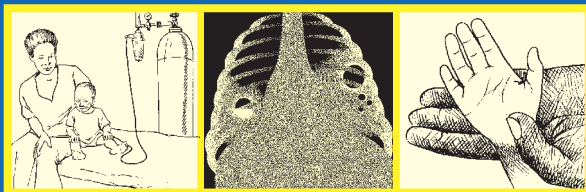


POCKET BOOK OF Hospital care for children



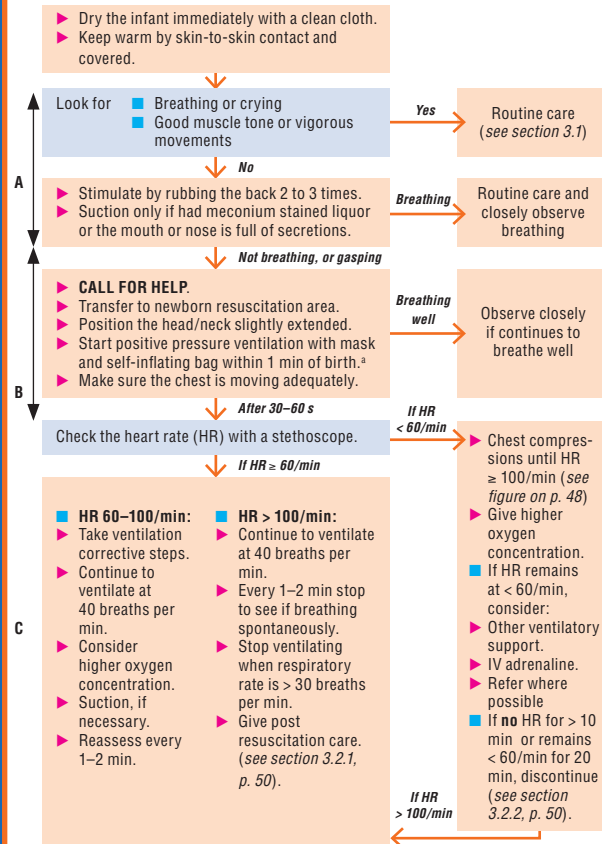
**GUIDELINES FOR THE MANAGEMENT OF
COMMON CHILDHOOD ILLNESSES**

Second edition



**World Health
Organization**

Chart 12. Neonatal resuscitation: Flow chart



^a Positive pressure ventilation should be initiated with air for infants with gestation > 32 weeks. For very preterm infants, it is preferable to start with 30% oxygen if possible.
A and **B** are basic resuscitation steps

Triage of all sick children

EMERGENCY SIGNS:

If any sign is positive, call for help, assess and resuscitate, give treatment(s), draw blood for emergency laboratory investigations (glucose, malaria smear, Hb)

ASSESS

Airway and breathing

- Obstructed or absent breathing or
- Central cyanosis or
- Severe respiratory distress

ANY SIGN
POSITIVE

TREAT

Do not move neck if a cervical spine injury is possible, but open the airway.

If foreign body aspirated

- ▶ Manage airway in choking child (Chart 3)

If no foreign body aspirated

- ▶ Manage airway (Chart 4)
- ▶ Give oxygen (Chart 5)
- ▶ Make sure the child is warm

Circulation

Cold skin with:

- Capillary refill longer than 3 s and
- Weak and fast pulse

SIGNS
POSITIVE

Check for
severe
malnutrition

- ▶ Stop any bleeding
- ▶ Give oxygen (Chart 5)
- ▶ Make sure the child is warm.

If no severe malnutrition

- ▶ Insert an IV line and begin giving fluids rapidly (Chart 7).

If peripheral IV cannot be inserted, insert an intraosseous or external jugular line (see pp. 340–342).

If severe malnutrition:

If lethargic or unconscious:

- ▶ Give IV glucose (Chart 10).
- ▶ Insert IV line and give fluids (Chart 8).

If not lethargic or unconscious:

- ▶ Give glucose orally or by nasogastric tube.
- ▶ Proceed immediately to full assessment and treatment.

EMERGENCY SIGNS:

If any sign is positive: call for help, assess and resuscitate, give treatment(s), draw blood for emergency laboratory investigations (glucose, malaria smear, Hb)

ASSESS

Coma/ convulsing

- Coma or
- Convulsing (now)

IF COMA OR
CONVULSION

TREAT

Do not move neck if you suspect cervical spine injury, but open the airway.

- ▶ Manage the airway (Chart 4)
- ▶ If convulsing, give diazepam rectally (Chart 9)
- ▶ Position the unconscious child (if head or neck trauma is suspected, stabilize the neck first) (Chart 6).
- ▶ Give IV glucose (Chart 10).

Severe dehydration

(only in a child with diarrhoea)

Diarrhoea plus any two of these signs:

- Lethargy
- Sunken eyes
- Very slow skin pinch
- Unable to drink or drinks poorly

DIARRHOEA
PLUS
two signs
positive

Check for
severe
malnutrition

- ▶ Make sure the child is warm.

If no severe malnutrition:

- ▶ Insert an IV line and begin giving fluids rapidly following Chart 11 and diarrhoea treatment plan C in hospital (Chart 13, p. 131).

If severe malnutrition:

- ▶ Do not insert an IV line.
- ▶ Proceed immediately to full assessment and treatment (see section 1.4, p. 19).

PRIORITY SIGNS

These children need prompt assessment and treatment

- Tiny infant (< 2 months)
- Temperature very high
- Trauma or other urgent surgical condition
- Pallor (severe)
- Poisoning (history of)
- Pain (severe)
- Respiratory distress
- Restless, continuously irritable, or lethargic
- Referral (urgent)
- Malnutrition: visible severe wasting
- Oedema of both feet or face
- Burns (major)

Note: If a child has trauma or other surgical problems, get surgical help or follow surgical guidelines.

NON-URGENT

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

POCKET BOOK
OF
**Hospital care
for children**

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Organization**

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Preface

This is the second edition of the World Health Organization (WHO) *Pocket book of hospital care for children*, which was first published in 2005. It is a compilation of the updated WHO guidelines for the management of common childhood illnesses at the first-referral level in low-resource countries. It presents relevant, up-to-date, evidence-based clinical guidelines that can be used by clinicians in their daily work in hospitals with basic laboratory facilities and inexpensive medicines. The guidelines focus on inpatient management of children who are severely ill with conditions that are major causes of childhood mortality, such as neonatal illness, pneumonia, diarrhoea, fever (mainly malaria, meningitis and septicaemia), severe acute malnutrition and HIV/AIDS. It also includes guidance on common surgical problems, appropriate supportive care and monitoring of patients on the ward.

The *Pocket book* is part of a series of tools for improving the quality of care for severely ill children and is consistent with the Integrated Management of Childhood Illness (IMCI) guidelines for outpatient management of sick children. It is for use by doctors, senior nurses and other senior health workers who are responsible for the care of young children at the first referral level in developing countries.

The first edition of the *Pocket book* was reviewed by a WHO guidelines steering committee, which identified those chapters that required updating, comprising:

- revisions to align the *Pocket book* with recently published, WHO-approved guidelines; and
- priorities for which new information had become available, which was collated, analysed and synthesized before updating.

In the first category, recommendations approved by the WHO Guidelines Review Committee were incorporated. The second category required synthesis of evidence and updates consistent with new recommendations. The changes made are therefore based on published WHO guidelines and recommendations as of 2012, which are listed in the bibliography on p. 329; in addition, certain subsections were added or removed, others reorganized and some editorial changes made on the basis of feedback from *Pocket book* users. In response to users' feedback and the popularity of the first edition, the presentation is similar.

All the changes were reviewed by external clinical experts and were approved by the WHO Guidelines Review Committee. A web version of the *Pocket book* will be updated regularly as new evidence with clinical implications emerges. Printed editions will be published every 5 years if there are substantial new changes. Users are therefore advised to check the WHO web site regularly for *Pocket book* updates (http://www.who.int/maternal_child_adolescent/en/).

The main changes in the second edition are listed below.

Chapters unchanged from the first edition of the *Pocket book* (2005):

Chapters with only editorial changes or reorganization but with no major update of previous information:

- Chapter 1. Triage and emergency conditions
- Chapter 2. Diagnostic approaches to the sick child
- Chapter 5. Diarrhoea
- Chapter 9. Common surgical problems
- Chapter 11. Monitoring the child's progress
- Chapter 12. Counselling and discharge from hospital
- Annexes 1, 3 and 6

Chapters substantially changed from the first edition of the *Pocket book* (2005):

Chapters with substantial changes to clinical guidance or which have been restructured are:

- Chapter 3. Problems of the neonate and young infant
- Chapter 4. Cough or difficulty in breathing
- Chapter 6. Fever
- Chapter 7. Severe acute malnutrition
- Chapter 8. Children with HIV/AIDS
- Chapter 10. Supportive care
- Annexes 2, 4 and 5

Additional sections or subsections in this second edition

Several sections of some chapters were added or substantially expanded in response to demand from users:

- Chapter 1, section 1.10. Trauma and injuries
- Chapter 3, section 3.7. Convulsions or fits
- Chapter 3, section 3.11.3. Respiratory distress syndrome
- Chapter 4, section 4.6.3. Epiglottitis
- Chapter 4, section 4.6.4. Anaphylaxis
- Chapter 4, section 4.9. Rheumatic heart disease
- Chapter 6, section 6.11. Rheumatic fever
- Chapter 8, section 8.5. Prevention of mother to child HIV transmission, and infant feeding

The *Pocket book* is presented in a format that could be carried by doctors, nurses and other health workers during their daily work and be available to help guide the management of sick children. Although some new topics have been added, standard textbooks of paediatrics should be consulted for rarer conditions not covered in the *Pocket book*. These guidelines are applicable in most areas of the world and may be adapted by countries to suit their specific circumstances.

WHO recommends that countries should locally adapt the *Pocket book* to include important conditions not covered and believes its widespread adoption would improve the care of children in hospital and lead to lower case fatality rates.

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Abbreviations

AIDS	acquired immunodeficiency syndrome
ART	antiretroviral therapy
AVPU	a lert, responding to v oice, responding to p ain, u nconscious (simple consciousness scale)
BCG	bacille Calmette-Guérin
CSF	cerebrospinal fluid
DPT	diphtheria, pertussis, tetanus
EVF	erythrocyte volume fraction (haematocrit)
Hb	haemoglobin
HIV	human immunodeficiency virus
IM	intramuscular (injection), intramuscularly
IMCI	Integrated Management of Childhood Illness
IV	intravenous (injection), intravenously
MDR	multidrug-resistant
NNRTI	non-nucleoside reverse transcriptase inhibitor
NRTI	nucleoside reverse transcriptase inhibitor
NSAID	non-steroidal anti-inflammatory drug
ORS	oral rehydration salt(s)
PCP	<i>Pneumocystis carinii</i> pneumonia
ReSoMal	rehydration solution for malnutrition
SD	standard deviation
TB	tuberculosis
WHO	World Health Organization

Symbols

- diagnostic sign or symptom
- treatment recommendation

Chart 1. Stages in the management of a sick child admitted to hospital: key elements

TRIAGE

- Check for emergency signs (present) → Give **emergency treatment** until stable
- (absent)
- Check for priority signs or conditions

HISTORY AND EXAMINATION

(including assessment of vaccination status, nutritional status and feeding)

- Check children with emergency and priority conditions first.

Laboratory and other investigations, if required

List and consider **differential diagnoses**

Select main diagnoses (and secondary diagnoses)

Plan and begin **inpatient treatment** (including supportive care)

Plan and begin **outpatient treatment**.

Arrange **follow-up**, if required.

Monitor for signs of
— improvement
— complications
— failure of treatment.

(not improving or new problem)

(improving)

Reassess
for causes of failure of
treatment.

Continue treatment.
Plan discharge.

Revise treatment.

Discharge home.
Arrange continuing care or
follow-up at hospital or in
the community.

CHAPTER 1

Triage and emergency conditions

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1.1 Triage

Triage is the process of rapidly screening sick children soon after their arrival in hospital, in order to identify:

- those with **emergency signs**, who require immediate emergency treatment;
- those with **priority signs**, who should be given priority in the queue so that they can be assessed and treated without delay; and
- non-urgent cases, who have neither emergency nor priority signs.

Emergency signs include:

- obstructed or absent breathing
- severe respiratory distress
- central cyanosis
- signs of shock (cold hands, capillary refill time longer than 3 s, high heart rate with weak pulse, and low or unmeasurable blood pressure)
- coma (or seriously reduced level of consciousness)
- convulsions
- signs of severe dehydration in a child with diarrhoea (lethargy, sunken eyes, very slow return after pinching the skin or any two of these).

Children with these signs require **immediate** emergency treatment to avert death.

The **priority signs** (see p. 6) identify children who are at higher risk of dying. These children should be **assessed without unnecessary delay**. If a child has one or more emergency signs, don't spend time looking for priority signs.

1.2 Summary of steps in emergency triage assessment and treatment

Steps in emergency triage assessment and treatment are summarized in the charts on pp. 5–17.

First check for **emergency signs** in three steps:

- **Step 1.** Check whether there is any airway or breathing problem; start immediate treatment to restore breathing. Manage the airway and give oxygen.
- **Step 2.** Quickly check whether the child is in shock or has diarrhoea with severe dehydration. Give oxygen and start IV fluid resuscitation. In trauma, if there is external bleeding, compress the wound to stop further blood loss.
- **Step 3.** Quickly determine whether the child is unconscious or convulsing. Give IV glucose for hypoglycaemia and/or an anti-convulsant for convulsing.

If emergency signs are found:

- Call for help from an experienced health professional if available, but do not delay starting treatment. Stay calm and work with other health workers who may be required to give the treatment, because a very sick child may need several treatments at once. The most experienced health professional should continue assessing the child (see Chapter 2, p. 41), to identify all underlying problems and prepare a treatment plan.
- Carry out emergency investigations (blood glucose, blood smear, haemoglobin [Hb]). Send blood for typing and cross-matching if the child is in shock, appears to be severely anaemic or is bleeding significantly.
- After giving emergency treatment, proceed immediately to assessing, diagnosing and treating the underlying problem.

Tables of common differential diagnoses for emergency signs are provided from p. 21 onwards.

If no emergency signs are found, check for priority signs:

- **Tiny infant:** any sick child aged < 2 months
- **Temperature:** child is very hot
- **Trauma** or other urgent surgical condition
- **Pallor** (severe)
- **Poisoning** (history of)
- **Pain** (severe)
- **Respiratory distress**
- **Restless**, continuously irritable or lethargic

ASSESSMENT OF EMERGENCY AND PRIORITY SIGNS

- Referral (urgent)
- Malnutrition: visible severe wasting
- Oedema of both feet
- Burns (major)

The above can be remembered from the mnemonic **3TPR MOB**.

These children need prompt assessment (no waiting in the queue) to determine what further treatment is needed. Move a child with any priority sign to the front of the queue to be assessed next. If a child has trauma or other surgical problems, get surgical help where available.

1.3 Assessment of emergency and priority signs

■ Assess the airway and breathing (A, B)

Does the child's breathing appear to be obstructed? Look at the chest wall movement, and listen to breath sounds to determine whether there is poor air movement during breathing. Stridor indicates obstruction.

Is there central cyanosis? Determine whether there is bluish or purplish discoloration of the tongue and the inside of the mouth.

Is the child breathing? Look and listen to determine whether the child is breathing.

Is there severe respiratory distress? The breathing is very laboured, fast or gasping, with chest indrawing, nasal flaring, grunting or the use of auxiliary muscles for breathing (head nodding). Child is unable to feed because of respiratory distress and tires easily.

■ Assess circulation (for shock) (C)

Children in shock who require bolus fluid resuscitation are lethargic and have cold skin, prolonged capillary refill, fast weak pulse and hypotension.

Check whether the child's hand is cold. If so, determine whether the child is in shock.

Check whether the capillary refill time is longer than 3 s. Apply pressure to whiten the nail of the thumb or the big toe for 5 s. Determine the time from the moment of release until total recovery of the pink colour.

If capillary refill is longer than 3 s, check the pulse. Is it weak and fast? If the radial pulse is strong and not obviously fast, the child is **not** in shock. If you cannot feel the radial pulse of an infant (< 1 year old), feel the brachial pulse or, if the infant is lying down, the femoral pulse. If you cannot feel the radial pulse of a child, feel the carotid.

Chart 2. Triage of all sick children

Emergency signs:

If any sign is positive, call for help, assess and resuscitate, give treatment(s), draw blood for emergency laboratory investigations (glucose, malaria smear, Hb)

ASSESS

Airway and breathing

- Obstructed or absent breathing
or
- Central cyanosis
or
- Severe respiratory distress

**ANY SIGN
POSITIVE**

Circulation

Cold skin with:

- Capillary refill longer than 3 s
and
- Weak and fast pulse

**SIGNS
POSITIVE**

*Check for
severe
malnutrition*

TREAT

Do not move neck if a cervical spine injury is possible, but open the airway.

If foreign body aspirated

- ▶ Manage airway in choking child (Chart 3)

If no foreign body aspirated

- ▶ Manage airway (Chart 4)
- ▶ Give oxygen (Chart 5)
- ▶ Make sure the child is warm

- ▶ Stop any bleeding
- ▶ Give oxygen (Chart 5)
- ▶ Make sure the child is warm.

If no severe malnutrition

- ▶ Insert an IV line and begin giving fluids rapidly (Chart 7).

If peripheral IV cannot be inserted, insert an intraosseous or external jugular line (see pp. 340, 342).

If severe malnutrition:

If lethargic or unconscious:

- ▶ Give IV glucose (Chart 10).
- ▶ Insert IV line and give fluids (Chart 8).

If not lethargic or unconscious:

- ▶ Give glucose orally or by nasogastric tube.
- ▶ Proceed immediately to full assessment and treatment.

Chart 2. Triage of all sick children

Emergency signs:

If any sign is positive: call for help, assess and resuscitate, give treatment(s), draw blood for emergency laboratory investigations (glucose, malaria smear, Hb)

ASSESS

Coma/ convulsing

- Coma
or
- Convulsing
(now)

**IF COMA OR
CONVULSION**

Severe dehydration

(only in a child
with diarrhoea)

Diarrhoea plus
any two of these
signs:

- Lethargy
- Sunken eyes
- Very slow skin pinch
- Unable to drink or drinks
poorly

**DIARRHOEA
PLUS**

**two signs
positive**

*Check for
severe
malnutrition*

TREAT

Do not move neck if you suspect cervical spine injury, but open the airway.

- ▶ Manage the airway (Chart 4)
- ▶ If convulsing, give diazepam rectally (Chart 9)
- ▶ Position the unconscious child (if head or neck trauma is suspected, stabilize the neck first) (Chart 6).
- ▶ Give IV glucose (Chart 10).

- ▶ Make sure the child is warm.

If no severe malnutrition:

- ▶ Insert an IV line and begin giving fluids rapidly following Chart 11 and diarrhoea treatment plan C in hospital (Chart 13, p. 131).

If severe malnutrition:

- ▶ Do not insert an IV line.
- ▶ Proceed immediately to full assessment and treatment (see section 1.4, p. 19).

PRIORITY SIGNS

These children need prompt assessment and treatment

- Tiny infant (< 2 months)
- Temperature very high
- Trauma or other urgent surgical condition
- Pallor (severe)
- Poisoning (history of)
- Pain (severe)
- Respiratory distress
- Restless, continuously irritable, or lethargic
- Referral (urgent)
- Malnutrition: visible severe wasting
- Oedema of both feet or face
- Burns (major)

Note: If a child has trauma or other surgical problems, get surgical help or follow surgical guidelines.

NON-URGENT

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

Chart 3. How to manage a choking infant***Back slaps***

- ▶ Lay the infant on your arm or thigh in a head-down position.
- ▶ Give five blows to the middle of the infant's back with the heel of the hand.
- ▶ If obstruction persists, turn the infant over and give five chest thrusts with two fingers on the lower half of the sternum.

***Chest thrusts***

- ▶ If obstruction persists, check infant's mouth for any obstruction that can be removed.
- ▶ If necessary, repeat sequence with back slaps.

Chart 3. How to manage a choking child (> 1 year of age)*Back blows to clear airway obstruction in a choking child*

Administer back blows to clear airway obstruction in a choking child.

- ▶ Give five blows to the middle of the child's back with the heel of the hand, with the child sitting, kneeling or lying.
- ▶ If the obstruction persists, go behind the child and pass your arms around the child's body; form a fist with one hand immediately below the child's sternum; place the other hand over the fist and pull upwards into the abdomen (see diagram); repeat this Heimlich manoeuvre five times.
- ▶ If the obstruction persists, check the child's mouth for any obstruction that can be removed.
- ▶ If necessary, repeat this sequence with back blows.

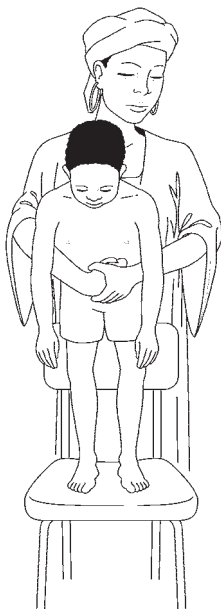
*Heimlich manoeuvre for a choking older child*

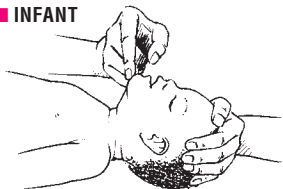
Chart 4. How to manage the airway in a child with obstructed breathing (or who has just stopped breathing)

A: When no neck trauma is suspected

Child conscious

1. Inspect mouth and remove foreign body, if present.
2. Clear secretions from the throat.
3. Let child assume position of maximal comfort.

■ INFANT



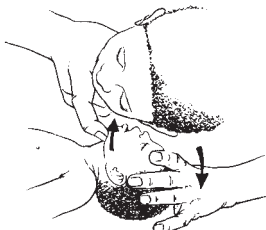
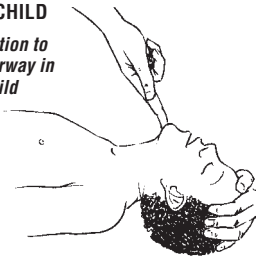
Neutral position to open the airway in an infant

Child unconscious

1. Tilt the head as shown, keep it tilted and lift chin to open airway.
2. Inspect mouth and remove foreign body if present and easily visible.
3. Clear secretions from the throat.
4. Check the airway by looking for chest movements, listening for breath sounds and feeling for breath (see diagram).

■ OLDER CHILD

Tilting position to open the airway in an older child



Look, listen and feel for breathing

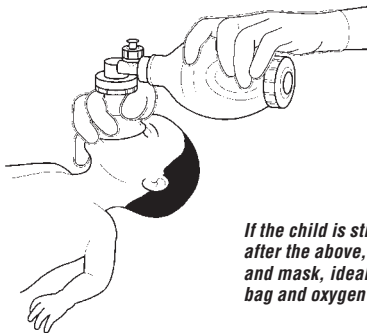
Chart 4. How to manage the airway in a child with obstructed breathing (or who has just stopped breathing)

B: When neck trauma or cervical spine injury is suspected: jaw thrust

1. Stabilize the neck as shown in Chart 6, and open the airway.
2. Inspect mouth and remove foreign body, if present.
3. Clear secretions from throat under direct vision.
4. Check the airway by looking for chest movements, listening for breath sounds and feeling for breath.



Use jaw thrust if airway are still not open. Place the fourth and fifth fingers behind the angle of the jaw and move it upwards so that the bottom of the jaw is thrust forwards, at 90° to the body



If the child is still not breathing after the above, ventilate with bag and mask, ideally with a reservoir bag and oxygen

Chart 5. How to give oxygen

Give oxygen through nasal prongs or a nasal catheter.

■ NASAL PRONGS

- ▶ Place the prongs just inside the nostrils and secure with tape.



■ NASAL CATHETER

- ▶ Use an 8 French gauge size tube
- ▶ Measure the distance from the side of the nostril to the inner eyebrow margin with the catheter.
- ▶ Insert the catheter as shown in the diagram.
- ▶ Secure with tape.

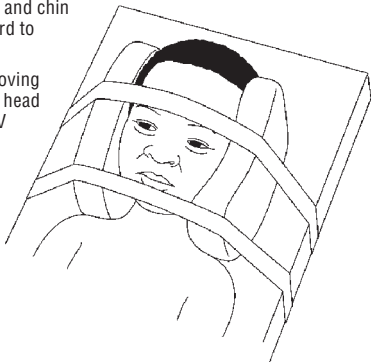


Start oxygen flow at 1–2 litres/min to aim for an oxygen saturation > 90% (see section 10.7, p. 312).

Chart 6. How to position an unconscious child

■ If neck trauma is suspected:

- ▶ Stabilize the child's neck and keep the child lying on the back.
- ▶ Tape the child's forehead and chin to the sides of a firm board to secure this position.
- ▶ Prevent the neck from moving by supporting the child's head (e.g. using litre bags of IV fluid on each side).
- ▶ If the child is vomiting, turn on the side, keeping the head in line with the body.



■ If neck trauma is not suspected:

- ▶ Turn the child on the side to reduce risk of aspiration.
- ▶ Keep the neck slightly extended, and stabilize by placing cheek on one hand.
- ▶ Bend one leg to stabilize the body position.



Chart 7. How to give intravenous fluids to a child in shock without severe malnutrition

- ▶ Check that the child is not severely malnourished, as the fluid volume and rate are different. (Shock with severe malnutrition, see Chart 8.)
- ▶ Insert an IV line (and draw blood for emergency laboratory investigations).
- ▶ Attach Ringer's lactate or normal saline; make sure the infusion is running well.
- ▶ Infuse 20 ml/kg as rapidly as possible.

Age (weight)	Volume of Ringer's lactate or normal saline solution (20 ml/kg)
2 months (< 4 kg)	50 ml
2–< 4 months (4–< 6 kg)	100 ml
4–< 12 months (6–< 10 kg)	150 ml
1–< 3 years (10–< 14 kg)	250 ml
3–< 5 years (14–19 kg)	350 ml

Reassess the child after the appropriate volume has run in.

Reassess after first infusion:	<ul style="list-style-type: none"> • If no improvement, repeat 10–20 ml/kg as rapidly as possible. • If bleeding, give blood at 20 ml/kg over 30 min, and observe closely.
Reassess after second infusion:	<ul style="list-style-type: none"> • If no improvement with signs of dehydration (as in profuse diarrhoea or cholera), repeat 20 ml/kg of Ringer's lactate or normal saline. • If no improvement, with suspected septic shock, repeat 20 ml/kg and consider adrenaline or dopamine if available (see Annex 2, p. 353). • If no improvement, see disease-specific treatment guidelines. You should have established a provisional diagnosis by now.

After improvement at **any stage** (pulse volume increases, heart rate slows, blood pressure increases by 10% or normalizes, faster capillary refill < 2 s), go to Chart 11, p. 17.

Note: In children with suspected malaria or anaemia with shock, rapid fluid infusion must be administered cautiously, or blood transfusion should be given in severe anaemia instead.

Chart 8. How to give intravenous fluids to a child in shock with severe malnutrition

Give this treatment only if the child has signs of shock (usually there will also be a *reduced level of consciousness, i.e. lethargy or loss of consciousness*):

- ▶ Insert an IV line (and draw blood for emergency laboratory investigations).
- ▶ Weigh the child (or estimate the weight) to calculate the volume of fluid to be given.
- ▶ Give IV fluid at 15 ml/kg over 1 h. Use one of the following solutions according to availability:
 - Ringer's lactate with 5% glucose (dextrose);
 - Half-strength Darrow's solution with 5% glucose (dextrose);
 - 0.45% NaCl plus 5% glucose (dextrose).

Weight	Volume of IV fluid Give over 1 h (15 ml/kg)	Weight	Volume of IV fluid Give over 1 h (15 ml/kg)
4 kg	60 ml	12 kg	180 ml
6 kg	90 ml	14 kg	210 ml
8 kg	120 ml	16 kg	240 ml
10 kg	150 ml	18 kg	270 ml

- ▶ Measure the pulse rate and volume and breathing rate at the start and every 5–10 min.

If there are signs of improvement (pulse rate falls, pulse volume increases or respiratory rate falls) and no evidence of pulmonary oedema

- repeat IV infusion at 15 ml/kg over 1 h; then
- switch to oral or nasogastric rehydration with ReSoMal at 10 ml/kg per h up to 10 h (see p. 204);
- initiate re-feeding with starter F-75 (see p. 209).

If the child fails to improve after two IV boluses of 15 ml/kg,

- give maintenance IV fluid (4 ml/kg per h) while waiting for blood;
- when blood is available, transfuse fresh whole blood at 10 ml/kg slowly over 3 h (use packed cells if the child is in cardiac failure); then
- initiate re-feeding with starter F-75 (see p. 209);
- start IV antibiotic treatment (see p. 207).

If the child deteriorates during IV rehydration (breathing rate increases by 5/min and pulse rate increases by 15/min, liver enlarges, fine crackles throughout lung fields, jugular venous pressure increases, galloping heart rhythm develops), stop the infusion, because IV fluid can worsen the child's condition by inducing pulmonary oedema.

Chart 9. How to give diazepam rectally

■ Give diazepam rectally:

- ▶ Draw up the dose from an ampoule of diazepam into a tuberculin (1-ml) syringe. Base the dose on the weight of the child, when possible. Then remove the needle.
- ▶ Insert the syringe 4–5 cm into the rectum, and inject the diazepam solution.
- ▶ Hold the buttocks together for a few minutes.

Age (weight)	Diazepam given rectally 10 mg/2 ml solution
	Dose 0.1 ml/kg
2 weeks to 2 months (< 4 kg) ^a	0.3 ml
2–< 4 months (4–< 6 kg)	0.5 ml
4–< 12 months (6–< 10 kg)	1.0 ml
1–< 3 years (10–< 14 kg)	1.25 ml
3–< 5 years (14–19 kg)	1.5 ml

^a Use phenobarbital (200 mg/ml solution) at a dose of 20 mg/kg to control convulsions in infants < 2 weeks of age:

Weight 2 kg – initial dose, 0.2 ml; repeat 0.1 ml after 30 min	} If convulsions continue
Weight 3 kg – initial dose, 0.3 ml; repeat 0.15 ml after 30 min	

If convulsions continue after 10 min, give a second dose of diazepam (or give diazepam IV at 0.05 ml/kg = 0.25 mg/kg if IV infusion is running).

Do not give more than two doses of diazepam.

If convulsions continue after another 10 min, suspect status epilepticus:

- ▶ Give phenobarbital IM or IV at 15 mg/kg over 15 min;
- or
- ▶ Phenytoin at 15–18 mg/kg IV (through a different line from diazepam) over 60 min. Ensure a very good IV line, as the drug is caustic and will cause local damage if it extravasates.

■ If high fever:

- ▶ Undress the child to reduce the fever.
- ▶ Do not give any oral medication until the convulsion has been controlled (danger of aspiration).
- ▶ After convulsions stop and child is able to take orally, give paracetamol or ibuprofen.

Warning: Always have a working bag and mask of appropriate size available in case the patient stops breathing, especially when diazepam is given.

Chart 10. How to give glucose intravenously

- ▶ Insert an IV line, and draw blood for emergency laboratory investigations.
- ▶ Check blood glucose with a glucose monitoring stick. If the level is < 2.5 mmol/litre (45 mg/dl) in a well-nourished or < 3 mmol/litre (54 mg/dl) in a severely malnourished child or if blood glucose cannot be measured as no stick test is available, treat as for hypoglycaemia:
- ▶ Give 5 ml/kg of 10% glucose solution rapidly by IV injection

Age (weight)	Volume of 10% glucose solution as bolus (5 ml/kg)
< 2 months (< 4 kg)	15 ml
2–< 4 months (4–< 6 kg)	25 ml
4–< 12 months (6–< 10 kg)	40 ml
1–< 3 years (10–< 14 kg)	60 ml
3–< 5 years (14–< 19 kg)	80 ml

- ▶ Recheck the blood glucose in 30 min. If it is still low, repeat 5 ml/kg of 10% glucose solution.
- ▶ Feed the child as soon as he or she is conscious.
If the child is unable to feed without danger of aspiration, give:
 - milk or sugar solution via a nasogastric tube (to make sugar solution, dissolve four level teaspoons of sugar (20 g) in a 200-ml cup of clean water), or
 - IV fluids containing 5–10% glucose (dextrose) (see Annex 4, p. 377)

Note: 50% glucose solution is the same as 50% dextrose solution.

If only 50% glucose solution is available: dilute one part 50% glucose solution in four parts sterile water, or dilute one part 50% glucose solution in nine parts 5% glucose solution. For example, 10 ml 50% solution with 90 ml 5% solution gives 100 ml of approximately a 10% solution.

Note: To use blood glucose stick tests, refer to instructions on box. Generally, the strip must be stored in its box at 2–3 °C, avoiding sunlight or high humidity. A drop of blood should be placed on the strip (it should cover all the reagent area). After 60 s, the blood should be washed off gently with drops of cold water and the colour compared with the key on the bottle or on the blood glucose reader. (The exact procedure varies for different strips.)

Note: Sublingual sugar may be used as an immediate 'first aid' measure in managing hypoglycaemia if IV access is impossible or delayed. Place one level teaspoonful of sugar moistened with water under the tongue every 10–20 min.

Chart 11. How to treat severe dehydration in an emergency after initial management of shock

For children with severe dehydration but without shock, refer to diarrhoea treatment plan C, p. 131.

If the child is in shock, first follow the instructions in Charts 7 and 8 (pp. 13 and 14). Switch to the chart below when the child's pulse becomes slower or capillary refill is faster.

- ▶ Give 70 ml/kg of Ringer's lactate (Hartmann's) solution (or, if not available, normal saline) over 5 h to infants (aged < 12 months) and over 2.5 h to children (aged 12 months to 5 years).

Weight	Total volume IV fluid (volume per hour)	
	Age < 12 months Give over 5 h	Age 12 months to 5 years Give over 2.5 h
< 4 kg	200 ml (40 ml/h)	–
4–6 kg	350 ml (70 ml/h)	–
6–10 kg	550 ml (110 ml/h)	550 ml (220 ml/h)
10–14 kg	850 ml (170 ml/h)	850 ml (340 ml/h)
14–19 kg	–	1200 ml (480 ml/h)

Reassess the child every 1–2 h. If the hydration status is not improving, give the IV drip more rapidly.

Also give oral rehydration salt (ORS) solution (about 5 ml/kg per h) as soon as the child can drink, usually after 3–4 h (in infants) or 1–2 h (in children).

Weight	Volume of ORS solution per hour
< 4 kg	15 ml
4–6 kg	25 ml
6–10 kg	40 ml
10–14 kg	60 ml
14–19 kg	85 ml

Reassess after 6 h for infants and after 3 h for children. Classify dehydration. Then choose the appropriate plan A, B or C (pp. 138, 135, 131) to continue treatment.

If possible, observe the child for at least 6 h after rehydration to be sure that the mother can maintain hydration by giving the child ORS solution by mouth.

ASSESSMENT OF EMERGENCY AND PRIORITY SIGNS

If the room is very cold, rely on the pulse to determine whether the child is in shock.

Check whether the systolic blood pressure is low for the child's age (see Table below). Shock may be present with normal blood pressure, but very low blood pressure means the child is in shock.

Normal blood pressure ranges in infants and children

Age	Systolic blood pressure
Premature	55–75
0–3 months	65–85
3–6 months	70–90
6–12 months	80–100
1–3 years	90–105
3–6 years	95–110

■ Assess for coma or convulsions or other abnormal mental status (C)

Is the child in coma? Check the level of consciousness on the 'AVPU' scale:

- A** alert,
- V** responds to voice,
- P** responds to pain,
- U** unconscious.

If the child is not awake and alert, try to rouse the child by talking or shaking the arm. If the child is not alert but responds to voice, he or she is lethargic. If there is no response, ask the mother whether the child has been abnormally sleepy or difficult to wake. Determine whether the child responds to pain or is unresponsive to a painful stimulus. If this is the case, the child is in coma (unconscious) and needs emergency treatment.

Is the child convulsing? Are there spasmodic repeated movements in an unresponsive child?

■ Assess the child for severe dehydration if he or she has diarrhoea

Does the child have sunken eyes? Ask the mother if the child's eyes are more sunken than usual.

Does a skin pinch go back very slowly (longer than 2 s)? Pinch the skin of the abdomen halfway between the umbilicus and the side for 1 s, then release and observe.

■ Assess for priority signs

While assessing the child for emergency signs, you will have noted several possible priority signs:

Is there any respiratory distress (not severe)?

Is the child lethargic or continuously irritable or restless?

This was noted when you assessed for coma.

Note the other priority signs (see p. 6).

1.4 Emergency treatment for a child with severe malnutrition

During triage, all children with severe malnutrition will be identified as having priority signs, which means that they require prompt assessment and treatment.

A few children with severe malnutrition will be found during triage assessment to have **emergency signs**.

Those with emergency signs for ‘airway and breathing’ or ‘coma or convulsions’ should receive emergency treatment accordingly (see charts on pp. 5–17).

- Those with signs of severe dehydration but not in shock should not be rehydrated with IV fluids, because severe dehydration is difficult to diagnose in severe malnutrition and is often misdiagnosed. Giving IV fluids puts these children at risk of over-hydration and death from heart failure. Therefore, these children should be rehydrated orally with the special rehydration solution for severe malnutrition (ReSoMal). See Chapter 7 (p. 204).
- In severe malnutrition, individual emergency signs of shock may be present even when there is no shock. Malnourished children with many signs of shock: lethargy, reduced level of consciousness, cold skin, prolonged capillary refill and fast weak pulse, should receive additional fluids for shock as above.
- Treatment of a malnourished child for shock differs from that for a well-nourished child, because shock from dehydration and sepsis are likely to coexist, and these are difficult to differentiate on clinical grounds alone, and because children with severe malnutrition may not cope with large amounts of water and salt. The amount of fluid given should be guided by the child’s response. Avoid over-hydration. Monitor the pulse and breathing at the start and every 5–10 min to check whether they are improving. Note that the type of IV fluid differs for severe malnutrition, and the infusion rate is slower.

All severely malnourished children require prompt assessment and treatment to deal with serious problems such as hypoglycaemia, hypothermia, severe

infection, severe anaemia and potentially blinding eye problems. It is equally important to take prompt action to prevent some of these problems, if they were not present at the time of admission to hospital.

1.5 Diagnostic considerations for children with emergency conditions

The following text provides guidance for approaches to the diagnosis and differential diagnosis of presenting conditions for which emergency treatment has been given. After you have stabilized the child and provided emergency treatment, determine the underlying cause of the problem, in order to provide specific curative treatment. The following lists and tables are complemented by the tables in the disease-specific chapters.

1.5.1 Child presenting with an airway or severe breathing problem

History

- Onset of symptoms: slow or sudden
- Previous similar episodes
- Upper respiratory tract infection
- Cough and duration in days
- History of choking
- Present since birth or acquired
- Vaccination history: diphtheria, pertussis, tetanus (DPT), measles
- Known HIV infection
- Family history of asthma

Examination

- Cough and quality of cough
- Cyanosis
- Respiratory distress
- Grunting
- Stridor, abnormal breath sounds
- Nasal flaring
- Swelling of the neck
- Crepitations
- Wheezing
 - generalized
 - focal
- Reduced air entry
 - generalized
 - focal

Table 1. Differential diagnosis in a child presenting with an airway or severe breathing problem

Diagnosis or underlying cause	In favour
Pneumonia	<ul style="list-style-type: none"> – Cough with fast breathing and fever – Grunting or difficulty in breathing – Development over days, getting worse – Crepitations on auscultation – Signs of consolidation or effusion
Asthma	<ul style="list-style-type: none"> – History of recurrent wheezing – Prolonged expiration – Wheezing or reduced air entry – Response to bronchodilators
Foreign body aspiration	<ul style="list-style-type: none"> – History of sudden choking – Sudden onset of stridor or respiratory distress – Focal reduced air entry or wheeze
Retropharyngeal abscess	<ul style="list-style-type: none"> – Slow development over days, getting worse – Inability to swallow – High fever
Croup	<ul style="list-style-type: none"> – Barking cough – Hoarse voice – Associated with upper respiratory tract infection – Stridor on inspiration – Signs of respiratory distress
Diphtheria	<ul style="list-style-type: none"> – ‘Bull neck’ appearance due to enlarged lymph nodes – Signs of airway obstruction with stridor and recession – Grey pharyngeal membrane – No DPT vaccination

1.5.2 Child presenting with shock

History

- Acute or sudden onset
- Trauma
- Bleeding
- History of congenital or rheumatic heart disease
- History of diarrhoea
- Any febrile illness

CHILD PRESENTING WITH SHOCK

- Known dengue outbreak
- Known meningitis outbreak
- Fever
- Able to feed

Examination

- Consciousness level
- Any bleeding sites
- Cold or warm extremities
- Neck veins (elevated jugular venous pressure)
- Pulse volume and rate
- Blood pressure
- Liver size increased
- Petechiae
- Purpura

Table 2. Differential diagnosis in a child presenting with shock

Children with shock are lethargic, have fast breathing, cold skin, prolonged capillary refill, fast weak pulse and may have low blood pressure as a late sign. To help make a specific diagnosis of the cause of shock, look for the signs below.

Diagnosis or underlying cause	In favour
Bleeding shock	<ul style="list-style-type: none"> – History of trauma – Bleeding site
Dengue shock syndrome	<ul style="list-style-type: none"> – Known dengue outbreak or season – History of high fever – Purpura
Cardiac shock	<ul style="list-style-type: none"> – History of heart disease or heart murmur – Enlarged neck veins and liver – Crepitations in both lung fields
Septic shock	<ul style="list-style-type: none"> – History of febrile illness – Very ill child – Skin may be warm but blood pressure low, or skin may be cold – Purpura may be present or history of meningococcal outbreak
Shock associated with severe dehydration	<ul style="list-style-type: none"> – History of profuse diarrhoea – Known cholera outbreak

1.5.3 Child presenting with lethargy, unconsciousness or convulsions

History

- Fever
- Head injury
- Drug overdose or toxin ingestion
- Convulsions: How long do they last? Have there been previous febrile convulsions? Epilepsy?

In the case of an infant < 1 week old, consider history of:

- birth asphyxia
- birth injury to the brain

Examination

General

- Jaundice
- Severe palmar pallor
- Peripheral or facial oedema (suggesting renal failure)
- Level of consciousness
- Petechial rash
- Blood pressure
- Determine AVPU score (see p. 18).

Head and neck

- Stiff neck
- Signs of head trauma or other injuries
- Pupil size and reactions to light
- Tense or bulging fontanelle
- Abnormal posture, especially opisthotonus (arched back).

The coma scale score should be monitored regularly. In young infants < 1 week old, note the time between birth and the onset of unconsciousness. Other causes of lethargy, unconsciousness or convulsions in some regions of the world include malaria, Japanese encephalitis, dengue haemorrhagic fever, measles encephalitis, typhoid and relapsing fever.

Laboratory investigations

- If meningitis is suspected and the child has no signs of raised intracranial pressure (unequal pupils, rigid posture, paralysis of limbs or trunk, irregular breathing), perform a lumbar puncture.

CHILD PRESENTING WITH LETHARGY, UNCONSCIOUSNESS OR CONVULSIONS

- In a malarious area, perform a rapid malaria diagnostic test and prepare a blood smear.
- If the child is unconscious, check the blood glucose. If not possible, then treat as hypoglycaemia; if the level of consciousness improves, presume hypoglycaemia.
- Carry out urine microscopy if possible.

Table 3. Differential diagnosis in a child presenting with lethargy, unconsciousness or convulsions

Diagnosis or underlying cause	In favour
Meningitis ^{a,b}	<ul style="list-style-type: none"> – Very irritable – Stiff neck or bulging fontanelle – Petechial rash (meningococcal meningitis only) – Opisthotonus
Cerebral malaria (only in children exposed to <i>P. falciparum</i> ; often seasonal)	<ul style="list-style-type: none"> – Blood smear or rapid diagnostic test positive for malaria parasites – Jaundice – Anaemia – Convulsions – Hypoglycaemia
Febrile convulsions (not likely to be the cause of unconsciousness)	<ul style="list-style-type: none"> – Prior episodes of short convulsions when febrile – Associated with fever – Age 6 months to 5 years – Blood smear normal
Hypoglycaemia (always seek the cause, e.g. severe malaria, and treat the cause to prevent a recurrence)	<ul style="list-style-type: none"> – Blood glucose low (< 2.5 mmol/litre (< 45 mg/dl) or < 3.0 mmol/litre (< 54 mg/dl) in a severely malnourished child); responds to glucose treatment
Head injury	<ul style="list-style-type: none"> – Signs or history of head trauma
Poisoning	<ul style="list-style-type: none"> – History of poison ingestion or drug overdose
Shock (can cause lethargy or unconsciousness, but is unlikely to cause convulsions)	<ul style="list-style-type: none"> – Poor perfusion – Rapid, weak pulse

Table 3. Continued

Diagnosis or underlying cause	In favour
Acute glomerulonephritis with encephalopathy	<ul style="list-style-type: none"> – Raised blood pressure – Peripheral or facial oedema – Blood and/or protein in urine – Decreased or no urine
Diabetic ketoacidosis	<ul style="list-style-type: none"> – High blood sugar – History of polydipsia and polyuria – Acidotic (deep, laboured) breathing

^a The differential diagnosis of meningitis may include encephalitis, cerebral abscess or tuberculous meningitis. Consult a standard textbook of paediatrics for further guidance.

^b A lumbar puncture should not be done if there are signs of raised intracranial pressure (see section 6.3, p. 167 and A1.4, p. 346). A positive lumbar puncture may show cloudy cerebrospinal fluid (CSF) on direct visual inspection, or CSF examination shows an abnormal number of white cells (usually > 100 polymorphonuclear cells per ml in bacterial meningitis). Confirmation is given by a low CSF glucose (< 1.5 mmol/litre), high CSF protein (> 0.4 g/litre), organisms identified by Gram staining or a positive culture.

Table 4. Differential diagnosis in a young infant (< 2 months) presenting with lethargy, unconsciousness or convulsions

Diagnosis or underlying cause	In favour
Birth asphyxia Hypoxic ischaemic encephalopathy Birth trauma	<ul style="list-style-type: none"> – Onset in first 3 days of life – History of difficult delivery
Intracranial haemorrhage	<ul style="list-style-type: none"> – Onset in first 3 days of life in a low-birth-weight or preterm infant
Haemolytic disease of the newborn, kernicterus	<ul style="list-style-type: none"> – Onset in first 3 days of life – Jaundice – Pallor – Serious bacterial infection – No vitamin K given
Neonatal tetanus	<ul style="list-style-type: none"> – Onset at age 3–14 days – Irritability – Difficulty in breastfeeding – Trismus – Muscle spasms – Convulsions

Table 4. Continued

Diagnosis or underlying cause	In favour
Meningitis	<ul style="list-style-type: none"> – Lethargy – Apnoeic episodes – Convulsions – High-pitched cry – Tense or bulging fontanelle
Sepsis	<ul style="list-style-type: none"> – Fever or hypothermia – Shock (lethargy, fast breathing, cold skin, prolonged capillary refill, fast weak pulse, and sometimes low blood pressure) – Seriously ill with no apparent cause

For poisoning and envenomation see below and p. 34.

1.6 Common poisoning

Suspect poisoning in any unexplained illness in a previously healthy child. Consult standard textbook of paediatrics for management of exposure to specific poisons and/or any local sources of expertise in the management of poisoning, for example a poison centre. Only the principles for managing ingestion of few common poisons are given here. Note that traditional medicines can be a source of poisoning.

Diagnosis

A diagnosis is based on a history from the child or carer, a clinical examination and the results of investigations, where appropriate.

- Obtain full details of the poisoning agent, the amount ingested and the time of ingestion. Attempt to identify the exact agent involved and ask to see the container, when relevant. Check that no other children were involved. The symptoms and signs depend on the agent ingested and therefore vary widely – see below.
- Check for signs of burns in or around the mouth or of stridor (upper airway or laryngeal damage), which suggest ingestion of corrosives.
- Admit all children who have deliberately ingested iron, pesticides, paracetamol or aspirin, narcotics or antidepressant drugs; and those who may have been given the drug or poison intentionally by another child or adult.
- Children who have ingested corrosives or petroleum products should not be sent home without observation for at least 6 h. Corrosives can cause

oesophageal burns, which may not be immediately apparent, and petroleum products, if aspirated, can cause pulmonary oedema, which may take some hours to develop.

1.6.1 Principles for ingested poisons

All children who present as poisoning cases should quickly be assessed for emergency signs (airway, breathing, circulation and level of consciousness), as some poisons depress breathing, cause shock or induce coma. Ingested poisons must be removed from the stomach.

Gastric decontamination is most effective within 1 h of ingestion. After this time, there is usually little benefit, except for agents that delay gastric emptying or in patients who are deeply unconscious. A decision to undertake gastric decontamination must weigh the likely benefits against the risks associated with each method. Gastric decontamination does not guarantee that all the substance has been removed, so the child may still be in danger.

Contraindications to gastric decontamination are:

- an unprotected airway in an unconscious child, except when the airway has been protected by intubation with an inflated tube by the anaesthetist
- ingestion of corrosives or petroleum products
- ▶ Check the child for emergency signs (see p. 2) and for hypoglycaemia; if blood glucose is not available and the child has a reduced level of consciousness, treat as if hypoglycaemia (p. 16).
- ▶ Identify the specific agent and remove or adsorb it as soon as possible. Treatment is most effective if given as quickly as possible after the poisoning event, ideally within 1 h.
- If the child swallowed kerosene, petrol or petrol-based products (note that most pesticides are in petrol-based solvents) or if the child's mouth and throat have been burnt (for example with bleach, toilet cleaner or battery acid), do not make the child vomit but give water or, if available, milk, orally. Call an anaesthetist to assess the airway.
- If the child has swallowed other poisons, never use salt as an emetic, as this can be fatal.
- ▶ Give activated charcoal, if available, and do not induce vomiting; give by mouth or nasogastric tube at the doses shown in Table 5. If a nasogastric tube is used, be particularly careful that the tube is in the stomach and not in the airway or lungs.

Table 5. Poisoning: Amount of activated charcoal per dose

Children \leq 1 year of age	1 g/kg
Children 1–12 years of age	25–50 g
Adolescents and adults	25–100 g

- Mix the charcoal in 8–10 volumes of water, e.g. 5 g in 40 ml of water.
- If possible, give the whole amount at once; if the child has difficulty in tolerating it, the charcoal dose can be divided.
- ▶ If charcoal is not available, then induce vomiting, but only if the child is conscious, and give an emetic such as paediatric ipecacuanha (10 ml for children aged 6 months to 2 years and 15 ml for those > 2 years). Note: Ipecacuanha can cause repeated vomiting, drowsiness and lethargy, which can confuse a diagnosis of poisoning. Never induce vomiting if a corrosive or petroleum-based poison has been ingested.

Gastric lavage

Undertake gastric lavage only if staff have experience in the procedure, if ingestion was less than 1 h previously and is life-threatening and if the child did not ingest corrosives or petroleum derivatives. Make sure a suction apparatus is available in case the child vomits. Place the child in the left lateral head-down position. Measure the length of tube to be inserted. Pass a 24–28 French gauge tube through the mouth into the stomach, as a smaller nasogastric tube is not sufficient to let particles such as tablets pass. Ensure the tube is in the stomach. Perform lavage with 10 ml/kg of normal saline (0.9%). The volume of lavage fluid returned should approximate the amount of fluid given. Lavage should be continued until the recovered lavage solution is clear of particulate matter.

Note that tracheal intubation by an anaesthetist may be required to reduce the risk of aspiration.

- ▶ Give a specific antidote if this is indicated.
- ▶ Give general care.
- ▶ Keep the child under observation for 4–24 h, depending on the poison swallowed.
- ▶ Keep unconscious children in the recovery position.
- ▶ Consider transferring the child to next level referral hospital only when appropriate and when this can be done safely, if the child is unconscious or has a deteriorating level of consciousness, has burns to the mouth and throat, is in severe respiratory distress, is cyanosed or is in heart failure.

1.6.2 Principles for poisons in contact with skin or eyes

Skin contamination

- ▶ Remove all clothing and personal effects, and thoroughly clean all exposed areas with copious amounts of tepid water. Use soap and water for oily substances. Attending staff should take care to protect themselves from secondary contamination by wearing gloves and aprons. Removed clothing and personal effects should be stored safely in a see-through plastic bag that can be sealed, for later cleansing or disposal.

Eye contamination

- ▶ Rinse the eye for 10–15 min with clean running water or normal saline, taking care that the run-off does not enter the other eye if the child is lying on the side, when it can run into the inner canthus and out the outer canthus. The use of anaesthetic eye drops will assist irrigation. Evert the eyelids and ensure that all surfaces are rinsed. When possible, the eye should be thoroughly examined under fluorescein staining for signs of corneal damage. If there is significant conjunctival or corneal damage, the child should be seen urgently by an ophthalmologist.

1.6.3 Principles for inhaled poisons

- ▶ Remove the child from the source of exposure.
- ▶ Urgently call for help.
- ▶ Administer supplementary oxygen if the child has respiratory distress, is cyanosed or has oxygen saturation $\leq 90\%$.
- ▶ Inhalation of irritant gases may cause swelling and upper airway obstruction, bronchospasm and delayed pneumonitis. Intubation, bronchodilators and ventilatory support may be required.

1.6.4 Specific poisons

Corrosive compounds

Examples: sodium hydroxide, potassium hydroxide, acids, bleaches or disinfectants

- ▶ **Do not** induce vomiting or use activated charcoal when corrosives have been ingested, as this may cause further damage to the mouth, throat, airway, lungs, oesophagus and stomach.
- ▶ Give milk or water as soon as possible to dilute the corrosive agent.
- ▶ Then give the child nothing by mouth and arrange for surgical review to check for oesophageal damage or rupture, if severe.

SPECIFIC POISONS

Petroleum compounds

Examples: kerosene, turpentine substitutes, petrol

- ▶ **Do not** induce vomiting or give activated charcoal, as inhalation can cause respiratory distress with hypoxaemia due to pulmonary oedema and lipid pneumonia. Ingestion can cause encephalopathy.
- ▶ Specific treatment includes oxygen therapy if there is respiratory distress (see p. 312).

Organophosphorus and carbamate compounds

Examples: organophosphorus compounds (malathion, parathion, tetra ethyl pyrophosphate, mevinphos (Phosdrin)); carbamates (methiocarb, carbaryl)

These compounds can be absorbed through the skin, ingested or inhaled.

The child may complain of vomiting, diarrhoea, blurred vision or weakness. The signs are those of excess parasympathetic activation: excessive bronchial secretion, salivation, sweating, lachrymation, slow pulse, small pupils, convulsions, muscle weakness or twitching, then paralysis and loss of bladder control, pulmonary oedema and respiratory depression.

Treatment

- ▶ Remove the poison by irrigating eye if in eye or washing skin if on skin.
- ▶ Give activated charcoal within 4 h of ingestion if ingested.
- ▶ Do not induce vomiting because most pesticides are in petrol-based solvents.
- ▶ In a serious case of ingestion, when activated charcoal cannot be given, consider careful aspiration of stomach contents by nasogastric tube (the airway should be protected).
- ▶ If the child has signs of excess parasympathetic activation (see above), one of the main risks is excessive bronchial secretion. Give atropine at 20 µg/kg (maximum dose, 2000 µg or 2 mg) IM or IV every 5–10 min, depending on the severity of the poisoning, until there is no sign of secretions in the chest, the skin becomes flushed and dry, the pupils dilate and tachycardia develops. Doses may be repeated every 1–4 h for at least 24 h to maintain atropine effects. The main aim is to reduce bronchial secretions while avoiding atropine toxicity. Auscultate the chest for signs of respiratory secretions, and monitor respiratory rate, heart rate and coma score (if appropriate).
- ▶ Check for hypoxaemia by pulse oximetry if atropine is given, as it can cause heart irregularities (ventricular arrhythmia) in hypoxic children. Give oxygen if the oxygen saturation is $\leq 90\%$

- ▶ If there is muscle weakness, give pralidoxime (cholinesterase reactivator) at 25–50 mg/kg diluted in 15 ml water by IV infusion over 30 min, repeated once or twice or followed by IV infusion of 10–20 mg/kg per h, as necessary.

Paracetamol

In paracetamol poisoning:

- ▶ If within 4 h of ingestion, give activated charcoal, if available, or induce vomiting unless an oral or IV antidote is required (see below).
- ▶ Decide whether an antidote is required to prevent liver damage: ingestion of 150 mg/kg or more or toxic 4-h paracetamol level when this is available. An antidote is more often required for older children who deliberately ingest paracetamol or when parents overdose children by mistake.
- ▶ If within 8 h of ingestion, give oral methionine or IV acetylcysteine. Methionine can be used if the child is conscious and not vomiting (< 6 years: 1 g every 4 h for four doses; ≥ 6 years: 2.5 g every 4 h for four doses).
- ▶ If more than 8 h after ingestion, or the child cannot take oral treatment, give IV acetylcysteine. Note that the fluid volumes used in the standard regimen are too large for young children.
- For children < 20 kg give the loading dose of 150 mg/kg in 3 ml/kg of 5% glucose over 15 min, followed by 50 mg/kg in 7 ml/kg of 5% glucose over 4 h, then 100 mg/kg IV in 14 ml/kg of 5% glucose over 16 h. The volume of glucose can be increased for larger children. Continue infusion of acetylcysteine beyond 20 h if presentation is late or there is evidence of liver toxicity. If liver enzymes can be measured and are elevated, continue IV infusion until enzyme levels fall.

Aspirin and other salicylates

Ingestion of these compounds can be very serious in young children because they rapidly become acidotic and are consequently more likely to suffer the severe central nervous system effects of toxicity. Salicylate overdose can be complex to manage.

- These compounds cause acidotic-like breathing, vomiting and tinnitus.
- ▶ Give activated charcoal if available. Note that salicylate tablets tend to form a concretion in the stomach, resulting in delayed absorption, so it is worthwhile giving several doses of charcoal. If charcoal is not available and a severely toxic dose has been ingested, perform gastric lavage or induce vomiting, as above.

SPECIFIC POISONS

- ▶ Give IV sodium bicarbonate at 1 mmol/kg over 4 h to correct acidosis and to raise the pH of the urine above 7.5 so that salicylate excretion is increased. Give oral supplementary potassium too (2–5 mmol/kg per day in three or four divided doses). Monitor urine pH hourly.
- ▶ Give IV fluids at maintenance requirements unless the child shows signs of dehydration, in which case give adequate rehydration (see Chapter 5).
- ▶ Monitor blood glucose every 6 h, and correct as necessary (see p. 350).
- ▶ Give vitamin K at 10 mg IM or IV.

Iron

Check for clinical features of iron poisoning: nausea, vomiting, abdominal pain and diarrhoea. The vomit and stools are often grey or black. In severe poisoning, there may be gastrointestinal haemorrhage, hypotension, drowsiness, convulsions and metabolic acidosis. Gastrointestinal features usually appear within the first 6 h, and a child who has remained asymptomatic for this time probably does not require an antidote.

- ▶ Activated charcoal does not bind to iron salts; therefore, consider a gastric lavage if potentially toxic amounts of iron were taken. This also allows deferoxamine, the antidote, to remain in the stomach to counteract any remaining iron.
- ▶ Decide whether to give the antidote. As this can have side-effects, it should be given only if there is clinical evidence of poisoning (see above).
- ▶ Give deferoxamine, preferably by slow IV infusion: initially 15 mg/kg per h, reduced after 4–6 h so that the total dose does not exceed 80 mg/kg in 24 h. Maximum dose, 6 g/day.
- ▶ If deferoxamine is given IM: 50 mg/kg every 6 h. Maximum dose, 6 g/day.
- ▶ More than 24 h therapy for acute iron overdose is uncommon. Therapeutic end-points for ceasing infusion may be a clinically stable patient and serum iron < 60 µmol/litre.

Morphine and other opiates

Check for reduced consciousness, vomiting or nausea, respiratory depression (slowing or absence of breathing), slow response time and pin-point pupils. Clear the airway; if necessary assist breathing with a bag-valve-mask and provide oxygen.

- ▶ Give the specific antidote naloxone IV 10 µg/kg; if no response, give another dose of 10 µg/kg. Further doses may be required if respiratory function deteriorates. If the IV route is not feasible, give IM, but the action will be slower.

Carbon monoxide

- ▶ Give 100% oxygen to accelerate removal of carbon monoxide (Note: patient can look pink but still be hypoxaemic) until signs of hypoxia disappear.
- ▶ Monitor with a pulse oximeter, but be aware that it can give falsely high readings. If in doubt, be guided by the presence or absence of clinical signs of hypoxaemia.

1.6.5 Prevention of poisoning

- ▶ Teach parents to keep drugs and poisons in proper containers and out of reach of children.
- ▶ Advise parents on first aid if poisoning occurs again.
 - Do not induce vomiting if the child has swallowed kerosene, petrol or petrol-based products, if the child's mouth and throat have been burnt or if the child is drowsy. If the child swallowed bleach or another corrosive, give milk or water to drink as soon as possible.
 - Take the child to a health facility as soon as possible, together with information about the substance concerned, e.g. the container, label, sample of tablets, berries.

1.7 Drowning

Initial assessment should include ensuring adequate airway patency, breathing, circulation and consciousness (the 'ABCs'). Check if there are any injuries, especially after diving or an accidental fall. Facial, head and cervical spine injuries are common.

Management

- ▶ Give oxygen and ensure adequate oxygenation.
- ▶ Remove all wet clothes.
- ▶ Use a nasogastric tube to remove swallowed water and debris from the stomach, and when necessary bronchoscopy to remove foreign material, such as aspirated debris or vomitus plugs, from the airway.
- ▶ Warm the child externally if the core temperature is $> 32^{\circ}\text{C}$ by using radiant heaters or warmed dry blankets; if the core temperature is $< 32^{\circ}\text{C}$, use warmed IV fluid (39°C) or conduct gastric lavage with warmed 0.9% saline.
- ▶ Check for hypoglycaemia and electrolyte abnormalities, especially hyponatraemia, which increase the risk of cerebral oedema.
- ▶ Give antibiotics for possible infection if there are pulmonary signs.

1.8 Electrocution

- ▶ Provide emergency care by ensuring airway patency, breathing and circulatory support. Provide oxygen, especially for children with severe hypoxia, facial or oral burns, loss of consciousness or inability to protect the airway, or respiratory distress.
- ▶ Assess for traumatic injuries such as pneumothorax, peritonitis or pelvic fractures.
- ▶ Begin normal saline or Ringer's lactate fluid resuscitation, and titrate to urine output of at least 2 ml/kg per h in any patient with significant burns or myoglobinuria.
- ▶ Consider furosemide or mannitol for further diuresis of myoglobin.
- ▶ Give tetanus vaccine as indicated, and provide wound care. Treatment may include early fasciotomy when necessary.

1.9 Common causes of envenoming

Accidents caused by venomous and poisonous animals may be relatively common in some countries. Management of these cases may be complex because of the variety of such animals, differences in the nature of the accidents and the course of envenoming or poisoning. It is important to have some knowledge of the common poisonous animals, early recognition of clinically relevant envenoming or poisoning, and symptomatic and specific forms of treatment available.

1.9.1 Snake bite

Snake bite should be considered in any case of severe pain or swelling of a limb or in any unexplained illness presenting with bleeding or abnormal neurological signs. Some cobras spit venom into the eyes of victims, causing pain and inflammation.

Diagnosis

- General signs include shock, vomiting and headache. Examine bite for signs such as local necrosis, bleeding or tender local lymph node enlargement.
- Specific signs depend on the venom and its effects. These include:
 - shock
 - local swelling that may gradually extend up the bitten limb
 - bleeding: external from gums, wounds or sores; internal, especially intracranial

- signs of neurotoxicity: respiratory difficulty or paralysis, ptosis, bulbar palsy (difficulty in swallowing and talking), limb weakness
- signs of muscle breakdown: muscle pains and black urine

■ Check Hb (when possible, blood clotting should be assessed).

Treatment

First aid

- ▶ Splint the limb to reduce movement and absorption of venom. If the bite is likely to have been by a snake with neurotoxic venom, apply a firm bandage to the affected limb, from fingers or toes to near the site of the bite.
- ▶ Clean the wound.
- ▶ If any of the above signs are present, transport the child to a hospital that has antivenom as soon as possible. If the snake has been killed, take it with the child to hospital.
- ▶ Avoid cutting the wound or applying a tourniquet.

Hospital care

Treatment of shock or respiratory arrest

- ▶ Treat shock, if present (see pp. 4, 13, 17).
- ▶ Paralysis of respiratory muscles can last for days and requires intubation and mechanical ventilation or manual ventilation (with a mask or endotracheal tube and bag-valve system) by relays of staff and/or relatives until respiratory function returns. Attention to carefully securing the endotracheal tube is important. An alternative is to perform an elective tracheostomy.

Antivenom

- If there are systemic or severe local signs (swelling of more than half the limb or severe necrosis), give antivenom, if available.
- ▶ Prepare IM adrenaline 0.15 ml of 1:1000 solution IM and IV chlorphenamine, and be ready to treat an allergic reaction (see below).
- ▶ Give monovalent antivenom if the species of snake is known. Give polyvalent antivenom if the species is not known. Follow the directions given on preparation of the antivenom. The dose for children is the same as that for adults.
- Dilute the antivenom in two to three volumes of 0.9% saline and give intravenously over 1 h. Give more slowly initially, and monitor closely for anaphylaxis or other serious adverse reactions.

SNAKE BITE

- ▶ If itching or an urticarial rash, restlessness, fever, cough or difficult breathing develop, then stop antivenom and give adrenaline at 0.15 ml of 1:1000 IM (see anaphylaxis treatment, p. 109). Possible additional treatment includes bronchodilators, antihistamines (chlorphenamine at 0.25 mg/kg) and steroids. When the child is stable, re-start antivenom infusion slowly.
- ▶ More antivenom should be given after 6 h if there is recurrence of blood clotting disorder or after 1–2 h if the patient is continuing to bleed briskly or has deteriorating neurotoxic or cardiovascular signs.
- ▶ Blood transfusion should not be required if antivenom is given. Clotting function returns to normal only after clotting factors are produced by the liver. The response of abnormal neurological signs to antivenom is more variable and depends on the type of venom.
- ▶ If there is no response to antivenom infusion, it should be repeated.
- ▶ Anticholinesterases can reverse neurological signs in children bitten by some species of snake (see standard textbooks of paediatrics for further details).

Other treatment

- ▶ Surgical opinion: Seek a surgical opinion if there is severe swelling in a limb, it is pulseless or painful or there is local necrosis. Surgical care will include:
 - excision of dead tissue from wound
 - incision of fascial membranes (fasciotomy) to relieve pressure in limb compartments, if necessary
 - skin grafting, if there is extensive necrosis
 - tracheostomy (or endotracheal intubation) if the muscles involved in swallowing are paralysed

Supportive care

- ▶ Give fluids orally or by nasogastric tube according to daily requirements (see p. 304). Keep a close record of fluid intake and output.
- ▶ Provide adequate pain relief.
- ▶ Elevate the limb if swollen.
- ▶ Give antitetanus prophylaxis.
- ▶ Antibiotic treatment is not required unless there is tissue necrosis at the wound site.
- ▶ Avoid IM injections.

- ▶ Monitor the patient very closely immediately after admission, then hourly for at least 24 h, as envenoming can develop rapidly.

1.9.2 Scorpion sting

Scorpion stings can be very painful for days. Systemic effects of venom are much commoner in children than adults.

Diagnosis

Signs of envenoming can develop within minutes and are due to autonomic nervous system activation. They include:

- shock
 - high or low blood pressure
 - fast and/or irregular pulse
 - nausea, vomiting, abdominal pain
 - breathing difficulty (due to heart failure) or respiratory failure
 - muscle twitches and spasms.
- ▶ Check for low blood pressure or raised blood pressure and treat if there are signs of heart failure (see p. 120).

Treatment

First aid

- ▶ Transport to hospital as soon as possible.

Hospital care

- ▶ If there are signs of severe envenoming, give scorpion antivenom, if available (as above for snake antivenom infusion).

Other treatment

- ▶ Treat heart failure, if present (see p. 120).
- ▶ Consider use of prazosin if there is pulmonary oedema (see standard textbooks of paediatrics).

Supportive care

- ▶ Give oral paracetamol or oral or IM morphine according to severity. If very severe, infiltrate site with 1% lignocaine, without adrenaline.

1.9.3 Other sources of envenoming

- Follow the same principles of treatment as above. Give antivenom, when available, if there are severe local or any systemic effects.

In general, venomous spider bites can be painful but rarely result in systemic envenoming. Antivenom is available for some species such as widow and banana spiders. Venomous fish can give very severe local pain, but, again, systemic envenoming is rare. Box jellyfish stings are occasionally rapidly life-threatening. Apply vinegar on cotton-wool to denature the protein in the skin. Adherent tentacles should be carefully removed. Rubbing the sting may cause further discharge of venom. Antivenom may be available. The dose of antivenom to jellyfish and spider venoms should be determined by the amount of venom injected. Higher doses are required for multiple bites, severe symptoms or delayed presentation.

1.10 Trauma and injuries

Severe multiple injuries or major trauma are life-threatening problems that children may present with to hospital. Multiple organs and limbs may be affected, and the cumulative effects of these injuries may cause rapid deterioration of the child's condition. Management requires urgent recognition of the life-threatening injuries.

Basic techniques of emergency triage and assessment are most critical in the first hour of the patient's arrival at hospital. When there is more than one life-threatening state, simultaneous treatment of injuries is essential and requires effective teamwork.

1.10.1 Primary survey or initial assessment

The initial rapid assessment, also commonly referred to as 'the primary survey', should identify life-threatening injuries such as:

- airway obstruction
- chest injuries with breathing difficulty
- severe external or internal haemorrhage
- head and cervical spine injuries
- abdominal injuries.

The primary survey should be systematic, as described in section 1.2. If there is a risk of neck injury, try to avoid moving the neck, and stabilize as appropriate (see p. 12).

During the primary survey, any deterioration in the patient's clinical condition should be managed by reassessment from the start of the protocol; as a previ-

ously undiagnosed injury may become apparent. Expose the child's whole body to look for injuries. Start with assessment and stabilization of the airway, assess breathing, circulation and level of consciousness, and stop any haemorrhage. The systematic approach should comprise assessment of:

- airway patency
- breathing adequacy
- circulation and control of haemorrhage
- central nervous system (assess coma scale), cervical spine immobilization
- exposure of the whole body and looking for injuries.
- ▶ Note all the key organ systems and body areas injured during the primary assessment, and provide emergency treatment.
- ▶ Resuscitate the patient as appropriate; give oxygen by bag or mask if necessary; stop any haemorrhage; gain circulatory access in order to support the circulation by infusion of crystalloids or blood if necessary. Draw blood for Hb and group and cross-matching as you set up IV access.
- ▶ Document all procedures undertaken.

1.10.2 Secondary survey

Conduct a secondary survey only when the patient's airway patency, breathing, circulation and consciousness are stable.

- ▶ Undertake a head-to-toe examination, noting particularly the following:
 - *Head*: scalp and ocular abnormalities, external ears and periorbital soft tissue injuries
 - *Neck*: penetrating wounds, subcutaneous emphysema, tracheal deviation and neck vein appearance
 - *Neurological*: brain function (level of consciousness, AVPU), spinal cord motor activity and sensation and reflex
 - *Chest*: clavicles and all ribs, breath sounds and heart sounds
 - *Abdominal*: penetrating abdominal wound requiring surgical exploration, blunt trauma and rectal examination when necessary
 - *Pelvis and limbs*: fractures, peripheral pulses, cuts, bruises and other minor injuries

Investigations

After the child is stabilized and when indicated, investigations can be performed (see details in section 9.3, p. 269). In general, the following investigations may be useful, depending on the type of injury:

TRAUMA AND INJURIES

- X-rays: depending on the suspected injury (may include chest, lateral neck, pelvis, cervical spine, with all seven vertebrae, long bones and skull).
- Ultrasound scan: a scan of the abdomen may be useful in diagnosing internal haemorrhage or organ injury.

Treatment

Once the child is stable, proceed with management, with emphasis on achieving and maintaining homeostasis, and, if necessary arrange transfer to an appropriate ward or referral hospital.

- ▶ In the absence of head injury, give morphine 0.05–0.1 mg/kg IV for pain relief, followed by 0.01–0.02 mg/kg increments at 10-min intervals until an adequate response is achieved. Pain relief and patient reassurance should be provided during all stages of care.
- ▶ If there are signs of shock, give 20 ml/kg of normal saline, and re-assess (see p. 13).
- ▶ If blood is required after haemorrhage, give initially 20 ml/kg of whole blood or 10 ml/kg of packed red cells.
- ▶ Manage hypoglycaemia (see p. 16).
- ▶ For management of specific injuries, see section 9.3, p. 269.

Notes

Diagnostic approaches to the sick child

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2.1 Relationship to the IMCI approach and stages of hospital care

The *Pocket book* is symptom-based in its approach, the symptoms following the sequence in the IMCI guidelines: cough, diarrhoea, fever. The diagnoses also closely match the IMCI classifications, except that the expertise and investigative capacity in a hospital setting allow classifications such as 'very severe disease' or 'very severe febrile disease' to be defined more precisely, making possible such diagnoses as severe pneumonia, severe malaria, septicæmia and meningitis.

Classifications for conditions such as pneumonia and dehydration follow the same principles as in the IMCI. Young infants (≤ 2 months) are considered separately (see Chapter 3), as in the IMCI approach. Severely malnourished children are also considered separately (see Chapter 7), because they require special attention and treatment if their high mortality risk is to be reduced.

In hospital, the stages of management for any child are:

- emergency triage
- emergency treatment (if required)
- taking a history
- examination
- laboratory investigations (if required)
- making a diagnosis or a differential diagnosis
- treatment

- supportive care
- monitoring
- planning discharge
- follow-up

This chapter summarizes taking a history, examining the child, laboratory investigations and making a differential diagnosis.

2.2 Taking history

Taking a history generally starts with understanding the presenting complaint: “*Why did you bring the child?*” It progresses to the history of the present illness. The symptom-specific chapters give some guidance on questions that should be asked about symptoms, which help in a differential diagnosis of the illness. These include personal, vaccination, family, social and environmental histories. They might lead to important counselling messages, such as sleeping under a bednet for a child with malaria, breastfeeding or sanitary practices for a child with diarrhoea, or reducing exposure to indoor air pollution for a child with pneumonia.

In younger infants, the history of pregnancy and birth is important. The feeding history of infants and younger children is essential, as this is often when malnutrition begins. For older children, information on development milestones is important. Whereas the history is obtained from a parent or caretaker for younger children, older children can contribute important information. You must establish a rapport with the child and the parent before starting the examination. In general, children between the ages of 8 months and 5 years require the most flexible approach.

2.3 Approach to the sick child and clinical examination

All children must be examined fully, so that no important sign is missed. In contrast to the systematic approach for adults, however, examination of a child should be organized in a way that does not upset the child. The approach to examining children should be flexible. Ideally, you will perform the most ‘invasive’ part of the examination (e.g. the head and neck examination) last.

- Do not upset the child unnecessarily.
- Leave the child in the arms of the mother or carer.
- Observe as many signs as possible before touching the child:
 - Does the child speak, cry or make any sound?
 - Is the child alert, interested and looking about?
 - Does the child appear drowsy?

- Is the child irritable?
- Is the child vomiting?
- Is the child able to suck or breastfeed?
- Is the child cyanosed or pale?
- Does the child show signs of respiratory distress?
- Does the child use auxiliary muscles of breathing?
- Is there lower chest wall indrawing?
- Does the child appear to breathe fast?
- Count the respiratory rate.

These and other signs should be recorded before the child is disturbed. You might ask the mother or caretaker to cautiously reveal part of the chest to look for lower chest wall indrawing or to count the respiratory rate. If the child is distressed or crying, he or she might have to be left for a brief time with its mother in order to settle, or the mother could be asked to breastfeed, before key signs such as respiratory rate can be measured.

Then proceed to signs that require touching the child but are minimally disturbing, such as feeling the pulse or listening to the chest. You obtain little useful information if you listen to the chest of a crying child. Signs that involve interfering with the child, such as recording the temperature, testing for skin turgor, capillary refill time, blood pressure or looking at the child's throat or ears should be done last. Measure the oxygen saturation with a pulse oximeter in all children who have fast breathing or chest indrawing.

- Perform bedside tests if available and appropriate

Some test may easily be performed at the point of care, sometimes called point of care tests:

- glucostix for an urgent blood sugar
- rapid diagnostic test for malaria or
- any other simple bedside tests.

2.4 Laboratory investigations

Laboratory investigations are targeted on the basis of the history and examination and help narrow the differential diagnosis. The following basic laboratory investigations should be available in all small hospitals that provide paediatric care in developing countries:

- Hb or packed cell volume
- full blood count
- blood smear for malaria parasites
- blood glucose

- microscopy of CSF
- urinalysis (including microscopy)
- blood grouping and cross-matching
- HIV testing

In the care of sick newborns (< 1 week), blood bilirubin is also an essential investigation.

Other common investigations are valuable:

- pulse oximetry,
- chest X-ray,
- stool microscopy
- blood cultures.

Indications for these tests are outlined in the appropriate sections of this *Pocket book*. Other investigations, such as pulse oximetry, chest X-ray, blood cultures and stool microscopy, are valuable in making a diagnosis.

2.5 Differential diagnoses

After the assessment has been completed, consider the various conditions that could cause the child's illness and make a list of possible differential diagnoses. This helps to ensure that wrong assumptions are not made, a wrong diagnosis is not chosen, and rare problems are not missed. Remember that a sick child might have more than one clinical problem requiring treatment.

Section 1.5, Tables 1–4 (pp. 21–26) present the differential diagnoses for emergency conditions encountered during triage. Further tables of symptom-specific differential diagnoses for common problems are given at the beginning of each chapter, with details of the symptoms, examination findings and results of laboratory investigations that can be used to determine the main diagnosis and any secondary diagnoses.

After the main diagnosis and any secondary diagnoses or problems have been determined, treatment should be planned and started. Once again, if there is more than one diagnosis or problem, treatment might have to be given together. The list of differential diagnoses should be reviewed after observing the response to treatment or in the light of new clinical findings. The diagnosis might be revised at this stage or additional diagnoses included in the considerations.

Notes

Problems of the neonate and young infant

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This chapter provides guidance on essential newborn care and the management of problems in neonates and young infants, from birth to 2 months of age. It includes neonatal resuscitation, the recognition and management of neonatal sepsis and other bacterial infections, and the management of preterm and low-birth-weight infants. A table giving the doses of commonly used drugs for neonates and young infants is included at the end of this chapter, which also lists the dosages for low-birth-weight and premature infants.

3.1 Essential newborn care at delivery

Most newborns require only simple supportive care at and after delivery.

- ▶ Dry the infant with a clean towel.
- ▶ Observe the infant while drying (see Chart 12).
- ▶ Maintain the infant in skin-to-skin contact position with the mother.
- ▶ Cover the infant to prevent heat loss.
- ▶ Clamp and cut the cord at least 1 min after birth.
- ▶ Encourage the mother to initiate breastfeeding within the first hour.

Skin-to-skin contact and early breastfeeding are the best ways to keep an infant warm and prevent hypoglycaemia. Term and low-birth-weight neonates weighing > 1200 g who do not have complications and are clinically stable should be put in skin-to-skin contact with the mother soon after birth after they have been dried thoroughly to prevent hypothermia.

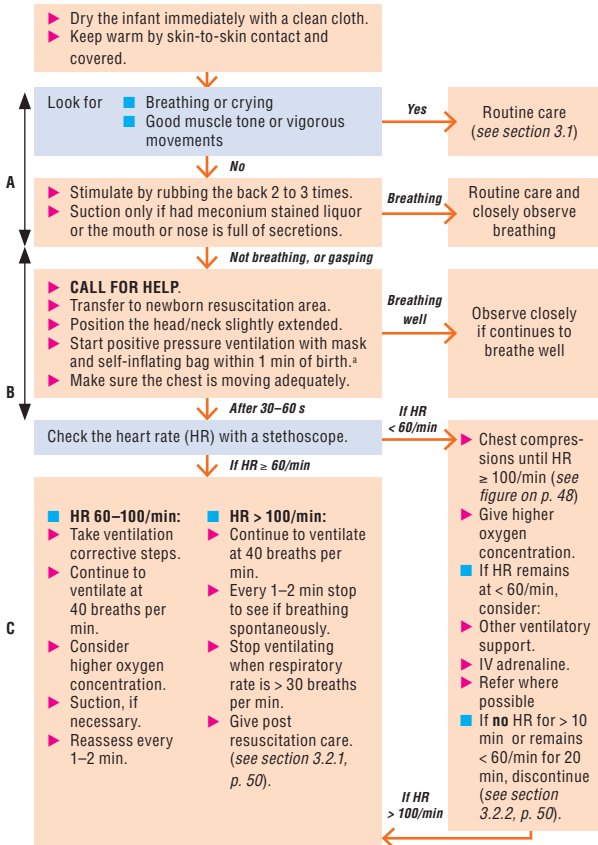
3.2 Neonatal resuscitation

Resuscitation may be required for some infants, such as those born to mothers with chronic illness, to mothers who had a previous fetal or neonatal death, to mothers with pre-eclampsia, in multiple pregnancies, in preterm delivery, in abnormal presentation of the fetus, infants with a prolapsed cord, or after prolonged labour, rupture of membranes or meconium-stained liquor.

For many infants, resuscitation cannot be anticipated before delivery. Therefore:

- be prepared for resuscitation at every delivery,
- follow the assessment steps in Chart 12.

Chart 12. Neonatal resuscitation: Flow chart



^a Positive pressure ventilation should be initiated with air for infants with gestation > 32 weeks. For very preterm infants, it is preferable to start with 30% oxygen if possible.
A and **B** are basic resuscitation steps

Chart 12. Neonatal resuscitation: Steps and process

There is no need to slap the infant; rubbing the back two or three times in addition to thorough drying is enough for stimulation.

A. Airway

- ▶ Keep the infant's head in a slightly extended position to open the airway.
- ▶ Do not suction routinely. Suction the airway if there is meconium-stained fluid **and** the infant is **not** crying and moving limbs. When the amniotic fluid is clear, suction only if the nose or mouth is full of secretions.
 - Suck the mouth, nose and oropharynx by direct vision; do not suck right down the throat, as this can cause apnoea or bradycardia.

B. Breathing

- ▶ Choose a mask size that fits over the nose and mouth (see below): size 1 for normal-weight infant, size 0 for small (< 2.5 kg) infants
- ▶ Ventilate with bag and mask at 40–60 breaths/min.
- Make sure the chest moves up with each press on the bag; in a very small infant, make sure the chest does not move too much (danger of causing pneumothorax).

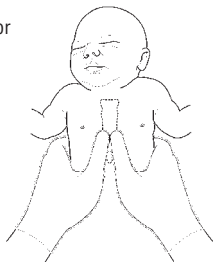
C. Circulation

- ▶ Give chest compressions if the heart rate is < 60/min after 30–60 s of ventilation with adequate chest movements: 90 compressions coordinated with 30 breaths/min (three compressions: one breath every 2 s).
- ▶ Place thumbs just below the line connecting the nipples on the sternum (see below).
- ▶ Compress one third the anterior–posterior diameter of the chest.



Correct head position to open up airway and for bag ventilation.

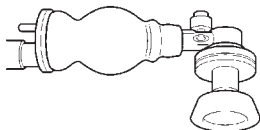
Do not hyperextend the neck.



Correct position of hands for cardiac massage of a neonate. The thumbs are used for compression over the sternum.

Chart 12. Neonatal resuscitation

Neonatal self-inflating resuscitation bag with round mask



Fitting mask over face:

Right size and position of mask



Right

Mask held too low



Wrong

Mask too small



Wrong

Mask too large

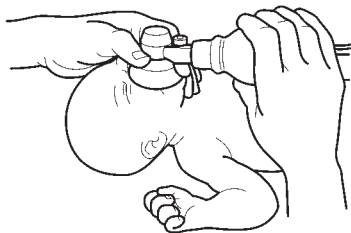


Wrong

Ventilating a neonate with bag and mask

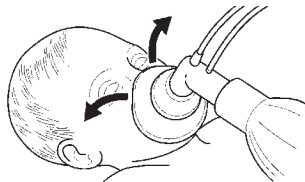
Pull the jaw forwards towards the mask with the third finger of the hand holding the mask.

Do not hyperextend the neck.



Inadequate seal

If you hear air escaping from the mask, form a better seal. The commonest leak is between the nose and the cheeks.



3.2.1 Post resuscitation care

Infants who require resuscitation are at risk for deterioration after their vital signs have returned to normal. Once adequate ventilation and circulation has been established:

- ▶ Stop ventilation.
- ▶ Return to mother for skin-to-skin contact as soon as possible.
- ▶ Closely monitor breathing difficulties, signs of asphyxia and anticipate need for further care.

3.2.2 Cessation of resuscitation

It is appropriate to consider discontinuing after effective resuscitation efforts if:

- Infant is not breathing and heartbeat is not detectable beyond 10 min, stop resuscitation.
- If no spontaneous breathing and heart rate remains below 60/min after 20 min of effective resuscitation, discontinue active resuscitation.

Record the event and explain to the mother or parents that the infant has died. Give them the infant to hold if they so wish.

3.3 Routine care for all newborns after delivery

The routine care described below applies to all newborns, either born in hospital or born outside and brought to the hospital.

- ▶ Keep the baby in skin-to-skin contact on the mother's chest or at her side, in a warm, draught-free room.
- ▶ Start breastfeeding within the first hour as soon as the baby shows signs of readiness to feed.
- ▶ Let the infant breastfeed on demand if able to suck.
- ▶ Give IM vitamin K (phytomethadione) to all newborns.
 - 1 ampoule (1 mg/0.5 ml or 1 mg/ml) once. (Do **not** use 10 mg/ml ampoule.)
 - For preterm neonates, give 0.4 mg/kg IM (maximum dose, 1 mg).
- ▶ Keep umbilical cord clean and dry.
- ▶ Apply antiseptic eye drops or ointment (e.g. tetracycline ointment) to both eyes once, according to national guidelines.
- ▶ Give oral polio, hepatitis B and bacille Calmette-Guérin (BCG) vaccines, depending on national guidelines.

3.4 Prevention of neonatal infections

Many early neonatal infections can be prevented by:

- avoiding unnecessary separation of the newborn from the mother e.g. baby unit
- hand-washing before delivering and handling the infant
- good basic hygiene and cleanliness during delivery (e.g. chlorhexidine cream for all maternal vaginal examinations)
- appropriate umbilical cord care
- appropriate eye care

Give prophylactic antibiotics only to neonates with documented risk factors for infection:

- Membranes ruptured > 18 h before delivery.
 - Mother had fever > 38 °C before delivery or during labour.
 - Amniotic fluid was foul-smelling or purulent.
- ▶ Give IM or IV ampicillin and gentamicin for at least 2 days and reassess; continue treatment only if there are signs of sepsis (or a positive blood culture).

Many late neonatal infections are acquired in hospitals. These can be prevented by:

- exclusive breastfeeding
- strict procedures for hand-washing or alcohol hand rubs for all staff and for families before and after handling infants
- using Kangaroo mother care (see p. 59) and avoiding use of incubators for preterm infants. If an incubator is used, do not use water for humidification (where *Pseudomonas* will easily colonize) and ensure that it was thoroughly cleaned with an antiseptic.
- strict sterility for all procedures
- clean injection practices
- removing intravenous drips when they are no longer necessary

3.5 Management of infants with hypoxic ischaemic encephalopathy

Hypoxic ischaemic encephalopathy can result from lack of oxygen to vital organs before, during or immediately after birth. The initial treatment is effective resuscitation as above.

Problems during the days after birth:

- ▶ *Convulsions*: Treat with phenobarbital (see p. 53); ensure hypoglycaemia is not present (check blood glucose).
- ▶ *Apnoea*: common after severe birth asphyxia; sometimes associated with convulsions. Resuscitate with bag and mask, and manage with oxygen by nasal prongs.
- ▶ *Inability to suck*: Feed with expressed breast milk via a nasogastric tube. Avoid delayed emptying of the stomach, which may lead to regurgitation of feeds.
- ▶ *Poor motor tone*: floppy or with limb stiffening (spasticity)

Prognosis can be predicted by recovery of motor function and sucking ability. An infant who is normally active will usually do well. An infant who, within a week of birth, is still floppy or spastic, unresponsive and cannot suck has a severe brain injury and will do poorly. The prognosis is less grim for infants who have recovered some motor function and are beginning to suck. The situation should be sensitively discussed with parents throughout the time the infant is in hospital.

3.6 Danger signs in newborns and young infants

Neonates and young infants often present with non-specific symptoms and signs that indicate severe illness. These signs might be present at or after delivery or in a newborn presenting to hospital or develop during hospital stay. The aim of initial management of a neonate presenting with these signs is stabilization and preventing deterioration. The signs include:

- not feeding well
- convulsions
- drowsy or unconscious
- movement only when stimulated or no movement at all
- fast breathing (60 breaths per min)
- grunting
- severe chest indrawing
- raised temperature, > 38 °C
- hypothermia, < 35.5 °C
- central cyanosis

Emergency management of danger signs:

- ▶ Open and maintain airway. Give oxygen by nasal prongs if the young infant is cyanosed or in severe respiratory distress or hypoxaemic (oxygen saturation $\leq 90\%$).
- ▶ Give bag and mask ventilation (p. 49) with oxygen (or room air if oxygen is not available) if there is apnoea, gasping or respiratory rate too slow (< 20).
- ▶ Insert venous cannula.
- ▶ Give ampicillin (or penicillin) and gentamicin (see below).
- ▶ If drowsy, unconscious or convulsing, check blood glucose. If glucose < 2.2 mmol/l (< 40 mg/100 ml), give 10% glucose at 2 ml/kg IV. Then give a sustained IV infusion of 5 ml/kg per h of 10% glucose for the next few days while oral feeds are built up.
If you cannot check blood glucose quickly, assume hypoglycaemia and give glucose IV. If you cannot insert an IV drip, give expressed breast milk or glucose through a nasogastric tube.
- ▶ Give phenobarbital if convulsing (see p. 53).
- ▶ Admit.
- ▶ Give vitamin K (if not given before).
- ▶ Monitor the infant frequently (see below).

3.7 Convulsions or fits

The commonest causes of neonatal convulsions include:

- hypoxic ischaemic encephalopathy (as a result of perinatal asphyxia)
- central nervous system infection
- hypoglycaemia
- hypocalcaemia

Treatment

Management of the neonate or young infant who is having a fit:

- ▶ Manage the airway and breathing.
- ▶ Ensure circulatory access.
- ▶ If hypoglycaemic, give glucose IV or nasogastrically (2 ml/kg of 10% glucose). If blood glucose cannot be measured, give empirical treatment with glucose.

- ▶ Treat convulsions with phenobarbital (loading dose 20 mg/kg IV). If convulsions persist, give further doses of phenobarbital 10 mg/kg up to a maximum of 40 mg/kg. Watch for apnoea. Always have a bag-mask available. If needed, continue phenobarbital at a maintenance dose of 5 mg/kg per day.
- ▶ If hypocalcaemic, symptoms may settle if the infant is given 2 ml/kg of 10% calcium gluconate as a slow IV infusion, and continue with oral supplementation.
- ▶ Rule out central nervous system infection. Treat if present (see below).

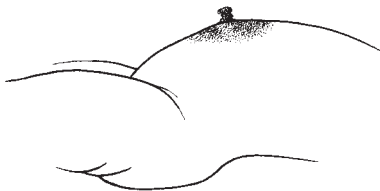
3.8 Serious bacterial infection

Newborns with documented risk factors (see p. 51) are more likely to develop serious bacterial infection. All of the **danger signs** listed in section 3.6 are signs of serious bacterial infection, but there are others:

- severe jaundice
- severe abdominal distension

Localizing signs of infection are:

- signs of pneumonia (see section 4.2)
- many or severe skin pustules
- umbilical redness extending to the peri-umbilical skin
- umbilicus draining pus
- bulging fontanelle (see below)
- painful joints, joint swelling, reduced movement and irritability if these parts are handled



Peri-umbilical flare in umbilical sepsis. The inflammation extends beyond the umbilicus to the abdominal wall.

Treatment

Antibiotic therapy

Empirical antibiotics should be given to children with suspected neonatal sepsis.

- ▶ Admit to hospital.
- ▶ When possible, do a lumbar puncture and obtain blood cultures before starting antibiotics.

- ▶ For newborns with any signs of serious bacterial infection or sepsis, give ampicillin (or penicillin) and gentamicin as first-line antibiotic treatment (for dosages see pp. 69–72)
- ▶ If at greater risk of staphylococcus infection (extensive skin pustules, abscess or omphalitis in addition to signs of sepsis), give IV cloxacillin and gentamicin.
- ▶ The most serious bacterial infections in newborns should be treated with antibiotics for at least 7–10 days.
- ▶ If an infant is not improving within 2–3 days, change the antibiotic treatment or refer the infant for further management.

Other treatment

- ▶ If the infant is drowsy or unconscious, ensure that hypoglycaemia is not present (see p. 53); if it is, give 2 ml/kg 10% glucose IV.
- ▶ Treat convulsions with phenobarbital (see p. 53).
- ▶ For management of pus draining from eyes, see p. 66.
- ▶ If the child is from a malarious area and has fever, take a blood film to check for malaria. Neonatal malaria is very rare. If confirmed, treat with artesunate or quinine (see p. 158).
- ▶ For supportive care, see p. 56.

3.9 Meningitis

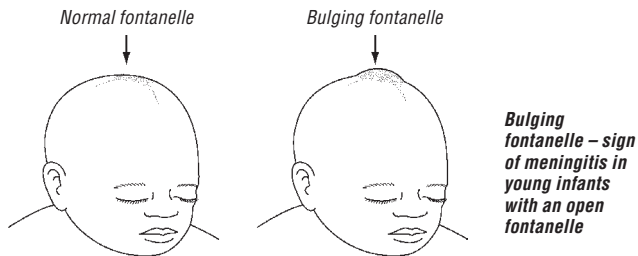
Clinical signs

Suspect meningitis if signs of serious bacterial infection (see section 3.8) are present, particularly if any one of the following is present:

The infant is:

- drowsy, lethargic or unconscious
- convulsing
- has a bulging fontanelle
- irritable
- has a high-pitched cry.

It is important to attempt lumbar puncture once the infant has been stabilized, ideally within 2 h of initiating antibiotic treatment, because it serves to confirm the diagnosis.



Treatment

- ▶ The first-line antibiotics are ampicillin and gentamicin for 3 weeks (see pp. 69–72).
- ▶ Alternatively, give a third-generation cephalosporin, such as ceftriaxone (50 mg/kg every 12 h if < 7 days of age and 75 mg/kg after 1 week) or cefotaxime (50 mg/kg every 12 h if < 7 days or every 6–8 h if > 7 days of age), and gentamicin for 3 weeks.
- ▶ If there are signs of hypoxaemia, give oxygen (see p. 58).
- ▶ If the infant is drowsy or unconscious, ensure that hypoglycaemia is not present (see p. 53); if it is, give 2 ml/kg 10% glucose IV.
- ▶ Treat convulsions (after ensuring they are not due to hypoglycaemia or hypoxaemia) with phenobarbital (see p. 53).
- ▶ Make regular checks for hypoglycaemia.

3.10 Supportive care for sick neonates

3.10.1 Thermal environment

- ▶ Keep the young infant dry and well wrapped.
- ▶ A hat can reduce heat loss. Keep the room warm (at least 25 °C). Keeping a young infant in close skin-to-skin contact with the mother (Kangaroo mother care, p. 59) for 24 h/day is an effective way of keeping the infant warm. An external heating device may be needed when the mother is asleep or too ill.
- ▶ Pay special attention to avoid chilling the infant during an examination or investigation.

- Check regularly that the infant's temperature is maintained in the range 36.5–37.5 °C (97.7–99.5 °F) rectal or 36.0–37.0 °C (96.8–98.6 °F) axillary. Use a low-reading thermometer to ensure detection of hypothermia.

3.10.2 Fluid management

Encourage the mother to breastfeed frequently to prevent hypoglycaemia. If the infant is unable to feed, give expressed breast milk by nasogastric tube.

- Withhold oral feeding if there is bowel obstruction, necrotizing enterocolitis, or the feeds are not tolerated, indicated e.g. by increasing abdominal distension or vomiting everything.
- Withhold oral feeding in the acute phase in infants who are lethargic, unconscious or having frequent convulsions.

If IV fluids are given, reduce the rate as the volume of oral or gastric milk feeds increases. IV fluids should ideally be given with an in-line burette to ensure the exact doses of fluids prescribed.

Increase the amount of fluid given over the first 3–5 days (total amount, oral plus IV).

Day 1	60 ml/kg per day
Day 2	90 ml/kg per day
Day 3	120 ml/kg per day
Then increase to	150 ml/kg per day

When the infant tolerates oral feeds well, the amount of fluid might be increased to 180 ml/kg per day after some days. Be careful in giving parenteral IV fluids, which can quickly overhydrate a child. Do not exceed 100 ml/kg per day of IV fluids, unless the infant is dehydrated or under phototherapy or a radiant heater. This amount is the **total** fluid intake an infant needs, and oral intake must be taken into account when calculating IV rates.

- Give more fluid if the infant is under a radiant heater (1.2–1.5 times).
- During the first 2 days of life give 10% glucose infusion IV. Do **not** use IV glucose without sodium **after** the first 2 days of life. Suitable alternative IV fluids after the first 2 days are half normal saline and 5% dextrose.

Monitor the IV infusion very carefully (ideally through an in-line burette).

- Use a monitoring sheet.
- Calculate the drip rate.
- Check the drip rate and volume infused every hour.

- Weigh the infant daily.
- Watch for facial swelling: if this occurs, reduce the IV fluid to a minimum or take out the IV line. Introduce breastfeeding or milk feeding by orogastric or nasogastric tube as soon as it is safe to do so.

3.10.3 Oxygen therapy

- Give oxygen to neonates or young infants with any of the following:
- central cyanosis or gasping
 - grunting with every breath
 - difficulty in feeding due to respiratory distress
 - severe lower chest wall indrawing
 - head nodding (i.e. a nodding movement of the head, synchronous with the respiration and indicating severe respiratory distress)

Use a pulse oximeter to guide oxygen therapy. Oxygen should be given if the oxygen saturation is $\leq 90\%$, and the oxygen flow should be regulated to maintain saturation of $> 90\%$. Oxygen can be discontinued once the infant can maintain saturation $> 90\%$ in room air.

Nasal prongs are the preferred method for delivering oxygen to this age group, with a flow rate of 0.5–1 litre/min, increased to 2 litres/min in severe respiratory distress to achieve oxygen saturation $> 90\%$. Thick secretions should be cleared from the throat by intermittent suction under direct observation, if they are obstructing the airway and the infant is too weak to clear them. Oxygen should be stopped when the infant's general condition improves and the above signs are no longer present.

3.10.4 High fever

Do not use antipyretic agents such as paracetamol to control fever in young infants; control the environment. If necessary, undress the child.

3.11 Preterm and low-birth-weight infants

3.11.1 Infants with a birth weight of 2.0–2.5 kg (35–36 weeks' gestation)

These infants are usually strong enough to breastfeed and maintain their body temperature. Start feeds within 1 h of delivery. Their mothers usually need additional support for exclusive breastfeeding. They should be kept warm at all times. All low-birth-weight infants are at risk of infection and should be closely observed for infection control.

3.11.2 Infants with a birth weight < 2.0 kg (< 35 weeks' gestation)

All infants with a gestation < 35 weeks or a birth weight < 2.0 kg should be admitted to a special care unit. These infants are at risk of hypothermia, feeding problems, apnoea, respiratory distress syndrome and necrotizing enterocolitis. The smaller the infant, the higher the risk.

The risks associated with keeping the child in hospital (e.g. hospital-acquired infections) should be balanced against the potential benefit of better care. See the infants at least twice a day to assess feeding ability, fluid intake or the presence of any **danger signs** (p. 52) or signs of serious bacterial infection (p. 54). If any of these signs is present, it should be closely monitored. Management of common problems is discussed below.

Preventing hypothermia

Low-birth-weight neonates (weighing < 2000 g) who are clinically stable should be given Kangaroo mother care starting soon after birth and ensured at all times, day and night. To provide Kangaroo mother care:

- Dress the infant only in a nappy, hat and socks.
- Place the infant skin-to-skin on the mother's chest between her breasts, with the infant's head turned to one side.
- Tie the infant to the mother with a cloth.
- Cover the mother and infant with the mother's clothes.
- Encourage the mother to breastfeed the infant frequently.

Aim for a core body temperature of 36–37 °C, with the feet warm and pink.

If the mother is unable to provide Kangaroo mother care, a clean incubator can be used. Incubators should be washed with disinfectant between infants and should be of a basic design that can be used appropriately by the staff available.



Position for Kangaroo mother care of young infant. Note: After wrapping the child, cover the head with a cap to prevent heat loss.

Feeding

Many low-birth-weight infants will be able to suckle at the breast. Infants who can suckle should be breastfed. Those who cannot breastfeed should be given expressed breast milk with a cup and spoon. When the infant is sucking well at the breast and gaining weight, reduce the cup feeds. Infants unable to feed from a cup and spoon should be given intermittent bolus feeds through a gastric tube.

Feed the infant only the mother's own milk. In exceptional situations, when this is not possible, donor human milk should be given, if safe milk-banking facilities are available. Formula should be given only if neither of the above is possible.

Special feeding considerations for infants weighing < 1.5 kg at birth

These infants are at the highest risk of feeding problems and necrotizing enterocolitis. The smaller the infant, the higher the risk.

- Starting on the first day, give 10 ml/kg per day of enteral feeds, preferably expressed breast milk, with the remaining fluid requirement at 50 ml/kg per day met by IV fluids. If the infant is well and active and not receiving IV fluids, give 2–4 ml of expressed breast milk every 2 h through a nasogastric tube, depending on the weight of the infant (see p. 57).
- If the infant cannot tolerate enteral feeds, give IV fluids at 60 ml/kg per day for the first day of life. It is best to use a paediatric (100 ml) intravenous burette; 60 drops = 1 ml, therefore one drop per minute = 1 ml/h.
- Check blood sugar every 6 h until enteral feeds are established, especially if the infant is apnoeic, lethargic or convulsing. Very low-birth-weight infants may need a 10% glucose solution. Add 10 ml of 50% glucose to every 90 ml of 4.3% glucose + 0.18% normal saline, or use 10% glucose in water solution.
- Start enteral feeding when the condition of the infant is stable and there is no abdominal distension or tenderness, bowel sounds are present, meconium passed and no apnoea.
- Calculate exact amounts for feeding and the timing of feeds.
- Use a prescription chart.
- Increase daily if well tolerated.
- When commencing milk feeds, start with 2–4 ml every 1–2 h by orogastric or nasogastric tube. Some active very-low-birth-weight infants can be fed with a cup and spoon or an eyedropper, which must be sterilized before each feed. Use only expressed breast milk if possible. If a 2–4-ml volume is tolerated with no vomiting, abdominal distension or gastric aspirates of more than half the feed, the volume can be increased by 1–2 ml per feed

each day. Reduce or withhold feeds if there are signs of poor tolerance. Aim to establish feeding within the first 5–7 days so that the IV drip can be removed, to avoid infection.

- The feeds may be increased during the first 2 weeks of life to 150–180 ml/kg per day (3-hourly feeds of 19–23 ml for a 1-kg infant and 28–34 ml for a 1.5-kg infant). As the infant grows, recalculate the feed volume on the basis of the higher weight.
- ▶ Give daily supplements when the infant is accepting full enteral feeds:
 - vitamin D at 400 IU
 - calcium at 120–140 mg/kg
 - phosphorus at 60–90 mg/kg.
- ▶ Start iron supplements at 2 weeks of age at a dosage of 2–4 mg/kg per day until 6 months of age.

Preventing apnoea

- Give caffeine citrate and aminophylline to prevent apnoea in premature infants. Caffeine is preferred if it is available.
- ▶ The loading dose of caffeine citrate is 20 mg/kg orally or IV (given slowly over 30 min). A maintenance dose of 5 mg/kg per day should be prescribed 24 h later and can be increased by 5 mg/kg every 24 h to a maximum of 20 mg/kg per day, unless side-effects develop. Continue 4–5 days after cessation of apnoea (see p. 69).
- ▶ If caffeine is not available, give a loading dose of aminophylline at 6 mg/kg IV over 20 min, followed by a maintenance dose of 2.5 mg/kg every 12 h (see p. 69).
- If an apnoea monitor is available, this should be used.
- If an apnoea monitor is not available, a pulse oximeter with the alarm turned on for hypoxaemia may help to detect apnoea if the neonate is breathing room air.

3.11.3 Common problems of low-birth-weight infants

Respiratory distress syndrome

Preterm infants are at risk for respiratory distress syndrome due to surfactant deficiency. This can be reduced if pregnant mothers at risk for premature delivery (e.g. premature contractions or premature rupture of membranes) are given dexamethasone at two doses of 12 mg 24 h apart. Respiratory distress usually occurs in a preterm infant during the first 3 days of life. It is a self-

limiting condition, because birth triggers an increase in surfactant production. The challenge is to support the infant for the first few days of life until such time as the deficiency resolves.

The key clinical features usually become obvious within 4 h of birth and include:

- tachypnoea
- an expiratory 'grunt'
- intercostal and/or subcostal recession and
- cyanosis.

Treatment

The principles of treatment are:

- minimal handling of the infant
- supplementary oxygen if needed to keep the oxygen saturation > 90% but < 95% to avoid eye damage
- initially no oral feeding
- IV fluids (see above)
- maintenance of a normal temperature range
- IV antibiotics for neonatal sepsis, as it is difficult to exclude pneumonia as a cause of respiratory distress

Continuous positive airway pressure is used, even in expiration, to prevent airway collapse, improve oxygenation and reduce breathing fatigue. See section 10.7 for further details.

If there is persistent respiratory distress or hypoxaemia, do chest X-ray to check for pneumothorax.

Necrotizing enterocolitis

Necrotizing enterocolitis (a bowel infection) may occur in low-birth-weight infants, especially after enteral feeds are started. The condition is commoner in low-birth-weight infants fed artificial formulae but may occur in breastfed infants.

Common signs of necrotizing enterocolitis are:

- abdominal distension or tenderness
- intolerance to feeding

- bile-stained vomit or bile-stained fluid up the nasogastric tube
- blood in the stools

General signs of systemic illness include

- apnoea
- drowsiness or unconsciousness
- fever or hypothermia

Treatment

- ▶ Stop enteral feeding.
- ▶ Pass a nasogastric tube and leave it on free drainage.
- ▶ Start an IV infusion of glucose–saline (see p. 57 for rate of infusion).
- ▶ Start antibiotics: give ampicillin (or penicillin) plus gentamicin plus metronidazole for 10 days.

If the infant has apnoea or other danger signs, give oxygen by nasal catheter. If apnoea continues, give aminophylline or caffeine IV (see p. 61).

If the infant is pale, check the Hb, and transfuse if Hb < 10 g/dl.

Take a supine and lateral decubitus abdominal X-ray. If there is gas in the abdominal cavity outside the bowel, there may be bowel perforation. Ask a surgeon to see the infant urgently.

Examine the infant carefully each day. Reintroduce expressed breast milk feeds by nasogastric tube when the abdomen is soft and not tender, the infant is passing normal stools with no blood and is not having bilious vomiting. Start feeds slowly, and gradually increase by 1–2 ml per feed each day.

3.11.4 Discharge and follow-up of low-birth-weight infants

Low-birth-weight infants can be discharged when:

- they have no **danger** signs or signs of serious infection
- they are gaining weight on breastfeeding alone
- they can maintain their temperature in the normal range (36–37 °C) in an open cot
- the mother is confident and able to care for the infant.

Low-birth-weight infants should be given all the scheduled vaccines at the time of birth and any second doses that are due by the time of discharge.

Counselling on discharge

Counsel parents before discharge on

- exclusive breastfeeding
- keeping the infant warm
- danger signs for seeking care

Low-birth-weight infants should be followed up weekly for weighing and assessment of feeding and general health, until they have reached 3 kg.

3.12 Other common neonatal problems**3.12.1 Jaundice**

More than 50% of normal newborns and 80% of preterm infants have some jaundice. Jaundice may be normal or abnormal:

Normal (physiological)

- skin and eyes yellow but none of the signs of abnormal jaundice below.

Abnormal (non-physiological)

- starting on the first day of life
- lasting > 14 days in term and > 21 days in preterm infants
- with fever
- deep jaundice: palms and soles of the infant deep yellow

Abnormal jaundice may be due to:

- serious bacterial infection
- haemolytic disease due to blood group incompatibility or glucose 6-phosphate dehydrogenase deficiency
- congenital syphilis (p. 67) or other intrauterine infection
- liver disease such as hepatitis or biliary atresia (stools pale and urine dark)
- hypothyroidism

Investigations for abnormal jaundice

All newborns should be monitored for the development of jaundice, which should be confirmed by a bilirubin measurement, when possible, in all:

- infants if jaundice appears on day 1
- preterm infants (< 35 weeks) if jaundice appears on day 2

- infants if palms and soles are yellow at any age.

The investigations depend on the probable diagnosis and what tests are available but may include:

- Hb or packed cell volume
- full blood count to identify signs of serious bacterial infection (high or low neutrophil count with > 20% band forms) and signs of haemolysis
- blood type of infant and mother and Coombs test
- syphilis serology, such as venereal disease research laboratory tests
- glucose 6-phosphate dehydrogenase screening, thyroid function tests, liver ultrasound

Treatment

► Phototherapy if

- jaundice on day 1
- deep jaundice involving palms and soles of the feet
- prematurity and jaundice
- jaundice due to haemolysis

Treatment of jaundice based on serum bilirubin level

Age	Phototherapy		Exchange transfusion ^a	
	Healthy infant ≥ 35 weeks	Preterm infant < 35 weeks' gestation or any risk factors ^b	Healthy infant ≥ 35 weeks	Preterm infant < 35 weeks' gestation or any risk factors
Day 1	Any visible jaundice ^c		260 µmol/l (15 mg/dl)	220 µmol/l (10 mg/dl)
Day 2	260 µmol/l (15 mg/dl)	170 µmol/l (10 mg/dl)	425 µmol/l (25 mg/dl)	260 µmol/l (15 mg/dl)
Day ≥ 3	310 µmol/l (18 mg/dl)	250 µmol/l (15 mg/dl)	425 µmol/l (25 mg/dl)	340 µmol/l (20 mg/dl)

^a Exchange transfusion is not described in this *Pocket book*. The serum bilirubin levels are included in case exchange transfusion is possible or if the infant can be transferred quickly and safely to another facility where exchange transfusion can be performed.

^b Risk factors include small size (< 2.5 kg at birth or born before 37 weeks' gestation), haemolysis and sepsis.

^c Visible jaundice anywhere on the body on day 1.

Continue phototherapy until the serum bilirubin level is lower than the threshold range or until the infant is well and there is no jaundice of palms and soles.

If the bilirubin level is very high (see table) and you can safely do exchange transfusion, consider doing so.

Antibiotics

- ▶ If infection or syphilis is suspected, treat for serious bacterial infection (pp. 54, 67).

Antimalarials

- ▶ If fever is present and the infant is from a malarious area, check blood films for malaria parasites, and give antimalarials if positive.
- ▶ Encourage breastfeeding.

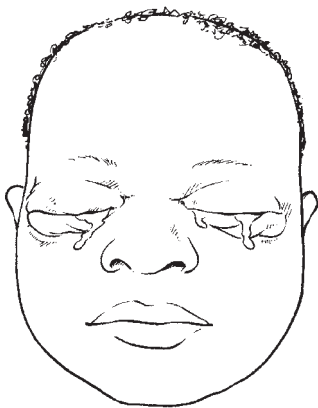
3.12.2 Conjunctivitis

Sticky eyes and mild conjunctivitis

- ▶ Treat as outpatient if child has no other serious problem.
- ▶ Show the mother how to wash the eyes with water or breast milk and how to put ointment into the eyes. The mother must wash her hands before and after doing so.
- ▶ Tell the mother to wash the eyes and put in eye ointment four times a day for 5 days.
- ▶ Give the mother a tube of tetracycline or chloramphenicol eye ointment to treat the child.

Review 48 h after starting treatment if the child is not improving. Severe conjunctivitis (a lot of pus and/or swelling of the eyelids) is often due to gonococcal infection. Treat as inpatient, as there is a risk for blindness, and twice-daily review is needed.

- ▶ Wash the eyes to clear as much pus as possible.
- ▶ Give ceftriaxone (50 mg/kg up to a maximum total dose of 150 mg



Ophthalmia neonatorum. Swollen, red eyelids with pus

IM **once**) or kanamycin (25 mg/kg up to a maximum total dose of 75 mg IM **once**), according to national guidelines.

Also use as described above:

- ▶ tetracycline eye ointment or
- ▶ chloramphenicol eye ointment

Also treat the mother and her partner for sexually transmitted infections: amoxicillin, spectinomycin or ciprofloxacin for gonorrhoea and tetracycline for *Chlamydia*, depending on the resistance pattern in the country. Refer to the sexually transmitted infection control guidelines.

3.12.3 Congenital malformations

See section 9.2 (p. 264) for:

- cleft lip and palate
- bowel obstruction
- abdominal wall defects
- myelomeningocele
- congenital dislocation of the hip
- talipes equinovarus (club foot)

3.13 Infants of mothers with infectious diseases

3.13.1 Congenital syphilis

Clinical signs

- often low birth weight
- palms and soles: red rash, grey patches, blisters or skin peeling
- 'snuffles': highly infectious rhinitis with nasal obstruction
- abdominal distension due to enlarged liver and spleen
- jaundice
- anaemia

Some very-low-birth-weight infants with syphilis have signs of severe sepsis with lethargy, respiratory distress, skin petechiae or other bleeding.

If you suspect syphilis, do a VDRL test if possible.

Treatment

- ▶ Asymptomatic neonates born to women with a positive VDRL or rapid plasma reagin test should receive 37.5 mg/kg (50 000 U/kg) of benzathine benzylpenicillin in a single IM dose.
- ▶ Symptomatic infants should be treated with:
 - procaine benzylpenicillin at 50 mg/kg as a single dose by deep IM injection daily for 10 days
 - or
 - benzylpenicillin at 30 mg/kg every 12 h IV for the first 7 days of life and then 30 mg/kg every 8 h for a further 3 days.
- ▶ Treat the mother and her partner for syphilis and check for other sexually transmitted infections.

3.13.2 Infants of mothers with tuberculosis

If the mother has active lung tuberculosis (TB) and was treated for < 2 months before the birth, or TB was diagnosed after the birth:

- Reassure the mother that it is safe for her to breastfeed her infant.
- Do not give the TB vaccine (BCG) at birth.
- Give prophylactic isoniazid at 10 mg/kg by mouth once daily.
- Re-evaluate the infant at the age of 6 weeks, noting weight gain and taking an X-ray of the chest, if possible.
- If any findings suggest active disease, start full anti-TB treatment, according to national guidelines (see p. 115).
- If the infant is doing well and tests are negative, continue prophylactic isoniazid to complete 6 months of treatment.
- Delay BCG vaccination until 2 weeks after treatment is completed. If BCG has already been given, repeat 2 weeks after the end of isoniazid treatment.

3.13.3 Infants of mothers with HIV infection

See Chapter 8 for guidance.

3.14 Doses of common drugs for neonates and low-birth-weight infants

Drug	Dosage	Form	Weight of infant in kg						
			1-< 1.5	1.5-< 2	2-2.5	2.5-< 3	3-3.5	3.5-< 4	4-< 4.5
Aminophylline to prevent apnoea	Calculate the exact oral maintenance dose								
	Loading dose: Oral or IV over 30 minutes 6 mg/kg, then	250 mg/10 ml vial. Dilute loading dose to 5 ml with sterile water, give slowly over 15-30 min	0.6 ml	0.8 ml	1.0 ml	Aminophylline is not usually used for term infants.			
	Maintenance dose: First week of life: Oral: 2.5 mg/ kg every 12 h Weeks 2-4 of life: Oral: 4 mg/kg every 12h		0.1- 0.15 ml	0.15- 0.20 ml	0.20- 0.25 ml				
Ampicillin	IM/IV: 50 mg/ kg First week of life: every 12 h Weeks 2-4 of life: Oral: 4 mg/kg every 12h	Vial of 250 mg mixed with 1.3 ml sterile water to 250 mg/1.5 ml	0.3- 0.6 ml	0.6- 0.9 ml	0.9- 1.2 ml	1.2- 1.5 ml	1.5- 2.0 ml	2.0- 2.5 ml	2.5- 3.0 ml
Caffeine citrate	Calculate the exact oral maintenance dose								
	Loading dose: Oral: 20 mg/kg (or IV over 30 min)		20-30 mg	30-40 mg	40-50 mg	50-60 mg	60-70 mg	70-80 mg	80-90 mg
	Maintenance dose: 5 mg/kg daily oral (or IV over 30 min)		5-7.5 mg	7.5-10 mg	10- 12.5 mg	12.5- 15 mg	15- 17.5 mg	17.5- 20 mg	20- 22.5 mg

DOSES OF COMMON DRUGS FOR NEONATES AND LOW-BIRTH-WEIGHT INFANTS

Drug	Dosage	Form	Weight of infant in kg						
			1-< 1.5	1.5-< 2	2-2.5	2.5-< 3	3-3.5	3.5-< 4	4-< 4.5
Cefotaxime	IV: 50 mg/kg Premature infants: every 12 h First week of life: every 8 h Weeks 2-4 of life: every 6 h	Vial of 500 mg mixed with 2 ml sterile water to 250 mg/ml	0.3 ml	0.4 ml	0.5 ml	0.6 ml	0.7 ml	0.8 ml	0.9 ml
Ceftriaxone For meningitis	IV: 50 mg/kg every 12 h IM/IV: 100 mg/kg once a day	1-g vial mix with 9.6 ml sterile water to 1 g/10 ml	0.5- 0.75 ml	0.75- 1 ml	1- 1.25 ml	1.25- 1.5 ml	1.5- 1.75 ml	1.75- 2 ml	2-2.5 ml
For pus draining from eye	50 mg/kg once IM (max, 125 mg)		1-1.5 ml	1.5-2 ml	2-2.5 ml	2.5-3 ml	3-3.5 ml	3.5-4 ml	4-4.5 ml
Cloxacillin	25-50 mg/kg per dose First week of life: every 12 h Weeks 2-4 of life: every 8 h	25-mg vial mixed with 1.3 ml sterile water to 250 mg/1.5 ml	25 mg/kg: 0.15- 0.3 ml	0.3- 0.5 ml	0.5- 0.6 ml	0.6- 0.75 ml	0.75- 1.0 ml	1.0- 1.25 ml	1.25- 1.5 ml
			50 mg/kg: 0.3- 0.6 ml	0.6- 0.9 ml	0.9- 1.2 ml	1.2- 1.5 ml	1.5- 2.0 ml	2- 2.5 ml	2.5- 3.0 ml

Drug	Dosage	Form	Weight of infant in kg						
			1-<1.5	1.5-<2	2-2.5	2.5-<3	3-3.5	3.5-<4	4-<4.5
Gentamicin	Preferably calculate exact dose based on the infant's weight								
	First week of life:	Vial 20 mg/2 ml	0.3-	0.5-	0.6-	1.25-	1.5-	1.75-	2-
	Low-birth-weight	Vial 80 mg/2 ml	0.5 ml	0.6 ml	0.75 ml	1.5 ml	1.75 ml	2 ml	2.25 ml
	infants: IM/IV: 3	Dilute to 8 ml							
	mg/kg once a day	with sterile water to 10 mg/ml							
	Normal birth weight: IM/IV: 5 mg/kg per dose once a day								
	Weeks 2-4 of life: IM/IV: 7.5 mg/kg once a day		0.75-1.1 ml	1.1-1.5 ml	1.5-1.8 ml	1.8-2.2 ml	2.2-2.6 ml	2.6-3.0 ml	3.0-3.3 ml
Note: To use a vial of 80 mg/2 ml, dilute to 8 ml with sterile water to 10 mg/ml, then use exactly the same dose as in the table above.									
Kanamycin	IM/IV: 20 mg/kg (one dose for pus draining from eyes)	2-ml vial to make 125 mg/ml	0.2-0.3 ml	0.3-0.4 ml	0.4-0.5 ml	0.5-0.6 ml	0.6-0.7 ml	0.7-0.8 ml	0.8-1.0 ml
Naloxone	0.1 mg/kg	Vial 0.4 mg/ml	0.25 ml	0.25 ml	0.5 ml	0.5 ml	0.75 ml	0.75 ml	1 ml
PENICILLIN									
Benzylpenicillin	50 000 U/kg per dose	Vial of 600 mg (1 000 000 U)	0.2 ml	0.2 ml	0.3 ml	0.5 ml	0.5 ml	0.6 ml	0.7 ml
	First week of life: every 12 h	dilute with 1.6 ml sterile water							
	Weeks 2-4 and older: every 6 h	to 500 000 U/ml							

Drug	Dosage	Form	Weight of infant in kg						
			1-<1.5	1.5-<2	2-2.5	2.5-<3	3-3.5	3.5-<4	4-<4.5
Benzathine benzylpenicillin	50 000 U/kg once a day	IM: vial of 1 200 000 U mixed with 4 ml sterile water	0.2 ml	0.3 ml	0.4 ml	0.5 ml	0.6 ml	0.7 ml	0.8 ml
Procaine benzylpenicillin	IM: 50 000 U/kg once a day	3-g vial (3 000 000 U) mixed with 4 ml sterile water	0.1 ml	0.15 ml	0.2 ml	0.25 ml	0.3 ml	0.3 ml	0.35 ml
Phenobarbital	Loading dose: IM/IV or oral: 20 mg/kg	Vial 200 mg/ml diluted with 4 ml sterile water	Calculate the exact dose						
		30-mg tablets	½	¾	1	1¼	1½	1¾	2
	Maintenance dose: Oral: 5 mg/kg per day	30-mg tablets	¼	¼	½	½	½	¾	¾

Notes

Cough or difficulty in breathing

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Cough and difficulty in breathing are common problems in young children. The causes range from a mild, self-limited illness to severe, life-threatening disease. This chapter provides guidelines for managing the most important conditions that cause cough, difficulty in breathing or both in children aged 2 months to 5 years. The differential diagnosis of these conditions is described in Chapter 2. Management of these problems in infants < 2 months of age is described in Chapter 3 and management in severely malnourished children in Chapter 7.

Most episodes of cough are due to the common cold, each child having several episodes a year. The commonest severe illness and cause of death that presents with cough or difficult breathing is pneumonia, which should be considered first in any differential diagnosis (Table 6, p. 77).

4.1 Child presenting with cough

History

Pay particular attention to:

- cough
 - duration in days
 - paroxysms with whoops or vomiting or central cyanosis
- exposure to someone with TB (or chronic cough) in the family
- history of choking or sudden onset of symptoms
- known or possible HIV infection
- vaccination history: BCG; diphtheria, pertussis, tetanus (DPT); measles; *Haemophilus influenzae* type b and pneumococcus
- personal or family history of asthma.

Examination

The symptoms and signs listed below are a guide for the clinician to reach a diagnosis. Not all children will show every symptom or sign.

General

- central cyanosis
- apnoea, gasping, grunting, nasal flaring, audible wheeze, stridor
- head nodding (a movement of the head synchronous with inspiration indicating severe respiratory distress)
- tachycardia
- severe palmar pallor

Chest

- respiratory rate (count during 1 min when the child is calm)
- fast breathing: < 2 months, ≥ 60 breaths
 2–11 months, ≥ 50 breaths
 1–5 years, ≥ 40 breaths