopapular (both seen and felt) rash starting on the face and spreading down the trunk to the arms and legs. Skin pigmentation and peeling may follow the rash.

4. **How can measles be prevented?**

By immunising all children. The occasional case of measles still occurs because all children are not fully immunised.

5. **What are the common complications of measles?**

Otitis media, laryngotracheobronchitis and pneumonia. Gastroenteritis and stomatitis (herpes or fungal) are also seen.
6. What is the relationship between measles and malnutrition?

Measles is often more severe, and can be fatal, in malnourished children. In addition, the degree of malnutrition often becomes worse after measles.

Measles is particularly severe in children with a deficiency of vitamin A. Therefore 200 000 units of vitamin A should be given orally to all children with measles.

7. Can measles cause tuberculosis or AIDS?

No. But measles suppresses the immune system which can result in the reactivation of tuberculosis (a child with an asymptomatic TB infection now develops clinical signs of tuberculosis). A child with asymptomatic HIV infection can also develop clinical AIDS following immunosuppression due to measles.

**CASE STUDY 2**

A 4-year-old child develops a very painful mouth, drools saliva and refuses all feeds. He has a high temperature and is generally unwell and very miserable. His mother had fever blisters on her lip a week before.

1. **What is the likely diagnosis?**

Herpes stomatitis. This presents with many small, very painful ulcers in the mouth. The children are also pyrexial and generally unwell. Drooling and refusing to eat is due to the sore mouth.

2. **What is the cause of this condition?**

The herpes simplex virus. This child almost certainly was infected from his mother’s fever blisters. During the acute phase of fever blisters, the herpes virus can be spread by direct contact such as kissing. Adults with fever blisters should never kiss a child.

3. **What is the danger of herpes stomatitis?**

Children may become dehydrated if they do not drink enough because of their sore mouth. They may need nasogastric feeds or intravenous rehydration.

4. **Which children often get severe herpes stomatitis?**

Children with malnutrition or measles.

5. **What else may cause severe stomatitis?**

Candidiasis (thrush) can cause severe stomatitis.

**CASE STUDY 3**

In an orphanage a number of children become ill. Some have a fever and loose stools while others develop jaundice and a tender abdomen. All have loss of appetite.

1. **Why have a number of children in the orphanage become ill?**

They probably have acute hepatitis A, which is often spread in crowded situations such as schools or orphanages. The virus is spread from the stools of a child to be ingested by other children (faeco-oral route). This is the most common cause of acute hepatitis in children.

2. **Why are some children unwell with loose stools but do not develop jaundice?**

Many children with acute hepatitis are asymptomatic while others become ill with loose stools but do not develop jaundice. Some become jaundiced for a few weeks. Rarely children with hepatitis become severely ill and may die of liver failure.

3. **How are children usually infected with the hepatitis B virus?**

They are infected by their mother at birth. Acute hepatitis due to the hepatitis B virus may not recover after a few weeks but progress
to chronic hepatitis. This can lead to cirrhosis and liver cancer in adulthood.

4. How can acute hepatitis A be prevented?

The spread of hepatitis A virus (and to a lesser extent, hepatitis B virus) can be reduced by washing hands after using the toilet and before eating. The safe distribution of human faeces (toilets) and a clean water supply is important. A vaccine is available.

5. How can acute hepatitis B be prevented?

Hepatitis B can be prevented by routinely immunising all children with hepatitis B vaccine. Mothers who have jaundice before or during pregnancy must be identified for special management.
Objectives
When you have completed this unit you should be able to:
• Diagnose and manage children with intestinal worms.
• Diagnose and treat giardiasis.
• Diagnose and treat amoebiasis.
• Diagnose and treat bilharzia.
• Diagnose and manage children with malaria.

INTRODUCTION

11-1 What are parasites?
These are small creatures (animals) which invade and infect (infest) the body. They may be either:
• External parasites which live on or in the skin, e.g. scabies and sandworms.
• Internal parasites which live in the body. Many internal parasites live in the bowel (i.e. intestinal parasites such as worms). Other parasites live in the blood (e.g. malaria) or other organs such as the bladder wall (e.g. bilharzia).

Children with AIDS may be infected with unusual parasites not normally seen in healthy children (e.g. Toxoplasmosis).

11-2 Which are the common intestinal parasites?
In Southern Africa the common intestinal parasites are:
• Roundworms
• Whipworms
• Pinworms
• Hookworms
• Giardia
• Tapeworms
• Amoebae

ROUNDWORMS

11-3 What is a roundworm?
Roundworms are the most common parasites found in the gut of children. The worms are pink and smooth and measure about 25 cm long. They look like pale garden earth worms.

Roundworms produce thousands of eggs a day which are passed in the child’s stool (faeces). The eggs have a very characteristic shape and can be easily recognised if a sample of stool is examined under a microscope.
Roundworms are common in children between the ages of 1 and 5 years.

**Roundworms are the most common bowel parasite in many poor countries.**

**Note:** The roundworm is *Ascaris lumbricoides*. Infection with roundworms is called ascariasis.

### 11-4 How do children get roundworms?

If human faeces are not disposed of in a hygienic way, or if sewerage sludge is used as a garden fertiliser, children can swallow and get infected by roundworm eggs. Roundworm eggs can survive in soil for years. Playing or crawling in contaminated soil or eating raw vegetables that have not been washed may result in infection. High prevalence rates are common in communities with poor sanitation. This is a major public health problem in many parts of South Africa.

Roundworm eggs hatch in the child’s small bowel, and the newly hatched larvae then pass through the bowel wall into the bloodstream and are carried to the alveoli of the lungs. From here they make their way up the bronchi and trachea then get swallowed. In the small bowel the roundworm larvae mature into adult worms where they can live for 2 years.

### 11-5 Do roundworms in the gut cause clinical problems?

Many children with roundworms appear healthy and have no symptoms. Often the only way the parents know that their children have roundworms, is when worms are seen in the stool. Sometimes worms can be vomited. When the child is ill with a fever, roundworms may make their way up the child’s oesophagus and come out of the nose.

Large numbers of worms in the bowel can cause problems:

- Vague abdominal pain or discomfort
- The amount of food they use can contribute to malnutrition (undernutrition). Roundworms also decrease the child’s appetite.
- A large bunch (bolus) of worms can cause colic (cramping abdominal pain) and even total small bowel obstruction. The mass of worms may be palpable on abdominal examination.
- Migrating worms can get stuck in the bile duct, resulting in acute, severe pain over the liver (biliary colic).

**Note:** Roundworms can also cause bowel perforation, volvulus, intussusception, colangitis and pancreatic duct obstruction. With heavy infections, bunches of roundworms can be seen in a plain abdominal X-ray. Do not give mebendazole or albendazole if acute abdominal pain is present as treatment increases the worms’ tendency to migrate and may precipitate bowel obstruction. Surgery must be considered if there are signs of obstruction.

### 11-6 How can roundworms cause chest problems?

The larvae (which hatch out of the eggs in the gut) can cause respiratory symptoms and signs during the time that they are migrating through the lungs. Children with roundworm larvae in the lungs present with a dry cough or wheeze.

**Note:** A high eosinophil count in the peripheral blood (10% or more) is typical. Chest X-ray may show a pneumonitis.

### 11-7 How are roundworms treated?

Roundworm infection can be treated with either:

- Mebendazole orally 100 mg (i.e. 1 tablet) twice a day for 3 days if below 5 years and 500 mg as a single dose if 5 years or older.
- Albendazole as a single dose 200 mg (2 tablets) for children below 2 years and 400 mg for children of 2 years or more.

### 11-8 How can infection with roundworms be prevented?

- By safely disposing of human faeces (adequate sanitation), e.g. water borne sewerage or correctly built pit latrines
Parasites

- By washing raw vegetables before they are eaten
- By washing hands before preparing or eating meals
- By preventing children from eating soil
- By routinely deworming children

11-9 When is deworming recommended?

Deworming every 6 months is recommended for children between the ages of 2 and 5 years in communities with poor hygiene and inadequate sanitation (poor toilet facilities). This should be done even if there is no history of roundworms in the stool. Medication is usually given at the local primary care clinic or in schools. Deworming has been found to improve the learning capacity and growth of school children.

Mebendazole is the drug of choice. Albendazole is more expensive. The dose for deworming is the same as for treating roundworms. Both these drugs are highly effective for roundworms.

11-10 What are whipworms?

Whipworms commonly infect the bowel of children in Southern Africa. They are short, thin worms (about 4 cm) that attach themselves to the mucosa of the large bowel where they cause bleeding. It is rare to see the worms in the stool.

As with roundworms, eggs are ingested (swallowed) with soil. The eggs hatch in the child’s gut and the larvae attach to the bowel wall. Unlike roundworms, the larvae do not migrate through the lungs.

Note: The whipworm is Trichuris trichura. The eggs in the stool have a typical ‘tea tray’ appearance.

11-11 What are the clinical features of whipworm infection?

Whipworms usually infect children over 5 years of age. If the infection is light there are usually no symptoms or signs. Heavy infection can cause:

- Loose stools containing blood.
- Rectal prolapse may occur with very heavy infections. With prolapse, the worms may be seen attached to the rectal mucosa.
- Iron deficiency anaemia due to chronic blood loss in the stool. This may be severe.
- Malnutrition

Whipworm infection can cause iron deficiency anaemia.

11-12 What is the treatment of whipworm infection?

1. Prevention through good hand hygiene, washing raw vegetables and the correct disposal of human faeces (as with prevention of roundworms)
2. Mebendazole or albendazole, as given for roundworms
3. Treat iron deficiency anaemia with oral iron.

11-13 What are pinworms?

Pinworm infection is very common. They are small, thin worms (about 4 cm long). Pinworms are especially common where children sleep or play together in crowded conditions. Adult female worms pass out the anus at night to lay eggs on the perineum. Eggs are swallowed from contaminated fingers, clothing or bed linen. Pinworms are common even where hygiene and sanitation are of a high standard. They are also known as threadworms.

Note: The pinworm is Enterobius vermicularis.
11-14 What are the clinical features of pinworm infection?
Perianal itching and scratching at night. This may cause loss of sleep. Secondary infection of the scratched skin is common. In girls the worms may enter the vulva causing irritation and vaginal discharge (vaginitis).

11-15 How is pinworm infection diagnosed?
The clinical diagnosis can be confirmed by the parent finding the small worms on the skin around the anus at night. A piece of sticky tape (Sellotape) should be placed against the anus and surrounding skin during the night and then immediately removed. In this way eggs can be collected and identified under a microscope.

11-16 What is the treatment of pinworms?
Mebendazole or albendazole, as used for roundworms

HOOKWORMS

11-17 What are hookworms?
Hookworms commonly occur in warm, moist climates such as northern KwaZulu-Natal and the Mozambique coast. With poor sanitation, hookworm eggs in the stool contaminate the soil and hatch rapidly. They then infect the feet of barefoot children. Once the skin is penetrated, hookworms behave like roundworms as they enter the bloodstream and travel via the lungs to get into the small bowel. The worms attach to the bowel mucosa and cause bleeding.

NOTE There are two types of hookworm, Ancylostoma duodenale and Necator americanus.

11-18 What are the clinical features of hookworm infection?
Usually, there are no symptoms unless there is heavy infection. The child may have an unusually large appetite and want to eat sand. In severe cases there may be signs of iron deficiency anaemia.

11-19 How is hookworm infection diagnosed?
Worms and their eggs may be found in the stools.

11-20 What is the treatment of hookworm infection?
Mebendazole or albendazole, as for roundworm infection.

NOTE Pyrantel (Combantrin) orally 10 mg/kg as a single dose may also be used.

TAPEWORMS

11-21 What are tapeworms?
The common tapeworms that infect the human gut are the pork and, to a lesser degree, the beef tapeworm. They are very long (up to 5 metres) segmented worms that grow in the small bowel of humans after eating uncooked or partially cooked meat, which is contaminated with tapeworm cysts. Tapeworm segments filled with eggs are excreted in human stools and later may be swallowed by animals (pigs or cows). The eggs hatch in the animal’s gut and are carried in the bloodstream to the muscles of the animals where they become tapeworm cysts. Eating infected, uncooked meat of these animals completes the life cycle of the tapeworm when the eggs hatch, resulting in adult worms living in the human gut.

Most tapeworms result from eating poorly cooked pork which is infected with tapeworm cysts.
11-22 How is tapeworm infection diagnosed?

Small segments of the worm are seen in the stool or may be found in the bed. Often there are no other symptoms. However, tapeworms can cause abdominal discomfort, failure to thrive and loss of appetite.

11-23 What is the treatment of tapeworm infection?

Mebendazole orally 100 mg twice daily for 7 days.

11-24 How can tapeworm infection be prevented?

If possible, animals should be slaughtered in a registered abattoir where all meat is inspected to ensure that it is not infected by tapeworm cysts. Cooking meat well kills the cysts. Therefore, avoid eating raw or partially cooked meat. Meat lightly cooked on an open fire may still contain live tapeworm cysts.

Human stools must be disposed of safely so that it cannot be eaten by pigs. This will prevent the pigs from becoming infected with tapeworm cysts. Parts of the Eastern Cape of South Africa are particularly heavily contaminated with tapeworm eggs.

11-25 Can tapeworm cysts enter the brain?

Yes. Sometimes the eggs of the pork tapeworm, which have been passed in human faeces, are swallowed by other humans (instead of by pigs) in food or water contaminated by infected human faeces. The eggs hatch in the child's gut and are then carried by the bloodstream into all parts of the body including the brain. In the brain they form many small tape worm cysts (neurocysticercosis) which cause fits (convulsions). Tapeworm cysts in the brain are a common cause of fits in children that live in rural areas where toilets are not available. Good sanitation, safe water, hand-washing and washed vegetables will reduce the risk of neurocysticercosis.

Swallowed pork tapeworm eggs from human faeces result in tapeworm cysts in the brain.

NOTE The tapeworm cysts (cysticerci) are best identified in the brain by MRI or CT scanning. With time they become calcified and can be seen on X-ray. Cysts may also occur in muscles. Antibody tests are of little help. Treatment of neurocysticercosis in hospital is with steroids and Praziquantel.

HYDATID DISEASE

11-26 What is hydatid disease?

This is caused by the dog tapeworm which can occur in the gut of dogs. Eggs, which are passed in the dog's stool, may be swallowed by sheep and goats, resulting in tapeworm cysts in their muscles. Other dogs can then be infected with tapeworms by eating the raw meat of these sheep or goats.

If eggs of the dog tapeworm are swallowed by humans instead, the eggs hatch in the human gut and are carried by the bloodstream to the liver or lung where they form large cysts (hydatid cysts). These large cysts may cause clinical problems (hydatid disease) and will have to be removed surgically.

Dogs should be dewormed regularly and they should not be allowed to eat raw meat, especially mutton or goat meat which is infected with the cysts of the dog tapeworm. Prevent children eating soil as it may be contaminated with dog tapeworm eggs. Always wash hands before eating. Also wash vegetables well.

Hydatid disease results when children swallow the eggs of the dog tapeworm.
Treatment is with mebendazole or albendazole daily for 6 weeks.

**NOTE** The dog tapeworm is *Echinococcus granulosus*.

The prevention, diagnosis and treatment of sandworm infection is discussed in Unit 12.

**GIARDIASIS**

11-27 What is giardiasis?

Giardiasis is an infection with a single-celled organism (protozoa) called giardia. The cysts of giardia are swallowed in contaminated food or water. Giardia lives in the small bowel and cysts are passed in the stool. The cysts in human stools contaminate the soil and nearby water.

**NOTE** *Giardia lamblia* is the cause of giardiasis.

11-28 What are the clinical features of giardia infection?

Giardiasis is usually asymptomatic. However, with heavy infection the child develops loose, foul-smelling, watery stools. Abdominal cramps and vomiting are common. Usually the infection resolves in a few days but it may become chronic. Chronic giardiasis may cause chronic diarrhoea with malabsorption leading to failure to thrive and malnutrition.

It is difficult to confirm the diagnosis by finding cysts in the stool. Therefore, diagnosis is usually suspected from the clinical history and confirmed when the symptoms and signs disappear after treatment.

**Giardiasis can cause chronic diarrhoea and failure to thrive.**

**NOTE** Giardia is a common cause of ‘travellers’ diarrhoea’.

11-29 What is the treatment of giardia infection?

Metronidazole (Flagyl) 500 mg (under 4 years) or 800 mg (4 years or older) daily for 3 days.

It is best to avoid infection with giardia by not drinking contaminated water or eating unwashed vegetables or salad.

**AMOEBIASIS**

11-30 What is amoebiasis?

Amoebiasis is an infection caused by a single-celled organism (protozoa) called an amoeba which infects the large bowel. Amoebae are passed in the stool from where they can contaminate food or water causing infection in others. Therefore, the provision of toilets and a safe water supply are important to prevent amoebiasis.

**NOTE** *Entamoeba histolytica* is the amoeba which causes amoebiasis.

11-31 What are the clinical features of amoebiasis?

Mild infection is asymptomatic. However, heavy infection causes abdominal discomfort and dysentery with blood and mucus in the stools. Amoebae can also cause abscesses in the liver. This presents with an enlarged tender liver. Severe bowel infection can result in perforation and peritonitis.

Amoebae can be seen microscopically in warm stool. A blood test for antibodies against amoebae is useful in identifying patients with amoebiasis.

11-32 What is the treatment of amoebiasis?

Metronidazole (Flagyl) 200 mg 3 times daily for 5 days. All children with severe dysentery or suspected liver abscess must be referred urgently. A large liver abscess may need to be aspirated.
Clean water, washing hands before eating, avoiding unwashed vegetables and salads, and the safe disposal of human faeces prevents amoebiasis.

11-33 How can infection with many types of intestinal parasite be prevented?

The same basic steps are needed to prevent most intestinal parasites:

1. The safe disposal of faeces is most important, e.g. water flush toilets or correctly-made pit toilets (VIP toilets). Never pass urine or stool near a stream or dam.
2. Hands should always be washed before preparing and eating food. They should also be washed before eating.
3. Always use a clean, safe source of water for drinking and washing.
4. Always wash raw vegetables or salads before eating.
5. Avoid eating meat which has not been thoroughly cooked.
6. Prevent pigs from eating human faeces.
7. Do not leave dog faeces lying around.

Public awareness campaigns are an important method of reducing the number of infected children. Methods of preventing infection with intestinal parasites should be taught and practised at schools.

11-34 What is the treatment of intestinal parasites?

Most intestinal parasites can be effectively treated with oral mebendazole or albendazole. Some require a single dose (roundworms, whipworms and pinworms) but others need a daily dose for a number of days (tapeworms). Giardia and Amoeba infections should be treated with metronidazole (Flagyl).

Regular treatment of children (e.g. deworming for roundworms) is advised for some intestinal parasites in communities where they are common.

It is important that parents are aware of the clinical features of infection with intestinal parasites and can recognise the worms if they are seen.

**BILHARZIA**

11-35 What is bilharzia?

Bilharzia (schistosomiasis) is a disease caused by the bilharzia parasite. About 2 million people are infected with bilharzia in South Africa. There are 2 forms of bilharzia. One affects the bowel while the other affects the bladder. Bilharzia of the bladder is the most common form of bilharzia in children in South Africa.

Eggs of the bladder parasite are passed in the urine. If the urine reaches a source of water, the parasite can infect and multiply in a special snail often found in pools, dams, reservoirs, canals or slow flowing streams. Parasites released from the snail can penetrate the skin of humans. From here the parasites enter the bloodstream and are carried to the bladder. Sometimes they may also reach other organs.

In the bladder wall the parasites cause inflammation, bleeding and eventually scarring. Damage can extend to the rest of the urinary tract, resulting in urinary obstruction with chronic renal failure.

**NOTE** Bilharzia (schistosomiasis) is caused by either *Schistosoma haematobium* (bladder parasite) or *Schistosoma mansoni* (bowel parasite).

**Bilharzia of the bladder is common in South Africa.**

11-36 What are the clinical features of bilharzia of the bladder?

At the time of infection an itchy, papular rash may occur at the site where the parasites enter the skin (called ‘swimmers’ itch’). This may be followed a few weeks later by a flu-like illness.
Mild bladder infection with bilharzia parasites is often asymptomatic. With more severe infection, the classical sign is terminal haematuria (blood seen in the urine towards the end of micturition).

11-37 How is the diagnosis of bilharzia of the bladder confirmed?

By finding the typical bilharzia eggs in the urine under a microscope. It is best to collect urine around midday when most eggs are released. A blood test for antibodies to the parasite is also available.

**Note** Bilharzia of the bowel may cause dysentery.

11-38 What is the treatment of bilharzia?

Praziquantel 40 mg/kg orally as a single dose. This treatment can be given at a clinic. Unfortunately, children who live in a bilharzia region may have to be treated repeatedly for bilharzia.

11-39 How can bilharzia be prevented?

Every effort must be made to prevent bilharzia infection. Never pass urine into a stream or pool of water. Standing or slow-moving water such as farm dams and irrigation furrows are the home of the bilharzias snail, especially in the eastern areas of South Africa and in Zimbabwe. Fast-moving streams are usually safe. Swimming or bathing in infected water must be avoided as this is the common way of getting bilharzias. Efforts are being made to kill the snails in high risk areas.

**Note** Eosinophilia in the blood is usually present with bilharzia.

11-40 What is malaria?

Malaria is a serious illness caused by a malaria parasite which is transmitted to humans by a special type of mosquito. When a mosquito bites an infected person, human blood containing malaria parasites is taken in by the mosquito. The mosquito becomes infected (but not ill) and can then bite and infect other humans. In the human, the malaria parasite infects both red cells and the liver. Infection of the red cells causes haemolysis, resulting in anaemia. It also causes the red cells to stick together which obstructs small blood vessels. Malaria is a common cause of chronic illness and death in many low lying regions where malaria mosquitoes occur.

**Malaria is an important cause of death in many parts of southern Africa.**

As falciparum malaria is by far the most common form of malaria in South Africa, other rarer forms of malaria will not be considered.

**Note** Almost all malaria in Southern Africa is caused by *Plasmodium falciparum* which is transmitted by female Anopheles mosquitoes (the vector of malaria).

11-41 What are the clinical signs of malaria?

The patient develops an acute illness with fever, shivering rigors and flu-like symptoms 1 to 2 weeks after being bitten by an infected mosquito. Headache, nausea and body pains are common in uncomplicated (mild) malaria. The symptoms and signs of malaria are very non-specific, making the clinical diagnosis difficult to confirm or exclude.

Severe headache, repeated vomiting and drowsiness suggest the development of severe malaria. Mild malaria may become severe and even fatal within hours.

**Note** Infection of other organs such as the liver (jaundice), gut (diarrhoea), lungs (respiratory...
Anyone who develops fever in a malaria area, or within 2 weeks of leaving a malaria area, must be suspected of having malaria. Thinking of malaria is the most important step in the clinical diagnosis. As the clinical symptoms and signs of malaria are very varied, it is always important to confirm the clinical suspicion. There are often no clinical signs at presentation.

Suspect malaria in anyone with a flu-like illness who lives in or has recently visited a malaria region.

11-42 How is the diagnosis of malaria confirmed?

1. Seeing the malaria parasites within red cells in a stained thick blood smear is the traditional ways of confirming the diagnosis. Repeated smears may be needed before malaria is excluded as the smear may be negative early in the infection.
2. A blood test to detect malaria proteins (rapid antigen test) is also useful in making a rapid diagnosis. It is very reliable and available at primary care facilities in malarial areas of South Africa.
3. It is very important to confirm the diagnosis of malaria as soon as possible.

Most deaths due to malaria are caused by delayed diagnosis or late treatment.

Remember that many other serious conditions may present with the same symptoms and signs as malaria, e.g. bacterial meningitis. Children may also have malaria plus another infection.

11-43 How can you tell whether malaria is uncomplicated or severe?

In uncomplicated malaria the patient:

- Has mild symptoms
- Is fully alert and able to stand and walk
- Is passing urine
- Is not vomiting repeatedly, and is able to take oral medication
- Has no signs of organ failure

**NOTE** In uncomplicated malaria the parasite count on a thin blood smear is less than 5%, i.e. less than 5% of red cells containing malaria parasites.

In severe malaria the patient may have any of the following:

- Signs of cerebral malaria
- Breathing difficulty
- Hypoglycaemia, jaundice or severe anaemia (Hb less than 5 g/dl)
- Repeated vomiting, apparent dehydration or little urine passed
- A shocked appearance

**NOTE** In severe malaria the parasite count is well over 5% (hyperparasitaemia). The higher the count, the more severe the malaria. Metabolic acidosis may occur.

11-44 What is cerebral malaria?

This is the most dangerous complication of severe malaria as the brain is affected and can lead to rapid death. Young children, pregnant women and people who are HIV infected are particularly susceptible to cerebral malaria. Each year many children die of cerebral malaria in Africa.

Signs of cerebral malaria must always be viewed with great concern:

- Depressed level of consciousness, i.e. drowsy, unable to stand, confused or unconscious
- Convulsions

**NOTE** In cerebral malaria the large numbers of parasites obstruct the normal blood flow to the brain.

Confusion is an important sign of potentially fatal cerebral malaria.
11-45 How is uncomplicated malaria treated?

Early and accurate diagnosis with urgent treatment using the correct drugs is the key to successful management. It is important to differentiate uncomplicated from severe malaria. If possible all patients with malaria are referred to a hospital or clinic where the staff are experience in treating malaria. They must be closely followed up for the first few days. Patients with confirmed malaria are usually treated with coartemether (Coartem). Coartem is a combination of two potent, rapidly acting anti-malarial drugs which are well tolerated.

For uncomplicated malaria, one dose of Coartem should be taken immediately, then again after 8 hours, followed by a twice daily dose for the next 2 days. Each dose is 1 tablet if 10–14 kg, 2 tablets if 15–24 kg, 3 tablets if 25–34 kg and 4 tablets if 35 kg or more. Best taken with food.

Drug resistance is a major problem with malarial treatment. Most strains of malaria are now resistant to chloroquine alone or in combination with other drugs. Paracetamol is best for reducing the fever. Make sure the patient is taking enough fluids.

Uncomplicated malaria can also be treated with oral quinine. However, there are some serious side effects of quinine, e.g. myocardial toxicity.

Note: The dose of oral quinine is 10 mg/kg 8 hourly for 7 days PLUS clindamycin 5 mg/kg 8 hourly for 7 days or doxycycline (if over 8 years of age) 4 mg/kg immediately then 2 mg/kg daily for 7 days.

The quinine tablets are very bitter but can be crushed and taken with jam, or mashed banana.

11-46 How is severe malaria treated?

Severe malaria is usually treated with intravenous quinine PLUS oral doxycycline (if over 8 years) or clindamycin (oral, intramuscular or intravenous in younger children). Intravenous drugs must be started immediately and the patient urgently referred to hospital. Look for and manage hypoglycaemia, shock or convulsions.

In future intravenous artesunate will probably replace quinine as it is safer. Rectal artesunate is also an effective emergency treatment.

Note: A loading dose of quinine 20 mg/kg diluted in 5% dextrose water (10 ml/kg) must always be given as a slow infusion over 4 hours and never as a bolus. This is followed by 10 mg/kg 8 hourly intravenously. Change to oral quinine as soon as possible.

Using a combination of drugs for both uncomplicated and severe malaria is more effective and less likely to result in resistance in the community than monotherapy (one drug only). The patient should improve clinically within 48 hours and the fever should settle within 5 days.

11-47 How is malaria prevented?

1. Pregnant women and young children should not enter a malaria areas if at all possible.
2. Mosquitoes usually bite in the early evening and early morning. Therefore, stay indoors with screens over windows and doors or wear light coloured clothes, long sleeves and trousers with shoes and socks in the evenings and early mornings.
3. Use a bed net impregnated with insecticide (pyrethroid) at night.
4. Use insect repellent on the skin and clothes or burn repellent coils or pads or sprays at night.
5. Antimalarial drug prophylaxis is recommended for short visits to a malaria area.
6. By reducing the number of mosquitoes. Preventing mosquito bites is more effective than prophylaxis. Usually both are needed.

11-48 What malaria prophylaxis is recommended?

Malaria prophylaxis is needed by all who enter a malaria area (a region where malaria occurs), even if it is only a one day visit. The risk of
becoming infected by malaria is particularly high in the rainy season when mosquitoes are common. Full compliance is very important. However, prophylaxis is never 100% effective.

1. Malanil or malarone (atovaquone plus proguanil) for children of 10 kg or more. It is well tolerated but expensive.
2. Mefloquine (Larium) for children of 5 kg or more.
3. Doxycycline for older children (over 8 years).

It is best for all children under 5 years, especially children under 5 kg, not to enter a malaria area as they are at high risk for severe infection. Chloroquine alone, chloroquine with proguanil, and Coartem should not be used for prophylaxis.

**NOTE** Malanil daily ¼ tablet if 5–20 kg, ½ tablet if 21–30 kg, ¾ tablet if 31–45 kg and 1 tablet if over 45 kg starting one day before entering and stopping one week after leaving a malaria area. Mefloquine weekly ¼ tablet if 5–20 kg, ½ tablet if 21–30 kg, ¾ tablet if 31–45 kg and 1 tablet if over 45 kg starting one week before entering and stopping 4 weeks after leaving a malaria area. Doxycycline 100 mg daily starting 1 day before entering and stopping 4 weeks after leaving a malaria area.

Seasonal Intermittent Treatment of children in malaria regions decreases the incidence of clinical malaria.

11-49 How can the number of mosquitoes be reduced?

1. By reducing the mosquito population with the use of controlled spraying around homes with insecticides. This is done by state-employed teams.
2. By reducing pools of water where mosquitoes can breed.

**NOTE** Malarial mosquitoes have become resistant to many insecticides. The controlled use of DDT is very effective but remains controversial due to the risk of environmental pollution and dangers to other animals and possibly the newborn infant.

**CASE STUDY 1**

A mother brings her 5-year-old son to the clinic because he has passed 2 roundworms with his stool. He is generally well but the mother complains that he scratches his anus at night which keeps him awake.

1. **How do children get roundworms?**

They ingest the roundworm eggs after playing in sand or soil. If human faeces are not disposed of correctly they can contaminate soil in the village, garden or playground. Eggs can survive for years in soil and may also contaminate pools of water or raw vegetables. This is a common public health problem.

2. **Can roundworms cause clinical problems?**

Usually not. However, with heavy infections children may complain of abdominal pain or discomfort and lose their appetite. Roundworms can cause bowel obstruction or block a bile duct. The larvae of roundworms pass through the lungs and can cause coughing and wheezing.

3. **How should this child be treated?**

With a single oral dose of mebendazole or albendazole. The mother should be told how to avoid reinfection.

4. **Is routine deworming recommended for all children?**

A deworming programme is recommended in regions where roundworms are common.

5. **What is a common cause of perianal itch at night in children?**

Pinworms. These are short worms that infect the gut and leave the anus at night, causing irritation to the skin around the anus. They can also cause a vaginal discharge in girls.
6. How can the diagnosis be confirmed?
A strip of Sellotape should be stuck onto the child's skin over and next to the anus and then immediately removed. Pinworm eggs will stick to the Sellotape. These can then be seen under a microscope. The treatment is the same as for roundworms.

5. Can tapeworms affect the brain?
Yes. If eggs of the pork tapeworm are passed in human faeces and then later get swallowed by another human rather than a pig, they can hatch in the gut of that person and then travel in the bloodstream to the brain where they form many small cysts. This is called neurocysticercosis and usually presents with convulsions. Neurocysticercosis is common in communities where there are pigs and human faeces are not disposed of safely.

CASE STUDY 2
A malnourished child from a rural village presents at the local clinic after passing a piece of tapeworm in her stool. Pigs run free and eat human faeces. There are also a number of dogs in the village.

1. What are the common types of tapeworms in children?
The pork or beef tapeworms. Pig tapeworms are more common.

2. What is the clinical presentation of tapeworms?
Infected children are often asymptomatic. However, tapeworms can cause poor appetite, abdominal discomfort and weight loss. This child's malnutrition may be partly explained by the tapeworm.

3. How did this child get infected with a tapeworm?
Probably by eating uncooked or partially cooked pork. Tapeworm eggs get passed in the stool and then may be eaten by pigs if toilets are not available. The eggs hatch in the pig's gut and then travel in the bloodstream to the muscles where they form cysts. If these cysts in the meat are eaten by humans, they hatch out in the gut to form a tapeworm.

4. What is used to treat intestinal tapeworms?
Oral mebendazole twice daily for 7 days.

6. What problems can be caused by the dog tapeworm?
If eggs of the dog tapeworm are ingested by humans they hatch in the gut, enter the bloodstream and are carried to organs such as the liver and lungs where they grow into large (hydatid) cysts. Therefore it is important that children do not play in areas where dog faeces are left to mix with the soil or pools of water.

Hydatid disease can be treated with oral daily mebendazole or albendazole for 6 weeks. Large cysts may have to be removed surgically.

CASE STUDY 3
A month after returning from holiday on a farm in the Eastern Cape, a 14-year-old child presents with a 3-week story of loose stools, and terminal haematuria for 2 days. While on holiday he swam in a farm dam.

1. What is the common cause of terminal haematuria?
Blood in the urine towards the end of micturition is typical of bilharzia. The bilharzia parasite settles in the wall of the bladder where it causes inflammation and bleeding.

2. When did the infection probably occur?
When he swam in the farm dam. The special bilharzia snail is common in the eastern parts of South Africa where it lives in standing or slow-moving water such as farm dams or
irrigation furrows. If someone with bilharzia passes urine into the water the snails can become infected. The parasites released from the snails can then penetrate the skin of anyone walking or playing in the water.

3. Can bilharzia be treated?
Yes. It can be treated very effectively with praziquantel. It is best to first confirm the diagnosis by seeing bilharzia parasites in a urine sample collected around midday. Chronic bilharzia infection can lead to damage of the urinary system causing renal failure.

4. What is the probable cause of the diarrhoea for the past 3 weeks?
The child may have a bowel infection with giardia, which causes diarrhoea. Although it is often acute it may last for weeks or months. Giardia is common where a safe water supply and adequate toilets are not present.

5. Which drug is used to treat giardiasis?
Metronidazole (Flagyl).

CASE STUDY 4

Two weeks after returning from a malaria area, a 10-year-old child presents with headache, shivering and vomiting. The mother gave her some paracetamol for the fever. A few hours later the child becomes confused and cannot stand up. The family did not take malarial prophylaxis because they planned to be in the area for 2 days only.

1. Do you think this child has malaria?
Yes. Malaria has an incubation period of 1 to 2 weeks and presents with fever and a flu-like illness.

2. How severe is the infection?
At presentation it was uncomplicated, with fever and vomiting. However, within hours she was confused and could not stand. This indicates severe, probably cerebral malaria. Malaria can progress from uncomplicated to severe within hours if not treated.

3. How can the diagnosis be confirmed?
By examining a blood smear or performing a malaria rapid antigen test.

4. What is the correct treatment?
She must be admitted to hospital urgently as cerebral malaria can be fatal. She needs to be treated with intravenous quinine plus either doxycycline or clindamycin. Uncomplicated malaria can be adequately treated with oral Coartem provided the clinical diagnosis has been confirmed.

5. How can malaria be prevented while on holiday?
The only way to confidently avoid malaria is not to enter a malaria area. However, malaria can usually be avoided by making efforts not to be bitten by mosquitoes and by taking malaria prophylaxis. Insecticide impregnated bed nets are very effective. Also keeping indoors after sunset with mosquito screens on the door and windows. Wear long trousers and sleeves, and shoes and socks if going out in the evening or early morning, when mosquitoes are most active.

6. What malaria prophylaxis should be taken?
The choice is atovaquone and proguanil (Malanil) for children of 10kg or more, or mefloquine (Larium) for children of 5 kg or more. Children over 8 years can also use doxycycline. The medication must be taken correctly, including for the correct period after leaving the malaria area. Prophylaxis must be taken even for a one day visit.
Objectives

When you have completed this unit you should be able to:
- Recognise the common types of rashes.
- Diagnose and treat common skin infections.
- Diagnose and treat rashes caused by skin parasites.
- Manage rashes caused by skin irritations or insect bites.
- Manage rashes due to allergy.
- Manage mild acne.

INTRODUCTION

12-1 Are skin conditions common in children?

Yes. Skin conditions are common in children, as young skin is sensitive. As a result a child’s skin is easily irritated or damaged. This may cause a rash.

12-2 What is a rash?

A rash is a skin disorder which causes a change in the normal appearance of the skin. It may appear suddenly or gradually and most rashes disappear after days or weeks. Some rashes may recur (come back repeatedly) or persist (become chronic). Any part of the body may be affected by a rash. However, if the rash only affects the skin of certain parts of the body, this may help with the diagnosis. While most rashes are mild and recover quickly, some are serious and need urgent treatment. There are many types (appearances) of rashes.

A rash is a skin disorder which causes a change in the normal appearance of the skin.

12-3 What are the common types of rash?

- Macule: This is a flat spot that can be seen but not felt. Macular rashes are usually pink or red (erythematous macules) and disappear (blanch) for a few seconds after pressing on them. This is because these macules consist of dilated, small capillaries. Rubella infection is one of the many causes of a pink macular rash. Pale or brown macules also occur, and are due to changes in the amount of pigment in the skin. They are often seen as part of the healing of damaged skin and do not disappear when pressed.

- Papule: This is a raised spot (a skin lump), which can be both seen and felt. A papule feels solid and can be any colour, although they are often pink or red or the colour of normal skin. Papular urticaria (allergic reaction to an insect bite) is one of the...
many causes of a papular rash. A nodule is larger than a papule.

- **Vesicle**: This is a small fluid filled blister that can be both seen and felt. The fluid in a vesicular rash is clear and may look like serum or water. If the vesicles leak, oozing of the fluid makes the skin wet (weepy). When the fluid dries it leaves a crust. If a vesicle bursts it leaves a small ulcer. Fever blisters (cold sores) and acute eczema are typical of a vesicular rash.

- **Pustule**: This is a small pus-filled blister. A pustular rash can be both seen and felt. If a pustule bursts it also forms a small ulcer, which may crust. Bacterial skin infection is one of the many causes of a pustular rash.

See the full-colour illustrations of skin conditions at the back of the book.

One type of rash often changes into another. For example, in chicken pox the rash starts as red macules, which develop into papules and eventually change into vesicles that heal leaving pale or dark macules or sometimes scars. Although identifying the type of rash does not necessarily give the diagnosis, it is an important step in limiting the range of possible diagnoses. Therefore a detailed description of the rash is needed.

It is important to describe the type of rash accurately.

Some rashes are caused by bleeding into the skin, e.g. petechiae (purpura) or bruises (small or large pink or purple spots which do not fade with pressure).

**NOTE** Haemorrhagic rashes do not blanch with pressure but change colour from pink (red) to blue to yellow over a few days as they resolve.

12-4 Do all skin conditions present as a rash?

No. Some skin conditions do not present as a typical rash. They usually last for years or are permanent, e.g. a ‘birth mark’. Most ‘birth marks’ present at or soon after delivery.

12-5 How are skin conditions managed?

First you need to make a diagnosis, if possible. Then the correct treatment must be given. As with many illnesses, even if a definite diagnosis cannot be made, many skin conditions can still be treated symptomatically.

All local (topical) treatments need to be carefully explained and demonstrated to the caregivers. Otherwise the treatment will fail as the local treatment is not applied correctly.

12-6 Which groups of skin conditions are common in children?

Skin conditions caused by:

- Local infections
- Systemic infections
- Skin parasites
- Skin irritations
- Allergies
- Conditions of unknown cause

**LOCAL VIRAL INFECTION**

12-7 What local viral infections are common?

- Molluscum contagiosum
- Warts
- Cold sores

12-8 How is molluscum contagiosum recognised and treated?

Molluscum contagiosum is a papular rash caused by a viral skin infection. The condition is most common in children between 2 and 5 years of age. Papules usually occur on the face, trunk and back of the hands but can occur anywhere. The virus is spread by direct contact with other children. Molluscum contagiosum is common and often extensive in children infected with HIV. In these children with a
weak immune system, the papules may be large and not respond to standard treatment. The molluscum papules have a typical, easily recognised appearance. They are pearly white and dome shaped with a central dimple. The papules vary in size but usually are as big as a match head. The rash is not itchy or painful, and usually clears spontaneously leaving no scars. Secondary bacterial infection of the papules can occur causing inflammation and pain.

It is best to leave them alone as they will disappear on their own after a few months. However, they can be treated by pricking each papule with a sharp stick (tooth pick). If necessary the contents can be gently squeezed out. With many papules, sedation or a general anaesthetic may be needed before treatment. Wart paint, benzoyl peroxide or liquid nitrogen have also been used.

Many common, mild skin infections may become severe and persistent in children with HIV infection.

12-9 How are warts recognised and managed?

Most children will have one or more warts during childhood. Warts are harmless growths on the surface of the skin. Most warts are skin coloured, raised, hard and have a rough surface. Sometimes they are flat, especially when on the face. Warts are caused by a virus and usually disappear on their own after 6 to 12 months. They are mildly infectious as the virus is spread by direct contact. Rarely warts can occur on the soles of the feet (plantar warts) where they are very painful when walking. Warts can be extensive in children who are infected with HIV. Genital warts may indicate sexual abuse.

Warts are best left alone, especially flat warts on the face. They can be treated by applying wart paint daily. The clear wart paint is applied to the wart, using a tooth pick, and allowed to dry (becomes white). The painted wart is then covered with a piece of plaster for 24 hours. When the plaster is removed the wart should be softened by soaking in warm water. The softened surface of the wart is then gently scraped to remove any loose pieces. The area of skin should be washed well and dried before applying more wart paint. Repeat the process daily until the wart has completely disappeared. Genital warts and warts which do not respond to treatment should be referred to a skin clinic.

Note Warts are caused by the human papilloma virus. Wart paint consists of 1 part salicylic acid, 1 part lactic acid and 3 parts colloidion.

12-10 What are cold sores and how are they managed?

Cold sores (fever blisters) are caused by infection with the Herpes simplex virus. They present as small, painful blisters, which occur on and around the lips, often after exposure to excess sunlight or if the child is ill or emotionally stressed. They usually start with a tingling, itching, burning sensation for a few hours before the painful blister develops. The blister bursts after a few days and then dries, leaving a crust, which disappears in a week or two. The problem with cold sores is that they often recur at the same site. The outbreaks of cold sores usually occur every few months but tend to become less frequent over time.

The management consists of applying povidone iodine (Betadine) ointment or 2% vioform in zinc cream twice daily to prevent bacterial infection. Local antiviral agents are of limited use. In severe cases, oral acyclovir can be used.

Note Herpes simplex virus, which remains in nerve ganglia, causes recurrent attacks of cold sores. A history of a primary infection of herpes stomatitis with many painful, small ulcers of the mouth and tongue, together with fever, may or may not be obtained. Often the primary infection with herpes virus is asymptomatic. Cold sores typically occur when immunity is depressed.
LOCAL FUNGAL INFECTIONS

12-11 What local fungal infections are common in children?
- Ringworm
- Athlete’s foot
- Tinea versicolor
- Dandruff
- Candida

12-12 What is ringworm?
Ringworm is not a worm. It is a rash caused by a fungal infection of the skin. Ringworm of the scalp (tinea capitis) is common. Less common is ringworm of the skin, feet (athlete’s foot) and nails. It is infectious and is spread by direct contact with infected humans (touching heads), things they use (sharing brushes, combs and clothes) or pets. Athlete’s foot is infectious and usually caught from the wet floors of bathrooms and changing rooms at school. Pets may also have ringworm.

Ringworm is not a worm but a rash caused by a fungus.

12-13 How is ringworm recognised?
- Ringworm of the scalp commonly presents as dry, scaly patches with hair loss (bald patches). Occasionally, the infected scalp becomes red and lumpy with pustules. This can easily be confused with impetigo.
- Ringworm may present on the face or trunk as a group of itchy, scaly, pink papules. Often the rash forms a ring with a well defined raised edge and normal skin in the centre. Vesicles may also occur along the edge.
- Athlete’s foot presents as a painful crack between the toes, usually between the small and next toe. It may also affect the sole of the foot. You do not need to be an athlete to catch athlete’s foot.
- Infection of the nail causes discolouration (yellow or white nails) with abnormal nail growth (crumbly nails).

HIV-infected children may develop extensive, severe fungal skin and nail infections which do not respond to standard treatment.

12-14 How should ringworm be treated?
1. Ringworm of the skin and feet is usually treated with clotrimazole ointment (e.g. Canesten) or 2% miconazole cream (Daktarin) twice daily for 2 to 4 weeks until the rash has cleared. Ideally treatment should be continued for 1 to 2 weeks after the rash has healed.
2. Ringworm of the scalp can be improved but not cured with local ointment (cream or shampoo). Fortunately it often disappears on its own over time (especially at puberty). If left untreated it may infect other children.
3. To prevent athlete’s foot, dry the feet well after washing, especially between the toes, wear clean socks every day and use open sandals.
4. Scalp ringworm and severe or chronic infection of skin, can be treated with oral griseofulvin 10 mg/kg/day for 6 weeks. Any secondary bacterial infection should be treated with antibiotics.
5. Fungal infections of the nails should be treated with oral griseofulvin 10 mg/kg/day for 3 months or until the nail returns to normal. It rarely gets better without treatment.

Every effort should be made to prevent the spread of ringworm to others. Families should avoid sharing clothes, towels and combs.

NOTE Because prolonged treatment is needed to cure fungal infection of nails, it is best to confirm the diagnosis by sending some crumbly discoloured nail for fungal culture.

12-15 What is tinea versicolor?
Tinea versicolor is caused by a fungal infection of the skin and presents as pale or pigmented patches on the neck or trunk. The patches do
not itch but are often covered with fine scales. After treatment the pale patches may remain for a few months.

Treat with selenium sulphide shampoo. Spread the shampoo over the whole body and leave it on overnight before washing it off. Treat weekly for 3 weeks. After treatment, the rash will take a few weeks to disappear. The rash may recur despite adequate treatment.

Tinea versicolor should not be mistaken for pityriasis sica alba, the common small, pale, scaly patches on the face, neck or arms.

**Note** The cause of pityriasis sica alba is not known. The pale patches tend to come and go but eventually disappear. Treatment is usually not needed although 1% hydrocortisone cream for one week speeds up healing.

12-16 How should you manage dandruff?

Dandruff is very common and is also caused by a fungus. It is usually mild and presents with fine flakes of skin on the scalp, in the hair and on clothing over the shoulders. Mild dandruff does not need treatment although it often improves with a change of shampoo. Treatment is needed if the dandruff becomes severe, the scalp becomes very itchy or red, or the scales become thick and greasy (seborrhoeic eczema). Dandruff usually recurs throughout life. People with dandruff often have greasy skin.

Treat with selenium sulphide (Selsun) or ketoconazole (Nizshampoo) or zinc pyrethium (Selsun Blue; Head and Shoulders) or tar shampoos. To remove thick scales, 2 to 10% salicylic cream can be applied for 2 hours in infants or overnight in older children before being washed off with shampoo.

12-17 How should you recognise and treat a candida rash?

Candida is a fungus which grows in warm, moist creases where it causes a red rash. A candida rash (monilial rash) presents with groups of pustules. If severe the rash may ulcerate. It is typically seen in the creases covered by a nappy. This differs from the common nappy rash which is worse over exposed skin and spares creases.

Management consists of keeping the skin dry and applying mycostatin cream. For severe cases, oral mycostatin may be needed to clear the fungus from the gut and stool.

**LOCAL BACTERIAL INFECTIONS**

12-18 What local bacterial infections are common?

- Impetigo
- Boils

12-19 What is impetigo?

Impetigo is a common superficial skin infection of children caused by bacteria (Streptococcus or Staphylococcus). Impetigo is an infectious condition and children can catch it from one another. It often complicates other skin conditions (secondary infection) where the skin is broken, e.g. cuts, eczema, nappy rash, scabies, papular urticaria and cold sores. If impetigo persists or recurs, always look for one of these underlying skin conditions.

The rash of impetigo starts as a group of small blisters, which soon burst leaving a raw area that becomes covered by a yellow crust of dried serum. The rash is not painful and does not itch. Even when extensive the child is usually well and has no fever. Without treatment the rash may last for weeks and often spreads to other areas. In small infants, impetigo may present as pus filled blisters (bullous impetigo) which later burst leaving crusts or scabs.

Treat by gently removing the crust, after soaking the area in warm water or a dilute antiseptic solution (e.g. Savlon). Dry and apply 2% vioform ointment, 10% povidone iodine (Betadine) ointment or an antibiotic ointment, e.g. mupirocin (Bactroban). Impetigo should heal in a few days if correctly treated. If the impetigo is
widespread, give an oral antibiotic such as flucloxacillin or erythromycin for 7 days.

Sometimes the infection can spread to deeper layers of the skin to cause veld sores (ecthyma). They present as crusted ulcers, particularly on the lower legs of older children. Treatment is the same as for impetigo.

**Impetigo due to bacterial infection often complicates other skin conditions.**

Impetigo due to Streptococcus can result in acute glomerulonephritis.

**12-20 How are boils diagnosed and managed?**

Boils are common in childhood. They occur when bacteria (Staphylococcus) infect a hair follicle. Boils present as very painful, red lumps under the skin. After a few days pus collects and a yellow head forms which eventually bursts onto the surface of the skin. Once the boil has burst it usually heals with some scarring.

Healing of a boil can be speeded up if an oral antibiotic, such as flucloxacillin or erythromycin, is given. Oral antibiotics should also be given if the local lymph nodes are enlarged or the child is pyrexial. If the boil bursts, clean away the pus with an antiseptic solution (e.g. Savlon) and then apply 2% vioform ointment.

Children who have repeated boils should wash their body and hair twice weekly with povidone iodine (Betadine). Put 0.5% chlorhexidine cream or mupirocin (Bactroban) ointment into the nostrils twice daily for a week and keep the nails short to decrease the number of bacteria on the skin.

**NOTE** Boils sufferers often carry Staphylococcus in their nose, on their skin and under their nails. If boils occur repeatedly, screen the child for diabetes. They may also be nasal carriers of Staphylococcus.

**RASHES DUE TO SYSTEMIC INFECTIONS**

**12-21 What common systemic infections cause a rash?**

These are usually viral infections such as:

- Rubella (German measles)
- Measles
- Chicken pox and shingles
- AIDS

*These infections are discussed in Unit 10 on common childhood illnesses and Unit 9 on AIDS.*

**NOTE** Some serious systemic bacterial infections, such as meningococcal septicaemia, also present with a rash. Many drugs used to treat systemic infections and other conditions may also cause rashes. Petechiae (purpura) associated with fever is a dangerous sign and these children must be referred immediately for investigation and treatment. A purple rash suggests necrotic skin or bleeding into the skin, and should always be taken seriously.

**12-22 How do you know that the rash is due to a systemic infection?**

Because the child is usually generally unwell with a fever. In some infections the rash appears when the child first becomes unwell. In other infections the rash may only appear when the child has been ill for a few days.

**LOCAL PARASITIC INFESTATIONS**

**12-23 What local parasites cause skin conditions in children?**

- Scabies
- Head lice
- Sandworm
12-24 What is scabies?

Scabies is a common, very itchy rash caused by mites. The female mites burrow into the outer layers of the skin to lay their eggs. The eggs hatch and the young mites start new burrows. The mites irritate the skin and result in a rash which is very itchy. Mites are passed very easily from person to person by touching or holding hands. Therefore, both the mother and other close contacts often also have scabies. It is common to have scabies among a group of friends at school and in overcrowded homes with shared beds.

**NOTE** The rash of scabies is due to an allergy to the *Sarcoptes scabiei* mite. After infestation with mites, it takes about a month for the child to become sensitized to the mites. Only then does the itch and rash start.

12-25 What are the typical symptoms and signs of scabies?

The rash of scabies presents as many small, very itchy papules or vesicles, especially over the wrists, between the fingers, on the hands and feet and waist. A few itchy papules in the skin folds of the axilla (arm pit), around the nipples and umbilicus, and on the scrotum are common presentations in infants. The face can also be affected in small children. The itching is worse at night when the skin is warm. Blisters, sores and scabs often result from the scratching. Bacterial infection (impetigo) of the blisters and sores, which have been scratched open, is common.

**Scabies presents as a rash which is very itchy, especially at night.**

**NOTE** Sometimes the mite’s burrows can be seen as thin lines under the skin between the fingers and on the wrists. The mite may be seen as a white or black dot at the end of the burrow. Some affected people have no symptoms as they are not sensitive to the mite.

12-26 How is scabies treated?

It important to treat all members of the family at the same time. Even members with no symptoms of scabies must be treated as they may still carry mites. Scabies can be treated with a local application of 12.5% benzyl benzoate (Ascabiol) lotion (half strength), which is applied from the neck down to the whole body. Only dress once the lotion has dried. In children over 2 years and adults, wash the lotion off after 24 hours. In children from 2 months to 2 years, use a 6.25% lotion (quarter strength) and wash off after 12 hours. After treatment, bath and dress in clean clothes. Wash all used clothes and change the bed linen. Remember that this lotion can be very irritating and may cause discomfort. A 1% hydrocortisone cream can be used after treatment to help control the itching.

Infants under 2 months should rather be treated with 5% sulphur ointment nightly for 3 days. Antiscabies soap alone is not effective treatment. Keeps nails short. Wash clothes and bedding in hot water.

**The whole family must be treated for scabies at the same time.**

If there is additional bacterial infection (impetigo), treat locally with 2% vioform in zinc ointment. Oral penicillin may be needed if the infection is severe, especially if the local lymph nodes are enlarged or the child is pyrexial. Treat the bacterial infection first before treating the scabies.

Secondary bacterial infection of scabies (impetigo) is a very important cause of acute glomerulonephritis.

**NOTE** Lindane, also known as gamma benzene hexachloride (Gambex), and pyrethrines (Lyclear and Nitagon), are less irritating but more expensive.

12-27 How does lice infestation present?

Head lice are very small insects, which live on blood, which they suck from the scalp. They
attach their small, white, shiny eggs (nits) to shafts of hair. Each egg is the size of a flake of dandruff. Lice are spread from person to person by direct contact and also by sharing brushes and combs. Epidemics of lice at schools are common, especially in girls with long hair.

Head lice usually present as itching and scratching of the scalp. Many small red spots can be seen on the scalp. While it is difficult to see the lice, their eggs are easy to recognise as they are firmly attached to the hairs. Unlike dandruff, nits are not easy to remove. Rarely lice may also infest other parts of the body. Some children have head lice without itching or scratching and only the nits are noticed. All children with head lice can spread the lice to others.

As with scabies, the scratching can cause secondary bacterial infection (impetigo) which must also be treated.

12-28 How should you treat head lice?
Massage about 30 ml 1% gamma benzene hexachloride shampoo (Gambex or Quellada shampoo) into the affected areas and leave on for 5 minutes before rinsing off thoroughly. Benzyl benzoate (Ascabiol) 12.5% (i.e. diluted 50:50) can also be used and applied to the whole scalp overnight and then washed off in the morning. Do not get the lotion into the eyes as it burns. Pyrethroid shampoos (Lyclear and Nitagon) are also effective in killing lice. The nits can be removed with a fine comb. Using hair conditioner after washing the hair helps to remove the nits as it makes the hair slippery. It is not necessary to cut or shave the hair off although this is an effective treatment. It is best to treat the whole family and look for nits in friends. Oral antibiotics should be given if impetigo is present. Do not share hairbrushes and combs.

12-29 How are sandworms recognised and treated?
Sandworms are the larvae of the dog or cat hookworm which burrow under the skin, especially over the feet, buttocks and genitalia. Infestation usually occurs when the child stands or sits in sand contaminated with dog or cat faeces. The pink, raised, red S-shaped burrows of the larvae can be seen and are very itchy. Treat with oral albendazole 1 tablet daily for 3 days.

**Note** Thiabendazole 10% in petroleum jelly (Vaseline) can also be applied locally, but is difficult to obtain. Ethyl chloride spray can also be applied to the affected area but it is very painful.

**Rashes due to skin irritants**

12-30 What skin irritants are common?
- Sunburn
- Nappy rash
- Insect bites and stings
- Miliaria

12-31 How should sunburn be managed?
Every effort must be made to prevent severe sunburn as it may permanently damage the skin and increase the risk of melanoma and skin cancer in adulthood. Children should not be exposed to prolonged periods in the sun, especially between 10 am and 4 pm. Hats, protective clothing and sunscreens should become part of a national campaign against sun damage. This is particularly important in infants and fair-skinned children who have very sensitive skins. Sunburn presents with redness and pain in areas exposed to excessive sunlight. Blisters and swelling can occur in severe cases.

Put a sunscreen on the child’s exposed skin whenever he or she goes into the sun. Always use a sunscreen with a sun protection factor of at least 15.
When the sunburn is first noticed, cool the child in a bath or shower. A simple moisturizing cream can be used to soothe the inflamed skin. Give children with severe sunburn frequent drinks of water to correct dehydration. Paracetamol may be needed for pain. The redness and pain resolves in a few days. This is often followed by peeling and itching of the affected skin.

NOTE Ultraviolet rays penetrate and damage the skin. Ultraviolet ray damage in childhood is an important cause of later skin cancer. Topical steroids may be used in severe sunburn.

12-32 What is nappy rash?

Nappy (diaper) rash is a red rash which occurs on the buttocks and perineum of infants who wear nappies. Most infants have mild nappy rash at times, especially if the stools are loose. Painful vesicles and small ulcers may develop if the nappy rash is severe. Secondary bacterial or fungal infection is common. Seborrhoeic dermatitis may also present in the nappy area as a nappy rash.

Nappy rash is usually caused by urine and stool in the nappy irritating the skin. The rash is worse on exposed parts of the skin while the creases are often protected.

Frequent nappy changes, together with a protective zinc cream or petroleum jelly (Vaseline), usually protects against nappy rash. The best treatment is to keep the skin dry by removing the nappy for a few days and allowing the infant to lie on an open clean nappy. Expose the buttocks to warm, dry air as often as possible. Linen or toweling nappies must be washed and well rinsed before use. Do not use plastic pants over nappies.

A rash in the nappy area can also be caused by a fungus (Candida). A fungal rash (candidiasis) is very red, often has small satellite spots, and is worse in the creases. Treat as for nappy rash but also cover the affected skin with mycostatin cream. In severe cases, oral mycostatin for a few days may also be needed to clear fungus from the stool. Any severe nappy rash that does not improve after 5 days treatment should be referred to a skin clinic.

12-33 How should common insect bites and stings be managed?

Insect bites and stings are usually due to fleas, mosquitoes and bed bugs at night. All cause a red, papular, itchy rash. Flea bites occur on skin covered by clothing or on the feet and lower legs. In contrast, mosquito bites occur on exposed skin, especially the face and hands. Bed bug bites tend to occur in rows as the bug bites as it walks along.

Children who are allergic to insect bites develop papular urticaria, which presents as raised, swollen and very itchy wheals. The papular urticaria should be managed by preventing the insect bites.

Prevent mosquito bites with insect repellent (Tabard, Peaceful Sleep). Remove any pools of standing water where mosquitoes breed, and use bed nets. As fleas often come from carpets and pets, vacuum the carpets and deflea cats and dogs. Bed bugs live in cracks in wooden beds. Therefore spray the bed with an insecticide and place the mattress in the sun.

Calamine lotion helps to relieve the itching. Oral antihistamines are useful in more severe cases. Do not use local antihistamine creams.

With bee stings, scrape the sting off with a blunt knife. Do not try to pull it out. The pain of both bee and wasp stings can be relieved by rubbing the area with ice. Bee stings can cause severe allergic reactions.

12-34 What is miliaria?

This is the very common heat rash usually seen on the neck of small infants who have a fever or who have been allowed to get too hot. The rash consists of small pink macules, which fade when pressed. The rash is caused by sweat irritating the infant’s sensitive skin. Miliaria usually disappears when washed with cold
RASHES DUE TO ALLERGIES

12-35 What rashes are caused by allergies?
- Eczema
- Urticaria

12-36 What is atopic eczema?
Eczema (or dermatitis) is an itchy, scaly rash, which has many causes. The most common form of eczema in children is atopic or allergic eczema. Atopic eczema is a form of allergy of the skin and occurs in about 5% of children. Most children with atopic eczema have a family history of asthma, hay fever or eczema. These children start with atopic eczema before 2 years of age and often later develop other forms of allergic disorder. They all have very dry skins.

Children with atopic eczema usually have a family history of allergy.

12-37 What are the clinical features of atopic eczema?
In young children, the rash of atopic eczema consists of a red, very itchy, oozing and crusting rash on the cheeks (acute eczema). The rash may spread to the scalp, the chest, the front of the elbows, the wrists and behind the knees. These children are very irritable and unhappy and want to scratch all the time.

In older children the rash is usually chronic and consists of dry, itchy, thickened, scaly patches on the face, neck, front and back of the elbows and wrists, front and back of the knees and ankles (chronic eczema). Bacterial infection often complicates eczema as a result of the scratching.

The rash of acute eczema is very itchy.

12-38 How should atopic eczema be managed?
Atopic eczema is rare in newborn infants and usually starts during the first months of life. In most children it disappears as they become older. In others it recurs or becomes chronic. A common pattern is mild chronic eczema with repeated flare-ups of acute eczema. Therefore, both the child and family need ongoing counselling and support as the condition may last for years.

Unless the eczema is mild, the child should be referred to a skin clinic at a hospital, if possible, for the management of acute eczema and the planning of management for chronic eczema. Specific management consists of the following:

1. Local management of the skin is most important in atopic eczema. Liberal amounts of emulsifying creams (moisturizing creams or emollients), such as 'aqueous cream', are used in acute eczema and emulsifying ointments, such as 'HEB' in chronic eczema. Emulsifying creams and ointments are used as first line treatment to prevent the skin from drying out. This helps to prevent inflammation. Emulsifying creams or ointments should be applied at least twice a day.

2. For mild or moderate eczema, 1% hydrocortisone in an emulsifying cream or ointment (emollients) should be applied twice daily. Stronger steroids (betamethasone) can be used on the trunk and limbs if 1% hydrocortisone fails to control the rash in 2 to 3 days. Do not use strong steroids for longer than one week without specialist advice. Do not use strong steroids on the face. Oral steroids must be avoided. The need for steroids is reduced if emulsifying cream or ointment is used to protect the skin. Many children
with mild eczema can be adequately managed with regular use of emulsifying cream or ointment alone.

3. 5% coal tar in emulsifying ointment is used on patches of chronic eczema.

4. If secondary bacterial infection (impetigo) is present, povidone iodine (Betadine) cream or ointment dressings are applied for 3 to 5 days. An oral antibiotic may be needed with widespread infection.

5. An oral antihistamine can be given for the itch and to provide some sedation in acute eczema. Local antihistamine creams are of no help. It is very difficult to stop small children from scratching. Unfortunately, scratching causes further itching and may introduce secondary bacterial infection. Gloves or socks over the hands may reduce scratching. Do not let the child get too warm as this makes itching worse. Keep the nails short.

6. The child should wash daily with aqueous cream instead of soap. Do not use soaps, shampoos, bubble baths or washing detergents as they often make the rash worse. Showers are better than baths. Aqueous cream or emulsifying ointment (or petroleum jelly) should be applied every day immediately after washing and drying.

7. Removing specific items from the diet may be useful in young infants but is less helpful in older children. Encourage breastfeeding.

8. Do not let the child overdress and get too hot. Avoid wool or nylon next to the skin. Cotton clothing is best.

9. Avoid people with cold sores, as secondary herpes virus infection is dangerous in children with eczema.

10. If the acute eczema is not much improved after a week of treatment, refer to a specialist skin clinic.

Emulsifying cream or ointment, with or without 1% hydrocortisone, is most important in treating eczema.

NOTE If possible, wet wraps should be used at night to manage acute eczema. Wet wraps are

stocking bandages (Stockinette) that have been moistened with warm water and covered in generous amounts of emulsifying ointment or aqueous cream. The wet wrap is placed over the skin where steroid has been applied. It ensures deep penetration of the steroid, and rehydrates the skin, lessens inflammation, reduces itching and discomfort and hastens healing. Wet wraps alone reduce the need for local steroids.

12-39 What is ‘lick eczema’?

This is a rash around the mouth caused by excessive licking or thumb-sucking. The lips are also dry and sore. The saliva irritates the lips and skin. Lip-licking and thumb-sucking are habits. The red scaly rash around the mouth, and the dry, chapped lips, get better when the habit stops.

1% hydrocortisone cream for a few days clears the rash. Petroleum jelly (Vaseline) can then be used to protect the skin. Lip cream will moisturize and protect the lips.

12-40 What is seborrhoeic dermatitis?

The cause of this condition is unknown. It presents with a red rash covered with greasy, sticky scales, especially over the face, behind the ears, the scalp, and the nappy area. It usually does not itch. The rash is most common in infants and usually disappears after a few months. Seborrhoeic dermatitis of the scalp in infants is called ‘cradle cap’.

The skin and scalp rash can be treated with 1% hydrocortisone ointment. Use baby oil or olive oil or 2% salicylic acid in vaseline to loosen the thick, yellow scales in severe cradle cap. They can then be washed off with shampoo.

Seborrhoeic dermatitis is becoming more common as it is associated with HIV-infected children.

NOTE As with atopic eczema, severe seborrhoeic dermatitis may need to be treated with a dilute steroid cream under a covered dressing.
12-41 How is acute urticaria diagnosed and treated?

Acute urticaria is a very itchy raised rash, which appears suddenly and fades within a few hours. It often reappears daily for a few days to weeks. The raised areas of skin are pale with pink borders. It can also present with larger areas of raised, swollen skin (wheals). Rarely, other signs of an acute generalized allergic reaction, such as wheezing, collapse and shock, may occur.

The cause in children is usually unknown but is probably caused by a viral infection. Less commonly, urticaria is a reaction to a specific food. These foods must be avoided.

Urticaria can usually be treated with an oral antihistamine. Local calamine lotion or 1% hydrocortisone cream may help. Local antihistamine cream is not effective. If the urticaria is recurrent, the child should be referred for a specialist opinion.

12-42 What is papular urticaria?

Papular urticaria is common and presents as groups of very itchy papules. The papules may develop into small blisters. The itching results in scratching and keeps the child awake at night. It often recurs or may become chronic. Secondary infection causing impetigo is a common complication of scratching.

Papular urticaria is caused by an allergy to insect bites, especially fleas, mosquitoes and bed bugs. It is particularly common in young children.

12-43 How is papular urticaria managed?

Insect control is most important. Treat the rash with calamine lotion which decreases the itching. An oral antihistamine syrup, such as chlorpheniramine (Chortrimeton), promethazine (Phene...
of acne and greasy skins. Acne may cause embarrassment and emotional problems.

At puberty, sex hormones result in an increase in secretion from sebaceous glands. This causes acne in some people. The ducts of the sebaceous glands become blocked (giving blackheads) and bacterial colonisation in the glands breaks down the sebaceous secretions causing inflammation (pimples) and pus formation (pustules). Diet has no affect on acne. Acne cannot be cured but the severity can be controlled until it clears spontaneously in adulthood. Acne is not infectious and not caused by poor hygiene (not washing).

12-47 What is the management of acne?
Most mild cases can be managed with local treatment:

1. Washing the face daily with water and a regular soap.
2. Acne cream (tretinoin) to promote mild peeling to open the blocked ducts of the sebaceous glands is the first line treatment of mild acne. This is best used at night. Stop treatment for a few days if the skin becomes red and tender.
3. A local antiseptic cream (benzoyl peroxide) to reduce inflammation in the sebaceous glands.
4. Mild exposure to sunshine.
5. No squeezing, picking or scrubbing the spots.

If the acne does not improve in 2 months, or if it is severe, the patient should be referred to a skin clinic at a hospital.

**TYPICAL PRESENTATION OF RASHES**

12-49 Which rashes typically cause itching?
- Scabies
- Ringworm
- Atopic eczema
- Urticaria

12-50 Which rashes are typically painful?
- Cold sores
- Athlete’s foot
- Plantar warts

12-51 Which rashes are typically scaly?
- Ringworm
- Chronic eczema
- Psoriasis

**CASE STUDY 1**

A mother brings her 7-year-old son to the clinic as she is worried about bald patches which have developed on his scalp. On examination, you find a number of areas of pale, scaly skin with hair loss.

1. What is the diagnosis?

Ringworm of the scalp.
2. Is this caused by a worm?
No. It is caused by a fungus.

3. Is this an infectious skin condition?
Yes. It is common in school children, who often borrow each others’ combs, brushes or caps and touch heads when they play. Pets may also have ringworm.

4. What is the correct treatment?
Oral griseofulvin 10 mg/kg/day for 6 weeks. Ringworm of the scalp will improve but not be cured with local treatment only.

5. Can this condition affect other parts of the body?
Yes. Ringworm often presents as a group of itchy, scaly, pink papules on the face or trunk. The rash typically forms a circle with normal skin in the centre. Vesicles may also occur. Treat with clotrimazole (Canesten) ointment twice daily for 2 to 4 weeks.

CASE STUDY 2

A mother brings her 3-year-old son to the clinic as he has an itchy rash over his wrists. He scratches both the rash and his scalp at night and sleeps badly. When you examine the child you notice that the rash is red and pustular with scratch marks. You also see small, shiny white spots in the child’s hair.

1. What do you think is the cause of the rash?
The history is typical of scabies with an itchy rash on the wrists. The itching is much worse at night when the child is warm. Usually the rash is papular. Scratch marks are common.

2. Why is this rash pustular?
Because the scabies has been complicated by secondary bacterial infection (impetigo). This is a common complication caused by scratching.

3. What are the white spots in the hair?
Probably the nits (eggs) of lice attached to the hairs. Unlike dandruff, nits cannot be easily combed out as they are tightly attached to the hairs. Lice suck blood from the scalp leaving small red spots, which itch.

4. Why would it be important to examine the mother?
Because she may also have scabies and lice. Both are infections and are spread by direct contact, such as sleeping in the same bed.

5. How should you treat this child?
First use 2% vioform in zinc ointment on the rash for a few days to treat the bacterial infection. Then put 12.5% benzyl benzoate lotion over his whole body, except the face. Wash the lotion off after 24 hours and then dress him in clean clothes. Wash the bed linen. The mother and other family members must be similarly treated.

The lice should be treated with 1% gamma benzene hexachloride shampoo (Gambex or Quellada). This should be rubbed onto the head and then left for 5 minutes before washing off. Comb out the nits with a fine comb. The rest of the family should also be treated.

6. Should the child’s head be shaved?
No. There is no need to cut the hair or shave his head.

CASE STUDY 3

A 4-year-old child presents with groups of very itchy, red papules on her face, arms and legs. She is generally well but her mother says she is restless at night because of the itching.

1. What is the most likely diagnosis?
Papular urticaria.
2. What is the cause?
An allergy to insect bites. As the rash is on exposed areas of skin, the allergy is probably due to mosquito bites.

3. How should the rash be treated?
Local calamine lotion is soothing. An oral antihistamine will reduce the itching.

4. What can be done to prevent the condition?
Every effort must be made to prevent the mosquito bites. Insect repellent is helpful.

CASE STUDY 4

A grandmother brings her grandson to clinic and complains that his atopic eczema has become much worse during the past few days. He is irritable and scratches all the time.

1. What is the appearance of the rash in acute atopic eczema?
The rash is red, oozing and crusted. It is very itchy and usually presents on the face and may spread to the scalp and chest, front of the elbows and wrists and back of the knees.

2. What is a common complication of the scratching?
Impetigo due to secondary bacterial infection.

3. How is this complication diagnosed and treated?
Impetigo presents as a group of small blisters which soon burst leaving a raw area that becomes covered by a yellow crust. It should be treated with 2% vioform or an antibiotic cream. An oral antibiotic, such as flucloxacillin, may be needed.

4. How is an acute flare up of atopic eczema managed?
Mild or moderate cases can be treated with 1% hydrocortisone in an emulsifying cream on the face twice daily. A stronger steroid ointment can be used for a few days on the rash over other parts of the body. The rash should respond and the treatment stopped in a week. Never use strong steroids on the face.

5. What is the long-term management of atopic eczema?
The skin must be kept moist and soft with regular use of an emulsifying ointment or aqueous cream twice daily. The child should wash daily with aqueous cream instead of soap.

CASE STUDY 5

A teenager complains of blackheads and pimples on his forehead and cheeks. He has had the rash for 6 months. He also has warts on his hand. Both make him embarrassed.

1. What is the rash on his face?
Acne. It is common at puberty, especially in boys. It presents with blackheads, pimples and pustules on the face. Severe cases can also involve the neck, back and chest.

2. What is the cause?
Acne is due to an increased secretion of sebaceous glands which happens at puberty due to increased sex hormone production. Acne is more common in families with greasy skins. It is not caused by poor hygiene or an incorrect diet.

3. What is the treatment?
Most cases of acne respond to tretinoin cream, which causes mild peeling, and benzoyl peroxide cream to reduce inflammation. Mild exposure to sunshine also helps. The rash may take a few months to respond. The patient should not pick, squeeze or scrub the rash.
4. When should patients be referred to a special skin clinic?
If the acne is severe or does not respond in 2 months.

5. How should warts be treated?
Many warts disappear spontaneously after a few months without treatment. Warts are best treated with daily applications of wart paint.
Objectives

When you have completed this unit you should be able to:

- Diagnose and manage acute rheumatic fever.
- Diagnose and manage acute glomerulonephritis.
- Diagnose and manage septicemia and meningitis.
- Diagnose and manage pyleonephritis.
- Diagnose and refer children with diabetes or epilepsy.
- List the warning signs of childhood cancer.

Some serious illnesses, such as pneumonia and typhoid, are discussed in other units.

INTRODUCTION

13-1 What serious bacterial infections are seen in children?

These are illnesses which can result in death if they are not correctly managed. Every effort must be made to prevent them, recognise them early and treat them correctly. Many serious illnesses which are rarely seen in children in developed countries, are still major problems in poor communities with overcrowding.

Important serious illnesses include:

- Acute rheumatic fever
- Acute glomerulonephritis
- Septicaemia, especially meningococcal septicaemia
- Meningitis
- Pyelonephritis

13-2 What is acute rheumatic fever?

Acute rheumatic fever is the most common cause of acquired heart disease in children, especially in poor, overcrowded communities. It is a complication of pharyngitis (a throat infection) caused by Streptococcus bacteria. An unusual immune response by the body to this bacterial infection damages the joints, heart and other tissues of the body. The exact mechanism whereby this happens is still not fully understood. Acute rheumatic fever is usually seen in children aged 5 to 15 years.

Note: Many strains of Group A beta haemolytic Streptococcus can cause rheumatic fever which is a multisystem disease affecting the heart, joints, skin and brain. Recent studies suggest that skin infections (impetigo) may also cause rheumatic fever.
13-3 What are the clinical features of acute rheumatic fever?

Acute rheumatic fever develops 2–3 weeks after a Streptococcal pharyngitis. The classical features of acute rheumatic fever are:

- Fever
- A ‘flitting’ polyarthritis. Pain, redness and swelling (arthritis) of a number of joints (polyarthritis) where the arthritis moves within days from joint to joint (flitting). Usually the large joints (elbows, knees) are involved.
- Carditis
- Erythema marginatum. A short-lived erythematous (pink) rash which forms irregular patterns on the trunk.
- Subcutaneous nodules. Small, non tender lumps under the skin over the elbows, knuckles, wrists, knees and spine.
- Chorea. Usually seen in girls who become clumsy and very emotional with unusual jerky movements. Their handwriting deteriorates and they have difficulty doing up buttons due to the abnormal movements. Chorea may only appear months after the throat infection.

Children with acute rheumatic fever do not necessarily develop all the classical signs. The rash, subcutaneous nodules and chorea are less common signs of acute rheumatic fever.

13-4 What are the signs of carditis?

Carditis is an inflammation of the heart. The heart muscle, valves and pericardium are involved. The signs of carditis are:

- A heart murmur due to inflammation or damage to one or more heart valves
- Tachycardia, especially when resting or asleep. Signs of heart failure may develop (e.g. shortness of breath).
- An enlarged heart seen on chest X-ray
- A rubbing noise (friction rub) heard on auscultation, which indicates an inflammation of the pericardium (pericarditis)

13-5 How is the clinical diagnosis of acute rheumatic fever made?

By documenting a Streptococcal infection plus 2 major or 1 major and 2 minor criteria.

The major criteria are:

- Flitting polyarthritis
- Carditis
- Erythema marginatum
- Nodules
- Chorea

The minor criteria are:

- Fever
- Arthralgia (joint pain only) without arthritis
- Blood tests indicating inflammation, i.e. raised erythrocyte sedimentation rate (ESR), raised C reactive protein (CRP) or a leucocytosis (raised white cell count)
- An abnormal electrocardiogram (ECG) especially a prolonged PR interval (do not use this minor criteria if carditis is used as a major criteria)

Note: These are the modified Duckett-Jones criteria. A Streptococcal infection is documented by a positive throat culture or a raised antistreptolysin O titre. A blood culture is useful to exclude bacterial endocarditis which should be considered in any child with fever and a murmur. Two minor criteria are needed to diagnose acute rheumatic fever in a child with-established rheumatic heart disease.

Always suspect acute rheumatic fever in an unwell child older than 3 years who presents with fever, tachycardia and shortness of breath or painful joints.

Strict clinical criteria are used to diagnose acute rheumatic fever.
13-6 How is acute rheumatic fever treated?

1. Bed rest until all signs of acute rheumatic fever have disappeared and the resting heart rate is normal. All children with acute rheumatic fever should be admitted to hospital if possible.
2. Amoxycillin 10 mg/kg 6 hourly orally for 10 days or a single dose of benzathine penicillin 1.2 million units intramuscularly.
3. Aspirin for symptomatic relief of fever and joint pain. Acute rheumatic fever is one of the very few indication for aspirin in children.
4. Observe closely for signs of heart failure.

13-7 How can the first attack of acute rheumatic fever be prevented?

It is difficult to know if an acute sore throat is due to a virus or Streptococcus. Therefore, antibiotics should be given to all children under 15 years who have a fever and sore throat (pharyngitis) without the signs of a common cold, i.e. blocked nose and nasal discharge. Oral penicillin, amoxycillin or erythromycin for 5 days are needed. However, it is also important that antibiotics are not given to all children with a viral upper respiratory tract infections such as the common cold or influenza.

With the more frequent use of antibiotics, acute rheumatic fever has become uncommon in wealthy countries.

13-8 How can repeated attacks of acute rheumatic fever be prevented?

Repeated attacks of acute rheumatic fever can be prevented in children, who have previously suffered one or more attacks, by giving benzathine penicillin (Bicillin LA) 1.2 million units intramuscularly every 4 weeks (600 000 units if the child weighs less than 30 kg). This must be continued until adulthood when it should be reviewed. As the injections are painful, the child and family must understand that it is most important to prevent ongoing heart damage. The mother should keep a card which records the monthly injections. Careful follow up is essential.

13-9 What are the possible outcomes of acute rheumatic fever?

Acute rheumatic fever should resolve in 4 weeks. Some children recover completely while others are left with permanent damage to their hearts. Acute rheumatic fever tends to recur and the risk of permanent heart damage (rheumatic heart disease) increases with each acute attack. Every effort must therefore be made to prevent repeat attacks.

One or more attacks of acute rheumatic fever can cause permanent damage to one or more heart valves. This is called chronic rheumatic heart disease. Leaking of the mitral valve (mitral incompetence) or narrowing of the mitral valve (mitral stenosis) are the most common permanent valve defects. Damage to a valve or damage to the heart muscle can cause heart failure.

Every effort must be made to prevent repeated attacks of acute rheumatic fever.

13-10 What are the features of chronic rheumatic heart disease?

These children are often underweight and have delayed developmental milestones due to their heart disease. Their schooling may be interrupted. On examination they have signs of leaking (incompetent) or narrowed (stenotic) heart valves. They may also have signs of heart failure.

These children are at great risk of developing infective endocarditis after dental procedures (bacteria enter the blood stream and then stick to the heart values where they cause infection and damage). The dentist should give a dose of prophylactic antibiotic before the procedure.

NOTE A large single oral dose of amoxycillin or clindamycin an hour before dental extraction reduces the risk of bacterial endocarditis on damaged valves.
Children with chronic rheumatic heart disease must be managed by a special cardiac clinic team. It is very important that they do not have any further attacks of rheumatic fever. Most children can be managed with drugs to control heart failure but some will require cardiac surgery.

13-11 What are the clinical symptoms and signs of heart failure?

- Tiredness with exhaustion after only a little exercise
- Shortness of breath and wheezing, especially when lying flat
- Swelling of the ankles due to oedema
- An enlarged liver

There are many causes of heart failure, including acute rheumatic fever, chronic rheumatic heart disease, congenital heart disease and severe anaemia.

ACUTE GLOMERULONEPHRITIS

13-12 What is acute glomerulonephritis?

It is an acute inflammation of the kidney which follows a few weeks after an infection with Streptococcus. The infection is usually of the skin (i.e. impetigo) but may follow a throat infection (therefore often called acute post-streptococcal glomerulonephritis). The inflammation of the kidney is the result of an unusual response to the infection by the body’s immune system. Antibodies produced against the Streptococcus damage the kidney. This is similar to the immune response which results in acute rheumatic fever. Again, the reason for this unusual response is not fully understood.

NOTE Damage to the glomeruli of both kidneys results in blood and protein leaking into the urine and a decrease in urine production. Retained fluid causes oedema and fluid overload. Although there are many causes of glomerulonephritis, acute glomerulonephritis is usually post-streptococcal. Proteins from specific strains of Group A Streptococcus combine with antibodies and complement to form immune complexes which are deposited in, and damage, the glomeruli.

13-13 What are the presenting signs of acute glomerulonephritis?

- Haematuria and proteinuria. There may be obvious blood in the urine seen with the naked eye (dark urine). Marked haematuria looks like dilute Coca Cola. The red cells can also be seen under the microscope. Haematuria and proteinuria can be detected with reagent strips.
- Decreased urine volume (oliguria). In severe cases there may be no urine produced (anuria).
- Oedema of the face (especially in the morning) and feet (especially in the evenings)
- Hypertension

The severity of signs varies widely. In many children the condition is asymptomatic and would only be diagnosed by testing the urine for blood and protein, or by measuring the blood pressure.

Acute glomerulonephritis usually presents with dark urine, reduced urine output and oedema.

NOTE Oedema plus marked proteinuria without haematuria suggests nephrotic syndrome.

13-14 What is the clinical course of acute glomerulonephritis?

Most children present with oedema and visible haematuria. However, hypertension can occur with no oedema and with haematuria only detected on reagent strips.

Children usually recover completely. By 2 weeks the urine output increases and the oedema and hypertension disappear. The urine may remain dark (due to blood) for up to 6 weeks but blood may be detected on reagent strips for a few months.

It is very important to look for signs of complications.
13-15 What are the complications of acute glomerulonephritis?

- Hypertensive encephalopathy which usually presents with headaches, vomiting, drowsiness and convulsions. This may be the first sign of acute glomerulonephritis.
- Pulmonary oedema and heart failure due to fluid overload. This presents with breathing difficulties, especially when lying down.
- Acute renal failure with raised serum urea and creatinine.

13-16 What is the management of a child with acute glomerulonephritis?

1. Refer the child to hospital if possible.
2. Oral phenoxymethyl penicillin (penicillin V) 12.5 mg/kg 6 hourly or oral amoxycillin for 10 days to treat the Streptococcal infection.
3. Restrict the daily fluid intake to 20 ml/kg plus the volume of the previous day's urine output. It is important to keep a careful check on the fluid intake and output.
4. Weigh daily to assess fluid status.
5. Low sodium and low protein diet until the urine output increases (diuresis). Bread, jam, rice, fruit and vegetables with no added salt is a practical diet.
6. Furosemide (Lasix) 1 mg/kg orally to help increase urine output.
7. Observe the blood pressure every 6 hours.
8. Check serum urea, creatinine and electrolytes to monitor any renal failure.

**Note** Severe hypertension can be treated as an emergency with nifedipine (Adalat) 0.25 mg/kg sublingually (under the tongue). Convulsions can be stopped with rectal diazepam.

13-17 How can acute glomerulonephritis be prevented?

Most cases occur in children over the age of 2 years in poor communities where Streptococcal infections, especially of the skin are common. It is important that skin infections are treated promptly with local antiseptics (e.g. Savlon). Scabies, which is often complicated by impetigo, should be treated. Oral penicillin should be given for 5 days if there is extensive impetigo. The more frequent use of antibiotics in developed countries has resulted in a fall in the number of children with acute glomerulonephritis (and acute rheumatic fever). However, this is not a reason to give antibiotics to every child with a few patches of impetigo that can be treated locally.

**SEPTICAEMIA**

13-18 What is septicaemia?

Septicaemia is an acute serious illness caused by bacterial infection of the blood. This is often a complication of local infection, such as pneumonia or pyelonephritis. Septicaemia may in turn result in the spread of infection to other sites, such as meningitis and osteitis.

Septicaemia may be caused by either Gram positive bacteria (such as Staphylococcus or Streptococcus) or Gram negative bacteria (such as *E. coli* or *Klebsiella*).

**Note** Gram described the method of staining bacteria blue and then dividing them into those bacteria that retained the stain (Gram positive) and those that lost the stain (Gram negative) when exposed to other chemicals. Gram positive bacteria usually live on the skin and in the upper respiratory tract while Gram negative bacteria normally live in the bowel. Rarely fungi can also cause septicaemia.

13-19 What are the clinical features of septicaemia?

- There may be a local source of infection.
- At first the child may feel generally unwell but not have any specific signs. It
is, therefore, often difficult to make an early clinical diagnosis of septicaemia. As the septicaemia becomes worse the child appears seriously ill.

- Fever is almost always present.
- The patient may become shocked (septic shock).
- Shock leads to failure of many organs such as the kidney and lungs.

**Children with septicaemia are seriously ill, often without an obvious site of infection.**

### 13-20 What is shock?

Shock is the failure of normal peripheral circulation with a fall in blood pressure. The heart rate increases and urine output falls. The skin temperature may be low with shock and the hands and feet often feel cold. The oxygen saturation may also fall. Most importantly, the capillary filling time is prolonged to over 3 seconds.

**Note** In early shock the blood pressure may still be normal (compensated shock) although the peripheral perfusion is poor. Later the blood pressure falls (uncompensated shock).

### 13-21 How is the capillary filling time measured?

This is estimated by compressing the skin for a few seconds over the hands, feet or chest, with your finger, to produce blanching (a pale area). When the pressure of the finger is removed, the time it takes for the pink colour to return is measured. This is called the capillary filling time. A normal capillary filling time is 3 seconds or less.

### 13-22 How is the clinical diagnosis of septicaemia confirmed?

With finding a positive blood culture. Always take a blood culture before starting treatment.

The white cell count may be high at first and later fall. The platelet count may also fall and the blood clotting factors may be low.

### 13-23 What is the management of septicaemia?

1. Start antibiotics immediately. Do not wait for the result of the blood culture.
2. Treat shock if it is present.
3. Transfer the patient urgently to hospital. Give oxygen during transport.
4. Look for an underlying cause and monitor for complications such as organ failure.

The first choice of antibiotics is either:

- Benzyl penicillin 50 000 units/kg every 6 hours intravenously (or ampicillin 50 mg/kg every 6 hours intravenously) plus gentamicin 7.5 mg/kg daily (or amikacin 20 mg/kg daily), given slowly intravenously over 5 minutes.
- Ceftriaxone 80 mg/kg daily intramuscularly or by slow intravenous injection. This is very useful in a primary care facility before the child is transferred to hospital.

### 13-24 What is the treatment of shock?

The aim of treatment is to correct the blood pressure and improve the peripheral perfusion. A fast intravenous infusion must be started immediately with 20 ml/kg of normal saline or Ringer’s lactate. If the signs of shock are not corrected, repeat the bolus of intravenous fluid. This will usually correct the shock. Always give oxygen. Urgent transfer to hospital is needed. Start treating shock before moving the patient.

### 13-25 What is meningococcal septicaemia?

This is a serious illness caused by septicaemia due to Meningococcus (i.e. *Neisseria*...
meningitidis). Meningococcus is transmitted from person to person by droplet spread (coughing and sneezing). It often causes asymptomatic colonisation of the upper respiratory tract only. However, some people get a septicemia, meningitis or both. Meningococcal infection is more common in overcrowded conditions where epidemics may occur.

**13-26 What is the typical presentation of meningococcal septicaemia?**

The patient presents with the signs of septicaemia. However, a rash also develops. This starts as small red spots on the skin and conjunctivae which rapidly become purpuric (larger pink or purple spots). The spots do not blanch when pressed. The rash becomes very dark and may become necrotic (ulcerate). Gangrene of the skin may occur. Without early treatment the mortality is high. It is very important to look for a rash in all children who are thought to have septicaemia.

**Always look carefully for a rash if a child has a diagnosis of possible septicaemia.**

Many children with meningococcal septicaemia will also have meningococcal meningitis. Most will rapidly develop shock.

**13-27 How is meningococcal septicaemia managed?**

Similarly to other types of septicaemia. The choice of antibiotic is benzyl penicillin or ceftriaxone intravenously. Start antibiotics immediately as the clinical condition deteriorates rapidly without treatment.

Do not do a lumbar puncture as this is very dangerous due to brain swelling and will not alter the choice of initial treatment. Treat shock and move the patient to hospital urgently.

Meningococcal infection is a notifiable disease in South Africa.

**13-28 How is meningococcal infection prevented?**

All those in contact with the patient, including the health staff, should take rifampicin 10 mg/kg twice a day for 2 days (5 mg/kg in infants less than 1 month) or ceftriaxone 125 mg intramuscularly once. This will treat and prevent colonisation of the upper respiratory tract. All contacts should be closely observed for signs of illness.

A short-lived vaccine against meningococcus can be used to help end epidemics. Over-crowding in schools, army camps and crèches should be avoided.

**MENINGITIS**

**13-29 What is meningitis?**

It is a serious infection of the meninges (the membranes covering the brain). Meningitis may be due to a viral or bacterial infection. Bacterial meningitis is usually far more dangerous. Causes of bacterial meningitis include both Gram positive and Gram negative bacteria. The most common causes are Pneumococcus (*Streptococcus pneumoniae*), Haemophilus (*Haemophilus influenzae*) and Meningococcus (*Neisseria meningitidis*).

Bacteria usually reach the meninges via the bloodstream. Rarely, infection is by direct spread, e.g. from mastoiditis. Tuberculosis also causes bacterial meningitis. Fungal meningitis may be seen in children with AIDS.

**13-30 What are the symptoms and signs of meningitis?**

- Feeling generally unwell with fever. Most children with meningitis rapidly appear seriously ill.
- A severe headache, vomiting and photophobia (avoids bright light)
- Irritability, drowsiness, loss of consciousness and convulsions
- Young infants may present with poor feeding, lethargy and apnoea.
• Neck stiffness. It is painful if the patient tries to flex his/her neck so that the chin touches the chest. It is also painful and difficult if the examiner tries to flex the patient’s neck. Neck stiffness may be absent in young children with meningitis.
• Infants may have a full (bulging) fontanelle.

The signs of meningitis and septicaemia are very similar. Both must be suspected in any child who is seriously ill or unconscious or who has a high fever without an obvious cause.

13-31 How is the clinical diagnosis of meningitis confirmed?

By obtaining a sample of cerebrospinal fluid (CSF) by lumbar puncture. CSF should be sent to the laboratory for chemistry, microscopic examination for cells and bacteria, and for culture. As many children with meningitis also have septicaemia, the bacterial cause can often also be identified on a blood culture.

**NOTE** Do not do a lumbar puncture if there is reduced level of consciousness, focal neurological signs or features of meningococcal meningitis. With bacterial meningitis the CSF protein is raised (normal 0.15–0.4 g/l) and the glucose is low (normal 2–4 mmol/l) with many polymorphonuclear cells. Bacteria may be seen on a stained spun deposit or may be cultured.

13-32 Is it easy to tell clinically whether meningitis in a child is due to a bacterial or viral infection?

No. Therefore, all cases of clinical meningitis must initially be managed as if they are bacterial meningitis until the cause of the meningitis is identified. However, children with viral meningitis are often not as severely ill as children with bacterial meningitis. Only the findings on the lumbar puncture enable one to tell whether the infection is viral or bacterial.

Children with viral meningitis usually improve rapidly after a lumbar puncture and have fewer complications. The management is supportive and antibiotics can be stopped once the results of the lumbar puncture exclude bacterial meningitis. Tuberculous meningitis also has a similar presentation and must be distinguished on lumbar puncture and other investigations.

13-34 Can meningitis be prevented?

The introduction of immunisation against *Haemophilus influenzae* into the routine schedule at 6, 10 and 14 weeks after birth...
serious illnesses has prevented most cases of haemophilus meningitis. The promise of new vaccines against Pneumococcus and Meningococcus will hopefully also prevent these causes of meningitis.

All those in contact with a patient with meningococcal meningitis or sepsicaemia should be given rifampicin or ceftriaxone prophylaxis.

13-35 What are the complications of meningitis?

About 25% of children with bacterial meningitis will die and about 25% of the survivors will have permanent brain damage such as:

- Cerebral palsy
- Intellectual impairment
- Nerve deafness
- Hydrocephalus
- Epilepsy

PYELONEPHRITIS

13-36 What is pyelonephritis?

Pyelonephritis is a bacterial infection of the kidney and the most serious form of urinary tract infection. If not diagnosed and treated early, repeated attacks of pyelonephritis can lead to permanent kidney damage resulting in hypertension and renal failure.

E. coli (Escherichia coli) is usually the bacteria causing a urinary tract infection. Most commonly the infection is mild and only affects the bladder (cystitis). Less commonly, the infection spreads up the ureters to affect the kidney (pyelonephritis). Pyelonephritis may be secondary to a renal tract abnormality that causes an obstruction to the normal flow of urine. This increases the chance that infection will spread to one or both kidneys.

13-37 What are the clinical features of a urinary tract infection?

Often the symptoms are non-specific and, therefore, the diagnosis is frequently missed. Fever, dysuria (pain or discomfort when passing urine), frequency (passing frequent small amounts of urine) and abdominal or back pain are common presenting complaints. A high fever and vomiting suggests pyelonephritis rather than a mild form of urinary tract infection.

13-38 How is the clinical diagnosis of a urinary tract infection confirmed?

It is very important to get a clean specimen of urine. A midstream urine or clean catch sample (urine collected after the child has already started passing urine), a sample collected by passing a catheter into the bladder under aseptic methods or a suprapubic aspiration (best done with ultrasonography) are by far the best methods. Using a urine bag is very inaccurate and is should be avoided if possible.

Leukocytes, nitrites and protein, and sometimes blood, are typical findings when the urine is tested with a reagent strip. It is probably not a urinary tract infection if the reagent strip test on a sample of freshly passed urine is completely normal, i.e. negative for protein, nitrite, blood and leucocyte esterase. Pus cells are usually present on a spun deposit of urine.

The only accurate way to confirm a urinary tract infection is a positive culture when the urine has been collected correctly. More than 100,000 bacteria/ml on a clean catch urine, more than 1,000 bacteria/ml on a catheter specimen or any bacteria on a suprapubic sample is abnormal.

It is very important to make an accurate diagnosis and not simply send a urine bag sample to the laboratory. A normal urine bag result will exclude a urinary tract infection but a positive result may simply be due to skin or stool contamination. A confirmed diagnosis is also important because it indicates that a series
of management steps is required. Treating a presumed urinary tract infection without confirming the diagnosis is bad practice.

13-39 How should a urinary tract infection be managed?

1. Once the urine sample has been collected, a course of antibiotics must be started, usually oral nalidixic acid 10 mg/kg 6 hourly for 7 days in children older than 3 months.
2. In younger infants and any child with a clinical diagnosis of pyelonephritis, intravenous cefuroxime or intramuscular ceftriaxone is indicated.
3. All children with a proven urinary tract infection must be referred for investigation. Usually an ultrasound examination is done. Other special investigations may also be needed.

OTHER BACTERIAL INFECTIONS

13-40 What serious bacterial infections are less common?

- Osteitis (bacterial infection of bone)
- Septic arthritis (bacterial infection of a joint)
- Mastoiditis (bacterial infection of the mastoid bone behind the ear)

DIABETES

13-41 What is diabetes?

Diabetes is due to inadequate amounts of insulin being produced by the pancreas. As a result, the body cannot remove glucose from the blood leading to a very high blood glucose concentration. Diabetes, if not well controlled, may result in severe complications and even death. Therefore, it is important to diagnose diabetes as soon as possible.

13-42 What are the presenting symptoms and signs of diabetes?

- Passing frequent, large amounts of urine (polyuria). The child may start to bed-wet again after being dry for months or years.
- Drinking a lot of water
- Weight loss and tiredness
- Collapse (shock), dehydration, loss of consciousness (diabetic coma) and fast breathing (due to metabolic acidosis). This is a life-threatening emergency.

The diagnosis of diabetes must be suspected if a very high blood glucose concentration is found, using reagent strips. All children with suspected diabetes must be referred urgently to hospital. An intravenous infusion with normal saline must be started before transferring a child with diabetic coma. Later the clinical diagnosis of diabetes must be confirmed with a glucose tolerance test. Children with diabetes usually need daily injections of insulin for life to control their diabetes.

Diabetes usually presents with tiredness, weight loss and polyuria.

CONVULSIONS

13-43 What are convulsions?

Convulsions (fits) present with a sudden onset of abnormal movements and an altered level of consciousness due to abnormal brain activity. Convulsions have many different causes and may present in a wide variety of ways. Important causes are:

- Epilepsy
- High fever
- Meningitis
Hypoglycaemia
Cerebral cysticercosis (brain cysts caused by the pig tapeworm)

All children with convulsions must be urgently transferred to hospital for investigation, to establish the cause, and start correct management.

Before moving a child with convulsions, make sure the airway is open and give oxygen. Always measure the blood glucose concentration with a reagent strip and correct any hypoglycaemia. Cool the child if the temperature is very high.

13-44 How are convulsions stopped?
Always look very carefully for the cause and treat this if possible. If a fit last longer than 5 minutes it can be usually be stopped with one of the following:
- A single dose of rectal diazepam (Valium) 0.5 mg/kg. Intravenous diazepam may cause apnoea unless given very slowly.
- Phenobarbitone 15 mg/kg intravenously or intramuscularly. This is safe.
- Phenytoin 15 mg/kg by slow intravenous injection can also be used. Never give phenytoin intramuscularly, as it damages the tissues locally.

Any convulsion lasting longer than 5 minutes should be stopped.

13-45 What are febrile convulsions?
These are generalised convulsions caused by a high temperature. Often there is an obvious cause of the fever, e.g. upper respiratory tract infection. The child is usually between 6 months and 5 years old and there may be a family history of febrile convulsions. Some children have febrile convulsions whenever they have a viral infection with a high fever. Usually the convulsion does not last longer than 15 minutes and there are no other abnormal neurological signs after the child recovers from the convulsion.

Management is to lower the fever and reassure the parents. Given paracetamol (Panado) when the child is ill to keep the temperature normal. Do not use aspirin. Children usually outgrow febrile convulsions. Oral anticonvulsants are usually not used to prevent febrile convulsions.

13-46 What is epilepsy?
Children with epilepsy have repeated generalised convulsions. There is usually no obvious cause, and they are well between convulsions. The diagnosis is usually based on the history. Epilepsy often starts at puberty and can be controlled (prevented) with oral anticonvulsants. All children with epilepsy should be referred to a neurological clinic for assessment and initial management. Long-term management can be supervised from a primary care clinic.

13-47 Are malignancies common in children?
Malignancies (‘cancers’) are not common in children. However, it is important to know the warning symptoms and signs of childhood malignancy as many childhood malignancies are curable if they are diagnosed and treated early.

Malignancy in children often has a good prognosis if diagnosed and treated early.

13-48 What malignancies occur in children?
- Leukaemia
- Lymphoma
- Brain cancer
- Kidney cancer (Wilm's tumour)
Less common malignancies in children include liver and bone cancer, retinoblastoma (eye), rhabdomyosarcoma (muscle) and germ cell tumours.

13-49 What are the warning signs of malignancy in children?

1. Pallor and bleeding
2. Aching bones or joints, especially waking the child at night; backache
3. Unexplained weight loss, fever or fatigue
4. Persistent, unexplained lymphadenopathy
5. Abdominal masses
6. Lumps in the neck, testes or limbs
7. Eye changes: white pupil, sudden squint or loss of vision, bulging eyeball
8. Neurological symptoms or signs: headaches, early morning vomiting, unsteady gait, cranial palsies, change in behaviour

Children presenting with any of these warning (danger) symptoms or signs must be urgently referred for an expert opinion.

CASE STUDY 1

A 5-year-old child presents with a fever and a one-week history of pain and swelling of the knees and elbows. Over the past few days the pain has moved from joint to joint. On examination the child is unwell with arthritis of both knees. The heart rate is noted to be 110 beats per minute. A soft murmur is heard when her heart is examined. The heart appears enlarged on a chest X-ray. On questioning the mother says the child had a sore throat a few weeks back.

1. What is your clinical diagnosis?
Acute rheumatic fever. The child has 2 major criteria (polyarthritis and carditis) and one minor criteria (fever). There is also a history of a sore throat.

2. What are the other major criteria?
A rash (erythema marginatum), subcutaneous nodules and chorea. Only 2 major criteria are needed to make the diagnosis of acute rheumatic fever.

3. What is the likely cause of the sore throat?
A streptococcal infection.

4. Which signs suggests that this child has carditis?
A heart murmur, tachycardia and enlarged heart.

5. What is the management of acute rheumatic fever?
The child should be referred to hospital. With bed rest, antibiotics (oral amoxycillin for 10 days or a single dose of intramuscular benzathine penicillin) and aspirin the acute rheumatic fever usually recovers within 4 weeks. It is important to look for signs of heart failure.

6. What is the danger of repeated attacks of acute rheumatic fever?
It may result in chronic rheumatic heart disease with damaged heart valves. Rheumatic fever is the most common cause of acquired heart disease in poor, overcrowded communities.

7. How can repeated attacks of acute rheumatic fever be prevented?
With 4 weekly intramuscular injections of benzathine penicillin.

CASE STUDY 2

A 3-year-old child has had a swollen face and dark urine for the past 24 hours. There are numerous areas of impetigo on his legs. The mother says he is very short of breath when he lies down.
1. What is the probable diagnosis?
Acute glomerulonephritis.

2. Why does he have dark urine and a swollen face.
The dark urine is probably due to the presence of blood. Haematuria can be confirmed with reagent strips. His swollen face is due to fluid overload as a result of decreased urine production.

3. What is the cause of this condition?
The streptococcal skin infection (impetigo). This is an unusual immune response to Streptococcus where antibodies damage the kidney.

4. How is this condition prevented?
By preventing or treating impetigo. Usually, local treatment is adequate. An oral antibiotic should be given with widespread impetigo.

5. Why is this child short of breath?
Due to fluid overload. The most serious complications of acute glomerulonephritis are:

- Severe hypertension resulting in encephalopathy
- Pulmonary oedema and cardiac failure due to fluid overload
- Acute renal failure

6. What is the management of the fluid overload?
Reduced fluid intake, a low salt diet and furosemide. These children should be managed in hospital.

That he has a fine rash which reminds her of purpura. The child is fully conscious with no neck stiffness.

1. What is the likely diagnosis?
The child has the clinical signs of septicaemia.

2. Why is the blood pressure low?
The low blood pressure, fast pulse and cold hands, in spite of a fever, indicate that the child is shocked. This is often seen in patients with septicaemia.

3. What does a capillary filling time of 8 seconds mean?
It is abnormally long, as the pink colour should return to a blanched (pale compressed area) area of skin within 3 seconds. The long capillary filling time confirms that the child is shocked.

4. Why is there a rash?
A fine pink or purpuric rash strongly suggests that the septicaemia is due to Meningococcus. This is an extremely serious condition.

5. How is the diagnosis of septicaemia confirmed?
By finding a positive blood culture.

6. Do you think the child has meningitis?
There are no signs of meningitis. However, meningitis is very common with meningococcal septicaemia.

7. What is the correct management of septicaemia with shock?
Take a blood culture and start a fast intravenous infusion with normal saline or Ringer’s lactate. Immediately start antibiotics. Benzyl penicillin or ampicillin plus gentamicin or amikacin would be the antibiotic combination of choice. Do not perform a lumbar puncture. The child should be moved to hospital as soon as possible.

CASE STUDY 3

A severely ill child is brought to the clinic. He has a high temperature without an obvious cause. His heart rate is fast, blood pressure low and hands feel cold. The capillary filling time over the chest is 8 seconds. The nurse notices
14

Home and society

Objectives

When you have completed this unit you should be able to:
• List the rights of children.
• Understand the role of poverty in ill health.
• Describe the importance of the social environment.
• Recognise and manage child abuse.
• Understand the problem of street children.
• Discuss the problems of orphans.
• Describe normal development.
• Identify neurodevelopmental disability.
• Manage behaviour and emotional problems.

CHILDREN’S RIGHTS

14-1 What are the rights of children?

South Africa has agreed to put children first in both it’s constitution and in the signing of the United Nations Convention of the Rights of the Child. Child rights should play a very important role in planning and delivering social services to children. Effective interventions for improving child survival and wellbeing are known and yet the gap between what can be done and what is actually being done widens each year in many low income countries.

Under the South African constitution children have certain rights:
• A name and nationality
• Family or parental care (or appropriate care if removed from the family)
• Basic nutrition
• Shelter
• Basic health and social services
• Protection from maltreatment, abuse, neglect and exploitation
• Legal representation and certain protection from detention
• Protection and exclusion from armed conflict
• Not to be required or allowed to work or provide services not appropriate for their age
• To have access to legal representation

Children’s rights to survival and healthy development must be respected, promoted and protected.

addresses the unique problems of the African child (socio-economic inequality, cultural and traditional barriers to progress, natural disasters, armed conflict, exploitation and hunger, female circumcision, child soldiers, literacy and children of imprisoned mothers) while the South African Constitution and Bill of Rights focus on the rights of children.

14-2 What threatens children’s rights?
The greatest threat to children’s rights is a dysfunctional family. This may be due to:

- Excessive demands on the family (illness, death, divorce, natural disaster, poverty, loss of employment, alcoholism, overcrowding, large family, violence and war)
- A lack of coping strategies available to the family (education, self-esteem, income, parenting skills, cultural beliefs, housing, friends, schools, safe neighbourhood, health and social services)

Infants and young children are totally dependent on their mothers or caregivers. Their family and social environment also have a huge influence on their wellbeing.

NOTE A rights-based approach to health focuses on the whole child and the creation of an environment which promotes the realisation of these rights. It implies duties and implications by the family, community and the state.

POVERTY

14-3 What is the role of poverty in child health?
Poverty, inequity, ignorance and neglect remain the main causes of ill health in children in many low resource countries. Poverty is the single most negative influence on children. Therefore, removing poverty is the most effective way of improving the survival and the quality of life of children. All governments must strive to reduce poverty. In many countries, grants are available to poor families.

14-4 Why does poverty place children at risk?
- The percentage of low birth weight is high.
- Teenage and unmarried mothers are common.
- Poor infrastructure and services – overcrowding, no clean water or safe sanitation, inadequate housing, poor hygiene
- High levels of stress and threat of violence
- Poor maternal education and skills training
- High level of rural-to-urban migration
- No financial security, with high levels of unemployment
- General disempowerment of women
- Malnutrition is common.
- General feelings of helplessness, hopelessness and depression
- Alcoholism and prostitution are common.

14-5 What political factors play a role in poverty?
Inappropriate state expenditure (e.g. arms instead of housing), policies (e.g. neglecting rural and slum areas) and strategies (e.g. building expensive hospitals without adequate staffing). Corruption, lack of vision and insight, and no political will to make the changes needed. War, civil strife and refugees remain a reality in many poor countries. We know what the problems are and how to correct them; the challenge is to make the changes needed in poor communities. Migration and urbanization lead to the breaking up of families and communities.
14-6 What can health workers do to help obtain social grants for children?

1. Know what grants are available to children, which children are eligible for grants, and the process of obtaining child grants.
2. Identify children who are eligible for grants.
3. Inform parents or caregivers about available grants.
4. Help with the process of applying for grants by referring parents or caregivers to the social security department and by getting medical reports completed.
5. As most grants are targeted at poor families an income means test will be needed.

In South Africa applications must be submitted through special social workers in the Department of Social Security and Population Development. Applications may need a medical certificate and processing through the Children’s Court.

**NOTE** The caregiver’s identity document, the child’s birth certificate, and proof of the financial status of the household will be needed for the application.

14-7 What grants are available?

There are a number of state grants aimed at supporting poor families, families of children with special needs, and families who are fostering a child.

In South Africa the following grants are available:

1. **Child support grant:** For children in very poor homes
   - **NOTE** For children under 14 years with a caregiver over 18 years and a monthly household income under R800 (rural) or R11000 (urban).

2. **Care dependency grant:** For the support of families of children with permanent handicaps
   - **NOTE** For children aged 2 to 18 years with a severe handicap and an annual family income below R 48 000.

3. **Foster care grant:** To assist foster families of a child in need

4. **Social relief grant:** An immediate short-term grant for children and families during a crisis situation (e.g. death of the breadwinner)
   - **NOTE** Usually food parcels or a small financial grant while other grant applications are being processed.

The types of grants and schemes to reduce poverty in South Africa are being rapidly expanded.

**SOCIAL ENVIRONMENT**

14-8 What home environmental factors can affect a child’s health?

- A home environment without adequate love, care and nutrition has a major effect on the health of children. Basic warmth, protection, clothing and food are essential.
- Smoke due to a family member smoking cigarettes or a fire inside the house is detrimental to health. The risk of cot death is increased if a parent smokes while respiratory illnesses, especially asthma, are aggravated by smoke.
- Clean water and adequate toilet facilities are essential to prevent diarrhea and other infectious diseases.
- The correct preparation of food under clean conditions is important. Milk formula must be mixed correctly under hygienic conditions.
- It is important to protect children from insects such as fleas, mosquitoes, flies and ticks which can spread disease.
- The education level of the mother is very important. Mothers with little formal education are more likely to have children with malnutrition or illness.
- Television. In well resourced countries obesity is closely associated with watching too much TV and too little physical
exercise. Violence on TV may result in emotional and behaviour problems.

14-9 What environmental factors outside the home can affect a child’s wellbeing?
- School
- Crime
- Drugs
- War

14-10 When do children not have access to health care?
- Despite free health care for preschool children in South Africa, children are often unable to access health care because of inadequate services, especially in rural areas where there is often a severe lack of health care facilities, staff, medication and transport.
- Poor knowledge by parents of the rights and needs of children. Parents may not take their children for immunisations and regular weight checks. They may even not take them for help when they become ill.
- Health services at school are often inadequate and feeding schemes may not function.

CHILD ABUSE

14-11 What is child abuse?
This is the purposeful maltreatment of a child with the aim of causing harm or injury. The child is always the innocent party. Abuse is usually by a family member, guardian or child minder. Child abuse is most common in children under the age of 5 years. The younger the child the greater is the risk of severe injury or death.

Child abuse is the intentional harm or injury of a child.

14-12 What are the forms of child abuse?
Abuse may be physical, emotional or sexual and takes many forms which often overlap with each other:
- Physical abuse (non-accidental injury): Intentionally causing a child physical harm. Physical abuse is identified by examining the child.
- Emotional abuse: Repeated blaming, shouting or verbally rejecting a child. This is often subtle and difficult to prove.
- Sexual abuse: Using a child for personal sexual gratification, e.g. fondling, voyeurism and exhibitionism, child pornography, masturbation or intercourse (vaginal, anal or oral penetration). The recognition of sexual abuse is often dependent on what the child says as sexual abuse often leaves no physical signs.
- Failure to thrive: Due to willful neglect and withholding food and care. Lack of love can also result in poor growth.
- Intentional overdosage or poisoning: purposely giving a child excess medication or a known poison.
- Medical neglect: The child is intentionally not taken for treatment when obviously ill.
- Safety neglect: Not keeping the child away from dangerous situations.

NOTE Sexual abuse occurs in a relationship where there is an imbalance of power between the child and the abuser. The child either does not consent or understand what is occurring.

14-13 When should you consider child abuse?
The most important step in making the correct diagnosis is to consider abuse. Abuse should always be thought of if any of the following occur:
- If the story does not explain the nature or degree of the injury
- If the story is vague or keeps changing
- If the child reports or hints at abuse
- A delay in seeking medical help
- Repeated or multiple injuries
- Any unusual type of injury
- An inappropriate emotional state or behaviour of the parents or child
- Pregnancy or a sexually transmitted infection in a child under 16 years

The most important sign of abuse is a history that does not adequately explain the degree or nature of the injury.

Unfortunately, the diagnosis of child abuse is often missed as it is not considered. Almost half of all abused children do not have physical injuries.

The most important step in the diagnosis is to consider child abuse.

14-14 What are the clinical signs of physical abuse in children?

Child abuse often presents with:

- Bruises of different ages (some fresh and others already discoloured)
- Bruises with a particular distribution (on the back and back of legs)
- Bruises with a particular pattern (hand, buckle, or tram line due to a stick)
- Cigarette burns
- Burns of the buttocks or perineum
- Burns on the hands and feet
- Any injuries in the mouth

An X-ray examination may show multiple injuries of different ages, e.g. new and old rib fractures.

14-15 What are the clinical signs of sexual abuse in children?

Sexual abuse may present with:

- Inappropriate emotional behaviour (withdrawal, separation anxiety, depression, poor school work, avoiding school)
- Inappropriate sexual behaviour
- Vaginal discharge
- Injuries to the vulva, anus or penis (tears, bruises, tenderness, redness, scars)

Often there are no obvious clinical signs. A family member may report the abuse.

NOTE: Special investigations may be indicated such as a full blood count and clotting profile if there is extensive bruising, skeletal survey for suspected repeated injury or brain scan if cerebral injury is suspected.

14-16 Why do people abuse children?

Adults who abuse children were often abused themselves as children. Child abuse is usually a family problem. Poverty, inadequate family and social support, alcoholism, unemployment and mental illness are risk factors for child abuse.

Child abusers were often abused themselves as children.

Physical abuse usually involves a stressed parent or caregiver, a vulnerable child, and a precipitating crisis.

Sexual abuse usually occurs when there is inadequate supervision of a child and involves seduction, bribes, threats or force.

14-17 What should you do if you think a child is being abused?

Abuse is best managed by a multi-disciplinary team who have experience with caring for abused children. Always be kind and gentle with the child, and handle the parents with support and understanding. Be non-judgemental and non-threatening as being accused of child abuse is always emotionally threatening. Stay calm and do not become aggressive with the parents. It is often very difficult to tell with certainty whether a child is or is not being abused.

1. A careful history from the child and family is important. Children rarely lie about abuse.
2. A full examination looking especially for unusual or unexplained injuries. The examination must not be traumatic for
the child. Look for signs of malnutrition or neglect. Has the child been drinking alcohol?
3. All past and present injuries must be carefully documented. Make good notes as they may be used in court. Always date and sign your notes.
4. Provide any immediate physical or emotional treatment needed.
5. Always consider the safety of the child. You may have to remove the child to a safe place until the investigation of child abuse is completed. Never allow a child to be taken home if you suspect that the abuse will be repeated. The safety and interests of the child must always come first.
6. If at all possible the child and parents should be seen urgently by someone who has had special training in the management of child abuse. Many big hospitals have a child abuse team. If this is not possible, contact an experienced person immediately.

**NOTE** Always examine the fundi of the eyes for retinal haemorrhages which are important indicators of physical abuse.

### 14-18 Should the authorities be informed?
Health workers have a specific responsibility to inform the authorities if a case of child abuse is suspected. Notify the police, a social worker or child welfare officer immediately.

**All cases of suspected child abuse must be notified to the authorities immediately.**

**NOTE** The Child Care Amendment Act 96 of 1996 in South Africa states that any person who suspects that a child is being maltreated or deliberately injured must immediately notify the authorities.

### 14-19 What is the long term goal of managing an abused child?
The repair and reconstruction of the family, if this is possible.

### 14-20 How should a child be managed if sexual abuse is suspected?
1. An examination of the anus and genital must be done only once. Younger children can be held on the mother's lap with their legs pulled up to expose the genitalia. Older child are best examined in the lateral position, never in the knee–chest position which is often used by abusers. This examination is usually not urgent. All signs of sexual interference (bruising, tears, swelling or scarring) will be at or external to the hymen. Therefore, an internal digital examination should not be done. However, a vaginal examination may be needed under a general anaesthetic if there is severe trauma. Describe the shape and appearance of the hymen. The findings must be carefully documented. Swabs must be taken for culture.

**NOTE** A special Crime Kit to collect semen samples is available if the sexual abuse has taken place in the past 4 days.

2. Take blood for VDRL and HIV screen.
3. Consider prophylaxis for syphilis, Chlamydia, gonorrhoea, Trichomonas, Gardnerella and HIV.
4. Prescribe pregnancy prophylaxis within 72 hours of rape in girls who have already started menstruating.
5. Debrief and counsel to prevent post-traumatic stress disorder.

**NOTE** Cefotaxime IMI once, metronidazole (Flagyl) for 7 days and erythromycin for 10 days to prevent most sexually transmitted infections. AZT and 3TC for 28 days for HIV prophylaxis.

### STREET CHILDREN

### 14-21 What are street children?
These are children under 16 years of age who live on the street. True street children have little or no contact with their family. The street is their home. They find shelter, food, security and friends on the street. True street children should not be confused with children who...
make a living on the street after school but return to their family and home at night.

Street children have left their home and family to make a new life on the street.

14-22 How do street children get onto the street?

- Some are ‘throw-away’ children who are orphaned or abandoned. They are forced out of their homes.
- Others are runaway children who have escaped an abnormal home environment of poverty, cruelty, neglect and exploitation. Some leave home so that they do not have to attend school.

Street children seek the freedom to find a better place to live. It is expected that the number of street children will increase dramatically as more and more families are affected by HIV.

14-23 How do street children survive on the streets?

They beg, scavenge, undertake simple tasks (e.g. cleaning car windscreens), steal and become sex workers. To cope with cold, hunger, loneliness and the stress of living on the street, many children abuse chemical substances (e.g. sniff glue).

Street children often suffer from malnutrition, poor hygiene, infections, trauma and sexually transmitted infections. Most have severe emotional and psychological problems due to the reasons behind leaving home as well as their experiences on the street.

Street children have many physical and emotional problems.

14-24 How should the problem of street children be managed?

Street children have the same rights and needs as other children. There are many programmes to help street children:

- Some help with basic needs such as food, clothing and safe shelter.
- Others provide basic services such as medical care, schooling, counselling and sport facilities.
- A few comprehensive programmes attempt to meet all the needs of street children and rehabilitate them back into society.
- Preventative programmes address the reasons why children leave home (e.g. life skills and parenting training).

It would be far better for citizens to contribute to one of the agencies which assist street children rather than giving money directly to these children. Giving food and money at street corners only encourages them to beg. Street children are often used and abused by older people to collect money.

Street children should be integrated back into society.

14-25 What are orphans?

These are children who have lost both parents. Children who have been abandoned in hospital or who have parents in jail have similar problems to orphaned children.

14-26 Are the number of orphans increasing in south Africa?

Yes. With the epidemic of AIDS and frequency of war in Africa, more and more children are becoming orphans. Everyday children are losing their parents to AIDS in South Africa. Most children born to an HIV-infected mother are not infected themselves. Therefore they are at risk of becoming orphaned if both parents die of AIDS. While many of these children are cared for by their grandparents or extended family, the number of child-led families is increasing. The support and management of
these orphans is a major challenge to both government and society.

14-27 What are the risks of being an orphan?

Parents are a child’s first line of protection and guidance. Therefore, children who lose both parents are vulnerable to exploitation, violence, discrimination, child labour, malnutrition, illness and abuse. Orphaned children without support often end up as prostitutes, servants and sweat shop workers or get involved in organized crime. In some countries they are used as child soldiers.

Being separated from parents by death, war or social breakdown is detrimental to a child’s development and general wellbeing. Many of these children are uneducated, unhealthy and impoverished.

Orphans are at an increased risk of deprivation and abuse.

14-28 What can be done to help orphans?

Every effort must be made to help and protect these children. They have the same physical and emotional needs as other children. Whenever possible they should remain in their extended families or within their broader society. The state must provide the financial support to make this possible. Only as a last resort should they be placed in orphanages. It is better if they can be fostered or adopted so that they can be part of a family.

Every effort must be made to care for orphans in their own family and community.

Children who are cared for outside their own family and community soon lose their family ties and sense of identity. This can be severely damaging emotionally.

DEVELOPMENTAL SCREENING

14-29 What is normal neurological development?

From birth to adulthood, children both grow and develop. Normal development follows a standard orderly sequence of events which can be measured. Along the path of development are critical stages called ‘milestones’. Milestones are important developmental achievements such as standing and talking. Determining the child’s milestones allows for an assessment of whether development is normal or not. Milestones are determined both from the history and examination.

Milestones are critical developmental achievements.

14-30 Do all normal children reach the same milestones at the same age?

Not all children reach the same milestones at the same age. The age at which children acquire various physical, mental and social skills varies. Some normal children develop faster than others. Therefore, there is a wide normal range around the average time most children achieve a certain milestone (i.e. some normal children talk earlier than others). It is better to look at when a range of milestones are reached rather than base a developmental assessment on a single milestone.

14-31 What is developmental screening?

Many tests are available to decide whether a child’s development is within the normal range. These are called screening tests. Some are quick and simple and are used at primary care clinics to screen all children. Others are complicated and take time and experience to perform correctly. These tests are used to screen children at high risk of developmental problems.

Basic developmental screening is part of normal primary health care. In infants
born preterm, their postnatal age should be corrected for the number of weeks that they were born early. Therefore, a one month old infant born at 36 weeks gestation should behave like a full term infant.

All children should have basic developmental screening.

14-32 What areas of development should be assessed?

Developmental assessment looks at the following areas:

- Gross motor
- Fine motor
- Language and communication (vision and hearing)
- Social interaction

14-33 What are the common milestones in gross motor development?

1. Smiling socially by 6 weeks
2. Sitting without support by 6 months
3. Pulling to a standing position by 9 months
4. Walking with help by 12 months
5. Walking well by 18 months

14-34 When do children develop fine motor skills?

1. The newborn infant will grasp anything placed in the hand.
2. By 6 months an object will be passed from hand to hand.
3. By 12 months a child should pick up small objects in a pincer grip between thumb and index finger.
4. By 18 months they should be able to build a tower with 3 blocks.

14-35 Which children are at high risk of developmental delay?

- Infants with severe perinatal complications (e.g. severe foetal growth restriction, foetal distress in labour, need for prolonged resuscitation at birth)
- Children with meningitis, cerebral bleeds or brain trauma
- Children with birth defects that affect the brain
- Children from emotionally-deprived homes

14-36 What should be done if a child has developmental delay?

The child should be referred to a developmental clinic for assessment by a multi-disciplinary team. Do not simply advise the parents that the child will outgrow the problems. Causes of any developmental delay should be looked for and corrected if possible. It may be necessary to test the child's sight and hearing. An interview with a social worker may be needed to exclude emotional or social problems at home or school. Children with developmental delay may be found to have a neurodevelopmental disability.

NEURODEVELOPMENTAL DISABILITY

14-37 What is disability?

A child with disability is not able to do something which most children are able to do at that age. Neurodevelopmental disability may be intellectual or physical or both.

14-38 How is intellectual disability assessed?

By measuring the intelligence quotient (IQ). Children without intellectual disability have an IQ of 75 or above. The developmental quotient (DQ) can also be used to assess intellectual ability, especially in young children. The developmental quotient is the developmental age divided by the chronological age,
multiplied by 100. 95% of children will have an IQ or DQ between 75 and 125.

14-39 What are the grades of intellectual disability?

Intellectual disability can be divided into 4 grades based on intelligence quotients (or developmental quotients):

- Mild disability (IQ 50–74). Common in disadvantaged communities with poverty, malnutrition, neglect and few educational opportunities. These children can usually remain in mainstream education.
- Moderate disability (IQ 35–49). They need special schooling.
- Severe (IQ 20–34) and profound disability (IQ less than 20). They require constant supervision and are dependent on others for their daily needs.

Moderate and severe intellectual disability are usually due to brain damage.

14-40 What is cerebral palsy?

A non-progressive motor disorder with abnormalities in tone, movement and posture. It is caused by damage to the immature, developing brain (before birth or in infancy). This is the most common cause of motor disability in children. There are a number of different types of cerebral palsy and part or all of the body may be affected. The most common is spastic cerebral palsy which may present as hemiplegia (weakness on one side of the body only), diplegia (legs affected more than arms) and quadriplegia (all limbs affected). Children with cerebral palsy may also have fits, learning difficulties, visual, hearing or speech problems. Spastic cerebral palsy is usually due to hypoxic damage during labour and delivery.

Cerebral palsy is a non progressive motor disorder involving tone, movements and posture.

14-41 How should cerebral palsy be managed?

Children with cerebral palsy must be referred for assessment and management by a multi-disciplinary team. Physiotherapy and occupational therapy are very helpful. The family often need support and financial help through a state grant. The involvement and co-operation of the family and community is very important. These children may be intellectually normal. If at all possible they should be cared for at home with the family and not institutionalised.

BEHAVIOUR AND EMOTIONAL PROBLEMS

14-42 What problems are common in young children?

- Sleeping difficulties
- Head banging
- Breath-holding attacks
- Faecal soiling

Most of these problems get better with time. Parents need understanding, support and advice. Refer the child if the problem does not disappear.

14-43 What problems are seen in older children?

- Attention deficit disorder
- Anxiety and fears
- Learning difficulties
- Eating disorders
- Depression
- Antisocial behaviour
- Substance abuse

Most of these problems need the help of experts and therefore these children should be referred.

14-44 What is the attention deficit disorder?

Children with attention deficit disorder (ADD) are more restless and impulsive than
others and have difficulty concentrating on one thing at a time. They are easily bored and distracted, and have difficulty completing tasks. They do not pay attention and have difficulty learning. This leads to serious schooling and behaviour problems. If they are very hyperactive the condition is called the attention deficit and hyperactivity disorder (ADHD). Hyperactive children are disruptive in the classroom and difficult at home. They cannot sit still.

The cause is usually unknown but it is more common in boys. There may be a family history of the condition. The diagnosis is usually made at about the time schooling starts. However, the correct diagnosis is often missed and the children are regarded as naughty or intellectually disabled. Attention deficit with hyperactivity is particularly common in children with foetal alcohol syndrome. Some children are worse after eating certain foods.

These children need early diagnosis and educational help. The parents need to understand the nature of the disorder.

**NOTE** Some, but not all, school children with attention deficit disorder respond dramatically to methylphenidate (Ritalin) taken after breakfast on school days. Recent findings suggest that the medication should be taken both during school days and holidays.

**CASE STUDY 1**

A very underweight child is brought to the local urban clinic by his mother who is unemployed. The mother has had little school education and relies on her boyfriend for food and shelter. Her boyfriend drinks heavily and abuses her. Unfortunately her family are far away in a rural village. The clinic nurse criticizes her for not feeding her child adequately and for not bringing him to the clinic regularly.

1. **What is the main problem facing this mother and child?**

   Poverty.

2. **Why is the mother in this situation?**

   She is unemployed and has had very little formal education. Therefore she has to rely on an abusive boyfriend for food and shelter, both for herself and her child.

3. **Why does she not seek employment?**

   She has no social support as her family are far away. She probably came to town looking for work, but she has little education and few work skills. Who would she leave the child with if she went to look for employment? This is a very common scenario in many poor countries which results in childhood malnutrition, ill health and delayed growth and development.

4. **What do you think of the attitude of the nurse?**

   This will not encourage the mother to bring her child to the clinic in future. This woman needs help, advice, understanding and support.

5. **What can be done to help her?**

   Her problem is not easily answered. Referral to a social worker would be helpful. Social grants are available for children in need.

6. **What are this child’s rights?**

   All children have a right to basic shelter, care and nutrition. They also have a right to basic health and social services.

**CASE STUDY 2**

A 2-year-old child is brought to a casualty department in the early hours of the morning. The parents give a vague story of the child falling off the bed. The parents are obviously drunk. On examination the child has bruises all over her body and a cigarette burn on the abdomen. Some bruises are fresh and others are old. A skeletal survey shows both recent and old fractures of the ribs. The medical
officer shouts at the parents and phones the police from a busy waiting room.

1. Why would you suspect child abuse from the history?
Because the history does not adequately explain the bruises all over the body. The fact that the child was brought to hospital so late at night and that the parents were drunk is also very suspicious.

2. Does the examination confirm your suspicions?
Yes. Both bruises of different ages and a cigarette burn are very strong evidence for abuse.

3. Are the X-ray findings typical of child abuse?
Yes. Multiple injuries of different ages are typical. It would be most unusual for a non-abused child to have rib fractures that occurred on more than one occasion.

4. What was wrong with the doctor’s actions?
It is very difficult to stay calm when you know that a child has been abused. However, it is important to behave in a professional manner. The authorities must be informed, but it is not appropriate to shout at the parents and discuss the child in a public place.

5. What would be the correct management of this child?
The child must not be allowed to return home as the abuse may be repeated. The parents need to be told of the suspected diagnosis and that the authorities have to be informed. If possible an abuse team should be notified. Very careful notes must be written to document the history and clinical findings.

6. Why do some parents abuse their children?
They were often abused themselves as children. Abuse is more common in a social background of poverty, poor education, a lack of emotional support, and alcoholism.

7. How should the child’s genitalia be examined if sexual abuse was suspected?
Children must not be hurt or frightened. It is best to examine young children on their mother’s lap. Inspection of the vulva and anus is usually all that is needed. A digital internal examination should not be done.

CASE STUDY 3

A child of 8 years is brought to a general practitioner following physical abuse by older boys. He has been living on the street for the past 6 months following the death of his mother and then his father. He does not know why they died.

1. How do children get onto the street?
Like this child, they may be orphaned. However, they may also be abandoned by their parents or run away from home.

2. What problems are common in street children?
They commonly suffer from malnutrition, poor hygiene, infections, trauma and sexually transmitted infections. They may also abuse drugs. Most have severe emotional and psychological problems due to their experiences on the street.

3. What is the aim of managing a street child?
To integrate the child back into society and, thereby, avoid all the risks of living on the street.
4. What should the general practitioner do to help this child?

Contact the local social services.

5. Where is the best place for orphaned children?

In their extended families, e.g. with a grandmother. If this is not possible, every effort should be made to get these children cared for in the community where they lived before losing their parents.

6. What factor explains many of the recently orphaned children in South Africa?

AIDS.

CASE STUDY 4

Parents bring a 1-year-old child to hospital because he is still unable to sit without support. They recognize that his development has been slower than that of their other children. On examination it is noted that the tone in his legs is much greater than that in his arms. He appears generally well. The mother says that he was very small at birth and had a gestational age of only 35 weeks. He remained in hospital for 3 months.

1. Should the parents be concerned about his slow development?

Yes. Most children are sitting without help by 6 months. One year is very late not to be sitting yet. Even with correction for his prematurity (10 weeks), he is developing very slowly.

2. Why do you think this child is developing slowly?

The increased tone in his legs suggests that he has spastic diplegia. This is a form of cerebral palsy that is typically seen in infants that were very low birth weight or preterm. The history indicates that he was born preterm and needed a long stay in hospital.

3. How can you tell whether this child also has intellectual disability?

He needs special tests to assess all aspects of development.

4. What areas of neurodevelopment should be assessed?

Gross motor, fine motor, language and communication (including vision and hearing) and social interaction. Neurodevelopment is best assessed by a multidisciplinary team.

5. Could the diagnosis have been made earlier?

Yes. Cerebral palsy can usually be detected by screening all children at regular intervals as part of primary care.

6. Can this child be helped?

He needs physiotherapy. The parents also need to be counselled about the cause, the management and the prognosis. It is very important to work with the parents.
15
Childhood mortality

Objectives

When you have completed this unit you should be able to:
• Calculate the under-5 mortality rate.
• Understand the importance of knowing local mortality rates.
• Manage a mortality meeting.
• List common causes of under-5 mortality.
• Identify important modifiable factors.

Under-5 deaths are often used as a measure of the number of childhood deaths.

NOTE The WHO defines a child as a person under the age of 18 years. Ideally all deaths under the age of 18 should be recorded as childhood deaths. However, this is rarely done as teenagers are usually not cared for by paediatric services. Many paediatric services only care for children up to the age of 13 (the common age of puberty).

INTRODUCTION

15-1 How are deaths during childhood counted?
The most common way of recording the number of deaths during childhood is to count the number of children who die before the age of 5 years, therefore children who are born alive but die before their fifth birthday will be counted as under-5 deaths but children who die on or after their fifth birthday will not be included. However, there are limitations to this method as it is important not to forget older children.

15-2 What is a mortality rate for children?
This is the number of children who die expressed as a proportion of all the children who could possibly die. For example, if there are 1000 liveborn children and 10 die, the mortality rate for these children is 10 per 1000.

It is more useful to know the mortality rate than only the number of children who die. Therefore, it is not good enough to simply know how many children died. Mortality rates allow you to compare deaths between different-sized groups of children.

15-3 What is the under-5 mortality rate?
The number of children who die under the age of 5 years is usually expressed as a rate per 1000. Therefore, the under-5 mortality rate is defined as the number of children who die under the age of 5 years per 1000 live born infants. The under-5 mortality rate indicates the
probability that a live born child will not survive to the age of 5 years. The under-5 mortality rate is one of the basic health indicators.

The under-5 mortality rate is the number of children who are born alive but die under the age of 5 years per 1000 liveborn infants.

15-4 How can under-5 deaths be grouped?

Under-5 deaths are usually divided into age groups:

Neonatal mortality includes all live born infants who die in the first 28 days of life. Often neonatal deaths are further divided into early neonatal deaths (deaths in the first 7 days of life) and late neonatal deaths (deaths between 8 and 28 days of life). The neonatal mortality rate is, therefore, the number of live born infants who die in the first 28 days of life per 1000 live born infants.

The neonatal mortality rate is the number of infants who are born alive but die in their first 28 days of life per 1000 live born infants.

Infant mortality includes all the children who die before the age of 1 year (i.e. before reaching their first birthday). Therefore the infant mortality rate is the number of children who die under 1 year per 1000 infant born that year.

The infant mortality rate is the number of infants who die before the age of 1 year per 1000 liveborn infants.

15-5 What is an annual mortality rate?

Usually the infant and under-5 mortality rates are calculated for a calendar year. This is called the annual mortality rate. Sometimes the mortality rate is expressed over a longer period of time, e.g. over 10 years. It is less accurate to calculate mortality rates over periods shorter than one year.

15-6 Should the mortality rates be calculated for a special area?

Yes. Mortality rate is usually calculated for a given health district (or region). For example, to determine the under-5 mortality rate for a health district, all under-5 deaths in each part of that service (each clinic and hospital) must be added together. The rate is then expressed per 1000 live births in that district. Sometimes the mortality rate is calculated for a whole province or country by combining the results of many districts.

This is much better than simply calculating the mortality rate of a single hospital. Due to differing patterns of referral, hospital deaths do not necessarily reflect all deaths in the districts which drain to that hospital. For example, deaths at home or at clinics are not included. Therefore, mortality rates are best expressed for a health district in 1 year.

It is best to calculate the under-5 mortality rate for a health district rather than only for a single hospital.

15-7 Are mortality rates the same for all health districts?

No. Mortality rates often differ markedly between health districts. Usually the rates are higher for poor districts than wealthy districts. Similarly, rates are higher in developing (poorly resourced) than in industrialised (well resourced) countries. Therefore, a single mortality rate for the whole nation is only of limited value.

All the childhood mortality rates are expressed per 1000 liveborn infants.

NOTE Sometimes the infant mortality rate is divided into the neonatal mortality rate and the post neonatal mortality rate (the number of infants who die between 1 month and 12 months per 1000 infants born that year). The child mortality rate is the number of children aged 1 to 4 who die per 1000 live births. The 5–18 mortality rate includes all the children dying from 5 up to but not including 18 years.
15-8 Do mortality rates remain the same?

No. Mortality rates may also differ between different time periods. In most countries mortality rates have fallen over the past years. With the AIDS epidemic in Southern Africa, infants and under-5 mortality rates are rising.

Therefore, mortality rates allow you to compare different groups of children, either in different places (districts, regions, provinces or countries) at the same time or in the same place at different times (months or years).

Mortality rates in the same place often vary over time.

15-9 Why is it important to know the infant and under-5 mortality rates?

Because they are one of the best ways of measuring the wellbeing of children. An improvement in mortality rates for a health district from one year to the next is a good way of showing that the wellbeing of children in that district is improving. An increase in the mortality rates indicates that the wellbeing is deteriorating. A high mortality rate draws attention to that district where there is obviously a problem.

The under-5 mortality rate is one of the best methods of assessing the wellbeing of children.

NOTE The 4th Millennium Developmental Goal set by the United Nations is to reduce the under-5 mortality rate between 2000 and 2015 by a third.

15-10 What determines the infant and under-5 mortality rates?

These mortality rates depend on both:

- The health, nutrition and home environment of children
- The quality of health care that is available to children

The mortality rate will increase if either the health, nutrition and home environment of children is poor or the health care service are poor. Often both poor socioeconomic conditions and inadequate access to good quality health services occur together. It is, therefore, not surprising that the mortality rates for children vary widely between different districts and countries. The district with a high rate may have a specific health problem (e.g. malaria) or a problem with the health service (e.g. low immunisation rate).

The under-5 mortality rate reflects both the socioeconomic conditions and quality of health care provided.

15-11 What is the under-5 mortality rate in well resourced countries?

In well resourced (wealthy) countries or well resourced communities in poor countries the under-5 mortality rate is usually below 10. This reflects a high standard of child health, nutrition and home conditions as well as a good health care service.

NOTE The neonatal mortality rate and infant mortality rate in industrialised countries is usually below 5/1000 and 7/1000 respectively.

15-12 What is the under-5 mortality rate in under resourced countries?

In under resourced (poor) countries or under resourced communities in wealthy countries the under-5 mortality rate is usually higher than 80. Every effort must be made to reduce the under-5 mortality rate in poor countries so that it approaches the rate in well resourced countries. Note the enormous difference in rates between wealthy and poor countries.

Every effort must be made to reduce the under-5 mortality rate in poor countries.

NOTE It is estimated that more than 10 million children die worldwide each year before their fifth birthday! Four million of these children die in their first month of life. The average worldwide under-5 mortality rate is about 80/1000 but some very poor countries have an under-5 mortality rate above 250/1000!
15-13 What is the under-5 mortality rate in South Africa?

This is not accurately known because the collection of mortality data is not good in all regions as many childhood deaths are not reported. However, the under-5 mortality rate in South Africa is estimated to be about 70/1000. In other words, for every 1000 infants that are born alive in South Africa, 70 will die before their fifth birthday. The under-5 mortality rate in South Africa is more like that of an under resourced than a wealthy country.

The under-5 mortality rate in South Africa is estimated at about 70/1000.

The under-5 mortality rate varies between urban (town and city) and rural (country) areas and between different regions of the country. Wealthy communities in urban areas have an under-5 mortality rate similar to well resourced countries while poor, rural areas have a rate similar to under resourced countries.

NOTE The under-5 mortality rates between provinces in South Africa vary from 40/1000 in the Western Cape to 80/1000 in the Eastern Cape. Similarly the under-5 rate for urban areas is 40/1000 while the rate in rural areas is 70/1000.

15-14 What is the infant mortality rate in South Africa?

The infant mortality rate in South Africa is estimated to be about 55 per 1000. Therefore, out of every 1000 infants born alive in South Africa, 55 will die before reaching the age of 12 months. This can be compared to an infant mortality rate of less than 10/1000 in developed countries and 20/1000 or more in developing (under resourced) countries. South Africa therefore has an infant mortality rate similar to that seen in most under resourced countries.

South Africa has an infant mortality rate typical of a developing country.

The high infant mortality rate in South Africa indicates that there are problems with the health of young children in the country. South Africa has a higher infant mortality rate than other countries with a similar income (e.g. Mexico and Brazil). Therefore, South Africa has the financial resources to lower the infant mortality rate. It is important that a country uses its resources wisely and develops the health service and improves living conditions for all.

Furthermore, about 45 out of every 60 under-5 deaths occur during the first year of life (i.e. 75%). Children under 1 year are, therefore, at greater risk of dying than are older children.

NOTE The neonatal mortality rate in South Africa is estimated to be about 20 per 1000. Therefore, about a third of all under-5 deaths occur in the first month of life, especially the first week of life when most neonatal deaths occur.

15-15 What do under-5 mortality rates tell us?

- How well a district, region, province or nation is caring for their children
- Which districts, regions or provinces have the greatest need for better child care
- It allows for comparison of mortality rates between different areas or countries with a similar income. In other words, how well we are using our income to improve the health of children.
- It helps identify areas or age groups where the causes of childhood death need urgent investigation.

COLLECTING INFORMATION ON UNDER-5 DEATHS

15-16 Should childhood deaths be notified?

Yes. All deaths are notifiable in most countries, including South Africa. The child’s age, gender and cause of death should be stated on the death notification form. Unfortunately the given cause of death is often unknown, incorrect or not helpful. For example, if a child with severe malnutrition due to poverty dies
of pneumonia, it is of little help if the cause of death is listed as pneumonia when the real underlying reason was the low socioeconomic status of the family (i.e. poverty). Similarly, deaths due to AIDS are often recorded as gastroenteritis or tuberculosis.

The list of common causes of death on official publications is, therefore, often misleading.

In well resourced countries with accurate records of all births and deaths, it is far easier to determine mortality rates and the important causes of death.

15-17 How should the causes of childhood deaths be accurately identified?

The fully history, detailed examination and any special investigations must be recorded and reviewed (discussed) before deciding on the most likely cause of death. Collecting this information is best done as soon as possible after the child’s death while the probable cause of death should be recorded after it has been discussed and reviewed.

All the infant’s case details must be collected and recorded as soon as possible after the death.

15-18 Why is it important to know the common causes of under-5 deaths?

Knowing the under-5 mortality rate is of limited value if you do not know why the children are dying, because the common causes of death during childhood vary greatly from one country to another.

The common causes of death need to be known before interventions can be planned to lower the mortality rate. It is very important that we learn why children die. This is done at a mortality review.

15-19 What is a mortality review?

This is an in-depth investigation and discussion about each child death. The mortality review is usually done at special mortality meetings. These are regular meeting of staff where every childhood death in that service is reviewed. This includes all children who die in a hospital ward, outpatient or casualty department, and hospital or peripheral clinics. Ideally all children who die at home within the service region should also be included. Deaths due to both medical and surgical conditions must be discussed. This is the best way of obtaining an accurate assessment of each death.

The cause of death is best decided after discussion at a mortality meeting.

15-20 What are the aims of the mortality review?

The main aims of a mortality review are to:

- Obtain data on the number of deaths and calculate the mortality rates.
- Identify the main cause of death as well as contributing causes.
- Identify any modifiable factors.
- Decide whether the child received good management.
- Allow all the staff involved with child care to contribute to the discussion.
- Discuss ways that both causes can be avoided and modifiable factors corrected.
- Use the discussion to teach. Getting the staff to identify the clinical and management problems is a very effective way of learning.
The main aims of mortality reviews are to identify problems and find answers.

An important part of the mortality review is the mortality meeting. Mortality meetings should be well organised and well managed.

15-21 How should a mortality meeting be managed?

1. A responsible person must be identified to arrange the meeting. This is usually a doctor working in the paediatric service.
2. Regular meetings are held once or twice a month depending on the number of deaths.
3. A suitable time and venue is needed. Often lunch times or late afternoons are best.
4. All staff involved with child care should be invited (nurses, doctors and administrators). Staff must understand that mortality meetings are very important.
5. A brief summary of each death, giving relevant information, must be prepared before each mortality meeting.
6. Anything discussed in the meeting must be viewed as confidential. Summary sheets should be destroyed after the meeting.
7. The meeting should discussed what ‘we’ did incorrectly and how ‘we’ could do better in future. The meeting must never become a ‘witch hunt’. Any disciplinary action must be handled with the person involved privately outside the meeting and never in front of other staff. Without a spirit of mutual support and trust, important details of the child’s management may be withheld. A team approach is needed to solve problems of patient management.
8. All decisions (causes and modifiable factors) made must be recorded on the mortality sheets (death data capture sheets) at the time of the meeting and not afterwards when important details may be forgotten.
9. Decisions about actions to be taken must be documented, and progress must be reviewed at the beginning of the next mortality meeting.

Discussions in a mortality meeting must be confidential and carried out in a constructive and non-threatening manner.

Well organised mortality meetings are one of the best ways of improving the standard of health care of children. Mortality meetings are also a very effective way of teaching. They help staff to identify and solve problems and provide a wonderful learning opportunity. They reduce the number of children who die.

Mortality meetings reduce the number of children who die.

15-22 What information is needed for each child who dies?

1. Full name, hospital or clinic number, gender (sex), age (date of birth) and date of death.
2. Full clinical history including past history, record of immunisation, review of the growth chart in the Road-to-Health Card, family history and home conditions.
3. Results of a full examination together with an assessment of the growth and nutritional status.
4. Any special investigations (e.g. blood and urine tests, X-rays).

All the information must be summarised before the meeting so that a brief summary can be presented. This is often handed out on an information sheet or presented with an overhead projector. It is boring and wastes time if information has to be looked for in the patient’s records during the meeting.

A register of all admissions and deaths must be kept in each service area (e.g. ward) so that no deaths are missed and the number of admissions are known. Basic information in the ward or clinic register must include
each patient’s name, folder number, age, sex and weight. All wards should keep a monthly death register which records all deaths in that month. Often each death is given a unique code (number).

A brief clinical summary must be prepared before the mortality meeting for each child who has died.

15-23 How is the cause of death decided?
This is one of the most important parts of the mortality meeting. All the possible causes must be considered before agreement is reached on the main cause of death. This is often only agreed upon after some discussion. If the cause of death is not certain, then the probable cause must be used. The cause of death, therefore, is decided by everyone at the meeting.

It is important to decide on the most likely cause of death.

15-24 How is the cause of death recorded?
For each child, the main cause of death must be identified. This is the most likely factor that lead to the death of the child. Sometimes it is not easy to decide which is the main cause and which are contributing causes. Any other contributing causes should also be recorded. If possible, an ICD 10 code should be allocated to the main as well as other contributing causes.

An example would be measles as the main cause with bacterial pneumonia and malnutrition as contributing causes.

It is important to have a formal document (death data capture sheet) on which all the relevant information as well as the causes and modifiable factors can be entered and coded.

15-25 How should you decide whether the management of a child was correct?
If possible, standard national protocols of care should be used. The management which was given can then be compared to the approved management. If a national protocol is not available, the most acceptable method of care should be obtained from a current textbook, journal article or expert on that condition. By asking questions at mortality meetings, better ways of preventing, diagnosing and managing childhood problems are often identified. This is one of the great benefits of these meetings. Modifiable factors must always be looked for and recorded at the mortality meeting.

By identifying errors in management and correcting these errors, the lives of children in future can be saved. This is one of the main aims of mortality meetings.

Identifying and correcting errors in management can save the lives of other children.

It is very important to praise good management, even if the child died. A positive attitude and willingness to compliment the staff for good care helps to encourage active participation and lessen the fear of criticism.

15-26 What is a modifiable factor?
A modifiable (avoidable) factor is a missed opportunity for good care or an example of substandard care which probably lead to the child’s death. No measles immunisation would be a missed opportunity in a 2-year-old child who died of measles, while failure to give adequate rehydration at a clinic would be substandard care in a child who died of acute diarrhoea.

Identifying modifiable factors is an important step in planning health care strategy and correcting problems which lead to poor care and deaths. It is important to decide whether each death is probably avoidable or not. The identification of modifiable factors enables problem solving.

Modifiable factors include all missed opportunities for good care and any substandard care which probably resulted in the death.
It is important to decide whether a death could probably have been avoided.

15-27 How can modifiable factors be classified?

Modifiable factors can be divided into:

- **Modifiable factors related to the family or caregiver.** Examples include not taking children for immunisation, delay in taking an ill child to clinic, poor nutrition, not recognising that a child was ill, neglect and abuse.
- **Modifiable factors associated with the clinical staff.** Examples include poor clinical assessment, giving the incorrect treatment, delay in referral, inadequate notes and not seeing a child when asked to do so.
- **Modifiable factors related to the administration.** Examples include lack of facilities, equipment or staff, lack of training, inadequate transport, poor communication, lack of policy or medications, and no laboratory service.

**NOTE** Any event, act or omission contributing to the death or to substandard care should be regarded as a modifiable factors.

A comprehensive (full) list of common modifiable factors should be drawn up and referred to when each death is discussed. It is helpful if each modifiable factor is given a specific code as this makes the analysis of modifiable factors much easier.

### CAUSES OF UNDER 5 DEATHS

15-28 What are the common causes of under-5 deaths in South African hospitals?

- Lower respiratory tract infection
- Diarrhoeal disease
- Septicaemia
- AIDS
- Severe malnutrition
- Tuberculosis

**NOTE** This data is from the Child Health Care Problem Identification Programme (Child PIP).

**Infections are the most common cause of under-5 mortality in South Africa.**

**NOTE** The most common cause of death in the 5–18 year age group in South Africa is trauma (e.g. motor vehicle accidents and violence).

15-29 How will the AIDS epidemic affect the common causes of death?

AIDS is becoming a much more common cause of death both in children and adults. Many of these children will eventually die of other infections such as pneumonia, diarrhoea, septicaemia and tuberculosis. Even if a child is not HIV-infected, death of one or both parents will increase their risk of dying under the age of 5 years. Therefore, the AIDS epidemic is expected to increase the under-5 mortality rate, and especially the infant mortality rate, in South Africa and many other developing countries.

**The spread of AIDS will increase the under-5 mortality rate in South Africa.**

15-30 Why is it important to determine the HIV status of each child that dies?

An assessment of the HIV status of each under-5 deaths should be made. Otherwise children who have died with AIDS may be misclassified. Often the HIV status of children who die is not known. As a result, the role of HIV infection is missed.

Clinical signs of HIV infection must always be looked for and documented. If possible the child’s HIV and immunological status should also be determined.

Children with definite or probable HIV infection can be classified into:
- Definite HIV infection with both clinical signs of HIV infection and positive HIV status
- Children with probable HIV infection who have clinical signs of HIV infection but an unknown HIV status (i.e. blood test not done)

The HIV status of all children who die must be assessed whenever possible.

15-31 How important is malnutrition as a cause of death?
Malnutrition is an important main or contributing cause of childhood death in most poor countries. Therefore it is important to determine the growth and nutritional status of all children seen at a clinic, admitted to a hospital, as well as all children who die.

The nutritional status of all children who die must be recorded.

THE ANALYSIS OF MORTALITY DATA

15-32 What data are needed to analyse childhood deaths?
Two sets of information are needed to analyse mortality data:
- Baseline population data. For calculating infant and under-5 mortality rates, the number if liveborn infants each year in that service or region is needed. For hospital mortality data, the total number of admission are needed. All deaths must be counted. This hospital data should be recorded in the ward admission books. Without this information, mortality rates cannot be calculated.
- The causes of death and modifiable factors. This information should be recorded on the forms completed at the mortality meetings.

15-33 How is the data analysed?
Previously, the information was counted and analysed by hand, using paper information records.

Today most analyses are done by computer. This is faster and more accurate. It is also possible to show the findings as graphs or tables.

All the information recorded onto the mortality data capture forms at the mortality meetings has to be transferred onto a computer-based record. This can be done after each meeting or the information can be entered in batches.

15-34 What results are obtained from the analysis?
- Details of the basic information, e.g. number of infants born alive each year and total hospital admissions. Admissions can be divided into age groups and by nutritional status (e.g. below the 3rd centile for weight).
- Number of deaths and mortality rates
- Causes of death and modifiable factors
- Tables and graphs can be printed giving monthly or annual information on the number of deaths, mortality rates, causes of death and modifiable factors.
- Children can be grouped by age and site of death.
- Data from more than one site or region can be combined.

15-35 What should be done with the results of the analysis?
It is extremely important that the results of the analysis be made available to all who are interested, especially the staff and administration. The results must be used to improve the care of children.

15-36 What is a mortality report?
This is usually an annual report prepared from the monthly results of the mortality meetings. The mortality report gives a summary of the results and also draws conclusions from
the results. It is of little value to collect and analyse mortality data throughout the year without interpreting what the results mean. The mortality report should also suggest ways that the results can be used to plan methods of reducing the mortality rate. The feedback loop between collecting mortality data, analysing the data and then using the data to improve care is very important.

**A mortality report must summarise mortality data and suggest ways to reduce mortality.**

At a report-back meeting all the staff must be given the findings of the mortality report. An annual mortality report should be prepared for each health district. Theses should be used to produce reports for each province and for the whole nation.

**15-37 What ongoing assessments are needed?**

Regular assessments are needed to measure whether there are improvements in mortality rates and whether causes and modifiable factors are being addressed. Only with ongoing assessments can the impact of mortality reports be judged. It is very important to identify and correct causes of death that are not becoming less frequent and modifiable factors that are not being corrected.

**15-38 What is the Child Health Care Problem Identification Programme?**

The Child Health Care Problem Identification Programme (ChildPIP) is an important and innovative computer-based system to collect, analyse and report on childhood mortality data. It was developed in South Africa and is modelled on the highly successful Perinatal Problem Identification Programme (PPIP).

The aim of ChildPIP is to determine the mortality rates, causes of death and modifiable factors which may prevent childhood deaths. This should improve the quality of care that children receive in the health service.

**Figure 15.1 shows the data collection sheet for childhood deaths from ChildPIP.**

**WAYS OF AVOIDING THE COMMON CAUSES OF UNDER 5 DEATHS**

15-39 What steps can be taken to reduce the under-5 mortality rate?

- Improve the general health, nutrition and home environment of children. This can be achieved by reducing poverty.
- Improve the access and quality of care provided by the health system.

15-40 How can under-5 mortality data be used to improve the quality of care in a health system?

By reviewing the data in hospitals and clinics, it is possible to decrease the under-5 mortality and improve the care of children. The problem of a high under-5 mortality rate cannot be addressed until the common causes of death and modifiable factors are fully understood.

**All health facilities should conduct regular mortality reviews as this can reduce the under-5 mortality rate.**

15-41 What should be done to address specific causes of under-5 deaths?

Once the cause of each death has been established, it is important to look actively for any modifiable factors. It is of little value to know the cause of death if nothing is done to prevent similar deaths due to that cause in future.

15-42 What should be done once the modifiable factors have been identified within a region?

A meeting of all role-players must be called to report and discuss the findings. It is
**Figure 15.1: The data collection sheet for childhood deaths from the ChildPIP**

<table>
<thead>
<tr>
<th>Patient name:</th>
<th>Folder no:</th>
<th>Nearest town/district:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DoB</strong> yyyy-mm-dd</td>
<td><strong>Age</strong></td>
<td><strong>Gender</strong> ♂ / ♀</td>
</tr>
<tr>
<td><strong>Re-admission</strong> ♂ / ♀ / ♂</td>
<td><strong>Dead on arrival</strong> ♂ / ♀ / ♂</td>
<td></td>
</tr>
<tr>
<td><strong>When death occurred</strong> Weekday (07:00-19:00)</td>
<td><strong>Weeknight</strong> (19:00-07:00)</td>
<td><strong>Weekend/ Public holiday</strong></td>
</tr>
<tr>
<td><strong>Date of Admission</strong> yyyy-mm-dd</td>
<td><strong>Time</strong></td>
<td><strong>Date of Death</strong> yyyy-mm-dd</td>
</tr>
</tbody>
</table>

**Records**

1. Folder not available
2. Folder present, records incomplete e.g. no RTHC
3. Folder present, notes inadequate (quality of notes is poor)
4. Folder present, records incomplete AND notes inadequate
5. Folder available, records & notes OK

**Referred**

<table>
<thead>
<tr>
<th><strong>Name of hospital/clinic:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>♂ / ♀ / ♂</td>
</tr>
</tbody>
</table>

- If yes, from:
  1. Another hospital
  2. A clinic
  3. Private sector
  Unknown

- If yes, from:
  1. Inside drainage area
  2. Outside drainage area
  Unknown

**Social**

<table>
<thead>
<tr>
<th><strong>Mother</strong></th>
<th><strong>Father</strong></th>
<th><strong>Primary caregiver</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alive and well</td>
<td>2. Dead</td>
<td>3. Sick</td>
</tr>
<tr>
<td>1. Alive and well</td>
<td>2. Dead</td>
<td>3. Sick</td>
</tr>
<tr>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

**Nutrition** (tick one category box, then fill in actual weight: enter “999” if weight unknown)


**HIV / AIDS (enter status at time of admission, not at time of audit: this is NOT a post-mortem assessment)**

<table>
<thead>
<tr>
<th>Lab</th>
<th>Clinical</th>
<th>PMTCT</th>
<th>Feeding in first 6 months</th>
<th>Cotrimoxazole</th>
<th>ARV (child)</th>
<th>ARV (mother)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Not tested (but indicated)</td>
<td>5. Not staged (but indicated)</td>
<td>6. Not tested (not indicated)</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>6. Not tested (but indicated)</td>
<td>6. Not staged (not indicated)</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

**Cause of Death (insert codes)**

<table>
<thead>
<tr>
<th>Main cause of death:</th>
<th>Underlying condition:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other important diagnoses (max 4):</td>
<td></td>
</tr>
</tbody>
</table>

**Modifiable Factors (insert codes)**

<table>
<thead>
<tr>
<th>Code</th>
<th>Family/Caregiver</th>
<th>Comments</th>
<th>Code</th>
<th>Clinic/Ambulatory</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>♂</td>
<td>Possible/ ?</td>
<td>Probable</td>
<td>♂</td>
<td>Possible/ ?</td>
<td>Probable</td>
</tr>
<tr>
<td>♂</td>
<td>Possible/ ?</td>
<td>Probable</td>
<td>♂</td>
<td>Possible/ ?</td>
<td>Probable</td>
</tr>
<tr>
<td>♂</td>
<td>Possible/ ?</td>
<td>Probable</td>
<td>♂</td>
<td>Possible/ ?</td>
<td>Probable</td>
</tr>
<tr>
<td>♂</td>
<td>Possible/ ?</td>
<td>Probable</td>
<td>♂</td>
<td>Possible/ ?</td>
<td>Probable</td>
</tr>
</tbody>
</table>

**Admissions & Emergency: Hospital**

|----------|-------------|----------|-------------|----------|-------------|----------|-------------|----------|-------------|


In your opinion, had the process of caring been different, would this death have been avoidable?

<table>
<thead>
<tr>
<th>Yes</th>
<th>Not sure</th>
<th>No</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
important to identify the most common and most important modifiable factors, especially those that can be addressed and corrected. Doctors, nurses and administrators should work together to find practical answers. A plan must then be developed to implement changes aimed at lowering the mortality rate. This usually requires an improvement in the quality of health care that children receive.

A regular assessment of both the causes and modifiable factors must be made to determine whether the interventions are in fact reducing the mortality rate by decreasing the frequency of deaths associated with those causes and modifiable factors. Positive results are a very powerful motivating factors for the staff. A failure to show an improvement indicates that the strategy to lower mortality is ineffective. The reasons for this must be found and corrected. In future it is hoped that the deaths of children of 5 years and older will also be recorded and analysed in a similar fashion.

3. Why is it important to know the under-5 mortality rate of a country?

Because it is one of the best indicators of the wellbeing of children in that country.

4. What important factors determine the under-5 mortality rate?

The under-5 mortality rate depends both on:

- The health, nutrition and home environment of children
- The quality of health care that is available to children

5. What is the definition of the infant mortality rate?

The number of liveborn infants who die in the first year of life. About 75% of all under-5 deaths occur in the first year of life.

6. What is the infant mortality rate in this hospital?

480/8000 = 60/1000 This is also typical of a developing country. South Africa has an infant mortality rate of 55 compared to rates of less than 7 in well-resourced countries.

7. Why is it of only limited value to know the mortality rate in a single hospital?

Because deaths at home and at clinics are not included, hospital deaths do not necessarily reflect all the deaths in the region that drains to that hospital. Therefore, it is better to determine the mortality rate in the whole region rather than just at one hospital.

8. Does South Africa have high infant and under-5 mortality rates because it is under resourced?

This is only part of the problem as some other countries with a similar income per person have lower rates. What is important is how a country spends its state funds. Resources must be spent wisely on improving the standard of living (and health) for all.
CASE STUDY 2

The manager of a state hospital decides to start monthly mortality meetings in the children’s ward because the administration has had complaints of poor care. He instructs all doctors to attend and asks the paediatrician to present the findings of each death in order to find out which staff members have been practising substandard care. The doctor reads from the hospital folders which takes a long time. This discourages the junior doctors from asking questions or contributing to the presentation as they want to go home. The doctor criticises one of the doctors who failed to notice that a child with diarrhoea was dehydrated. The story is spread in the ward the next day.

1. What are the aims of a mortality meeting?

To improve the care of children by finding out the common causes of death and identifying associated factors which may have contributed to the death. If these problems are successfully addressed, the lives of other children may be saved. Mortality meetings are also an excellent opportunity to learn how to identify and solve problems. They provide a wonderful teaching opportunity.

2. What is wrong with the way the hospital manager arranged these meetings?

All staff members should be encouraged to attend these meetings, not just doctors. A team approach to identifying problems in patient management is essential if mortality meetings are to be helpful. These meetings should be a team effort. Everyone attending the meeting should be encouraged to participate.

3. Should the paediatrician read the notes from the patients’ folders?

No. The history, examination and special investigations for each child must be summarised before the meeting. It is very useful if the summaries are handed out at the meeting or shown on an overhead projector. This saves a lot of time.

4. Are the findings in a mortality meeting confidential?

Yes. All the discussions in the meeting must be confidential and gossip about the findings must not be allowed. Without strict confidentiality, many staff will not attend the meetings. It is a good idea to destroy the handouts at the end of the meeting.

5. Should mortality meetings be used to identify staff who have made mistakes?

No. These meetings must never become a ‘witch hunt’. Any disciplinary action must take place privately and never in front of colleagues. The spirit of mortality meetings is to explore how ‘we’ could have managed the child better. It is important to praise good care, even if the child died.

CASE STUDY 3

A 4-year-old undernourished child with severe measles develops pneumonia and dies soon after arrival at hospital. Only when the child had been ill for 5 days did the mother take him to the local clinic. He had never been immunised against measles although this was available at the local clinic. The mother did not bring his Road-to-Health Card. While waiting for transport to hospital the child was cyanosed but no oxygen was available at the clinic. The history of this child is presented at a mortality meeting.

1. What was the main cause of death?

Measles

2. What were important contributing causes?

Pneumonia, either viral or bacterial. Malnutrition may also have contributed to the death, as measles is often severe in malnourished children.
3. Was this death avoidable?
Definitely yes.

4. What were the modifiable factors related to the family?
The child had not been taken for immunisation although this was available. The child was also not brought to the clinic until severely ill. As the mother did not have his Road-to-Health Card, it was not known how long he had been underweight. Family factors, related to poverty almost certainly contributed to the lack of routine clinic visits.

5. What was the administration-related factor that needs to be addressed?
There was no emergency oxygen available at the clinic.

6. When should these details be entered onto the death data capture sheet?
The history and clinical details are best entered at the time of the death when all the documentation is available. The causes and modifiable factors should be entered at the mortality meeting.

CASE STUDY 4

A 2-year-old child with clinical signs of AIDS is brought to hospital from a poor, rural area. She has not eaten for days because of a severe fungal infection of the mouth and oesophagus. On admission the child is pyrexial and has signs of serious bacterial infection. The child dies the following day. The HIV screening test is positive and the CD4 count is very low. The mother says that she did not receive antenatal care as there is no clinic close to their home.

1. Should this child be classified as an infant death?
No, as infant deaths are defined as deaths before the age of 1 year. Her death would be classified as an under-5 death.

2. What is the main cause of death?
AIDS. The screening test for HIV infection was positive. This diagnosis is supported both the clinical findings (an opportunistic infection) and the immunological results.

3. What are contributing causes?
Septicaemia and fungal infection of the mouth and oesophagus, both complications of AIDS.

4. What is the important modifiable factor?
The important modifiable factor is related to administration. As there is no local clinic, the woman could not receive antenatal care with counselling and screening for HIV. Prophylactic antiretroviral drugs may have prevented the child from being infected with HIV.

5. How could this modifiable factor be addressed?
The adequacy of the local health service needs to be assessed. The community should also be empowered to ask for improved primary care services.
Tests

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