- *Mouth ulcers.* If the child can drink and eat, clean the mouth with clean, salted water (a pinch of salt in a cup of water) at least four times a day.
  - Apply 0.25% gentian violet to sores in the mouth after cleaning.
  - If the mouth ulcers are severe and/or smelly, give IM or IV benzylpenicillin (50 000 U/kg every 6 h) and oral metronidazole (7.5 mg/kg three times a day) for 5 days.
  - If the mouth sores result in decreased intake of food or fluids, the child may require feeding via a nasogastric tube.
- *Neurological complications.* Convulsions, excessive sleepiness, drowsiness or coma may be symptoms of encephalitis or severe dehydration. Assess the child for dehydration and treat accordingly (see section 5.2, p. 127). See Chart 9, p. 15, for treatment of convulsions and care of an unconscious child.
- *Severe acute malnutrition:* See guidelines in Chapter 7, p. 197.

Monitoring

Take the child's temperature twice a day, and check for the presence of the above complications daily.

Follow-up

Recovery after acute measles is often delayed for many weeks and even months, especially in children who are malnourished. Arrange for the child to receive the third dose of vitamin A before discharge, if this has not already been given.

Public health measures

If possible, isolate children admitted to hospital for measles for at least 4 days after the onset of the rash. Ideally, they should be kept in a separate ward from other children. For malnourished and immunocompromised children, isolation should be continued throughout the illness.

When there are measles cases in the hospital, vaccinate all other children > 6 months of age (including those seen as outpatients, admitted in the week after a measles case and HIV-positive children). If infants aged 6–9 months receive measles vaccine, it is essential that the second dose be given as soon as possible after 9 months of age.

Check the vaccination status of hospital staff and vaccinate, if necessary.

6.4.2 Non-severe measles

Diagnosis

Diagnose non-severe measles in a child whose mother clearly reports that the child has had a measles rash, or if the child has:

- fever and
- a generalized rash and
- one of the following: cough, runny nose or red eyes, but
- none of the features of severe measles (see section 6.4.1, p. 175).

Treatment

- Treat as an outpatient.
- *Vitamin A therapy.* Check whether the child has already been given adequate vitamin A for this illness. If not, give 50 000 IU (if aged < 6 months), 100 000 IU (6–11 months) or 200 000 IU (1–5 years). See details on p. 369.

Supportive care

- *Fever.* If the child's temperature is ≥ 39 °C (≥ 102.2 °F) and is causing distress or discomfort, give paracetamol.
- *Nutritional support.* Assess the nutritional status by measuring the mid upper arm circumference (MUAC). Encourage the mother to continue breastfeeding and to give the child frequent small meals. Check for mouth ulcers and treat, if present (see above).
- *Eye care.* For mild conjunctivitis with only a clear watery discharge, no treatment is needed. If there is pus, clean the eyes with cotton-wool boiled in water or a clean cloth dipped in clean water. Apply tetracycline eye ointment three times a day for 7 days. Never use steroid ointment.
- *Mouth care.* If the child has a sore mouth, ask the mother to wash the mouth with clean, salted water (a pinch of salt in a cup of water) at least four times a day. Advise the mother to avoid giving salty, spicy or hot foods to the child.

Follow-up

Ask the mother to return with the child in 2 days to see whether the mouth or eye problems are resolving, to exclude any severe complications and to monitor nutrition and growth.

6.5 Septicaemia

Septicaemia should be considered in a child with acute fever who is severely ill, when no other cause is found. Septicaemia can also occur as a complication of meningitis, pneumonia, urinary tract infection or any other bacterial infection. The common causative agents include *Streptococcus*, *Haemophilus influenza, Staphylococcus aureus* and enteric Gram-negative bacilli (which are common in severe malnutrition), such as *Escherichia coli* and *Klebsiella*. Non-typhoidal *Salmonella* is a common cause in malarious areas. Where meningococcal disease is common, a clinical diagnosis of meningococcal septicaemia can be made if petaechiae or purpura (haemorrhagic skin lesions) are present.

Diagnosis

The child's history helps determine the likely source of sepsis. Always fully undress the child and examine carefully for signs of local infection before deciding that there is no other cause.

On examination, look for:

- fever with no obvious focus of infection
- negative blood film for malaria
- no stiff neck or other specific sign of meningitis, or negative lumbar puncture for meningitis
- confusion or lethargy
- signs of systemic upset (e.g. inability to drink or breastfeed, convulsions, lethargy or vomiting everything, tachypnoea)
- Purpura may be present.

Investigations

The investigations will depend on presentation but may include:

- full blood count
- urinalysis (including urine culture)
- blood culture
- chest X-rays.

In some severe cases, a child may present with signs of septic shock: cold hands with poor peripheral perfusion and increased capillary refill time (> 3 s), fast, weak pulse volume, hypotension and decreased mental status.

Treatment

Start the child immediately on antibiotics.

- Give IV ampicillin at 50 mg/kg every 6 h plus IV gentamicin 7.5 mg/kg once a day for 7–10 days; alternatively, give ceftriaxone at 80–100 mg/kg IV once daily over 30–60 min for 7–10 days.
- When staphylococcal infection is strongly suspected, give flucloxacillin at 50 mg/kg every 6 h IV plus IV gentamicin at 7.5 mg/kg once a day.
- Give oxygen if the child is in respiratory distress or shock.
- Treat septic shock with rapid IV infusion of 20 ml/kg of normal saline or Ringer's lactate. Reassess. If the child is still in shock, repeat 20 ml/kg of fluid up to 60 ml/kg. If the child is still in shock (fluid-refractory shock), start adrenaline or dopamine if available.

Supportive care

- If the child has a high fever (≥ 39 °C or 102.2 °F) that is causing distress or discomfort, give paracetamol or ibuprofen.
- Monitor Hb or EVF, and, when indicated, give a blood transfusion of 20 ml/kg fresh whole blood or 10 ml/kg of packed cells, the rate of infusion depending on the circulatory status.

Monitoring

- The child should be checked by a nurse at least every 3 h and by a doctor at least twice a day. Check for the presence of new complications, such as shock, cyanosis, reduced urine output, signs of bleeding (petaechiae, purpura, bleeding from venepuncture sites) or skin ulceration.
- Monitor Hb or EVF. If they are low and falling, weigh the benefits of transfusion against the risk for bloodborne infection (see section 10.6, p. 308).

6.6 Typhoid fever

Consider typhoid fever if a child presents with fever and any of the following: constipation, vomiting, abdominal pain, headache, cough, transient rash, particularly if the fever has persisted for ≥ 7 days and malaria has been excluded.

Diagnosis

On examination, the main diagnostic features of typhoid are:

- fever with no obvious focus of infection

- no stiff neck or other specific sign of meningitis, or negative lumbar puncture for meningitis (Note: children with typhoid can occasionally have a stiff neck)
- signs of systemic upset, e.g. inability to drink or breastfeed, convulsions, lethargy, disorientation or confusion, or vomiting everything
- Pink spots on the abdominal wall may be seen in light-skinned children.
- hepatosplenomegaly, tender or distended abdomen

Typhoid fever can present atypically in young infants as an acute febrile illness with shock and hypothermia. In areas where typhus is common, it may be difficult to distinguish between typhoid fever and typhus by clinical examination alone (See standard paediatrics textbook for diagnosis of typhus).

Treatment

- Treat with oral ciprofloxacin at 15 mg/kg twice a day or any other fluoroquinolone (gatifloxacin, ofloxacin, perfloxacin) as first-line treatment for 7–10 days.
- If the response to treatment is poor after 48 h, consider drug-resistant typhoid, and treat with second-line antibiotic. Give IV ceftriaxone at 80 mg/kg per day or oral azithromycin at 20 mg/kg per day or any other third-generation cephalosporin for 5–7 days.
- Where drug resistance to antibiotics among *Salmonella* isolates is known, follow the national guidelines on local susceptibility.

Supportive care

- If the child has high fever (≥ 39 °C or ≥ 102.2 °F) that is causing distress or discomfort, give paracetamol.

Monitoring

The child should be checked by a nurse at least every 3 h and by a doctor at least twice a day.

Complications

Complications of typhoid fever include convulsions, confusion or coma, diarrhoea, dehydration, shock, cardiac failure, pneumonia, osteomyelitis and anaemia. In young infants, shock and hypothermia can occur.

Acute gastrointestinal perforation with haemorrhage and peritonitis can occur, usually presenting as severe abdominal pain, vomiting, abdominal tenderness on palpation, severe pallor and shock. Abdominal examination may show an abdominal mass due to abscess formation and an enlarged liver and/or spleen.

If there are signs of gastrointestinal perforation, pass an IV line and nasogastric tube, start appropriate fluids, and obtain urgent surgical attention.

6.7 Ear infections

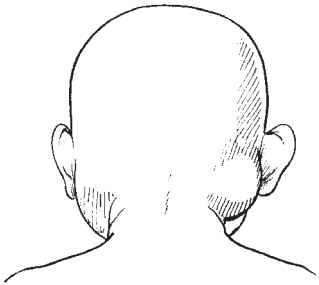
6.7.1 Mastoiditis

Mastoiditis is a bacterial infection of the mastoid bone behind the ear. Without treatment it can lead to meningitis and brain abscess.

Diagnosis

Key diagnostic features are:

- high fever
- tender swelling behind the ear.



Mastoiditis: a tender swelling behind the ear which pushes the ear forward

Treatment

- Give IV or IM cloxacillin or flucloxacillin at 50 mg/kg every 6 h or ceftriaxone until the child improves, for a total course of 10 days.
- If there is no response to treatment within 48 h or the child's condition deteriorates, refer the child to a surgical specialist to consider incision and drainage of mastoid abscesses or mastoidectomy.
- If there are signs of meningitis or brain abscess, give antibiotic treatment as outlined in section 6.3 (p. 169), and, if possible, refer to a specialist hospital immediately.

Supportive care

- If the child has a high fever (≥ 39 °C or ≥ 102.2 °F) that is causing distress or discomfort, give paracetamol.

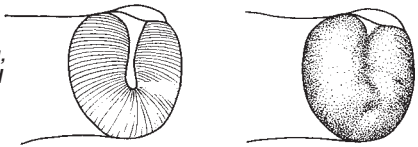
Monitoring

The child should be checked by a nurse at least every 6 h and by a doctor at least once a day. If the child responds poorly to treatment, such as decreasing level of consciousness, seizure or localizing neurological signs, consider the possibility of meningitis or brain abscess (see section 6.3, p. 167).

6.7.2 Acute otitis media

Diagnosis

This is based on a history of ear pain or pus draining from the ear (for < 2 weeks). On examination, confirm acute otitis media by otoscopy. The ear-drum will be red, inflamed, bulging and opaque, or perforated with discharge.



Acute otitis media: bulging, red ear-drum (on right) and normal ear-drum (on left)

Treatment

Treat the child as an outpatient.

- Give oral antibiotics in one of the following regimens:-
  - First choice: oral amoxicillin at 40 mg/kg twice a day for at least 5 days
  - Alternatively, when the pathogens causing acute otitis media are known to be sensitive to co-trimoxazole, give co-trimoxazole (trimethoprim 4 mg/kg and sulfamethoxozole 20 mg/kg) twice a day for at least 5 days.
- If pus is draining from the ear, show the mother how to dry the ear by wicking. Advise the mother to wick the ear three times daily until there is no more pus.
- Tell the mother not to place anything in the ear between wicking treatments. Do not allow the child to go swimming or get water in the ear.
- If the child has ear pain or high fever (≥ 39 °C or ≥ 102.2 °F) that is causing distress, give paracetamol.

Wicking the child's ear dry in otitis media

Follow-up

Ask the mother to return after 5 days.

- If ear pain or discharge persists, treat for 5 more days with the same antibiotic and continue wicking the ear. Follow up in 5 days.

6.7.3 Chronic otitis media

If pus has been draining from the ear for ≥ 2 weeks, the child has a chronic ear infection.

Diagnosis

A diagnosis is based on a history of pus draining from the ear for > 2 weeks. On examination, confirm chronic otitis media (where possible) by otoscopy.

Treatment

Treat the child as an outpatient.

- ▶ Keep the ear dry by wicking (see above).
- ▶ Instill topical antibiotic drops containing quinolones with or without steroids (such as ciprofloxacin, norfloxacin, ofloxacin) twice a day for 2 weeks. Drops containing quinolones are more effective than other antibiotic drops. Topical antiseptics are not effective in the treatment of chronic otitis media in children.

Follow-up

Ask the mother to return after 5 days.

If the ear discharge persists:

- Check that the mother is continuing to wick the ear. Do not give repeated courses of oral antibiotics for a draining ear.
- Consider other causative organisms like *Pseudomonas* or possible tuberculous infection. Encourage the mother to continue to wick the ear dry and give parenteral antibiotics that are effective against *Pseudomonas* (such as gentamicin, azlocillin and ceftazidine) or TB treatment after confirmation.

6.8 Urinary tract infection

Urinary tract infection is common in boys during young infancy because of posterior urethral valves; it occurs in older female infants and children. When bacterial culture is not possible, the diagnosis is based on clinical signs and microscopy for bacteria and white cells on a good-quality sample of urine (see below).

Diagnosis

In young children, urinary tract infection often presents as nonspecific signs. Consider a diagnosis of urinary tract infection in all infants and children with:

- fever of ≥ 38 °C for at least 24 h without obvious cause
- vomiting or poor feeding
- irritability, lethargy, failure to thrive, abdominal pain, jaundice (neonates)
- specific symptoms such as increased frequency, pain on passing urine, abdominal (loin) pain or increased frequency of passing urine, especially in older children

Half of all infants with a urinary tract infection have fever and no other symptom or sign; so the only way to make the diagnosis is to check the urine.

Investigations

- Examine a clean, fresh, un-centrifuged specimen of urine under a microscope. Cases of urinary tract infection usually have more than five white cells per high-power field, or a dipstick shows a positive result for leukocytes. If microscopy shows no bacteriuria and no pyuria or the dipstick tests are negative, rule out urinary tract infection.
- If possible, obtain a 'clean' urine sample for culture. In sick infants, a specimen taken with an in–out urinary catheter or supra-pubic bladder aspiration may be required (see p. 350).

Treatment

- Treat the child as an outpatient. Give an oral antibiotic for 7–10 days, except:
  - when there is high fever and systemic upset (such as vomiting or inability to drink or breastfeed)
  - when there are signs of pyelonephritis (loin pain or tenderness)
  - for infants
- Give oral co-trimoxazole (10 mg/kg trimethoprim and 40 mg/kg sulfamethoxazole every 12 h) for 5 days. Alternatives include ampicillin, amoxicillin and cefalexin, depending on local sensitivity patterns of *E. coli* and other Gram-negative bacilli that cause urinary tract infection and on the availability of antibiotics (see p. 353 for details of dosage regimens).
- If there is a poor response to the first-line antibiotic or the child's condition deteriorates or with complications, give gentamicin (7.5 mg/kg IM or IV once daily) plus ampicillin (50 mg/kg IM or IV every 6 h) or parenteral

cephalosporin (see p. 358). Consider complications such as pyelonephritis (tenderness in the costo-vertebral angle and high fever) or septicaemia.

▶ Treat young infants aged < 2 months with gentamicin at 7.5 mg/kg IM or IV once daily until the fever has subsided; then review, look for signs of systemic infection, and, if absent, continue with oral treatment, as described above.

Supportive care

- The child should be encouraged to drink or breastfeed regularly in order to maintain a good fluid intake, which will assist in clearing the infection and prevent dehydration.
- If the child has pain, treat with paracetamol; avoid non-steroidal anti-inflammatory drugs (NSAIDs).

Follow-up

Investigate all episodes of urinary tract infection in all children with more than one episode in order to identify a possible anatomical cause. This may require referral to a larger hospital with facilities for appropriate ultrasound investigations.

6.9 Septic arthritis or osteomyelitis

Acute infection of the bone or joint is usually caused by spread of bacteria through the blood. However, some bone or joint infections result from an adjacent focus of infection or from a penetrating injury. Occasionally, several bones or joints are involved.

Diagnosis

In acute cases of bone or joint infection, the child looks ill, is febrile and usually refuses to move the affected limb or joint or bear weight on the affected leg. In acute osteomyelitis, there is usually swelling over the bone and tenderness. Septic arthritis typically presents as a hot, swollen, tender joint or joints with reduced range of movement.

These infections sometimes present as chronic illness; the child appears less ill, with less marked local signs, and may not have a fever. Consider tuberculous osteomyelitis when the illness is chronic, there are discharging sinuses or the child has other signs of TB.

Laboratory investigations

X-rays are not helpful in diagnosis in the early stages of the disease. If septic arthritis is strongly suspected, introduce a sterile needle under strictly aseptic

conditions into the affected joint and aspirate it. The fluid may be cloudy. If there is pus in the joint, use a wide-bore needle (after local anaesthesia with 1% lignocaine) to obtain a sample and remove as much pus as possible. Examine the fluid for white blood cells and carry out culture, if possible.

Staphylococcus aureus is the usual cause in children aged > 3 years. In younger children, the commonest causes are *H. influenzae* type b, *Streptococcus pneumoniae* or *S. pyogenes* group A. *Salmonella* is a common cause in young children in malarious areas and with sickle-cell disease.

Treatment

The choice of antibiotic is based on the organism involved, modified by the results of Gram staining and culture. If culture is possible, treat according to the causative organism and the results of antibiotic sensitivity tests. Otherwise:

- Treat with IM or IV cloxacillin or flucloxacillin (50 mg/kg every 6 h) for children aged > 3 years. If this is not available, give chloramphenicol.
- Clindamycin or second- or third-generation cephalosporins may be given.
- Once the child's temperature returns to normal, change to equivalent oral treatment with the same antibiotics, and continue for a total of 3 weeks for septic arthritis and 5 weeks for osteomyelitis.
- In cases of septic arthritis, remove the pus by aspirating the joint. If swelling recurs repeatedly after aspiration, or if the infection responds poorly to 3 weeks of antibiotic treatment, exploration, drainage of pus and excision of any dead bone should be done by a surgeon. In the case of septic arthritis, open drainage may be required. The duration of antibiotic treatment should be extended in these circumstances to 6 weeks.
- Tuberculous osteomyelitis is suggested by a history of slow onset of swelling and a chronic course, which does not respond well to the above treatment. Treat according to national TB control programme guidelines. Surgical treatment is almost never needed because the abscesses will subside with anti-TB treatment.

Supportive care

The affected limb or joint should be rested. If it is the leg, the child should not be allowed to bear weight on it until pain-free. Treat pain or high fever (if it is causing discomfort to the child) with paracetamol.

6.10 Dengue

Dengue is caused by an arbovirus transmitted by Aedes mosquitoes. It is highly seasonal in many countries in Asia and South America and increasingly in Africa. The illness usually starts with acute onset of fever, retro-orbital pain and continuously high temperatures for 2–7 days. Most children recover, but a small proportion develop severe disease. During the recovery period, a macular or confluent blanching rash is often noted.

Diagnosis

Suspect dengue fever in an area of risk for dengue if the child has fever lasting > 2 days.

- Headache, pain behind the eyes, joint and muscle pain, abdominal pain, vomiting and/or a rash may occur but are not always present. It can be difficult to distinguish dengue from other common childhood infections.

Treatment

Most children can be managed at home, provided the parents have good access to a hospital.

- Counsel the parents to bring the child back for daily follow-up and to return immediately if any of the following occur: severe abdominal pain, persistent vomiting, cold, clammy extremities, lethargy or restlessness, bleeding, e.g. black stools or coffee-ground vomit.
- Encourage oral fluid intake with clean water or ORS solution to replace losses during fever and vomiting.
- Give paracetamol for high fever if the child is uncomfortable. **Do not give aspirin or NSAIDs such as ibuprofen, as these drugs may aggravate bleeding**.
- Follow-up the child daily until the temperature is normal. Check the EVF daily if possible. Check for signs of severe disease.
- Admit any child with signs of severe disease (mucosal or severe skin bleeding, shock, altered mental status, convulsions or jaundice) or with a rapid or marked rise in EVF.

6.10.1 Severe dengue

Severe dengue is defined by one or more of the following:

- plasma leakage that may lead to shock (dengue shock) and fluid accumulation
- severe bleeding
- severe organ impairment.

Plasma leakage, sometimes sufficient to cause shock, is the most important complication of dengue infection in children. The patient is considered to have shock if the pulse pressure (i.e. the difference between the systolic and diastolic pressures) is ≤ 20 mm Hg or he or she has signs of poor capillary perfusion (cold extremities, delayed capillary refill or rapid weak pulse rate). Systolic hypotension is usually a late sign. Shock often occurs on day 4–5 of illness. Early presentation with shock (day 2 or 3 of illness), very narrow pulse pressure (≤ 10 mm Hg) or undetectable pulse and blood pressure suggest very severe disease.

Other complications of dengue include skin or mucosal bleeding and, occasionally, hepatitis and encephalopathy. Most deaths occur in children in profound shock, particularly if the situation is complicated by fluid overload (see below).

Diagnosis

Suspect severe dengue in an area of risk for dengue if the child has fever lasting > 2 days, and any of the following features:

- evidence of plasma leakage
  - high or progressively rising EVF
  - pleural effusions or ascites
- circulatory compromise or shock
  - cold, clammy extremities
  - prolonged capillary refill time (> 3 s)
  - weak pulse (fast pulse may be absent even with significant volume depletion)
  - narrow pulse pressure (see above)
- spontaneous bleeding
  - from the nose or gums
  - black stools or coffee-ground vomit
  - skin bruising or extensive petaechiae
- altered level of consciousness
  - lethargy or restlessness
  - coma
  - convulsions
- severe gastrointestinal involvement
  - persistent vomiting
  - increasing abdominal pain with tenderness in the right upper quadrant
  - jaundice

Treatment

- Admit all patients with severe dengue to a hospital with facilities for urgent IV fluid treatment and blood pressure and EVF monitoring.

Fluid management: patients without shock (pulse pressure > 20 mm Hg)

- Give IV fluids for repeated vomiting or a high or rapidly rising EVF.
- Give only isotonic solutions such as normal saline and Ringer's lactate (Hartmann's solution) or 5% glucose in Ringer's lactate.
- Start with 6 ml/kg per h for 2 h, and then reduce to 2–3 ml/kg per h as soon as possible, depending on the clinical response.

Give the minimum volume required to maintain good perfusion and urine output. IV fluids are usually needed only for 24–48 h, as the capillary leak resolves spontaneously after that time.

Fluid management: patients in shock (pulse pressure ≤ 20 mm Hg)

- Treat as an emergency. Give 10–20 ml/kg of an isotonic crystalloid solution such as Ringer's lactate (Hartmann's solution) or normal saline over 1 h.
  - If the child responds (capillary refill and peripheral perfusion start to improve, pulse pressure widens), reduce to 10 ml/kg for 1 h and then gradually to 2–3 ml/kg per h over the next 6–8 h.
  - If the child does not respond (continuing signs of shock), give a further 20 ml/kg of the crystalloid over 1 h, or consider giving 10 ml/kg of a colloid solution such as 6% dextran 70 or 6% hetastarch (molecular mass, 200 000) over 1 h. Revert to the crystalloid schedule described above as soon as possible.
- Further small boluses of extra fluid (5–10 ml/kg over 1 h) may be required during the next 24–48 h.
- Decide on fluid treatment on the basis of clinical response, i.e. review vital signs hourly, EVF and monitor urine output closely. Changes in the EVF can be a useful guide to treatment but must be interpreted with the clinical response. For example, a rising EVF with unstable vital signs (particularly narrowing of the pulse pressure) indicates the need for a further bolus of fluid, but extra fluid is not needed if the vital signs are stable, even if the EVF is very high (50–55%). In these circumstances, continue to monitor frequently. The EVF is likely to start falling within the next 24 h as the reabsorptive phase of the disease begins.
- In most cases, IV fluids can be stopped after 36–48 h. Remember that too much fluid can result into death due to fluid overload.

Treatment of haemorrhagic complications

- Mucosal bleeding may occur in any patient with dengue but is usually minor. It is due mainly to the low platelet count, and this usually improves rapidly during the second week of illness.
- If major bleeding occurs, it is usually in the gastrointestinal tract, particularly in patients with very severe or prolonged shock. Internal bleeding may not become apparent for many hours, until the first black stool is passed. Consider this possibility in children with shock who fail to improve clinically with fluid treatment, particularly if they become very pale, if their EVF is falling or if the abdomen is distended and tender.
- In children with profound thrombocytopenia (< 20 000 platelets/mm^3), ensure strict bed rest and protect from trauma to reduce the risk of bleeding. Do not give IM injections.
- Monitor the clinical condition, EVF and, when possible, platelet count.
- Transfusion is rarely necessary. When indicated, it should be given with extreme care because of the problem of fluid overload. If major bleeding is suspected, give 5–10 ml/kg fresh whole blood or 10 ml/kg packed cells slowly over 2–4 h, and observe the clinical response. Consider repeating if there is a good clinical response and significant bleeding is confirmed.
- Platelet concentrates (if available) should be given only if there is severe bleeding. They are of no value for the treatment of thrombocytopenia without bleeding and may be harmful.

Treatment of fluid overload

Fluid overload is an important complication of treatment for shock. It can develop due to:

- excess or too rapid IV fluids
- incorrect use of hypotonic rather than isotonic crystalloid solutions
- continuation of IV fluids for too long (once plasma leakage has resolved)
- use of large volumes of IV fluid in children with severe capillary leakage

- Early signs:
  - fast breathing
  - chest indrawing
  - large pleural effusions
  - ascites
  - peri-orbital or soft tissue oedema

- Late signs:
  - pulmonary oedema
  - cyanosis
  - irreversible shock (often a combination of ongoing hypovolaemia and cardiac failure)

The management of fluid overload varies depending on whether the child is in or out of shock:

- Children who remain in shock and show signs of severe fluid overload are extremely difficult to manage and have a high mortality.
- ▶ Repeated small boluses of a colloid solution may help, with inotropic agents to support the circulation (see standard textbooks of paediatrics).
- ▶ Avoid diuretics, as they will cause further intravascular fluid depletion.
- ▶ Aspiration of large pleural effusions or ascites may be needed to relieve respiratory symptoms, but there is the risk of bleeding during the procedure.
- ▶ If available, consider early positive pressure ventilation before pulmonary oedema develops.
- If shock has resolved but the child has fast or difficult breathing and large effusions, give oral or IV furosemide at 1 mg/kg once or twice a day for 24 h and oxygen therapy (see p. 312).
- If shock has resolved and the child is stable, stop IV fluids and keep the child on strict bed rest for 24–48 h. Excess fluid will be reabsorbed and lost through urinary diuresis.

Supportive care

- ▶ Treat high fever with paracetamol if the child is uncomfortable. Do not give aspirin or NSAIDs such as ibuprofen, as they aggravate the bleeding.
- ▶ Do not give steroids.
- ▶ Convulsions are not common in children with severe dengue. If they occur, manage as outlined in Chart 9, p. 15.
- ▶ If the child is unconscious, follow the guidelines in section 1.5.3, p. 23.
- ▶ Children in shock or with respiratory distress should receive oxygen, if possible with nasal continuous positive airway pressure (see above).
- ▶ Hypoglycaemia (blood glucose < 2.5 mmol/litre or < 45 mg/dl) is unusual. If present, give IV glucose as described in Chart 10, p. 16.
- ▶ If the child has severe hepatic involvement, see standard paediatric textbook for guidelines.

Monitoring

- For children in shock, monitor the vital signs hourly (particularly the pulse pressure, if possible) until the patient is stable, and check the EVF three or four times a day. A doctor should review the patient at least four times a day and prescribe IV fluids for a maximum of 6 h at a time.
- For children without shock, a nurse should check the child's vital signs (temperature, pulse and blood pressure) at least four times a day and the EVF once daily, and a doctor should review the patient at least once daily.
- Check the platelet count daily, when possible in the acute phase.
- Keep a detailed record of all fluid intake and output.

6.11 Rheumatic fever

Rheumatic fever commonly follows *S. pyogenes* infection of the throat or skin. Some children present with fever and pains in the large joints, which may move from one joint to another. The infection can damage the heart valves (especially the mitral and aortic valves), leading to respiratory distress and heart failure. Children with mild disease may have only a heart murmur. Severe disease can present with fever, fast or difficult breathing and lethargy. The child may have chest pain or fainting. Affected children are usually > 5 years of age. Those that present with heart failure have a rapid heart rate, respiratory distress and an enlarged liver.

Diagnosis

Diagnosis of rheumatic fever is important because penicillin prophylaxis can prevent further episodes and avoid worsening damage to the heart valves.

Acute rheumatic fever is diagnosed clinically by WHO criteria based on the revised Jones criteria (Table 20). The diagnosis is based on two major or one major and two minor manifestations **plus** evidence of a previous group A streptococcal infection.

Investigations

Diagnosis of rheumatic fever requires evidence of a prior streptococcal infection.

- Streptococcal serum antibody tests (antistreptolysin-O test and antideoxyribonuclease B test)
- acute-phase reactants (erythrocyte sedimentation rate and C-reactive protein)
- full blood count

Table 20. WHO criteria for the diagnosis of rheumatic fever (based on the revised Jones criteria)

Diagnostic category	Criteria
Primary episode of rheumatic fever **or** Recurrent attack of rheumatic fever in a patient without established rheumatic heart disease	Two major[a] or one major and two minor[b] manifestations **plus** evidence of a previous group A streptococcal infection[c]
Recurrent attack of rheumatic fever in a patient with established rheumatic heart disease	Two minor manifestations **plus** evidence of a previous group A streptococcal infection[d]
Rheumatic chorea **or** Insidious onset rheumatic carditis	Other major manifestations or evidence of group A streptococcal infection not required

[a] Major manifestations
- carditis
- polyarthritis
- chorea
- erythema marginatum
- subcutaneous nodules

[b] Minor manifestations
- clinical: fever, polyarthralgia
- laboratory: elevated acute phase reactants (erythrocyte sedimentation rate or leukocyte count)

[c] Supporting evidence of a previous streptococcal infection within the past 45 days
- electrocardiogram: prolonged P–R interval
- elevated or rising antistreptolysin-O or other streptococcal antibody, or
- a positive throat culture, or
- rapid antigen test for group A streptococci, or
- recent scarlet fever

[d] Some patients with recurrent attacks may not fulfil these criteria.

- chest X-ray
- echocardiography with Doppler examination if available.

Management

Admit to hospital

▶ Give aspirin at 20 mg/kg every 6 h until joint pains improve (1–2 weeks), and then reduce dose to 15 mg/kg for an additional 3–6 weeks.

If heart failure is present:

▶ bed rest with restricted sodium diet

- oxygen
- furosemide at 1 mg/kg every 6 h
- prednisolone at 1 mg/kg per day orally for 1 week for severe heart failure
- blood transfusion if Hb < 8 mg/dl
- antibiotics to eradicate pharyngeal streptococcal infection

Follow-up care

All children will require antibiotic prophylaxis.

- Give monthly benzathine benzylpenicillin at 600 000 U IM every 3–4 weeks or oral penicillin V at 250 mg twice a day.
- Ensure vaccinations are up to date.
- Review every 3–6 months.

Notes

Notes

CHAPTER 7

Severe acute malnutrition

7.1 Severe acute malnutrition

Severe acute malnutrition is defined in these guidelines as the presence of oedema of both feet or severe wasting (weight-for-height/length <-3SD or mid-upper arm circumference < 115 mm). No distinction is made between the clinical conditions of kwashiorkor or severe wasting because their treatment is similar.

Children who are <-3SD weight-for-age may be stunted (short stature) but not severely wasted. Stunted children who are not severely wasted do not require hospital admission unless they have a serious illness.

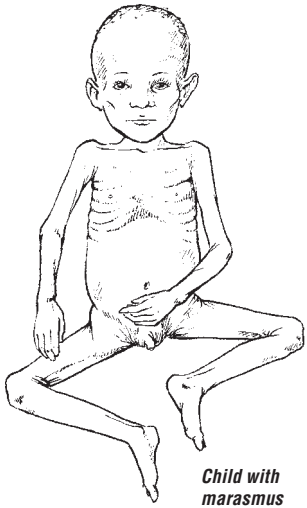
Diagnosis

The main diagnostic features are:

- weight-for-length/height < -3SD (wasted) (see p. 386) or
- mid-upper arm circumference < 115 mm or
- oedema of both feet (kwashiorkor with or without severe wasting).

Children with severe acute malnutrition should first be assessed with a full clinical examination to confirm whether they have any general danger sign, medical complications and an appetite.

Children with severe acute malnutrition with loss of appetite or any medical complication have ***complicated severe acute malnutrition*** and should be admitted for inpatient care. Children who have a good appetite and no medical complications can be managed as outpatients.



Child with marasmus

7.2 Initial assessment

Assess for general danger signs or emergency signs and take a history concerning:

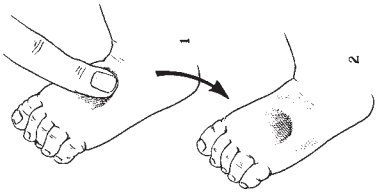
- recent intake of food and fluids
- usual diet before the current illness

- breastfeeding
- duration and frequency of diarrhoea and vomiting
- type of diarrhoea (watery/bloody)
- loss of appetite
- family circumstances
- cough > 2 weeks
- contact with TB
- recent contact with measles
- known or suspected HIV infection/exposure.

On examination, look for:

- shock: lethargic or unconscious; with cold hands, slow capillary refill (> 3 s), or weak (low volume), rapid pulse and low blood pressure
- signs of dehydration
- severe palmar pallor
- bilateral pitting oedema
- eye signs of vitamin A deficiency:
  - dry conjunctiva or cornea, Bitot spots
  - corneal ulceration
  - keratomalacia

Child with severe acute malnutrition oedema



Pitting oedema on dorsum of foot. When pressure is applied for a few seconds, a pit remains after the finger is removed.

Children with vitamin A deficiency are likely to be photophobic and will keep their eyes closed. It is important to examine the eyes very gently to prevent corneal rupture.

- localizing signs of infection, including ear and throat infections, skin infection or pneumonia
- signs of HIV infection (see Chapter 8, p. 225)

- fever (temperature ≥ 37.5 °C or ≥ 99.5 °F) or hypothermia (rectal temperature < 35.5 °C or < 95.9 °F)
- mouth ulcers
- skin changes of kwashiorkor:
  - hypo- or hyperpigmentation
  - desquamation
  - ulceration (spreading over limbs, thighs, genitalia, groin and behind the ears)
  - exudative lesions (resembling severe burns) often with secondary infection (including *Candida*).
- Conduct an appetite test:
  - Check if the child has appetite by providing ready-to-use therapeutic food.

Laboratory investigations should be conducted for Hb or EVF, especially if there is severe palmar pallor.

7.3 Organization of care

Children who have an appetite (pass the appetite test) and are clinically well and alert should be treated as outpatients for uncomplicated severe acute malnutrition. Children who have severe oedema +++ or a poor appetite (fail the appetite test) or present with one or more general danger signs or medical conditions requiring admission should be treated as inpatients.

▶ On admission, a child with complicated severe acute malnutrition should be separated from infectious children and kept in a warm area (25–30 °C, with no draughts) or in a special nutrition unit if available, and constantly monitored.

Facilities and sufficient staff should be available to ensure correct preparation of appropriate therapeutic foods and to feed the child regularly, day and night. Accurate weighing machines or MUAC tapes are needed, and records of the feeds given and the child's weight or anthropometric measurements should be kept so that progress can be monitored.

7.4 General management

Plan for inpatient care

For triage assessment of children with severe acute malnutrition and management of shock, see Chapter 1, pp. 3, 14 and 19. When there is corneal ulceration, give vitamin A, instil chloramphenicol or tetracycline and atropine drops into

the eye, cover with a saline-soaked eye pad, and bandage (see section 7.5.1, p. 217). Severe anaemia, if present, will require urgent treatment (see section 7.5.2, p. 218).

General treatment involves 10 steps in two phases: initial stabilization and rehabilitation (see Table 21).

Table 21. Time frame for the management of a child with complicated severe acute malnutrition

	Stabilization		Rehabilitation
	Days 1–2	Days 3–7	Weeks 2–6
1. Hypoglycaemia	→		
2. Hypothermia	→		
3. Dehydration	→		
4. Electrolytes	→	→	→
5. Infection	→	→	
6. Micronutrients	no iron →	→	with iron →
7. Initiate feeding	→	→	
8. Catch-up feeding			→
9. Sensory stimulation		→	→
10. Prepare for follow-up			→

7.4.1 Hypoglycaemia

All severely malnourished children are at risk of hypoglycaemia and, immediately on admission, should be given a feed or 10% glucose or sucrose (see below). Frequent 2 h feeding is important.

Diagnosis

If there is any suspicion of hypoglycaemia and when blood glucose can be measured quickly (e.g. with Dextrostix®), this should be done immediately. Hypoglycaemia is present when the blood glucose is < 3 mmol/litre (< 54 mg/dl). If blood glucose cannot be measured, it should be assumed that all children with severe acute malnutrition are hypoglycaemic and given treatment.

Treatment

- Give 50 ml of 10% glucose or sucrose solution (one rounded teaspoon of sugar in three tablespoons of water) orally or by nasogastric tube, followed by the first feed as soon as possible.

- Give the first feed of F-75 therapeutic milk, if it is quickly available, and then continue with feeds every 2 h for 24 h; then continue feeds every 2 or 3 h, day and night.
- If the child is unconscious, treat with IV 10% glucose at 5 ml/kg or, if IV access cannot be quickly established, then give 10% glucose or sucrose solution by nasogastric tube (see p. 345). If IV glucose is not available, give one teaspoon of sugar moistened with one or two drops of water sublingually, and repeat every 20 min to prevent relapse. Children should be monitored for early swallowing, which leads to delayed absorption; in this case another dose of sugar should be given. Continue with 2 h oral or nasogastric feeds to prevent recurrence.
- Start on appropriate IV or IM antibiotics (see p. 207).

Monitoring

If the initial blood glucose was low, repeat the measurement (using finger or heel prick blood and measure with the Dextrostix®, when available) after 30 min.

- If blood glucose falls to < 3 mmol/litre (< 54 mg/dl), repeat the 10% glucose or oral sugar solution.
- If the rectal temperature falls to < 35.5 °C, or if the level of consciousness deteriorates, repeat the Dextrostix® measurement and treat accordingly.

Prevention

- Feed every 2 h, starting immediately (see initial refeeding, p. 209) or, when dehydrated, rehydrate first. Continue feeding throughout the night.
- Encourage mothers to watch for any deterioration, help feed and keep the child warm.
- Check on abdominal distension.

7.4.2 Hypothermia

Hypothermia is very common in malnourished children and often indicates coexisting hypoglycaemia or serious infection.

Diagnosis

- If the axillary temperature is < 35 °C (< 95°F) or does not register on a normal thermometer, assume hypothermia. When a low-reading thermometer is available, take the rectal temperature (< 35.5 °C or < 95.9 °F) to confirm hypothermia.

Treatment

All children with hypothermia should be treated routinely for hypoglycaemia and infection.

- Feed the child immediately and then every 2 h unless they have abdominal distension; if dehydrated, rehydrate first.
- Re-warm the child: Make sure the child is clothed (especially the head); cover with a warmed blanket and place a heater (not pointing directly at the child) or lamp nearby, or put the child on the mother's bare chest or abdomen (skin-to-skin) and cover them with a warmed blanket and/or warm clothing.
- Keep the child away from draughts.
- Give appropriate IV or IM antibiotics (see p. 207).

Monitoring

- Take the child's rectal temperature every 2 h until it rises to > 36.5 °C. Take it every 30 min if a heater is being used.
- Ensure that the child is covered at all times, especially at night. Keep the head covered, preferably with a warm bonnet, to reduce heat loss.
- Check for hypoglycaemia whenever hypothermia is found.

Prevention

- Feed immediately and then every 2–3 h, day and night.
- Place the bed in a warm, draught-free part of the ward, and keep the child covered.
- Use the Kangaroo technique for infants (see p. 59), cover with a blanket and let the mother sleep with child to keep the child warm.
- Avoid exposing the child to cold (e.g. after bathing or during medical examinations).
- Change wet nappies, clothes and bedding to keep the child and the bed dry. Dry carefully after bathing, but do not bathe if very ill.
- Use a heater or incandescent lamp with caution.
- Do not use a hot water bottle or fluorescent lamp.

7.4.3 Dehydration

Diagnosis

Dehydration tends to be overdiagnosed and its severity overestimated in children with severe acute malnutrition because it is difficult to determine

dehydration accurately from clinical signs alone. Assume that all children with watery diarrhoea or reduced urine output have some dehydration. It is important to note that poor circulatory volume or perfusion can co-exist with oedema.

Treatment

Do not use the IV route for rehydration, except in cases of shock (see p. 14). Rehydrate slowly, either orally or by nasogastric tube, using oral rehydration solution for malnourished children (5–10ml/kg per h up to a maximum of 12 hours). The standard WHO ORS solution for general use has a high sodium and low potassium content, which is not suitable for severely malnourished children. Instead, give special rehydration solution for malnutrition, ReSoMal.

- Give the ***ReSoMal rehydration fluid orally*** or by nasogastric tube, more slowly than you would when rehydrating a well-nourished child:
  - Give 5 ml/kg every 30 min for the first 2 h.
  - Then give 5–10 ml/kg per h for the next 4–10 h on alternate hours, with F-75 formula. The exact amount depends on how much the child wants, the volume of stool loss and whether the child is vomiting.
- If not available then give ***half strength*** standard WHO oral rehydration solution with added potassium and glucose as per the ReSoMal recipe below, unless the child has cholera or profuse watery diarrhoea.
- If rehydration is still required at 10 h, give starter F-75 (see recipes on pp. 212–3) instead of ReSoMal, at the same times. Use the same volume of starter F-75 as of ReSoMal.
- If in shock or severe dehydration but cannot be rehydrated orally or by nasogastric tube, give IV fluids, either Ringer's lactate solution with 5% dextrose or half-strength Darrow's solution with 5% dextrose. If neither is available, 0.45% saline with 5% dextrose should be used (see Chart 8, p. 14)

Monitoring

During rehydration, respiration and pulse rate should fall and urine start to be passed. The return of tears, a moist mouth, less sunken eyes and fontanelle, and improved skin turgor are also signs that rehydration is proceeding, but many severely malnourished children will not show these changes even when fully rehydrated. Monitor weight gain.

Monitor the progress of rehydration every 30 min for 2 h, then every hour for the next 4–10 h. Be alert for signs of overhydration, which is very dangerous and may lead to heart failure. Check for:

- weight gain to ensure that it is not quick and excessive.

Recipe for ReSoMal using standard WHO ORS

Ingredient	Amount
Water	2 litres
WHO ORS	One 1-litre packet[a]
Sucrose	50 g
Electrolyte/mineral solution[b]	40 ml

[a] 2.6 g sodium chloride, 2.9 g trisodium citrate dihydrate, 1.5 g potassium chloride, 13.5 g glucose

[b] See below for the recipe for the electrolyte/mineral solution. If you use a commercially prepared electrolyte and mineral powder, follow the manufacturer's instructions. If these cannot be made up, use 45 ml of potassium chloride solution (100 g potassium chloride in 1 litre of water) instead.

ReSoMal contains approximately 45 mmol sodium, 40 mmol potassium and 3 mmol magnesium per litre.

Formula for concentrated electrolyte/mineral solution

This solution is used in the preparation of starter and catch-up feeding formulas and ReSoMal. Electrolyte and mineral powders are produced by some manufacturers. If these are not available or affordable, prepare the solution (2500 ml) using the following ingredients:

Ingredient	g	mol/20 ml
Potassium chloride (KCl)	224	24 mmol
Tripotassium citrate	81	2 mmol
Magnesium chloride ($MgCl_2.6H_2O$)	76	3 mmol
Zinc acetate (Zn acetate.$2H_2O$)	8.2	300 µmol
Copper sulfate ($CuSO_4.5H_2O$)	1.4	45 µmol
Water to make up to	2500 ml	

If available, also add selenium (0.028 g sodium selenate, $NaSeO_4.10H_2O$) and iodine (0.012 g potassium iodide, KI) per 2500 ml.

- Dissolve the ingredients in cooled boiled water.
- Store the solution in sterilized bottles in a refrigerator to retard deterioration. Discard if it turns cloudy. Make up fresh each month.
- Add 20 ml of the concentrated electrolyte/mineral solution to each 1000 ml of milk feed. If it is not possible to prepare this electrolyte/mineral solution and pre-mixed sachets are not available, give potassium, magnesium and zinc separately. Make a 10% stock solution of potassium chloride (100 g in 1 litre of water) and a 1.5% solution of zinc acetate (15 g in 1 litre of water).

For the oral rehydration solution ReSoMal, use 45 ml of the stock potassium chloride solution instead of 40 ml electrolyte/mineral solution

For milk feeds F-75 and F-100, add 22.5 ml of the stock potassium chloride solution instead of 20 ml of the electrolyte/mineral solution to 1000 ml of feed. Give the 1.5% zinc acetate solution by mouth at 1 ml/kg per day. Give 0.3 ml/kg of 50% magnesium sulfate intramuscularly once to a maximum of 2 ml.

- increase in respiratory rate
- increase in pulse rate
- urine frequency (Has the child urinated since last checked?)
- enlarging liver size on palpation
- frequency of stools and vomit.

If you find signs of overhydration (early signs are respiratory rate increasing by 5/min and pulse rate by 25/min), stop ReSoMal immediately and reassess after 1 h.

Prevention

Measures to prevent dehydration due to continuing watery diarrhoea are similar to those for well-nourished children (see treatment plan A on p. 138), except that ReSoMal fluid is used instead of standard ORS.

- If the child is breastfed, continue breastfeeding.
- Initiate re-feeding with starter F-75.
- Give ReSoMal between feeds to replace stool losses. As a guide, give 50–100 ml after each watery stool.

7.4.4 Electrolyte imbalance

All severely malnourished children have deficiencies of potassium and magnesium, which may take about 2 weeks to correct. Oedema is partly a result of potassium deficiency and sodium retention. Do not treat oedema with a diuretic. Excess body sodium exists even though the plasma sodium may be low. Giving high sodium loads could kill the child.

Treatment

- Give extra potassium (3–4 mmol/kg per day).
- Give extra magnesium (0.4–0.6 mmol/kg per day).

The extra potassium and magnesium should be added to the feed during its preparation if not pre-mixed. See p. 205 for a recipe for a combined electrolyte/mineral solution. Add 20 ml of this solution to 1 litre of feed to supply the extra potassium and magnesium required. Alternatively, use commercially available pre-mixed sachets (specially formulated for malnourished children).

- When rehydrating, give low sodium rehydration fluid (ReSoMal) (see recipe, p. 205).
- Prepare food without added salt.

7.4.5 Infection

In severe acute malnutrition, the usual signs of bacterial infection, such as fever, are often absent, yet multiple infections are common. Therefore, assume that all children with severe acute malnutrition have an infection on their arrival in hospital, and treat with antibiotics immediately. Hypoglycaemia and hypothermia are often signs of severe infection.

Treatment

Give all severely malnourished children:

- a broad-spectrum antibiotic
- measles vaccine if the child is ≥ 6 months and not vaccinated or was vaccinated before 9 months age. Delay vaccination if the child is in shock.

Choice of broad-spectrum antibiotics

- If the child has uncomplicated severe acute malnutrition, give oral amoxicillin (for dosage, see p. 356) for 5 days.
- If there are complications (hypoglycaemia, hypothermia or the child looks lethargic or sickly) or any other medical complication, give parenteral antibiotics:
  - benzylpenicillin (50 000 U/kg IM or IV every 6 h) or ampicillin (50 mg/kg IM or IV every 6 h) for 2 days, then oral amoxicillin (25–40 mg/kg every 8 h for 5 days)

  plus

  - gentamicin (7.5 mg/kg IM or IV) once a day for 7 days.

These regimens should be adapted to local resistance patterns.

Note: *Metronidazole 7.5 mg/kg every 8 h for 7 days may be given in addition to broad-spectrum antibiotics; however, the efficacy of this treatment has not been established in clinical trials.*

- Treat other infections as appropriate:
  - If meningitis is suspected, do a lumbar puncture for confirmation, where possible, and treat with the antibiotic regime (section 6.3.1, p. 169).
  - If you identify other specific infections (such as pneumonia, dysentery, skin or soft-tissue infections), give antibiotics as appropriate.
  - Add antimalarial treatment if the child has a positive blood film for malaria parasites or a positive malaria rapid diagnostic test.

- TB is common, but anti-TB treatment should be given only if TB is diagnosed or strongly suspected (see section 7.5.5, p. 219).
- For HIV-exposed children, see Chapter 8.

Treatment for parasitic worms

If there is evidence of worm infestation, treatment should be delayed until the rehabilitation phase. Give albendazole as a single dose or mebendazole 100 mg orally twice a day for 3 days. In countries where infestation is prevalent, also give mebendazole to children with no evidence of infestation 7 days after admission.

HIV infection

Where HIV infection is common, children with severe acute malnutrition should be tested for HIV to determine their need for antiretroviral therapy (ART). If the child is infected with HIV, start ART as soon as possible after stabilization of metabolic complications and sepsis. They should be monitored closely (inpatient and outpatient) in the first 6–8 weeks following initiation of ART to identify early metabolic complications and opportunistic infections (see Chapter 8).

Monitoring

If the child is still anorexic after 7 days of antibiotic treatment, continue for a full 10-day course. If anorexia persists, reassess the child fully.

7.4.6 Micronutrient deficiencies

All severely malnourished children have vitamin and mineral deficiencies. Although anaemia is common, do not give iron initially, but wait until the child has a good appetite and starts gaining weight (usually in the second week), because iron can make infections worse.

Multvitamins including vitamin A and folic acid, zinc and copper are already present in F-75, F-100 and ready-to-use therapeutic food packets. When premixed packets are used, there is no need for additional doses.

In addition, if there are no eye signs or history of measles, then do not give a high dose of vitamin A because the amounts already present in therapeutic foods are enough.

Treatment

- Give vitamin A on day 1 and repeat on days 2 and 14 only if child has any signs of vitamin A deficiency like corneal ulceration or a history of measles (see section 7.5.1, p. 217).

- < 6 months, 50 000 U
- 6–12 months, 100 000 U
- > 12 months, 200 000 U

▶ Start iron at 3 mg/kg per day after 2 days on F-100 catch-up formula. Do not give iron in the stabilization phase, and do not give iron if the child is receiving ***ready-to-use therapeutic food (RUTF)***.

If child is **not** on any of the pre-mixed therapeutic foods, give the following micronutrients daily for at least 2 weeks:

▶ folic acid at 5 mg on day 1; then 1 mg daily

▶ multivitamin syrup at 5 ml

▶ zinc at 2 mg/kg per day

▶ copper at 0.3 mg/kg per day

7.4.7 Initial re-feeding

In the initial phase, re-feeding should be gradual.

Treatment

The essential features of initial feeding are:

- frequent (every 2–3 h) oral small feeds of low osmolality and low lactose
- nasogastric feeding if the child is eating ≤ 80% of the amount offered at two consecutive feeds
- calories at 100 kcal/kg per day
- protein at 1–1.5 g/kg per day
- liquid at 130 ml/kg per day or 100 ml/kg per day if the child has severe oedema
- in addition, if the child is breastfed, encourage continued breastfeeding, but make sure the prescribed amounts of starter formula are given:

Days	Frequency	Volume/kg feed	Volume/kg per day
1–2	2 h	11 ml	130 ml
3–5	3 h	16 ml	130 ml
≥ 6	4 h	22 ml	130 ml

The suggested starter formula and feeding schedules given below are designed to meet these targets. Milk-based formulas, such as starter F-75 (with 75 kcal and 0.9 g protein/100 ml), will be satisfactory for most children (see p. 212

for recipes). As cereal-based F-75 partially replaces sugar with cereal flour, it has the advantage of lower osmolarity, which may benefit some children with persistent diarrhoea, but it has to be cooked.

Feed from a cup or a bowl. Use a spoon, dropper or syringe to feed very weak children.

A recommended schedule, with a gradual increase in the feed volume and a gradual decrease in feeding frequency, see Table 22, p. 211. For children with a good appetite and no oedema, this schedule can be completed in 2–3 days.

Note: *If staff resources are limited, give priority to 2-hourly feeds for only the most seriously ill children, and aim for at least 3-hourly feeds initially. Ask mothers and other carers to help with feeding. Show them what to do, and supervise them. Night feeds are essential, and staff rosters may have to be adjusted. If, despite all efforts, not all the night feeds can be given, the feeds should be spaced equally through the night to avoid long periods without a feed (with the risk of increased hypoglycaemia and mortality).*

If the child's intake (after allowing for any vomiting) does not reach 80 kcal/kg per day, despite frequent feeds, coaxing and re-offering, give the remaining feed by nasogastric tube. Do not exceed 100 kcal/kg per day in this initial phase.

In very hot climates, children might need extra water, as these foods may not contain enough water if the children are sweating.

Monitoring

Monitor and record:

- amounts of feed offered and left over
- vomiting
- stool frequency and consistency
- daily body weight

7.4.8 Catch-up growth feeding

Children in the catch-up phase should in most cases be managed as outpatients. Signs that a child has reached rehabilitation phase for catch-up growth are:

- return of appetite
- no episodes of hypoglycaemia (metabolically stable)
- reduced or disappearance of all oedema

Table 22. Volumes of F-75 per feed for malnourished children (approximately 130 ml/kg per day)

Child's weight (kg)	2-hourly (ml/feed)	3-hourly (ml/feed)	4-hourly (ml/feed)
2.0	20	30	45
2.2	25	35	50
2.4	25	40	55
2.6	30	45	55
2.8	30	45	60
3.0	35	50	65
3.2	35	55	70
3.4	35	55	75
3.6	40	60	80
3.8	40	60	85
4.0	45	65	90
4.2	45	70	90
4.4	50	70	95
4.6	50	75	100
4.8	55	80	105
5.0	55	80	110
5.2	55	85	115
5.4	60	90	120
5.6	60	90	125
5.8	65	95	130
6.0	65	100	130
6.2	70	100	135
6.4	70	105	140
6.6	75	110	145
6.8	75	110	150
7.0	75	115	155
7.2	80	120	160
7.4	80	120	160
7.6	85	125	165
7.8	85	130	170
8.0	90	130	175
8.2	90	135	180
8.4	90	140	185
8.6	95	140	190
8.8	95	145	195
9.0	100	145	200
9.2	100	150	200
9.4	105	155	205
9.6	105	155	210
9.8	110	160	215
10.0	110	160	220

Recipes for re-feeding formulas F-75 and F-100

	F-75[a] (starter: cereal-based)	F-100[b] (catch-up)
Dried skimmed milk (g)	25	80
Sugar (g)	70	50
Cereal flour (g)	35	—
Vegetable oil (g)	27	60
Electrolyte/mineral solution (ml)	20	20
Water: make up to (ml)	1000	1000
Content per 100 ml		
Energy (kcal)	75	100
Protein (g)	1.1	2.9
Lactose (g)	1.3	4.2
Potassium (mmol)	4.2	6.3
Sodium (mmol)	0.6	1.9
Magnesium (mmol)	0.46	0.73
Zinc (mg)	2.0	2.3
Copper (mg)	0.25	0.25
% energy from protein	6	12
% energy from fat	32	53
Osmolality (mOsm/litre)	334	419

[a] Cook for 4 min and add mineral/vitamin mix after cooking. This may be helpful for children with dysentery or persistent diarrhoea.

[b] A comparable catch-up formula can be made from 110 g whole dried milk, 50 g sugar, 30 g oil, 20 ml electrolyte/mineral solution and water to make 1000 ml. If using fresh cow's milk, take 880 ml milk, 75 g sugar, 20 ml oil, 20 ml electrolyte/mineral solution and water to make 1000 ml.

Recipes for re-feeding formulas F-75 and F-100

Alternative for F-75 if milk is unavailable

Use precooked corn–soya or wheat–soya blend

Corn–soya or wheat–soya blend, 50 g
Sugar, 85 g
Oil, 25 g
Electrolyte/mineral mix, 20 ml
Make up to 1000 ml with boiled water

Alternative for F-100 if milk is unavailable

Use precooked corn-soya or wheat-soya blend

Corn–soya or wheat–soya blend, 150 g
Sugar, 25 g
Oil, 40 g
Electrolyte/mineral mix, 20 ml
Make up to 1000 ml with boiled water.

Treatment

Make a gradual transition from starter F-75 to catch-up formula F-100 or ready-to-use therapeutic food over 2–3 days, as tolerated.

- Replace starter F-75 with an equal amount of catch-up F-100 for 2 days. Give a milk-based formula, such as catch-up F-100 containing 100 kcal/100 ml and 2.9 g of protein per 100 ml (see recipe, p. 212) or ready-to-use therapeutic food (see below).
- On the third day if on F-100, increase each successive feed by 10 ml until some feed remains uneaten. The point at which some feed remains unconsumed is likely to be when intake reaches about 200 ml/kg per day.

  After a gradual transition, give:

  – frequent feeds, unlimited amounts
  – 150–220 kcal/kg per day
  – 4–6 g of protein/kg per day.
- If on ready-to-use therapeutic food:
  – Start with small but regular meals of RUTF and encourage the child to eat often (first 8 meals per day, and later 5–6 meals per day). If the child

cannot eat the whole amount of RUTF per meal in the transition phase, top up with F-75 to complete the feed, until is able to eat a full RUTF meal.

- If the child cannot take at least half of recommended amount of RUTF in 12 h, stop RUTF and give F-75. Try introducing RUTF again in 1–2 days until the child is able to take adequate amounts.
- If still breastfeeding, offer breast milk first before every RUTF feed.

▶ After the transition phase, refer the child for rehabilitation in outpatient care or to a community feeding programme.

Recommended amounts per day of ready-to-use therapeutic food containing 500 kcal

	Transition Phase 150 kcal/kg/day	Rehabilitation Phase 200 kcal/kg/day
Child's weight (kg)	Packets per day (92 g Packets Containing 500 kcal)	Packets per day (92 g Packets Containing 500 kcal)
4.0–4.9	1.5	2.0
5.0–6.9	2.1	2.5
7.0–8.4	2.5	3.0
8.5–9.4	2.8	3.5
9.5–10.4	3.1	4.0
10.5–11.9	3.6	4.5
≥ 12.0	4.0	5.0

▶ Wash hands before giving feeds.

- Sit with the child on the lap and gently offer the feeds.
- Encourage the child to eat the RUTF without forced feeding.
- Offer plenty of clean water in a cup, when the child is eating RUTF.

Monitoring

Avoid causing heart failure. Monitor for early signs of congestive heart failure (rapid pulse, fast breathing, basal lung crepitations, enlarging liver, gallop heart rhythm, raised jugular venous pressure). If both pulse and breathing rates increase (breathing by 5 breaths/min and pulse by 25 beats/min), and the increase is sustained for two successive 4-hourly readings, then:

- Reduce the volume fed to 100 ml/kg per day for 24 h.

- Then, gradually increase as follows:
  - 115 ml/kg per day for next 24 h
  - 130 ml/kg per day for the following 48 h
- Thereafter, increase each feed by 10 ml as described earlier.

Assess progress. After the transition, monitor progress by the rate of weight gain:

- Weigh the child every morning before feeding, and plot the weight.
- Calculate and record the weight gain every 3 days as g/kg per day (see box below).

Calculating weight gain

This example is for weight gain over 3 days.

- Current weight of the child in grams = 6300 g
- Weight 3 days ago in grams = 6000 g

Step 1. Calculate weight gain in grams: 6300–6000 = 300 g

Step 2. Calculate average daily weight gain: 300 g ÷ 3 days = 100 g/day

Step 3. Divide by child's average weight in kg: 100 g/day ÷ 6.15 kg = 16.3 g/kg per day

If the weight gain is:

- poor (< 5 g/kg per day), the child requires a full re-assessment
- moderate (5–10 g/kg per day), check whether the intake targets are being met or if infection has been overlooked
- good (> 10 g/kg per day).

7.4.9 Sensory stimulation

Provide:

- tender loving care
- a cheerful, stimulating environment
- structured play therapy for 15–30 min/day
- physical activity as soon as the child is well enough
- support for as much maternal involvement as possible (e.g. comforting, feeding, bathing, playing).

Provide suitable toys and play activities for the child (see p. 315).

7.4.10 Severe acute malnutrition in infants aged < 6 months

Severe acute malnutrition is less common in infants < 6 months than in older children. An organic cause for the malnutrition or failure to thrive should be considered, and, when appropriate, treated. Infants less than 6 months of age with severe acute malnutrition with any of the following complicating factors should be admitted for inpatient care:

- general danger signs or serious clinical condition as outlined for infants 6 months or older.
- recent weight loss or failure to gain weight.
- ineffective breastfeeding (attachment, positioning or suckling) directly observed for 15–20 min, ideally in a supervised separated area.
- any pitting bilateral oedema of the feet.
- any medical problem needing more detailed assessment
- any social issue requiring detailed assessment or intensive support (e.g. disability or depression of caretaker or other adverse social circumstances).

Treatment

- Admit infants with any of the above complicating factors.
- Give parenteral antibiotics to treat possible sepsis, and appropriate treatment for other medical complications.
- Re-establish effective exclusive breastfeeding by the mother or other caregiver. If not possible, give replacement commercial infant formula with advice on safe preparation and use.
- For infants with severe acute malnutrition and oedema, give infant formula or F-75 or diluted F-100 (add water to formula on p. 212 up to 1.5 litres instead of 1 litre) to supplement breastfeeding.
- For infants with severe acute malnutrition with no oedema, give expressed breast milk; and when not possible, commercial infant formula or F-75 or diluted F-100, in this order of preference.

During nutritional rehabilitation, the basic principles for older children apply; however, young infants are less able to excrete salt and urea in their urine, especially in hot climates. Therefore, the preferred diets in the stabilization phase are (in order of preference):

- breast milk (if available in sufficient quantity)
- commercial infant formula

Assessment of the physical and mental health of mothers or caretakers should be promoted and relevant treatment or support provided.

Discharge

Infants less than 6 months of age admitted to inpatient care can be transferred to outpatient care if:

- all clinical conditions or medical complications including oedema are resolved or the child is clinically well and alert,
- the child is breastfeeding effectively or feeding well,
- weight gain is satisfactory e.g. above the median of the WHO growth velocity standards or more than 5gm/kg per day for at least 3 successive days.

Before discharge, the infant's vaccination status and other routine interventions should be checked and provided as appropriate. Mothers or caregivers should then be linked with any necessary community follow-up and support. A child should only be discharged from all nutritional care only when he or she:

- is breastfeeding effectively or feeding well with replacement feeds, and
- has an adequate weight gain, and
- has a weight-for-length equal or higher than -2 z scores (see p. 386).

7.5 Treatment of associated conditions

7.5.1 Eye problems

If the child has any eye signs of vitamin A deficiency (see p. 199):

▶ Give vitamin A orally on days 1, 2 and 14 (age < 6 months, 50 000 IU; age 6–12 months, 100 000 IU; older children, 200 000 IU). If the first dose was given in the referring centre, treat on days 1 and 14 only.

If the eyes show signs of corneal clouding or ulceration, give the following additional care to prevent corneal rupture and extrusion of the lens:

▶ Instil chloramphenicol or tetracycline eye drops four times a day, as required, for 7–10 days.

▶ Instil atropine eye drops, one drop three times a day, for 3–5 days.

▶ Cover with saline-soaked eye pads.

▶ Bandage the eye(s).

7.5.2 Severe anaemia

Blood transfusion should be given in the first 24 h only if:

- Hb is < 4 g/dl
- Hb is 4–6 g/dl and the child has respiratory distress.

In severe acute malnutrition, the transfusion must be slower and of smaller volume than for a well-nourished child. Give:

▶ whole blood, 10 ml/kg, slowly over 3 h

▶ furosemide, 1 mg/kg IV at the start of the transfusion.

If the child has signs of heart failure, give 10 ml/kg of packed cells, because whole blood is likely to worsen this condition. Children with severe acute malnutrition with oedema may have redistribution of fluid leading to apparent low Hb, which does not require transfusion.

Monitoring

Monitor the pulse and breathing rates, listen to the lung fields, examine the abdomen for liver size and check the jugular venous pressure every 15 min during the transfusion.

– If either breathing or heart rate increases (breathing by 5 breaths/min or pulse by 25 beats/min), transfuse more slowly.

– If there are basal lung crepitations or an enlarging liver, stop the transfusion and give furosemide at 1 mg/kg IV.

Note: *Do not repeat transfusion even if the Hb is still low or within 4 days of the last transfusion.*

7.5.3 Skin lesions in kwashiorkor

Zinc deficiency is usual in children with kwashiorkor, and their skin quickly improves with zinc supplementation. In addition:

▶ Bathe or soak the affected areas for 10 min/day in 0.01% potassium permanganate solution.

▶ Apply barrier cream (zinc and castor oil ointment, petroleum jelly or tulle gras) to the raw areas, and gentian violet or nystatin cream to skin sores.

▶ Avoid using nappies so that the perineum can stay dry.

7.5.4 Continuing diarrhoea

Treatment

Giardiasis

Where possible, examine the stools by microscopy.

- If cysts or trophozoites of *Giardia lamblia* are found, give metronidazole (7.5 mg/kg every 8 h for 7 days). Treat with metronidazole if stool microscopy cannot be undertaken or if there is only clinical suspicion of giardiasis.

Lactose intolerance

Diarrhoea is only rarely due to lactose intolerance. Intolerance should be diagnosed only if copious watery diarrhoea occurs promptly after milk-based feeds are begun and if the diarrhoea clearly improves when milk intake is reduced or stopped. Starter F-75 is a low-lactose feed. In exceptional cases:

- replace milk feeds with yoghurt or a lactose-free infant formula
- reintroduce milk feeds gradually in the rehabilitation phase.

Osmotic diarrhoea

Osmotic diarrhoea may be suspected if the diarrhoea worsens substantially with hyperosmolar F-75 and ceases when the sugar content and osmolarity are reduced. In these cases:

- Use cereal-based starter F-75 (see recipe, p. 212) or, if necessary, a commercially available isotonic starter F-75.
- Introduce catch-up F-100 or ready-to-use therapeutic food gradually.

7.5.5 Tuberculosis

If TB is strongly suspected:

- Perform a Mantoux test (***Note:*** *false-negative results are frequent*).
- Take a chest X-ray, if possible.

If these are positive or TB is strongly suspected, treat according to national TB guidelines (see section 4.7.2, p. 115).

7.6 Discharge and follow-up

7.6.1 Transfer to outpatient care

Children admitted to hospital with complicated severe acute malnutrition can be transferred to outpatient care during the rehabilitation phase. Social factors, such as loss of earnings for the mother and care for other children, should also be taken into account, as should the fact that those without complications can

be managed as outpatients or in the community. Carefully assess the child and the available community support. The child will require continuing care as an outpatient to complete rehabilitation and prevent relapse.

The decision to transfer children to outpatient care should not be based on achievement of specific anthropometric or weight-for-height/length outcomes. Children should be discharged from hospital to outpatient or a nutritional programme when:

- they have completed parenteral antibiotic treatment, and are clinically well and alert
- medical complications are resolved
- their appetite has fully recovered and they are eating well
- oedema has reduced or resolved.

It is important to prepare the parents for outpatient treatment or in a community nutrition programme where such services are available. Ask the caregiver to bring the child back for weekly therapeutic food, and make sure the child receives vaccinations and routine vitamin A supplements, as appropriate.

The mother or carer should:

- be available for child care
- have received specific counselling on appropriate child feeding practices (types, amount, frequency)
- have the resources to feed the child. If this is not the case, give advice on available support.

7.6.2 Discharge from nutritional treatment

Children with severe acute malnutrition should be discharged from the nutritional treatment programme only when their:

- weight-for-height/length is at least ≥ -2 z score and they have had no oedema for at least 2 weeks, or
- mid-upper-arm circumference is ≥ 125 mm and they have had no oedema for at least 2 weeks.

The decision should be based on the same anthropometric indicator that was used on admission. Thus, if mid-upper arm circumference was used, then it should be used to assess and confirm nutritional recovery, and similarly for weight for length/height. Children admitted with only bilateral pitting oedema, should be discharged on the basis of either mid-upper arm circumference or weight-for-height/length depending on the indicator used routinely in the national nutrition programme. Percentage weight gain should not be used as a discharge criterion.

The child should be fed at least five times a day with foods that contain approximately 100 kcal and 2–3 g protein per 100 g of food. It is essential to give frequent meals with a high energy and protein content. The mother should be counselled on appropriate feeding to:

- give appropriate meals (and the correct quantity of food) at least five times daily.
- give high-energy snacks between meals (e.g. milk, banana, bread, biscuits).
- assist and encourage the child to complete each meal.
- give food separately to the child so that the child's intake can be checked.
- breastfeed as often as the child wants.

7.6.3 Follow-up

When a child is discharged to outpatient, make a plan for following up of the child until full recovery, and contact the outpatient department, nutrition rehabilitation centre, local health clinic or health worker who will take responsibility for continuing supervision of the child. In general, the child should be weighed weekly after discharge.

If he or she fails to gain weight over a 2-week period or loses weight between two measurements or develops loss of appetite or oedema, the child should be referred back to hospital for further assessment. Once discharged from the nutritional treatment, he or she should be periodically monitored to avoid relapse.

7.7 Monitoring the quality of care

7.7.1 Mortality audit

A register of admissions, discharges and deaths should be kept. This should contain information about the children (such as weight, age and sex), day of admission, date of discharge or date and time of death.

To identify factors that can be changed to improve care, determine whether most of the deaths occurred:

- within 24 h: consider untreated or delayed treatment of hypoglycaemia, hypothermia, septicaemia or severe anaemia, incorrect rehydration fluid or volume of fluid or overuse of IV fluids.
- within 72 h: check whether the volume of feed given during re-feeding was too high or the formulation was wrong. Were potassium and antibiotics given?
- over 72 h: consider nosocomial infection, re-feeding syndrome, heart failure and HIV infection.

- at night: consider hypothermia due to insufficient covering of the child or no night feeds.
- when beginning F-100 or RUTF: consider too rapid a transition from starter to catch-up feeds.

7.7.2 Weight gain during rehabilitation

Standardize weighing on the hospital ward. Calibrate the scales every day. Weigh children at the same time each day (e.g. morning) after removing clothes (but avoid hypothermia).

Weight gain is defined as:

- poor: < 5 g/kg per day
- moderate: 5–10 g/kg per day
- good: > 10 g/kg per day.

If the weight gain is < 5 g/kg per day, determine whether this occurred:

- in all children being treated (if so, a major review of case management is required)
- in specific cases (reassess these children as if they were new admissions).

General aspects to be checked if weight gain is poor are described below.

Inadequate feeding

Check:

- that night feeds are given
- that target energy and protein intakes are achieved. Is the actual intake (i.e. what was offered minus what was left over) correctly recorded? Is the quantity of feed recalculated as the child gains weight? Is the child vomiting or ruminating?
- feeding technique: Is the child given frequent feeds in unlimited amounts?
- quality of care: Are staff motivated, gentle, loving and patient?
- all aspects of feed preparation: scales, measurement of ingredients, mixing, taste, hygienic storage, adequate stirring if separating out
- whether the complementary foods given to the child are energy-dense enough
- adequacy of multivitamin composition and shelf-life
- preparation of mineral mix and whether correctly prescribed and administered. If you are in a goitrous region, check whether potassium iodide is added to the electrolyte/mineral mix (12 mg/2500 ml), or give all children Lugol iodine (5–10 drops a day).

- if complementary foods are given, check that they contain electrolyte/mineral solution.

Untreated infection

If feeding is adequate and there is no malabsorption, suspect a hidden infection if there is recurrence of oedema, hypoglycaemia or hypothermia. The following are easily overlooked: urinary tract infections, otitis media, TB and giardiasis. In such cases:

- re-examine carefully
- repeat urine microscopy for white blood cells
- examine the stools
- if possible, take a chest X-ray.

Consider treatment in the absence of a confirmatory diagnosis.

HIV/AIDS

Children with HIV and AIDS can recover from malnutrition, but it may take longer, and treatment failures are commoner. Initial nutritional treatment of severe acute malnutrition in children with HIV/AIDS should be the same as for HIV-negative children.

For other HIV-related conditions, see Chapter 8.

Psychological problems

Check for abnormal behaviour, such as stereotyped movements (rocking), rumination (i.e. self-stimulation through regurgitation) and attention-seeking. Treat by giving the child special love and attention. For children who ruminate, firmness with affection can assist. Encourage the mother to spend time playing with her child (see p. 315).

Notes

Notes

CHAPTER 8

Children with HIV/AIDS

In general, the management of specific conditions in HIV-infected children is similar to that in other children (see Chapters 3–7). Most infections in HIV-positive children are caused by the same pathogens as in HIV-negative children, although they may be more frequent, more severe and occur repeatedly. Some, infections, however, are due to unusual pathogens.

Many HIV-positive children die from common childhood illnesses, and some of these deaths are preventable by early diagnosis and correct management or by giving routine scheduled vaccinations and improving nutrition. These children have a particularly greater risk for staphylococcal and pneumococcal infections and TB. Saving children's lives depends on early identification, immediate treatment with ART and co-trimoxazole prophylaxis for those who are HIV-infected.

All infants and children should have their HIV status established at their first contact with the health system, ideally at birth or at the earliest opportunity thereafter. To facilitate this, all areas of the hospital in which maternal, neonatal and child services are delivered should offer HIV serological testing to mothers and their infants and children.

This chapter covers mainly the management of children with HIV/AIDS: diagnosis of HIV infection, counselling and testing, clinical staging, ART, management of HIV-related conditions, supportive care, breastfeeding, planning discharge and follow-up and palliative care for terminally ill children.

8.1 Sick child with suspected or confirmed HIV infection

8.1.1 Clinical diagnosis

The clinical expression of HIV infection in children is highly variable. Many HIV-positive children show severe HIV-related signs and symptoms in the first year of life, while others may remain asymptomatic or mildly symptomatic for more than a year and may survive for several years.

Clinical experience indicates that children infected with HIV perinatally who are not on antiretroviral therapy fit into one of three categories:

- those with rapid progression (25–30%), most of whom die before their first birthday; they are thought to have acquired the infection in utero or during the early postnatal period;
- children who develop symptoms early in life, then follow a downhill course and die at the age of 3–5 years (50–60%);
- long-term survivors, who live beyond 8 years of age (5–25%); they tend to have lymphoid interstitial pneumonitis and stunting, with low weight and height for age.

Suspect HIV if any of the following signs, which are not common in HIV-negative children, are present:

Signs that may indicate possible HIV infection

- *recurrent infection:* three or more severe episodes of a bacterial infection (such as pneumonia, meningitis, sepsis, cellulitis) in the past 12 months
- *oral thrush:* erythema and white-beige pseudomembranous plaques on the palate, gums and buccal mucosa. After the neonatal period, the presence of oral thrush is highly suggestive of HIV infection when it lasts > 30 days despite antibiotic treatment, recurs, extends beyond the tongue or presents as oesophageal candidiasis.
- *chronic parotitis:* unilateral or bilateral parotid swelling (just in front of the ear) for ≥ 14 days, with or without associated pain or fever.
- *generalized lymphadenopathy:* enlarged lymph nodes in two or more extra-inguinal regions with no apparent underlying cause.
- *hepatomegaly with no apparent cause:* in the absence of concurrent viral infections such as cytomegalovirus.
- *persistent and/or recurrent fever:* fever (> 38 °C) lasting ≥ 7 days or occurring more than once over 7 days.
- *neurological dysfunction:* progressive neurological impairment, micro-cephaly, delay in achieving developmental milestones, hypertonia or mental confusion
- *herpes zoster (shingles):* painful rash with blisters confined to one dermatome on one side
- *HIV dermatitis:* erythematous papular rash. Typical skin rashes include extensive fungal infections of the skin, nails and scalp and extensive mol-luscum contagiosum.
- chronic suppurative lung disease

Signs or conditions specific to HIV-infected children

Strongly suspect HIV infection if the following are present:

- *Pneumocystis jiroveci* (formerly *carinii*) pneumonia (PCP)
- oesophageal candidiasis
- lymphocytic interstitial pneumonia
- Kaposi sarcoma
- acquired recto-vaginal fistula (in girls)

Signs common in HIV-infected children but which also occur in ill children with no HIV infection:

- chronic otitis media: ear discharge lasting ≥ 14 days
- persistent diarrhoea: diarrhoea lasting ≥ 14 days
- moderate or severe acute malnutrition: weight loss or a gradual but steady deterioration in weight gain from that expected, as indicated on the child's growth card. Suspect HIV particularly in breastfed infants < 6 months old who fail to thrive.

8.1.2 HIV counselling

HIV provider-initiated testing and counselling should be offered to all children attending clinical services in countries with generalized HIV epidemics (prevalence over 1% in pregnant women). If the child's HIV status is not known, counsel the family and offer diagnostic testing for HIV.

As the majority of children are infected by vertical transmission from the mother, the mother and often the father are probably infected but may not know it. Even in countries with a high prevalence of HIV infection, it remains an extremely stigmatizing condition, and the parents may feel reluctant to undergo testing.

In HIV counselling, the child should be treated as part of the family by taking into account the psychological implications of HIV for the child, mother, father and other family members. Counsellors should stress that, although there is no definitive cure, early initiation of ART and supportive care can greatly improve the child's and the parents' quality of life and survival.

Counselling requires time and must be done by trained staff. If there are no trained staff, assistance should be sought from local AIDS support organizations. HIV testing should be voluntary, with no coercion, and informed consent should be obtained before testing is performed.

Indications for HIV counselling and testing

All infants and children in countries with generalized HIV epidemics with unknown HIV status should be offered counselling and testing. In most cases, the HIV status of the child is established by asking about maternal HIV testing during pregnancy, labour or postpartum and checking the child's or mother's health card. If the HIV status is not known, counselling and testing should be offered in the following situations to:

- all infants and children in generalized HIV epidemic settings (prevalence > 1% in pregnant women).

- all HIV-exposed infants at birth or at the earliest opportunity thereafter.
- any infant or child presenting with signs, symptoms or medical conditions that could indicate HIV infection.
- all pregnant women and their partners in generalized HIV epidemics.

8.1.3 Testing and diagnosis of HIV infection

Diagnosis of HIV infection in perinatally exposed infants and young children < 18 months of age is difficult, because passively acquired maternal HIV antibodies may still be present in the child's blood. Additional diagnostic challenges arise if the child is still breastfeeding or has been breastfed. Although many children will have lost HIV antibodies between 9 and 18 months, a virological test is the only reliable method for determining the HIV status of a child < 18 months of age.

When either the mother or the child has a positive serological HIV test and the child has specific symptoms suggestive of HIV infection but virological testing is not available, the child may presumptively be diagnosed as having HIV infection. However, HIV virological testing should be done at the earliest opportunity to confirm infection.

All diagnostic HIV testing of children must be confidential, be accompanied by counselling and conducted only with informed consent, so that it is both informed and voluntary.

HIV serological antibody test (ELISA or rapid tests)

Rapid tests are widely available, sensitive and reliable for diagnosing HIV infection in children > 18 months. For children < 18 months, HIV antibody tests are a sensitive, reliable way of detecting exposure and of excluding HIV infection in non-breastfeeding children.

Rapid HIV tests can be used to exclude HIV infection in a child presenting with severe acute malnutrition, or TB or any other serious clinical event in areas of high HIV prevalence. For children aged < 18 months, confirm all positive HIV serological results by virological testing as soon as possible (see below). When this is not possible, repeat antibody testing at 18 months.

Virological tests

Virological testing for HIV-specific RNA or DNA is the most reliable method for diagnosing HIV infection in children < 18 months of age. This may require sending a blood sample to a specialized laboratory that can perform this test, although virological testing is becoming more widely available in many countries. The tests are relatively cheap, easy to standardize and can be done

on dried blood spots. The following assays (and respective specimen types) may be available:

- HIV DNA on whole blood specimen or dried blood spots
- HIV RNA on plasma or dried blood spots
- ultrasensitive p24 antigen detection in plasma or dried blood spots

One positive virological test at 4–8 weeks is sufficient to diagnose HIV infection in a young infant. ART should be started without delay, and, at the same time, a second specimen should be collected to confirm the positive virological test result.

If the infant is still breastfeeding and the virological test is negative, it should be repeated 6 weeks after complete cessation of breastfeeding to confirm that the child is not infected with HIV.

The results of virological testing in infants should be returned to the clinic and to the child, mother or carer as soon as possible but at the very latest within 4 weeks of specimen collection.

Diagnosing HIV infection in breastfeeding infants

A breastfeeding infant is at risk of acquiring HIV infection from an infected mother throughout the period of breastfeeding. Breastfeeding should not be stopped in order to perform diagnostic HIV viral testing. Positive test results should be considered to reflect HIV infection. The interpretation of negative results is, however, difficult because a 6-week period after complete cessation of breastfeeding is required before negative viral test results can reliably indicate HIV infection status.

8.1.4 Clinical staging

In a child with diagnosed or highly suspected HIV infection, the clinical staging system helps to determine the degree of damage to the immune system and to plan treatment and care.

The clinical stages represent a progressive sequence from least to most severe, each higher clinical stage indicating a poorer prognosis. Initiating ART, with good adherence, dramatically improves the prognosis. Clinical staging events can be used to identify the response to ART if there is no easy access to tests for viral load or CD4 count.

Table 23. WHO paediatric clinical staging system for HIV infection

For use in children aged < 13 years with confirmed laboratory evidence of HIV infection (HIV antibodies for children > 18 months, virological testing for those aged < 18 months)

STAGE 1
- Asymptomatic
- Persistent generalized lymphadenopathy

STAGE 2
- Hepatosplenomegaly
- Papular pruritic eruptions
- Seborrhoeic dermatitis
- Fungal nail infections
- Angular cheilitis
- Linear gingival erythema
- Extensive human papillomavirus infection or molluscum infection (> 5% body area)
- Recurrent oral ulcerations (two or more episodes in 6 months)
- Parotid enlargement
- Herpes zoster
- Recurrent or chronic upper respiratory tract infection (otitis media, otorrhoea, sinusitis; two or more episodes in any 6-month period)

STAGE 3
- Unexplained moderate malnutrition that does not respond to standard therapy
- Unexplained persistent diarrhoea (> 14 days)
- Unexplained persistent fever (intermittent or constant, for > 1 month)
- Oral candidiasis (outside neonatal period)
- Oral hairy leukoplakia
- Pulmonary TB[a]
- Severe recurrent presumed bacterial pneumonia (two or more episodes in 6 months)
- Acute necrotizing ulcerative gingivitis or periodontitis
- Lymphoid interstitial pneumonia
- Unexplained anaemia (< 8 g/dl), neutropenia (< 500/mm^3) or thrombocytopenia (< 30 000/mm^3) for > 1 month
- HIV-related cardiomyopathy
- HIV-related nephropathy

STAGE 4
- Unexplained severe wasting or severe malnutrition that does not respond to standard therapy
- PCP
- Recurrent severe presumed bacterial infections (two or more episodes within 1 year, e.g. empyema, pyomyositis, bone or joint infection, meningitis, but excluding pneumonia)

- Chronic orolabial or cutaneous herpes simplex infection (lasting > 1 month)
- Disseminated or extrapulmonary TB
- Kaposi sarcoma
- Oesophageal candidiasis
- Symptomatic HIV seropositive infant < 18 months with two or more of the following: oral thrush, severe pneumonia, failure to thrive, severe sepsis[b]
- Cytomegalovirus retinitis
- Central nervous system toxoplasmosis
- Any disseminated endemic mycosis, including cryptococcal meningitis (e.g. extrapulmonary cryptococcosis, histoplasmosis, coccidiomycosis, penicilliosis)
- Cryptosporidiosis or isosporiasis (with diarrhoea lasting > 1 month)
- Cytomegalovirus infection (onset at age > 1 month in an organ other than liver, spleen or lymph nodes)
- Disseminated mycobacterial disease other than TB
- Candida of trachea, bronchi or lungs
- Acquired HIV-related rectovesical fistula
- Cerebral or B cell non-Hodgkin lymphoma
- Progressive multifocal leukoencephalopathy
- HIV encephalopathy

[a] TB may occur at any CD4 count; the percentage CD4 should be considered when available.
[b] Presumptive diagnosis of stage 4 disease in seropositive children < 18 months requires confirmation with HIV virological tests or an HIV antibody test after 18 months of age.

8.2 Antiretroviral therapy

All HIV-infected infants < 60 months of age should immediately begin ART once diagnosed with HIV infection, regardless of clinical or immunological status. Although antiretroviral drugs cannot cure HIV infection, they dramatically reduce mortality and morbidity and improve the children's quality of life.

The current standard first-line treatment for HIV infection is use of three antiretroviral medications (**triple drug therapy**) to suppress viral replication as much as possible and thus arrest the progression of HIV disease. Fixed-dose combinations are now available and are preferable to syrups or single drugs because they encourage adherence to treatment, and reduce the cost.

Clinicians should be familiar with the national paediatric HIV treatment guidelines. The underlying principles of ART and the choice of first-line drugs for children are largely the same as for adults. Suitable formulations for children may not be available for some antiretroviral drugs (particularly the protease inhibitor class). It is nevertheless important to consider:

- the availability of a suitable formulation that can be taken in appropriate doses
- the simplicity of the dosage schedule

- the taste and palatability, and hence compliance, for young children.

It is also important to ensure that HIV-infected parents access treatment; and ART should ideally be ensured for other family members.

8.2.1 Antiretroviral drugs

Antiretroviral drugs fall into three main classes:

- nucleoside reverse transcriptase inhibitors (NRTIs),
- non-nucleoside reverse transcriptase inhibitors (NNRTIs), and
- protease inhibitors (see Table 24).

Triple therapy is the standard of care, and first-line regimens should be based on two NRTIs plus one NNRTI or protease inhibitor.

All infants and children < 3 years of age should be started on Lopinavir/ritonavir (LPV/r) plus two NRTIs, regardless of exposure to nevirapine (NVP) to prevent mother-to-child transmission. When viral load monitoring is available, consideration can be given to substituting LPV/r with an NNRTI after virological suppression is sustained.

For children ≥ 3 years efavirenz (EFV) is the preferred NNRTI for first-line treatment particularly once daily therapy, although NVP may be used as an alternative especially for children who are on twice daily therapy. Efavirenz is also the NNRTI of choice in children who are on rifampicin, if treatment has to start before anti-TB therapy is completed.

For drug dosages and regimens see Annex 2, pp. 370–3.

Calculation of drug dosages

In general, children metabolize protease inhibitor and NNRTI drugs faster than adults and therefore require higher equivalent doses to achieve appropriate drug levels. Drug doses must be increased as the child grows; otherwise, there is a risk for under-dosage and the development of resistance.

Drug dosages are given on pp. 370–4, per kilogram of body weight for some drugs and per surface area of the child for others. A table listing the equivalent weights of various surface area values is given in Annex 2 (p. 354) to help in calculating dosages. The use of weight bands for paediatric dosing has also simplified treatment regimens.

Formulations

Dosing in children is usually based on either body surface area or weight, **or, more conveniently, on weight bands**. As these change with growth, drug doses must be adjusted in order to avoid the risk for under-dosage.

Table 24. Classes of antiretroviral drugs recommended for use in children

Nucleoside analogue reverse transcriptase inhibitors	
Zidovudine	ZDV (AZT)
Lamivudine	3TC
Abacavir	ABC
Emtricitabine	FTC
Tenofovir	TDF
Non-nucleoside analogue reverse transcriptase inhibitors	
Nevirapine	NVP
Efavirenz	EFV
Protease inhibitors	
Lopinavir/ritonavir	LPV/RTV
Atazanavir	ATZ

Table 25. First-line treatment regimens for children

WHO-recommended preferred first-line antiretroviral regimens for infants and children	
First-line regimens for children < 3 years	**First-line regimens for children ≥ 3 years up to 12 years**
Abacavir (ABC)[a] or zidovudine (ZDV) *plus* Lamivudine (3TC) *plus* Lopinavir/ritonavir (LPV/RTV)[a]	Abacavir (ABC)[b] or zidovudine (ZDV) *plus* Lamivudine (3TC) *plus* Efavirenz (EFV)[b] or nevirapine (NVP)
Abacavir (ABC) or zidovudine (ZDV) *plus* Lamivudine (3TC) *plus* Nevirapine (NVP)	Tenofovir (TDF) *plus* Emtricitabine (FTC) or Lamivudine (3TC) *plus* Efavirenz (EFV) or nevirapine (NVP)

[a] Preferred regimen for children < 36 months regardless of exposure to nevirapine or other NNRTIs directly or via maternal treatment in preventing mother-to-child transmission.

[b] ABC+3TC+EFV is the preferred regimen for children ≥ 3 years up to 12 years.

8.2.2 When to start antiretroviral therapy

All HIV-infected infants and children < 60 months of age should begin ART, regardless of clinical or immunological status.

Infants and children < 60 months

- All children < 60 months of age with confirmed HIV infection should be started on ART, irrespective of clinical or immunological stage.
- Where viral testing is not available, infants < 18 months of age with clinically diagnosed presumptive severe HIV infection should start ART. Confirmation of HIV infection should be obtained as soon as possible.

Children ≥ 60 months

For children aged > 60 months, initiate ART for all those with:

- CD4 count < 500 cells/mm^3 irrespective of WHO clinical stage.
- CD4 count ≤ 350 cells/mm^3 which should be considered a priority, as in adults.

The decision of when to start ART should also take account of the child's social environment, including identification of a clearly defined caregiver who understands the prognosis of HIV and the requirements of ART. Occasionally immediate initiation of ART treatment may be deferred until the child is stabilized during treatment of acute infections.

In the case of confirmed or presumptive TB, initiating TB treatment is the priority. Any child with active TB should begin TB treatment immediately and start ART as soon as it can be tolerated but within the first 8 weeks of TB therapy. For children on TB treatment:

- children > 3 years and at least 10 kg, a regimen containing EFV is preferred.
- children < 3 years of age, if the child is on a LPV/r-containing regimen, consider adding RTV in a 1:1 ration of LPV:RTV to achieve a full therapeutic dose of LPV.
- A triple NNRTI-containing regimen may be used as an alternative.

8.2.3 Side-effects and monitoring

The response to and side-effects of ART should be monitored in all children on ART. A child's responses to therapy (i.e. reassessment of clinical status and stage, laboratory parameters and, symptoms of potential drug side effects or toxicity) should be done regularly. Common side effects are summarized in Table 26, p. 236.

Table 26. Common side-effects of antiretroviral drugs

Drug	Abbreviation	Side-effects[a]	Comments
Nucleoside reverse transcriptase inhibitors (NRTIs)			
Lamivudine	3TC	Headache, abdominal pain, pancreatitis	Well tolerated
Stavudine[b]	d4T	Headache, abdominal pain, neuropathy	Large volume of suspension capsules can be opened.
Zidovudine	ZDV (AZT)	Headache, anaemia, neutropenia	Do not use with d4T (antagonistic antiretroviral effect).
Abacavir	ABC	Hypersensitivity reaction, fever mucositis rash. If these occur, stop the drug.	Tablets can be crushed.
Emtricitabine	FTC	Headache, diarrhoea, nausea, and rash. May cause hepatotoxicity or lactic acidosis.	
Tenofovir	TDF	Renal insufficiency, decrease in bone mineral density	
Non-nucleoside reverse transcriptase inhibitors (NNRTIs)			
Efavirenz	EFV	Strange dreams, sleepiness, rash	Take at night; avoid taking with fatty food
Nevirapine	NVP	Rash, liver toxicity	When given with rifampicin, increase nevirapine dose by ~30% or avoid use. Drug interactions
Protease inhibitors			
Lopinavir/ ritonavir[a]	LPV/RTV	Diarrhoea, nausea	Take with food; bitter taste
Atazanavir		ATZ	Jaundice, prolonged PR interval, nephrolithiasis

[a] General long-term side-effects of ART include lipodystrophy.
[b] Requires cold storage and cold chain for transport

Immune reconstitution inflammatory syndrome

Immune reconstitution inflammatory syndrome (IRIS) is a spectrum of clinical signs and symptoms associated with immune recovery brought about by a response to antiretroviral treatment. Although most HIV-infected children experience rapid benefit from ART, some undergo clinical deterioration. This is the result of either the unmasking of latent or subclinical infection or the reactivation of previously diagnosed, and often treated, conditions (infectious or non-infectious).

The onset of IRIS in children usually occurs within the first weeks to months after initiation of ART and is seen most often in children who initiate ART with very low percentge CD4+ levels (< 15%). The commonest opportunistic infections associated with IRIS in children include:

- TB the commonest;
- pneumocystis pneumonia (PCP) or cryptosporidiosis;
- herpes simplex virus (HSV) infection;
- fungal, parasitic or other infections.

Where BCG immunization of infants and children is routine, BCG-associated IRIS (localized and systemic) is frequently observed.

Most cases of paradoxical IRIS resolve spontaneously, or can be managed with non-steroidal anti-inflammatory drugs, although some episodes can be severe and even lead to death.

▶ Give specific treatment for the opportunistic infection

▶ Start on anti-inflammatory therapy.

Occasionally, IRIS becomes progressively worse and may require a short course of treatment with corticosteroids and, rarely, temporary discontinuation of ART. The same ART regimen should be restarted once IRIS has improved.

Monitoring

In addition to checking for ART side effects, a clinical assessment should be made of the child's or caregiver's adherence to therapy and the need for additional support. The frequency of clinical monitoring depends on the response to ART. At a minimum, after the start of ART, follow-up visits should be made:

- for infants < 12 months, at weeks 2, 4 and 8 and then every 4 weeks for the first year
- for children > 12 months, at weeks 2, 4, 8 and 12 and then every 2–3 months once the child has stabilized on ART

- any time there is a problem of concern to the caregiver or intercurrent illness.

Important signs of infants' and children's responses to ART include:

- improvement in the growth in children who have been failing to grow
- improvement in neurological symptoms and development of children with encephalopathy or who had delayed achievement of developmental milestones
- decreased frequency of infections (bacterial infections, oral thrush and other opportunistic infections)

Long-term follow-up

- A clinician should see the child at least every 3 months.
- A non-clinician (ideally, the provider of ART, such as a pharmacist) should assess adherence and provide adherence counselling.
- Children who are clinically unstable should be seen more frequently, preferably by a clinician.

The organization of follow-up care depends on local expertise, and should be decentralized as much as possible.

Monitoring response at each visit:

- weight and height
- neurodevelopment
- adherence to treatment
- CD4 (%) count, if available (every 6 months)
- baseline Hb or EVF (if on ZDV/AZT) and alanine aminotransferase activity, if available
- symptom-directed laboratory testing: Hb, EVF or full blood count, alanine aminotransferase activity

8.2.4 When to change treatment

When to substitute

If toxic effects can be associated with an identifiable drug in a regimen, it can be replaced by another drug in the same class that does not have the same adverse effect. As few antiretroviral drugs are available, drug substitutions should be limited to:

- severe or life-threatening toxicity, such as:
  - Stevens Johnson syndrome

  - severe liver toxicity
  - severe haematological effects
- drug interaction (e.g. TB treatment with rifampicin interfering with nevirapine or protease inhibitor).
- potential lack of adherence by the patient if he or she cannot tolerate the regimen.

When to switch

ART failure may be due to:

- poor adherence
- inadequate drug level
- prior or treatment experienced drug resistance
- inadequate potency of the drug

A reasonable trial of the therapy is required before ART is determined to be failing on clinical criteria alone:

- The child should have received the regimen for at least 24 weeks.
- Adherence to therapy should be considered optimal.
- Any opportunistic infections have been treated and resolved.
- IRIS has been excluded.
- The child is receiving adequate nutrition.

Treatment failure is identified from:

- clinical failure (clinical criteria): appearance or reappearance of WHO clinical stage 4 events after at least 24 weeks on ART, with adherence to treatment
- immunological failure (CD4 criteria): count of < 200 cells/mm^3 or CD4 < 10% for a child aged < 5 years and in a child aged > 5 years persistent CD4 levels < 100 cells/mm^3
- virological failure (viral load criteria): persistent viral load > 1000 RNA copies/ml after at least 24 weeks on ART, and based on two consecutive measurements within 3 months, with adherence to treatment.

When treatment failure is confirmed, switching to a second-line regimen becomes necessary.

Second-line treatment regimens

In the event of treatment failure, the entire regimen should be changed from a first-line to a second-line combination. The second-line regimen should include at least three new drugs, one or more of them in a new class. Recommending potent, effective second-line regimens for infants and children is particularly difficult because of the lack of experience in use of second-line regimens in children and the limited number of formulations appropriate for children.

After failure of a first-line NNRTI-based regimen, a regimen with boosted protease inhibitor plus two NRTIs is recommended for second-line ART. LPV/RTV is the preferred boosted protease inhibitor for a second-line ART regimen after failure of a first-line NNRTI-based regimen.

Table 27. Recommended second-line treatment regimens for children

First-line treatment		Recommended second-line treatment	
		Children < 3 years	Children ≥ 3 years up to 12 years
LPV/r-based first line	ABC + 3TC + LPV/r	No change[a]	ZDV + 3TC + EFV
	ZDV + 3TC + LPV/r	No change[a]	ABC or TDF + 3TC + EFV
NNRTI-based first line	ABC + 3TC + EFV (or NVP)	ZDV + 3TC + LPV/r	ZDV + 3TC + LPV/r
	TDF + XTC[b] + EFV (or NVP)	–	ZDV + 3TC + LPV/r
	ZDV+ 3TC + EFV (or NVP)	ABC + 3TC + LPV/r	ABC or TDF + 3TC + LPV/r

[a] Could switch to NVP based regimen if the reason for failure is poor palatability of LPV/r

[b] Lamivudine (3TC) or emtricitabine (FTC)

8.3 Supportive care for HIV-positive children

8.3.1 Vaccination

HIV-exposed infants and children should receive all vaccines in the Expanded Programme for Immunization, including *H. influenzae* type B and pneumococcal vaccine, according to the national schedule. The schedules of the Expanded Programme might have to be modified for HIV-infected infants and children:

- *Measles:* Because of their increased risk for early and severe measles infection, infants with HIV should receive a dose of standard measles vaccine at

6 months of age and a second dose as soon as possible after 9 months of age, unless they are severely immunocompromised at that time.

- *Pneumococcal vaccine:* Pneumococcal conjugate vaccine should be given to all children, but vaccination may be delayed if the child is severely immunocompromised.
- *Haemophilus influenzae: H. influenzae* type B conjugate vaccine should be given to all children, but vaccination may be delayed if the child is severely immunocompromised.
- *BCG:* New findings indicate that infants who have HIV infection are at high risk for disseminated BCG disease. Therefore, BCG vaccine should not be given to children known to be HIV-infected. As infants cannot always be identified as HIV-infected at birth, BCG vaccine should be given to all infants at birth in areas with a high prevalence of both TB and of HIV, except those known to be infected with HIV.
- *Yellow fever:* Yellow fever vaccine should not be administered to children with symptomatic HIV infection.

8.3.2 Co-trimoxazole prophylaxis

Co-trimoxazole prevents PCP in infants and reduces morbidity and mortality among infants and children living with, or exposed, to HIV. Co-trimoxazole also protects against common bacterial infections, toxoplasmosis and malaria.

Who should receive co-trimoxazole?

- All infants born to HIV-infected mothers should receive co-trimoxazole 4–6 weeks after birth or at their first encounter with the health care system. They should continue until HIV infection has been excluded and they are no longer at risk of acquiring HIV from breast milk.
- All infected children should be continued on co-trimoxazole even when on ART.

How long co-trimoxazole should be given?

Adherence should be discussed at initiation and monitored at each visit. Co-trimoxazole must be taken as follows:

- HIV-exposed children: for the first year or until HIV infection has been definitively ruled out and the mother is no longer breastfeeding
- When on ART: Co-trimoxazole may be stopped once clinical or immunological indicators confirm restoration of the immune system for ≥ 6 months (also

see below). It is not known whether co-trimoxazole continues to provide protection after the immune system is restored.

- Children with a history of PCP: Continue indefinitely.

Under what circumstances should co-trimoxazole be discontinued?

- If the child develops severe cutaneous reactions such as Stevens Johnson syndrome, renal or hepatic insufficiency or severe haematological toxicity
- after HIV infection has confidently been excluded in an HIV-exposed child:
  - in a non-breastfed child aged < 18 months by a negative virological test
  - in a breastfed child aged < 18 months by a negative virological test conducted 6 weeks after cessation of breastfeeding
  - in a breastfed child aged > 18 months by a negative HIV serological test 6 weeks after cessation of breastfeeding
- In HIV-infected children, co-trimoxazole should be continued until they are 5 years of age and on ART with a sustained CD4 percentage > 25%.
- Co-trimoxazole should not be discontinued if not on ART.

What doses of co-trimoxazole should be used?

- Recommended dosages of 6–8 mg/kg trimethoprim once daily should be used.
  - children aged < 6 months, give one paediatric tablet (or one quarter of an adult tablet, 20 mg trimethoprim–100 mg sulfamethoxazole);
  - children aged 6 months to 5 years, give two paediatric tablets or half an adult tablet (40 mg trimethoprim–200 mg sulfamethoxazole); and
  - children aged > 5 years, give one adult tablet.
- If the child is allergic to co-trimoxazole, dapsone is the best alternative. It can be given from 4 weeks of age at 2 mg/kg per day orally once daily.

What follow-up is required?

- Assessment of tolerance and adherence: Co-trimoxazole prophylaxis should be a routine part of the care of HIV-infected children and be assessed at all regular clinic or follow-up visits by health workers or other members of multidisciplinary care teams. Clinical follow-up could initially be monthly, then every 3 months, if co-trimoxazole is well tolerated.

8.3.3 Nutrition

The mothers of infants and young children known to be infected with HIV are strongly encouraged to breastfeed them exclusively for 6 months and to continue breastfeeding up to the age of 1 year. Older children should eat varied, energy-rich food to increase their energy intake and to ensure adequate micronutrient intake.

Children should be assessed routinely for nutritional status, including weight and height, at scheduled visits. Their energy intake might have to be increased by 25–30% if they lose weight or grow poorly.

HIV-infected children who have severe acute malnutrition should be managed according to the guidelines for uninfected children and given 50–100% additional energy-rich foods (see Chapter 7, p. 197).

8.4 Management of HIV-related conditions

The treatment of most infections (such as pneumonia, diarrhoea and meningitis) in HIV-infected children is the same as in other children. In cases of treatment failure, consider giving a second-line antibiotic. Treatment of recurrent infections is the same, regardless of the number of recurrences.

Some HIV-related conditions that require specific management are described below.

8.4.1 Tuberculosis

In a child with suspected or proven HIV infection, a diagnosis of TB should always be considered, although it is often difficult to confirm. Early in HIV infection, when immunity is not impaired, the signs of TB are similar to those in a child without HIV infection. Pulmonary TB is still the commonest form of TB, even in HIV-infected children. As HIV infection progresses and immunity declines, dissemination of TB becomes more common, and tuberculous meningitis, miliary TB and widespread tuberculous lymphadenopathy occur.

HIV-infected infants and children with active TB should begin TB treatment immediately. If they are not yet started on ART, this should be started as soon as it is tolerated, within the first 8 weeks of TB therapy, irrespective of CD4 count and clinical stage (see section 8.2.2, p. 235).

- Treat TB in HIV-infected children with the same anti-TB drug regimen as for uninfected children with TB. (Refer to national TB guidelines, or see section 4.7.2, p. 115.)

Isoniazid preventive therapy

All HIV-infected infants and children should be screened for TB infection, as they are at special risk. If a child has cough, fever or weight loss, assess for TB. If the child does not have TB, give isoniazid preventive therapy (IPT) daily for 6 months.

- Give isoniazid preventive therapy to:
  - all HIV-infected infants and children exposed to TB from household contacts, but with no evidence of active disease, are well and thriving.
  - children > 12 months living with HIV infection, including those previously treated for TB, who are not likely to have active TB and are not known to be exposed to TB
- Give 10 mg/kg isoniazid daily for at least 6 months. See the child monthly and give a 1-month supply of isoniazid at each visit.

Note: *Infants living with HIV infection who are unlikely to have active TB and are not known to have been exposed to TB should not receive isoniazid preventive therapy as part of HIV care.*

8.4.2 *Pneumocystis jiroveci* pneumonia

PCP should be suspected in any HIV-positive infant with severe pneumonia. If PCP is untreated, mortality from this condition is very high. It is therefore imperative to provide treatment as early as possible.

Diagnosis

- is most likely in a child < 12 months (peak age, 4–6 months),
- subacute or acute onset of non-productive cough and difficulty in breathing,
- no or low-grade fever,
- cyanosis or persistent hypoxia,
- poor response to 48 h of first-line antibiotics for pneumonia, and
- elevated levels of lactate dehydrogenase.

Although clinical and radiological signs are not diagnostic, the presence of severe respiratory distress (tachypnoea, chest indrawing and cyanosis), with disproportionate clear chest or diffuse signs on auscultation and low oxygen saturation are typical of PCP infection.

- A chest X-ray is falsely negative in 10–20% of proven cases of PCP but typically shows a bilateral diffuse interstitial reticulogranular ('ground glass')

pattern, with no hilar lymph nodes or effusion. PCP may also present with pneumothorax.

Induced sputum and nasopharyngeal aspiration are useful for obtaining sputum for examination.

Treatment

- Promptly give oral or preferably IV high-dose co-trimoxazole (8 mg/kg trimethoprim–40 mg/kg sulfamethoxazole) three times a day for 3 weeks.
- If the child has a severe drug reaction, change to pentamidine (4 mg/kg once a day) by IV infusion for 3 weeks. For management of a child presenting with clinical pneumonia in settings with a high HIV prevalence, see p. 84.
- Prednisolone at 1–2 mg/kg per day for 1 week may be helpful early in the disease if severe hypoxia or severe respiratory distress is present.
- Continue co-trimoxazole prophylaxis on recovery, and ensure that ART is given.

8.4.3 Lymphoid interstitial pneumonitis

Diagnosis

The child is often asymptomatic in the early stages but may later have:

- persistent cough, with or without difficulty in breathing,
- bilateral parotid swelling,
- persistent generalized lymphadenopathy,
- hepatomegaly and other signs of heart failure, and
- finger-clubbing.
- Chest X-ray: Suspect lymphoid interstitial pneumonitis if the chest X-ray shows a bilateral reticulonodular interstitial pattern, which should be distinguished from pulmonary TB and bilateral hilar adenopathy (see figure p. 247).

Treatment

- Give a trial of antibiotic treatment for bacterial pneumonia (see section 4.2, p. 82) before starting treatment with prednisolone.
- Start treatment with steroids only if the chest X-ray shows lymphoid interstitial pneumonitis, plus any of the following signs:
  - fast or difficult breathing
  - cyanosis
  - pulse oximetry reading of oxygen saturation ≤ 90%.

- Give oral prednisolone at 1–2 mg/kg per day for 2 weeks. Then decrease the dose over 2–4 weeks, depending on the response to treatment. Beware of reactivating TB.
- Start ART if not already on treatment.

8.4.4 Fungal infections

Oral and oesophageal candidiasis

- Treat oral thrush with nystatin (100 000 U/ml) suspension. Give 1–2 ml into the mouth four times a day for 7 days. If this is not available, apply 1% gentian violet solution. If these are ineffective, give 2% miconazole gel at 5 ml twice a day, if available.

Suspect oesophageal candidiasis if the child has difficulty or pain while vomiting or swallowing, is reluctant to take food, is salivating excessively or cries during feeding. The condition may occur with or without evidence of oral thrush. If oral thrush is not found, give a trial of treatment with fluconazole. Exclude other causes of painful swallowing (such as cytomegalovirus, herpes simplex, lymphoma and, rarely, Kaposi sarcoma), if necessary by referral to a larger hospital where appropriate testing is possible.

- Give oral fluconazole (3–6 mg/kg once a day) for 7 days, except if the child has active liver disease.
- Give amphotericin B (0.5 mg/kg once a day) by IV infusion for 10–14 days to children who don't respond to oral therapy or are unable to tolerate oral medications or risk disseminated candidiasis (e.g. a child with leukopenia).

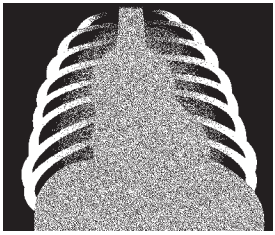
Cryptococcal meningitis

Suspect cryptococcus as a cause in any HIV-infected child with signs of meningitis. The presentation is often subacute, with chronic headache or only mental status changes. An India ink stain of CSF confirms the diagnosis.

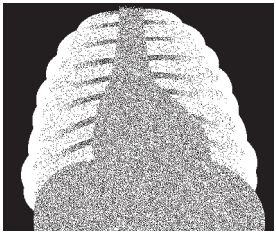
- Treat with amphotericin at 0.5–1.5 mg/kg per day for 14 days, then with fluconazole 6–12 mg/kg (maximum 800 mg) for 8 weeks.
- Start fluconazole 6 mg/kg daily (maximum 200 mg) prophylaxis after treatment.

8.4.5 Kaposi sarcoma

Consider Kaposi sarcoma in children presenting with nodular skin lesions, diffuse lymphadenopathy and lesions on the palate and conjunctiva with periorbital bruising. Diagnosis is usually clinical but can be confirmed by a needle biopsy of skin lesions or lymph node. Suspect Kaposi sarcoma also in children with



Lymphocytic interstitial pneumonia: typical hilar lymphadenopathy and lace-like infiltrates



Pneumocystis jiroveci pneumonia (PCP): typical 'ground glass' appearance

persistent diarrhoea, weight loss, intestinal obstruction, abdominal pain or large pleural effusion. Consider referral to a larger hospital for management.

8.5 Prevention of mother-to-child HIV transmission, and infant feeding

8.5.1 Prevention of mother-to-child HIV transmission

HIV may be transmitted during pregnancy, labour and delivery or through breastfeeding. The best way to prevent transmission is to prevent HIV infection in general, especially in pregnant women, and to prevent unintended pregnancies in HIV-positive women. If an HIV-infected woman becomes pregnant, she should be provided with ART, safe obstetric care and counselling and support for infant feeding.

HIV-infected pregnant women should be given ART both to benefit their own health and to prevent HIV transmission to their infants during pregnancy and breastfeeding.

- Start lifelong ART for all pregnant women with HIV infection regardless of symptoms.

In order to eliminate paediatric HIV there are two main options, which should start early in pregnancy, at 14 weeks or as soon as possible thereafter. These options significantly reduce mother-to-child transmission:

- *Option B:* A three-drug prophylactic regimen for the mother taken during pregnancy and throughout breastfeeding, as well as infant prophylaxis for 6 weeks after birth, whether or not the infant is breastfeeding.

- *Option B+:* A Triple ARV treatment regimen for the mother beginning in pregnancy and continued for life, as well as infant prophylaxis for 6 weeks after birth, whether or not the infant is breastfeeding.

Option B+ is now preferred.

8.5.2 Infant feeding in the context of HIV infection

In the absence of any interventions, 15–25% of HIV-positive mothers will infect their infants during pregnancy or delivery; if they breastfeed, there is an additional absolute risk of 5–20%. Although avoidance of breastfeeding eliminates the risk for HIV transmission through breast milk, replacement feeds have been associated with increased infant morbidity and mortality.

Exclusive breastfeeding during the first months of life carries less risk for HIV transmission than mixed feeding, and it provides considerable protection against infectious diseases and other benefits.

ART greatly reduces the risk for HIV transmission, while simultaneously ensuring that the mother receives appropriate care to improve her own health. If an HIV-positive mother breastfeeds her infant while taking ART and gives ART to her infant each day, the risk for transmission is reduced to 2% or 4% if she breastfeeds for 6 or 12 months, respectively. It is important to:

- Support mothers known to be HIV-positive in achieving the greatest likelihood that their child will be HIV-free and survive, while taking into consideration their own health.
- Balance the prevention of HIV transmission against meeting the nutritional requirements and protection of infants against non-HIV morbidity and mortality.
- HIV-positive mothers should preferably receive lifelong ART treatment to improve their own health, and the infant should be put on ART prophylaxis while breastfeeding.

Infant feeding advice

National guidelines should be followed in the feeding of an HIV-exposed infant: to either breastfeed while receiving ART (mother or infant) or to avoid breastfeeding.

- When national guidelines recommend that HIV-positive mothers should breastfeed and take ART to prevent transmission, mothers should breastfeed their infants exclusively for the first 6 months of life, introducing appropriate complementary foods thereafter, and should continue breastfeeding for the first 12 months of life.

- When a decision has been taken to continue breastfeeding because the child is already infected, ART treatment and infant feeding options should be discussed for future pregnancies.
- If the mother is known to be HIV-positive and the child's HIV status is unknown, the mother should be counselled about the benefits of breastfeeding as well as the risk for transmission, and the child should be tested. If replacement feeding is acceptable, feasible, affordable, sustainable and safe, avoidance of further breastfeeding is recommended. Otherwise, exclusive breastfeeding should be practised until 6 months of age, breastfeeding continued up to 12 months and complimentary feeding provided.

Mothers will require continued counselling and support to feed their infants optimally. Counselling should be done by a trained, experienced counsellor. Local people experienced in counselling should be consulted, so that the advice given is consistent. If the mother is using breast-milk substitutes, counsel her about their correct use and demonstrate safe preparation.

8.6 Follow-up

8.6.1 Discharge from hospital

HIV-infected children may respond slowly or incompletely to the usual treatment. They may have persistent fever, persistent diarrhoea and chronic cough. If the general condition of these children is good, they need not remain in hospital but can be seen regularly as outpatients.

8.6.2 Referral

If the necessary facilities are not available, consider referring a child suspected of having HIV infection:

- for HIV testing with pre- and post-test counselling
- to another centre or hospital for further investigations or second-line treatment if there has been little or no response to treatment
- to a trained counsellor for HIV and infant feeding, if the local health worker cannot do this
- to a community or home-based care programme, a community or institution-based voluntary counselling and testing centre or a community-based social support programme for further counselling and continuing psychosocial support.

Orphans must be referred to essential services, including health care education and birth registration.

8.6.3 Clinical follow-up

Children who are known to be HIV-infected should, when not ill, attend well-infant clinics like other children. In addition, they need regular clinical follow-up at first-level facilities to monitor their:

- clinical condition
- growth
- nutritional intake
- vaccination status

They should also be given psychosocial support, if possible in community programmes.

8.7 Palliative and end-of-life care

An HIV-infected, immunologically compromised child often has considerable discomfort, so good palliative care is essential. All decisions should be taken with the parents or caretaker, and the decisions should be clearly communicated to other staff (including night staff). Consider palliative care at home as an alternative to hospital care. Some treatments for pain control and relief of distressing conditions (such as oesophageal candidiasis or convulsions) can significantly improve the quality of the child's remaining life.

Give end-of-life (terminal) care if:

- the child has progressively worsening illness
- everything possible has been done to treat the presenting illness.

Ensuring that the family has appropriate support to cope with the impending death of the child is an important part of care in the terminal stages of HIV/AIDS. Parents should be supported in their efforts to give palliative care at home so that the child is not kept in hospital unnecessarily.

8.7.1 Pain control

The management of pain in HIV-infected children follows the same principles as for other chronic diseases, such as cancer and sickle-cell disease. Particular attention should be paid to ensuring that the care is culturally appropriate and sensitive.

- Give analgesics in two steps according to whether the pain is mild or moderate-to-severe.

- Give analgesics regularly ('by the clock'), so that the child does not have to experience recurrence of severe pain in order to obtain another dose of analgesic.
- Administer by the most appropriate, simplest, most effective and least painful route, by mouth when possible (IM treatment can be painful).
- Tailor the dose for each child, because children have different dose requirements for the same effect, and progressively titrate the dose to ensure adequate pain relief.

Use the following drugs for effective pain control:

Mild pain: such as headaches

- Give paracetamol or ibuprofen to children > 3 months who can take oral medication. For children < 3 months of age, use only paracetamol.
  - paracetamol at 10–15 mg/kg every 4–6 h
  - ibuprofen at 5–10 mg/kg every 6–8 h

Moderate-to-severe pain and pain that does not respond to the above treatment: strong opioids

- Give morphine orally or IV every 4–6 h or by continuous IV infusion
- If morphine does not adequately relieve the pain, then switch to alternative opioids, such as fentanyl or hydromorphone.

Note: *Monitor carefully for respiratory depression. If tolerance develops, the dose should be increased to maintain the same degree of pain relief.*

Adjuvant medicines: There is no sufficient evidence that adjuvant therapy relieves persistent pain or specific types such as neuropathic pain, bone pain and pain associated with muscle spasm in children. Commonly used drugs include diazepam for muscle spasm, carbamazepine for neuralgic pain and corticosteroids (such as dexamethasone) for pain due to an inflammatory swelling pressing on a nerve.

Pain control for procedures and painful lesions in the skin or mucosa

Local anaesthetics: during painful procedures, lidocaine should be infiltrated at 1–2%; for painful lesions in the skin or mucosa:

- lidocaine: apply (with gloves) on a gauze pad to painful mouth ulcers before feeds; acts within 2–5 min
- tetracaine, adrenaline and cocaine: apply to a gauze pad and place over open wounds; particularly useful during suturing

8.7.2 Management of anorexia, nausea and vomiting

Loss of appetite during a terminal illness is difficult to treat. Encourage carers to continue providing meals and to try:

- giving small feeds more frequently, particularly in the morning when the child's appetite may be better
- giving cool foods rather than hot foods
- avoiding salty or spicy foods
- giving oral metoclopramide (1–2 mg/kg) every 2–4 h, if the child has distressing nausea and vomiting.

8.7.3 Prevention and treatment of pressure sores

Teach carers to turn the child at least once every 2 h. If pressure sores develop, keep them clean and dry. Use local anaesthetics such as tetracaine, adrenaline and cocaine to relieve pain.

8.7.4 Care of the mouth

Teach carers to wash out the mouth after every meal. If mouth ulcers develop, clean the mouth at least four times a day with clean water or salt solution and a clean cloth rolled into a wick. Apply 0.25% or 0.5% gentian violet to any sores. If the child has a high fever or is irritable or in pain, give paracetamol. Crushed ice wrapped in gauze and given to the child to suck may give some relief. If the child is bottle-fed, advise the carer to use a spoon and cup instead. If a bottle continues to be used, advise the carer to clean the teat with water before each feed.

If oral thrush develops, apply miconazole gel to the affected areas at least three times a day for 5 days, or give 1 ml nystatin suspension four times a day for 7 days, pouring it slowly into the corner of the mouth so that it reaches the affected parts.

If there is pus due to a secondary bacterial infection, apply tetracycline or chloramphenicol ointment. If there is a foul smell in the mouth, give IM benzylpenicillin (50 000 U/kg every 6 h), plus oral metronidazole suspension (7.5 mg/kg every 8 h) for 7 days.

8.7.5 Airway management

Give priority to keeping the child comfortable rather than prolonging life.

8.7.6 Psychosocial support

Helping parents and siblings through their emotional reaction towards the dying child is one of the most important aspects of care in the terminal stage of HIV disease. How this is done depends on whether care is being given at home, in hospital or in a hospice. At home, much of the support can be given by close family members, relatives and friends.

Keep up to date on how to contact local community home care programmes and HIV/AIDS counselling groups. Find out if the carers are receiving support from these groups. If not, discuss the family's attitude towards these groups and the possibility of linking the family with them.

Notes

Notes

CHAPTER 9

Common surgical problems

Infants and children have distinct surgical diseases and special perioperative needs. This chapter provides guidelines for the supportive care of children with surgical problems and briefly describes the management of the commonest surgical conditions. Detailed surgical and anaesthesia guidance can be found in the WHO manual *Surgical care in the district hospital*[1] or the toolkit for integrated management for emergency and essential surgical care.

9.1 Care before, during and after surgery

Good surgical care neither begins nor ends with the procedure. In most instances, it is the preparation for surgery, the anaesthetic and the postoperative care that ensure a good outcome.

9.1.1 Preoperative care

Both the child and the parents should be prepared for the procedure and must consent.

- Explain why the procedure is needed, the anticipated outcome and the potential risks and benefits.
- Ensure that the child is medically fit for an operation:
  - Correct any fluid deficit and resuscitate as appropriate before an emergency procedure (IV bolus of normal saline, 10–20 ml/kg, repeated as needed). Restoration of urine output implies adequate volume resuscitation.
  - Correct anaemia. Severe anaemia interferes with oxygen transport. As a consequence, the heart must pump more blood. Surgery may cause blood loss, and the anaesthetic may affect oxygen transport in the blood. Ideally, the child's Hb should be checked to ensure that it is normal for the age and population.
    - Reserve blood transfusions for situations in which anaemia must be corrected quickly, e.g. emergency surgery.
    - In children undergoing elective surgery, correct anaemia with oral medications (p. 364).
    - Children with haemoglobinopathy (HbSS, HbAS, HbSC and thalassaemias) who require surgery and anaesthesia need special care. Refer to standard texts of paediatrics for details.

[1] World Health Organization. *Surgical care at the district hospital*. Geneva, 2003. http://www.who.int/surgery/publications/en/.

  - Check that the child is in the best nutritional state possible. Good nutrition is needed to heal wounds.
- Check that the child has an empty stomach before a general anaesthetic.
  - Infants < 12 months: the child should be given no solids orally for 8 h, no formula for 6 h, no clear liquids for 4 h or no breast milk for 4 h before the operation.
  - If prolonged periods of fasting are anticipated (> 6 h), give IV fluids that contain glucose.
- Preoperative laboratory screening is generally not essential; however, carry out the following if possible:
  - Infants < 6 months: check Hb or EVF
  - Children 6 months to 12 years:
    - minor surgery (e.g. hernia repair): no investigations
    - major surgery: check Hb or EVF, group and cross-match blood for possible transfusion.
  - Other investigations may be indicated after full clinical examination of the child.
- Preoperative antibiotics should be given for:
  - Infected and contaminated cases (e.g. those requiring bowel or bladder surgery):
    - ▶ Bowel: give ampicillin (25–50 mg/kg IM or IV four times a day), gentamicin (7.5 mg/kg IM or IV once a day) and metronidazole (10 mg/kg three times a day) before and for 3–5 days after the operation.
    - ▶ Urinary tract: give ampicillin (50 mg/kg IM or IV four times a day) and gentamicin (7.5 mg/kg IM or IV once a day) before and for 3–5 days after the operation.
  - Children at risk for endocarditis (children with congenital heart disease or valvular heart disease) undergoing dental, oral, respiratory or oesophageal procedures:
    - ▶ Give amoxicillin at 50 mg/kg orally before the operation or, if the child is unable to take oral medications, ampicillin at 50 mg/kg IV within 30 min of surgery.
- For major surgery, give premedication to allay anxiety.

9.1.2 Intraoperative care

Successful procedures require teamwork and careful planning. The operating room staff should function as a team, including surgeons, anaesthesia staff, nurses, scrub technicians and others. Ensure that essential supplies are readily available before the start of the operation.

Anaesthesia

Infants and children experience pain just like adults, but may express it differently.

- Make the procedure as painless as possible.

▶ For minor procedures in cooperative children, give a local anaesthetic by local infiltration, such as:

  – lidocaine at 3 mg/kg (0.3 ml/kg of 1% solution and 0.15 ml/kg of 2% solution; maximum dose, 200 mg), not repeated within 2 h

  – bupivacaine at 0.5–2.5 mg/kg as a 0.25% or 0.5% solution; maximum dose, 1 ml/kg of 0.25% solution, 0.5 ml/kg of 0.5% solution (2.5 mg/kg)

▶ For major procedures, give general anaesthesia.

Ketamine is an excellent anaesthetic when muscle relaxation is not required.

  – Insert an intravenous cannula. It may be more convenient to delay this until after ketamine has been given IM.

- Induction and maintenance of anaesthesia (short procedures) and analgesia for short painful procedures:

▶ Give ketamine at 5–8 mg IM or 1–2 mg/kg IV over 60 s for surgical anaesthesia, adjusted according to response. The child should be ready in 2–3 min if given IV or 3–5 min if given IM.

▶ Give a further dose of ketamine at 1–2 mg/kg IM or 0.5–1 mg/kg IV if the child responds to a painful stimulus.

- Induction and maintenance of anaesthesia (longer procedures) by continuous IV infusion:

▶ Neonate: Give initially 0.5–2 mg/kg loading dose followed by a continuous IV infusion of 500 µg/kg per h, adjusted according to response; up to 2 mg/kg per h can be used to produce deep anaesthesia.

▶ Infant or child: Give initially 0.5–2 mg/kg loading dose followed by a continuous IV infusion of 0.5–2.5 mg/kg per h, adjusted according to response.

- At the end of the procedure, turn the child into the lateral position and closely supervise recovery in a quiet place.

Special considerations

Airway

- The smaller-diameter airway of children makes them especially susceptible to airway obstruction, so they often need intubation to protect their airway during surgical procedures.
- Small children also have difficulty in moving heavy columns of air, so that adult vaporizer units are unacceptable.
- Endotracheal tube sizes for children are given in Table 28.

Table 28. Endotracheal tube size, by age

Age (years)	Tube size (mm)
Premature infant	2.5–3.0
Newborn	3.5
1	4.0
2	4.5
2–4	5.0
5	5.5
6	6
6–8	6.5
8	Cuffed 5.5
10	Cuffed 6.0

Alternatively, as a rough guide for normally nourished children aged > 2 years, use the following formula:

$$\text{Internal diameter of tube (mm)} = \frac{\text{Age (years)}}{4} + 4$$

Another rough indicator of the correct tube size is the diameter of the child's little finger. Always have tubes one size larger and smaller available. A non-cuffed tube should have a small air leak. Listen to the lungs with a stethoscope after intubation to ensure that the breath sounds are equal on the two sides.

Hypothermia

Small children lose heat more rapidly than adults because they have a greater relative surface area and are poorly insulated. This is important, as hypothermia can affect drug metabolism, anaesthesia and blood coagulation.

- Prevent hypothermia in the operating room by maintaining a temperature > 28 °C when operating on an infant or small child, and cover the exposed parts of the child.
- Use warmed fluids (but not too hot).
- Avoid long procedures (> 1 h) unless the child can be kept warm.
- Monitor the child's temperature as frequently as possible and at completion of the operation. Preferably use a low-reading thermometer.

Hypoglycaemia

Infants and children are at risk for hypoglycaemia because of their limited ability to use fat and protein to synthesize glucose.

- Use glucose infusions during anaesthesia to help maintain the blood sugar level. For most paediatric operations, other than minor ones, give Ringer's lactate or normal saline with 5% glucose at a rate of 5 ml/kg per h, in addition to replacing the measured fluid losses.
- Check blood glucose regularly, as the signs of hypoglycaemia might be masked by anaesthesia.

Blood loss

Children have smaller blood volumes than adults, so even small amounts of blood loss can be life-threatening, especially if the child is already anaemic.

- Measure blood loss during operations as accurately as possible.
- Consider blood transfusion if the blood loss exceeds 10% of blood volume (see Table 29).
- Have blood available in the operating room if blood loss is anticipated.

Table 29. Blood volume of children by age

	ml/kg body weight
Neonate	85–90
Children	80
Adults	70

9.1.3 Postoperative care

Communicate to the family the outcome of the operation, any problems encountered during the procedure and the expected postoperative course.

Immediately after surgery

Ensure that the child recovers safely from the anaesthesia. The patient should be kept on the ward or recovery area where she or he can be adequately monitored, with clear orders to:

- monitor the airway, breathing and circulation
- observe vital signs: temperature, pulse (see Table 30), respiratory rate and blood pressure (with the correct size of cuff, Table 30). Observations should be made more often if there is a change from a normal to an abnormal value.
- monitor oxygen saturation (normal, > 94%) after a general anaesthetic. Give oxygen if required.
- Observe the patient closely until the effect of the anaesthetic has worn off.

Table 30. Normal pulse rate and blood pressure in children

Age (years)	Pulse rate (range)	Systolic blood pressure (mm Hg)
0–1	100–160	> 60
1–3	90–150	> 70
3–6	80–140	> 75

Note: *Normal pulse rates are 10% slower in sleeping children. In infants and children, the presence or absence of a strong central pulse is often a more useful guide to the presence or absence of shock than a blood pressure reading.*

Fluid management

Postoperatively, children commonly require more than maintenance fluid. Children who have undergone abdominal operations typically require 150% of baseline requirements (p. 304) and even larger amounts if peritonitis is present. The preferred IV fluids are Ringer's lactate with 5% glucose, normal saline with 5% glucose or half-normal saline with 5% glucose. Note that normal saline and Ringer's lactate do not contain glucose and are therefore a risk in hypoglycaemia; large amounts of 5% glucose contain no sodium and can produce hyponatraemia and cerebral oedema (see Annex 4, p. 377).

Monitor fluid status closely.

- Record inputs and outputs (IV fluids, nasogastric drainage, vomit, urine drain outputs) every 4–6 h.

Urine output is the most sensitive indicator of fluid status in a child:

- Normal urine output: infants, 1–2 ml/kg per h; children, 1 ml/kg per h

If urinary retention is suspected, pass a urinary catheter. This also allows hourly measurements of urine output, which can be valuable for severely ill children. Suspect urinary retention if the bladder is palpable or the child is unable to void urine.

Pain control

Have a plan for postoperative pain management.

- Mild pain

▶ Give paracetamol (10–15 mg/kg every 4–6 h) by mouth or rectally. Oral paracetamol can be given several hours before the operation or rectally at the completion of surgery.

- Severe pain

▶ Give IV narcotic analgesics (IM injections are painful)

  – Morphine sulfate, 0.05–0.1 mg/kg IV every 2–4 h

Nutrition

Many surgical conditions increase caloric needs or prevent adequate nutritional intake. Many children with surgical problems present in a debilitated state. Poor nutrition adversely affects their response to injury and delays wound healing.

- Feed children as soon as possible after surgery.
- Provide a high-calorie diet containing adequate protein and vitamin supplements.
- Consider feeding by nasogastric tube for children whose oral intake is poor.
- Monitor the child's weight.

Prevention of complications

- Encourage early mobilization:
  – deep breathing and coughing
  – active daily exercise
- Move joints passively
  – muscular strengthening
  – provide walking aids, such as canes, crutches and walkers, with instructions for their use
- Prevent skin breakdown and pressure sores:
  – Turn the patient frequently.
  – Keep urine and faeces off skin.

Common postoperative problems

- Tachycardia (raised pulse rate, see Table 30, p. 261) may be caused by pain, hypovolaemia, anaemia, fever, hypoglycaemia or infection.
  - Examine the child.
  - Review the child's pre-operative and intra-operative care.
  - Monitor the response to pain medication, boluses of IV fluids, oxygen and IV transfusions, when appropriate.

  Bradycardia in a child should be considered a sign of hypoxia until proven otherwise.
- Fever

  May be due to tissue injury, wound infection, pneumonia, internal abscess, urinary tract infection (from indwelling catheters), phlebitis (from an IV catheter site) or other concomitant infection (e.g. malaria).
  - See section 9.3.6, p. 279 for information on the diagnosis and treatment of wound infections.
- Low urine output may be due to hypovolaemia, urinary retention or renal failure; usually due to inadequate fluid resuscitation.
  - Examine the child.
  - Review the child's fluid record.
  - If hypovolaemia is suspected, give normal saline (10–20 ml/kg) and repeat once (total highest safe level, 40 ml/kg; watch closely after first 20 ml/kg for circulatory fluid overload), as needed.
  - If urinary retention is suspected (the child is uncomfortable and has a full bladder on physical examination), pass a urinary catheter.
- Wound abscess
  - If there is pus or fluid, open and drain the wound. Remove infected skin or subcutaneous sutures, and debride the wound. Do not remove fascial sutures.
  - If there is an abscess without cellulitis, antibiotics are not required.
  - Place a damp, sterile normal saline dressing in the wound, and change the dressing every 24 h.
  - If the infection is superficial and does not involve deep tissues, monitor for development of an abscess and give antibiotics:
  - Give ampicillin (25–50 mg/kg IM or IV four times a day) and metronidazole (10 mg/kg three times a day) before and for 3–5 days after the operation.

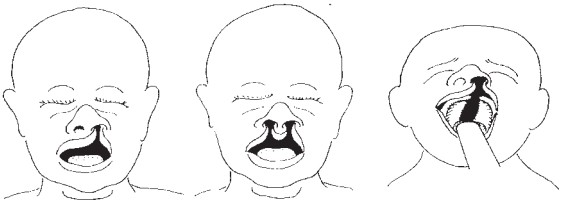
– If the infection is deep, involves muscles and is causing necrosis (necrotizing fasciitis), give antibiotics until necrotic tissue has been removed and the patient is fever-free for 48 h.
– Give ampicillin (25–50 mg/kg IM or IV four times a day) plus gentamicin (7.5 mg/kg IM or IV once a day) and metronidazole (10 mg/kg three times a day).

9.2 Congenital anomalies

There are many types of congenital anomaly, but only a few are common. Some require urgent surgical attention, while others should be left until the child is older. Early recognition results in better outcomes and allows the parents to inform themselves about treatment options.

9.2.1 Cleft lip and palate

These may occur together or separately (see figure). Reassure the parents that the problem can be dealt with, as there may be concern about the unattractive appearance.



Unilateral *Bilateral* *With cleft palate*

Cleft lip and palate

Treatment

Infants with isolated cleft lip can feed normally, whereas cleft palate is associated with feeding difficulties. The infant can swallow normally but is unable to suck adequately, and milk regurgitates through the nose and may be aspirated into the lungs. If associated Pierre Robin syndrome is present (small mandible and backward placement of the jaw), the child may have upper airway obstruction during sleep.

▶ Feed with expressed breast milk from a cup and spoon or bottles, if available and adequate sterility can be ensured; a special teat may be used. The technique of feeding is to deliver a bolus of milk over the back of the tongue into the pharynx with a spoon, pipette or some other pouring device. The infant will then swallow normally.

Sleep-related upper airway obstruction can cause hypoxaemia and growth failure and requires specialist paediatric treatment.

- Close monitoring of feeding and growth in infancy is required.
- Surgical closure of the lip can be done at 6 months of age and of the palate at 1 year of age. The lip may be repaired earlier if it is safe to give an anaesthetic and the repair is technically possible.
- Follow-up after surgery is required to monitor hearing (middle-ear infections are common) and speech development.

9.2.2 Bowel obstruction

Bowel obstruction in a newborn may be due to hypertrophic pyloric stenosis, bowel atresia, malrotation with volvulus, meconium plug syndrome, Hirschsprung disease (colonic aganglionosis) or imperforate anus.

Diagnosis

- The level of obstruction determines the clinical presentation. Proximal obstruction presents as vomiting with minimal distension and distal obstruction as distension with vomiting occurring late.
- Bile-stained (green) vomit in an infant is due to bowel obstruction until proven otherwise and is a surgical emergency.
- Pyloric stenosis presents as projectile (forceful) non-bilious vomiting, typically between 3 and 6 weeks of age.
  - Dehydration and electrolyte abnormalities are common.
  - An olive-like mass (the enlarged pylorus) may be palpated in the upper abdomen.

Consider other causes of abdominal distension, such as ileus related to sepsis, necrotizing enterocolitis, congenital syphilis and ascites.

Treatment

▶ Prompt resuscitation and **urgent review** by a surgeon experienced in paediatric surgery

▶ Give nothing orally. Pass a nasogastric tube if there is vomiting or abdominal distension.

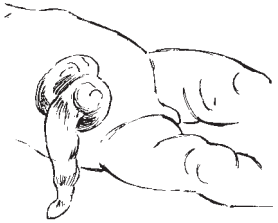
- Intravenous fluid: use half-strength Darrow's solution or normal saline plus 5% glucose (dextrose):
  - Correct shock, if present, with 20 ml/kg bolus of normal saline or Ringer's lactate as a rapid IV bolus.
  - If there is no shock but dehydration, give 10–20 ml/kg half-strength Darrow's solution or normal saline plus 5% glucose over 20 min.
  - Then give maintenance fluid volume (p. 304) plus the same volume that comes out of the nasogastric tube plus any vomit.
- Give ampicillin (25–50 mg/kg IV four times a day) plus gentamicin (7.5 mg/kg IV once a day) plus metronidazole (15 mg/kg as a single loading dose, followed by 7.5 mg/kg every 12 h starting 24 h after the loading dose).

9.2.3 Abdominal wall defects

The abdominal wall does not fully develop and remains open.

Diagnosis

- There may be exposed bowel (gastroschisis) or a thin layer covering the bowel (omphalocoele) (see figure).



Newborn with an omphalocoele

Treatment

- Apply a sterile dressing, and cover with a plastic bag or cling film (to prevent fluid loss). An exposed bowel can lead to rapid fluid loss and hypothermia.
- Give nothing orally. Pass a nasogastric tube for free drainage.
- Give IV fluids: normal saline plus 5% glucose (dextrose) or half-strength Darrow solution
  - Correct shock, if present, with 20 ml/kg bolus of normal saline or Hartmann's solution as a rapid IV bolus.
  - If there is no shock but dehydration, give 10–20 ml/kg half-strength Darrow solution or normal saline plus 5% glucose over 20 min.
  - Then give maintenance fluid requirements (p. 304) plus the same volume that comes out of the nasogastric tube.
- Give ampicillin (25–50 mg/kg IV four times a day) plus gentamicin (7.5 mg/kg IV once a day) plus metronidazole (15 mg/kg as a single loading dose, followed by 7.5 mg/kg every 12 h starting 24 h after loading dose).

Urgent review by a surgeon experienced in paediatric surgery.

9.2.4 Myelomeningocoele

Diagnosis

- Small sac that protrudes through a bony defect in the skull or vertebrae. The commonest site is the lumbar region.
- May be associated with neurological problems (bowel, bladder and motor deficits in the lower extremities) and hydrocephalus.

Treatment

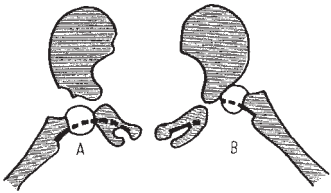
- Apply a sterile dressing.
- If ruptured, give benzylpenicillin (100–150 mg/kg daily in two divided doses) or ampicillin (25–50 mg/kg IM or IV four times a day) plus gentamicin (7.5 mg/kg once a day) for 5 days.

Review by a surgeon experienced in paediatric surgery.

9.2.5 Congenital dislocation of the hip

Diagnosis

- Severe cases should be detected by routine physical examination at birth.
- When the condition is unilateral, the limb is short, there is limited abduction when the hip is flexed, and the skin crease at the back of the hip appears asymmetrical. When the flexed hip is abducted, a click can often be felt as the dislocated femoral head enters the acetabulum (Ortolani's sign).
- Diagnosis requires X-ray and/or specialist ultrasound (See paediatric textbook for details).



Radiological diagnosis of congenital dislocation of the hip

Treatment

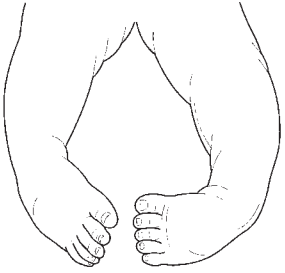
- In milder cases, keep the hip in flexion and abduction through double nappies or an abduction brace in an abducted position for 2–3 months. The traditional way in many cultures of carrying the child on the back with the hip flexed and abducted will serve the same purpose.
- In more severe cases, keep the hip abducted and flexed in a splint.
- **Review by** a surgeon experienced in paediatric surgery.

9.2.6 Talipes equinovarus (club foot)

Diagnosis

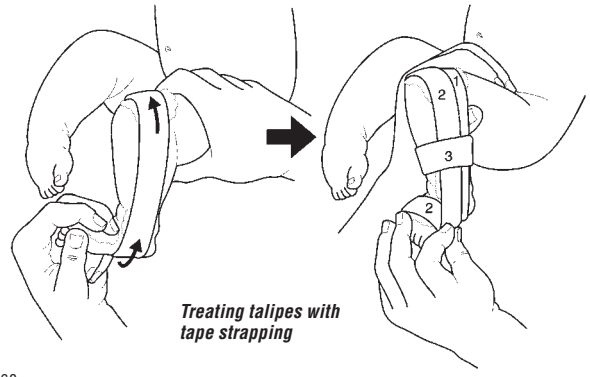
- The foot cannot be placed in the normal position.
- The commonest form includes three deformities: plantar flexion of the foot, inversion (inturning of the heel) and inturning of the forefoot.

Treatment



Talipes

- Mild positional deformity (the foot can be passively corrected): simple stretching of foot beginning shortly after birth
- Moderate deformity: serial manipulations beginning shortly after birth
  - Maintain position with tape strapping or well-padded plaster of Paris casts. Apply this in the sequence 1, then 2, then 3 as in figure below.
  - These manipulations should be repeated every 2 weeks or until the deformity is corrected.
  - Special splints may need to be worn until the child begins to walk.
- Severe deformity or late presentation requires surgical repair.



Treating talipes with tape strapping

9.3 Injuries

Injuries are the commonest surgical problems of children. Proper treatment can prevent death and lifelong disability. Whenever possible, try to prevent childhood injuries.

- See Chapter 1, section 1.10, p. 38 for guidelines for assessing children with severe injuries. More detailed surgical guidance is given in the WHO manual *Surgical care in the district hospital*.

9.3.1 Burns

Burns and scalds result in high mortality in children. Other injuries might also have occurred, depending on the type of burn, such as from inhaled hot gases. Children who survive may suffer from disfigurement and psychological trauma as a result of a painful, prolonged stay in the hospital.

Assessment

Burns may be partial or full thickness. A full-thickness burn involves destruction of the entire thickness of the skin, and the skin will not regenerate. Ask two questions:

How deep is the burn?

- Full thickness burns are black or white, usually dry, have no sensation and do not blanch on pressure.
- Partial thickness burns are pink or red, blistering or weeping and painful.

How much of the body is burnt?

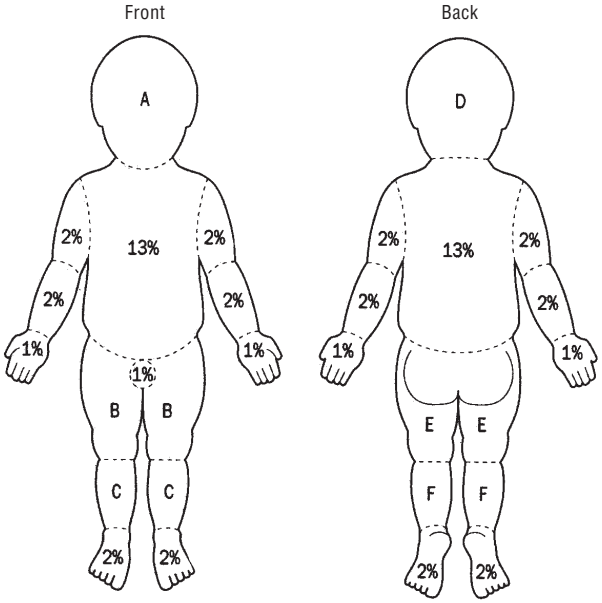
- Use a body surface area chart below according to age.
- Alternatively, use the child's palm to estimate the burnt area. A child's palm represents approximately 1% of the total body surface area.

Treatment

- Admit all children with burns covering > 10% of their body surface; those involving the face, hands, feet, perineum and joints; those that are circumferential and those that cannot be managed in an outpatient ward.
- Initially, burns are sterile. Focus treatment on speedy healing and prevention of infection.
- Consider whether the child has a respiratory injury due to smoke inhalation.
  - If there is evidence of respiratory distress, provide supplementary oxygen (p. 312), and ensure the airway are safe and remain safe by regular observation. Inform the anaesthetist if there is potential airway obstruction.

Chart for estimating the percentage of body surface burnt

Estimate the total area burnt by adding the percentage of body surface area affected as shown in the figure; refer to the table for areas A–F, which change according to the age of the child.



	By age in years			
Area	**0**	**1**	**5**	**10**
Head (A/D)	10%	9%	7%	6%
Thigh (B/E)	3%	3%	4%	5%
Leg (C/F)	2%	3%	3%	3%

- Severe facial burns and inhalation injuries may require early intubation or tracheostomy to prevent or treat airway obstruction.

- Fluid resuscitation is required for burns covering > 10% total body surface. Use Ringer's lactate or normal saline with 5% glucose; for maintenance, use Ringer's lactate with 5% glucose or half-normal saline with 5% glucose.
  - First 24 h: Calculate fluid requirements by adding maintenance fluid requirements (p. 304) to the additional emergency fluid requirements (volume equal to 4 ml/kg for every 1% of surface burnt).
- Administer half of total fluid in first 8 h, and remaining fluid in next 16 h.

  Example: 20 kg child with a 25% burn:

  Total fluid in first 24 h = (60 ml/h x 24 h) + 4 ml x 20 kg x 25% burn

  = 1440 ml + 2000 ml

  = 3440 ml (1720 ml over first 8 h)
  - Second 24 h: give half to three quarters of fluid required during the first day.
  - Monitor the child closely while giving emergency fluids (pulse, respiratory rate, blood pressure and urine output), taking care to avoid circulatory fluid overload.
  - Blood may be given to correct anaemia or for deep burns to replace blood loss.
- In all cases, administer tetanus prophylaxis.
- Prevent infection:
  - If skin is intact, clean with antiseptic solution, gently, without breaking the skin.
  - If skin is not intact, carefully debride the burn. Except for very small burns, debride all bullae, and excise adherent necrotic (dead) tissue during the first few days.
  - Give topical antibiotics or antiseptics (the options depend on resources; they include: silver nitrate, silver sulfadiazine, gentian violet, betadine and even mashed papaya). Clean and dress the wound daily.
  - Small burns and those in areas that are difficult to cover can be managed by leaving them open to the air and keeping them clean and dry.
- Treat secondary infection if present.
  - If there is evidence of local infection (pus, foul odour or presence of cellulitis), treat with amoxicillin (15 mg/kg orally three times a day) plus

cloxacillin (25 mg/kg orally four times a day). If septicaemia is suspected, use gentamicin (7.5 mg/kg IM or IV once a day) plus cloxacillin (25–50 mg/kg IM or IV four times a day). If infection is suspected beneath an eschar, remove the eschar.

▶ Pain control

Make sure that pain control is adequate, including before procedures such as changing dressings.

– Give paracetamol (10–15 mg/kg every 6 h) by mouth, or give IV narcotic analgesics (IM injections are painful), such as morphine sulfate (0.05–0.1 mg/kg IV every 4 h) if pain is severe.

▶ Check tetanus vaccination status.

– If not immunized, give tetanus immune globulin.
– If immunized, give tetanus toxoid booster, if this is due.

▶ Nutrition

– Begin feeding as soon as practical in the first 24 h.
– Children should receive a high-calorie diet containing adequate protein, and vitamin and iron supplements. (Omit the iron initially in severe malnutrition.)
– Children with extensive burns require about 1.5 times the normal calorie and two to three times the normal protein requirements.

- Burn contractures: burn scars across flexor surfaces contract. This happens even with the best treatment (and nearly always happens with poor treatment).
  – Prevent contractures by passive mobilization of the involved areas and by splinting flexor surfaces to keep them extended. Splints can be made of plaster of Paris. Splints should be worn only at night.
- Physiotherapy and rehabilitation
  – Should begin early and continue throughout the course of burn care
  – If the child is admitted for a prolonged period, ensure that she or he has access to toys and is encouraged to play.

9.3.2 Head injuries

Head injuries are a common cause of death from trauma in children. The aim of treatment is to prevent secondary brain damage from hypoxia, hypotension or hypoglycaemia. There may be a skull fracture (closed, open or depressed) or a brain injury. Brain injuries fall into three categories (three Cs):

- Concussion: the mildest injury, with temporary loss of brain function
- Contusion: the brain is bruised, and function may be affected for hours to days or even weeks.
- Compression: may result from swelling or a growing blood clot (epidural or subdural haematoma). If compression is due to a blood clot, an urgent operation may be required.

Children more frequently suffer from acute brain swelling after a severe head injury.

Diagnosis

- History of head trauma
- Look for lacerations, bleeding and bruising, and palpate for fractures or deformity.
- Look for signs of fractured base of skull: periorbital bruising, blood behind the eardrum, CSF leak or bleeding from the nose or ears
- Do X-ray if available.

Treatment

Assess the ABC and resuscitate as necessary. The best way of retaining brain function after a head injury is to ensure that the airway remains open and breathing is adequate, correct shock and prevent hypotension. If the child does not respond to pain or is unconscious (P or U on the AVPU scale), seek urgent help from an anaesthetist, who can protect the airway. In a young child, check for hypoglycaemia, and correct as appropriate (see p. 16).

- Give nothing orally, but use an orogastric (rather than a nasogastric) tube if the base of the skull may be fractured (see above).
- Limit fluid intake (to two thirds of maintenance fluid requirements, see above for recommended fluids and p. 304 for fluid volumes).
- Elevate the head of the bed to 30°, but keep in recovery position if consciousness level is reduced.
- Diagnose and treat other injuries.

Urgent review by a surgeon experienced in paediatric surgery.

9.3.3 Chest injuries

Chest injuries can be life threatening. They may result from blunt or penetrating injuries. Because the rib-cage of children is more pliable than that of adults, there may be extensive chest injuries without rib fractures. Chest injuries

include rib fractures, pulmonary contusions, pneumothorax and haemothorax. All suspected chest injuries require **urgent review** by a surgeon experienced in paediatric surgery.

Pneumothorax

Tension pneumothorax develops when air enters the pleural space but cannot leave. The child will have severe shortness of breath, cyanosis (hypoxaemia), decreased chest movement and no air entry on the side of pneumothorax but with hyper-resonance on percussion (see p. 90).

- Insert needle for urgent decompression, before insertion of an intercostal drain (see p. 349).
- Give oxygen as near to 100% as possible (mask with reservoir).
- Insert a chest drain.
- Seek urgent surgical advice

Haemothorax

Haemothorax is commoner in penetrating than in non-penetrating injures to the chest, with blood leaking into the pleural space. If the haemorrhage is severe, hypovolaemic shock will occur, as well as respiratory distress due to compression of the lung on the involved side. The child may be in respiratory distress with cyanosis, decreased chest movement and air entry on the affected side but with dullness on percussion.

- Insert a large chest tube for drainage (see p. 348).
- Seek urgent surgical advice, as continued bleeding may require thoracotomy.
- Give IV fluids as 10–20 ml/kg of normal saline initially, and transfuse with fresh whole blood at 20 ml/kg as soon as possible.
- Give oxygen as near to 100% as possible (mask with reservoir).

Pulmonary contusion

Pulmonary contusion (bruising) is common after chest trauma. It is a potentially life-threatening condition. The onset of symptoms may be slow and may progress over 24 h after the injury. Symptoms and signs may include shortness of breath, hypoxaemia and rib fractures.

- Give oxygen as near to 100% as possible (mask with reservoir).
- Seek urgent surgical advice.

Rib fractures

Fractured ribs may occur at the point of impact, and damage to the underlying lung may produce lung bruising or puncture. The ribs usually become fairly stable within 10 days to 2 weeks, and firm healing with callus formation is seen after 4–6 weeks in children.

9.3.4 Abdominal injuries

The abdomen is commonly injured in cases of multiple trauma. Blunt and penetrating trauma to the abdomen may injure a variety of organs. Splenic injuries from blunt trauma and liver injuries from penetrating trauma are especially common. Any child involved in a serious accident should be considered to have an abdominal injury until proven otherwise. Severe abdominal injuries are life-threatening because they can cause severe internal blood loss.

- Assume that a penetrating wound to the abdominal wall has entered the abdominal cavity and that there may be injuries to the intra-abdominal organs. Any penetration of the bowel wall will lead to peritonitis in a day or two, and surgical intervention is essential.
- Be especially cautious with injuries around the anus, as penetrating rectal injuries can be easily missed.
- Look for signs of bruising and penetrating trauma, listen for bowel sounds, check renal angles and examine urine for blood. Ultrasound is useful, if available, to investigate intra-abdominal bleeding and injury to internal organs.
- ▶ Assess the patient for airway patency and breathing, give oxygen, assess the circulation, set up an IV access, take blood for Hb, blood cross-matching and amylase activity (if available).
- ▶ Transfuse as necessary.
- ▶ Seek urgent surgical advice.

9.3.5 Fractures

Children heal fractures well if the bones are aligned properly.

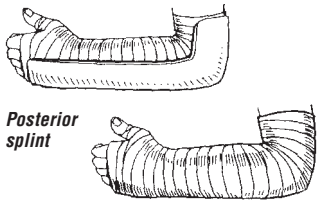
Diagnosis

- Pain, swelling, deformity, crepitus, unnatural movement and loss of function
- Fractures may be closed (the skin is intact) or open (there is wounding of the skin). Open fractures may lead to serious bone infection. Suspect an open fracture if there is an associated wound.

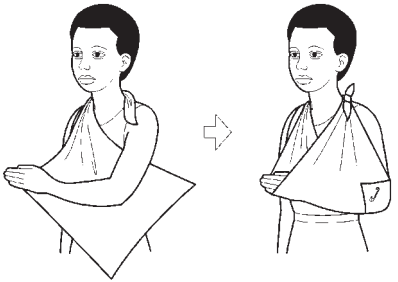
Treatment

- Ask two questions:
  - Is there a fracture?
  - Which bone is broken (either by clinical examination or X-ray)?
- Consider referral for **review** by a surgeon experienced in paediatric surgery for complicated fractures such as those that are displaced, involve growth plates or are open.
- Open fractures require antibiotics: cloxacillin (25–50 mg/kg IV or orally four times a day) and gentamicin (7.5 mg/kg IM or IV once a day); and meticulous cleaning to prevent osteomyelitis (see section 9.3.6, p. 279, for principles of wound care).
- The figures below show simple methods for treating some of the commonest childhood fractures. For further details of how to manage these fractures, consult the WHO manual *Surgical care at the district hospital* or a standard textbook of (surgical) paediatrics.

A posterior splint can be used for upper and lower extremity injuries. The extremity is first wrapped with soft padding (e.g. cotton), then a plaster of Paris splint is placed to maintain the extremity in a neutral position. The posterior splint is held in place with an elastic bandage. Monitor capillary refill and temperature of the fingers to ensure that the splint has not been placed too tightly.



Posterior splint



Sling to support an injured arm