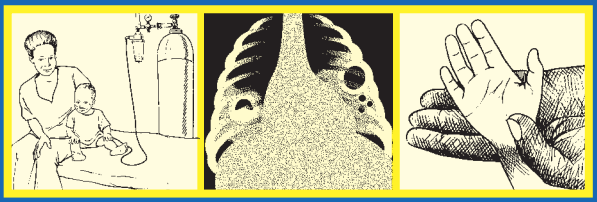
2013 EDITION

POCKET BOOK
OF

Hospital care for children



GUIDELINES FOR THE MANAGEMENT OF COMMON CHILDHOOD ILLNESSES

Second edition

World Health Organization

ANTIMICROBIAL DRUGS FOR COMMON CONDITIONS

Please fill the blanks with your country's most recent updated treatment guidelines. Page numbers refer to where generic guidance is found in the Pocket Book.

Condition	Drug	Dose
Dysentery (p. 144)		
HIV treatment (p. 233)		
drug 2		
drug 3		
Malaria, non severe (p. 164–5)		
drug 2		
Malaria, severe (p. 158)		
Mastoiditis (p. 182)		
drug 2		
Meningitis (p. 169)		
drug 2		
Osteomyelitis (p. 187)		
drug 2		
Otitis media, acute (p. 183)		
Pneumonia, non-severe (p. 86)		
Pneumonia, severe (p. 82)		
drug 2		
Sepsis, neonatal (p. 55)		
drug 2		
Sepsis, older child (p. 180)		
drug 2		
Severe acute malnutrition, uncomplicated (p. 207)		
complicated (p. 207)		
drug 2		
drug 3		
Tuberculosis (p.116-7)		
drug 2		
drug 3		
drug 4		
Typhoid fever (p. 181)		
drug 2		
Urinary tract infection (p. 185)		
drug 2		

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Contents

Preface xv
Acknowledgements xviii
Abbreviations xxi
Chart 1: Stages in the management of a sick child admitted to hospital: key elements xxii

1. TRIAGE AND EMERGENCY CONDITIONS 1

1.1 Triage 2
1.2 Summary of steps in emergency triage assessment and treatment 3
1.3 Assessment of emergency and priority signs 4
Triage of all sick children 5
How to manage a choking infant or child 7
How to manage the airway in a child with obstructed breathing 9
How to give oxygen 11
How to position the unconscious child 12
Give IV fluids for shock in a child without severe acute malnutrition 13
Give IV fluids for shock in a child with severe acute malnutrition 14
Give diazepam rectally 15
Give IV glucose 16
Treat severe dehydration in an emergency setting 17
1.4 Emergency treatment for a child with severe malnutrition 19
1.5 Diagnostic considerations for children with emergency conditions 20
1.5.1 Child presenting with an airway or severe breathing problem 20
1.5.2 Child presenting with shock 21
1.5.3 Child presenting with lethargy, unconsciousness or convulsions 23
1.6 Common poisoning 26
1.6.1 Principles for ingested poisons 27
1.6.2 Principles for poisons in contact with skin or eyes 29

1.6.3 Principles for inhaled poisons 29
1.6.4 Specific poisons 29
Corrosive compounds 29
Petroleum compounds 30
Organophosphorus and carbamate compounds 30
Paracetamol 31
Aspirin and other salicylates 31
Iron 32
Morphine and other opiates 32
Carbon monoxide 33
1.6.5 Prevention of poisoning 33
1.7 Drowning 33
1.8 Electrocution 34
1.9 Common causes of envenoming 34
1.9.1 Snake bite 34
1.9.2 Scorpion sting 37
1.9.3 Other sources of envenoming 38
1.10 Trauma and injuries 38
1.10.1 Primary survey or initial assessment 38
1.10.2 Secondary survey 39

2. DIAGNOSTIC APPROACHES TO THE SICK CHILD 41

2.1 Relationship to the IMCI approach and stages of hospital care 41
2.2 Taking history 42
2.3 Approach to the sick child and clinical examination 43
2.4 Laboratory investigations 43
2.5 Differential diagnoses 44

3. PROBLEMS OF THE NEONATE AND YOUNG INFANT 45

3.1 Essential newborn care at delivery 46
3.2 Neonatal resuscitation 46
3.2.1 Post resuscitation care 50
3.2.2 Cessation of resuscitation 50
3.3 Routine care for all newborns after delivery 50
3.4 Prevention of neonatal infections 51

3.5 Management of the infant with hypoxic ischaemic encephalopathy 51
3.6 Danger signs in newborns and young infants 52
3.7 Convulsions or fits 53
3.8 Serious bacterial infection 54
3.9 Meningitis 55
3.10 Supportive care for sick neonates 56
3.10.1 Thermal environment 56
3.10.2 Fluid management 57
3.10.3 Oxygen therapy 58
3.10.4 High fever 58
3.11 Preterm and low-birth-weight infants 58
3.11.1 Infants with a birth weight of 2.0–2.5 kg (35–36 weeks' gestation) 58
3.11.2 Infants with a birth weight < 2.0 kg (< 35 weeks' gestation) 59
3.11.3 Common problems of low-birth-weight infants 61
3.11.4 Discharge and follow-up of low-birth-weight infants 63
3.12 Other common neonatal problems 64
3.12.1 Jaundice 64
3.12.2 Conjunctivitis 66
3.12.3 Congential malformations 67
3.13 Infants of mothers with infectious diseases 67
3.13.1 Congenital syphilis 67
3.13.2 Infants of mothers with tuberculosis 68
3.13.3 Infants of mothers with HIV infection 68
3.14 Doses of common drugs for neonates and low-birth-weight infants 69

4. COUGH OR DIFFICULTY IN BREATHING 75

4.1 Child presenting with cough 76
4.2 Pneumonia 80
4.2.1 Severe pneumonia 80
4.2.2 Pneumonia 86
4.3 Complications of pneumonia 88
4.3.1 Pleural effusion and empyema 88

4.3.2 Lung abscess 89
4.3.3 Pneumothorax 90
4.4 Cough or cold 90
4.5 Conditions presenting with wheeze 91
4.5.1 Bronchiolitis 94
4.5.2 Asthma 96
4.5.3 Wheeze with cough or cold 101
4.6 Conditions presenting with stridor 102
4.6.1 Viral croup 102
4.6.2 Diphtheria 105
4.6.3 Epiglottitis 107
4.6.4 Anaphylaxis 108
4.7 Conditions presenting with chronic cough 109
4.7.1 Pertussis 111
4.7.2 Tuberculosis 115
4.7.3 Foreign body inhalation 119
4.8 Heart failure 120
4.9 Rheumatic heart disease 122

5. DIARRHOEA 125

5.1 Child presenting with diarrhoea 126
5.2 Acute diarrhoea 127
5.2.1 Severe dehydration 129
5.2.2 Some dehydration 132
5.2.3 No dehydration 134
5.3 Persistent diarrhoea 137
5.3.1 Severe persistent diarrhoea 137
5.3.2 Persistent diarrhoea (non-severe) 142
5.4 Dysentery 143

6. FEVER 149

6.1 Child presenting with fever 150
6.1.1 Fever lasting 7 days or less 150
6.1.2 Fever lasting longer than 7 days 153

6.2 Malaria 156
6.2.1 Severe malaria 156
6.2.2 Uncomplicated malaria 163
6.3 Meningitis 167
6.3.1 Bacterial meningitis 167
6.3.2 Meningococcal epidemics 170
6.3.3 Tuberculous meningitis 171
6.3.4 Cryptococcal meningitis 172
6.4 Measles 174
6.4.1 Severe complicated measles 175
6.4.2 Non-severe measles 178
6.5 Septicaemia 179
6.6 Typhoid fever 180
6.7 Ear infections 182
6.7.1 Mastoiditis 182
6.7.2 Acute otitis media 183
6.7.3 Chronic otitis media 184
6.8 Urinary tract infection 184
6.9 Septic arthritis or osteomyelitis 186
6.10 Dengue 188
6.10.1 Severe dengue 188
6.11 Rheumatic fever 193

7. SEVERE ACUTE MALNUTRITION 197

7.1 Severe acute malnutrition 198
7.2 Initial assessment of a child with severe acute malnutrition 198
7.3 Organization of care 200
7.4 General management 200
7.4.1 Hypoglycaemia 201
7.4.2 Hypothermia 202
7.4.3 Dehydration 203
7.4.4 Electrolyte imbalance 206
7.4.5 Infection 207
7.4.6 Micronutrient deficiencies 208

7.4.7 Initial re-feeding 209
7.4.8 Catch-up growth feeding 210
7.4.9 Sensory stimulation 215
7.4.10 Severe acute malnutrition in infants aged < 6 months 216
7.5 Treatment of associated conditions 217
7.5.1 Eye problems 217
7.5.2 Severe anaemia 218
7.5.3 Skin lesions in kwashiorkor 218
7.5.4 Continuing diarrhoea 219
7.5.5 Tuberculosis 219
7.6 Discharge and follow-up 219
7.6.1 Discharge to outpatient care 219
7.6.2 Discharge from nutritional treatment 220
7.6.3 Follow up 221
7.7 Monitoring the quality of care 221
7.7.1 Mortality audit 221
7.7.2 Weight gain during rehabilitation 222

8. CHILDREN WITH HIV/AIDS 225

8.1 Sick child with suspected or confirmed HIV infection 226
8.1.1 Clinical diagnosis 226
8.1.2 HIV counselling 228
8.1.3 Testing and diagnosis of HIV infection 229
8.1.4 Clinical staging 230
8.2 Antiretroviral therapy 232
8.2.1 Antiretroviral drugs 233
8.2.2 When to start antiretroviral therapy 235
8.2.3 Side-effects and monitoring 235
8.2.4 When to change treatment 238
8.3 Supportive care for HIV-positive children 240
8.3.1 Vaccination 240
8.3.2 Co-trimoxazole prophylaxis 241
8.3.3 Nutrition 243

8.4 Management of HIV-related conditions 243
8.4.1 Tuberculosis 243
8.4.2 *Pneumocystis jiroveci* pneumonia 244
8.4.3 Lymphoid interstitial pneumonitis 245
8.4.4 Fungal infections 246
8.4.5 Kaposi sarcoma 246
8.5 Prevention of mother-to-child HIV transmission, and infant feeding 247
8.5.1 Prevention of mother-to-child HIV transmission 247
8.5.2 Infant feeding in the context of HIV infection 248
8.6 Follow-up 249
8.6.1 Discharge from hospital 249
8.6.2 Referral 249
8.6.3 Clinical follow-up 250
8.7 Palliative and end-of-life care 250
8.7.1 Pain control 250
8.7.2 Management of anorexia, nausea and vomiting 252
8.7.3 Prevention and treatment of pressure sores 252
8.7.4 Care of the mouth 252
8.7.5 Airway management 252
8.7.6 Psychosocial support 253

9. COMMON SURGICAL PROBLEMS 255

9.1 Care before, during and after surgery 256
9.1.1 Preoperative care 256
9.1.2 Intraoperative care 258
9.1.3 Postoperative care 260
9.2 Congenital anomalies 264
9.2.1 Cleft lip and palate 264
9.2.2 Bowel obstruction 265
9.2.3 Abdominal wall defects 266
9.2.4 Myelomeningocoele 267
9.2.5 Congenital dislocation of the hip 267
9.2.6 Talipes equinovarus (club foot) 268

9.3 Injuries 269
9.3.1 Burns 269
9.3.2 Head injuries 272
9.3.3 Chest injuries 273
9.3.4 Abdominal injuries 275
9.3.5 Fractures 275
9.3.6 Principles of wound care 279
9.4 Abdominal problems 281
9.4.1 Abdominal pain 281
9.4.2 Appendicitis 282
9.4.3 Bowel obstruction after the neonatal period 283
9.4.4 Intussusception 284
9.4.5 Umbilical hernia 285
9.4.6 Inguinal hernia 285
9.4.7 Incarcerated hernia 286
9.4.8 Testicular torsion 286
9.4.9 Rectal prolapse 287
9.5 Infections requiring surgery 287
9.5.1 Abscess 287
9.5.2 Osteomyelitis 288
9.5.3 Septic arthritis 289
9.5.4 Pyomyositis 291

10. SUPPORTIVE CARE 293

10.1 Nutritional management 294
10.1.1 Supporting breastfeeding 294
10.1.2 Nutritional management of sick children 299
10.2 Fluid management 304
10.3 Management of fever 305
10.4 Pain control 306
10.5 Management of anaemia 307
10.6 Blood transfusion 308
10.6.1 Storage of blood 308
10.6.2 Problems in blood transfusion 308

10.6.3 Indications for blood transfusion 309
10.6.4 Giving a blood transfusion 309
10.6.5 Transfusion reactions 310
10.7 Oxygen therapy 312
10.8 Toys and play therapy 315

11. MONITORING THE CHILD'S PROGRESS 319

11.1 Monitoring procedures 319
11.2 Monitoring chart 320
11.3 Audit of paediatric care 320

12. COUNSELLING AND DISCHARGE FROM HOSPITAL 321

12.1 Timing of discharge from hospital 321
12.2 Counselling 322
12.3 Nutrition counselling 323
12.4 Home treatment 324
12.5 Checking the mother's health 324
12.6 Checking immunization status 325
12.7 Communicating with the first-level health worker 325
12.8 Providing follow-up care 327

BIBLIOGRAPHY 329

ANNEXES

Annex 1. Practical procedures 333
A1.1 Giving injections 335
A1.1.1 Intramuscular 336
A1.1.2 Subcutaneous 336
A1.1.3 Intradermal 336
A1.2 Giving parenteral fluids 338
A1.2.1 Insertion of an indwelling intravenous cannula in a peripheral vein 338
A1.2.2 Intraosseous infusion 340
A1.2.3 Central vein cannulation 342
A1.2.4 Venous cut-down 343
A1.2.5 Umbilical vein catheterization 344
A1.3 Insertion of a nasogastric tube 345
A1.4 Lumbar puncture 346

A1.5 Insertion of a chest drain 348
A1.6 Supra-pubic aspiration 350
A1.7 Measuring blood glucose 350
Annex 2. Drug dosages and regimens 353
Annex 3. Equipment sizes 375
Annex 4. Intravenous fluids 377
A4.1 Choice of intravenous fluids 378
Annex 5. Assessing nutritional status 379
A5.1 Calculating a child's weight-for-age 379
A5.2 Calculating a child's weight-for-length or height 386
Annex 6. Job aids and charts 403

INDEX 405

CHARTS

Chart 1. Stages in the management of a sick child admitted to hospital: key elements xxii
Chart 2. Triage of all sick children 5
Chart 3. How to manage a choking infant or child 7
Chart 4. How to manage the airways in a child with obstructed breathing (or who has just stopped breathing) 9
Chart 5. How to give oxygen 11
Chart 6. How to position an unconscious child 12
Chart 7. How to give intravenous fluids rapidly to a child in shock without severe malnutrition 13
Chart 8. How to give intravenous fluids to a child in shock with severe malnutrition 14
Chart 9. How to give diazepam rectally 15
Chart 10. How to give glucose intravenously 16
Chart 11. How to treat severe dehydration in an emergency after initial management of shock 17
Chart 12. Neonatal resuscitation 47
Chart 13. Diarrhoea treatment plan C: Treat severe dehydration quickly 130
Chart 14. Diarrhoea treatment plan B: Treat some dehydration with oral rehydration salts 135
Chart 15. Diarrhoea treatment plan A: Treat diarrhoea at home 138
Chart 16. Feeding recommendations during sickness and health 302

TABLES

Table 1.	Differential diagnosis in a child presenting with an airways or severe breathing problem	21
Table 2.	Differential diagnosis in a child presenting with shock	22
Table 3.	Differential diagnosis in a child presenting with lethargy, unconsciousness or convulsions	24
Table 4.	Differential diagnosis in a young infant (< 2 months) presenting with lethargy, unconsciousness or convulsions	25
Table 5.	Poisoning: amount of activated charcoal per dose	28
Table 6.	Differential diagnosis in a child presenting with cough or difficulty in breathing	77
Table 7.	Classification of the severity of pneumonia	81
Table 8.	Differential diagnosis in a child presenting with wheeze	93
Table 9.	Differential diagnosis in a child presenting with stridor	103
Table 10.	Differential diagnosis in a child presenting with chronic cough	110
Table 11.	Differential diagnosis in a child presenting with diarrhoea	127
Table 12.	Classification of the severity of dehydration in children with diarrhoea	128
Table 13.	Administration of intravenous fluids to a severely dehydrated child	130
Table 14.	First diet for persistent diarrhoea: a starch-based, reduced-milk (low-lactose) diet	141
Table 15.	Second diet for persistent diarrhoea: a reduced-starch (cereal) no-milk (lactose-free) diet	141
Table 16.	Differential diagnosis of fever without localizing signs	151
Table 17.	Differential diagnosis of fever with localized signs	152
Table 18.	Differential diagnosis of fever with rash	153
Table 19.	Additional differential diagnosis of fever lasting longer than 7 days	155
Table 20	WHO criteria for the diagnosis of rheumatic fever (based on the revised Jones criteria)	194
Table 21.	Time frame for the management of a child with severe acute malnutrition	201
Table 22.	Volumes of F-75 per feed for malnourished children (approximately 130 ml/kg per day)	211
Table 23.	WHO paediatric clinical staging system for HIV infection	231
Table 24.	Classes of antiretroviral drugs recommended for use in children	234

Table 25.	First-line treatment regimens for children	234
Table 26.	Common side-effects of antiretroviral drugs	236
Table 27.	Recommended second-line treatment regimens for children	240
Table 28.	Endotracheal tube size by age	259
Table 29.	Blood volume of children by age	260
Table 30.	Normal pulse rate and blood pressure in children	261
Table 31.	Examples of local adaptations of feeding recommendations on the mother's card in Bolivia, Indonesia, Nepal, South Africa and the United Republic of Tanzania	303
Table 32.	Maintenance fluid requirements	304
Table 33.	Primary vaccination schedule for infants recommended in the Expanded Programme on Immunization	326
Table A2.1	Drug dosage by surface area (m^2) of the child	354
Table A5.1.1	Weight-for-age from birth to 5 years: Boys	379
Table A5.1.2	Weight-for-age from birth to 5 years: Girls	381
Table A5.2.1	Weight-for-length from birth to 2 years: Boys	386
Table A5.2.2	Weight-for-length from birth to 2 years: Girls	391
Table A5.2.3	Weight-for-height from 2 to 5 years: Boys	395
Table A5.2.4	Weight-for-height from 2 to 5 years: Girls	399

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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Guideline development group

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Institutions

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Abbreviations

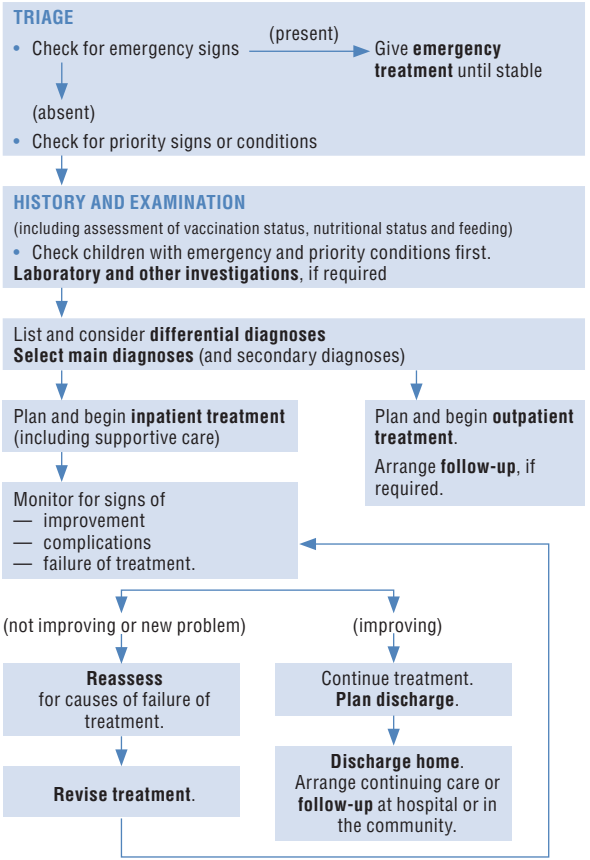
AIDS	acquired immunodeficiency syndrome
ART	antiretroviral therapy
AVPU	**a**lert, responding to **v**oice, responding to **p**ain, **u**nconscious (simple consciousness scale)
BCG	bacille Calmette-Guérin
CSF	cerebrospinal fluid
DPT	diphtheria, pertussis, tetanus
EVF	erythrocyte volume fraction (haematocrit)
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	*Pneumocystis carinii* 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



CHAPTER 1

Triage and emergency conditions

1.1 Triage 2
1.2 Summary of steps in emergency triage assessment and treatment 3
1.3 Assessment of emergency and priority signs 4
Triage of all sick children 5
How to manage a choking infant or child 7
How to manage the airway in a child with obstructed breathing 9
How to give oxygen 11
How to position the unconscious child 12
Give IV fluids for shock in a child without severe acute malnutrition 13
Give IV fluids for shock in a child with severe acute malnutrition 14
Give diazepam rectally 15
Give IV glucose 16
Treat severe dehydration in an emergency setting 17
1.4 Emergency treatment for a child with severe malnutrition 19
1.5 Diagnostic considerations for children with emergency conditions 20
1.5.1 Child presenting with an airway or severe breathing problem 20
1.5.2 Child presenting with shock 21
1.5.3 Child presenting with lethargy, unconsciousness or convulsions 23
1.6 Common poisoning 26
1.6.1 Principles for ingested poisons 27
1.6.2 Principles for poisons in contact with skin or eyes 29
1.6.3 Principles for inhaled poisons 29
1.6.4 Specific poisons 29
Corrosive compounds 29
Petroleum compounds 30
Organophosphorus and carbamate compounds 30
Paracetamol 31
Aspirin and other salicylates 31
Iron 32
Morphine and other opiates 32
Carbon monoxide 33
1.6.5 Prevention of poisoning 33

1.7 Drowning 33
1.8 Electrocution 34
1.9 Common causes of envenoming 34
1.9.1 Snake bite 34
1.9.2 Scorpion sting 37
1.9.3 Other sources of envenoming 38
1.10 Trauma and injuries 38
1.10.1 Primary survey or initial assessment 38
1.10.2 Secondary survey 39

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:

- **T**iny infant: any sick child aged < 2 months
- **T**emperature: child is very hot
- **T**rauma or other urgent surgical condition
- **P**allor (severe)
- **P**oisoning (history of)
- **P**ain (severe)
- **R**espiratory distress
- **R**estless, continuously irritable or lethargic

- **R**eferral (urgent)
- **M**alnutrition: visible severe wasting
- **O**edema of both feet
- **B**urns (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

TREAT

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

Airway and breathing

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

ANY SIGN POSITIVE

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.

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		TREAT
		Do not move neck if you suspect cervical spine injury, but open the airway.
Coma/ convulsing ■ Coma *or* ■ Convulsing (now)	***IF COMA OR CONVULSION***	▶ 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

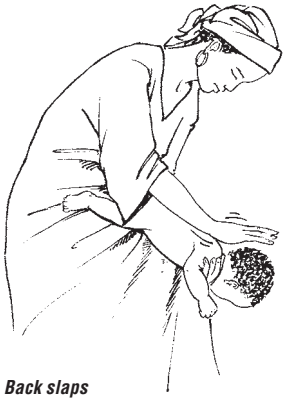
- Tiny infant (< 2 months)
- Temperature very high
- Trauma or other urgent surgical condition
- Pallor (severe)
- Poisoning (history of)
- Pain (severe)
- Respiratory distress
- Restless, continuously irritable, or lethargic
- Referral (urgent)
- Malnutrition: visible severe wasting
- Oedema of both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

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

NON-URGENT

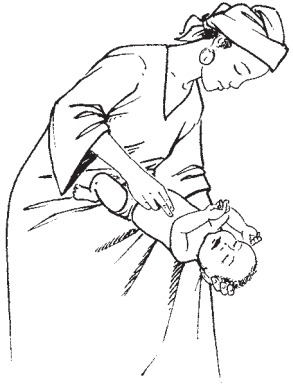
Proceed with assessment and further treatment according to the child's priority.

Chart 3. How to manage a choking infant



Back slaps

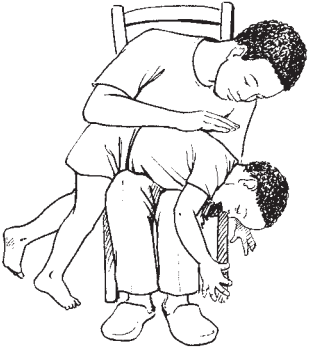
- Lay the infant on your arm or thigh in a head-down position.
- Give five blows to the middle of the infant's back with the heel of the hand.
- If obstruction persists, turn the infant over and give five chest thrusts with two fingers on the lower half of the sternum.



Chest thrusts

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

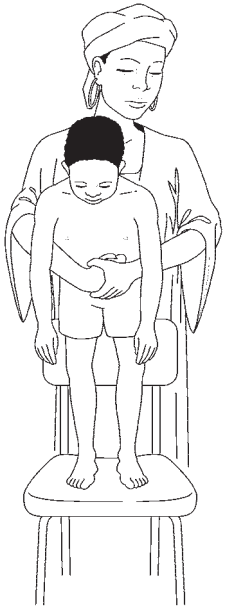
Chart 3. How to manage a choking child (> 1 year of age)



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

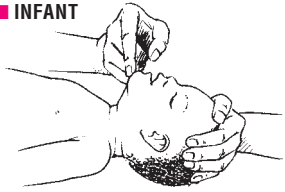
Child conscious

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

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).

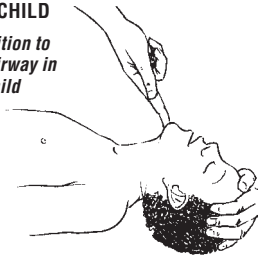
INFANT

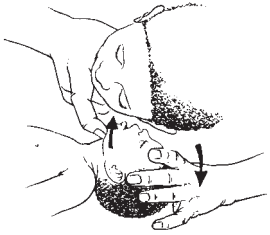


Neutral position to open the airway in an infant

OLDER CHILD

Tilting position to open the airway in an older child



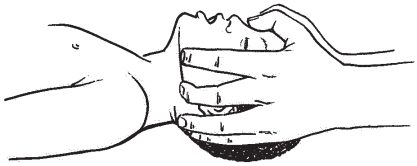


Look, listen and feel for breathing

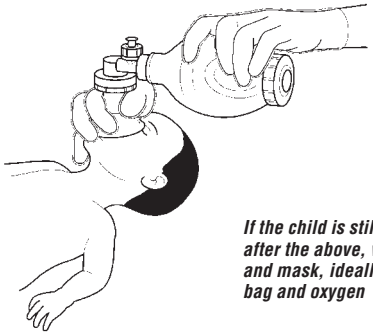
Chart 4. How to manage the airway in a child with obstructed breathing (or who has just stopped breathing)

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

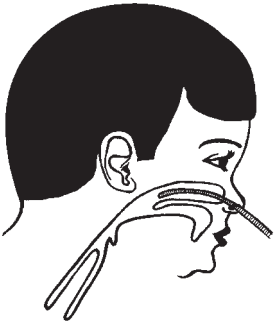
Give oxygen through nasal prongs or a nasal catheter.

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.

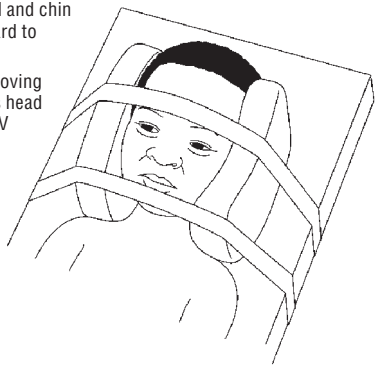


Start oxygen flow at 1–2 litres/min to aim for an oxygen saturation > 90% (see section 10.7, p. 312).

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:	• 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:	• 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
Weight 3 kg – initial dose, 0.3 ml; repeat 0.15 ml after 30 min
} If convulsions continue

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).

	Total volume IV fluid (volume per hour)	
Weight	**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.

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 **a**lert,
V responds to **v**oice,
P responds to **p**ain,
U **u**nconscious.

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	– 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	– History of recurrent wheezing – Prolonged expiration – Wheezing or reduced air entry – Response to bronchodilators
Foreign body aspiration	– History of sudden choking – Sudden onset of stridor or respiratory distress – Focal reduced air entry or wheeze
Retropharyngeal abscess	– Slow development over days, getting worse – Inability to swallow – High fever
Croup	– Barking cough – Hoarse voice – Associated with upper respiratory tract infection – Stridor on inspiration – Signs of respiratory distress
Diphtheria	– '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

- 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
- Petaechiae
- 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	– History of trauma – Bleeding site
Dengue shock syndrome	– Known dengue outbreak or season – History of high fever – Purpura
Cardiac shock	– History of heart disease or heart murmur – Enlarged neck veins and liver – Crepitations in both lung fields
Septic shock	– 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	– 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
- Petaechial 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.

- 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]	– Very irritable – Stiff neck or bulging fontanelle – Petaechial rash (meningococcal meningitis only) – Opisthotonous
Cerebral malaria (only in children exposed to *P. falciparum*; often seasonal)	– Blood smear or rapid diagnostic test positive for malaria parasites – Jaundice – Anaemia – Convulsions – Hypoglycaemia
Febrile convulsions (not likely to be the cause of unconsciousness)	– 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)	– 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	– Signs or history of head trauma
Poisoning	– History of poison ingestion or drug overdose
Shock (can cause lethargy or unconsciousness, but is unlikely to cause convulsions)	– Poor perfusion – Rapid, weak pulse

Table 3. Continued

Diagnosis or underlying cause	In favour
Acute glomerulonephritis with encephalopathy	– Raised blood pressure – Peripheral or facial oedema – Blood and/or protein in urine – Decreased or no urine
Diabetic ketoacidosis	– 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	– Onset in first 3 days of life – History of difficult delivery
Intracranial haemorrhage	– Onset in first 3 days of life in a low-birth-weight or preterm infant
Haemolytic disease of the newborn, kernicterus	– Onset in first 3 days of life – Jaundice – Pallor – Serious bacterial infection – No vitamin K given
Neonatal tetanus	– Onset at age 3–14 days – Irritability – Difficulty in breastfeeding – Trismus – Muscle spasms – Convulsions

Table 4. Continued

Diagnosis or underlying cause	In favour
Meningitis	– Lethargy – Apnoeic episodes – Convulsions – High-pitched cry – Tense or bulging fontanelle
Sepsis	– 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 ≤ 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 ≤ 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.

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 lipoid 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 ≤ 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.

- 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 °C by using radiant heaters or warmed dry blankets; if the core temperature is < 32 °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.

- 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:

- 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

CHAPTER 2

Diagnostic approaches to the sick child

2.1 Relationship to the Integrated Management of Childhood Illness approach and stages of hospital care 41
2.2 Taking history 42
2.3 Approach to the sick child and clinical examination 43
2.4 Laboratory investigations 43
2.5 Differential diagnoses 44

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, septicaemia 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 ask 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

CHAPTER 3

Problems of the neonate and young infant

3.1 Essential newborn care at delivery 46
3.2 Neonatal resuscitation 46
3.2.1 Post-resuscitation care 50
3.2.2 Cessation of resuscitation 50
3.3 Routine care for all newborns after delivery 50
3.4 Prevention of neonatal infections 51
3.5 Management of the infant with hypoxic ischaemic encephalopathy 51
3.6 Danger signs in newborns and young infants 52
3.7 Convulsions or fits 53
3.8 Serious bacterial infection 54
3.9 Meningitis 55
3.10 Supportive care for sick neonates 56
3.10.1 Thermal environment 56
3.10.2 Fluid management 57
3.10.3 Oxygen therapy 58
3.10.4 High fever 58
3.11 Preterm and low-birth-weight infants 58
3.11.1 Infants with a birth weight of 2.0–2.5 kg (35–36 weeks' gestation) 58
3.11.2 Infants with a birth weight < 2.0 kg (< 35 weeks' gestation) 59
3.11.3 Common problems of low-birth-weight infants 61
3.11.4 Discharge and follow-up of low-birth-weight infants 63
3.12 Other common neonatal problems 64
3.12.1 Jaundice 64
3.12.2 Conjunctivitis 66
3.12.3 Congenital malformations 67
3.13 Infants of mothers with infectious diseases 67
3.13.1 Congenital syphilis 67
3.13.2 Infants of mothers with tuberculosis 68
3.13.3 Infants of mothers with HIV infection 68
3.14 Doses of common drugs for neonates and low-birth-weight infants 69

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

- Dry the infant immediately with a clean cloth.
- Keep warm by skin-to-skin contact and covered.

A

Look for
- Breathing or crying
- Good muscle tone or vigorous movements

Yes → Routine care (*see section 3.1*)

No

- Stimulate by rubbing the back 2 to 3 times.
- Suction only if had meconium stained liquor or the mouth or nose is full of secretions.

Breathing → Routine care and closely observe breathing

Not breathing, or gasping

B

- **CALL FOR HELP**.
- Transfer to newborn resuscitation area.
- Position the head/neck slightly extended.
- Start positive pressure ventilation with mask and self-inflating bag within 1 min of birth.[a]
- Make sure the chest is moving adequately.

Breathing well → Observe closely if continues to breathe well

After 30–60 s

Check the heart rate (HR) with a stethoscope.

If HR < 60/min

- Chest compressions until HR ≥ 100/min (*see figure on p. 48*)
- Give higher oxygen concentration.
- If HR remains at < 60/min, consider:
- Other ventilatory support.
- IV adrenaline.
- Refer where possible
- If **no** HR for > 10 min or remains < 60/min for 20 min, discontinue (*see section 3.2.2, p. 50*).

If HR ≥ 60/min

C

HR 60–100/min:
- Take ventilation corrective steps.
- Continue to ventilate at 40 breaths per min.
- Consider higher oxygen concentration.
- Suction, if necessary.
- Reassess every 1–2 min.

HR > 100/min:
- Continue to ventilate at 40 breaths per min.
- Every 1–2 min stop to see if breathing spontaneously.
- Stop ventilating when respiratory rate is > 30 breaths per min.
- Give post resuscitation care. (*see section 3.2.1, p. 50*).

If HR > 100/min

[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

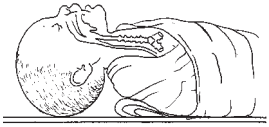
- Keep the infant's head in a slightly extended position to open the airway.
- Do not suction routinely. Suction the airway if there is meconium-stained fluid **and** the infant is **not** crying and moving limbs. When the amniotic fluid is clear, suction only if the nose or mouth is full of secretions.
  - 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).

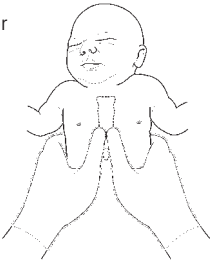
C. Circulation

- 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.

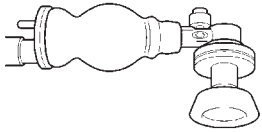
Do not hyperextend the neck.



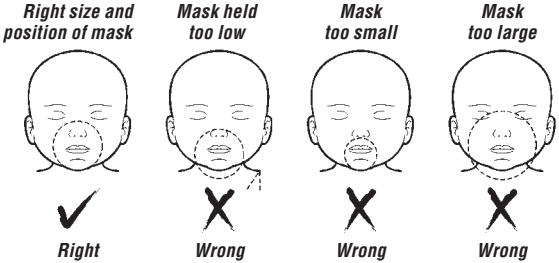
Correct position of hands for cardiac massage of a neonate. The thumbs are used for compression over the sternum.

Chart 12. Neonatal resuscitation

Neonatal self-inflating resuscitation bag with round mask



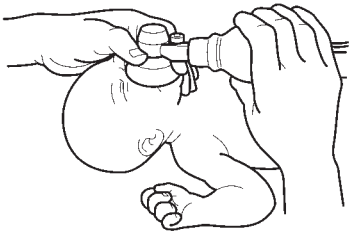
Fitting mask over face:



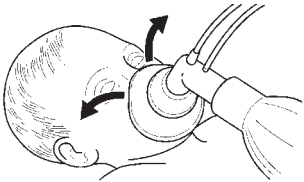
Ventilating a neonate with bag and mask

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 ≤ 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).

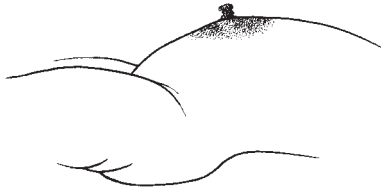
3.8 Serious bacterial infection

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

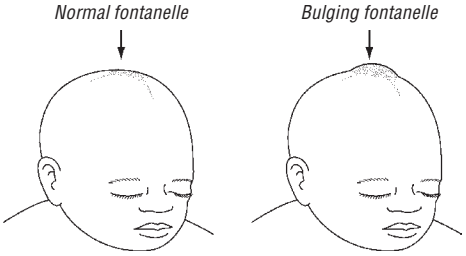
Clinical signs

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.



Bulging fontanelle – sign of meningitis in young infants with an open fontanelle

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 ≤ 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.

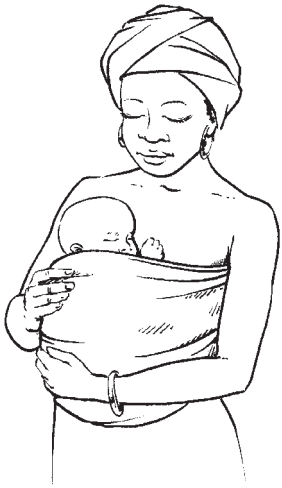
Preventing hypothermia

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

	Phototherapy		Exchange transfusion[a]	
Age	**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.

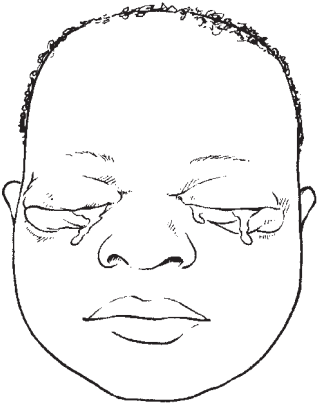
3.12.2 Conjunctivitis

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
- myelomeningocoele
- 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 petaechiae 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		0.1–0.15 ml	0.15–0.20 ml	0.20–0.25 ml				
	Weeks 2–4 of life: Oral: 4 mg/kg every 12h		0.15–0.2 ml	0.25–0.3 ml	0.30–0.4 ml				
Ampicillin	IM/IV: 50 mg/kg First week of life: every 12 h Weeks 2–4 of life: every 8 h	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

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	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
	IM/IV: 100 mg/kg once a day		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
For pus draining from eye	50 mg/kg once IM (max, 125 mg)								
Cloxacillin	25–50 mg/kg per dose First week of life: every 12 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
	Weeks 2–4 of life: every 8 h		**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: Low-birth-weight infants: IM/IV: 3 mg/kg once a day Normal birth weight: IM/IV: 5 mg/kg per dose once a day	Vial 20 mg/2 ml Vial 80 mg/2 ml Dilute to 8 ml with sterile water to 10 mg/ml	0.3– 0.5 ml	0.5– 0.6 ml	0.6– 0.75 ml	1.25– 1.5 ml	1.5– 1.75 ml	1.75– 2 ml	2– 2.25 ml
	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 **First week of life:** every 12 h **Weeks 2–4 and older:** every 6 h	Vial of 600 mg (1 000 000 U) dilute with 1.6 ml sterile water to 500 000 U/ml	0.2 ml	0.2 ml	0.3 ml	0.5 ml	0.5 ml	0.6 ml	0.7 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

Notes

CHAPTER 4

Cough or difficulty in breathing

4.1	Child presenting with cough	76
4.2	Pneumonia	80
	4.2.1 Severe pneumonia	80
	4.2.2 Pneumonia	86
4.3	Complications of pneumonia	88
	4.3.1 Pleural effusion and empyema	88
	4.3.2 Lung abscess	89
	4.3.3 Pneumothorax	90
4.4	Cough or cold	90
4.5	Conditions presenting with wheeze	91
	4.5.1 Bronchiolitis	94
	4.5.2 Asthma	96
	4.5.3 Wheeze with cough or cold	101
4.6	Conditions presenting with stridor	102
	4.6.1 Viral croup	102
	4.6.2 Diphtheria	105
	4.6.3 Epiglottitis	107
	4.6.4 Anaphylaxis	108
4.7	Conditions presenting with chronic cough	109
	4.7.1 Pertussis	111
	4.7.2 Tuberculosis	115
	4.7.3 Foreign body inhalation	119
4.8	Heart failure	120
4.9	Rheumatic heart disease	122

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

- lower chest wall indrawing
- hyperinflated chest
- apex beat displaced or trachea shifted from midline
- raised jugular venous pressure
- on auscultation, coarse crackles, no air entry or bronchial breath sounds or wheeze
- abnormal heart rhythm on auscultation
- percussion signs of pleural effusion (stony dullness) or pneumothorax (hyper-resonance)

Note: *Lower chest wall indrawing is when the lower chest wall goes in when the child breathes in; if only the soft tissue between the ribs or above the clavicle goes in when the child breathes, this is not lower chest wall indrawing.*

Abdomen

- abdominal masses (e.g. lymphadenopathy)
- enlarged liver and spleen

Investigations

- pulse oximetry to detect hypoxia and as a guide to when to start or stop oxygen therapy
- full blood count
- chest X-ray only for children with severe pneumonia or pneumonia that does not respond to treatment or complications or unclear diagnosis or associated with HIV.

Table 6. Differential diagnosis in a child presenting with cough or difficulty in breathing

Diagnosis	In favour
Pneumonia	– Cough with fast breathing – Lower chest wall indrawing – Fever – Coarse crackles or bronchial breath sounds or dullness to percussion – Grunting

Table 6. Continued

Diagnosis	In favour
Effusion or empyema	– Reduced movement on affected side of chest – Stony dullness to percussion (over the effusion) – Air entry absent (over the effusion)
Asthma or wheeze	– Recurrent episodes of shortness of breath or wheeze – Night cough or cough and wheeze with exercise – Response to bronchodilators – Known or family history of allergy or asthma
Bronchiolitis	– Cough – Wheeze and crackles – Age usually < 1 year
Malaria	– Fast breathing in a febrile child – Blood smear or malaria rapid diagnostic test confirms parasitaemia – Anaemia or palmar pallor – Lives in or travelled to a malarious area – In severe malaria, deep (acidotic) breathing or lower chest indrawing – Chest clear on auscultation
Severe anaemia	– Shortness of breath on exertion – Severe palmar pallor – Hb < 6 g/dl
Cardiac failure	– Raised jugular venous pressure in older children – Apex beat displaced to the left – Heart murmur (in some cases) – Gallop rhythm – Fine crackles in the bases of the lung fields – Enlarged palpable liver
Congenital heart disease (cyanotic)	– Cyanosis – Finger clubbing – Heart murmur – Signs of cardiac failure
Congenital heart disease (acyanotic)	– Difficulty in feeding or breastfeeding with failure to thrive – Sweating of the forehead – Heaving precordium – Heart murmur (in some cases) – Signs of cardiac failure

Table 6. Continued

Diagnosis	In favour
Tuberculosis	– Chronic cough (> 14 days) – History of contact with TB patient – Poor growth, wasting or weight loss – Positive Mantoux test – Diagnostic chest X-ray may show primary complex or miliary TB – Sputum positive in older child
Pertussis	– Paroxysms of cough followed by whoop, vomiting, cyanosis or apnoea – No symptoms between bouts of cough – No fever – No history of DPT vaccination
Foreign body	– History of sudden choking – Sudden onset of stridor or respiratory distress – Focal areas of wheeze or reduced breath sounds
Pneumothorax	– Sudden onset, usually after major chest trauma – Hyper-resonance on percussion of one side of the chest – Shift in mediastinum to opposite side
Pneumocystis pneumonia	– 2–6-month-old child with central cyanosis – Hyperexpanded chest – Fast breathing (tachypnoea) – Finger clubbing – Chest X-ray changes, but chest clear on auscultation – HIV test positive in mother or child
Croup	– Inspiratory stridor – Current measles – Barking character to cough – Hoarse voice
Diphtheria	– No history of DPT vaccination – Inspiratory stridor – Grey pharyngeal membrane – Cardiac arrhythmia

4.2 Pneumonia

Pneumonia is caused by viruses or bacteria. It is usually not possible to determine the specific cause of pneumonia by clinical features or chest X-ray appearance. Pneumonia is classified as severe or non-severe on the basis of clinical features, the management being based on the classification. Antibiotic therapy should be given in most cases of pneumonia and severe pneumonia. Severe pneumonia may require additional supportive care, such as oxygen, to be given in hospital.

4.2.1 Severe pneumonia

Diagnosis

Cough or difficulty in breathing, plus at least one of the following:

- central cyanosis or oxygen saturation < 90% on pulse oximetry
- severe respiratory distress (e.g. grunting, very severe chest indrawing)
- signs of pneumonia with a general danger sign:
  - inability to breastfeed or drink,
  - lethargy or unconscious,
  - convulsions.
- In addition, some or all of the other signs of pneumonia may be present, such as:
  - signs of pneumonia
    - fast breathing: age 2–11 months, ≥ 50/min
      age 1–5 years, ≥ 40/min
  - chest indrawing: lower chest wall indrawing (i.e. lower chest wall goes in when the child breathes in)
  - chest auscultation signs:
    - decreased breath sounds
    - bronchial breath sounds
    - crackles
    - abnormal vocal resonance (decreased over a pleural effusion or empyema, increased over lobar consolidation)
    - pleural rub

Table 7. Classification of the severity of pneumonia

Sign or symptom	Classification	Treatment
Cough or difficulty in breathing with: ■ Oxygen saturation < 90% or central cyanosis ■ Severe respiratory distress (e.g. grunting, very severe chest indrawing) ■ Signs of pneumonia with a general danger sign (inability to breastfeed or drink, lethargy or reduced level of consciousness, convulsions)	**Severe pneumonia**	– Admit to hospital. – Give oxygen if saturation < 90%. – Manage airway as appropriate. – Give recommended antibiotic. – Treat high fever if present.
■ Fast breathing: – ≥ 50 breaths/min in a child aged 2–11 months – ≥ 40 breaths/min in a child aged 1–5 years ■ Chest indrawing	**Pneumonia**	– Home care – Give appropriate antibiotic. – Advise the mother when to return immediately if symptoms of severe pneumonia. – Follow up after 3 days.
■ No signs of pneumonia or severe pneumonia	**No pneumonia: cough or cold**	– Home care – Soothe the throat and relieve cough with safe remedy. – Advise the mother when to return. – Follow up after 5 days if not improving – If coughing for more than 14 days, refer to chronic cough (see p. 109)

Investigations

- Measure oxygen saturation with pulse oximetry in all children suspected of having pneumonia.
- If possible, obtain a chest X-ray to identify pleural effusion, empyema, pneumothorax, pneumatocoele, interstitial pneumonia or pericardial effusion.

Treatment

- Admit the child to hospital.

Oxygen therapy

Ensure continuous oxygen supply, either as cylinders or oxygen concentrator, at all times.

- Give oxygen to all children with oxygen saturation < 90%
- Use nasal prongs as the preferred method of oxygen delivery to young infants; if not available, a nasal or nasopharyngeal catheter may be used. The different methods of oxygen administration and diagrams showing their use are given in section 10.7, p. 312.
- Use a pulse oximetry to guide oxygen therapy (to keep oxygen saturation > 90%). If a pulse oximeter is not available, continue oxygen until the signs of hypoxia (such as inability to breastfeed or breathing rate ≥ 70/min) are no longer present.
- Remove oxygen for a trial period each day for stable children while continuing to use a pulse oximeter to determine oxygen saturation. Discontinue oxygen if the saturation remains stable at > 90% (at least 15 min on room air).

Nurses should check every 3 h that the nasal prongs are not blocked with mucus and are in the correct place and that all connections are secure.

Antibiotic therapy

- Give intravenous ampicillin (or benzylpenicillin) and gentamicin.
  - Ampicillin 50 mg/kg or benzylpenicillin 50 000 U/kg IM or IV every 6 h for at least 5 days
  - Gentamicin 7.5 mg/kg IM or IV once a day for at least 5 days.
- If the child does not show signs of improvement within 48 h and staphylococcal pneumonia is suspected, switch to gentamicin 7.5 mg/kg IM or IV once a day and cloxacillin 50 mg/kg IM or IV every 6 h (p. 83).
- Use ceftriaxone (80 mg/kg IM or IV once daily) in cases of failure of first-line treatment.

Supportive care

- Remove by gentle suction any thick secretions at the entrance to the nasal passages or throat, which the child cannot clear.
- If the child has fever (≥ 39 °C or ≥ 102.2 °F) which appears to be causing distress, give paracetamol.
- If wheeze is present, give a rapid-acting bronchodilator (see p. 98), and start steroids when appropriate.
- Ensure that the child receives daily maintenance fluids appropriate for his or her age (see section 10.2, p. 304), but avoid over-hydration.
  - Encourage breastfeeding and oral fluids.
  - If the child cannot drink, insert a nasogastric tube and give maintenance fluids in frequent small amounts. If the child is taking fluids adequately by mouth, do not use a nasogastric tube as it increases the risk for aspiration pneumonia and obstructs part of the nasal airway. If oxygen is given by nasal catheter at the same time as nasogastric fluids, pass both tubes through the same nostril.
- Encourage the child to eat as soon as food can be taken.

Monitoring

The child should be checked by a nurse at least every 3 h and by a doctor at least twice a day. In the absence of complications, within 2 days there should be signs of improvement (breathing slower, less indrawing of the lower chest wall, less fever, improved ability to eat and drink, better oxygen saturation).

Other alternative diagnosis and treatment

- If the child has not improved after 2 days or if the child's condition has worsened, look for complications (see section 4.3) or alternative diagnoses. If possible, obtain a chest X-ray. The commonest other possible diagnoses are:

Staphylococcal pneumonia. This is suggested if there is rapid clinical deterioration despite treatment, by a pneumatocoele or pneumothorax with effusion on chest X-ray, numerous Gram-positive cocci in a smear of sputum or heavy growth of *S. aureus* in cultured sputum or empyema fluid. The presence of septic skin pustules supports the diagnosis.

- Treat with cloxacillin (50 mg/kg IM or IV every 6 h) and gentamicin (7.5 mg/kg IM or IV once a day). When the child improves (after at least 7 days of IV or IM antibiotics), continue cloxacillin orally four times a day for a total course of 3 weeks. Note that cloxacillin can be replaced by another anti-staphylococcal antibiotic, such as oxacillin, flucloxacillin or dicloxacillin.

Tuberculosis. A child with persistent cough and fever for more than 2 weeks and signs of pneumonia after adequate antibiotic treatment should be evaluated for TB. If another cause of the fever cannot be found, TB should be considered, particularly in malnourished children. Further investigations and treatment for TB, following national guidelines, may be initiated and response to anti-TB treatment evaluated (see section 4.7.2, p. 115). The HIV status of all children suspected of having TB should be confirmed if not known.

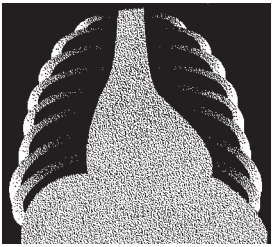
HIV infection or exposure to HIV. Some aspects of antibiotic treatment are different for children who are HIV positive or in whom HIV infection is suspected. Although pneumonia in many of these children has the same etiology as that in children without HIV, *Pneumocystis* pneumonia (PCP), often at the age of 4–6 months (see section 8.4, p. 244) is an important cause to be suspected and treated.

- Treat as for severe pneumonia above; give ampicillin plus gentamicin IM or IV for 10 days.
- If the child does not improve within 48 h, switch to ceftriaxone at 80 mg/kg IV once daily over 30 min. If ceftriaxone is not available, give gentamicin plus cloxacillin, as above.
- For children < 12 months, also give high-dose co-trimoxazole (8 mg/kg trimethoprim and 40 mg/kg sulfamethoxazole IV every 8 h or orally three times a day) for 3 weeks. For a child aged 12–59 months, give this treatment only if there are clinical signs of PCP (such as chest X-ray findings of interstitial pneumonia).
- For further management of the child, including PCP prophylaxis, see Chapter 8, p. 225).

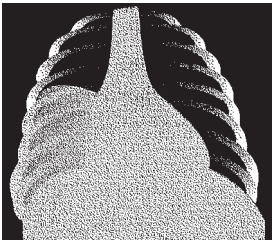
Discharge

Children with severe pneumonia can be discharged when:

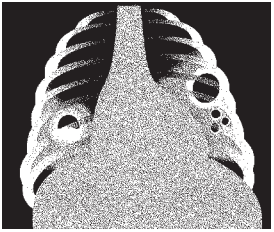
- Respiratory distress has resolved.
- There is no hypoxaemia (oxygen saturation, > 90%).
- They are feeding well.
- They are able to take oral medication or have completed a course of parenteral antibiotics.
- The parents understand the signs of pneumonia, risk factors and when to return.



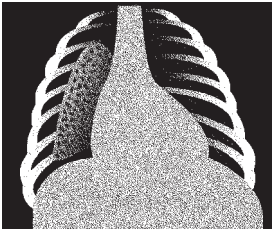
Normal chest X-ray



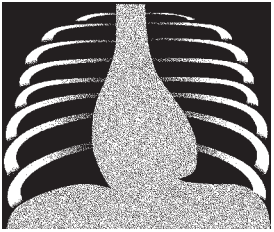
Lobar pneumonia of the right lower zone indicated by a consolidation (X-ray)



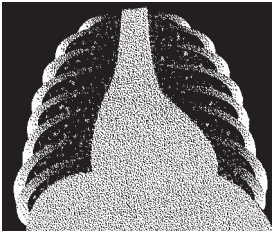
Staphylococcal pneumonia. *Typical features include pneumatocoeles (right), and an abscess with an air-fluid level (left) (X-ray).*



Pneumothorax. *The right lung (left side on image) is collapsed towards the hilus, leaving a transparent margin without lung structure. In contrast, the right side (normal) demonstrates markings extending to the periphery (X-ray).*



Hyperinflated chest. *Features are an increased transverse diameter, ribs running more horizontally, a small contour of the heart, and flattened diaphragm (X-ray).*



Appearance of miliary tuberculosis: *widespread small patchy infiltrates throughout both lungs: "snow storm appearance" (X-ray).*

Follow-up

Children with severe pneumonia may cough for several weeks. As they have been very sick, their nutrition is often poor. Give the vaccinations that are due, and arrange follow-up 2 weeks after discharge, if possible, to check the child's nutrition. Also address risk factors such as malnutrition, indoor air pollution and parental smoking.

4.2.2 Pneumonia

Diagnosis

Cough or difficult breathing plus at least one of the following signs:

- fast breathing: age 2–11 months, ≥ 50/min
  age 1–5 years, ≥ 40/min
- lower chest wall indrawing

In addition, either crackles or pleural rub may be present on chest auscultation.

Check that there are no signs of severe pneumonia, such as:

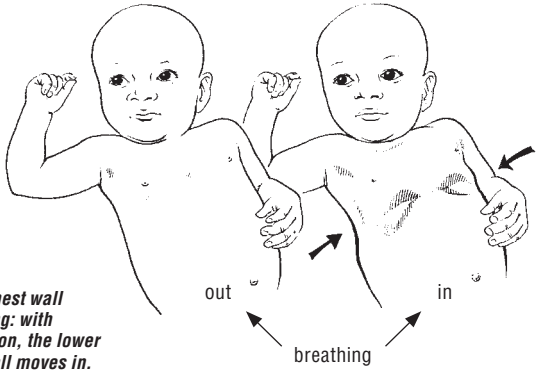
- oxygen saturation < 90% on pulse oximetry or central cyanosis
- severe respiratory distress (e.g. grunting, very severe chest indrawing)
- inability to breastfeed or drink or vomiting everything
- convulsions, lethargy or reduced level of consciousness
- auscultatory findings of decreased or bronchial breath sounds or signs of pleural effusion or empyema.

Treatment

- Treat child as outpatient.
- Advise carers to give normal fluid requirements plus extra breast milk or fluids if there is a fever. Small frequent drinks are more likely to be taken and less likely to be vomited

Antibiotic therapy

- Give the first dose at the clinic and teach the mother how to give the other doses at home.
- Give oral amoxicillin:
  - In settings with high HIV infection rate, give oral amoxicillin at least 40 mg/kg per dose twice a day for 5 days.
  - In areas with low HIV prevalence, give amoxicillin at least 40 mg/kg per dose twice a day for 3 days.



Lower chest wall indrawing: with inspiration, the lower chest wall moves in.

- Avoid unnecessary harmful medications such as remedies containing atropine, codeine derivatives or alcohol.

Follow-up

Encourage the mother to feed the child. Advise her to bring the child back after 3 days, or earlier if the child becomes sicker or is unable to drink or breastfeed. When the child returns, check:

- Whether the breathing has improved (slower), there is no chest indrawing, less fever, and the child is eating better; complete the antibiotic treatment.
- If the breathing rate and/or chest indrawing or fever and/or eating have not improved, exclude a wheeze. If no wheeze, admit to hospital for investigations to exclude complications or alternative diagnosis.
- If signs of severe pneumonia are present, admit the child to hospital and treat as above.
- Address risk factors such as malnutrition, indoor air pollution and parental smoking.

Pneumonia in children with HIV infection

- Admit to hospital and manage as severe pneumonia (see section 4.2.1, p. 80).
- For further management of these children, including PCP prophylaxis (see Chapter 8, p. 225).

4.3 Complications of pneumonia

Septicaemia is the most common pneumonia complication and occurs when the bacteria causing pneumonia spreads into the bloodstream (see section 6.5, p. 179). The spread of bacteria can lead to septic shock or metastatic secondary infections like meningitis especially in infants, peritonitis, and endocarditis especially in patients with vulvar heart disease or septic arthritis. Other common complication include pleural effusion, empyema and lung abscess.

4.3.1 Pleural effusion and empyema

Diagnosis

A child with pneumonia may develop pleural effusion or empyema.

- On examination, the chest is dull to percussion, and breath sounds are reduced or absent over the affected area.
- A pleural rub may be heard at an early stage before the effusion is fully developed.
- A chest X-ray shows fluid on one or both sides of the chest.
- When empyema is present, fever persists despite antibiotic therapy, and the pleural fluid is cloudy or frankly purulent.

Treatment

Drainage

- Pleural effusions should be drained, unless they are very small. If effusions are present on both sides of the chest, drain both. It may be necessary to repeat drainage two or three times if fluid returns. See Annex A1.5, p. 348, for guidelines on chest drainage.

Subsequent management depends on the character of the fluid obtained. When possible, pleural fluid should be analysed for protein and glucose content, cell count and differential count, and examined after Gram and Ziehl-Neelsen staining and bacterial and *Mycobacterium tuberculosis* culture.

Antibiotic therapy

- Give ampicillin or cloxacillin or flucloxacillin (50 mg/kg IM or IV every 6 h) and gentamicin (7.5 mg/kg IM or IV once a day). When the child improves (after at least 7 days of IV or IM antibiotics), continue cloxacillin orally four times a day for a total course of 3 weeks.

Note: *Cloxacillin is preferable if staphylococcal infection is suspected; it can be replaced by another anti-staphylococcal antibiotic such as oxacillin, flucloxacillin*

or dicloxacillin. Infection with S. aureus is more likely if pneumatocoeles are also present.

Failure to improve

If fever and other signs of illness continue, despite adequate chest drainage and antimicrobial therapy, test for HIV infection and assess for possible TB.

▶ A trial of anti-TB therapy may be required (see section 4.7.2, p. 115).

4.3.2 Lung abscess

A lung abscess is a circumscribed, thick-walled cavity in the lung that contains purulent material resulting from suppuration and necrosis of the involved lung parenchyma. It frequently develops in an unresolved area of pneumonia. This could be a result of pulmonary aspiration, diminished clearance mechanisms, embolic phenomena, or haematogenous spread.

Diagnosis

Common signs and symptoms:

- Fever
- Pleuritic chest pain
- Sputum production or haemoptysis
- Weight loss
- On examination: reduced chest movement, decreased breath sounds, dullness to percussion, crackles, and bronchial breathing.
- Chest X-ray: solitary, thick-walled cavity in the lung with or without air fluid level.
- Ultrasonography and CT scan: to localize the lesion and guide drainage or needle aspiration.

Treatment

The choice of antibiotic is usually empirical and is based on the underlying condition of the patient and the presumed etiological agent.

▶ Give ampicillin or cloxacillin or flucloxacillin (50 mg/kg IM or IV every 6 h) and gentamicin (7.5 mg/kg IM or IV once a day). Continue treatment as in empyema (see section 4.3.1) for up to 3 weeks.

▶ Surgical management is considered in cases of large lung abscess especially when associated with haemoptysis or clinical deterioration despite

appropriate antibiotic therapy. Drainage is usually through percutaneous tube drainage or ultrasound guided needle aspiration.

4.3.3 Pneumothorax

Pneumothorax is usually secondary to an accumulation of air in the pleural spaces from alveolar rupture or from infection with gas-producing microorganisms.

Diagnosis

- Signs and symptoms may vary according to the extent of lung collapse, degree of intrapleural pressure, and rapidity of onset.
- On examination: chest bulging on the affected side if one side is involved, shift of cardiac impulse away from the site of the pneumothorax, decreased breath sounds on the affected side, grunting, severe respiratory distress and cyanosis may occur late in the progression of the complication.
- Differential diagnosis include lung cyst, lobar emphysema, bullae, diaphragmatic hernia
- Chest X-ray is crucial in the confirmation of diagnosis.

Treatment

- ▶ Insert needle for urgent decompression, before insertion of an intercostal chest drain.

See Annex A1.5, p. 348, for guidelines on chest drainage.

4.4 Cough or cold

These are common, self-limited viral infections that require only supportive care. Antibiotics should not be given. Wheeze or stridor may occur in some children, especially infants. Most episodes end within 14 days. Cough lasting 14 days or more may be caused by TB, asthma, pertussis or symptomatic HIV infection (see Chapter 8, p. 225).

Diagnosis

Common features:

- cough
- nasal discharge
- mouth breathing
- fever

The following are **absent**:

– general danger signs.
– signs of severe pneumonia or pneumonia
– stridor when the child is calm

Wheezing may occur in young children (see below).

Treatment

- Treat the child as an outpatient.
- Soothe the throat and relieve the cough with a safe remedy, such as a warm, sweet drink.
- Relieve high fever (≥ 39 °C or ≥ 102.2 °F) with paracetamol if the fever is causing distress to the child.
- Clear secretions from the child's nose before feeds with a cloth soaked in water that has been twisted to form a pointed wick.

Give normal fluid requirements plus extra breast milk or fluids if there is fever. Small frequent drinks are more likely to be taken and less likely to be vomited.

- Do **not** give any of the following:
  – an antibiotic (they are not effective and do not prevent pneumonia)
  – remedies containing atropine, codeine or codeine derivatives, or alcohol (these may be harmful) or mucolytics
  – medicated nose drops.

Follow-up

Advise the mother to:

- feed the child
- watch for fast or difficult breathing and return if either develops
- return if the child becomes sicker or is unable to drink or breastfeed.

4.5 Conditions presenting with wheeze

Wheeze is a high-pitched whistling sound on expiration. It is caused by spasmodic narrowing of the distal airway. To hear a wheeze, even in mild cases, place your ear next to the child's mouth and listen to the breathing while the child is calm, or use a stethoscope.

In the first 2 years of life, wheezing is most commonly caused by acute viral respiratory infections such as bronchiolitis or coughs and colds. After 2 years

of age, most wheezing is due to asthma (Table 8, p. 93). Some children with pneumonia present with wheeze. It is important always to consider treatment for pneumonia, particularly in the first 2 years of life. Children with wheeze but no fever, chest indrawing or danger signs are unlikely to have pneumonia and should therefore not be given antibiotics.

History

- previous episodes of wheeze
- night-time or early morning shortness of breath, cough or wheeze
- response to bronchodilators
- asthma diagnosis or long-term treatment for asthma
- family history of allergy or asthma

Examination

- wheezing on expiration
- prolonged expiration
- resonant percussion note
- hyperinflated chest
- rhonchi on auscultation
- shortness of breath at rest or on exertion
- lower chest wall indrawing if severe.

Response to rapid-acting bronchodilator

- If the cause of the wheeze is not clear or if the child has fast breathing or chest indrawing in addition to wheeze, give a rapid-acting bronchodilator and assess after 15 min. The response to a rapid-acting bronchodilator helps to determine the underlying diagnosis and treatment.
- Give the rapid-acting bronchodilator by one of the following methods:
  - nebulized salbutamol
  - salbutamol by a metered dose inhaler with spacer device
  - if neither of the above methods is available, give a subcutaneous injection of adrenaline.

For details of administering the above, see pp. 98–99.

- Assess the response after 15 min. Signs of improvement are:
  - less respiratory distress (easier breathing)

Table 8. Differential diagnosis in a child presenting with wheeze

Diagnosis	In favour
Asthma	– History of recurrent wheeze, chest tightness, some unrelated to coughs and colds or induced by exercise – Hyperinflation of the chest – Prolonged expiration – Reduced air entry (if very severe, airway obstruction) – Good response to bronchodilators, unless very severe
Bronchiolitis	– First episode of wheeze in a child aged < 2 years – Wheeze episode at time of seasonal bronchiolitis – Hyperinflation of the chest – Prolonged expiration – Reduced air entry (if very severe, airway obstruction) – Poor or no response to bronchodilators – Apnoea in young infants, especially if born preterm
Wheeze associated with cough or cold	– Wheeze always related to coughs and colds – No family or personal history of asthma, eczema, hay-fever – Prolonged expiration – Reduced air entry (if very severe, airway obstruction) – Good response to bronchodilators – Tends to be less severe than wheeze associated with asthma
Foreign body	– History of sudden onset of choking or wheezing – Wheeze may be unilateral – Air trapping with hyper-resonance and mediastinal shift – Signs of lung collapse: reduced air entry and impaired breathing – No response to bronchodilators
Pneumonia	– Fever – Coarse crackles – Grunting

- less lower chest wall indrawing
- improved air entry.

▶ Children who still have signs of hypoxia (central cyanosis, low oxygen saturation ≤ 90%, unable to drink due to respiratory distress, severe lower chest wall indrawing) or have fast breathing should be given a second dose of bronchodilator and admitted to hospital for further treatment.

4.5.1 Bronchiolitis

Bronchiolitis is a lower respiratory viral infection, which is typically most severe in young infants, occurs in annual epidemics and is characterized by airways obstruction and wheezing. It is most commonly caused by respiratory syncytial virus. Secondary bacterial infection may occur. The management of bronchiolitis associated with fast breathing or other sign of respiratory distress is therefore similar to that of pneumonia. Episodes of wheeze may occur for months after an attack of bronchiolitis, but will eventually stop.

Diagnosis

Typical features of bronchiolitis, on examination, include:

- wheezing that is not relieved by up to three doses of a rapid-acting bronchodilator
- hyperinflation of the chest, with increased resonance to percussion
- lower chest wall indrawing
- fine crackles and wheeze on auscultation of the chest
- difficulty in feeding, breastfeeding or drinking owing to respiratory distress
- nasal discharge, which can cause severe nasal obstruction.

Treatment

Most children can be treated at home, but those with the following signs of severe pneumonia (see section 4.2.1) should be treated in hospital:

- oxygen saturation < 90% or central cyanosis.
- apnoea or history of apnoea
- inability to breastfeed or drink, or vomiting everything
- convulsions, lethargy or unconsciousness
- gasping and grunting (especially in young infants).

Oxygen

- Give oxygen to all children with severe respiratory distress or oxygen saturation ≤ 90% (see section 4.2.1). The recommended method for delivering oxygen is by nasal prongs or a nasal catheter (see p. 312).
- The nurse should check, every 3 h, that the prongs are in the correct position and not blocked with mucus, and that all connections are secure.

Antibiotic treatment

- If the infant is treated at home, give amoxicillin (40 mg/kg twice a day) orally for 5 days only if the child has signs of pneumonia (fast breathing and lower chest wall indrawing).
- If there are signs of severe pneumonia, give ampicillin at 50 mg/kg or benzylpenicillin at 50 000 U/kg IM or IV every 6 h for at least 5 days and gentamicin 7.5 mg/kg IM or IV once a day for at least 5 days (see p. 82).

Supportive care

- If the child has fever (≥ 39 °C or ≥ 102.2 °F) that appears to be causing distress, give paracetamol.
- Ensure that the hospitalized child receives daily maintenance fluids appropriate for age (see section 10.2, p. 304), but avoid overhydration. Encourage breastfeeding and oral fluids.
- Encourage the child to eat as soon as food can be taken. Nasogastric feeding should be considered in any patient who is unable to maintain oral intake or hydration (expressed breast milk is the best).
- Gentle nasal suction should be used to clear secretions in infants where nasal blockage appears to be causing respiratory distress.

Monitoring

A hospitalized child should be assessed by a nurse every 6 h (or every 3 h if there are signs of very severe illness) and by a doctor at least once a day. Monitor oxygen therapy as described on p. 314. Watch for signs of respiratory failure, i.e. increasing hypoxia and respiratory distress leading to exhaustion.

Complications

If the child fails to respond to oxygen therapy or the child's condition worsens suddenly, obtain a chest X-ray to look for evidence of pneumothorax.

Tension pneumothorax associated with severe respiratory distress and shift of the heart requires immediate relief by placing a needle to allow the air that is

under pressure to escape (needle thoracocentesis). Following this, a continuous air exit should be assured by inserting a chest tube with an underwater seal until the air leak closes spontaneously and the lung expands (see Annex A1.5, p. 348).

If respiratory failure develops, continuous positive airway pressure may be helpful.

Infection control

Bronchiolitis is very infectious and dangerous to other young children in hospital with other conditions. The following strategies may reduce cross-infection:

- hand-washing by personnel between patients
- ideally isolate the child, but maintain close observation
- during epidemics, restrict visits to children by parents and siblings with symptoms of upper respiratory tract infection.

Discharge

An infant with bronchiolitis can be discharged when respiratory distress and hypoxaemia have resolved, when there is no apnoea and the infant is feeding well. Infants are at risk for recurrent bronchiolitis if they live in families where adults smoke or if they are not breastfed. So, advise the parents against smoking.

Follow-up

Infants with bronchiolitis may have cough and wheeze for up to 3 weeks. As long as they are well with no respiratory distress, fever or apnoea and are feeding well they do not need antibiotics.

4.5.2 Asthma

Asthma is a chronic inflammatory condition with reversible airways obstruction. It is characterized by recurrent episodes of wheezing, often with cough, which respond to treatment with bronchodilators and anti-inflammatory drugs. Antibiotics should be given only when there are signs of pneumonia.

Diagnosis

History of recurrent episodes of wheezing, often with cough, difficulty in breathing and tightness in the chest, particularly if these are frequent and recurrent or are worse at night and in the early morning. Findings on examination may include:

- rapid or increasing respiratory rate
- hyperinflation of the chest

- hypoxia (oxygen saturation ≤ 90%)
- lower chest wall indrawing
- use of accessory muscles for respiration (best noted by feeling the neck muscles)
- prolonged expiration with audible wheeze
- reduced or no air intake when obstruction is life-threatening
- absence of fever
- good response to treatment with a bronchodilator.

If the diagnosis is uncertain, give a dose of a rapid-acting bronchodilator (see salbutamol, p. 98). A child with asthma will often improve rapidly with such treatment, showing signs such as slower respiratory rate, less chest wall indrawing and less respiratory distress. A child with severe asthma may require several doses in quick succession before a response is seen (see below).

Treatment

- A child with a **first episode of wheezing and no respiratory distress** can usually be managed at home with supportive care. A bronchodilator is not necessary.
- If the child is in **respiratory distress (acute severe asthma) or has recurrent wheezing**, give salbutamol by metered-dose inhaler and spacer device or, if not available, by nebulizer (see below for details). If salbutamol is not available, give subcutaneous adrenaline.
- Reassess the child after 15 min to determine subsequent treatment:
  - If respiratory distress has resolved, and the child does not have fast breathing, advise the mother on home care with inhaled salbutamol from a metered dose inhaler and spacer device (which can be made locally from plastic bottles).
  - If respiratory distress persists, admit to hospital and treat with oxygen, rapid-acting bronchodilators and other drugs, as described below.

Severe life-threatening asthma

- If the child has life-threatening acute asthma, is in severe respiratory distress with central cyanosis or reduced oxygen saturation ≤ 90%, has poor air entry (silent chest), is unable to drink or speak or is exhausted and confused, admit to hospital and treat with oxygen, rapid-acting bronchodilators and other drugs, as described below.

- In children admitted to hospital, promptly give oxygen, a rapid-acting bronchodilator and a first dose of steroids.

Oxygen

- Give oxygen to keep oxygen saturation > 95% in all children with asthma who are cyanosed (oxygen saturation ≤ 90%) or whose difficulty in breathing interferes with talking, eating or breastfeeding.

Rapid-acting bronchodilators

- Give the child a rapid-acting bronchodilator, such as nebulized salbutamol or salbutamol by metered-dose inhaler with a spacer device. If salbutamol is not available, give subcutaneous adrenaline, as described below.

Nebulized salbutamol

The driving source for the nebulizer must deliver at least 6–9 litres/min. Recommended methods are an air compressor, ultrasonic nebulizer or oxygen cylinder, but in severe or life-threatening asthma oxygen must be used. If these are not available, use an inhaler and spacer. An easy-to-operate foot pump may be used but is less effective.

- Put the dose of the bronchodilator solution in the nebulizer compartment, add 2–4 ml of sterile saline and nebulize the child until the liquid is almost all used up. The dose of salbutamol is 2.5 mg (i.e. 0.5 ml of the 5 mg/ml nebulizer solution).
- If the response to treatment is poor, give salbutamol more frequently.
- In severe or life-threatening asthma, when a child cannot speak, is hypoxic or tiring with lowered consciousness, give continuous back-to-back nebulizers until the child improves, while setting up an IV cannula. As asthma improves, a nebulizer can be given every 4 h and then every 6–8 h.

Giving salbutamol by metered-dose inhaler with a spacer device

Spacer devices with a volume of 750 ml are commercially available.

- Introduce two puffs (200 µg) into the spacer chamber. Then, place the child's mouth over the opening in the spacer and allow normal breathing for three to five breaths. This can be repeated in rapid succession until six puffs of the drug have been given to a child < 5 years, 12 puffs for > 5 years of age. After 6 or 12 puffs, depending on age, assess the response and repeat regularly until the child's condition improves. In severe cases, 6 or 12 puffs can be given several times an hour for a short period.

Some infants and young children cooperate better when a face mask is attached to the spacer instead of the mouthpiece.

If commercial devices are not available, a spacer device can be made from a plastic cup or a 1-litre plastic bottle. These deliver three to four puffs of salbutamol, and the child should breathe from the device for up to 30 s.

Use of spacer device and face mask to give bronchodilator treatment. A spacer can be made locally from a plastic soft-drink bottle.

Subcutaneous adrenaline

- If the above two methods of delivering salbutamol are not available, give a subcutaneous injection of adrenaline at 0.01 ml/kg of 1:1000 solution (up to a maximum of 0.3 ml), measured accurately with a 1-ml syringe (for injection technique, see p. 336). If there is no improvement after 15 min, repeat the dose once.

Steroids

- If a child has a severe or life-threatening acute attack of wheezing (asthma), give oral prednisolone, 1 mg/kg, for 3–5 days (maximum, 60 mg) or 20 mg for children aged 2–5 years. If the child remains very sick, continue the treatment until improvement is seen.

Repeat the dose of prednisolone for children who vomit, and consider IV steroids if the child is unable to retain orally ingested medication. Treatment for up to 3 days is usually sufficient, but the duration should be tailored to bring about recovery. Tapering of short courses (7–14 days) of steroids is not necessary. IV hydrocortisone (4 mg/kg repeated every 4 h) provides no benefit and should be considered only for children who are unable to retain oral medication.

Magnesium sulfate

Intravenous magnesium sulfate may provide additional benefit in children with severe asthma treated with bronchodilators and corticosteroids. Magnesium sulfate has a better safety profile in the management of acute severe asthma

than aminophylline. As it is more widely available, it can be used in children who are not responsive to the medications described above.

▶ Give 50% magnesium sulfate as a bolus of 0.1 ml/kg (50 mg/kg) IV over 20 min.

Aminophylline

Aminophylline is not recommended in children with mild-to-moderate acute asthma. It is reserved for children who do not improve after several doses of a rapid-acting bronchodilator given at short intervals plus oral prednisolone. If indicated in these circumstances:

▶ Admit the child ideally to a high-care or intensive-care unit, if available, for continuous monitoring.

▶ Weigh the child carefully and then give IV aminophylline at an initial loading dose of 5–6 mg/kg (up to a maximum of 300 mg) over at least 20 min but preferably over 1 h, followed by a maintenance dose of 5 mg/kg every 6 h.

IV aminophylline can be dangerous at an overdose or when given too rapidly.

- Omit the initial dose if the child has already received any form of aminophylline or caffeine in the previous 24 h.
- Stop giving it immediately if the child starts to vomit, has a pulse rate > 180/min, develops a headache or has a convulsion.

Oral bronchodilators

Use of oral salbutamol (in syrup or tablets) is **not** recommended in the treatment of severe or persistent wheeze. It should be used only when inhaled salbutamol is not available for a child who has improved sufficiently to be discharged home.

Dosage:

- Age 1 month to 2 years: 100 µg/kg (maximum, 2 mg) up to four times daily
- Age 2–6 years: 1–2 mg up to four times daily

Antibiotics

▶ Antibiotics should not be given routinely for asthma or to a child with asthma who has fast breathing without fever. Antimicrobial treatment is indicated, however, when there is persistent fever and other signs of pneumonia (see section 4.2, p. 80).

Supportive care

- Ensure that the child receives daily maintenance fluids appropriate for his or her age (see p. 304). Encourage breastfeeding and oral fluids. Encourage adequate complementary feeding for the young child, as soon as food can be taken.

Monitoring

A hospitalized child should be assessed by a nurse every 3 h or every 6 h as the child shows improvement (i.e. slower breathing rate, less lower chest wall indrawing and less respiratory distress) and by a doctor at least once a day. Record the respiratory rate, and watch especially for signs of respiratory failure – increasing hypoxia and respiratory distress leading to exhaustion. Monitor oxygen therapy as described on p. 314.

Complications

- If the child fails to respond to the above therapy, or the child's condition worsens suddenly, obtain a chest X-ray to look for evidence of pneumothorax. Be very careful in making this diagnosis as the hyperinflation in asthma can mimic a pneumothorax on a chest X-ray. Treat as described on p. 90.

Follow-up care

Asthma is a chronic and recurrent condition.

- Once the child has improved sufficiently to be discharged home, inhaled salbutamol through a metered dose inhaler should be prescribed with a suitable (not necessarily commercial) spacer and the mother instructed on how to use it.
- A long-term treatment plan should be made on the basis of the frequency and severity of symptoms. This may include intermittent or regular treatment with bronchodilators, regular treatment with inhaled steroids or intermittent courses of oral steroids. Up-to-date international or specialized national guidelines should be consulted for more information.

4.5.3 Wheeze with cough or cold

Most first episodes of wheezing in children aged < 2 years are associated with cough and cold. These children are not likely to have a family history of atopy (e.g. hay-fever, eczema, allergic rhinitis), and their wheezing episodes become less frequent as they grow older. The wheezing, if troublesome, may be treated with inhaled salbutamol at home.

4.6 Conditions presenting with stridor

Presenting sign is stridor

Stridor is a harsh noise during inspiration, which is due to narrowing of the air passages in the oropharynx, subglottis or trachea. If the obstruction is below the larynx, stridor may also occur during expiration.

The major causes of severe stridor are viral croup (commonly caused by measles or other viruses), foreign body inhalation, retropharyngeal abscess, diphtheria and trauma to the larynx (Table 9). It may also occur in early infancy due to congenital abnormalities.

History

- first episode or recurrent episode of stridor
- history of choking
- stridor present soon after birth

4.6.1 Viral croup

Croup causes obstruction of the upper airway, which, when severe, can be life-threatening. Most severe episodes occur in children ≤ 2 years of age. This section deals with croup caused by various respiratory viruses. For croup associated with measles, see p. 175.

Diagnosis

Mild croup is characterized by:

- fever
- a hoarse voice
- a barking or hacking cough
- stridor that is heard only when the child is agitated.

Severe croup is characterized additionally by:

- stridor even when the child is at rest
- rapid breathing and lower chest indrawing
- cyanosis or oxygen saturation ≤ 90%.

Treatment

Mild croup can be managed at home with supportive care, including encouraging oral fluids, breastfeeding or feeding, as appropriate.

Table 9. Differential diagnosis in a child presenting with stridor

Diagnosis	In favour
Viral croup	– Barking cough – Respiratory distress – Hoarse voice – If due to measles, signs of measles (see p. 175)
Retropharyngeal abscess	– Soft tissue swelling in back of the throat – Difficulty in swallowing – Fever
Foreign body	– Sudden history of choking – Respiratory distress
Diphtheria	– Bull neck appearance due to enlarged cervical nodes and oedema – Red throat – Grey pharyngeal membrane – Blood-stained nasal discharge – No evidence of DPT vaccination
Epiglottitis	– Soft stridor – 'Septic' child – Little or no cough – Drooling of saliva – Inability to drink
Congenital anomaly	– Stridor present since birth
Anaphylaxis	– History of allergen exposure – Wheeze – Shock – Urticaria and oedema of lips and face
Burns	– Swollen lips – Smoke inhalation

A child with **severe croup** should be admitted to hospital. Try to avoid invasive procedures unless undertaken in the presence of an anaesthetist, as they may precipitate complete airway obstruction.

- **Steroid treatment.** Give one dose of oral dexamethasone (0.6 mg/kg) or equivalent dose of some other steroid: dexamethasone (see p. 361) or prednisolone (p. 369). If available, use nebulized budesonide at 2 mg. Start the steroids as soon as possible. It is preferable to dissolve the tablet in a spoonful of water for children unable to swallow tablets. Repeat the dose of steroid for children who vomit.

- **Adrenaline.** As a trial, give the child nebulized adrenaline (2 ml of 1:1000 solution). If this is effective, repeat as often as every hour, with careful monitoring. While this treatment can lead to improvement within 30 min in some children, it is often temporary and may last only about 2 h.
- **Antibiotics.** These are not effective and should not be given.
- Monitor the child closely and ensure that facilities for an emergency intubation and/or tracheostomy are immediately available if required, as airway obstruction can occur suddenly.

In a child with severe croup who is deteriorating, consider the following:

- **Intubation and/or tracheostomy:** If there are signs of incipient complete airway obstruction, such as severe lower chest wall indrawing and restlessness, intubate the child immediately.
- If this is not possible, transfer the child urgently to a hospital where intubation or emergency tracheostomy can be done. Tracheostomy should be done only by experienced staff.
- Avoid using oxygen unless there is incipient airway obstruction. Signs such as severe lower chest wall indrawing and restlessness are more likely to indicate the need for intubation or tracheostomy than oxygen. Nasal prongs or a nasal or nasopharyngeal catheter can upset the child and precipitate obstruction of the airway.
- However, oxygen should be given if there is incipient complete airway obstruction and intubation or tracheostomy is deemed necessary. **Call for help** from an anaesthetist and surgeon to intubate or perform a tracheostomy.

Supportive care

- Keep the child calm, and avoid disturbance as much possible.
- If the child has fever (≥ 39 °C or ≥ 102.2 °F) that appears to be causing distress, give paracetamol.
- Encourage breastfeeding and oral fluids. Avoid parenteral fluids, as this involves placing an IV cannula, which can cause distress that might precipitate complete airway obstruction.
- Encourage the child to eat as soon as food can be taken.

Avoid using mist tents, which are not effective, which separate the child from the parents and which make observation of the child's condition difficult. Do not give sedatives or antitussive medicines.

Monitoring

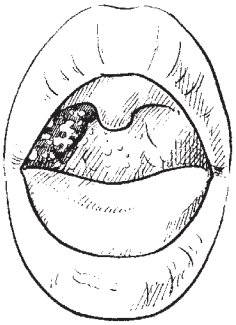
The child's condition, especially respiratory status, should be assessed by nurses every 3 h and by doctors twice a day. The child should occupy a bed close to the nursing station, so that any sign of incipient airway obstruction can be detected as soon as it develops.

4.6.2 Diphtheria

Diphtheria is a bacterial infection, which can be prevented by immunization. Infection in the upper airway or nasopharynx produces a grey membrane, which, when present in the larynx or trachea, can cause stridor and obstruction. Nasal involvement produces a bloody discharge. Diphtheria toxin causes muscular paralysis and myocarditis, which are associated with mortality.

Diagnosis

- Carefully examine the child's nose and throat and look for a grey, adherent membrane. Great care is needed when examining the throat, as the examination may precipitate complete obstruction of the airway. A child with pharyngeal diphtheria may have an obviously swollen neck, termed a 'bull neck'.



Pharyngeal membrane of diphtheria. Note: the membrane extends beyond the tonsils and covers the adjacent pharyngeal wall.

Treatment

Antitoxin

- Give 40 000 U diphtheria antitoxin (IM or IV) immediately, because delay can increase the risk for mortality. As there is a small risk for a serious allergic reaction to the horse serum in the antitoxin, an initial intradermal test to detect hypersensitivity should be carried out, as described in the instructions, and treatment for anaphylaxis should be available (see p. 108).

Antibiotics

- Any child with suspected diphtheria should be given a daily deep IM injection of procaine benzylpenicillin at 50 mg/kg (maximum, 1.2 g) daily for 10 days. This drug should not be given IV.

Oxygen

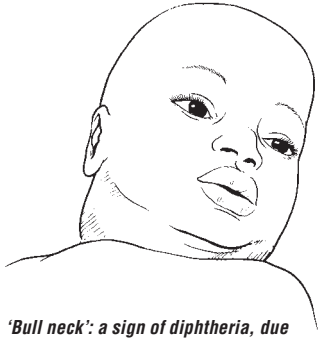
- Avoid using oxygen unless there is incipient airway obstruction.

Signs such as severe lower chest wall indrawing and restlessness are more likely to indicate the need for tracheostomy (or intubation) than oxygen. Moreover, the use of a nasal or nasopharyngeal catheter can upset the child and precipitate obstruction of the airway.

- However, oxygen should be given if there is incipient airway obstruction and intubation or a tracheostomy is deemed necessary.

Tracheostomy/intubation

- Tracheostomy should be performed, only by experienced staff, if there are signs of incipient complete airway obstruction, such as severe lower chest wall indrawing and restlessness. If obstruction occurs, an emergency tracheostomy should be carried out. Orotracheal intubation is an alternative but may dislodge the membrane and fail to relieve the obstruction.



'Bull neck': a sign of diphtheria, due to enlarged lymph nodes in the neck

Supportive care

- If the child has fever (≥ 39 °C or ≥ 102.2 °F) that appears to be causing distress, give paracetamol.
- Encourage the child to eat and drink. If the child has difficulty in swallowing, nasogastric feeding is required. The nasogastric tube should be placed by an experienced clinician or, if available, an anaesthetist (see p. 345).

Avoid frequent examinations and invasive procedures when possible or disturbing the child unnecessarily.

Monitoring

The child's condition, especially respiratory status, should be assessed by a nurse every 3 h and by a doctor twice a day. The child should occupy a bed close to the nursing station, so that any sign of incipient airway obstruction can be detected as soon as it develops.

Complications

Myocarditis and paralysis may occur 2–7 weeks after the onset of illness.

- Signs of myocarditis include a weak, irregular pulse and evidence of heart failure. Refer to standard paediatric textbooks for details of the diagnosis and management of myocarditis.

Public health measures

- The child should be nursed in a separate room by staff who are fully vaccinated against diphtheria.
- Give all vaccinated household contacts a diphtheria toxoid booster.
- Give all unvaccinated household contacts one dose of benzathine penicillin (600 000 U for those aged ≤ 5 years, 1 200 000 U for those > 5 years). Give them diphtheria toxoid, and check daily for 5 days for any signs of diphtheria.

4.6.3 Epiglottitis

Epiglottitis is a medical emergency that may result in death if not treated quickly. It is mainly caused by the bacteria *H. influenzae* type b but may also be caused by other bacteria or viruses associated with upper respiratory infections. Epiglottitis usually begins as an inflammation and swelling between the base of the tongue and the epiglottis. The swelling may obstruct the airway.

Diagnosis

- sore throat with difficulty in speaking
- difficulty in breathing
- soft stridor
- fever
- drooling of saliva
- difficulty in swallowing or inability to drink.

Treatment

Treatment of patients with epiglottitis is directed to **relieving** the airway obstruction and eradicating the infectious agent.

- Keep the child calm, and provide humidified oxygen, with close monitoring.
- Avoid examining the throat if the signs are typical, to avoid precipitating obstruction.

- Call for help and secure the airway as an emergency because of the danger of sudden, unpredictable airway obstruction. Elective intubation is the best treatment if there is severe obstruction but may be very difficult; consider the need for surgical intervention to ensure airway patency.
- Give IV antibiotics when the airway is safe: ceftriaxone at 80 mg/kg once daily for 5 days.

4.6.4 Anaphylaxis

Anaphylaxis is a severe allergic reaction, which may cause upper airway obstruction with stridor, lower airway obstruction with wheezing or shock or all three. Common causes include allergic reactions to antibiotics, to vaccines, to blood transfusion and to certain foods, especially nuts.

Consider the diagnosis if any of the following symptoms is present and there is a history of previous severe reaction, rapid progression or a history of asthma, eczema or atopy.

Severity	Symptoms	Signs
Mild	– Itching mouth – Nausea	– Urticaria – Oedema of the face – Conjunctivitis – Red throat
Moderate	– Cough or wheeze – Diarrhoea – Sweating	– Wheeze – Tachycardia – Pallor
Severe	– Difficulty in breathing – Collapse – Vomiting	– Severe wheeze with poor air entry – Oedema of the larynx – Shock – Respiratory arrest – Cardiac arrest

This situation is potentially life-threatening and may result in a change in level of consciousness, collapse, or respiratory or cardiac arrest.

- Assess the airways, breathing and circulation.
  - If the child is not breathing, give five rescue breaths with a bag-valve mask and 100% oxygen and assess circulation.
  - If no pulse, start basic life support.

Treatment

- Remove the allergen as appropriate.
- For mild cases (just rash and itching), give oral antihistamine and oral prednisolone at 1 mg/kg.
- For moderate cases with stridor and obstruction or wheeze:
  - Give adrenaline at 0.15 ml of 1:1000 IM into the thigh (or subcutaneous); the dose may be repeated every 5–15 min.
- For severe anaphylactic shock:
  - Give adrenaline at 0.15 ml of 1:1000 IM and repeat every 5–15 min.
  - Give 100% oxygen.
  - Ensure stabilization of the airway, breathing, circulation and secure IV access.
  - If the obstruction is severe, consider intubation or call an anaesthetist and surgeon to intubate or create a surgical airway.
  - Administer 20 ml/kg normal saline 0.9% or Ringer's lactate solution IV as rapidly as possible. If IV access is not possible, insert an intraosseous line.

4.7 Conditions presenting with chronic cough

A chronic cough is one that lasts ≥ 14 days. Many conditions may present with a chronic cough such as TB, pertussis, foreign body or asthma (see Table 10).

History

- duration of coughing
- nocturnal cough
- paroxysmal cough or associated severe bouts ending with vomiting or whooping
- weight loss or failure to thrive (check growth chart, if available),
- night sweats
- persistent fever
- close contact with a known case of sputum-positive TB or pertussis
- history of attacks of wheeze and a family history of allergy or asthma
- history of choking or inhalation of a foreign body
- child suspected or known to be HIV-infected
- treatment given and response.

Table 10. Differential diagnosis in a child presenting with chronic cough

Diagnosis	In favour
TB	– Weight loss or failure to thrive – Anorexia – Night sweats – Enlarged liver and spleen – Chronic or intermittent fever – History of exposure to infectious TB – Abnormal chest X-ray
Asthma	– History of recurrent wheeze – Hyperinflation of the chest – Prolonged expiration – Reduced air entry (in very severe airway obstruction) – Good response to bronchodilators
Foreign body	– Sudden onset of choking or stridor – Unilateral chest signs (e.g. wheezing or hyperinflation) – Recurrent lobar consolidation – Poor response to medical treatment
Pertussis	– Paroxysms of cough followed by whoop, vomiting, cyanosis or apnoea – Sub-conjunctival haemorrhages – No history of DPT vaccination – No fever
HIV	– Known or suspected maternal or sibling HIV infection – Failure to thrive – Oral or oesophageal thrush – Chronic parotitis – Skin infection with herpes zoster (past or present) – Generalized lymphadenopathy – Chronic fever – Persistent diarrhoea – Finger clubbing
Bronchiectasis	– History of severe pneumonia, TB or aspirated foreign body – Poor weight gain – Purulent sputum, bad breath – Finger clubbing – Localized signs on X-ray
Lung abscess	– Reduced breath sounds over abscess – Poor weight gain or chronically ill child – Cystic or cavitating lesion on chest X-ray

Examination

- fever
- lymphadenopathy (generalized and localized, e.g. in the neck)
- wasting
- wheeze or prolonged expiration
- clubbing
- apnoeic episodes (with pertussis)
- subconjunctival haemorrhages
- signs associated with foreign body aspiration:
  - unilateral wheeze
  - area of decreased breath sounds that is either dull or hyper-resonant on percussion
  - deviation of the trachea or apex beat
- signs associated with HIV infection (see p. 225).

Treatment guidelines for the most common causes of chronic cough are indicated below:

- Asthma (p. 96).
- Pertussis (p. 111).
- TB (p. 115).
- Foreign body (p. 119).
- HIV (pp. 84, 243).

4.7.1 Pertussis

Pertussis is most severe in young infants who have not yet been immunized. After an incubation period of 7–10 days, the child has fever, usually with a cough and nasal discharge that are clinically indistinguishable from the common cough and cold. In the second week, there is paroxysmal coughing that can be recognized as pertussis. The episodes of coughing can continue for 3 months or longer. The child is infectious for up to 3 weeks after the onset of bouts of whooping cough.

Diagnosis

Suspect pertussis if a child has had a severe cough for more than 2 weeks, especially if the disease is known to be occurring locally. The most useful diagnostic signs are:

- paroxysmal coughing followed by a whoop when breathing in, often with vomiting
- subconjunctival haemorrhages
- child not vaccinated against pertussis
- young infants may not whoop; instead, the cough may be followed by suspension of breathing (apnoea) or cyanosis, or apnoea may occur without coughing.

Also examine the child for signs of pneumonia, and ask about convulsions.

Subconjunctival haemorrhages prominent on the white sclera

Treatment

Treat mild cases in children aged ≥ 6 months at home with supportive care (see below). Admit infants aged < 6 months to hospital; also admit any child with pneumonia, convulsions, dehydration, severe malnutrition or prolonged apnoea or cyanosis after coughing.

Antibiotics

- Give oral erythromycin (12.5 mg/kg four times a day) for 10 days. This does not shorten the illness but reduces the period of infectiousness.
- Alternatively, if available, give azithromycin at 10 mg/kg (maximum, 500 mg) on the first day, then 5 mg/kg (maximum, 250 mg) once a day for 4 days.
- If there is fever, if erythromycin or azithromycin is not available, or if there are signs of pneumonia, treat with amoxicillin as possible secondary pneumonia. Follow the other guidelines for severe pneumonia (see 4.2.1, p. 80).

Oxygen

- Give oxygen to children who have spells of apnoea or cyanosis, severe paroxysms of coughing or low oxygen saturation ≤ 90% on a pulse oximeter.

Use nasal prongs, not a nasopharyngeal catheter or nasal catheter, which can provoke coughing. Place the prongs just inside the nostrils and secure with a piece of tape just above the upper lip. Care should be taken to keep the nostrils clear of mucus, as this blocks the flow of oxygen. Set a flow rate of 1–2 litres/min (0.5 litre/min for young infants). Humidification is not required with nasal prongs.

- Continue oxygen therapy until the above signs are no longer present, after which there is no value in continuing oxygen.
- A nurse should check, every 3 h, that the prongs or catheter are in the correct place and not blocked with mucus and that all connections are secure. See p. 314 for further details.

Airway management

- During paroxysms of coughing, place the child in the recovery position to prevent inhalation of vomitus and to aid expectoration of secretions.
  - If the child has cyanotic episodes, clear secretions from the nose and throat with brief, gentle suction.
  - If apnoea occurs, clear the airways immediately with gentle suction under direct vision, breathe for the infant using a bag-valve mask ideally with a reservoir bag and connected to high-flow oxygen

Supportive care

- Avoid, as far as possible, any procedure that could trigger coughing, such as application of suction, throat examination or use of a nasogastric tube (unless the child cannot drink).
- Do not give cough suppressants, sedatives, mucolytic agents or antihistamines.
- If the child has fever (≥ 39 °C, ≥ 102.2 °F) that appears to be causing distress, give paracetamol.
- Encourage breastfeeding or oral fluids. If the child cannot drink, pass a nasogastric tube and give small, frequent amounts of fluid (ideally expressed breast milk) to meet the child's maintenance needs (see p. 304). If there is severe respiratory distress and maintenance fluids cannot be given through a nasogastric tube because of persistent vomiting, give IV fluids to avoid the risk of aspiration and avoid triggering coughing.

Ensure adequate nutrition by giving small, frequent feeds. If there is continued weight loss despite these measures, feed the child by nasogastric tube.

Monitoring

The child should be assessed by a nurse every 3 h and by a doctor once a day. To facilitate early detection and treatment of apnoeic or cyanotic spells or severe episodes of coughing, the child should occupy a bed in a place close to the nursing station, where oxygen and assisted ventilation are available. Also, teach the child's mother to recognize apnoeic spells and to alert the nurse if these occur.

Complications

Pneumonia: This is the commonest complication of pertussis and is caused by secondary bacterial infection or inhalation of vomit.

- Signs suggesting pneumonia include fast breathing between coughing episodes, fever and the rapid onset of respiratory distress.
- Treat pneumonia in children with pertussis as follows:
  - Give parenteral ampicillin (or benzylpenicillin) and gentamicin for 5 days, or alternatively give azithromycin for 5 days.
  - Give oxygen as described for the treatment of severe pneumonia (see sections 4.2.1 and 10.7, pp. 80 and 312).

Convulsions. These may result from anoxia associated with an apnoeic or cyanotic episode or toxin-mediated encephalopathy.

- If a convulsion does not stop within 2 min, give diazepam, following the guidelines in Chapter 1 (Chart 9, p. 15).

Malnutrition. Children with pertussis may become malnourished as a result of reduced food intake and frequent vomiting.

- Prevent malnutrition by ensuring adequate feeding, as described above, under 'Supportive care'.

Haemorrhage and hernias

- Subconjunctival haemorrhage and epistaxis are common during pertussis.
- No specific treatment is needed.
- Umbilical or inguinal hernias may be caused by violent coughing.
- Do not treat them unless there are signs of bowel obstruction, but refer the child for surgical evaluation after the acute phase.

Public health measures

- Give DPT vaccine to any child in the family who is not fully immunized and to the child with pertussis.
- Give a DPT booster to previously vaccinated children.
- Give erythromycin estolate (12.5 mg/kg four times a day) for 10 days to any infant in the family who is < 6 months old and has fever or other signs of a respiratory infection.

4.7.2 Tuberculosis

Most children infected with *M. tuberculosis* do not develop TB. The only evidence of infection may be a positive skin test. The development of TB depends on the competence of the immune system to resist multiplication of the *M. tuberculosis* infection. This competence varies with age, being least in the very young. HIV infection and malnutrition lower the body's defenses, and measles and whooping cough temporarily impair the strength of the immune system. In the presence of any of these conditions, TB can develop more easily.

TB is most often severe when it is located in the lungs, meninges or kidney. Cervical lymph nodes, bones, joints, abdomen, ears, eyes and skin may also be affected. Many children present only with failure to grow normally, weight loss or prolonged fever. Cough for > 14 days can also be a presenting sign; in children, however, sputum-positive pulmonary TB is rarely diagnosed.

Diagnosis

The risk for TB is increased when there is an active case (infectious, smear-positive pulmonary TB) in the same house or when the child is malnourished, has HIV/AIDS or had measles in the past few months. Consider TB in any child with:

A history of:

- unexplained weight loss or failure to grow normally
- unexplained fever, especially when it continues for longer than 2 weeks
- chronic cough (i.e. cough for > 14 days, with or without a wheeze)
- exposure to an adult with probable or definite infectious pulmonary TB.

On examination:

- fluid on one side of the chest (reduced air entry, stony dullness to percussion)
- enlarged non-tender lymph nodes or a lymph node abscess, especially in the neck
- signs of meningitis, especially when these develop over several days and the spinal fluid contains mostly lymphocytes and elevated protein
- abdominal swelling, with or without palpable lumps
- progressive swelling or deformity in the bone or a joint, including the spine

Investigations

- Try to obtain specimens for microscopic examination of acid-fast bacilli (Ziehl-Neelsen stain) and for culture of tubercle bacilli. Possible specimens include three consecutive early-morning, fasting gastric aspirates, CSF (if clinically indicated) and pleural fluid and ascites fluid (if present). As the

detection rates with these methods are low, a positive result confirms TB, but a negative result does not exclude the disease.

- New rapid diagnostic tests are more accurate and may be more widely available in future.
- Obtain a chest X-ray. A diagnosis of TB is supported when a chest X-ray shows a miliary pattern of infiltrates or a persistent area of infiltrate or consolidation, often with pleural effusion, or a primary complex.
- Perform a purified protein derivative skin test (***PPD or mantoux test***). The test is usually positive in children with pulmonary TB (reactions of > 10 mm suggest TB; < 10 mm in a child previously vaccinated with BCG is equivocal). The purified protein derivative test may be negative in children with TB who have HIV/AIDS, miliary disease, severe malnutrition or recent measles.
- Xpert MTB/RIF should be used as the initial diagnostic test in children suspected of having multidrug-resistant TB (MDR-TB) or HIV-associated TB.
- Routine HIV testing should be offered to all children suspected of TB.

Treatment

- Give a full course of treatment to all confirmed or strongly suspected cases.
- When in doubt, e.g. in a child with strongly suspected TB or who fails to respond to treatment for other probable diagnoses, give treatment for TB.

Treatment failures for other diagnoses include antibiotic treatment for apparent bacterial pneumonia (when the child has pulmonary symptoms), for possible meningitis (when the child has neurological symptoms) or for intestinal worms or giardiasis (when the child fails to thrive or has diarrhoea or abdominal symptoms).

- Suspected or confirmed childhood TB should be treated with a combination of anti-TB drugs, depending on the severity of disease, HIV status and level of isoniazid resistance.
- Follow the national TB programme guidelines for recommended treatment.
- To reduce the risk for drug-induced hepatotoxicity in children, follow the recommended dosages:
  - Isoniazid (H): 10 mg/kg (range, 10–15 mg/kg); maximum dose, 300 mg/day
  - Rifampicin (R): 15 mg/kg (range, 10–20 mg/kg); maximum dose, 600 mg/kg per day
  - Pyrazinamide (Z): 35 mg/kg (range, 30–40 mg/kg)
  - Ethambutol (E): 20 mg/kg (range, 15–25 mg/kg).

Treatment regimens

If national recommendations are not available, follow the WHO guidelines according to the regimens given below:

- *Four-drug regimen:* HRZE for 2 months, followed by a two-drug (HR) regimen for 4 months for all children with suspected or confirmed pulmonary TB or peripheral lymphadenitis living in an area of high HIV prevalence or where resistance to H is high or children with extensive pulmonary disease living in areas of low HIV prevalence or low H resistance;
- *Three-drug regimen:* HRZ for 2 months, followed by a two-drug (HR) regimen for 4 months for children with suspected or confirmed pulmonary TB or tuberculous peripheral lymphadenitis living in areas of low HIV prevalence or low H resistance or HIV-negative;
- In cases of suspected or confirmed tuberculous meningitis, spinal TB with neurological signs or osteo-articular TB, treat for 12 months with a four-drug regimen (HRZE) for 2 months, followed by a two-drug (HR) regimen for 10 months;
- In infants (aged 0–3 months) with suspected or confirmed pulmonary TB or tuberculous peripheral lymphadenitis, treat promptly with the standard regimens described above, with adjustment of doses to reconcile the effect of age and possible toxicity in young infants.

Intermittent regimens: In areas with well-established directly observed therapy, thrice-weekly regimens can be considered for children known to be HIV-negative. They should not be used in areas with a high HIV prevalence, because there is a high risk of treatment failure and development of multidrug-resistant TB.

Precautions: Streptomycin should not be used as part of first-line treatment regimens for children with pulmonary TB or tuberculous peripheral lymphadenitis. It should be reserved for the treatment of multidrug-resistant TB in children with known susceptibility to this medicine.

Multidrug-resistant TB

- In cases of MDR TB, treat children with proven or suspected pulmonary TB or tuberculous meningitis with a fluoroquinolone or other second-line TB drug. An appropriate MDR TB treatment regimen in the context of a well-functioning MDR TB control programme should be used. The decision to treat should be taken by a clinician experienced in managing paediatric TB.

Monitoring

Confirm that the medication is being taken as instructed, by direct observation of each dose. Monitor the child's weight gain daily and temperature twice a

day in order to check for resolution of fever. These are signs of response to therapy. When treatment is given for suspected TB, improvement should be seen within 1 month. If this does not occur, review the patient, check compliance, re-investigate and reconsider the diagnosis.

Public health measures

- Notify the case to the responsible district health authorities. Ensure that treatment is monitored as recommended by the national TB programme. Check all household members of the child (and, if necessary, school contacts) for undetected cases of TB, and arrange treatment for any that are found.
- Children < 5 years of age who are household or close contacts of people with TB and who, after an appropriate clinical evaluation, are found not to have active TB should be given 6 months of isoniazid preventive therapy (10 mg/kg/day, range 7–15 mg/kg, maximum dose 300 mg/day).

Follow-up

A programme of 'active' follow-up, in which a health worker visits the child and his or her family at home, can reduce default from TB treatment. During follow-up at home or in hospital, health workers can:

- Check whether medications for TB are being taken regularly.
- Remind the family and the treatment supporter about the importance of taking medications regularly, even if the child is well, for the full duration of treatment.
- Screen family contacts, including other children in the family, by inquiring about cough, and start these children on isoniazid preventive therapy.
- Suggest how the family's home environment might be made healthier for children, such as eliminating smoking inside the house, good ventilation and hand-washing.
- Discuss with the parents the importance of nutrition in recovery from TB and any problems in providing good nutrition for their children.
- Check the child for growth, nutritional state and signs of TB and other treatable conditions. If problems are found, the health worker should recommend how these can be treated or refer the family to a paediatrician.
- Check the child's health record, and tell the parents when and where they should bring the child for doses of vaccine.
- Ask the parents if they have any questions or concerns, and answer or discuss these, or refer the family to a paediatrician.
- Record their observations on the TB treatment card.

4.7.3 Foreign body inhalation

Nuts, seeds or other small objects may be inhaled, most often by children < 4 years of age. The foreign body usually lodges in a bronchus (more often in the right) and can cause collapse or consolidation of the portion of lung distal to the site of blockage. Choking is a frequent initial symptom. This may be followed by a symptom-free interval of days or weeks before the child presents with persistent wheeze, chronic cough or pneumonia, which fails to respond to treatment. Small sharp objects can lodge in the larynx, causing stridor or wheeze. Rarely, a large object lodged in the larynx can cause sudden death from asphyxia, unless it can be dislodged or an emergency tracheostomy be done.

Diagnosis

Inhalation of a foreign body should be considered in a child with the following signs:

- sudden onset of choking, coughing or wheezing; or
- segmental or lobar pneumonia that fails to respond to antibiotic therapy.

Examine the child for:

- unilateral wheeze
- an area of decreased breath sounds that is either dull or hyper-resonant on percussion
- deviation of the trachea or apex beat.

Obtain a chest X-ray at full expiration to detect an area of hyperinflation or collapse, mediastinal shift (away from the affected side) or a foreign body if it is radio-opaque.

Treatment

Emergency first aid for the choking child (see p. 7): Attempt to dislodge and expel the foreign body. The management depends on the age of the child.

For infants:

- Lay the infant in a head-down position on one of your arms or on your thigh.
- Strike the middle of the infant's back five times with the heel of your hand.
- If the obstruction persists, turn the infant over and give five firm chest thrusts with two fingers on the lower half of the sternum.
- If the obstruction persists, check the infant's mouth for any obstruction that can be removed.

- If necessary, repeat this sequence with back slaps.

For older children:

- While the child is sitting, kneeling or lying, strike the child's back five times with the heel of the hand.
- 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 sternum; place the other hand over the fist, and thrust sharply upwards into the abdomen. Repeat this up to five times.
- Then check the child's mouth for any obstruction that can be removed.
- If necessary, repeat the sequence with back slaps.

Once this has been done, it is important to check the patency of the airway by:

- looking for chest movements
- listening for breath sounds and
- feeling for breath.

If further management of the airways is required after the obstruction is removed, Chart 4, pp. 9–10 describes actions that will keep the child's airways open and prevent the tongue from falling back to obstruct the pharynx while the child recovers.

- *Later treatment of suspected foreign body aspiration.* If a foreign body is suspected, refer the child to a hospital where diagnosis is possible and the object can be removed after bronchoscopy. If there is evidence of pneumonia, begin treatment with ampicillin (or benzylpenicillin) and gentamicin, as for severe pneumonia (see p. 82), before attempting to remove the foreign body.

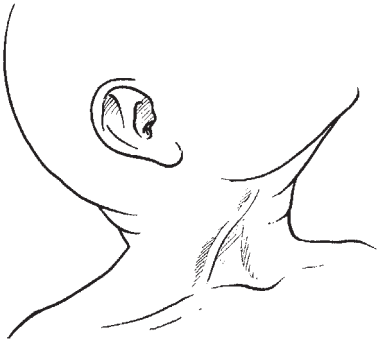
4.8 Heart failure

Heart failure causes fast breathing and respiratory distress. The underlying causes include congenital heart disease (usually in the first months of life), acute rheumatic fever, cardiac arrhythmia, myocarditis, suppurative pericarditis with constriction, infective endocarditis, acute glomerulonephritis, severe anaemia, severe pneumonia and severe malnutrition. Heart failure can be precipitated or worsened by fluid overload, especially when large volumes of IV fluids are given.

Diagnosis

The commonest signs of heart failure, on examination, are:

- tachycardia (heart rate > 160/min in a child < 12 months; > 120/min in a child aged 12 months to 5 years)
- gallop rhythm with basal crackles on auscultation
- enlarged, tender liver
- in infants, fast breathing (or sweating), especially when feeding (see section 4.1, p. 76, for definition of fast breathing); in older children, oedema of the feet, hands or face or distended neck veins (raised jugular venous pressure)



Raised jugular venous pressure – a sign of heart failure

Severe palmar pallor may be present if severe anaemia is the cause of the heart failure.

Heart murmur may be present in rheumatic heart disease, congenital heart disease or endocarditis.

If the diagnosis is in doubt, a chest X-ray can be taken and may show an enlarged heart or abnormal shape.

Measure blood pressure if possible. If it is raised, consider acute glomerulonephritis (See standard paediatric textbook for treatment).

Treatment

Treatment depends on the underlying heart disease (Consult international or national paediatric guidelines). The main measures for treating heart failure in children who are not severely malnourished are:

- *Oxygen.* Give oxygen if the child has a respiratory rate of ≥ 70/min, shows signs of respiratory distress, or has central cyanosis or low oxygen saturation. Aim to keep oxygen saturation > 90%. See p. 314.
- *Diuretics.* Give furosemide: A dose of 1 mg/kg should increase urine flow within 2 h. For faster action, give the drug IV. If the initial dose is not effective, give 2 mg/kg and repeat in 12 h, if necessary. Thereafter, a single daily dose of 1–2 mg/kg orally is usually sufficient.

- *Digoxin.* Consider giving digoxin (see Annex 2, p. 362).
- *Supplemental potassium.* Supplemental potassium is not required when furosemide is given alone for treatment lasting only a few days. When digoxin and furosemide are given, or if furosemide is given for more than 5 days, give oral potassium at 3–5 mmol/kg per day.

Supportive care

- Avoid giving IV fluids, if possible.
- Support the child in a semi-seated position with head and shoulders elevated and lower limbs dependent.
- Relieve any fever with paracetamol to reduce the cardiac workload.
- Consider transfusion if severe anaemia is present.

Monitoring

The child should be checked by a nurse every 6 h (every 3 h while on oxygen therapy) and by a doctor once a day. Monitor both respiratory and pulse rates, liver size and body weight to assess the response to treatment. Continue treatment until the respiratory and pulse rates are normal and the liver is no longer enlarged.

4.9 Rheumatic heart disease

Chronic rheumatic heart disease is a complication of acute rheumatic fever, which leaves permanent damage to the heart valves (see p. 193). In some children, antibodies produced in response to group A β-haemolytic streptococci lead to varying degrees of pancarditis, with associated valve insufficiency in the acute phase.

The risk for rheumatic heart disease is higher with repeated episodes of acute rheumatic fever. It leads to valve stenosis, with varying degrees of regurgitation, atrial dilatation, arrhythmia and ventricular dysfunction. Chronic rheumatic heart disease is a major cause of mitral valve stenosis in children.

Diagnosis

Rheumatic heart disease should be suspected in any child with a previous history of rheumatic fever who presents with heart failure or is found to have a heart murmur. Diagnosis is important because penicillin prophylaxis can prevent further episodes of rheumatic fever and avoid worse damage to the heart valves.

The presentation depends on the severity. Mild disease may cause few symptoms except for a heart murmur in an otherwise well child and is rarely

diagnosed. Severe disease may present with symptoms that depend on the extent of heart damage or the presence of infective endocarditis.

History

- chest pain
- heart palpitations
- symptoms of heart failure (including orthopnoea, paroxysmal nocturnal dyspnoea and oedema)
- fever or stroke usually associated with infection of damaged heart valves
- breathlessness on exertion or exercise
- fainting (syncope)

Examination

- signs of heart failure
- cardiomegaly with a heart murmur
- signs of infective endocarditis (e.g. conjunctival or retinal haemorrhages, hemiparesis, Osler nodes, Roth spots and splenomegaly)

Investigations

- chest X-ray: cardiomegaly with congested lungs
- an echocardiogram, if available, is useful for confirming rheumatic heart disease, the extent of valve damage and evidence of infective endocarditis.
- full blood count
- blood culture

Management

- Admit the child if in heart failure or has suspected bacterial endocarditis.
- Treatment depends on the type and extent of valvular damage.
- Manage heart failure if present (see p. 121).

▶ Give diuretics to relieve symptoms of pulmonary congestion and vasodilators when necessary.

▶ Give penicillin or ampicillin or ceftriaxone plus gentamicin IV or IM for 4–6 weeks for infective endocarditis.

▶ Refer for echocardiographic evaluation and decision on long-term management. May require surgical management in severe valvular stenosis or regurgitation.

Follow-up care

- All children with rheumatic heart disease should receive routine antibiotic prophylaxis.
- ▶ Give benzathine benzylpenicillin at 600 000 U IM every 3–4 weeks
- Ensure antibiotic prophylaxis for endocarditis before dental and invasive surgical procedures.
- Ensure that vaccinations are up to date.
- Review every 3–6 months, depending on severity of valvular damage.

Complications

Infective endocarditis is more common. It presents with fever and heart murmur in a very unwell child. Treat with ampicillin and gentamicin for 6 weeks.

Atrial fibrillation or thromboembolism may occur, especially in the presence of mitral stenosis.

Notes

CHAPTER 5

Diarrhoea

5.1	Child presenting with diarrhoea	126
5.2	Acute diarrhoea	127
	5.2.1 Severe dehydration	129
	5.2.2 Some dehydration	132
	5.2.3 No dehydration	134
5.3	Persistent diarrhoea	137
	5.3.1 Severe persistent diarrhoea	137
	5.3.2 Persistent diarrhoea (non-severe)	142
5.4	Dysentery	143

This chapter gives treatment guidelines on the management of acute diarrhoea (with severe, some or no dehydration), persistent diarrhoea and dysentery in children aged 1 week to 5 years. Assessment of severely malnourished children is described in sections 7.2 and 7.4.3 (pp. 198 and 203). The three essential elements in the management of all children with diarrhoea are **rehydration therapy, zinc supplementation** and counselling for **continued feeding and prevention**.

In diarrhoea, there is excess loss of water, electrolytes (sodium, potassium, and bicarbonate) and zinc in liquid stools. Dehydration occurs when these losses are not adequately replaced and there are deficits of water and electrolytes. The degree of dehydration is graded according to symptoms and signs that reflect the amount of fluid lost; see sections 2.3 (p. 43) and 5.2 (p. 127). The rehydration regimen is selected according to the degree of dehydration. All children with diarrhoea should receive zinc supplements.

During diarrhoea, decreased food intake and nutrient absorption and increased nutrient requirements often combine to cause weight loss and failure to grow. Malnutrition can make diarrhoea more severe, more prolonged and more frequent than in well-nourished children. This vicious circle can be broken by giving nutrient-rich foods during and continuing after the diarrhoea episode, when the child is well.

Antibiotics should not be used except for children with bloody diarrhoea (probable shigellosis), suspected cholera with severe dehydration and other serious non-intestinal infections such as pneumonia and urinary tract infection. Antiprotozoal drugs are rarely indicated. 'Antidiarrhoeal' drugs and anti-emetics should not be given to young children with acute or persistent diarrhoea or dysentery: they do not prevent dehydration or improve nutritional status, and some have dangerous, sometimes fatal, side-effects.

5.1 Child presenting with diarrhoea

History

A careful feeding history is essential in the management of a child with diarrhoea. Inquiries should also be made about:

- frequency of stools
- number of days of diarrhoea
- blood in stools
- report of a cholera outbreak in the area
- recent antibiotic or other drug treatment
- attacks of crying with pallor in an infant.

Examination

Look for:

- signs of some dehydration or severe dehydration:
  - restlessness or irritability
  - lethargy or reduced level of consciousness
  - sunken eyes
  - skin pinch returns slowly or very slowly
  - thirsty or drinks eagerly, or drinking poorly or not able to drink
- blood in stools
- signs of severe malnutrition
- abdominal mass
- abdominal distension.

There is no need for routine stool microscopy or culture in children with non-bloody diarrhoea.

Table 11. Differential diagnosis in a child presenting with diarrhoea

Diagnosis	In favour
Acute (watery) diarrhoea	– More than three loose stools per day – No blood in stools
Cholera	– Profuse watery diarrhoea with severe dehydration during cholera outbreak – Positive stool culture for *Vibrio cholerae* O1 or O139
Dysentery	– Blood mixed with the stools (seen or reported)
Persistent diarrhoea	– Diarrhoea lasting ≥ 14 days
Diarrhoea with severe malnutrition	– Any diarrhoea with signs of severe acute malnutrition (see section 7.4 (p. 200)
Diarrhoea associated with recent antibiotic use	– Recent course of broad-spectrum oral antibiotics
Intussusception	– Blood and mucus in stools – Abdominal mass – Attacks of crying with pallor in infant or young child

5.2 Acute diarrhoea

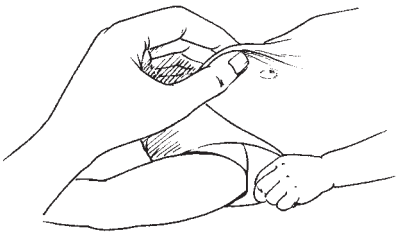
Assessing dehydration

For all children with diarrhoea, their hydration status should be classified as **severe dehydration, some dehydration** or **no dehydration** (Table 12) and appropriate treatment given. In a child with diarrhoea, assess the general condition, look for sunken eyes, make a skin pinch, and offer the child fluid to see if he or she is thirsty or drinking poorly.

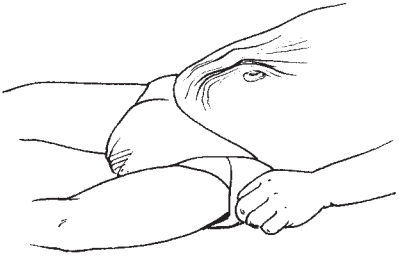
Sunken eyes

Table 12. Classification of the severity of dehydration in children with diarrhoea

Classification	Signs or symptoms	Treatment
Severe dehydration	Two or more of the following signs: ■ lethargy or unconsciousness ■ sunken eyes ■ unable to drink or drinks poorly ■ skin pinch goes back very slowly (≥ 2 s)	▶ Give fluids for severe dehydration (see diarrhoea treatment plan C in hospital, p. 131)
Some dehydration	Two or more of the following signs: ■ restlessness, irritability ■ sunken eyes ■ drinks eagerly, thirsty ■ skin pinch goes back slowly	▶ Give fluid and food for some dehydration (see diarrhoea treatment plan B, p. 135) ▶ After rehydration, advise mother on home treatment and when to return immediately (see pp. 133–4) ▶ Follow up in 5 days if not improving.
No dehydration	Not enough signs to classify as some or severe dehydration	▶ Give fluid and food to treat diarrhoea at home (see diarrhoea treatment plan A, p. 138) ▶ Advise mother on when to return immediately (see p. 133) ▶ Follow up in 5 days if not improving.



Pinching the child's abdomen to test for decreased skin turgor



Slow return of skin pinch in severe dehydration

5.2.1 Severe dehydration

Children with severe dehydration require rapid IV rehydration with close monitoring, followed by oral rehydration and zinc once the child starts to improve sufficiently. In areas where there is a cholera outbreak, give an antibiotic effective against cholera (p. 130).

Diagnosis

Severe dehydration should be diagnosed if any two signs or symptoms of severe dehydration are present in a child with diarrhoea (see Table 12).

Treatment

Children with severe dehydration should be given rapid IV rehydration followed by oral rehydration therapy.

- Start IV fluids immediately. While the drip is being set up, give ORS solution if the child can drink.

Note: *The best IV fluid solutions for rehydration are isotonic solutions: Ringer's lactate solution (called Hartmann's solution for Injection) and normal saline solution (0.9% NaCl). Do not use 5% glucose (dextrose) solution or 0.18% saline with 5% dextrose solution, as they increase the risk for hyponatraemia, which can cause cerebral oedema.*

- Give 100 ml/kg of the chosen solution, divided as shown in Table 13.

Table 13. Administration of intravenous fluids to a severely dehydrated child

Age (months)	First, give 30 ml/kg in:	Then, give 70 ml/kg in:
< 12	1 h[a]	5 h
≥ 12	30 min[a]	2.5 h

[a] Repeat if the radial pulse is still very weak or not detectable.

For more information, see treatment plan C in hospital, p. 131, which includes guidelines for giving ORS solution by nasogastric tube or by mouth when IV therapy is not possible.

Cholera

- Suspect cholera in children > 2 years old who have acute watery diarrhoea and signs of severe dehydration or shock, if cholera is present in the area.
- Assess and treat dehydration as for other acute diarrhoea.
- Give an oral antibiotic to which strains of *V. cholerae* in the area are known to be sensitive. Possible choices are: erythromycin, ciprofloxacin and co-trimoxazole (for dosages, see Annex 2, p. 353).
- Prescribe zinc supplementation as soon as vomiting stops (pp. 133–4).

Monitoring

Reassess the child every 15–30 min until a strong radial pulse is present. Thereafter, reassess the child by checking skin pinch, level of consciousness and ability to drink at least every hour, in order to confirm that hydration is improving. Sunken eyes recover more slowly than other signs and are less useful for monitoring.

When the full amount of IV fluid has been given, reassess the child's hydration status fully, using Chart 7 (p. 13).

- *If signs of severe dehydration are still present*, repeat the IV fluid infusion outlined earlier. Persistent severe dehydration after IV rehydration is unusual; it usually occurs only in children who pass large watery stools frequently during the rehydration period.
- *If the child is improving but still shows signs of some dehydration*, discontinue IV treatment and give ORS solution for 4 h (see section 5.2.2 and treatment plan B, p. 135). If the child is usually breastfed, encourage the mother to continue breastfeeding frequently.
- *If there are no signs of dehydration*, follow the guidelines in section 5.1.3 and treatment plan A, p. 138. When appropriate, encourage the mother to continue breastfeeding frequently. Observe the child for at least 6 h before

Chart 13. Diarrhoea treatment plan C: Treat severe dehydration quickly

→ Follow the arrows. If the answer is **YES**, go across. If **NO**, go down.

START HERE

Can you give intravenous (IV) fluid immediately?

YES →

- Start IV fluid immediately. If the child can drink, give ORS by mouth while the drip is being set up. Give 100 ml/kg Ringer's lactate solution (or, if not available, normal saline), divided as follows:

Age	First give 30 ml/kg in:	Then give 70 ml/kg in:
Infants (< 12 months)	1 h[a]	5 h
Children (12 months to 5 years)	30 min[a]	2.5 h

[a] Repeat once if radial pulse is still weak or not detectable

- Reassess the child every 15–30 min. If hydration status is not improving, give the IV drip more rapidly. Also watch for over-hydration.
- Also give ORS (about 5 ml/kg per h) as soon as the child can drink: usually after 3–4 h (infants) and 1–2 h (children).
- Reassess an infant after 6 h and a child after 3 h. Classify dehydration. Then choose the appropriate plan (A, B or C) to continue treatment.

NO ↓

Is IV treatment available nearby within 30 min?

YES →

- Refer **urgently** to hospital for IV treatment.
- If the child can drink, give the mother ORS solution, and show her how to give frequent sips during the trip.

NO ↓

Are you trained to use a nasogastric tube for rehydration?

YES →

- Start rehydration by tube (or mouth) with ORS solution: give 20 ml/kg per h for 6 h (total, 120 ml/kg).
- Reassess the child every 1–2 h:
  - If there is repeated vomiting or increasing abdominal distension, give the fluid more slowly.
  - If hydration status is not improving after 3 h, send the child for IV therapy.
- After 6 h, reassess the child and classify dehydration. Then, choose the appropriate plan (A, B or C) to continue treatment.

NO ↓

Can the child drink?

NO ↓

Refer urgently to hospital for IV or nasogastric treatment.

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

discharge, to confirm that the mother is able to maintain the child's hydration by giving ORS solution.

All children should start to receive some ORS solution (about 5 ml/kg per h) by cup when they can drink without difficulty (usually within 3–4 h for infants and 1–2 h for older children). ORS provides additional base and potassium, which may not be adequately supplied by IV fluid.

When severe dehydration is corrected, prescribe zinc (pp. 133–4).

5.2.2 Some dehydration

In general, children with some dehydration should be given ORS solution for the first 4 h at a clinic, while the child is monitored and the mother is taught how to prepare and give ORS solution.

Diagnosis

If the child has two or more of the following signs, he or she has some dehydration:

- restlessness or irritability
- thirsty and drinks eagerly
- sunken eyes
- skin pinch goes back slowly.

Note that if a child has only one of the above signs and one of the signs of severe dehydration (e.g. restlessness or irritable and drinking poorly), then the child also has some dehydration.

Treatment

- In the first 4 h, give the child ORS solution according to the child's weight (or age if the weight is not known), as shown in Chart 14. If the child wants more to drink, give more.
- Show the mother how to give the child ORS solution: a teaspoonful every 1–2 min if the child is < 2 years; frequent sips from a cup for an older child.
- Check regularly to see whether there are problems.
  - If the child vomits, wait 10 min; then, resume ORS solution more slowly (e.g. a spoonful every 2–3 min).
  - If the child's eyelids become puffy, stop ORS solution, reduce the fluid intake and continue with breast milk. Weigh the child, and monitor urine output.

- Advise breastfeeding mothers to continue to breastfeed whenever the child wants.
- Check blood glucose or electrolytes if possible in a child who is restless or irritable and convulsing, in case hypoglycaemia or hypernatraemia is present. Manage the child accordingly; if blood glucose measurement is not possible, give IV glucose or oral sugar.
- If the mother cannot stay for 4 h, show her how to prepare ORS solution and give her enough ORS packets to complete rehydration at home plus enough for 2 more days.
- Reassess the child after 4 h, checking for signs of dehydration listed earlier.

Note: *Reassess the child before 4 h if he or she is not taking the ORS solution or seems to be getting worse.*

- *If there is no dehydration*, teach the mother the four rules of home treatment:
  (i) Give extra fluid.
  (ii) Give zinc supplements for 10–14 days.
  (iii) Continue feeding (see Chapter 10, p. 294).
  (iv) Return if the child develops any of the following signs:
    – drinking poorly or unable to drink or breastfeed
    – develops a general danger sign
    – becomes sicker
    – develops a fever
    – has blood mixed with the stools or more than a few drops on the outside of the stool
- *If the child still has some dehydration*, repeat treatment with ORS solution for another 4 h, as above, and start to offer food, milk or juice and breastfeed frequently.
- *If there are signs of severe dehydration*, see section 5.2.1 (p. 129) for treatment.

Treatment plans B and A on pp. 135 and 138 give further details.

Give zinc supplements

Zinc is an important micronutrient for a child's overall health and development but is lost in greater quantities during diarrhoea. Replacement helps the child's recovery, reduces the duration and severity of the episode, and lowers the incidence of diarrhoea in the following 2–3 months.

- Give zinc and advise the mother how much to give:

  ≤ 6 months: half tablet (10 mg) per day for 10–14 days

  ≥ 6 months: one tablet (20 mg) per day for 10–14 days

Feeding

Continuation of nutritious feeding is an important element in the management of diarrhoea.

- In the initial 4-h rehydration period, do not give any food except breast milk. Breastfed children should continue to breastfeed frequently throughout the episode of diarrhoea. If they cannot suck from the breast, consider giving expressed breast milk either orally from a cup or by nasogastric tube.
- After 4 h, if the child still has some dehydration and ORS continues to be given, give food every 3–4 h.
- All children > 6 months should be given some food before being sent home.

If the child is not normally breastfed, explore the feasibility of **relactation** (i.e. restarting breastfeeding after it was stopped, see p. 297) or give the usual breast milk substitute. If the child is ≥ 6 months or already taking solid food, give freshly prepared foods – cooked, mashed or ground. The following are recommended:

- cereal or another starchy food mixed with pulses, vegetables and meat or fish, if possible, with 1–2 teaspoons of vegetable oil added to each serving
- local complementary foods recommended by the IMCI in that area (see section 10.1.2, p. 299)
- fresh fruit juice or mashed banana to provide potassium.

- Encourage the child to eat by offering food at least six times a day. Give the same foods after the diarrhoea stops, and give an extra meal a day for 2 weeks.

5.2.3 No dehydration

Children with diarrhoea but no dehydration should receive extra fluids at home to prevent dehydration. They should continue to receive an appropriate diet for their age, including continued breastfeeding.

Diagnosis

Diarrhoea with no dehydration should be diagnosed if the child does not have two or more signs that characterize some or severe dehydration, as described above (see Table 12, p. 128).

Chart 14. Diarrhoea treatment plan B: Treat some dehydration with oral rehydration salts

GIVE THE RECOMMENDED AMOUNT OF ORS IN THE CLINIC OVER 4 H

▶ **Determine amount of ORS to give during first 4 h:**

Age[a]	≤ 4 months	4 to ≤ 12 months	12 months to ≤ 2 years	2 years to ≤ 5 years
Weight	< 6 kg	6–< 10 kg	10–< 12 kg	12–19 kg
	200–400 ml	400–700 ml	700–900 ml	900–1400 ml

[a] Use the child's age only when you do not know the weight. The approximate amount of ORS required (in ml) can also be calculated by multiplying the child's weight (in kg) by 75.

If the child wants more ORS than shown, give more.

▶ **Show the mother how to give ORS solution.**

- Give frequent small sips from a cup.
- If the child vomits, wait 10 min, then continue, but more slowly.
- Continue breastfeeding whenever the child wants.

■ **After 4 h:**

- Reassess the child and classify him or her for dehydration.
- Select the appropriate plan to continue treatment.
- Begin feeding the child in the clinic.

▶ **If the mother must leave before completing treatment:**

- Show her how to prepare ORS solution at home.
- Show her how much ORS to give to finish the 4-h treatment at home.
- Give her enough ORS packets to complete rehydration. Also give her two packets as recommended in plan A.
- Explain the four rules of home treatment:

1. **Give extra fluid.**
2. **Give zinc supplements.**
3. **Continue feeding.**
4. **Know when to return to the clinic.**

See diarrhoea treatment plan A (p. 138) and mother's card (p. 322)

Treatment

- Treat the child as an outpatient.
- Counsel the mother on the ***four rules*** of home treatment:
  - Give extra fluid.
  - Give zinc supplements.
  - Continue feeding.
  - Know when to return to the clinic.

  See treatment plan A (Chart 15 on p. 138).
- Give extra fluid, as follows:
  - If the child is being breastfed, advise the mother to breastfeed frequently and for longer at each feed. If the child is exclusively breastfed, give ORS solution or clean water in addition to breast milk. After the diarrhoea stops, exclusive breastfeeding should be resumed, if appropriate to the child's age.
  - In non-exclusively breastfed children, give one or more of the following:
    - ORS solution
    - food-based fluids (such as soup, rice water and yoghurt drinks)
    - clean water.

To prevent dehydration, advise the mother to give as much extra fluids as the child will take:

- for children < 2 years, about 50–100 ml after each loose stool
- for children ≥ 2 years, about 100–200 ml after each loose stool.

Tell the mother to give small sips from a cup. If the child vomits, wait 10 min, and then give more slowly. She should continue giving extra fluid until the diarrhoea stops.

Teach the mother how to mix and give ORS solution, and give her two packets of ORS to take home.

- Give zinc supplements
  - Tell the mother how much zinc to give:
    - ≤ 6 months: half tablet (10 mg) per day
    - ≥ 6 months: one tablet (20 mg) per day for 10–14 days
  - Show the mother how to give the zinc supplement:
    - For infants, dissolve the tablet in a small amount of clean water, expressed milk or ORS.

- Older children can chew the tablet or drink it dissolved.

– Remind the mother to give the zinc supplement for the full 10–14 days.

▶ Continue feeding: see nutrition counselling in Chapters 10 (p. 293) and 12 (p. 323).

▶ Advise the mother on when to return (see below).

Follow-up

▶ Advise the mother to return immediately to the clinic if the child becomes sicker, is unable to drink or breastfeed, drinks poorly, develops a fever or has blood in the stool. If the child shows none of these signs but is still not improving, advise the mother to return for follow-up after 5 days.

Also explain that the same treatment should be given in the future as soon as diarrhoea develops. See treatment plan A, (Chart 15, p. 138).

5.3 Persistent diarrhoea

Persistent diarrhoea is diarrhoea, with or without blood, that begins acutely and lasts for ≥ 14 days. When there is some or severe dehydration, persistent diarrhoea is classified as 'severe'.

The following guidelines are for children with persistent diarrhoea who are not severely malnourished. Severely malnourished children with severe persistent diarrhoea require hospitalization and specific treatment, as described in Chapter 7 (section 7.5.4, p. 219).

In areas where HIV infection is highly prevalent, suspect HIV infection if there are other suggestive clinical signs, and assess the child for HIV infection and do an appropriate HIV test (see Chapter 8, p. 225). Perform stool microscopy for parasites such as *Isospora* and *Cryptosporidium*.

5.3.1 Severe persistent diarrhoea

Diagnosis

■ Infants or children with diarrhoea lasting ≥ 14 days with signs of dehydration (see Table 12, p. 128) have severe persistent diarrhoea and require hospital treatment.

■ Assess the child for signs of dehydration

Treatment

▶ *Give fluids according to treatment plan B or C, as appropriate* (see pp. 135 and 131).

Chart 15. Diarrhoea treatment plan A: Treat diarrhoea at home

COUNSEL THE MOTHER ON THE FOUR RULES OF HOME TREATMENT: GIVE EXTRA FLUID. GIVE ZINC SUPPLEMENTS. CONTINUE FEEDING. KNOW WHEN TO RETURN TO THE CLINIC.

1. Give as much extra fluid as the child will take.

- Tell the mother to:
  - Breastfeed frequently and for longer at each feed.
  - If the child is exclusively breastfed, give ORS or clean water in addition to breast milk
  - If the child is not exclusively breastfed, give one or more of the following: ORS solution, food-based fluids (such as soup, rice water and yoghurt drinks) or clean water.

It is especially important to give ORS at home when:
- the child has been treated according to plan B or plan C during this visit.
- the child cannot return to a clinic if the diarrhoea gets worse.

- Teach the mother how to mix and give ORS. Give the mother two packets of ORS to use at home.
- Show the mother how much fluid to give in addition to the usual fluid intake:
  ≤ 2 years: 50–100 ml after each loose stool
  ≥ 2 years: 100–200 ml after each loose stool

Tell the mother to:
- Give frequent small sips from a cup.
- If the child vomits, wait 10 min. Then continue, but more slowly.
- Continue giving extra fluid until the diarrhoea stops.

2. Give zinc supplements.

- **Tell the mother how much zinc to give:**
  ≤ 6 months: half tablet (10 mg) per day for 10–14 days
  ≥ 6 months: one tablet (20 mg) per day for 10–14 days
- **Show the mother how to give zinc supplement:**
  - For infants, dissolve the tablet in a small amount of clean water, expressed milk or ORS in a small cup or spoon.
  - Older children can chew the tablet or drink it dissolved in a small amount of clean water in a cup or spoon.
- **REMIND THE MOTHER TO GIVE THE ZINC SUPPLEMENT FOR THE FULL 10–14 DAYS.**

3. Continue feeding.

4. Know when to return to the clinic.

See mother's card (p. 322)

ORS solution is effective for most children with persistent diarrhoea. A few children, however, may have impaired glucose absorption, and ORS solution may not be as effective. When these children are given ORS, their stool volume increases markedly, thirst increases, signs of dehydration develop or worsen, and the stools contain a large amount of unabsorbed glucose. These children require IV rehydration until ORS solution can be taken without causing the diarrhoea to worsen.

Routine treatment of persistent diarrhoea with antibiotics is not effective and should not be done. Some children, however, have non-intestinal or intestinal infections that require specific antibiotic therapy.

- *Examine every child with persistent diarrhoea for non-intestinal infections* such as pneumonia, sepsis, urinary tract infection, oral thrush and otitis media, and treat appropriately.
- Give micronutrients and vitamins as shown in the box on p. 141.
- Treat persistent diarrhoea with blood in the stools with an oral antibiotic effective for *Shigella*, as described in section 5.4, p. 143.
- Give oral metronidazole at 10 mg/kg three times a day for 5 days only if:
  - microscopic examination of fresh faeces reveals trophozoites of *Entamoeba histolytica* within red blood cells; **or**
  - trophozoites or cysts of giardia are seen in the faeces, **or**
  - two different antibiotics that are usually effective for *Shigella* locally have been given without clinical improvement.
  - if stool examination is not possible, when diarrhoea persists for > 1 month.

Feeding

Careful attention to feeding is essential for all children with persistent diarrhoea. Breastfeeding should be continued for as often and as long as the child wants. Other food should be withheld for 4–6 h only for children with dehydration who are being rehydrated following treatment plan B or C.

Hospital diet

Children treated in hospital require special diets until their diarrhoea lessens and they are gaining weight. The goal is to give a daily intake of at least 110 calories/kg.

Infants aged < 6 months

- Encourage exclusive breastfeeding. Help mothers who are not breastfeeding exclusively to do so.

- If the child is not breastfeeding, give a breast milk substitute that is low in lactose, such as yoghurt, or is lactose-free. Use a spoon or cup; do not use a feeding bottle. Once the child improves, help the mother to re-establish lactation.
- If the mother is not breastfeeding because she is HIV-positive, she should receive appropriate counselling about the correct use of breast milk substitutes.

Children aged ≥ 6 months

Feeding should be restarted as soon as the child can eat. Food should be given six times a day to achieve a total intake of at least 110 calories/kg per day. Many children will eat poorly, however, until any serious infection has been treated for 24–48 h. These children may require nasogastric feeding initially.

Two recommended diets

Tables 14 and 15 show two diets recommended for children and infants aged > 6 months with severe persistent diarrhoea. If there are signs of dietary failure (see below) or if the child is not improving after 7 days of treatment, the first diet should be stopped and the second diet given for 7 days.

Successful treatment with either diet is characterized by:

- adequate food intake
- weight gain
- fewer diarrhoeal stools
- absence of fever.

The most important criterion is weight gain. Weight should increase for at least three successive days before weight gain can be assumed.

Give additional fresh fruit and well-cooked vegetables to children who are responding well. After 7 days of treatment with the effective diet, they should resume an appropriate diet for their age, including milk, which provides at least 110 calories/kg per day. Children may then return home but must be followed up regularly to ensure continued weight gain and compliance with feeding advice.

Dietary failure is indicated by:

- an increase in stool frequency (usually to > 10 watery stools a day), often with a return of signs of dehydration (usually shortly after a new diet is begun), **or**
- failure to establish daily weight gain within 7 days.

Table 14. First diet for persistent diarrhoea: a starch-based, reduced-milk (low-lactose) diet

The diet should contain at least 70 calories/100 g, provide milk or yoghurt as a source of animal protein, but no more than 3.7 g lactose/kg per day and should provide at least 10% of calories as protein. The following example provides 83 calories/100 g, 3.7 g lactose/kg per day and 11% of calories as protein:

full-fat dried milk (or whole liquid milk: 85 ml)	11 g
rice	15 g
vegetable oil	3.5 g
cane sugar	3.0 g
water to make up	200 ml

Table 15. Second diet for persistent diarrhoea: a reduced-starch (cereal) no-milk (lactose-free) diet

The diet should contain at least 70 calories/100 g and provide at least 10% of calories as protein (egg or chicken). The following example provides 75 calories/100 g:

whole egg	64 g
rice	3 g
vegetable oil	4 g
glucose	3 g
water to make up	200 ml

Finely ground, cooked chicken (12 g) can be used in place of egg to give a diet providing 70 calories/100 g

Supplementary multivitamins and minerals

Give all children with persistent diarrhoea daily supplementary multivitamins and minerals for 2 weeks. These should provide as broad a range of vitamins and minerals as possible, including at least two recommended daily allowances of folate, vitamin A, zinc, magnesium and copper.

As a guide, one recommended daily allowance for a child aged 1 year is:

- folate, 50 µg
- zinc, 10 mg
- vitamin A, 400 µg
- iron, 10 mg
- copper, 1 mg
- magnesium, 80 mg

Monitoring

Nurses should check the following daily:

- body weight
- temperature
- food taken
- number of diarrhoeal stools.

5.3.2 Persistent diarrhoea (non-severe)

Children with non-severe persistent diarrhoea do not require hospital treatment but need special feeding and extra fluids at home.

Diagnosis

Children with diarrhoea lasting ≥ 14 days but with no signs of dehydration or severe malnutrition

Treatment

- Treat the child as an outpatient.
- Give supplementary multivitamins and minerals as shown in the box on p. 141.

Prevent dehydration

- Give fluids according to treatment plan A, p. 138. ORS solution is effective for most children with persistent diarrhoea. In a few, however, glucose absorption is impaired, and when they are given ORS solution their stool volume increases markedly, thirst increases, signs of dehydration develop or worsen, and the stools contain a large amount of unabsorbed glucose. These children require admission to hospital for IV rehydration until ORS solution can be taken without aggravating the diarrhoea.

Identify and treat specific infections

- Do not routinely treat with antibiotics, as they are not effective; however, give antibiotic treatment to children with specific non-intestinal or intestinal infections. Until these infections are treated correctly, persistent diarrhoea will not improve.
- *Non-intestinal infections*. Examine every child with persistent diarrhoea for non-intestinal infections, such as pneumonia, sepsis, urinary tract infection, oral thrush and otitis media. Treat each specific disease.
- *Intestinal infections*. Treat persistent diarrhoea with blood in the stools with an oral antibiotic that is effective for *Shigella*, as described in section 5.3.1.

Feeding

Careful attention to feeding is essential for all children with persistent diarrhoea. These children may have difficulty in digesting animal milk other than breast milk.

- Advise the mother to reduce the amount of animal milk in the child's diet temporarily.
- Continue breastfeeding and give appropriate complementary foods:
  - If still breastfeeding, give more frequent, longer breastfeeds, day and night.
  - If taking other animal milk, explore the feasibility of replacing animal milk with fermented milk products (e.g. yoghurt), which contain less lactose and are better tolerated.
  - If replacement of animal milk is not possible, limit animal milk to 50 ml/kg per day. Mix the milk with the child's cereal, but do not dilute it.
  - Give other foods appropriate for the child's age to ensure an adequate caloric intake. Infants aged > 4 months whose only food has been animal milk should begin to take solid foods.
  - Give frequent small meals, at least six times a day.

Supplementary micronutrients, including zinc

See box, p. 141.

Follow-up

- Ask the mother to bring the child back for reassessment after 5 days, or earlier if the diarrhoea worsens or other problems develop.
- Fully reassess children who have not gained weight or whose diarrhoea has not improved in order to identify the cause, such as dehydration or infection, which requires immediate attention or admission to hospital.

Those who have gained weight and who have three or fewer loose stools per day may resume a normal diet for their age.

5.4 Dysentery

Dysentery is diarrhoea presenting with frequent loose stools mixed with blood (not just a few smears on the surface). Most episodes are due to *Shigella*, and nearly all require antibiotic treatment. Shigellosis can lead to life-threatening complications, including intestinal perforation, toxic megacolon and haemolytic uraemic syndrome.

Diagnosis

The diagnostic signs of dysentery are frequent loose stools mixed with visible red blood. Other findings on examination may include:

- abdominal pain
- fever
- convulsions
- lethargy
- dehydration (see section 5.2, p. 127)
- rectal prolapse.

Treatment

Most children can be treated at home.

- Admit to hospital:
  - young infants (< 2 months old)
  - severely ill children, who look lethargic, have abdominal distension and tenderness or convulsions
  - children with any another condition requiring hospital treatment.
- Give an oral antibiotic (for 5 days) to which most local strains of *Shigella* are sensitive.
  - Give ciprofloxacin at 15 mg/kg twice a day for 3 days if antibiotic sensitivity is unknown. If local antimicrobial sensitivity is known, follow local guidelines.
  - Give ceftriaxone IV or IM at 50–80 mg/kg per day for 3 days to severely ill children or as second-line treatment.
- Give zinc supplements as for children with watery diarrhoea.

Note: *There is widespread* Shigella *resistance to ampicillin, co-trimoxazole, chloramphenicol, nalidixic acid, tetracycline, gentamicin and first- and second-generation cephalosporin, which are no longer effective. There is also already reported resistance to ciprofloxacin in some countries.*

Follow-up

Follow up children after 2 days, and look for signs of improvement, such as no fever, fewer stools with less blood, improved appetite.

- If there is no improvement after 2 full days of treatment:
  - ▶ check for other conditions (see Chapter 2),
  - ▶ stop the first antibiotic, and give a second-line antibiotic or a known effective against *Shigella* in the area (see Annex 2 for dosages).
- If the two antibiotics that are usually effective against *Shigella* in the area have each been given for 2 days, with no sign of clinical improvement, check for other conditions (consult a standard paediatric textbook).
  - – If amoebiasis is possible, give metronidazole at 10 mg/kg three times a day for 5 days.

▶ Admit the child if there is an indication requiring hospital treatment.

Infants and young children

Consider surgical causes of blood in the stools (for example, intussusception; see section 9.4, p. 281), and refer to a surgeon, if appropriate. Dysentery is unusual in neonates and young infants; therefore, consider life-threatening bacterial sepsis

▶ For suspected sepsis give IM or IV ceftriaxone at 100 mg/kg once daily for 5 days.

Severely malnourished children

See Chapter 7 for the general management of severely malnourished children.

▶ Treat for *Shigella* first and then for amoebiasis on clinical grounds if laboratory examination is not possible.

▶ If microscopic examination of fresh stools in a reliable laboratory is possible, check for trophozoites of *Entamoeba histolytica* in red blood cells and treat for amoebiasis, if present. Also examine stools for trophozoites of *Giardia lamblia* and treat if present.

Supportive care

Supportive care includes the prevention or correction of dehydration and continued feeding. For guidelines on supportive care of severe acutely malnourished children with bloody diarrhoea, see also Chapter 7 (p. 197).

Never give drugs for symptomatic relief of abdominal or rectal pain or to reduce the frequency of stools, as these drugs can increase the severity of the illness.

Treatment of dehydration

▶ Assess the child for signs of dehydration and give fluids according to treatment plan A, B or C (pp. 138, 135, 131), as appropriate.

Nutritional management

Ensuring a good diet is important, as dysentery has a marked adverse effect on nutritional status. Feeding is often difficult because of lack of appetite; return of appetite is an important sign of improvement.

- Breastfeeding should be continued throughout the course of the illness, more frequently than normal, if possible, because the infant may not take the usual amount per feed.
- Children aged 6 months or more should receive their normal foods. Encourage the child to eat, and allow the child to select preferred foods.

Complications

- *Dehydration.* Dehydration is the commonest complication of dysentery, and children should be assessed and managed for dehydration irrespective of any other complication. Give fluids according to treatment plan A, B or C, as appropriate.
- *Potassium depletion.* Potassium depletion can be prevented by giving ORS solution (when indicated) or potassium-rich foods such as bananas, coconut water or dark-green leafy vegetables.
- *High fever.* If the child has high fever (≥ 39 °C or ≥ 102.2 °F) that appears to be causing distress, give paracetamol and consider severe bacterial infection.
- *Rectal prolapse.* Gently push back the rectal prolapse using a surgical glove or a wet cloth. Alternatively, prepare a warm solution of saturated magnesium sulfate, and apply compresses with this solution to reduce the prolapse by decreasing oedema.
- *Convulsions.* A single convulsion is the commonest finding. If they are prolonged or repeated, give diazepam (see chart 9, p. 15). Avoid giving rectal diazepam. Always check for hypoglycaemia.
- *Haemolytic uraemic syndrome.* Where laboratory tests are not possible, suspect haemolytic uraemic syndrome in patients with easy bruising, pallor, altered consciousness and low or no urine output.
- *Toxic megacolon.* Toxic megacolon usually presents with fever, abdominal distension, pain and tenderness with loss of bowel sounds, tachycardia and dehydration. Give IV fluids for dehydration, pass a nasogastric tube, and start antibiotics.

Further details of treatment can be found in standard paediatric textbooks.

Notes

Notes

CHAPTER 6

Fever

6.1	Child presenting with fever	150
6.1.1	Fever lasting 7 days or less	150
6.1.2	Fever lasting longer than 7 days	153
6.2	Malaria	156
6.2.1	Severe malaria	156
6.2.2	Uncomplicated malaria	163
6.3	Meningitis	167
6.3.1	Bacterial meningitis	167
6.3.2	Meningococcal epidemics	170
6.3.3	Tuberculous meningitis	171
6.3.4	Cryptococcal meningitis	172
6.4	Measles	174
6.4.1	Severe complicated measles	175
6.4.2	Non-severe measles	178
6.5	Septicaemia	179
6.6	Typhoid fever	180
6.7	Ear infections	182
6.7.1	Mastoiditis	182
6.7.2	Acute otitis media	183
6.7.3	Chronic otitis media	184
6.8	Urinary tract infection	184
6.9	Septic arthritis or osteomyelitis	186
6.10	Dengue	188
6.10.1	Severe dengue	188
6.11	Rheumatic fever	193

This chapter gives treatment guidelines for the management of the most important conditions for which children aged between 2 months and 5 years present with fever. Management of febrile conditions in young infants (< 2 months) is described in Chapter 3, p. 45.

6.1 Child presenting with fever

6.1.1 Fever lasting 7 days or less

Special attention should be paid to children presenting with fever. The main aim is to differentiate serious, treatable infections from mild self-resolving febrile illness.

History

- duration of fever
- residence in or recent travel to an area with malaria transmission
- recent contact with a person with an infectious disease
- vaccination history
- skin rash
- stiff neck or neck pain
- headache
- convulsions or seizures
- pain on passing urine
- ear pain.

Examination

For details see Tables 16–19.

- *General:* drowsiness or altered consciousness, pallor or cyanosis, or lymphadenopathy
- *Head and neck:* bulging fontanel, stiff neck, discharge from ear or red, immobile ear-drum on otoscopy, swelling or tenderness in mastoid region
- *Chest:* fast breathing (pneumonia, septicaemia or malaria)
- *Abdomen:* enlarged spleen (malaria) or enlarged liver
- *Limbs:* difficulty in moving joint or limb (abscess, septic arthritis, osteomyelitis, rheumatic fever)
- Skin rash
  - Pustules, or signs of infection: red, hot, swollen, tender (staphylococcal infection)
  - Haemorrhagic rash: purpura, petaechiae (meningococcal infection, dengue)
  - Maculopapular rash (measles, other viral infections)

Laboratory investigations

- oxygen saturation
- blood smear
- urine microscopy and culture
- full blood count
- lumbar puncture if signs suggest meningitis
- blood culture

Differential diagnosis

The four major categories of fever in children are:

- due to infection, with non-localized signs (Table 16)
- due to infection, with localized signs (Table 17, p. 152)
- with rash (Table 18, p. 153)
- lasting longer than 7 days.

Table 16. Differential diagnosis of fever without localizing signs

Diagnosis	In favour
Malaria (in endemic area)	– Positive blood film or rapid diagnostic test for malaria parasites – Anaemia – Enlarged spleen
Septicaemia	– Seriously ill with no apparent cause – Purpura, petaechiae – Shock – Hypothermia in a young infant or severely malnourished child
Typhoid	– Seriously ill with no apparent cause – Abdominal tenderness – Shock – Confusion
Urinary tract infection	– Abdominal pain – Loin or suprapubic tenderness – Crying on passing urine – Passing urine more frequently than usual – Incontinence in previously continent child – White blood cells and/or bacteria in urine on microscopy, or positive dipstick
Fever associated with HIV infection	– Signs of HIV infection (see Chapter 8, p. 225)

Table 17. Differential diagnosis of fever with localized signs

Diagnosis	In favour
Meningitis	– Multiple or complicated convulsions – Altered level of consciousness – Lumbar puncture positive – Stiff neck – Bulging fontanelle in infancy – Meningococcal rash (petaechial or purpuric)
Otitis media	– Red immobile ear-drum on otoscopy – Pus draining from ear – Ear pain
Mastoiditis	– Tender swelling behind the ear
Osteomyelitis	– Local tenderness – Refusal to move the affected limb – Refusal to bear weight on leg
Septic arthritis	– Joint hot, tender, swollen
Acute rheumatic fever	– Migratory joint pains – Heart murmur(s)
Skin and soft tissue infection	– Cellulitis – Skin boils – Pustules – Pyomyositis (purulent infection of muscles)
Pneumonia (see 4.2 and 4.3, pp. 80–90 for other clinical findings)	– Cough with fast breathing – Lower chest wall indrawing – Grunting – Nasal flaring – Coarse crackles, consolidation, effusion
Viral upper respiratory tract infection	– Symptoms of cough or cold – No systemic upset
Retropharyngeal abscess	– Sore throat in older child – Difficulty in swallowing, drooling of saliva – Tender cervical nodes
Sinusitis	– Facial tenderness on percussion over affected sinus – Foul nasal discharge
Hepatitis	– Severe anorexia – Abdominal pain – Jaundice with dark urine

Table 18. Differential diagnosis of fever with rash

Diagnosis	In favour
Measles	– Typical rash (see p. 174) – Cough, runny nose, red eyes – Mouth ulcers – Corneal clouding – Recent exposure to a measles case – No documented measles vaccination
Viral infections	– Mild systemic upset – Cough or cold – Mild systemic upset – Transient non-specific rash
Relapsing fever	– Petaechial rash, skin haemorrhages – Jaundice – Tender enlarged liver and spleen – History of previous episode of relapsing fever – Positive blood smear for *Borrelia*
Typhus[a]	– Epidemic of typhus in region – Characteristic macular rash – Muscle aches
Dengue haemorrhagic fever[b]	– Bleeding from nose or gums or in vomitus – Bleeding in stools or black stools – Skin petaechiae or purpura – Enlarged liver and spleen – Shock – Abdominal tenderness

[a] In some regions, other rickettsial infections may be relatively common.
[b] In some regions, the presentation of other viral haemorrhagic fevers is similar to that of dengue.

These categories overlap to some extent. Some causes of fever are found only in certain regions (e.g. malaria, dengue haemorrhagic fever, relapsing fever). Other fevers may be seasonal (e.g. malaria, meningococcal meningitis) or occur in epidemics (measles, dengue, meningococcal meningitis, typhus).

6.1.2 Fever lasting longer than 7 days

As there are many causes of prolonged fever, it is important to know the commonest causes in a given area. Investigations to determine the most likely cause can then be started and treatment decided. Sometimes there is need for a 'trial of treatment', e.g. for highly suspected TB or Salmonella infections; improvement supports the suspected diagnosis.

History

Take a history, as for fever (see p. 150). In addition, consider the possibility of HIV, TB or malignancy, which can cause persistent fever.

Examination

Fully undress the child, and examine the whole body for the following signs:

- fast breathing or chest indrawing (pneumonia)
- stiff neck or bulging fontanel (meningitis)
- red tender joint (septic arthritis or rheumatic fever)
- fast breathing or chest indrawing (pneumonia or severe pneumonia)
- petaechial or purpuric rash (meningococcal disease or dengue)
- maculopapular rash (viral infection or drug reaction)
- inflamed throat and mucous membranes (throat infection)
- red, painful ear with immobile ear-drum (otitis media)
- jaundice or anaemia (malaria, hepatitis, leptospirosis or septicaemia)
- painful spine, hips or other joints (septic arthritis)
- tender abdomen (suprapubic or loin in urinary tract infection)

Some causes of persistent fever may have no localizing diagnostic signs, such as septicaemia, *Salmonella* infections, miliary TB, HIV infection or urinary tract infection.

Laboratory investigations

When available, perform the following:

- blood films or rapid diagnostic test for malaria parasites (a positive test in an endemic area does not exclude other, co-existing causes of fever)
- full blood count, including platelet count, and examination of a thin film for cell morphology
- urinalysis, including microscopy

Mantoux test (***Note:*** *often negative in a child who has miliary TB, severe malnutrition or HIV infection*)

- chest X-ray
- blood culture
- HIV testing (if the fever has lasted > 30 days and there is reason to suspect HIV infection)
- lumbar puncture (to exclude meningitis if there are suggestive signs).

Differential diagnosis

Review all the conditions listed in Tables 16–18 (pp. 151–3). In addition, consider the causes of fever lasting > 7 days in Table 19.

Table 19. Additional differential diagnoses of fever lasting longer than 7 days

Diagnosis	In favour
Abscess	– Fever with no obvious focus of infection (deep abscess) – Tender or fluctuant mass – Local tenderness or pain – Specific signs depend on site, e.g. subphrenic, psoas, retroperitoneal, lung, renal
Salmonella infection (non-typhoidal)	– Child with sickle-cell disease – Osteomyelitis or arthritis in infant
Infective endocarditis	– Weight loss – Enlarged spleen – Anaemia – Heart murmur or underlying heart disease – Petaechiae – Splinter haemorrhages in nail beds – Microscopic haematuria – Finger clubbing
Rheumatic fever	– Heart murmur, which may change over time – Arthritis or arthralgia – Cardiac failure – Persistent, fast pulse rate – Pericardial friction rub – Chorea – Recent known streptococcal infection
Miliary TB	– Weight loss – Anorexia, night sweats – Enlarged liver and/or spleen – Cough – Tuberculin test negative – Family history of TB – Fine miliary pattern on chest X-ray (see p. 85)
Brucellosis (local knowledge of prevalence is important)	– Chronic relapsing or persistent fever – Malaise – Musculoskeletal pain – Lower backache or hip pain – Enlarged spleen – Anaemia – History of drinking unboiled milk

Table 19. Continued

Diagnosis	In favour
Borreliosis (relapsing fever) (local knowledge of prevalence important)	– Painful muscles and joints – Red eyes – Enlarged liver and spleen – Jaundice – Petaechial rash – Decreased level of consciousness – Spirochaetes on blood film

6.2 Malaria

6.2.1 Severe malaria

Severe malaria, which is usually due to *Plasmodium falciparum*, is a life-threatening condition. The illness starts with fever and often vomiting. Children can deteriorate rapidly over 1–2 days, developing complications, the commonest of which are coma (cerebral malaria) or less profound altered level of consciousness, inability to sit up or drink (prostration), convulsions, severe anaemia, respiratory distress (due to acidosis) and hypoglycaemia.

Diagnosis

History. Children with severe malaria present with some of the clinical features listed below. A change of behaviour, confusion, drowsiness, altered consciousness and generalized weakness are usually indicative of 'cerebral malaria'.

Examination. Make a rapid clinical assessment, with special attention to level of consciousness, blood pressure, rate and depth of respiration and pallor. Assess neck stiffness and examine for rash to exclude alternative diagnoses. The main features indicative of severe malaria are:

- generalized multiple convulsions: more than two episodes in 24 h
- impaired consciousness, including unrousable coma
- generalized weakness (prostration) or lethargy, i.e. the child is unable walk or sit up without assistance
- deep laboured breathing and respiratory distress (acidotic breathing)
- pulmonary oedema (or radiological evidence)
- abnormal bleeding
- clinical jaundice plus evidence of other vital organ dysfunction
- severe pallor

- circulatory collapse or shock with systolic blood pressure < 50 mm Hg
- haemoglobinuria (dark urine)

Laboratory findings. Children with the following findings on investigation have severe malaria:

- hypoglycaemia (blood glucose < 2.5 mmol/litre or < 45 mg/dl). Check blood glucose in all children with signs suggesting severe malaria.
- hyperparasitaemia (thick blood smears and thin blood smear if species identification required). Hyperparasitaemia > 100 000/µl (2.5%) in low-intensity transmission areas or 20% hyperparasitaemia in areas of high transmission. Where microscopy is not feasible or may be delayed, a positive rapid diagnostic test is diagnostic.
- severe anaemia (erythrocyte volume fraction [EVF], < 15%; Hb, < 5 g/dl)
- high blood lactate (> 5 mmol/litre)
- high serum creatinine (renal impairment, creatinine >265 umol/l)
- lumbar puncture to exclude bacterial meningitis in a child with severe malaria and altered level of consciousness or in coma. A lumbar puncture should be done if there are no contraindications (see p. 346). If lumbar puncture is delayed and bacterial meningitis cannot be excluded, give antibiotic treatment in addition to antimalarial treatment (see p. 169).

If severe malaria is suspected and the initial blood smear is negative, perform a rapid diagnostic test, if available. If the test is positive, treat for severe malaria but continue to look for other causes of severe illness (including severe bacterial infections). If the rapid diagnostic test is negative, malaria is unlikely to be the cause of illness, and an alternative diagnosis must be sought.

Treatment

Emergency measures, to be taken within the first hour

- If the child is unconscious, minimize the risk for aspiration pneumonia by inserting a nasogastric tube and removing the gastric contents by suction. Keep the airway open, and place in recovery position.
- Check for hypoglycaemia and correct, if present (see p. 161). If blood glucose cannot be measured and hypoglycaemia is suspected, give glucose.
- Treat convulsions with rectal or IV diazepam (see Chart 9, p. 15). Do not give prophylactic anticonvulsants.
- Start treatment with an effective antimalarial agent (see below).
- If hyperpyrexia is present, give paracetamol or ibuprofen to reduce temperature below 39 °C.

- Check for associated dehydration, and treat appropriately if present (see fluid balance disturbances, p. 159).
- Treat severe anaemia (see p. 160).
- Institute regular observation of vital and neurological signs.

Antimalarial treatment

If confirmation of malaria from a blood smear or rapid diagnostic test is likely to take more than 1 h, start antimalarial treatment before the diagnosis is confirmed.

Parenteral artesunate is the drug of choice for the treatment of severe *P. falciparum* malaria. If it is not available, parenteral artemether or quinine should be used. Give antimalarial agents by the parenteral route until the child can take oral medication or for a minimum of 24 h even if the patient can tolerate oral medication earlier.

- **Artesunate:** Give artesunate at 2.4 mg/kg IV or IM on admission, then at 12 h and 24 h, then daily until the child can take oral medication but for a minimum of 24 h even if the child can tolerate oral medication earlier.
- **Quinine:** Give a loading dose of quinine dihydrochloride salt at 20 mg/kg by infusion in 10 ml/kg of IV fluid over 2–4 h. Then, 8 h after the start of the loading dose, give 10 mg/kg quinine salt in IV fluid over 2 h, and repeat every 8 h until the child can take oral medication. The infusion rate should not exceed a total of 5 mg/kg per h of quinine dihydrochloride salt.

IV quinine should **never** be given as a bolus injection but as a 2–4 h infusion under close nursing supervision. If IV quinine infusion is not possible, quinine dihydrochloride can be given as a diluted divided IM injection. Give the loading dose split into two as 10 mg/kg of quinine salt into the anterior aspect of each thigh. Then, continue with 10 mg/kg every 8 h until oral medication is tolerated. The diluted parenteral solution is better absorbed and less painful.

- **Artemether:** Give artemether at 3.2 mg/kg IM on admission, then 1.6 mg/kg daily until the child can take oral medication. Use a 1-ml tuberculin syringe to give the small injection volume. As absorption of artemether may be erratic, it should be used only if artesunate or quinine is not available.

Give parenteral antimalarial agent for the treatment of severe malaria for at least 24 h; thereafter, complete treatment with a full course of artemisinin-based combination therapy, such as:

- artemether–lumefantrine
- artesunate plus amodiaquine

- artesunate plus sulfadoxine–pyrimethamine,
- dihydroartemisinin plus piperaquine.

Supportive care

- Ensure meticulous nursing care, especially for unconscious patients.
- Ensure that they receive daily fluid requirements, and monitor fluid status carefully by keeping a careful record of fluid intake and output.
- Feed children unable to feed for more than 1–2 days by nasogastric tube, which is preferable to prolonged IV fluids.
- Avoid giving any harmful drugs like corticosteroids, low-molecular-mass dextran and other anti-inflammatory drugs.

Dehydration

Examine frequently for signs of dehydration (see p. 128) or fluid overload, and treat appropriately. The most reliable sign of fluid overload is an enlarged liver. Additional signs are gallop rhythm, fine crackles at lung bases and fullness of neck veins when upright. Eyelid oedema is a useful sign of fluid overload.

If, after careful rehydration, the urine output over 24 h is < 4 ml/kg, give IV furosemide, initially at 2 mg/kg. If there is no response, double the dose at hourly intervals to a maximum of 8 mg/kg (given over 15 min). Large doses should be given once to avoid possible nephrotoxicity.

For an unconscious child:

- ▶ Maintain clear airway.
- ▶ Nurse the child in recovery position or 30° head-up to avoid aspiration of fluids.
- ▶ Insert a nasogastric tube for feeding and to minimize the risk of aspiration.
- ▶ Turn the patient every 2 h.
- Do not allow the child to lie in a wet bed.
- Pay attention to pressure points.

Complications

Coma (cerebral malaria)

The earliest symptom of cerebral malaria is usually a brief (1–2-day) history of fever, followed by inability to eat or drink preceding a change in behaviour or altered level of consciousness. In children with cerebral malaria:

- Assess, monitor and record the level of consciousness according to the AVPU or another locally used coma scale for children (see p. 18).

- Exclude other treatable causes of coma (e.g. hypoglycaemia, bacterial meningitis). Always exclude hypoglycaemia by checking blood glucose; if this is not possible, treat for hypoglycaemia (see p. 161). Perform a lumbar puncture if there are no contraindications. If you cannot do a lumbar puncture to exclude meningitis, give antibiotics for bacterial meningitis (see section 6.3, p. 167).
- Monitor all other vital signs (temperature, respiratory rate, heart rate, blood pressure and urine output).
- Manage convulsions if present.

Convulsions

Convulsions are common before and after the onset of coma. They may be very subtle, such as intermittent nystagmus, twitching of a limb, a single digit or a corner of the mouth, or an irregular breathing pattern.

▶ Give anticonvulsant treatment with rectal diazepam or slow IV injection (see Chart 9, p. 15).

- Check blood glucose to exclude hypoglycaemia, and correct with IV glucose if present; if blood glucose cannot be measured, treat for hypoglycaemia (see p. 161).

▶ If there are repeated convulsions, give phenobarbital (see Chart 9, p. 15).

▶ If temperature is ≥ 39 °C, give a dose of paracetamol.

Shock

Some children may already be in shock, with cold extremities (clammy skin), weak rapid pulse, capillary refill longer than 3 s and low blood pressure. These features may indicate complicating septicaemia, although dehydration may also contribute to the hypotension.

- Correct hypovolaemia as appropriate.
- Take blood for culture
- Do urinalysis.

▶ Give both antimalarial and antibiotic treatment for septicaemia (see section 6.5, p. 179).

Severe anaemia

Severe anaemia is indicated by severe palmar pallor, often with a fast pulse rate, difficult breathing, confusion or restlessness. Signs of heart failure such as gallop rhythm, enlarged liver and, rarely, pulmonary oedema (fast breathing, fine basal crackles on auscultation) may be present

- Give a blood transfusion as soon as possible (see p. 308) to:
  - all children with an EVF ≤ 12% or Hb ≤ 4 g/dl.
  - less severely anaemic children (EVF > 12–15%; Hb 4–5 g/dl) with any of the following:
    - shock or clinically detectable dehydration
    - impaired consciousness
    - respiratory acidosis (deep, laboured breathing)
    - heart failure
    - very high parasitaemia (> 20% of red cells parasitized).
- Give 10 ml/kg packed cells or 20 ml/kg whole blood over 3–4 h.
  - A diuretic is not usually indicated, because many of these children are usually hypovolaemic with a low blood volume.
  - Check the respiratory rate and pulse rate every 15 min. If one of them rises, transfuse more slowly. If there is any evidence of fluid overload due to the blood transfusion, give IV furosemide (1–2 mg/kg) up to a maximum total of 20 mg.
  - After the transfusion, if the Hb remains low, repeat the transfusion.
  - In severely malnourished children, fluid overload is a common and a serious complication. Give whole blood (10 ml/kg rather than 20 ml/kg) once only and do not repeat the transfusion.
- Give a daily iron–folate tablet or iron syrup for 14 days (see p. 364).

Hypoglycaemia

Hypoglycaemia (blood glucose < 2.5 mmol/litre or < 45 mg/dl) is particularly common in children < 3 years, especially those with convulsions or hyperparasitaemia and who are comatose. It is easily overlooked because the clinical signs may mimic cerebral malaria. Hypoglycaemia should be corrected if glucose is < 3 mmol/l (54 mg/dl).

- Give 5 ml/kg of 10% glucose (dextrose) solution IV rapidly (see Chart 10, p. 16). If IV access is not possible, place an intraosseous needle (see p. 340) or give sublingual sugar solution. Recheck the blood glucose after 30 min, and repeat the dextrose (5 ml/kg) if the level is low (< 3.0 mmol/l; < 54 mg/dl).

Prevent further hypoglycaemia in an unconscious child by giving 10% dextrose in normal saline or Ringer's lactate for maintenance infusion (add 20 ml of 50% glucose to 80 ml of 0.9% normal saline or Ringer's lactate). Do not exceed the maintenance fluid requirements for the child's weight (see section 10.2, p. 304).

Monitor blood glucose and signs of fluid overload. If the child develops fluid overload and blood glucose is still low, stop the infusion; repeat 10% glucose (5 ml/kg), and feed the child by nasogastric tube as appropriate.

Once the child can take food orally, stop IV treatment and feed the child by nasogastric tube. Breastfeed every 3 h, if possible, or give milk feeds of 15 ml/kg if the child can swallow. If the child cannot feed without risk of aspiration, especially if the gag reflex is still absent, give sugar solution or small feeds by nasogastric tube (see Chart 10, p. 16). Continue monitoring blood glucose, and treat accordingly (as above) if it is < 2.5 mmol/litre or < 45 mg/dl.

Respiratory distress (acidosis)

Respiratory distress presents as deep, laboured breathing, while the chest is clear on auscultation, often accompanied by lower chest wall indrawing. It is commonly caused by systemic metabolic acidosis (frequently lactic acidosis). It may develop in a fully conscious child but more often occurs in children with an altered level of consciousness, prostration, cerebral malaria, severe anaemia or hypoglycaemia. Respiratory distress due to acidosis must be distinguished from that caused by pneumonia (including history of aspiration) or pulmonary oedema due to fluid overload. If acidosis is present:

- Give oxygen.
- Correct reversible causes of acidosis, especially dehydration and severe anaemia:
  - If Hb is ≥ 5 g/dl, give 20 ml/kg normal saline or Ringer's lactate (Hartmann's solution) IV over 30 min.
  - If Hb is < 5 g/dl, give whole blood (10 ml/kg) over 30 min and a further 10 ml/kg over 1–2 h without diuretics. Check the respiratory rate and pulse rate every 15 min. If either shows any rise, transfuse more slowly to avoid precipitating pulmonary oedema (see guidelines on blood transfusion, section 10.6, p. 308).

▶ Monitor response by continuous clinical observation (oxygen saturation, Hb, packed cell volume, blood glucose and acid–base balance if available)

Aspiration pneumonia

Treat aspiration pneumonia immediately, as it can be fatal.

- Place the child on his or her side or at least 30° head-up.
- Give oxygen if oxygen saturation is ≤ 90% or, if you cannot do pulse oximetry, if there is cyanosis, severe lower chest wall indrawing or a respiratory rate ≥ 70/min.

- Give IV ampicillin and gentamicin for a total of 7 days.

Monitoring

The child should be checked by a nurse at least every 3 h and by a doctor at least twice a day. The IV infusion rate should be checked hourly. Children with cold extremities, hypoglycaemia on admission, respiratory distress and/or deep coma are at greatest risk of death and must be kept under very close observation.

- Monitor and report immediately any change in the level of consciousness, convulsions or the child's behaviour.
- Monitor temperature, pulse rate, respiratory rate (and, if possible, blood pressure) every 6 h for at least the first 48 h.
- Monitor the blood glucose level every 3 h until the child is fully conscious.
- Check the IV infusion rate regularly. If available, use a chamber with a volume of 100–150 ml. Avoid over-infusion of fluids from a 500-ml or 1-litre bottles or bags, especially if the child is not supervised all the time. Partially empty the IV bottle or bag to reduce the amount before starting the infusion. If the risk of over-infusion cannot be ruled out, it is safer to rehydrate or feed through a nasogastric tube.
- Keep a careful record of fluid intake (including IV infusions) and output.

6.2.2 Uncomplicated malaria

The presentation of uncomplicated malaria is highly variable and may mimic many other causes of fever.

Diagnosis

The child has:

- fever (temperature ≥ 37.5°C or ≥ 99.5 °F) or history of fever
- a positive blood smear or positive rapid diagnostic test for malaria
- *no* signs of severe malaria:
  - altered consciousness
  - severe anaemia (EVF < 15% or Hb < 5 g/dl)
  - hypoglycaemia (blood glucose < 2.5 mmol/litre or < 45 mg/dl)
  - respiratory distress
  - jaundice

Note: *If a child in a malarious area has fever with no obvious cause and it is not possible to confirm malaria on a blood film or with a rapid diagnostic test, treat the child for malaria.*

Treatment

Treat with a first-line antimalarial agent, as in the national guidelines, with one of the following recommended regimens:

Uncomplicated* P. falciparum *malaria: Treat for 3 days with one of the recommended artemisinin-based combination therapy options:

- **Artemether–lumefantrine:** combined tablets containing 20 mg of artemether and 120 mg of lumefantrine:

  Dosage for combined tablet:

  - child weighing 5 – < 15 kg: one tablet twice a day for 3 days
  - child weighing 15–24 kg: 2 tablets twice a day for 3 days
  - child > 25 kg: 3 tablets twice a day for 3 days

- **Artesunate plus amodiaquine:** a fixed-dose formulation in tablets containing 25/67.5 mg, 50/135 mg or 100/270 mg of artesunate/amodiaquine.

  Dosage for combined tablet:

  - Aim for a target dose of 4 mg/kg per day artesunate and 10 mg/kg per day amodiaquine once a day for 3 days.
  - child weighing 3 – < 10 kg: one tablet (25 mg/67.5 mg) twice a day for 3 days
  - child weighing 10–18 kg: one tablet (50 mg/135 mg) twice a day for 3 days.

- **Artesunate plus sulfadoxine–pyrimethamine.** Separate tablets of 50 mg artesunate and 500 mg sulfadoxine–25 mg pyrimethamine:

  Dosage:

  - Aim for a target dose of 4 mg/kg per day artesunate once a day for 3 days and 25 mg/kg sulfadoxine – 1.25 mg/kg pyrimethamine on day 1.

  Artesunate:

  - child weighing 3 – < 10 kg: half tablet once daily for 3 days
  - child weighing ≥ 10 kg: one tablet once daily for 3 days

  Sulfadoxine–pyrimethamine:

  - child weighing 3 – < 10 kg: half tablet once on day 1
  - child weighing ≥ 10 kg: one tablet once on day 1

- **Artesunate plus mefloquine.** Separate tablets of 50 mg artesunate and 250 mg mefloquine base:

  Dosage:

  Aim for a target dose of 4 mg/kg per day artesunate once a day for 3 days and 25 mg/kg of mefloquine divided into two or three doses.

- **Dihydroartemisinin plus piperaquine.** Fixed-dose combination in tablets containing 40 mg dihydroartemisinin and 320 mg piperaquine.

  Dosage:

  Aim for a target dose of 4 mg/kg per day dihydroartemisinin and 18 mg/kg per day piperaquine once a day for 3 days.

  Dosage of combined tablet:

  - Child weighing 5 – < 7 kg: half tablet (20 mg/160 mg) once a day for 3 days
  - Child weighing 7 – < 13 kg: one tablet (20 mg/160 mg) once a day for 3 days
  - Child weighing 13 – < 24 kg: one tablet (320 mg/40 mg) once a day for 3 days

Children with HIV infection: Give prompt antimalarial treatment as recommended above. Patients on zidovudine or efavirenz should, however, avoid amodiaquine-containing artemisinin-based combination therapy, and those on co-trimoxazole (trimethoprim plus sulfamethoxazole) prophylaxis should avoid sulfadoxine–pyrimethamine.

Uncomplicated* P. vivax, ovale *and* malariae *malaria: Malaria due to these organisms is still sensitive to 3 days' treatment with chloroquine, followed by primaquine for 14 days. For *P. vivax*, treatment with artemisinin-based combination therapy is also recommended.

- For *P. vivax*, give a 3-day course of artemisinin-based combination therapy as recommended for *P. falciparum* (with the exception of artesunate plus sulfadoxine–pyrimethamine) combined with primaquine at 0.25 mg base/kg, taken with food once daily for 14 days.
- Give oral chloroquine at a total dose of 25 mg base/kg, combined with primaquine.

  Dosage:

  - Chloroquine at an initial dose of 10 mg base/kg, followed by 10 mg/kg on the second day and 5 mg/kg on the third day.
  - Primaquine at 0.25 mg base/kg, taken with food once daily for 14 days.

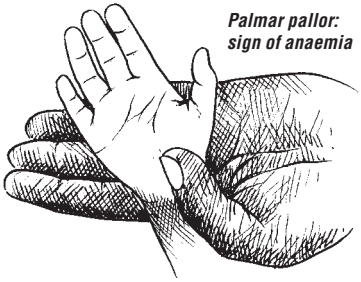
- Chloroquine-resistant vivax malaria should be treated with amodiaquine, mefloquine or dihydroartemisinin plus piperaquine as the drugs of choice.

Complications

Anaemia

In any child with palmar pallor, determine the Hb or EVF. Hb of 5–9.3 g/dl (equivalent to approximately 15–27%) indicates moderate anaemia. Begin treatment with iron and folate immediately after completion of antimalarial treatment or on discharge (omit iron for any child with severe malnutrition until recovery).

- Give a daily iron–folate tablet or iron syrup for 14 days; see p. 364).
  - Ask the parent to return with the child in 14 days. Treat for 3 months, as it takes 2–4 weeks to correct anaemia and 1–3 months to build up iron stores.



Palmar pallor: sign of anaemia

- If the child is > 1 year and has not received mebendazole in the previous 6 months, give one dose of mebendazole (500 mg) for possible hookworm or whipworm infestation (see p. 365).
- Advise the mother about good feeding practice.

Follow-up

If the child is treated as an outpatient, ask the mother to return if the fever persists after 3 days' treatment, or sooner if the child's condition gets worse. If the child returns, check if the child actually took the full dose of treatment and repeat a blood smear. If the treatment was not taken, repeat it. If it was taken but the blood smear is still positive, treat with a second-line antimalarial agent. Reassess the child to exclude the possibility of other causes of fever (see section 6.1, pp. 150–6).

If the fever persists after 3 days of treatment with the second-line antimalarial agent, ask the mother to return with the child to assess other causes of fever.

6.3 Meningitis

Early diagnosis is essential for effective treatment. This section refers to children and infants > 2 months. For diagnosis and treatment of meningitis in young infants, see section 3.9, p. 55.

6.3.1 Bacterial meningitis

Bacterial meningitis is a serious illness that is responsible for considerable morbidity and mortality. No single clinical feature emerges as sufficiently distinctive to make a robust diagnosis, but a history of fever and seizures with the presence of meningeal signs and altered consciousness are common features of meningitis. The possibility of viral encephalitis or tuberculous meningitis must be considered as differential diagnoses in children with meningeal signs.

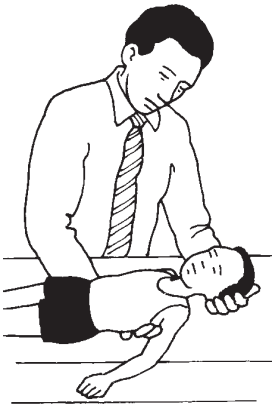
Diagnosis

Look for a history of:

- convulsions
- vomiting
- inability to drink or breastfeed
- a headache or pain in back of neck
- irritability
- a recent head injury

On examination, look for:

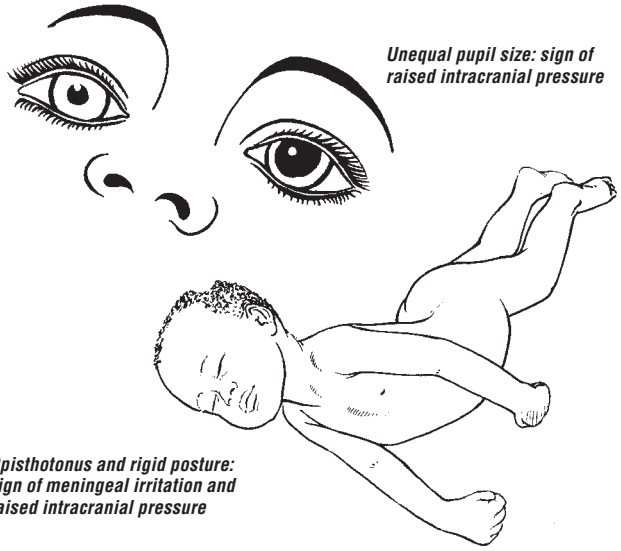
- altered level of consciousness
- neck stiffness
- repeated convulsions
- bulging fontanelle in infants
- non-blanching petaechial rash or purpura
- lethargy
- irritability
- evidence of head trauma suggesting possible recent skull fracture.



Looking and feeling for stiff neck in a child

Also look for any of the following signs of raised intracranial pressure:

- decreased consciousness level
- unequal pupils



Unequal pupil size: sign of raised intracranial pressure

Opisthotonus and rigid posture: sign of meningeal irritation and raised intracranial pressure

- rigid posture or posturing
- focal paralysis in any of the limbs
- irregular breathing

Laboratory investigations

- Confirm the diagnosis with a lumbar puncture and examination of the CSF. If the CSF is cloudy, assume meningitis and start treatment while waiting for laboratory confirmation.
- Microscopy should indicate the presence of meningitis in the majority of cases with a white cell (polymorph) count < 100/mm^3. Confirmation can be obtained from CSF glucose (low: < 1.5 mmol/litre or a ratio of CSF to serum glucose of ≤ 0.4), CSF protein (high: > 0.4 g/litre) and Gram staining and culture of CSF, where possible.
- Blood culture if available.

Precaution: If there are signs of increased intracranial pressure, the potential value of the information from a lumbar puncture should be carefully weighed against the risk of the procedure. If in doubt, it might be better to start treatment for suspected meningitis and delay performing a lumbar puncture (see p. 346).

Treatment

Start treatment with antibiotics immediately before the results of laboratory CSF examination if meningitis is clinically suspected or the CSF is obviously cloudy. If the child has signs of meningitis and a lumbar puncture is not possible, treat immediately.

Antibiotic treatment

▶ Give antibiotic treatment as soon as possible. Choose one of the following regimens:

1. Ceftriaxone: 50 mg/kg per dose IM or IV every 12 h; or 100 mg/kg once daily for 7–10 days administered by deep IM injection or as a slow IV injection over 30–60 min.

or

2. Cefotaxime: 50 mg/kg per dose IM or IV every 6 h for 7–10 days.

or

3. When there is no known significant resistance to chloramphenicol and β-lactam antibiotics among bacteria that cause meningitis, follow national guidelines or choose either of the following two regimens:
   - Chloramphenicol: 25 mg/kg IM or IV every 6 h plus ampicillin: 50 mg/kg IM or IV every 6 h for 10 days

   or

   - Chloramphenicol: 25 mg/kg IM or IV every 6 h plus benzylpenicillin: 60 mg/kg (100 000 U/kg) every 6 h IM or IV for 10 days.

▶ Review therapy when CSF results are available.

If the diagnosis is confirmed, continue with parenteral antibiotics to complete treatment as above. Once the child has improved, continue with daily injections of third-generation cephalosporins to complete treatment, or, if on chloramphenicol, give orally, unless there is concern about oral absorption (e.g. in severely malnourished children or in those with diarrhoea), in which cases the full treatment should be given parenterally.

If there is a poor response to treatment:

– Consider the presence of common complications, such as subdural effusions (persistent fever plus focal neurological signs or reduced level of consciousness) or a cerebral abscess. If these are suspected, refer the child to a hospital with specialized facilities for further management (see a standard paediatrics textbook for details of treatment).
– Look for other sites of infection that may be the cause of fever, such as cellulitis at injection sites, arthritis or osteomyelitis.

Repeat the lumbar puncture after 3–5 days if fever is still present and the child's overall condition is not improving, and look for evidence of improvement (e.g. fall in leukocyte count and rise in glucose level).

Steroid treatment

Steroids offer some benefit in certain cases of bacterial meningitis (*H. influenza*, tuberculous and pneumococcal) by reducing the degree of inflammation and improving outcome. The recommended dexamethasone dose in bacterial meningitis is 0.15 mg/kg every 6 h for 2–4 days. Steroids should be given within 10–20 min before or during administration of antibiotics. There is insufficient evidence to recommend routine use of steroids in all children with bacterial meningitis in developing countries, except in tuberculous meningitis.

Do not use steroids in:

- newborns
- suspected cerebral malaria
- suspected viral encephalitis

Antimalarial treatment

In malarious areas, take a blood smear or do a rapid diagnostic test to check for malaria, as severe malaria should be considered a differential diagnosis or co-existing condition.

▶ Treat with an appropriate antimalarial drug if malaria is diagnosed. If for any reason a blood smear cannot be taken, treat presumptively for malaria.

6.3.2 Meningococcal epidemics

During a confirmed epidemic of meningococcal meningitis, lumbar punctures need not be performed for all children who have petaechial or purpuric signs, which are characteristic of meningococcal infection.

- For children aged 0–23 months, treatment should be adapted according to the patient's age, and an effort should be made to exclude any other cause of meningitis.

- For children aged ≥ 2–5 years, *Neisseria meningitidis* is the most likely pathogen and presumptive treatment is justified.

▶ Give ceftriaxone at 100 mg/kg/day IM or IV once daily for 5 days to children aged 2 months to 5 years or for at least 7 days to children aged 0–2 months.

or

▶ Give oily chloramphenicol (100 mg/kg IM as a single dose up to a maximum of 3 g). If no improvement after 24 h, give a second dose of 100 mg/kg, or change to ceftriaxone as above. The oily chloramphenicol suspension is thick and may be difficult to push through the needle. If this problem is encountered, the dose can be divided into two and an injection given into each buttock of the child.

6.3.3 Tuberculous meningitis

Tuberculous meningitis may have an acute or chronic presentation, with the duration of presenting symptoms varying from 1 day to 9 months. It may present with cranial nerve deficits, or it may have a more indolent course involving headache, meningismus and altered mental status. The initial symptoms are usually nonspecific, including headache, vomiting, photophobia and fever. Consult up-to-date international and national guidelines for further details if tuberculous meningitis is suspected. Consider tuberculous meningitis if any of the following is present:

- Fever has persisted for 14 days.
- Fever has persisted for > 7 days, and a family member has TB.
- A chest X-ray suggests TB.
- The patient is unconscious and remains so despite treatment for bacterial meningitis.
- The patient is known to have HIV infection or is exposed to HIV.
- The CSF has a moderately high white blood cell count (typically < 500 white cells per ml, mostly lymphocytes), elevated protein (0.8–4 g/l) and low glucose (< 1.5 mmol/litre), or this pattern persists despite adequate treatment for bacterial meningitis.

Occasionally, when the diagnosis is not clear, a trial of treatment for tuberculous meningitis is added to treatment for bacterial meningitis. Consult national TB programme guidelines.

Treatment: The optimal treatment regimen comprises:

▶ Four-drug regimen (HRZE) for 2 months, followed by a two-drug regimen (HR) for 10 months, the total duration of treatment being 12 months.

- Isoniazid (H): 10 mg/kg (range, 10–15 mg/kg); maximum dose, 300 mg/day
- Rifampicin (R): 15 mg/kg (range, 10–20 mg/kg); maximum dose, 600 mg/kg per day
- Pyrazinamide (Z): 35 mg/kg (range, 30–40 mg/kg)
- Ethambutol (E): 20 mg/kg (range, 15–25 mg/kg)

▶ Dexamethasone (0.6 mg/kg per day for 2–3 weeks, reducing the dose over a further 2–3 weeks) should be given in all cases of tuberculous meningitis.

▶ Children with proven or suspected tuberculous meningitis caused by MDR bacilli can be treated with a fluoroquinolone and other second-line drugs in the context of a well-functioning MDR TB control programme and within an appropriate MDR TB regimen. The decision to treat should be taken by a clinician experienced in managing paediatric TB.

Note: *Streptomycin is not advised for children as it may cause otoxicity and nephrotoxicity, and the injections are painful.*

6.3.4 Cryptococcal meningitis

Consider cryptococcal meningitis in older children known or suspected to be HIV-positive with immunosuppression. Children will present with meningitis with altered mental status.

- Perform a lumbar puncture. The opening pressure may be elevated, but CSF cell count, glucose and protein may be virtually normal.
- Analyse CSF with India ink preparation, or, if available, do a rapid CSF cryptococcal antigen latex agglutination test or lateral flow assay.

Treatment: A combination of amphotericin and fluconazole (see p. 246).

Supportive care

Examine all children with convulsions for hyperpyrexia and check blood glucose. Control fever if high (≥ 39 °C or ≥ 102.2 °F) with paracetamol, and treat hypoglycaemia.

▶ ***Convulsions:*** If convulsions occur, give anticonvulsant treatment with intravenous or rectal diazepam (see Chart 9, p. 15). Treat repeated convulsions with a preventive anticonvulsant, such as phenytoin or phenobarbitone.

▶ ***Hypoglycaemia:*** Monitor blood glucose regularly, especially in children who are convulsing or not feeding well.

- If hypoglycaemia is present, give 5 ml/kg of 10% glucose (dextrose)

solution IV or intraosseusly rapidly (see Chart 10, p. 16). Recheck the blood glucose after 30 min. If the level is low (< 2.5 mmol/litre or < 45 mg/dl), repeat the glucose (5 ml/kg). If blood glucose cannot be measured, treat all children who are fitting or have reduced consciousness for hypoglycaemia.

– Prevent further hypoglycaemia by oral feeding (see above). If the child is not feeding, prevent hypoglycaemia by adding 10 ml of 50% glucose to 90 ml of Ringer's lactate or normal saline infusion. Do not exceed maintenance fluid requirements for the child's weight (see section 10.2, p. 304). If the child develops signs of fluid overload, stop the infusion and feed by nasogastric tube.

▶ ***Unconscious child:*** In an unconscious child, ensure that the airway is open at all times and that the patient is breathing adequately.

- Maintain clear airway.
- Nurse the child in the recovery position to avoid aspiration of fluids.
- Turn the patient every 2 h.
- Do not allow the child to lie in a wet bed.
- Pay attention to pressure points.

▶ ***Oxygen treatment:*** Give oxygen if the child has convulsions or associated severe pneumonia with hypoxia (oxygen saturation ≤ 90% by pulse oximetry), or, if the child has cyanosis, severe lower chest wall indrawing, respiratory rate > 70/min. Aim to keep oxygen saturation > 90% (see section 10.7, p. 312).

▶ ***Fluid and nutritional management:*** Although children with bacterial meningitis are at risk for developing brain oedema due to a syndrome of inappropriate antidiuretic hormone secretion or fluid overload, under-hydration may also lead to cerebral hypoperfusion. Correct dehydration if present. Some children with meningitis require only 50–75% of their normal daily fluid requirement IV in the first 2 days to maintain normal fluid balance; more will cause oedema (see p. 304). Avoid fluid overload, ensure an accurate record of intake and output, and examine frequently for signs of fluid overload (eyelid oedema, enlarged liver, crackles at lung bases or fullness of neck veins).

Give due attention to acute nutritional support and rehabilitation (see p. 294). Feed the child as soon as it is safe. Breastfeed every 3 h, if possible, or give milk feeds of 15 ml/kg if the child can swallow. If there is a risk of aspiration, it is safer to continue with IV fluids; otherwise, feed by nasogastric tube (see Chart 10, p. 16). Continue to monitor blood glucose, and treat accordingly (as above) if < 2.5 mmol/litre or < 45 mg/dl.

Monitoring

A nurse should monitor the child's state of consciousness and vital signs (respiratory rate, heart rate and pupil size) every 3 h during the first 24 h (thereafter, every 6 h), and a doctor should monitor the child at least twice a day.

At the time of discharge, assess all children for neurological problems, especially hearing loss. Measure and record the head circumference of infants. If there is neurological damage, refer the child for physiotherapy, and give the mother suggestions for simple passive exercises.

Complications

Complications may occur during the acute phase of the disease or as long-term neurological sequelae:

- *Acute phase complications:* Convulsions are common, and focal convulsions are more likely to be associated with neurological sequelae. Other acute complications may include shock (see section 1.5.2, p. 21), hyponatraemia and subdural effusions, which may lead to persistent fever.
- *Long-term complications:* Some children have sensory hearing loss, motor or development problems and epilepsy.

Follow-up

Sensorineural deafness is common after meningitis. Arrange a hearing assessment for all children 1 month after discharge from hospital.

Public health measures

In meningococcal meningitis epidemics, advise families of the possibility of secondary cases in the household so that they report for treatment promptly. Chemoprophylaxis should be considered only for those in close contact with people with meningococcal infection.

6.4 Measles

Measles is a highly contagious viral disease with serious complications (such as blindness in children with pre-existing vitamin A deficiency) and high mortality. It is rare in infants < 3 months of age.

Diagnosis

Diagnose measles if the child has:

- fever (sometimes with a febrile convulsion) and
- a generalized maculopapular rash and

Corneal clouding: sign of xerophthalamia in vitamin A-deficient child (left side) in comparison with the normal eye (right side)

- one of the following: cough, runny nose or red eyes.

In children with HIV infection, some of these signs may not be present, and the diagnosis of measles may be difficult.

6.4.1 Severe complicated measles

Diagnosis

In a child with evidence of measles (as above), any one of the following symptoms and signs indicates the presence of severe complicated measles:

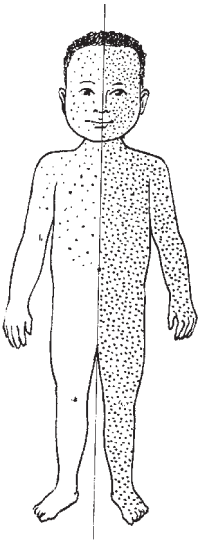
- inability to drink or breastfeed
- vomits everything
- convulsions

On examination, look for signs of complications, such as:

- lethargy or unconsciousness
- corneal clouding
- deep or extensive mouth ulcers
- pneumonia (see section 4.2, p. 80)
- dehydration from diarrhoea (see section 5.2, p. 127)
- stridor due to measles croup
- severe malnutrition

Treatment

Children with severe complicated measles require treatment in hospital.



Distribution of measles rash. The left side of the drawing shows the early rash covering the head and upper part of the trunk; the right side shows the later rash covering the whole body.

- *Vitamin A therapy.* Give oral vitamin A to all children with measles, unless the child has already had adequate vitamin A treatment for this illness as an outpatient. Give oral vitamin A at 50 000 IU (for a child aged < 6 months), 100 000 IU (6–11 months) or 200 000 IU (1–5 years). See details on p. 369. If the child shows any eye sign of vitamin A deficiency, give a third dose 2–4 weeks after the second dose on follow-up.

Supportive care

Fever

- If the child's temperature is ≥ 39 °C (≥ 102.2 °F) and is causing distress, give paracetamol.

Nutritional support

Assess the nutritional status by weighing the child and plotting the weight on a growth chart (rehydrate before weighing). Encourage continued breastfeeding. Encourage the child to take frequent small meals. Check for mouth ulcers and treat them, if present (see below). Follow the guidelines on nutritional management given in Chapter 10 (p. 294).

Complications

Follow the guidelines given in other sections of this manual for the management of the following complications:

- *Pneumonia:* Give antibiotics for pneumonia to all children with measles and signs of pneumonia, as over 50% of all cases of pneumonia in measles have secondary bacterial infection (section 4.2, p. 80).
- *Otitis media* (pp. 183–4).
- *Diarrhoea:* Treat dehydration, bloody diarrhoea or persistent diarrhoea (see Chapter 5, p. 125).
- *Measles croup* (see section 4.6.1, p. 102): Give supportive care. Do not give steroids.
- *Eye problems.* Conjunctivitis and corneal and retinal damage may occur due to infection, vitamin A deficiency or harmful local remedies. In addition to giving vitamin A (as above), treat any infection present. If there is a clear watery discharge, no treatment is needed. If there is pus discharge, clean the eyes with cotton-wool boiled in water or a clean cloth dipped in clean water. Apply tetracycline eye ointment three times a day for 7 days. Never use steroid ointment. Use a protective eye pad to prevent other infections. If there is no improvement, refer to an eye specialist.

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

Monitoring

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

Follow-up

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

Public health measures

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

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

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

6.4.2 Non-severe measles

Diagnosis

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

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

Treatment

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

Supportive care

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

Follow-up

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

6.5 Septicaemia

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

Diagnosis

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

On examination, look for:

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

Investigations

The investigations will depend on presentation but may include:

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

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

Treatment

Start the child immediately on antibiotics.

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

Supportive care

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

Monitoring

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

6.6 Typhoid fever

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

Diagnosis

On examination, the main diagnostic features of typhoid are:

- fever with no obvious focus of infection

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

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

Treatment

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

Supportive care

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

Monitoring

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

Complications

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

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

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

6.7 Ear infections

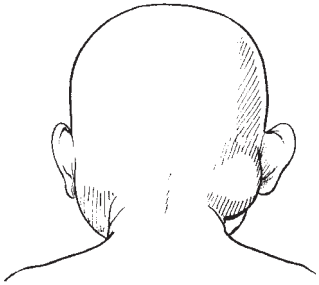
6.7.1 Mastoiditis

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

Diagnosis

Key diagnostic features are:

- high fever
- tender swelling behind the ear.



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

Treatment

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

Supportive care

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

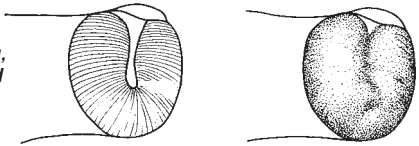
Monitoring

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

6.7.2 Acute otitis media

Diagnosis

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

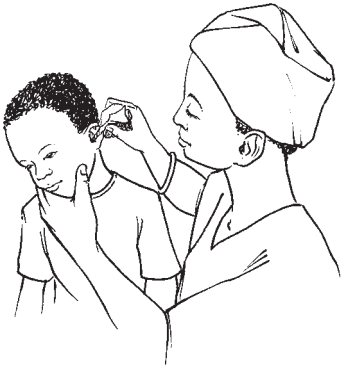


Acute otitis media: bulging, red ear-drum (on right) and normal ear-drum (on left)

Treatment

Treat the child as an outpatient.

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



Wicking the child's ear dry in otitis media

Follow-up

Ask the mother to return after 5 days.

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

6.7.3 Chronic otitis media

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

Diagnosis

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

Treatment

Treat the child as an outpatient.

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

Follow-up

Ask the mother to return after 5 days.

If the ear discharge persists:

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

6.8 Urinary tract infection

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

Diagnosis

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

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

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

Investigations

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

Treatment

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

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

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

Supportive care

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

Follow-up

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

6.9 Septic arthritis or osteomyelitis

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

Diagnosis

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

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

Laboratory investigations

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

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

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

Treatment

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

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

Supportive care

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

6.10 Dengue

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

Diagnosis

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

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

Treatment

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

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

6.10.1 Severe dengue

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

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

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

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

Diagnosis

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

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

Treatment

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

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

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

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

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

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

Treatment of haemorrhagic complications

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

Treatment of fluid overload

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

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

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

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

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

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

Supportive care

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

Monitoring

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

6.11 Rheumatic fever

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

Diagnosis

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

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

Investigations

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

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

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

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

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

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

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

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

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

Management

Admit to hospital

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

If heart failure is present:

▶ bed rest with restricted sodium diet

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

Follow-up care

All children will require antibiotic prophylaxis.

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

Notes

Notes

CHAPTER 7

Severe acute malnutrition

7.1	Severe acute malnutrition	198
7.2	Initial assessment	198
7.3	Organization of care	200
7.4	General management	200
	7.4.1 Hypoglycaemia	201
	7.4.2 Hypothermia	202
	7.4.3 Dehydration	203
	7.4.4 Electrolyte imbalance	206
	7.4.5 Infection	207
	7.4.6 Micronutrient deficiencies	208
	7.4.7 Initial re-feeding	209
	7.4.8 Catch-up growth feeding	210
	7.4.9 Sensory stimulation	215
	7.4.10 Severe acute malnutrition in infants aged < 6 months	216
7.5	Treatment of associated conditions	217
	7.5.1 Eye problems	217
	7.5.2 Severe anaemia	218
	7.5.3 Skin lesions in kwashiorkor	218
	7.5.4 Continuing diarrhoea	219
	7.5.5 Tuberculosis	219
7.6	Discharge and follow-up	219
	7.6.1 Discharge to outpatient care	219
	7.6.2 Discharge from nutritional treatment	220
	7.6.3 Follow-up	221
7.7	Monitoring the quality of care	221
	7.7.1 Mortality audit	221
	7.7.2 Weight gain during rehabilitation	222

7.1 Severe acute malnutrition

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

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

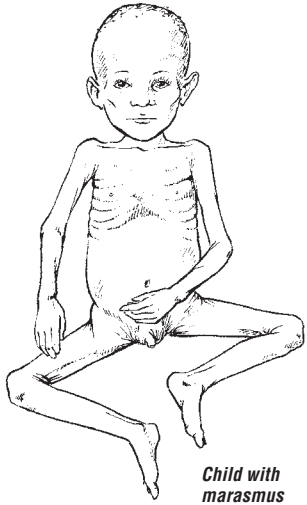
Diagnosis

The main diagnostic features are:

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

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

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



Child with marasmus

7.2 Initial assessment

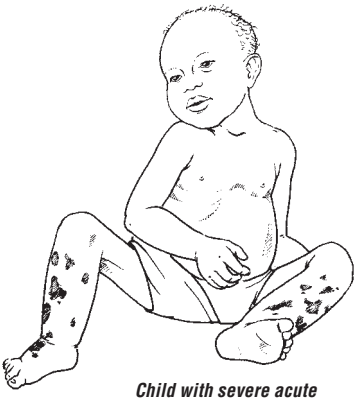
Assess for general danger signs or emergency signs and take a history concerning:

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

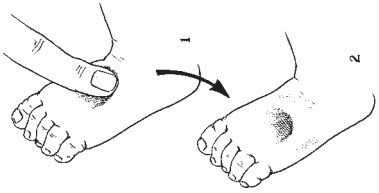
- breastfeeding
- duration and frequency of diarrhoea and vomiting
- type of diarrhoea (watery/bloody)
- loss of appetite
- family circumstances
- cough > 2 weeks
- contact with TB
- recent contact with measles
- known or suspected HIV infection/exposure.

On examination, look for:

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



Child with severe acute malnutrition oedema



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

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

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

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

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

7.3 Organization of care

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

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

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

7.4 General management

Plan for inpatient care

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

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

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

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

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

7.4.1 Hypoglycaemia

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

Diagnosis

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

Treatment

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

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

Monitoring

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

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

Prevention

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

7.4.2 Hypothermia

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

Diagnosis

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

Treatment

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

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

Monitoring

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

Prevention

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

7.4.3 Dehydration

Diagnosis

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

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

Treatment

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

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

Monitoring

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

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

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

Recipe for ReSoMal using standard WHO ORS

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

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

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

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

Formula for concentrated electrolyte/mineral solution

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

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

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

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

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

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

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

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

Prevention

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

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

7.4.4 Electrolyte imbalance

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

Treatment

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

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

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

7.4.5 Infection

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

Treatment

Give all severely malnourished children:

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

Choice of broad-spectrum antibiotics

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

  plus

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

These regimens should be adapted to local resistance patterns.

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

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

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

Treatment for parasitic worms

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

HIV infection

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

Monitoring

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

7.4.6 Micronutrient deficiencies

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

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

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

Treatment

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

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

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

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

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

▶ multivitamin syrup at 5 ml

▶ zinc at 2 mg/kg per day

▶ copper at 0.3 mg/kg per day

7.4.7 Initial re-feeding

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

Treatment

The essential features of initial feeding are:

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

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

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

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

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

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

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

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

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

Monitoring

Monitor and record:

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

7.4.8 Catch-up growth feeding

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

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

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

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

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

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

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

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

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

Alternative for F-75 if milk is unavailable

Use precooked corn–soya or wheat–soya blend

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

Alternative for F-100 if milk is unavailable

Use precooked corn-soya or wheat-soya blend

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

Treatment

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

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

  After a gradual transition, give:

  – frequent feeds, unlimited amounts
  – 150–220 kcal/kg per day
  – 4–6 g of protein/kg per day.
- If on ready-to-use therapeutic food:

  – Start with small but regular meals of RUTF and encourage the child to eat often (first 8 meals per day, and later 5–6 meals per day). If the child

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

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

– If still breastfeeding, offer breast milk first before every RUTF feed.

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

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

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

▶ Wash hands before giving feeds.

– Sit with the child on the lap and gently offer the feeds.

– Encourage the child to eat the RUTF without forced feeding.

– Offer plenty of clean water in a cup, when the child is eating RUTF.

Monitoring

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

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

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

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

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

Calculating weight gain

This example is for weight gain over 3 days.

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

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

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

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

If the weight gain is:

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

7.4.9 Sensory stimulation

Provide:

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

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

7.4.10 Severe acute malnutrition in infants aged < 6 months

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

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

Treatment

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

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

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

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

Discharge

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

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

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

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

7.5 Treatment of associated conditions

7.5.1 Eye problems

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

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

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

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

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

▶ Cover with saline-soaked eye pads.

▶ Bandage the eye(s).

7.5.2 Severe anaemia

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

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

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

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

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

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

Monitoring

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

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

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

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

7.5.3 Skin lesions in kwashiorkor

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

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

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

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

7.5.4 Continuing diarrhoea

Treatment

Giardiasis

Where possible, examine the stools by microscopy.

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

Lactose intolerance

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

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

Osmotic diarrhoea

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

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

7.5.5 Tuberculosis

If TB is strongly suspected:

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

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

7.6 Discharge and follow-up

7.6.1 Transfer to outpatient care

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

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

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

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

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

The mother or carer should:

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

7.6.2 Discharge from nutritional treatment

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

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

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

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

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

7.6.3 Follow-up

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

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

7.7 Monitoring the quality of care

7.7.1 Mortality audit

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

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

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

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

7.7.2 Weight gain during rehabilitation

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

Weight gain is defined as:

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

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

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

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

Inadequate feeding

Check:

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

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

Untreated infection

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

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

Consider treatment in the absence of a confirmatory diagnosis.

HIV/AIDS

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

For other HIV-related conditions, see Chapter 8.

Psychological problems

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

Notes

Notes

CHAPTER 8

Children with HIV/AIDS

8.1 Sick child with suspected or confirmed HIV infection 226
8.1.1 Clinical diagnosis 226
8.1.2 HIV counselling 228
8.1.3 Testing and diagnosis of HIV infection 229
8.1.4 Clinical staging 230
8.2 Antiretroviral therapy 232
8.2.1 Antiretroviral drugs 233
8.2.2 When to start antiretroviral therapy 235
8.2.3 Side-effects and monitoring 235
8.2.4 When to change treatment 238
8.3 Supportive care for HIV-positive children 240
8.3.1 Vaccination 240
8.3.2 Co-trimoxazole prophylaxis 241
8.3.3 Nutrition 243
8.4 Management of HIV-related conditions 243
8.4.1 Tuberculosis 243
8.4.2 *Pneumocystis jiroveci* pneumonia 244
8.4.3 Lymphoid interstitial pneumonitis 245
8.4.4 Fungal infections 246
8.4.5 Kaposi sarcoma 246
8.5 Prevention of mother-to-child HIV transmission, and infant feeding 247
8.5.1 Prevention of mother-to-child HIV transmission 247
8.5.2 Infant feeding in the context of HIV infection 248
8.6 Follow-up 249
8.6.1 Discharge from hospital 249
8.6.2 Referral 249
8.6.3 Clinical follow-up 250
8.7 Palliative and end-of-life care 250
8.7.1 Pain control 250
8.7.2 Management of anorexia, nausea and vomiting 252
8.7.3 Prevention and treatment of pressure sores 252
8.7.4 Care of the mouth 252
8.7.5 Airway management 252
8.7.6 Psychosocial support 253

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

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

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

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

8.1 Sick child with suspected or confirmed HIV infection

8.1.1 Clinical diagnosis

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

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

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

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

Signs that may indicate possible HIV infection

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

Signs or conditions specific to HIV-infected children

Strongly suspect HIV infection if the following are present:

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

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

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

8.1.2 HIV counselling

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

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

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

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

Indications for HIV counselling and testing

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

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

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

8.1.3 Testing and diagnosis of HIV infection

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

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

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

HIV serological antibody test (ELISA or rapid tests)

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

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

Virological tests

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

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

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

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

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

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

Diagnosing HIV infection in breastfeeding infants

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

8.1.4 Clinical staging

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

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

Table 23. WHO paediatric clinical staging system for HIV infection

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

STAGE 1
- Asymptomatic
- Persistent generalized lymphadenopathy

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

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

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

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

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

8.2 Antiretroviral therapy

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

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

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

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

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

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

8.2.1 Antiretroviral drugs

Antiretroviral drugs fall into three main classes:

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

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

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

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

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

Calculation of drug dosages

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

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

Formulations

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

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

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

Table 25. First-line treatment regimens for children

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

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

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

8.2.2 When to start antiretroviral therapy

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

Infants and children < 60 months

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

Children ≥ 60 months

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

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

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

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

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

8.2.3 Side-effects and monitoring

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

Table 26. Common side-effects of antiretroviral drugs

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

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

Immune reconstitution inflammatory syndrome

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

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

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

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

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

▶ Give specific treatment for the opportunistic infection

▶ Start on anti-inflammatory therapy.

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

Monitoring

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

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

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

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

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

Long-term follow-up

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

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

Monitoring response at each visit:

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

8.2.4 When to change treatment

When to substitute

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

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

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

When to switch

ART failure may be due to:

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

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

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

Treatment failure is identified from:

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

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

Second-line treatment regimens

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

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

Table 27. Recommended second-line treatment regimens for children

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

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

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

8.3 Supportive care for HIV-positive children

8.3.1 Vaccination

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

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

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

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

8.3.2 Co-trimoxazole prophylaxis

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

Who should receive co-trimoxazole?

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

How long co-trimoxazole should be given?

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

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

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

- Children with a history of PCP: Continue indefinitely.

Under what circumstances should co-trimoxazole be discontinued?

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

What doses of co-trimoxazole should be used?

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

What follow-up is required?

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

8.3.3 Nutrition

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

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

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

8.4 Management of HIV-related conditions

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

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

8.4.1 Tuberculosis

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

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

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

Isoniazid preventive therapy

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

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

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

8.4.2 *Pneumocystis jiroveci* pneumonia

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

Diagnosis

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

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

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

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

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

Treatment

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

8.4.3 Lymphoid interstitial pneumonitis

Diagnosis

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

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

Treatment

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

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

8.4.4 Fungal infections

Oral and oesophageal candidiasis

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

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

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

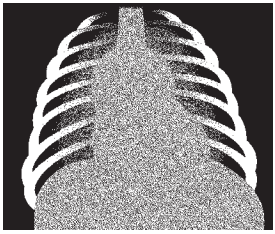
Cryptococcal meningitis

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

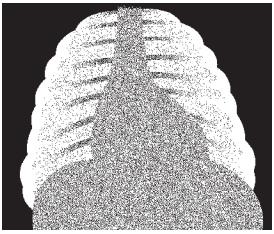
- Treat with amphotericin at 0.5–1.5 mg/kg per day for 14 days, then with fluconazole 6–12 mg/kg (maximum 800 mg) for 8 weeks.
- Start fluconazole 6 mg/kg daily (maximum 200 mg) prophylaxis after treatment.

8.4.5 Kaposi sarcoma

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



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



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

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

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

8.5.1 Prevention of mother-to-child HIV transmission

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

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

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

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

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

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

Option B+ is now preferred.

8.5.2 Infant feeding in the context of HIV infection

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

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

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

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

Infant feeding advice

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

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

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

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

8.6 Follow-up

8.6.1 Discharge from hospital

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

8.6.2 Referral

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

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

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

8.6.3 Clinical follow-up

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

- clinical condition
- growth
- nutritional intake
- vaccination status

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

8.7 Palliative and end-of-life care

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

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

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

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

8.7.1 Pain control

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

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

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

Use the following drugs for effective pain control:

Mild pain: such as headaches

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

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

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

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

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

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

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

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

8.7.2 Management of anorexia, nausea and vomiting

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

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

8.7.3 Prevention and treatment of pressure sores

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

8.7.4 Care of the mouth

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

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

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

8.7.5 Airway management

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

8.7.6 Psychosocial support

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

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

Notes

Notes

CHAPTER 9

Common surgical problems

9.1	Care before, during and after surgery	256
	9.1.1 Preoperative care	256
	9.1.2 Intraoperative care	258
	9.1.3 Postoperative care	260
9.2	Congenital anomalies	264
	9.2.1 Cleft lip and palate	264
	9.2.2 Bowel obstruction	265
	9.2.3 Abdominal wall defects	266
	9.2.4 Myelomeningocoele	267
	9.2.5 Congenital dislocation of the hip	267
	9.2.6 Talipes equinovarus (club foot)	268
9.3	Injuries	269
	9.3.1 Burns	269
	9.3.2 Head injuries	272
	9.3.3 Chest injuries	273
	9.3.4 Abdominal injuries	275
	9.3.5 Fractures	275
	9.3.6 Principles of wound care	279
9.4	Abdominal problems	281
	9.4.1 Abdominal pain	281
	9.4.2 Appendicitis	282
	9.4.3 Bowel obstruction after the neonatal period	283
	9.4.4 Intussusception	284
	9.4.5 Umbilical hernia	285
	9.4.6 Inguinal hernia	285
	9.4.7 Incarcerated hernia	286
	9.4.8 Testicular torsion	286
	9.4.9 Rectal prolapse	287
9.5	Infections requiring surgery	287
	9.5.1 Abscess	287
	9.5.2 Osteomyelitis	288
	9.5.3 Septic arthritis	289
	9.5.4 Pyomyositis	291

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

9.1 Care before, during and after surgery

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

9.1.1 Preoperative care

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

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

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

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

9.1.2 Intraoperative care

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

Anaesthesia

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

- Make the procedure as painless as possible.

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

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

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

▶ For major procedures, give general anaesthesia.

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

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

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

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

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

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

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

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

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

Special considerations

Airway

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

Table 28. Endotracheal tube size, by age

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

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

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

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

Hypothermia

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

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

Hypoglycaemia

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

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

Blood loss

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

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

Table 29. Blood volume of children by age

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

9.1.3 Postoperative care

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

Immediately after surgery

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

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

Table 30. Normal pulse rate and blood pressure in children

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

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

Fluid management

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

Monitor fluid status closely.

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

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

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

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

Pain control

Have a plan for postoperative pain management.

- Mild pain
- ▶ Give paracetamol (10–15 mg/kg every 4–6 h) by mouth or rectally. Oral paracetamol can be given several hours before the operation or rectally at the completion of surgery.
- Severe pain
- ▶ Give IV narcotic analgesics (IM injections are painful)
  - Morphine sulfate, 0.05–0.1 mg/kg IV every 2–4 h

Nutrition

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

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

Prevention of complications

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

Common postoperative problems

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

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

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

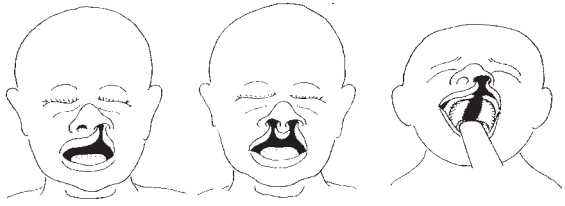
– If the infection is deep, involves muscles and is causing necrosis (necrotizing fasciitis), give antibiotics until necrotic tissue has been removed and the patient is fever-free for 48 h.
– Give ampicillin (25–50 mg/kg IM or IV four times a day) plus gentamicin (7.5 mg/kg IM or IV once a day) and metronidazole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

9.2 Congenital anomalies

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

9.2.1 Cleft lip and palate

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



Unilateral *Bilateral* *With cleft palate*

Cleft lip and palate

Treatment

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

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

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

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

9.2.2 Bowel obstruction

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

Diagnosis

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

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

Treatment

- Prompt resuscitation and **urgent review** by a surgeon experienced in paediatric surgery
- Give nothing orally. Pass a nasogastric tube if there is vomiting or abdominal distension.

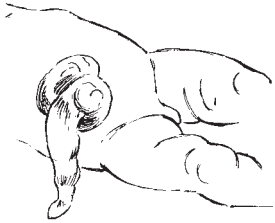
- Intravenous fluid: use half-strength Darrow's solution or normal saline plus 5% glucose (dextrose):
  - Correct shock, if present, with 20 ml/kg bolus of normal saline or Ringer's lactate as a rapid IV bolus.
  - If there is no shock but dehydration, give 10–20 ml/kg half-strength Darrow's solution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

9.2.3 Abdominal wall defects

The abdominal wall does not fully develop and remains open.

Diagnosis

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



Newborn with an omphalocoele

Treatment

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

Urgent review by a surgeon experienced in paediatric surgery.

9.2.4 Myelomeningocoele

Diagnosis

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

Treatment

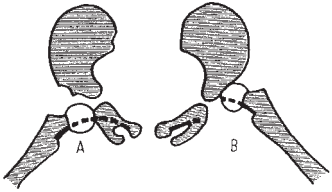
- Apply a sterile dressing.
- If ruptured, give benzylpenicillin (100–150 mg/kg daily in two divided doses) or ampicillin (25–50 mg/kg IM or IV four times a day) plus gentamicin (7.5 mg/kg once a day) for 5 days.

Review by a surgeon experienced in paediatric surgery.

9.2.5 Congenital dislocation of the hip

Diagnosis

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



Radiological diagnosis of congenital dislocation of the hip

Treatment

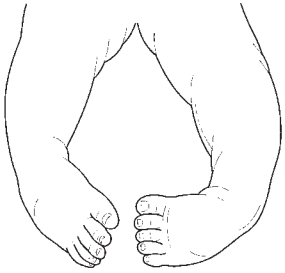
- In milder cases, keep the hip in flexion and abduction through double nappies or an abduction brace in an abducted position for 2–3 months. The traditional way in many cultures of carrying the child on the back with the hip flexed and abducted will serve the same purpose.
- In more severe cases, keep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

9.2.6 Talipes equinovarus (club foot)

Diagnosis

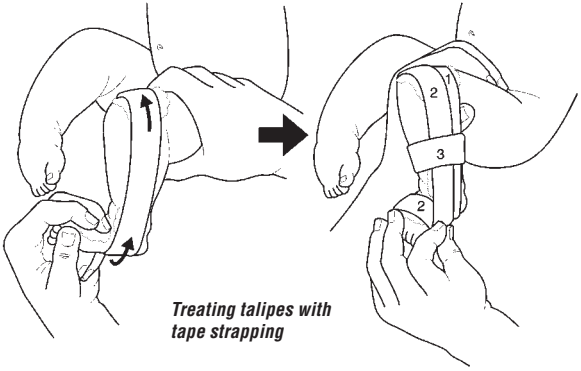
- The foot cannot be placed in the normal position.
- The commonest form includes three deformities: plantar flexion of the foot, inversion (inturning of the heel) and inturning of the forefoot.

Treatment



Talipes

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



Treating talipes with tape strapping

9.3 Injuries

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

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

9.3.1 Burns

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

Assessment

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

How deep is the burn?

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

How much of the body is burnt?

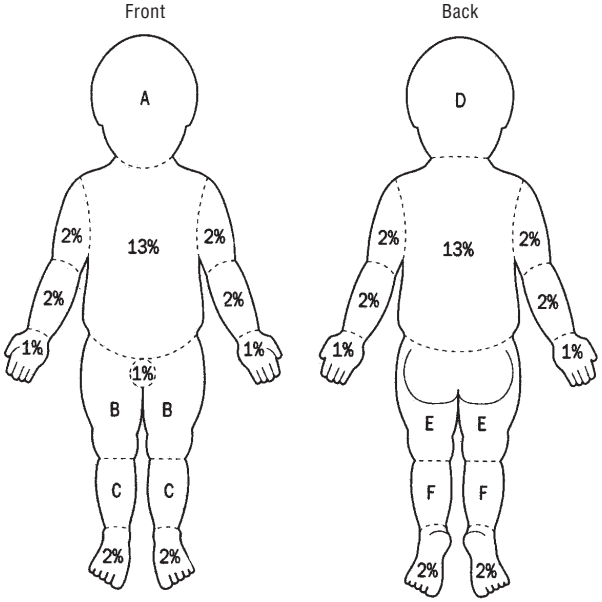
- Use a body surface area chart below according to age.
- Alternatively, use the child's palm to estimate the burnt area. A child's palm represents approximately 1% of the total body surface area.

Treatment

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

Chart for estimating the percentage of body surface burnt

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



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

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

▶ Fluid resuscitation is required for burns covering > 10% total body surface. Use Ringer's lactate or normal saline with 5% glucose; for maintenance, use Ringer's lactate with 5% glucose or half-normal saline with 5% glucose.

- First 24 h: Calculate fluid requirements by adding maintenance fluid requirements (p. 304) to the additional emergency fluid requirements (volume equal to 4 ml/kg for every 1% of surface burnt).

▶ Administer half of total fluid in first 8 h, and remaining fluid in next 16 h.

Example: 20 kg child with a 25% burn:

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

= 1440 ml + 2000 ml

= 3440 ml (1720 ml over first 8 h)

- Second 24 h: give half to three quarters of fluid required during the first day.
- Monitor the child closely while giving emergency fluids (pulse, respiratory rate, blood pressure and urine output), taking care to avoid circulatory fluid overload.
- Blood may be given to correct anaemia or for deep burns to replace blood loss.

▶ In all cases, administer tetanus prophylaxis.

▶ Prevent infection:

- If skin is intact, clean with antiseptic solution, gently, without breaking the skin.
- If skin is not intact, carefully debride the burn. Except for very small burns, debride all bullae, and excise adherent necrotic (dead) tissue during the first few days.
- Give topical antibiotics or antiseptics (the options depend on resources; they include: silver nitrate, silver sulfadiazine, gentian violet, betadine and even mashed papaya). Clean and dress the wound daily.
- Small burns and those in areas that are difficult to cover can be managed by leaving them open to the air and keeping them clean and dry.

▶ Treat secondary infection if present.

- If there is evidence of local infection (pus, foul odour or presence of cellulitis), treat with amoxicillin (15 mg/kg orally three times a day) plus

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

▶ Pain control

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

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

▶ Check tetanus vaccination status.

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

▶ Nutrition

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

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

9.3.2 Head injuries

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

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

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

Diagnosis

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

Treatment

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

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

Urgent review by a surgeon experienced in paediatric surgery.

9.3.3 Chest injuries

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

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

Pneumothorax

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

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

Haemothorax

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

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

Pulmonary contusion

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

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

Rib fractures

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

9.3.4 Abdominal injuries

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

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

9.3.5 Fractures

Children heal fractures well if the bones are aligned properly.

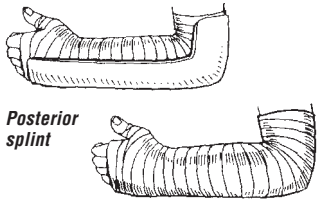
Diagnosis

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

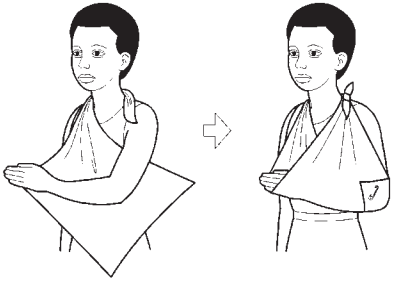
Treatment

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

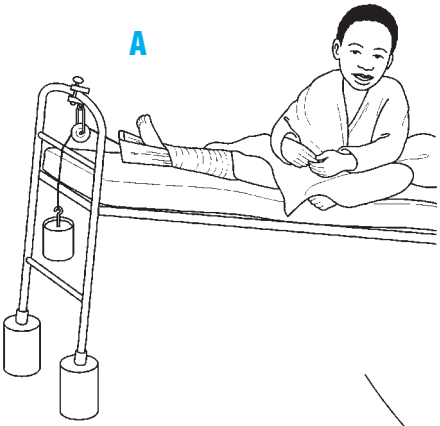
A posterior splint can be used for upper and lower extremity injuries. The extremity is first wrapped with soft padding (e.g. cotton), then a plaster of Paris splint is placed to maintain the extremity in a neutral position. The posterior splint is held in place with an elastic bandage. Monitor capillary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



Posterior splint

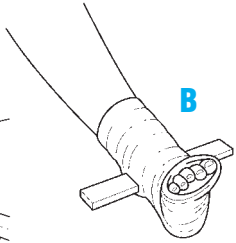


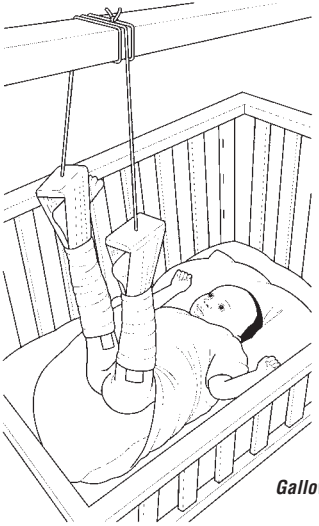
Sling to support an injured arm



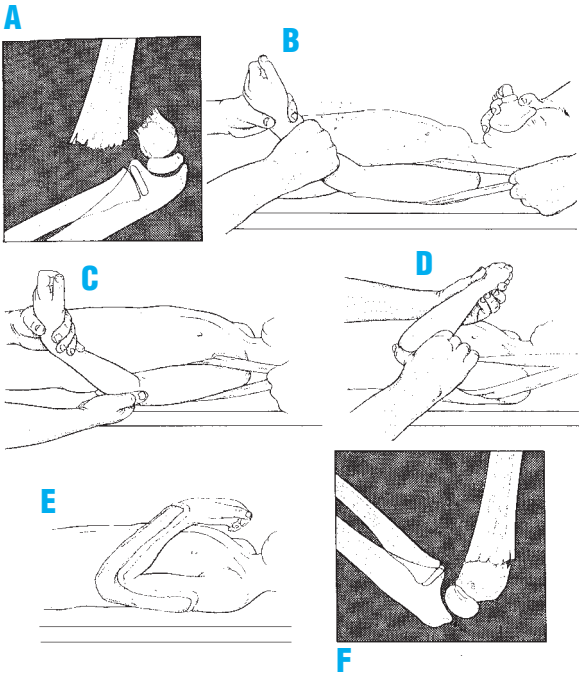
A: Lower extremity skin traction

B: Prevention of rotational deformity can be achieved by adding a piece of wood to a foot plaster.





Gallows traction



Treatment of a supracondylar fracture

A. X-ray of displaced supracondylar fracture
B. Pull as shown to reduce the fracture displacement.
C. Carefully bend the elbow, maintaining traction.
D. Hold the elbow flexed, and keep the fracture in position as shown.
E. Apply a back slab.
F. Check the position of the fracture on an X-ray.

Treatment of a supra-condylar fracture is shown on the previous page. An important complication of this fracture is constriction of the artery at the elbow, where it can become entrapped. Assess the blood flow to the hand. If the artery is obstructed, the hand will be cool, capillary refill will be slow and the radial pulse will be absent. If the artery is obstructed, reduction must be done urgently.

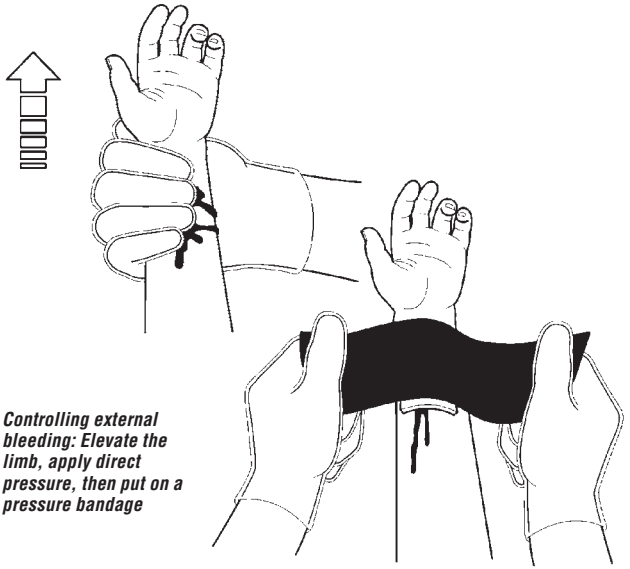
A mid-shaft femoral fracture in a child < 3 years of age is treated with a gallows splint (see figure on p. 277). Every few hours, the attendant should check that the circulation of the feet is good and the toes are warm.

Treatment of a mid-shaft femoral fracture in an older child is skin traction (see figure A on p. 277). This is a simple, effective method for treating femur fractures in children aged 3–15 years. If the child can raise his or her leg off the bed, the fracture has united and the child is ready for ambulation on crutches (usually after about 3 weeks).

9.3.6 Principles of wound care

Wounds are common surgical problems in children. The goal of caring for any wound is to stop bleeding, prevent infection, assess damage to underlying structures and promote healing. More detailed surgical guidance is given in the WHO manual *Surgical care in the district hospital*.

- Stop bleeding
  - Direct pressure will control any bleeding (see figure on p. 280).
  - Bleeding from extremities can be controlled for periods of not more than 10 min with a sphygmomanometer cuff inflated above the arterial pressure.
  - Prolonged use (> 10 min) of tourniquets can damage the extremity. Never use a tourniquet in a child with sickle-cell anaemia.
- Prevent infection
  - Cleaning the wound is the most important way of preventing wound infection. Most wounds are contaminated when first seen. They may contain blood clots, dirt, dead or dying tissue and perhaps foreign bodies.
  - Clean the skin around the wound thoroughly with soap and water or antiseptic. Pour water and antiseptic into the wound.
  - After giving a local anaesthetic such as lidocaine (≤ 3 mg/kg) or 0.25% bupivacaine (≤ 1 ml/kg) by infiltration around the wound, search carefully for foreign bodies, and excise any dead tissue. Determine what damage may have been done. Major wounds require a general anaesthetic.



Controlling external bleeding: Elevate the limb, apply direct pressure, then put on a pressure bandage

- Antibiotics are usually not necessary when wounds are carefully cleaned; however, some wounds should be treated with antibiotics:
  - wounds older than 12 h (likely to be already infected)
  - wounds penetrating deep into tissue (e.g. a dirty stick, knife wound or animal bite)

▶ Tetanus prophylaxis

- If the child is not vaccinated, give anti-tetanus serum, if available, and start a course of tetanus toxoid vaccine.
- If the child has had active immunization, give a booster if vaccination status is not current.

▶ Wound closure

- If the wound is < 1 day old and has been cleaned satisfactorily, it can be closed ('primary closure').

- The wound should not be closed if it is > 24 h old, it contained a lot of dirt and foreign material or it was caused by an animal bite.
- Wounds not treated with primary closure should be packed lightly with damp sterile gauze. If the wound is clean 48 h later, it can be closed (delayed primary closure).
- If the wound is infected, pack it lightly and let it heal on its own.

▶ Wound infections
- Clinical signs: pain, swelling, redness, warmth and pus drainage
- Treatment:
  - Open the wound if pus is suspected.
  - Clean the wound with disinfectant.
  - Pack the wound lightly with damp sterile gauze. Change the dressing every day and more frequently if needed.
  - Give antibiotics until surrounding cellulitis has resolved (usually 5 days).

▶ Give cloxacillin (25–50 mg/kg orally four times a day) for most wounds to treat possible *S. aureus* infection.

▶ Give ampicillin (25–50 mg/kg orally four times a day), gentamicin (7.5 mg/kg IM or IV once a day) plus metronidazole (7.5 mg/kg three times a day) if bowel flora are suspected.

9.4 Abdominal problems

9.4.1 Abdominal pain

Not all abdominal pain is caused by gastrointestinal infections. Abdominal pain lasting > 4 h should be regarded as a potential abdominal emergency.

Assessment

■ Ask three questions:
- Are there associated symptoms? The presence of nausea, vomiting, diarrhoea, constipation, fever, cough, headache, sore throat or dysuria (pain on passing urine) helps determine the severity of the problem and can narrow the diagnosis.
- Where does it hurt? Ask the child to point to where it hurts most. This can also narrow the diagnosis. Periumbilical pain is nonspecific.
- Does the child have peritonitis? This is a critical question, as most causes of peritonitis in children require surgery.

- Signs of peritonitis include tenderness during palpation, pain in the abdomen, especially on movement, and involuntary guarding (spasm of the abdominal musculature on palpation). A rigid abdomen that does not move with respiration is another sign of peritonitis. Absent bowel sounds through a stethoscope on the abdomen is a strong indicator.

Treatment

- Give the child nothing orally.
- If the child is vomiting or has abdominal distension, place a nasogastric tube.
- Give IV fluids. Correct shock, if present, with 20 ml/kg normal saline or Hartmann's solution as a rapid IV bolus (see Chart 7, p. 13). If shock persists, repeat the IV bolus of 20 ml/kg, but watch carefully for circulatory fluid overload. If there is no shock but the child is dehydrated, give 10–20 ml/kg half-strength Darrow solution or normal saline plus 5% glucose over 20 min, and give 150% maintenance fluid requirements (see p. 304).
- Give analgesics if the pain is severe (This will not mask a serious intra-abdominal problem and may facilitate examination).
- Repeat the examinations if the diagnosis is in question.
- Give antibiotics if there are signs of peritonitis. To deal with enteric flora (Gram-negative rods, enterococci and anaerobes), give ampicillin (25–50 mg/kg IM or IV four times a day), gentamicin (7.5 mg/kg IM or IV once a day) and metronidazole (10 mg/kg three times a day).

Urgent review by a surgeon experienced in paediatric surgery is required.

9.4.2 Appendicitis

Appendicitis is due to obstruction of the lumen of the appendix. Faecoliths, lymphoid hyperplasia and gastrointestinal parasites can cause obstruction. If appendicitis is not recognized, the appendix ruptures, leading to peritonitis and abscess formation.

Diagnosis

This is very difficult, especially in young children.

- fever, anorexia, vomiting (variable)
- may begin as periumbilical pain, but the most important clinical finding is persistent pain and tenderness in the right lower quadrant.
- may be confused with urinary tract infections, kidney stones, ovarian problems, mesenteric adenitis, ileitis

A raised white blood cell count can be helpful. Ultrasound examination by a skilled observer can be very helpful.

Treatment

- Give the child nothing orally.
- Give IV fluids.
  - Correct shock, if present, with 20 ml/kg normal saline or Hartmann's solution as a rapid IV bolus (see p. 13). If shock persists, repeat the IV bolus of 20 ml/kg, but watch carefully for circulatory fluid overload. If the child is not in shock but is dehydrated, give 10–20 ml/kg half-strength Darrow solution or normal saline plus 5% glucose over 20 min.
- Give antibiotics once the diagnosis is established: ampicillin (25–50 mg/kg IM or IV four times a day), gentamicin (7.5 mg/kg IM or IV once a day) and metronidazole (10 mg/kg three times a day).
- **Urgent review** by a surgeon experienced in paediatric surgery is required. Appendectomy should be done as soon as possible to prevent perforation, peritonitis and abscess formation. It is better to operate and be wrong about the diagnosis than to delay and have peritonitis occur.

9.4.3 Bowel obstruction after the neonatal period

Bowel obstruction may be due to incarcerated hernias, adhesions (scarring from previous surgery), *Ascaris* infection or intussusception (see section 9.4.4).

Diagnosis

- Clinical presentation is determined by the level of obstruction. Proximal obstruction presents with vomiting with minimal distension. Distal obstruction presents with distension, with vomiting occurring later.
- Typically, there is cramping abdominal pain, distension and no flatus.
- Sometimes, peristalsis waves can be seen through the abdominal wall.
- Abdominal X-rays show distended loops of bowel with air fluid levels.

Treatment

- Give the child nothing orally.
- Give fluid resuscitation. Most children presenting with bowel obstruction have been vomiting and are dehydrated.
- Correct shock, if present, with 20 ml/kg normal saline or Hartmann's solution as a rapid IV bolus (see p. 13). If shock persists, repeat the IV bolus of

20 ml/kg, but watch carefully for circulatory fluid overload. If the child is not in shock but is dehydrated, give 10–20 ml/kg half-strength Darrow solution or normal saline plus 5% glucose over 20 min.

- Pass a nasogastric tube to relieve nausea and vomiting and prevent bowel perforation by keeping the bowel decompressed.
- **Urgent review** by a surgeon experienced in paediatric surgery is required.

9.4.4 Intussusception

Intussusception is a form of bowel obstruction in which one segment of the intestine telescopes into the next. It occurs most commonly at the ileal–caecal junction.

Diagnosis

- Usually occurs in children < 2 years of age, but can occur in older children.
- Clinical presentation:
  - Early: colicky abdominal pain with vomiting. The child cries with pain, doubles over, and pulls the legs up.
  - Late: pallor, abdominal distension, tenderness, bloody diarrhoea ('red currant jelly stool') and dehydration.
- Palpable abdominal mass (begins in right lower quadrant and may extend along line of colon).

Treatment

- Arrange **urgent review** by a surgeon experienced in paediatric surgery. Proceed to an operation if air or a barium enema is unable to reduce the intussusception. If the bowel is ischaemic or dead, bowel resection will be required.

Transfer the patient if there is no one with experience in reducing an intussusception with an air or barium enema, or X-ray facilities are not available.

To reduce an intussusception, an unlubricated 35-ml Foley catheter is passed into the rectum; the bag is inflated, and the buttocks strapped together. A warm solution of barium in normal saline is allowed to flow under gravity from a height of 1 m, and its entrance into the colon is observed on an abdominal X-ray. The diagnosis is confirmed when the barium outlines a concave 'meniscus'. The pressure of the column of barium slowly reduces the intussusception; the reduction is complete only when several loops of small bowel are seen to fill with barium.

- Pass a nasogastric tube.
- Give fluid resuscitation. Correct shock, if present, with 20 ml/kg normal saline or Hartmann's solution as a rapid IV bolus (see p. 13). If shock persists, repeat the IV bolus of 20 ml/kg, but watch carefully for circulatory fluid overload. If the child is not in shock but is dehydrated, give 10–20 ml/kg half-strength Darrow's solution or normal saline plus 5% glucose over 20 min.
- Give antibiotics if there are signs of infection (fever, peritonitis). Give ampicillin (25–50 mg/kg IM or IV four times a day), gentamicin (7.5 mg/kg IM or IV once a day) and metronidazole (10 mg/kg three times a day). The duration of post-operative antibiotics depends on the severity of disease: in an uncomplicated intussusception reduced with an air enema, give for 24–48 h postoperatively; in a child with a perforated bowel with resection, continue antibiotics for 7–14 days, depending on response.

9.4.5 Umbilical hernia

Diagnosis

- Soft reducible swelling at umbilicus

Treatment

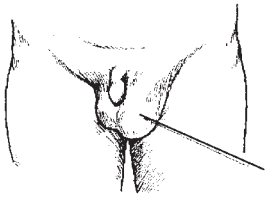
Most close spontaneously.

- Repair if not closed by the age of 6 years, or if there is a history of the hernia being difficult to reduce.

9.4.6 Inguinal hernia

Diagnosis

- Intermittent reducible swelling in the groin observed when the child is crying or straining.
- Occurs where the spermatic cord exits the abdomen (inguinal canal).
- Distinguish from a hydrocoele (fluid that collects around a testicle due to a patent processus vaginalis). Hydrocoeles transilluminate and usually do not extend up into the inguinal canal.
- Occurs rarely in girls



Swelling when the child coughs

Treatment

- Uncomplicated inguinal hernia: elective surgical repair to prevent incarceration
- Hydrocoele: repair if not resolved by the age of 1 year. Unrepaired hydrocoeles can become inguinal hernias.

9.4.7 Incarcerated hernia

These occur when the bowel or other intra-abdominal structure (e.g. omentum) is trapped in the hernia.

Diagnosis

- Non-reducible tender swelling at the site of an inguinal or very rarely an umbilical hernia
- There may be signs of intestinal obstruction (vomiting and abdominal distension) if the bowel is trapped in the hernia.

Treatment

- **Urgent review** by a surgeon experienced in paediatric surgery is required.
- Attempt to reduce the hernia by steady constant pressure, provided that there are no signs of strangulation or perforation. If the hernia does not reduce easily, an operation will be required.
- Give the child nothing orally.
- Give IV fluids.
- Pass a nasogastric tube if there is vomiting or abdominal distension.
- Give antibiotics if compromised bowel is suspected: give ampicillin (25–50 mg/kg IM or IV four times a day), gentamicin (7.5 mg/kg IM or IV once a day) plus metronidazole (10 mg/kg three times a day).

9.4.8 Testicular torsion

Torsion of a testis produces an acute swelling in one side of the scrotum. There is severe pain, and the testis is extremely tender to the touch.

If the testis is to be preserved, urgent surgical treatment is needed (if done within 6 h, 90% will be successful).

Differential diagnoses include an incarcerated hernia (which extends up into the inguinal canal and its upper limit cannot be felt) and epididymo-orchitis (which is rare in young children).

9.4.9 Rectal prolapse

Rectal prolapse is caused by straining during a bowel motion and is associated with chronic diarrhoea and poor nutrition. Causative factors include gastrointestinal parasites (such as *Trichuris*) and cystic fibrosis.

Diagnosis

- The prolapse occurs on defaecation. Initially, the prolapsed section reduces spontaneously, but later it may require manual reduction.
- May be complicated by bleeding or even strangulation, with gangrene

Treatment

- If the prolapsed rectum is not dead (it is pink or red and bleeds), reduce with gentle constant pressure.
- Apply firm strapping across the buttocks to maintain the reduction.
- Correct the underlying cause of diarrhoea and malnutrition.
- Treat for a helminth infection (such as mebendazole at 100 mg orally twice a day for 3 days or 500 mg once only).
- **Review** by a surgeon experienced in paediatric surgery is required. Recurrent prolapse may require a Thiersch stitch.

9.5 Infections requiring surgery

9.5.1 Abscess

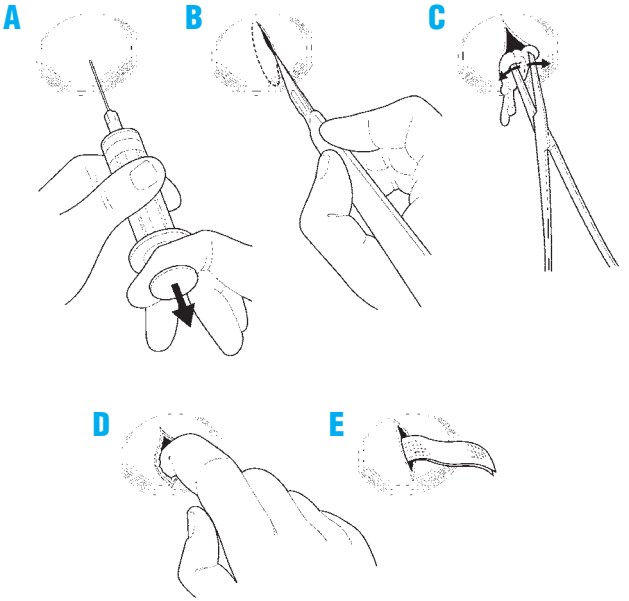
Infection can cause a collection of pus in almost any area of the body.

Diagnosis

- Fever, swelling, tenderness and a fluctuant mass.
- Determine the cause of the abscess (e.g. injection, foreign body or underlying bone infection). Injection abscesses usually develop 2–3 weeks after an injection.

Treatment

- Incision and drainage (see figure on p. 288).
- Incision and drainage of large abscesses may require general anaesthesia.
- Antibiotics: cloxacillin (25–50 mg/kg four times a day) for 5 days or until surrounding cellulitis resolves. If bowel flora are suspected (e.g. perirectal



Incision and drainage of an abscess. *A: Aspirating to identify site of pus (send to the laboratory, if available, and always do microscopy and culture for TB); B: elliptical incision; C-D: breaking up loculations; E: loose packing in place*

abscess), give ampicillin (25–50 mg/kg IM or IV four times a day), gentamicin (7.5 mg/kg IM or IV once a day) plus metronidazole (10 mg/kg three times a day).

9.5.2 Osteomyelitis

Infection of a bone usually results from blood spread (see p. 186). It may also occur in open fractures. The commonest organisms include *S. aureus*, *Salmonella* (in sickle-cell disease) and *Mycobacterium tuberculosis*.

Diagnosis

- Acute osteomyelitis:
  - pain and tenderness of the involved bone
  - usually, intermittent fever
  - refusal to move the affected limb
  - refusal to bear weight if in the leg

In early osteomyelitis, the X-ray may be normal; it usually takes 12–14 days for X-ray changes to appear.

- Chronic osteomyelitis
  - chronic draining sinuses over the involved bone
  - X-ray shows elevated periosteum and sequestrum (collection of dead bone).

Treatment

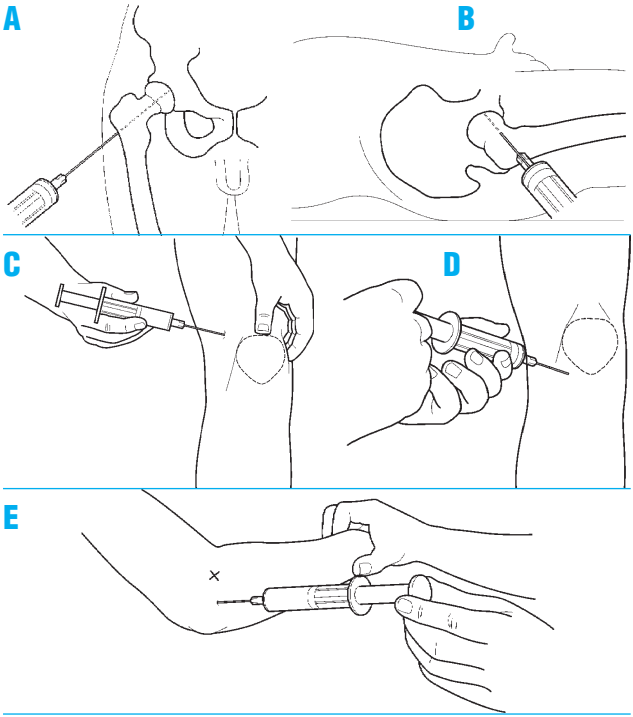
- **Review** by a surgeon experienced in paediatric surgery is required.
- In early osteomyelitis with fever and toxaemia, give chloramphenicol (25 mg/kg three times a day) to children aged < 3 years and those with sickle-cell disease; or give cloxacillin (50 mg/kg IM or IV four times a day) to children aged > 3 years for at least 5 weeks. Give parenteral antibiotics until the child has improved clinically, then orally to complete the course.
- In chronic osteomyelitis, sequestrectomy (removal of dead bone) is usually necessary as well as antibiotic treatment, as above.

9.5.3 Septic arthritis

This condition is similar to osteomyelitis, but involves the joint. (See p. 186.)

Diagnosis

- Pain and swelling of the joint.
- Usually, intermittent fever
- Examination of the joint shows two important physical signs:
  - swelling and tenderness over the joint
  - decreased range of movement



Techniques for aspirating hip (A,B), knee (C,D) and elbow (E) joints

Treatment

- Aspiration of the joint to confirm the diagnosis (see figure, above). The commonest organism is *S. aureus*. Aspiration should be done under sterile conditions.
- **Urgent review** by a surgeon experienced in paediatric surgery is required for washing out the joint. Pus under pressure destroys a joint.

- Give chloramphenicol (25 mg/kg three times a day) to children aged < 3 years and those with sickle cell disease; or give cloxacillin (50 mg/kg IM or IV four times a day) to children aged > 3 years for at least 3 weeks. Give parenteral antibiotics until the child has improved clinically, then orally to complete the course

9.5.4 Pyomyositis

In this condition, there is pus within the substance of a muscle.

Diagnosis

- Fever, tenderness and swelling of the involved muscle. A fluctuant mass may not be detected if the inflammation is deep in the muscle.
- Commonly occurs in the thigh

Treatment

- Incision and drainage (usually require general anaesthesia)
- Leave a drain in the abscess cavity for 2–3 days.
- X-ray to exclude underlying osteomyelitis
- Give cloxacillin (50 mg/kg IM or IV four times a day) for 5–10 days, as the commonest organism is *S. aureus*.

Notes

Notes

CHAPTER 10

Supportive care

10.1	Nutritional management	294
	10.1.1 Supporting breastfeeding	294
	10.1.2 Nutritional management of sick children	299
10.2	Fluid management	304
10.3	Management of fever	305
10.4	Pain control	306
10.5	Management of anaemia	307
10.6	Blood transfusion	308
	10.6.1 Storage of blood	308
	10.6.2 Problems in blood transfusion	308
	10.6.3 Indications for blood transfusion	309
	10.6.4 Giving a blood transfusion	309
	10.6.5 Transfusion reactions	310
10.7	Oxygen therapy	312
10.8	Toys and play therapy	315

In order to provide good inpatient care, hospital policies and working practices should promote the basic principles of child care, such as:

- communicating with the parents
- arranging the paediatric ward so that the most seriously ill children receive the closest attention and are close to oxygen and other emergency treatments
- keeping the child as comfortable as possible and controlling pain, especially in invasive procedures
- preventing the spread of hospital-acquired infection by encouraging staff to wash their hands regularly and other measures
- keeping warm the area in which young infants or children, especially those with severe malnutrition, are being looked after, in order to prevent complications like hypothermia.

10.1 Nutritional management

Health workers should follow the advice on counselling in sections 12.3 and 12.4 (pp. 322–4). A mother's card with pictures of the advice can be helpful for the mother to take home as a reminder (see Annex 6, p. 403).

10.1.1 Supporting breastfeeding

Breastfeeding is most important for protecting infants from illness and for their recovery from illness.

- Exclusive breastfeeding is recommended from birth until 6 months of age.
- Continued breastfeeding, with adequate complementary foods, is recommended from 6 months to ≥ 2 years.

Health workers treating sick young children have the responsibility to encourage mothers to breastfeed and to help them overcome any difficulties.

Assessing a breastfeed

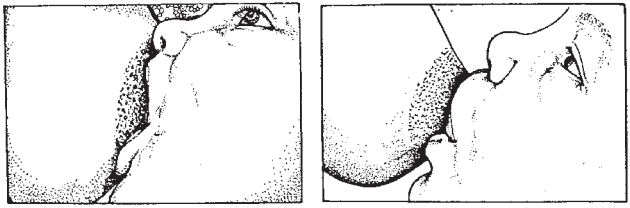
Take a breastfeeding history by asking about the infant's feeding and behaviour. Observe the mother while breastfeeding to decide whether she needs help. Observe:

- how the infant is attached to the breast (see next page). Signs of good attachment are:
  - areola visible above infant's mouth
  - mouth wide open
  - lower lip turned out
  - infant's chin touching the breast
- how the mother holds her infant (see next page)
  - should be held close to the mother
  - should face the breast
  - body should be in a straight line with the head
  - whole body should be supported
- how the mother holds her breast

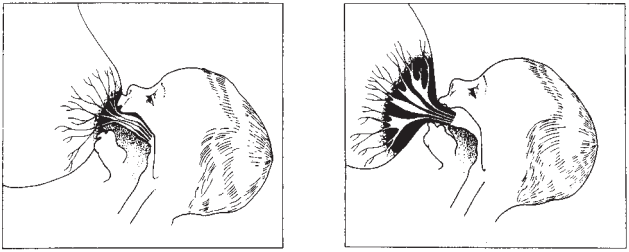
Overcoming difficulties

1. 'Not enough milk'

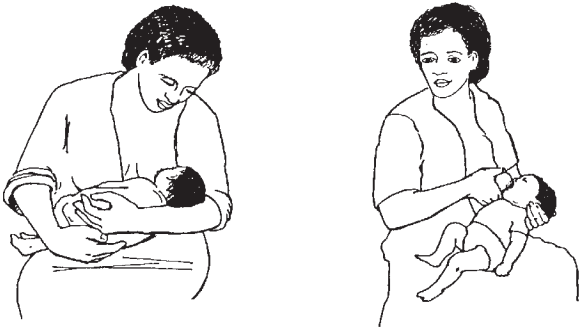
Almost all mothers can produce enough breast milk for one or even two infants; however, sometimes an infant is not getting enough breast milk. The signs are:



Good (left) and poor (right) attachment of infant to the mother's breast



Good (left) and poor (right) attachment: cross-sectional view of breast and infant



Good (left) and poor (right) positioning of infant for breastfeeding

- poor weight gain (< 500 g/month or < 125 g/week or infant weighing less than the birth weight after 2 weeks)
- passing a small amount of concentrated urine (less than six times a day, yellow and strong-smelling)

Common reasons why an infant may not be getting enough breast milk are:

- poor breastfeeding practices: poor attachment (very common cause), delayed start of breastfeeding, feeding at fixed times, no night feeds, short feeds, use of bottles, pacifiers, other foods and other fluids
- psychological factors in the mother: lack of confidence, worry, stress, depression, dislike of breastfeeding, rejection of infant, tiredness
- mother's physical condition: chronic illness (e.g. TB, severe anaemia or rheumatic heart disease), contraceptive pill, diuretics, pregnancy, severe malnutrition, alcohol, smoking, retained piece of placenta (rare)
- infant's condition: illness or congenital anomaly (such as cleft palate or congenital heart disease) that interferes with feeding.

A mother whose breast milk supply is reduced will have to increase it, while a mother who has stopped breastfeeding may need to relactate.

Help a mother to breastfeed again by:

- keeping the infant close to her and not giving him or her to other carers
- ensuring plenty of skin-to-skin contact between the mother and the infant at all times
- offering the infant her breast whenever the infant is willing to suckle
- helping the infant to take the breast by expressing breast milk into the infant's mouth, and positioning the infant so that he or she can easily attach to the breast
- avoiding use of bottles, teats and pacifiers. If necessary, express the breast milk and give it by cup. If this cannot be done, artificial feeds may be needed until an adequate milk supply is established.

2. How to increase the milk supply

The main way to increase or restart the supply of breast milk is for the infant to suckle often in order to stimulate the breast.

- Give other feeds from a cup while waiting for breast milk to come. Do not use bottles or pacifiers. Reduce the other milk by 30–60 ml per day as the mother's breast milk starts to increase. Monitor the infant's weight gain.

3. Refusal or reluctance to breastfeed

The main reasons why an infant might refuse to breastfeed are:

- The infant is ill, in pain or sedated.
  - If the infant is able to suckle, encourage the mother to breastfeed more often. If the infant is very ill, the mother may need to express breast milk and feed by cup or gastric tube until the infant can breastfeed again.
  - If the infant is in hospital, arrange for the mother to stay with the infant in order to breastfeed.
  - Help the mother to find a way to hold her infant without pressing on a painful place.
  - Explain to the mother how to clear a blocked nose. Suggest short feeds, more often than usual, for a few days.
  - A sore mouth may be due to *Candida* infection (thrush) or teething. Treat the infection with nystatin (100 000 U/ml) suspension. Give 1–2 ml dropped into the mouth four times a day for 7 days. If this is not available, apply 1% gentian violet solution. Encourage the mother of a teething infant to be patient and keep offering the breast.
  - If the mother is on regular sedation, reduce the dose or try a less sedating alternative.
- There is difficulty with the breastfeeding technique
  - Help the mother with her technique: ensure that the infant is positioned and attached well without pressing on the infant's head or shaking the breast.
  - Advise her not to use a feeding bottle or pacifier: if necessary, use a cup.
  - Treat engorgement by removing milk from the breast; otherwise mastitis or an abscess may develop. If the infant is not able to suckle, help the mother to express her milk.
  - Help reduce oversupply. If an infant is poorly attached and suckles ineffectively, the infant may breastfeed more frequently or for a longer time, stimulating the breast so that more milk is produced than required. Oversupply may also occur if a mother tries to make her infant feed from both breasts at each feed, when this is not necessary.
- A change has upset the infant.

  Changes such as separation from the mother, a new carer, illness of the mother, a change in the family routine or the mother's smell (due to a different soap, food or menstruation) can upset the infant and cause refusal to breastfeed.

Low-birth-weight and sick infants

Infants with a birth weight < 2.5 kg need breast milk even more than larger infants; often, however, they cannot breastfeed immediately after birth, especially if they are very small.

For the first few days, an infant may not be able to take oral feeds and may have to be fed IV. Initiate early feeding with small oral feeds even on day 1 or as soon as the infant can tolerate enteral feeds.

Very low-birth-weight infants (< 1.5 kg) may have to be fed by naso- or orogastric tube during the first days of life. Preferably give the mother's expressed breast milk. The mother can let the infant suck on her cleaned finger while being tube fed. This may stimulate the infant's digestive tract and help weight gain.

Low-birth-weight infants at ≥ 32 weeks' gestational age can start suckling on the breast. Let the mother put her infant to the breast as soon as the infant is well enough. Continue giving expressed breast milk by cup or tube to make sure that the infant gets all the nutrition needed.

Infants at ≥ 34–36 weeks' gestational age can usually take all that they need directly from the breast.

Infants who cannot breastfeed

Non-breastfed infants should receive either:

- expressed breast milk (preferably from their own mothers) or donor human milk where safe and affordable milk-banking facilities are available
- formula milk prepared with clean water according to instructions or, if possible, ready-made liquid formula
- If the above are not available, consider animal milk. Dilute cow's milk by adding 50 ml of water to 100 ml of milk, then add 10 g of sugar, with an approved micronutrient supplement. If possible, do not use for premature infants.

Feeding infant with expressed breast milk from a cup

Expressed breast milk is the best choice, in the following amounts:

- *Infants ≥ 2.0 kg:* Give 150 ml/kg daily, divided into eight feeds at 3-h intervals.
- *Infants < 2.0 kg:* See p. 60 for detailed guidance for low-birth-weight infants.
- If the child is too weak to suck but can swallow, feeding can be done with a cup. Feed by naso- or orogastric tube if the child is lethargic or severely anorexic or unable to swallow.

10.1.2 Nutritional management of sick children

The principles for feeding sick infants and young children are:

- Continue breastfeeding.
- Do not withhold food.
- Give frequent, small feeds, every 2–3 h.
- Coax, encourage, and be patient.
- Feed by nasogastric tube if the child is severely anorexic.
- Promote catch-up growth after the appetite returns.

The food provided should be:

- palatable (to the child)
- easily eaten (soft or liquid consistency)
- easily digested
- nutritious: rich in energy and nutrients.

The basic principle of nutritional management is to provide a diet with sufficient energy-producing foods and high-quality proteins. Foods with a high oil or fat content are recommended; up to 30–40% of the total calories can be given as fat. In addition, feeding at frequent intervals is necessary to achieve high energy intake. For sick children, provide multivitamin and mineral supplements.

The child should be encouraged to eat relatively small amounts frequently. If young children are left to feed themselves or have to compete with siblings for food, they may not get enough to eat.

A blocked nose, with dry or thick mucus, may interfere with feeding. Put drops of saline into the nose with a moistened wick to help soften the mucus.

A minority of children who are unable to eat for a number of days (due, e.g. to impaired consciousness in meningitis or respiratory distress in severe

Catch-up meals

The recipes provide 100 kcal and 3 g protein/100 ml. The individual servings contain approximately 200 kcal and 6 g protein. A child should eat seven meals in 24 h.

Recipe 1 (porridge without milk)

Ingredient	To make 1 litre	For one serving
Cereal flour	100 g	20 g
Groundnut or oilseed paste	100 g	20 g
Sugar	50 g	10 g

Make a thick porridge and then stir in the paste and sugar. Make up to 1 litre.

Recipe 2 (porridge with milk, or rice pudding)

Ingredient	To make 1 litre	For one serving
Cereal flour	125 g	25 g
Milk (fresh or long-life whole milk)	600 ml	120 ml
Sugar	75 g	15 g
Oil or margarine	25 g	5 g

Make a thick porridge with milk and just a little water (or use 75 g whole milk powder instead of the 600 ml liquid milk), then add sugar and oil. Make up to 1 litre.

For rice pudding, replace cereal flour with the same amount of rice.

These recipes may have to be supplemented with vitamins and minerals.

Recipe 3 (rice-based meal)

Ingredient	To make 600 g	For one serving
Rice	75 g	25
Lentils (dhal)	50 g	20 g
Pumpkin	75 g	25 g
Green leaves	75 g	25 g
Oil or margarine	25 g	10 g
Water	800 ml	

Put rice, lentils, pumpkin, oil, spices and water in a pot and cook with a lid on. Just before the rice is cooked, add chopped leaves. Cook for a few more minutes.

Recipe 4 (rice-based meal with cooked family foods)

Ingredient	Amount for one serving
Cooked rice	90 g (four and a half big spoons)[a]
Cooked mashed beans, peas or lentils	30 g (one and a half big spoons)
Cooked mashed pumpkin	30 g (one and a half big spoons)
Margarine or oil	10 g (two teaspoons)[b]

Soften the mashed foods with the oil or margarine

Recipe 5 (maize-based meal with family foods)

Ingredient	Amount for one serving
Thick maize porridge (cooked)	140 g (six big spoons)[a]
Groundnut paste	15 g (three teaspoons)[b]
Egg	30 g (one egg)
Green leaves	20 g (handful)

Stir groundnut paste and raw egg into cooked porridge. Cook for a few minutes. Fry onion and tomato for flavour and add leaves. Stir into porridge or serve separately.

[a] Big = 10 ml spoon, rounded
[b] Teaspoon = 5 ml

Chart 16. Feeding recommendations during sickness and health[a]

Up to 6 months of age

- Breastfeed as often as the child wants, day and night, at least eight times in 24 h. Frequent feeding produces more milk.
- If child is < 1 week and is low birth weight, feed at least every 2 to 3 h. Wake the baby for feeding after 3 h.
- Do not give other foods or fluids.
- If the child is > 4 months, appears hungry after breastfeeding and is not gaining weight adequately:
  - Add complementary foods (see below).
  - Give 2–3 tablespoons of these foods once or twice a day after breastfeeding.

6–12 months

- Breastfeed as often as the child wants day and night, at least eight times in 24 h.
- Give adequate servings of locally appropriate nutrient-dense foods, well mashed or finely chopped, increasing gradually (see Table 31 for examples):
  - three times per day if breastfed
  - five times per day if not breastfed, plus 1–2 cups of milk

12 months to 2 years

- Breastfeed as often as the child wants.
- Give a variety of adequate servings of locally appropriate nutrient-dense foods (see Table 31 for examples) or family foods five times a day.
- Offer one or two snacks between meals and continue to encourage and patiently feed the child during meals.

≥ 2 years

- Give family foods at three meals each day. Also, twice a day, give nutritious food between meals (see Table 31 for examples).
- Talk with your child during meals and keep eye contact.

[a] A good daily diet should be adequate in quantity and include an energy-rich food (for example, thick cereal with added oil), meat, fish, eggs or pulses and fruit and vegetables.

Table 31. Examples of local adaptations of feeding recommendations on the mother's card in Bolivia, Indonesia, Nepal, South Africa and the United Republic of Tanzania

Country	6–12 months	1–2 years	≥ 2 years
Bolivia	Cereal gruel, vegetable puree, minced meat or egg yolk, fruit From 9 months: fish, whole egg	Family meals plus additional seasonal fruit, milk-based desserts (custard, milk rice), yoghurt, cheese, milk twice a day	
Indonesia	Adequate amounts of rice porridge with egg, chicken, fish, meat, *tempe*, *tahu*, carrot, spinach, green beans, oil, coconut milk. Also, snacks twice a day between meals, such as green beans, porridge, banana, biscuit, *nagasari*		Adequate amounts of family foods at three meals a day, consisting of rice, side-dishes, vegetables and fruit. Also twice a day, nutritious foods between meals, such as green beans, porridge, banana, biscuit, *nagasari*
Nepal	Adequate servings of (mashed) foods such as rice, lentils (*dhal*), mashed bread (*roti*), biscuits, milk, yoghurt, seasonal fruits (such as banana, guava, mango), vegetables (such as potatoes, carrots, green leafy vegetables, beans), meat, fish and eggs		
South Africa	Porridge with added oil, peanut butter or ground peanuts, margarine and chicken, beans, full-cream milk, fruit and vegetables, mashed avocado or family food	Porridge with added oil, peanut butter or ground peanuts, margarine and chicken, beans, full-cream milk, fruit and vegetables, mashed avocado or banana, tinned fish or family food	Bread and peanut butter, fresh fruit or full cream
United Republic of Tanzania	Thick gruel, mixed food containing milk, mashed foods (rice, potato, *ugali*). Added beans, other legumes, meat, fish or groundnuts. Added greens or fruit such as pawpaw, mango, banana or avocado. Spoonful of extra oil added to food.		Nutritious snacks such as thick enriched *uji*, milk, fruit twice a day

pneumonia) may have to be fed through a nasogastric tube. The risk for aspiration can be reduced if small volumes are given frequently and by ensuring before each feed that the tube is in the stomach.

To supplement the child's nutritional management in hospital, feeding should be increased during convalescence to make up for any lost weight. It is important that the mother or carer offer food to the child more frequently than normal (at least one additional meal a day) after the child's appetite increases.

10.2 Fluid management

The total daily fluid requirement of a child is calculated from the following formula: 100 ml/kg for the first 10 kg, then 50 ml/kg for the next 10 kg, thereafter 25 ml/kg for each subsequent kg. For example, an 8-kg infant receives 8 x 100 ml = 800 ml per day, a 15 kg child (10 x 100) + (5 x 50) = 1250 ml per day.

Table 32. Maintenance fluid requirements

Body weight of child (kg)	Fluid (ml/day)
2	200
4	400
6	600
8	800
10	1000
12	1100
14	1200
16	1300
18	1400
20	1500
22	1550
24	1600
26	1650

Give the sick child more than the above amounts if he or she has fever (increase by 10% for every 1 °C of fever).

Monitoring fluid intake

Pay careful attention to maintaining adequate hydration in very sick children, who may have had no oral fluid intake for some time. ***Fluids should preferably be given orally (by mouth or nasogastric tube)***.

If fluids have to be given IV, it is important to monitor infusion closely because of the risk for fluid overload, which can lead to heart failure or cerebral oedema.

If it is impossible to monitor the IV fluid infusion closely, the IV route should be used only for the management of severe dehydration, septic shock, delivering IV antibiotics and for children for whom oral fluids are contraindicated (such as those with perforation of the intestine or other surgical abdominal problems). Possible IV maintenance fluids include half-normal saline plus 5% or 10% glucose. Do not give 5% glucose alone as this can lead to hyponatraemia. See Annex 4, p. 377 for composition of IV fluids.

10.3 Management of fever

The temperatures given in these guidelines are **rectal temperatures**, unless otherwise stated. Oral and axillary temperatures are lower by approximately 0.5 °C and 0.8 °C, respectively.

Fever is not an indication for antibiotic treatment and may help the immune defence against infection. High fever (> 39 °C or > 102.2 °F) can have harmful effects, such as:

- reducing the appetite
- making the child irritable
- precipitating convulsions in some children aged 6 months to 5 years
- increasing oxygen consumption (e.g. in a child with very severe pneumonia, heart failure or meningitis).

All children with fever should be examined for signs and symptoms that indicate the underlying cause of the fever, and should be treated accordingly (see Chapter 6, p. 149).

Antipyretic treatment

Paracetamol

Treatment with oral paracetamol should be restricted to children aged ≥ 2 months who have a fever of ≥ 39 °C (≥ 102.2 °F) and are uncomfortable or distressed because of the high fever. Children who are alert and active are unlikely to benefit from paracetamol.

▶ Paracetamol dose is 15 mg/kg every 6 h.

Ibuprofen

The effectiveness in lowering temperature and the safety of ibuprofen and acetaminophen are comparable, except that ibuprofen, like any NSAID, can cause gastritis and is slightly more expensive.

▶ Ibuprofen dose is 10 mg/kg every 6–8 h.

Other agents

Aspirin is not recommended as a first-line antipyretic because it has been linked with Reye syndrome, a rare but serious condition affecting the liver and brain. Avoid giving aspirin to children with chickenpox, dengue fever and other haemorrhagic disorders.

Other agents are not recommended because of their toxicity and inefficacy (dipyrone, phenylbutazone).

Supportive care

Children with fever should be lightly clothed, kept in a warm but well-ventilated room, and encouraged to increase their oral fluid intake.

10.4 Pain control

Correct use of analgesics will relieve pain in most children with pain due to medical illness, when given as follows:

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

Use the following drugs for effective pain control:

Mild pain: such as headaches, post-traumatic pain and pain due to spasticity

▶ Give paracetamol or ibuprofen to children > 3 months who can take oral medication. For infants < 3 months of age, use only paracetamol.

  – paracetamol at 10–15 mg/kg every 4–6 h

  – ibuprofen at 5–10 mg/kg every 6–8 h

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

■ Give morphine orally or IV every 4–6 h or by continuous IV infusion

- If morphine does not adequately relieve pain, then switch to alternative opioids, such as fentanyl or hydromorphone.

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

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

Pain control for procedures:

Local anaesthetics: for painful lesions in the skin or mucosa or during painful procedures (lidocaine inflitrated at 1–2%)

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

10.5 Management of anaemia

Non-severe anaemia

Young children (aged < 6 years) are anaemic if their Hb is < 9.3 g/dl (approximately equivalent to an EVF of < 27%). If anaemia is present, begin treatment, unless the child has severe acute malnutrition, in which case see p. 218.

- Give (home) treatment with iron (daily iron–folate tablet or dose of iron syrup) for 14 days.
- Ask the parent to return with the child in 14 days. Treat for 3 months when possible, as it takes 2–4 weeks to correct anaemia and 1–3 months to build up iron stores.
- If the child is ≥ 1 year and has not received mebendazole in the previous 6 months, give one dose of mebendazole (500 mg) for possible hookworm or whipworm infestation.
- Advise the mother about good feeding practice.

Severe anaemia

▶ Give a blood transfusion as soon as possible (see below) to:

- all children with an EVF of ≤ 12% or Hb of ≤ 4 g/dl
- less severely anaemic children (EVF, 13–18%; Hb, 4–6 g/dl) with any of the following clinical features:
  - clinically detectable dehydration
  - shock
  - impaired consciousness
  - heart failure
  - deep, laboured breathing
  - very high malaria parasitaemia (> 10% of red cells with parasites).

- If packed cells are available, give 10 ml/kg over 3–4 h in preference to whole blood. If not available, give fresh whole blood (20 ml/kg) over 3–4 h.
- Check the respiratory rate and pulse rate every 15 min. If either rises or there is other evidence of heart failure, such as basal lung crepitations, enlarged liver or raised jugular venous pressure, transfuse more slowly. If there is any evidence of fluid overload due to the blood transfusion, give IV furosemide at 1–2 mg/kg, up to a maximum total of 20 mg.
- After the transfusion, if the Hb remains as low as before, repeat the transfusion.
- In children with severe acute malnutrition, fluid overload is a common and serious complication. Give packed cells when available or whole blood at 10 ml/kg (rather than 20 ml/kg), and do not repeat transfusion based on the Hb level, or within 4 days of transfusion(see p. 218).

10.6 Blood transfusion

10.6.1 Storage of blood

Use blood that has been screened and found negative for transfusion-transmissible infections. Do not use blood that has passed its expiry date or has been out of the refrigerator for more than 2 h.

Large-volume, rapid transfusion at a rate > 15 ml/kg per h of blood stored at 4 °C may cause hypothermia, especially in small infants.

10.6.2 Problems in blood transfusion

Blood can be the vehicle for transmitting infections (e.g. malaria, syphilis, hepatitis B and C, HIV). Therefore, screen donors for as many of these infections as possible. To minimize the risk, give blood transfusions only when essential.

10.6.3 Indications for blood transfusion

There are five general indications for blood transfusion:

- acute blood loss, when 20–30% of the total blood volume has been lost, and bleeding is continuing
- severe anaemia
- septic shock (if IV fluids are insufficient to maintain adequate circulation; transfusion to be given in addition to antibiotic therapy)
- whole fresh blood is required to provide plasma and platelets for clotting factors, if specific blood components are not available
- exchange transfusion in neonates with severe jaundice.

10.6.4 Giving a blood transfusion

Before transfusion, check that:

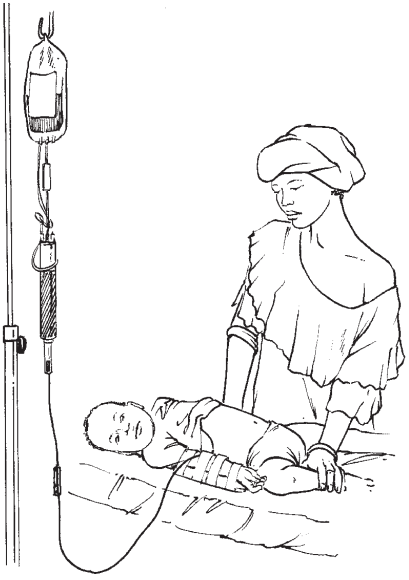
- the blood is the correct group, and the patient's name and number are on both the label and the form (in an emergency, reduce the risk for incompatibility or transfusion reactions by cross-matching group-specific blood or giving O-negative blood if available)
- the blood transfusion bag has no leaks
- the blood pack has not been out of the refrigerator for more than 2 h, the plasma is not pink or has large clots, and the red cells do not look purple or black
- the child has no signs of heart failure. If present, give 1 mg/kg of furosemide IV at the start of the transfusion to children whose circulating blood volume is normal. Do not inject into the blood pack.

Make baseline recordings of the child's temperature, respiratory rate and pulse rate.

The volume of whole blood transfused should initially be 20 ml/kg, given over 3–4 h.

During transfusion:

- If available, use an infusion device to control the rate of transfusion.
- Check that the blood is flowing at the correct speed.
- Look for signs of a transfusion reaction (see below), particularly carefully in the first 15 min of transfusion.
- Record the child's general appearance, temperature, pulse and respiratory rate every 30 min.



Giving a blood transfusion.
Note: A burette is used to measure the blood volume, and the arm is splinted to prevent flexion of the elbow.

- Record the times the transfusion was started and ended, the volume of blood transfused and any reactions.

After transfusion:

- Reassess the child. If more blood is needed, a similar quantity should be transfused and the dose of furosemide (if given) repeated.

10.6.5 Transfusion reactions

If a transfusion reaction occurs, first check the blood pack labels and the patient's identity. If there is any discrepancy, stop the transfusion immediately and notify the blood bank.

Mild reaction (due to mild hypersensitivity)

Signs and symptoms:

- itchy rash

Management

- Slow the transfusion.
- Give chlorphenamine at 0.1 mg/kg IM, if available.
- Continue the transfusion at the normal rate if there is no progression of symptoms after 30 min.
- If the symptoms persist, treat as a moderately severe reaction (see below).

Moderately severe reaction (due to moderate hypersensitivity, non-haemolytic reactions, pyrogens or bacterial contamination)

Signs and symptoms:

- severe itchy rash (urticaria)
- flushing
- fever > 38 °C (> 100.4 °F) (***Note:*** *Fever may have been present before the transfusion.*)
- rigor
- restlessness
- raised heart rate

Management

- Stop the transfusion, remove the IV line but not the cannula. Set up a new infusion with normal saline.
- Give 200 mg hydrocortisone IV or 0.25 mg/kg chlorphenamine IM, if available.
- Give a bronchodilator if wheezing (see pp. 103–4).
- Send the following to the blood bank: the blood-giving set that was used, a blood sample from another body site and urine samples collected over 24 h.
- If there is improvement, restart the transfusion slowly with new blood and observe carefully.
- If there is no improvement in 15 min, treat as a life-threatening reaction (see below), and report to the doctor in charge and to the blood bank.

Life-threatening reaction (due to haemolysis, bacterial contamination and septic shock, fluid overload or anaphylaxis)

Signs and symptoms

- fever > 38 °C (> 100.4 °F) (***Note:*** *Fever may have been present before the transfusion.*)
- rigor
- restlessness
- raised heart rate
- fast breathing
- black or dark-red urine (haemoglobinuria)
- unexplained bleeding
- confusion
- collapse

Note that in an unconscious child, uncontrolled bleeding or shock may be the only signs of a life-threatening reaction.

Management

- Stop the transfusion, take out the IV line, but keep in the cannula. Set up an IV infusion with normal saline.
- Maintain airway and give oxygen (see p. 11).
- Give adrenaline 0.15 ml of 1:1000 solution IM.
- Treat shock (see p. 13).
- Give 200 mg hydrocortisone IV or chlorphenamine 0.1 mg/kg IM, if available.
- Give a bronchodilator, if there is wheezing (see pp. 98–9).
- Report to the doctor in charge and to the blood laboratory as soon as possible.
- Maintain renal blood flow with IV furosemide at 1 mg/kg.
- Give antibiotics as for septicaemia (see p. 179).

10.7 Oxygen therapy

Indications

Oxygen therapy should be guided by pulse oximetry (see p. 315). Give oxygen to children with an oxygen saturation < 90%. When a pulse oximeter is not available, the necessity for oxygen therapy should be guided by clinical signs,

although they are less reliable. Oxygen should be given to children with very severe pneumonia, bronchiolitis or asthma who have:

- central cyanosis
- inability to drink (when this is due to respiratory distress)
- severe lower chest wall indrawing
- respiratory rate ≥ 70/min
- grunting with every breath (in young infants)
- depressed mental status.

Sources

Oxygen should be available at all times. The two main sources of oxygen are cylinders and oxygen concentrators. It is important that all equipment is checked for compatibility.

Oxygen cylinders and concentrators

See list of recommended equipment for use with oxygen cylinders and concentrators and instructions for their use in the WHO manuals on clinical use of oxygen therapy and on oxygen systems.

Oxygen delivery

Nasal prongs are the preferred method of delivery in most circumstances, as they are safe, non-invasive, reliable and do not obstruct the nasal airway. Nasal or nasopharyngeal catheters may be used as an alternative only when nasal prongs are not available. The use of headboxes is not recommended. Face masks with a reservoir attached to deliver 100% oxygen may be used for resuscitation.

Oxygen therapy: Nasal prongs correctly positioned and secured

Nasal prongs. These are short tubes inserted into the nostrils. Place them just inside the nostrils, and secure with a piece of

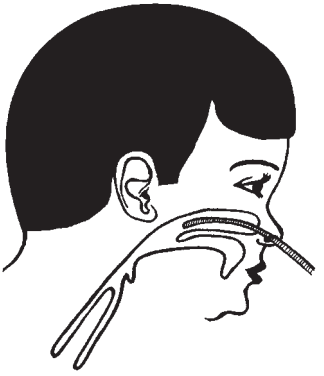
tape on the cheeks near the nose (see figure). Care should be taken to keep the nostrils clear of mucus, which could block the flow of oxygen.

- Set a flow rate of 1–2 litres/min (0.5 litre/min for young infants) to deliver an inspired oxygen concentration of up to 40%. Humidification is not required with nasal prongs.

Nasal catheter: a 6 or 8 French gauge catheter that is passed to the back of the nasal cavity. Insert the catheter at a distance equal to that from the side of the nostril to the inner margin of the eyebrow.

- Set a flow rate of 1–2 litres/min. Humidification is not required.

Nasopharyngeal catheter. A 6 or 8 French gauge catheter is passed to the pharynx just below the level of the uvula. Insert the catheter at a distance equal to that from the side of the nostril to the front of the ear (see figure). If it is placed too far down, gagging and vomiting and, rarely, gastric distension can occur.



- Set a flow rate of 1–2 litres/min to avoid gastric distension. Humidification is required.

Monitoring

Train nurses to place and secure the nasal prongs correctly. Check regularly that the equipment is working properly, and remove and clean the prongs at least twice a day.

Monitor the child at least every 3 h to identify and correct any problems, including:

- oxygen saturation, by pulse oximeter
- position of nasal prongs
- leaks in the oxygen delivery system
- correct oxygen flow rate
- airway obstructed by mucus (clear the nose with a moist wick or by gentle suction)

Pulse oximetry

Normal oxygen saturation at sea level in a child is 95–100%; in children with severe pneumonia, this usually decreases. Oxygen should be given if saturation drops to < 90% (measured at room air). Different cut-offs might be used at altitude or if oxygen is scarce. The response to oxygen therapy can also be measured with a pulse oximeter, as the oxygen saturation should increase if the child has lung disease (with cyanotic heart disease, oxygen saturation does not change when oxygen is given). The oxygen flow can be titrated with the pulse oximeter to obtain a stable oxygen saturation > 90% without wasting too much oxygen.

Duration of oxygen therapy

Continue giving oxygen continuously until the child is able to maintain an oxygen saturation > 90% in room air. When the child is stable and improving, take the child off oxygen for a few minutes. If the oxygen saturation remains > 90%, discontinue oxygen, but check again half an hour later and every 3 h thereafter on the first day off oxygen to ensure that the child is stable. When pulse oximetry is not available, the duration of oxygen therapy is guided by clinical signs (see p. 313), which are less reliable.

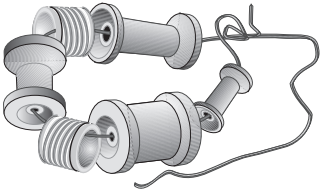
10.8 Toys and play therapy

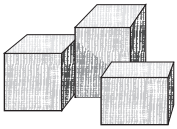
Each play session should include language and motor activities and activities with toys. Teach the child local songs. Encourage the child to laugh, vocalize and describe what he or she is doing. Always encourage the child to perform the next appropriate motor activity.

Activities with toys

Ring on a string (from 6 months)

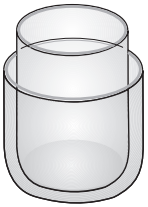
Thread cotton reels and other small objects (e.g. cut from the neck of plastic bottles) onto a string. Tie the string in a ring, leaving a long piece of string hanging.





Blocks (from 9 months)

Smooth the surfaces of small blocks of wood with sandpaper and paint in bright colours, if possible.

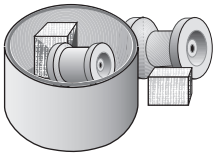


Nesting toys (from 9 months)

Cut off the bottoms of two bottles of identical shape but different size, and place the smaller bottle inside the larger bottle.

In-and-out toy (from 9 months)

Any plastic or cardboard container and small objects (not small enough to be swallowed)



Rattle (from 12 months)

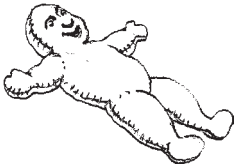
Cut long strips of plastic from coloured plastic bottles. Place them in a small transparent plastic bottle, and glue the top on firmly.

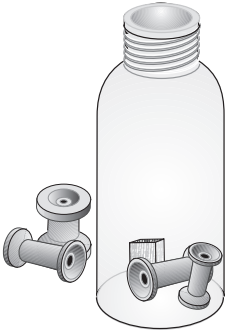
Drum (from 12 months)

Any tin with a tightly fitting lid

Doll (from 12 months)

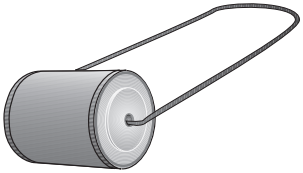
Cut out two doll shapes from a piece of cloth and sew the edges together, leaving a small opening. Turn the doll inside-out, and stuff with scraps of materials. Stitch up the opening and sew or draw a face on the doll.





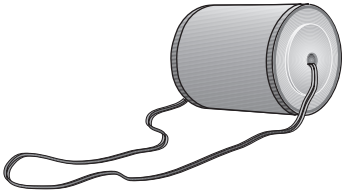
Posting bottle (from 12 months)

Take a large transparent plastic bottle with a small neck, and place small long objects that fit through the neck (not small enough to be swallowed).



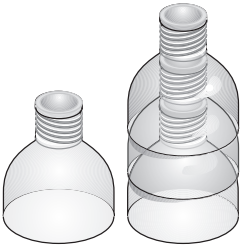
Push-along toy (from 12 months)

Make a hole in the centre of the base and lid of a cylindrical tin. Thread a piece of wire (about 60 cm long) through each hole, and tie the ends inside the tin. Put some metal bottle tops inside the tin and close the lid.



Pull-along toy (from 12 months)

As above, except that string is used instead of wire.

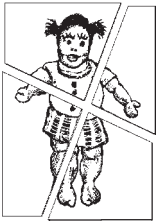


Stacking bottle tops (from 12 months)

Cut at least three identical round plastic bottles in half and stack them.

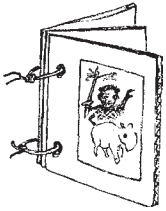
Mirror (from 18 months)

A tin lid with no sharp edges



Puzzle (from 18 months)

Draw a figure (e.g. a doll) with a crayon on a square or rectangular piece of cardboard. Cut the figure in half or quarters.



Book (from 18 months)

Cut out three rectangular pieces of the same size from a cardboard box. Glue or draw a picture on both sides of each piece. Make two holes down one side of each piece and thread string through to make a book.

Notes

CHAPTER 11

Monitoring the child's progress

11.1 Monitoring procedures 319
11.2 Monitoring chart 320
11.3 Audit of paediatric care 320

11.1 Monitoring procedures

In order for monitoring to be effective, the health worker must know:

- the correct administration of the treatment
- the expected progress of the child
- the possible adverse effects of the treatment
- the complications that may arise and how they can be identified
- possible alternative diagnoses in a child who is not responding to treatment.

Children treated in hospital should be checked regularly, so that any deterioration in their condition or complications, adverse effects of treatment or errors in the administration of treatment can be identified promptly. The frequency of monitoring depends on the severity and nature of the illness (see relevant sections in chapters 3–8).

Details of the child's condition and progress should be recorded, so that they can be reviewed by other members of staff. A senior health worker who is responsible for the care of the child and has the authority to change treatment should supervise the records and examine the child regularly.

Children who are seriously ill should be visited by a doctor (or other senior health professional) soon after admission to hospital. These visits should be seen as an opportunity to encourage communication between the families of sick children and hospital staff.

11.2 Monitoring chart

A monitoring chart should include the following items.

- patient's details
- vital signs (indicated by pulse rate and volume, respiratory rate and presence of lower chest indrawing, coma score or level of consciousness [AVPU], temperature and body weight)
- fluid balance (urine output, any vomiting, any stool)
- presence of clinical signs, complications and positive findings of investigations. At each review of the child, record whether these signs are still present. Record any new signs or complications.
- treatments given
- feeding and nutrition. Record the child's weight on admission and at appropriate intervals during treatment. There should be a daily record of the child's drinking, breastfeeding and eating. Record the amount of food taken and details of any feeding problems.

See Annex 6 (p. 403) for references to examples of monitoring charts and critical care pathways.

11.3 Audit of paediatric care

The quality of care given to sick children in hospital can be improved if there is a system for reviewing the outcomes of each child admitted to the hospital. At a minimum, the system should keep records of all children who died in the hospital. Trends in case fatality rates over time can then be compared, and the treatment given can be discussed by all staff with the aim of identifying any problems and finding solutions. Clinical audit meetings to discuss near-death events or deaths in children, especially those in which some aspect of treatment might have gone wrong, can also be helpful. The aim is to improve care and solve problems, not to attribute blame for errors.

An audit of hospital paediatric care can be carried out by comparing the quality of care actually given with a recognized standard, such as the WHO recommendations contained in this *Pocket book*. A successful audit calls for full, constructive participation of all medical and nursing staff. The audit should be simple and not take up too much of the time required for caring for sick children. One suggestion is to ask medical and nursing staff for their views on improving the quality of care and to give priority to the conditions or problems they identify.

CHAPTER 12

Counselling and discharge from hospital

12.1 Timing of discharge from hospital 321
12.2 Counselling 322
12.3 Nutrition counselling 323
12.4 Home treatment 324
12.5 Checking the mother's health 324
12.6 Checking immunization status 325
12.7 Communicating with the first-level health worker 325
12.8 Providing follow-up care 327

The discharge process of all children should include:

- correct timing of discharge from hospital
- counselling the mother on treatment and feeding the child at home
- ensuring that the child's vaccination status and record card are up to date
- communicating with the health worker who referred the child or who will be responsible for follow-up care
- giving instructions on when to return to hospital for follow-up and on symptoms and signs indicating the need to return urgently
- assisting the family with special support, e.g. providing equipment for a child with a disability or linking with community support organizations for children with HIV/AIDS.

12.1 Timing of discharge from hospital

In general, in the management of acute infections, a child can be considered ready for discharge after the clinical condition has improved markedly (afebrile, alert, eating and sleeping normally), and oral treatment has been started.

A decision on when to discharge should be made on an individual basis, taking into consideration factors such as:

- the family's home circumstances and how much support is available to care for the child
- the staff's judgement of the likelihood that the treatment course will be completed at home
- the staff's judgement of the likelihood that the family will return immediately to hospital if the child's condition worsens.

The timing of discharge of a child with severe acute malnutrition is particularly important and is discussed in Chapter 7, p. 219. In each case, the family should be given as much warning as possible of the discharge date, so that appropriate arrangements can be made to support the child at home.

If the family removes the child prematurely against the advice of the hospital staff, counsel the mother on how to continue treatment at home, and encourage her to bring the child for follow-up after 1–2 days and to make contact with the local health worker for help in the follow-up care of the child.

12.2 Counselling

Mother's card

A simple, pictorial card reminding the mother of home care instructions, when to return for follow-up care and the signs indicating the need to return immediately to the hospital can be given to each mother. This card will help her to remember the appropriate foods and fluids and when to return to the health worker.

Appropriate cards should be available as part of national IMCI guidelines. If they are available, use them; if not, see Annex 6 for a reference to an example.

When reviewing the mother's card with the mother:

- Hold the card so that she can easily see the pictures, or allow her to hold it herself.
- Point to the pictures as you talk, and explain each one; this will help her to remember what the pictures represent.
- Mark the information that is relevant to the mother. For example, put circles around the feeding advice for the child's age and around the signs to return immediately. If the child has diarrhoea, tick the appropriate fluid(s) to be given. Record the date for the next vaccination.
- Watch to see if the mother looks worried or puzzled. If so, encourage questions.
- Ask the mother to tell you in her own words what she should do at home. Encourage her to use the card to help her remember.

- Give her the card to take home. Suggest that she show it to other family members. (If you do not have a large enough supply of cards to give to every mother, keep several in the clinic to show to mothers.)
- Provide an effective interpreter if language is a barrier.

12.3 Nutrition counselling

For HIV counselling, see p. 243.

Identifying feeding problems

First, identify any feeding problems that have not been fully resolved.

Ask the following questions:

- ***Do you breastfeed your child?***
  - How many times during the day?
  - Do you also breastfeed during the night?
- ***Does the child take any other food or fluids?***
  - What food or fluids?
  - How many times a day?
  - What do you use to feed the child?
  - How large are the servings?
  - Does the child receive his or her own serving?
  - Who feeds the child and how?

Compare the child's actual feeding with the recommended guidelines for feeding a child of that age (see section 10.1.2, p. 299). Identify any differences, and list these as feeding problems.

In addition, consider:

- ***Difficulty in breastfeeding***
- ***Lack of active feeding***
- ***Not feeding well during the illness***

Advise the mother how to overcome the problems and how to feed the child.

Refer to local feeding recommendations for children of different ages. These recommendations should include details of locally appropriate energy-rich and nutrient-rich complementary foods.

Even when specific feeding problems are not found, praise the mother for what she does well. Give her advice that promotes:

- breastfeeding
- improved complementary feeding practices with locally available energy- and nutrient-rich foods
- giving nutritious snacks to children aged ≥ 2 years.

Examples of nutritionally adequate diets (see Chart 15, p. 106 in the WHO manual *Management of the child with a serious infection or severe malnutrition* could be printed on the reverse of a locally adapted mother's card.

12.4 Home treatment

- Use words the mother understands.
- Use teaching aids that are familiar (e.g. common containers for mixing ORS).
- Allow the mother to practise what she must do, e.g. preparing ORS solution or giving an oral medication, and encourage her to ask questions.
- Give advice in a helpful, constructive manner, praising the mother for correct answers or good practice.
- Teaching mothers is not just giving instructions. It should include:
  - ***Give information***. Explain to the mother how to give treatment, e.g. preparing ORS, giving an oral antibiotic or applying eye ointment.
  - ***Show an example***. Demonstrate to the mother how to give the treatment.
  - ***Let her practice***. Ask the mother to prepare the medicine or give the treatment while you watch. Help her as needed, so that she does it correctly.
  - ***Check her understanding***. Ask the mother to repeat the instructions in her own words, or ask her questions to see that she has understood correctly.

12.5 Checking the mother's health

If the mother is sick, provide treatment for her, and help to arrange follow-up at a first-level clinic close to her home. Check the mother's nutritional status, and give any appropriate counselling. Check the mother's immunization status, and, if needed, give her tetanus toxoid. Make sure the mother has access to family planning and birth spacing and counselling about preventing sexually transmitted and HIV infections. If the child has TB, the mother and other members of the family should have a chest X-ray and a Mantoux test. Make sure the mother knows where to have them, and explain why they are needed.

12.6 Checking immunization status

Ask to see the child's immunization card, and determine whether all the vaccinations recommended for the child's age have been given. Note any vaccinations the child still needs, and explain this to the mother. Give the vaccinations before the child leaves hospital, and record them on the card.

Recommended vaccination schedule

Table 33 below lists WHO's international recommendations. National recommendations take account of local disease patterns.

Contraindications

It is important to vaccinate all children, including those who are sick and malnourished, unless there are contraindications. There are **only three contraindications** to vaccination:

- Do not give BCG or yellow fever vaccine to a child with **symptomatic** HIV infection or AIDS, but do give the other vaccines.
- Do not give DPT-2 or -3 to a child who has had convulsions or shock within 3 days of the most recent dose.
- Do not give DPT to a child with recurrent convulsions or an active disease of the central nervous system.

A child with diarrhoea who is due to receive oral polio vaccine should be given a dose, but this dose should not be counted in the schedule. Make a note on the child's immunization record that it coincided with diarrhoea, so that the health worker will give the child an extra dose.

12.7 Communicating with the first-level health worker

The first-level health worker who referred the child to hospital should receive information about the child's care in hospital, which should include:

- diagnosis or diagnoses
- treatment(s) given and duration of stay in hospital
- response of the child to treatment
- instructions given to the mother for follow-up treatment or other care at home
- other matters for follow-up (e.g. vaccinations).

If the child has a health card, the above information can be recorded on it, and the mother should be asked to show it to the health worker. When there is no health card, these details should be recorded in a short note for the mother and health worker.

Table 33. Primary vaccination schedule for infants recommended in the Expanded Programme of Immunization

Vaccine		Age				
		Birth	**6 weeks**	**10 weeks**	**14 weeks**	**9 months**
BCG		x				
Polio	Oral polio vaccine	x[a]	x	x	x	
	Inactivated polio vaccine		8 weeks		x	5 months
DPT			x	x	x	
Hepatitis B	Option 1[b]	x	x		x	
	Option 2[b]	x	x	x	x	
H. influenzae type b		x	x	x		
Pneumococcal	Option 1		x	x	x	
	Option 2		x		x	x
Rotavirus	Rotarix		x	x		
	Rota Teq		x	x	x	
Yellow fever						x[c]
Measles						x[d]
Rubella						x

[a] In polio-endemic countries

[b] Option 1 is recommended in areas where perinatal transmission of hepatitis B virus is frequent (e.g. in South-East Asia). Option 2 may be used in areas where perinatal transmission is less frequent (e.g. in sub-Saharan Africa).

[c] In countries where yellow fever poses a risk

[d] In exceptional situations, where measles morbidity and mortality in infants < 9 months of age represent more than 15% of cases and deaths, give an extra dose of measles vaccine at 6 months of age. The scheduled dose should also be given as soon as possible after 9 months of age. The extra measles dose is also recommended for groups at high risk for death from measles, such as infants in refugee camps, infants admitted to hospitals, HIV-positive infants and infants affected by disasters and during outbreaks of measles.
A second opportunity to receive a dose of measles vaccine should be provided for all children. This may be done either as part of the routine schedule or in a campaign.

12.8 Providing follow-up care

Advise all mothers who are taking their children home after assessment in the hospital when to go to a health worker for follow-up care. Mothers may need to return to hospital:

- for a follow-up visit within a specified number of days (e.g. when it is necessary to check progress or the response to an antibiotic)
- if signs appear that suggest that the illness or injury (e.g. head injury) is worsening
- for the child's next vaccination.

It is especially important to teach the mother the signs that indicate the need to return to hospital immediately. Guidance on the follow-up of specific clinical conditions is given in appropriate sections of this *Pocket book*.

Follow-up for feeding and nutritional problems

- If a child has a feeding problem and changes in feeding have been recommended, follow up in 5 days to see whether the mother has made the changes, and give further counselling if needed.
- If the child has anaemia, follow up in 14 days to give more oral iron.
- If the child has a very low weight, additional follow-up is needed in 30 days, which involves weighing the child, reassessing feeding practices and giving further nutritional counselling.

When to return immediately

Advise the mother to return immediately if the child develops any of the following signs:

- unable to drink or breastfeed
- becomes sicker
- develops a fever
- signs of illness return after successful treatment in hospital
- a cough or cold: fast or difficult breathing
- diarrhoea: blood in stool or drinking poorly.

Next 'well-child' visit

Remind the mother about the child's next visit for vaccination, and record the date on the mother's card or the child's immunization record.

Notes

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This *Pocket book* was updated on the basis of recommendations and guidelines derived from published guidelines that are regularly reviewed and updated by the Guidelines Review Committee. These can be accessed on the WHO website at **http://www.who.int/maternal_child_adolescent/en/**. The second edition of the *Pocket book* has been revised to be consistent with current WHO guidelines and recommendations as of June 2012.

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ANNEX 1

Practical procedures

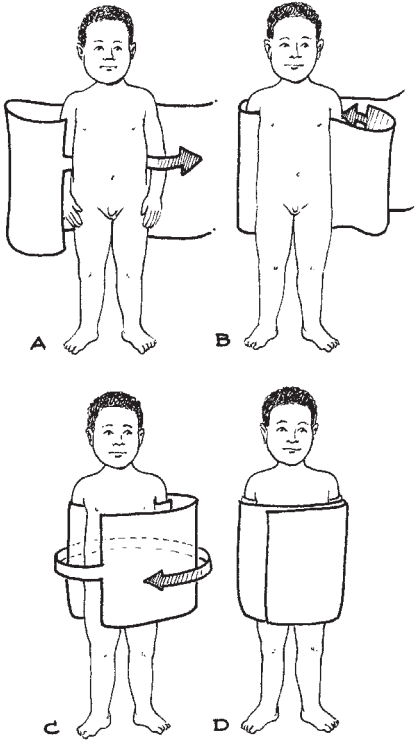
A1.1 Giving injections 335
A1.1.1 Intramuscular 336
A1.1.2 Subcutaneous 336
A1.1.3 Intradermal 336
A1.2 Giving parenteral fluids 338
A1.2.1 Insertion of an indwelling intravenous cannula in a peripheral vein 338
A1.2.2 Intraosseous infusion 340
A1.2.3 Central vein cannulation 342
A1.2.4 Venous cut-down 343
A1.2.5 Umbilical vein catheterization 344
A1.3 Insertion of a nasogastric tube 345
A1.4 Lumbar puncture 345
A1.5 Insertion of a chest drain 348
A1.6 Supra-pubic aspiration 350
A1.7 Measuring blood glucose 350

Practical procedures should first be explained to the parents or to the child if she or he is old enough; any risks should also be discussed with them and their consent obtained. Procedures on young infants should be carried out in warm surroundings to avoid hypothermia. Good light is essential. Older children should be told what is to happen. Analgesia should be given when necessary.

Analgesia and sedation for procedures

For some procedures (e.g. chest tube insertion or femoral cannulation), sedation with diazepam or light anaesthesia with ketamine should be considered (see section 9.1.2, p. 258).

For diazepam sedation, give 0.1–0.2 mg/kg IV. For ketamine, give 2–4 mg/kg IM; this takes 5–10 min to act and lasts for about 20 min.



Wrapping the child to hold him or her securely during a practical procedure

One end of a folded sheet should be pulled through under the arms on both sides (A and B). The other end is then brought across the front and wrapped around the child (C and D).

Restraining the child for examination of eyes, ears or mouth

When giving any sedation or light anaesthesia, manage the child's airway, beware of respiratory depression, and monitor oxygen saturation with a pulse oximeter, when possible. **Make sure** you have a resuscitation bag available and, if possible, oxygen.

A1.1 Giving Injections

First, find out whether the child has reacted adversely to drugs in the past. Wash your hands thoroughly. Use disposable needles and syringes.

Clean the chosen site with an antiseptic solution. Carefully check the dose of the drug to be given, and draw the correct amount into the syringe. Expel the air from the syringe before injecting. Always record the name and amount of the drug given. Discard disposable syringes in a safe container.

A1.1.1 Intramuscular

In children aged > 2 years, give the injection into the outer thigh or the upper, outer quadrant of the buttock, well away from the sciatic nerve. In younger or severely malnourished children, use the outer side of the thigh midway between the hip and the knee or over the deltoid muscle in the upper arm. Push the needle (23–25-gauge) into the muscle at a 90° angle (45° angle in the thigh). Draw back the plunger to make sure there is no blood (if there is, withdraw slightly and try again). Give the drug by pushing the plunger slowly until the end. Remove the needle, and press a small swab or cotton-wool firmly over the injection site.

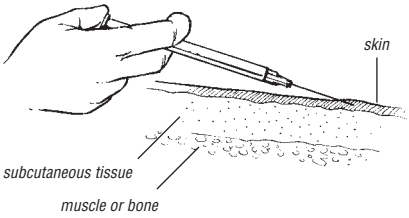
Intramuscular injection into the thigh

A1.1.2 Subcutaneous

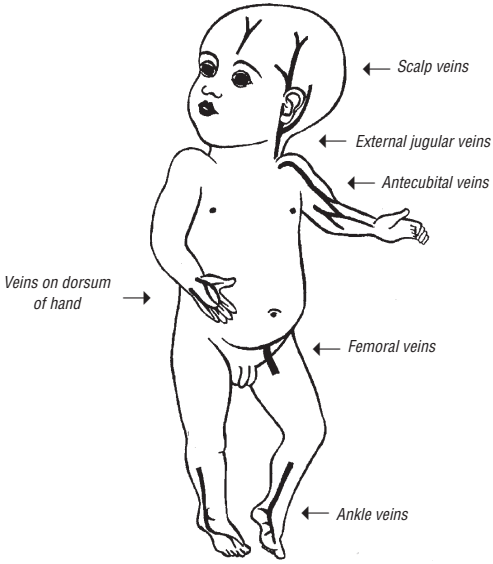
Select the site as described above for intramuscular injection. Push the needle (23–25-gauge) under the skin at a 45° angle into the subcutaneous fatty tissue. Do not enter the underlying muscle. Draw back the plunger to make sure there is no blood (if there is, withdraw slightly and try again). Give the drug by pushing the plunger slowly until the end. Remove the needle and press cotton-wool firmly over the injection site.

A1.1.3 Intradermal

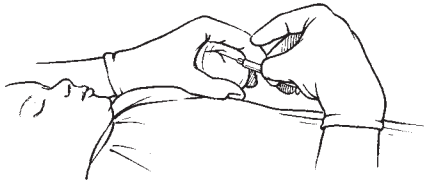
For an intradermal injection, select an undamaged, uninfected area of skin (e.g. over the deltoid in the upper arm). Stretch the skin between the thumb and forefinger of one hand; with the other, slowly insert the needle (25 gauge), bevel upwards, about 2 mm just under and almost parallel to the surface of the skin. Considerable resistance is felt when injecting intradermally. A raised, blanched bleb showing the surface of the hair follicles is a sign that the injection has been given correctly.



Intradermal injection (for example in Mantoux test)



Sites for IV access in infants and young children



Inserting an IV cannula into a vein on the back of the hand. The hand is bent to obstruct venous return and thus make the veins visible.

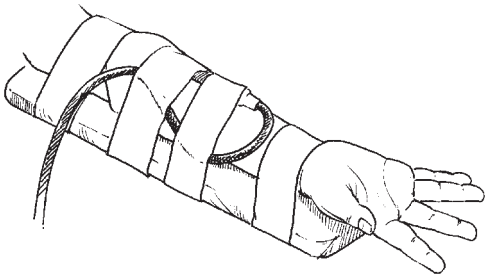
A1.2 Giving parenteral fluids

A1.2.1 Insertion of an indwelling intravenous cannula in a peripheral vein

Select a suitable vein to place the cannula or a gauge 21 or 23 butterfly needle.

Peripheral vein

- Identify an accessible peripheral vein. In young children aged > 2 months, this is usually the cephalic vein in the antecubital fossa or the fourth interdigital vein on the dorsum of the hand.
- An assistant should keep the position of the limb steady and should act as a tourniquet by obstructing the venous return with his or her fingers lightly closed around the limb.
- Clean the surrounding skin with an antiseptic solution (such as spirit, iodine, isopropyl alcohol or 70% alcohol solution), then introduce the cannula into



Splinted arm for IV infusion to prevent bending of the elbow

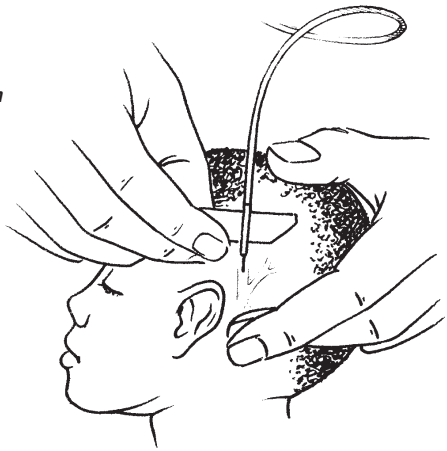
the vein and insert most of its length. Fix the catheter securely with tape. Apply a splint with the limb in an appropriate position (e.g. elbow extended, wrist slightly flexed).

Scalp vein

These are often used in children aged < 2 years but are most suitable in young infants.

- Find a suitable scalp vein (usually in the midline of the forehead, the temporal area, or above or behind the ear).
- Shave the area if necessary, and clean the skin with an antiseptic solution. The assistant should occlude the vein proximal to the site of puncture. Fill a syringe with normal saline, and flush the butterfly set. Disconnect the syringe and leave the end of the tubing open. Introduce the butterfly needle as described above. Blood flowing back slowly through the tubing indicates that the needle is in the vein.
- Care should be taken not to cannulate an artery, which is recognized by palpation. If there is a pulsatile spurting of blood, withdraw the needle and apply pressure until the bleeding stops; then look for a vein.

Inserting a butterfly needle into a scalp vein to set up an IV infusion in a young infant



Care of the cannula

Secure the cannula when introduced. This may require splinting neighbouring joints to limit the movement of the catheter. Keep the overlying skin clean and dry. Flush and fill the cannula with normal saline immediately after the initial insertion and after each injection.

Common complications

Superficial infection of the skin at the cannula site is the commonest complication. The infection may lead to thrombophlebitis, which will occlude the vein and result in fever. The surrounding skin is red and tender. Remove the cannula to reduce the risk of further spread of the infection. Apply a warm, moist compress to the site for 30 min every 6 h. If fever persists for more than 24 h, antibiotic treatment (effective against *Staphylococcus aureus*) should be given.

Intravenous drug administration through an indwelling cannula

Attach the syringe containing the IV drug to the injection port of the cannula and introduce the drug. Once all the drug has been given, flush with normal saline until all the blood has been expelled and the catheter is filled with the solution.

If infusion through a peripheral vein or scalp vein is not possible, and it is essential to give IV fluids to keep the child alive:

- set up an intraosseous infusion
- **or** use a central vein
- **or** perform a venous cut-down.

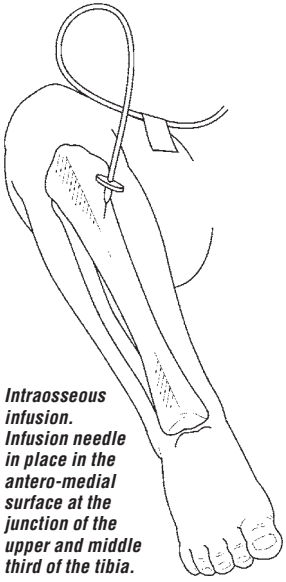
A1.2.2 Intraosseous infusion

Intraosseous infusion is a safe, simple, reliable method of giving fluid and drugs in an emergency when venous access is not possible.

The first choice for the puncture is the proximal tibia. The site for needle insertion is in the middle of the antero-medial surface of the tibia, at the junction of the upper and middle third to avoid damaging the epiphyseal plate (which is higher in the tibia) or at least 1–2 cm below the tibial tuberosity. An alternative site for needle insertion is the distal femur, 2 cm above the lateral condyle.

- Prepare the necessary equipment, i.e.:
  - bone marrow aspiration or intraosseous needles (15–18 gauge or, if not available, 21 gauge). If these are not available, bone marrow needles or large-bore hypodermic or butterfly needles can be used in young children
  - antiseptic solution and sterile gauze to clean the site

  - a sterile 5-ml syringe filled with normal saline
  - a second sterile 5-ml syringe
  - IV infusion equipment
  - sterile gloves.
- Place padding under the child's knee so that it is bent 30° from the straight (180°) position, with the heel resting on the table.
- Locate the correct position (described above and shown opposite).
- Wash the hands and put on sterile gloves.
- Clean the skin over and surrounding the site with an antiseptic solution.
- Stabilize the proximal tibia with the left hand (this hand is now not sterile) by grasping the thigh and knee above and lateral to the cannulation site, with the fingers and thumb wrapped around the knee but not directly behind the insertion site.



Intraosseous infusion. Infusion needle in place in the antero-medial surface at the junction of the upper and middle third of the tibia.

- Palpate the landmarks again with the sterile glove (right hand).
- Insert the needle at a 90° angle with the bevel pointing towards the foot. Advance the needle slowly using a gentle but firm, twisting or drilling motion.
- Stop advancing the needle when you feel a sudden decrease in resistance or when you can aspirate blood. The needle should now be fixed in the bone.
- Remove the stylet.
- Aspirate 1 ml of the marrow contents (looks like blood), using the 5-ml syringe, to confirm that the needle is in the marrow cavity.
- Attach the second 5-ml syringe filled with normal saline. Stabilize the needle and slowly inject 3 ml while palpating the area for any leakage under the skin. If no infiltration is seen, start the infusion.
- Apply dressings and secure the needle in its place.
- ***Note:*** *Failure to aspirate marrow contents does not mean that the needle is not correctly placed.*

- Monitor the infusion by the ease with which the fluid flows and by the clinical response of the patient.
- Check that the calf does not swell during the infusion.
- Stop the intraosseous infusion and remove the needle as soon as venous access is available. In any case, it should not continue for more than 8 h.

Complications include:

- Incomplete penetration of the bony cortex
  Signs: The needle is not well fixed; infiltration occurs under the skin.
- Penetration of the posterior bone cortex (more common)
  Signs: Infiltration occurs, calf becomes tense.
- Infection
  Signs: Cellulitis at the site of the infusion.

A1.2.3 Central vein cannulation

This should not be used routinely; only when IV access is urgent. Remove the cannula from a central vein as soon as possible (i.e. when IV fluid is no longer essential or when a peripheral vein can be cannulated successfully).

External jugular vein

- Hold the child securely, with the head turned to one side away from the puncture site and slightly lower than the body (15–30° head-down position). Restrain the child as necessary in this position.
- After cleaning the skin with an antiseptic solution, identify the external jugular vein as it passes over the sternocleidomastoid muscle at the junction of its middle and lower thirds. An assistant should occlude the vein to keep it distended and keep its position steady by pressing over the lower end of the visible part of the vein just above the clavicle. Pierce the skin over the vein, pointing in the direction of the clavicle. A short firm thrust will push the needle into the vein. Proceed with cannulation of the vein, as described above for a peripheral vein.

Femoral vein

- The child should be supine with the buttocks elevated 5 cm on a rolled-up towel so that the hip is slightly extended. Abduct and externally rotate the hip joint, and flex the knee. An assistant should hold the leg in this position and keep the other leg out of the way. If the child is conscious, infiltrate the area with 1% lignocaine.

- Clean the skin with an antiseptic solution to ensure that the procedure is aseptic. Palpate the femoral artery (below the inguinal ligament in the middle of the femoral triangle). The femoral vein runs medial to the femoral artery.
- Clean the skin with antiseptic. Introduce the needle at 10–20° to the skin, 1–2 cm distal to the inguinal ligament, 0.5–1 cm medial to the femoral artery.
- Venous blood will flow into the syringe when the needle is in the femoral vein.
- Proceed with cannulation of the vein by advancing the cannula at an angle of 10° to the skin.
- Stitch the cannula in place, and put a sterile occlusive dressing on the skin under the cannula and another one over the top of the cannula. Fix firmly in place with adhesive tape. It may be necessary to splint the leg to prevent flexion of the hip.
- Monitor the site closely for as long as the cannula is in place, taking care to keep the leg immobile during the infusion. A femoral line can last for up to 5 days with correct care.
- Withdraw the cannula after the IV infusion has been given, and apply firm pressure over the site for 2–3 min.

A1.2.4 Venous cut-down

This is less appropriate if speed is essential.

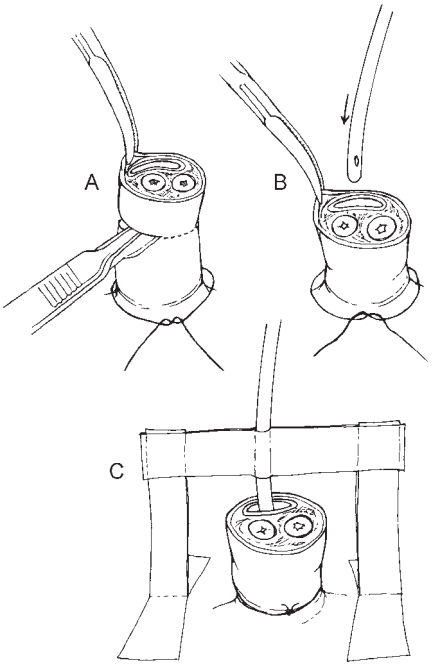
- Immoblize the child's lower leg, and clean the skin, as described above. Identify the long saphenous vein, which lies half a fingerbreadth (in the infant) or one fingerbreadth (in the older child) superior and anterior to the medial malleolus.
- Infiltrate the skin with 1% lignocaine, and make an incision through the skin perpendicular to the course of the vein. Bluntly dissect the subcutaneous tissue with haemostat forceps.
- Identify and free a 1–2-cm strip of vein. Pass a proximal and a distal ligature.
- Tie off the distal end of the vein, keeping the ties as long as possible.
- Make a small hole in the upper part of the exposed vein and insert the cannula into this, while holding the distal tie to stabilize the position of the vein.
- Secure the cannula in place with the upper ligature.
- Attach a syringe filled with normal saline, and ensure that the fluid flows freely up the vein. If it does not, check that the cannula is in the vein, or try withdrawing it slightly to improve the flow.

- Tie the distal ligature around the catheter, and then close the skin incision with interrupted sutures. Fix the cannula to the skin and cover with a sterile dressing.

A1.2.5 Umbilical vein catheterization

This procedure can be used for resuscitation or exchange transfusion and is usually possible in neonates in the first few days of life. In some circumstances, it might be possible at up to 5 days of life.

- Attach a sterile three-way tap and syringe to a sterile 5 French gauge catheter and fill with sterile 0.9% saline, then close the tap to prevent air entry (which may cause an air embolus).



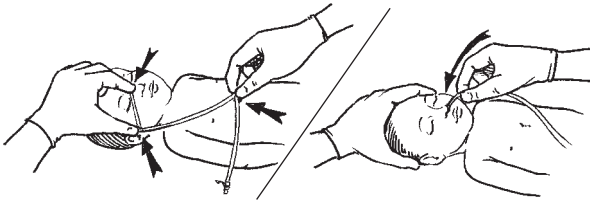
Inserting an umbilical vein catheter

A. Preparation of the umbilical cord
B. Inserting the catheter into the umbilical vein. This is the larger, thin walled structure towards the head. Note the two umbilical arteries, which are thick-walled and towards the legs of the infant.
C. Fixation of the inserted catheter, which prevents kinking

- Clean the umbilical cord and surrounding skin with an antiseptic solution, and then tie a suture around the base of the cord.
- Cut the cord 1–2 cm from the base with a sterile scalpel. Identify the umbilical vein (larger gaping vessel) and umbilical arteries (two thicker-walled vessels apart from the vein). Hold the cord (near the umbilical vein) with sterile forceps.
- Hold the near end of the catheter with sterile forceps, and advance it into the vein (it should pass easily) for 4–6 cm.
- Check that the catheter is not kinked and that blood draws back easily; if there is a block, pull gently on the cord, pull back the catheter partly, and re-insert.
- Secure with two sutures into the cord, leaving 5-cm long suture ends. Tape the suture and catheter (see diagram).
- After removal, apply pressure to the umbilical stump for 5–10 min.

A1.3 Insertion of a nasogastric tube

- Holding the tip of the tube against the child's nose, measure the distance from the nose to the ear lobe, then to the xiphisternum (epigastrium). Mark the tube at this point.
- Hold the child firmly. Lubricate the tip of the catheter with water, and pass it directly into one nostril, pushing it slowly in. It should pass easily down into the stomach without resistance. When the measured distance is reached, fix the tube with tape at the nose.
- Aspirate a small amount of stomach contents with a syringe to confirm that the tube is in place (check that it turns blue litmus paper pink). If no aspirate is obtained, inject air down the tube and listen over the abdomen with a stethoscope.



Inserting a nasogastric tube. The distance is measured from the nose to the ear and then to the epigastrium, and then the tube is inserted to the measured distance.

- If there is any doubt about the location of the tube, withdraw it and start again.
- When the tube is in place, fix a 20-ml syringe (without the plunger) to the end of the tube, and pour food or fluid into the syringe, allowing it to flow by gravity.

If oxygen therapy is to be given by nasopharyngeal catheter at the same time, pass both tubes down the same nostril and try to keep the other nostril patent by wiping away crusts and secretions, or pass the feeding tube through the mouth.

A1.4 Lumbar puncture

The following are *contraindications*:

- signs of raised intracranial pressure (unequal pupils, rigid posture or paralysis in any of the limbs or trunk, irregular breathing)
- skin infection in the area through which the needle will have to pass

If contraindications are present, the potential value of the information gained from a lumbar puncture should be carefully weighed against the risk of the procedure. If in doubt, it might be better to start treatment for suspected meningitis, and delay performing a lumbar puncture.

Position the child

There are two possible positions:

- lying on the left side (particularly for young infants)
- in the sitting position (particularly for older children)

Lumbar puncture when the child is lying on the side

- A hard surface should be used. Place the child on the side so that the vertebral column is parallel to this surface, and the transverse axis of the back is vertical (see figure next page).
- The assistant should flex the back of the child, pull the knees up towards the chest, and hold the child at the upper back between the shoulders and buttocks so that the back is bent. Hold the child firmly in this position. Make sure that the airway is not obstructed and the child can breathe normally. Take particular care in holding young infants. The assistant should not hold a young infant by the neck nor flex the neck to avoid airway obstruction.

Check anatomical landmarks

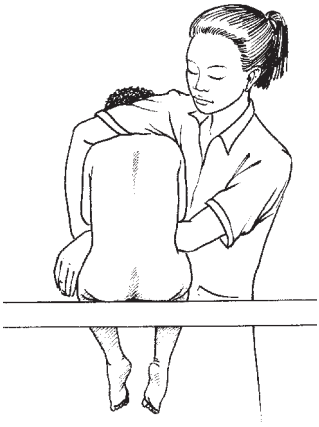
Locate the space between the third and fourth or between the fourth and fifth lumbar vertebrae. (The third lumbar vertebra is at the junction of the line between the iliac crests and the vertebral column).

Prepare the site

- Use aseptic technique. Scrub the hands and wear sterile gloves.
- Prepare the skin around the site with an antiseptic solution.
- Sterile towels may be used.
- In older children who are alert, give a local anaesthetic (1% lignocaine) infiltrated in the skin over the site.

Perform the lumbar puncture

- Use a lumbar puncture needle with stylet (22 gauge for a young infant, 20 gauge for an older infant or child; if these are not available, hypodermic needles may be used). Insert the needle into the middle of the intervertebral space, and aim the needle towards the umbilicus.



Restraining an older child in sitting position in order to carry out a lumbar puncture

- Advance the needle slowly. The needle will pass easily until it encounters the ligament between the vertebral processes. More pressure is needed to penetrate this ligament, less resistance is felt as the dura is penetrated. In young infants this decrease in resistance is not always felt, so advance the needle very carefully.
- Withdraw the stylet, and drops of CSF will pass out of the needle. If no CSF is obtained, the stylet can be reinserted and the needle advanced slightly.
- Obtain a sample of 0.5–1 ml CSF, and place in a sterile container.
- Withdraw the needle and stylet completely, and put pressure over the site for a few seconds. Put a sterile dressing over the needle puncture site.
- If the needle is introduced too far, a lumbar vein may be punctured. This will result in a 'traumatic tap', and the spinal fluid will be bloody. The needle should be withdrawn and the procedure repeated in another disc space.

A1.5 Insertion of a chest drain

Pleural effusions should be drained, except when small. It is sometimes necessary to drain both sides of the chest. You may have to drain the chest two or three times if the fluid keeps coming back.

Diagnostic procedure

- Consider giving the child sedation or light anaesthesia with ketamine.
- Wash the hands and put on sterile gloves.
- Lay the child on the back.
- Clean the skin over the chest with an antiseptic solution (for example, 70% alcohol).
- Select a point in the mid-axillary line (at the side of the chest) just below the level of the nipple (fifth intercostal space, see figure on p. 349).
- Inject about 1 ml of 1% lignocaine into the skin and subcutaneous tissue at this point.
- Insert a needle or catheter through the skin and pleura and aspirate to confirm the presence of pleural fluid. Withdraw a sample for microscopy and other tests, and place in a container.

If the fluid is clear (straw-coloured or brownish), pull out the needle or catheter after withdrawing enough fluid to relieve distress, and put a dressing over the puncture site. Consider a differential diagnosis of TB (see section 4.7.2, p. 115).

If the fluid is thin pus or cloudy (like milk), leave the catheter in place so that you can draw out more pus several times a day. Make sure you seal the end of the catheter so that no air can get in.

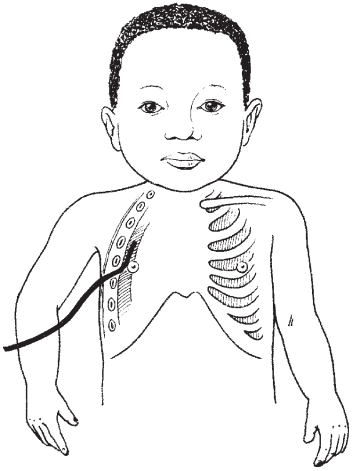
If the fluid is thick pus, which cannot pass easily through the needle or catheter, insert a chest tube (see figure).

Insertion of a chest tube

Select and prepare the site as described above.

- Make a 2–3-cm skin incision along the line of the Intercostal space, just above the rib below (to avoid damaging the vessels which lie under the lower edge of each rib).
- Use sterile forceps to push through the subcutaneous tissue just above the upper edge of the rib, and puncture the pleura.
- Pass a gloved finger into the incision and clear a path to the pleura. (This is not possible in infants.)

- Use the forceps to hold the drainage catheter (16 gauge) and introduce it into the chest for several centimetres, pointing upwards. Ensure that all drainage holes of the catheter are inside the chest.
- Connect the catheter to a collection bottle with an underwater seal.
- Suture the catheter in place, secure with tape, and apply a gauze dressing.



Insertion of a chest tube: the site is selected in the mid-axillary line in the 5th intercostal space (at the level of the nipple) on the superior aspect of the 6th rib.

Needle thoracocentesis

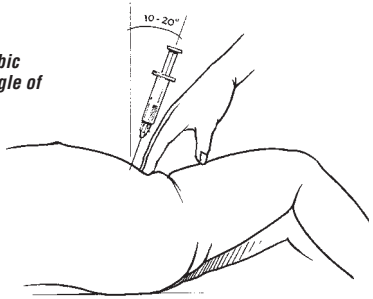
This procedure is used for a rapidly deteriorating patient who has a life-threatening tension pneumothorax (see section 4.3.3, p. 90). In such cases, immediate insertion of a chest drain may subsequently be necessary.

- Identify the second intercostal space in the mid-clavicular line on the side of the pneumothorax (the opposite side to the direction of tracheal deviation and the same side as the hyper-resonance).
- Swab the chest wall with antiseptic or an alcohol swab.
- Attach the syringe to the over-needle or intravenous cannula.
- Insert the cannula into the chest wall, just above the rib below, aspirating all the time.
- If air is aspirated, remove the needle, leaving the plastic cannula in place.
- Tape the cannula in place, and proceed to insert the chest drain as soon as possible.

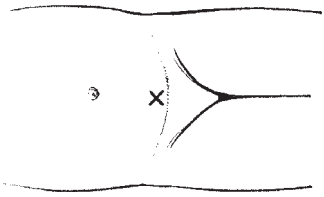
A1.6 Supra-pubic aspiration

Aspirate to a depth of 3 cm in the midline at the proximal transverse crease above the pubis with a 23-gauge needle under sterile conditions. Do this only in a child with a full bladder, which can be demonstrated by percussion. Do not use urine bags to collect urine because the specimens may become contaminated.

Have a clean urine jar ready in case the child passes urine during the procedure.



Position for carrying out suprapubic aspirate – side view. Note the angle of insertion of the needle.



Selecting the place for a suprapubic aspirate. The bladder is punctured in the midline, just above the symphysis.

A1.7 Measuring blood glucose

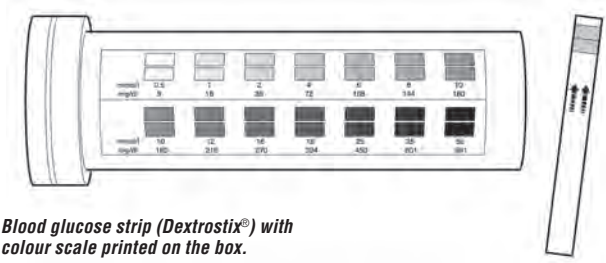
Blood glucose can be measured with a rapid diagnostic test (e.g. Dextrostix®) at the bedside, which provides an estimate of blood glucose within a few minutes. There are several brands on the market, which differ slightly in how they should be used. Instructions on the box and the package leaflet must therefore be read before using them.

Generally, a drop of blood is placed on the reagent strip and left for 30 s to 1 min, depending on the brand of strip. The blood is then wiped off, and after another fixed period (e.g. 1 further minute), the colour change on the reagent

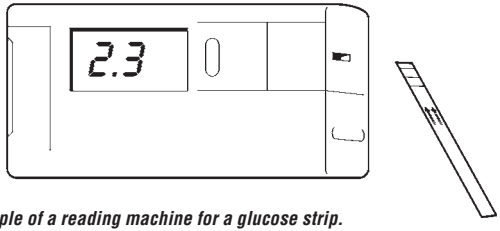
field of the strip is read and compared with a colour scale printed on the box. This allows estimation of the glucose level within a certain range, e.g. between 2 and 5 mmol/l, but does not allow exact determination.

Some strips come with an electronic reading machine, which has a battery as a power source. After the blood is wiped off, the strip is inserted into the reading machine, which provides a more accurate value.

As the reagents deteriorate with exposure to ambient humidity, they must be kept in a closed box, and the box must be closed again immediately after a strip has been taken out.



Blood glucose strip (Dextrostix®) with colour scale printed on the box.



Example of a reading machine for a glucose strip. The strip is inserted into a slot on the right side of the machine.

Notes

ANNEX 2

Drug dosages and regimens

This section gives the doses of the drugs mentioned in these guidelines that are suitable for infants and children. For ease of use and to avoid having to make calculations, doses are given according to the body weight of the child. As errors in calculating drug doses are common in hospital practice worldwide, calculations should be avoided, when possible. Doses are given covering a range of body weights, from 3–29 kg. A table for neonates in the first 2 months of life is included in Chapter 3, pp. 69–72.

For some drugs (for example, antiretroviral drugs), however, it is better to calculate the **exact** individual doses on the basis of the body weight of the child, where this is possible. The drugs include those for which the exact dose is critically important to ensure a therapeutic effect or to avoid toxicity, e.g. digoxin, chloramphenicol, aminophylline and antiretroviral drugs.

For some antiretroviral drugs, the recommended dosages are often given according to the surface area of the child. A table giving approximate child surface area for different weight categories is given below to help in this calculation. The doses in the table can then be used to check that the calculated dose is approximately correct (and to check that a calculation error has not been made).

$$\text{Body surface area in } m^2 = \sqrt{\frac{\{\text{height (cm)} \times \text{weight (kg)}\}}{3600}}$$

Thus, a child weighing 10 kg and 72 cm long has a body surface area of

$$\sqrt{(10 \times 72/3600)} = 0.45\ m^2$$

Table A2.1 Drug dosage by surface area (m^2) of the child

Age or weight of child	Surface area (m^2)
Neonate (< 1 month)	0.2–0.25
Young infant (1–< 3 months)	0.25–0.35
Child 5–9 kg	0.3–0.45
Child 10–14 kg	0.45–0.6
Child 15–19 kg	0.6–0.8
Child 20–24 kg	0.8–0.9
Child 25–29 kg	0.9–1.1
Child 30–39 kg	1.1–1.3

Example: if the recommended dose is given as 400 mg/m^2 twice a day, then for a child in the weight range 15–19 kg the recommended dose range will be: (0.6–0.8) x 400 = 244–316 mg twice a day.

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Abacavir (see separate table for antiretrovirals, p. 372)							
Adrenaline							
For wheeze	0.01 ml/kg (up to a maximum of 0.3 ml) of 1:1000 solution (or 0.1 ml/kg of 1:10 000 solution) given subcutaneously with a 1-ml syringe		Calculate **exact** dose based on body weight (as rapid-acting bronchodilator)				
For severe viral croup	0.5 ml/kg of 1:1000 solution (maximum dose: 5 ml)		–	3 ml	5 ml	5 ml	5 ml
For anaphylaxis	0.15 ml of 1:1000 solution IM (0.3 ml for children > 6 years)						
Note: *Make up a 1:10 000 solution by adding 1 ml of 1:1000 solution to 9 ml of normal saline or 5% glucose*							
Aminophylline							
For asthma	Oral: 6 mg/kg	Tablets: 100 mg	¼	½	¾	1	1½
		Tablets: 200 mg	–	¼	½	½	¾
	IV: Calculate exact dose based on body weight when possible; use the doses below only when this is not possible.						
	Loading dose:						
	IV: 5–6 mg/kg (max. 300 mg) slowly over 20–60 min	250 g/10-ml vial	1 ml	1.5 ml	2.5 ml	3.5 ml	5 ml

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Aminophylline For asthma (*continued*)	**Maintenance dose:** IV: 5 mg/kg up to every 6 h		1 ml	1.5 ml	2.5 ml	3.5 ml	5 ml
	or by continuous infusion at 0.9 mg/kg per h		Calculate **exact** dose				
Give IV loading dose only if the child has not taken aminophylline or theophylline within 24 h. *For dosage and dosage intervals for apnoea in neonates and premature infants, see p. 69.*							
Amoxicillin	25 mg/kg twice a day	250 mg tablet (chewable or dispersible)	½	1	1½	2	2½
		Syrup (containing 250 mg/5 ml)	2.5 ml	5 ml	7.5 ml	10 ml	–
For pneumonia	40 mg/kg twice a day		1 2.5 ml	1½ 7.5 ml	2 10 ml	3 –	4 –
Amphotericin B For oesophageal candidiasis	0.25 mg/kg per day increasing to 1 mg/kg per day, as tolerated, by IV infusion over 6 h/day for 10–14 days	50 mg vial	–	2–8 mg	3–12 mg	4.5–18 mg	6–24 mg
Ampicillin	IM/IV: 50 mg/kg every 6 h	Vial of 500 mg mixed with 2.1 ml sterile water to give 500 mg/2.5 ml	1 ml	2 ml	3 ml	5 ml	6 ml

Note: *These oral doses are for mild disease. If oral ampicillin is required after a course of injectable ampicillin for severe disease, the oral dose must be two to four times higher than that given here.*
For dosages and dosage intervals in neonates and premature infants, see p. 69.

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Antituberculosis antibiotics (see p. 370)							
Artemether For severe malaria	**Loading dose:** IM: 3.2 mg/kg	40 mg/1-ml ampoule 80 mg/1-ml ampoule	0.4 ml 0.2 ml	0.8 ml 0.4 ml	1.2 ml 0.6 ml	1.6 ml 0.8 ml	2.4 ml 1.2 ml
	Maintenance dose: IM: 1.6 mg/kg	40 mg/1-ml ampoule 80 mg/1-ml ampoule	0.2 ml 0.1 ml	0.4 ml 0.2 ml	0.6 ml 0.3 ml	0.8 ml 0.4 ml	1.2 ml 0.6 ml
Give the maintenance dose daily for a minimum of 24 h until the patient can take oral artemisinin-based combination therapy.							
Artemether/ lumefantrine	Oral: 2 mg/kg artemether – 12 mg/kg lumefantrine twice per day	Tablet: 20 mg artemether–120 mg lumefantrine	1	1	1	2	2
Artesunate For severe malaria	IV or IM: 2.4 mg/kg	60 mg artesumic acid (already dissolved in 0.6 ml of saline and sodium bicarbonate) in 3.4 ml of saline and glucose	0.8 ml	1.4 ml	2.4 ml	3.0 ml	5.0 ml
The IV solution should be prepared just before use. Dilute by dissolving 60 mg artesunic acid (which is already dissolved in 0.6 ml of 5% sodium bicarbonate) in 3.4 ml of 5% glucose. Give a dose at 0, 12 and 24 h and then daily until child is able to take it orally. If the patient is able to swallow, give the recommended full dose of artemisinin-based combination therapy.							
Artesunate–mefloquine	Oral: 4 mg/kg artesunate–8.3 mg/kg mefloquine once a day	Tablet: 25 mg artesunate–55 mg mefloquine	–	1	2	2	3
Not recommended for children < 5 months of age owing to limited information.							
Aspirin	Oral: 10–20 mg/kg every 4–6 h	300 mg tablet	–	¼	½	¾	1
Note: *Avoid in young children, if possible, because of the risk of Reye syndrome.*							

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Benzathine penicillin – see Penicillin							
Cefotaxime	IV: 50 mg/kg every 6 h	Vial of 500 mg mixed with 2 ml sterile water or vial of 1 g mixed with 4 ml sterile water or vial of 2 g mixed with 8 ml sterile water	0.8 ml	1.5 ml	2.5 ml	3.5 ml	5 ml
For dosage and dosage intervals in neonates and premature infants, see p. 70.							
Ceftriaxone	IV: 80 mg/kg per day as a single dose given over 30 min as infusion or 3 min as IV injection	Vial of 1 g mixed with 9.6 ml sterile water to give 1 g/10 ml **or** vial of 2 g mixed with 19 ml of sterile water to give 2 g/20 ml	3 ml	6 ml	10 ml	14 ml	20 ml
For meningitis	IM/IV: 50 mg/kg every 12 h (max single dose, 4 g)		2 ml	4 ml	6 ml	9 ml	12.5 ml
	or IM/IV: 100 mg/kg		4 ml	8 ml	12 ml	18 ml	25 ml
For dosage and dosage intervals in neonates and premature infants, see p. 70.							
Cefalexin	12.5 mg/kg four times a day	250 mg tablet	¼	½	¾	1	1¼

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Chloramphenicol For meningitis	*Calculate exact dose based on body weight. Use the doses below only if this is not possible.*						
	IV: 25 mg/kg every 6 h (max, 1 g per dose)	Vial of 1 g mixed with 9.2 ml sterile water to give 1 g/10 ml	0.75–1.25 ml	1.5–2.25 ml	2.5–3.5 ml	3.75–4.75 ml	5–7.25 ml
For cholera	IM: 20 mg/kg every 6 h for 3 days	Vial of 1 g mixed with 3.2 ml sterile water to give 1 g/4 ml	0.3–0.5 ml	0.6–0.9 ml	1–1.4 ml	1.5–1.9 ml	2–2.9 ml
For other conditions	Oral: 25 mg/kg every 8 h	125 mg/5 ml suspension (palmitate)	3–5 ml	6–9 ml	10–14 ml	15–19 ml	–
	(maximum 1 g per dose)	250 mg capsule	–	–	1	1½	2
Phenobarbital reduces and phenytoin increases chloramphenicol levels when given together.							
Chloramphenicol, oily (for treatment of meningococcal meningitis during epidemics)	100 mg/kg single dose; max, 3 g	IM: vial of 0.5 g in 2 ml	1.2–2 ml	2.4–3.6 ml	4–5.6 ml	6–7.6 ml	8–11.6 ml
Chlorphenamine	IM/IV or SC:	10 mg in 1 ml	0.1 ml	0.2 ml	0.3 ml	0.5 ml	0.6 ml
	0.25 mg/kg once (can be repeated up to four times in 24 h	IV solution					
	Oral: two or three times daily	Tablet: 4 mg	–	–	–	–	½

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Ciprofloxacin	Oral: 10-20 mg/kg per dose given twice a day for 5 days (max, 500 mg per dose)	100 mg tablet	½	1	1½	2	3
		250 mg tablet	¼	½	½	1	1½
Cloxacillin or flucloxacillin or oxacillin	IV: 25–50 mg/kg every 6 h	Vial of 500 mg mixed with 8-ml dose in sterile water to give 500 mg/10 ml	2–(4) ml	4–(8) ml	6–(12) ml	8–(16) ml	12–(24) ml
	IM: 25–50 mg/kg every 6 h	Vial of 250 mg mixed with 1.3 ml sterile water to give 250 mg/1.5 ml	0.6 (1.2) ml	1 (2) ml	1.8 (3.6) ml	2.5 (5) ml	3.75 (7.5) ml
		250 mg capsule	half (1)	1 (2)	1 (2)	2 (3)	2 (4)
For treating abscesses	15 mg/kg every 6 h	250-mg capsule	¼	½	1	1½	2½
For dosage and dosage intervals in neonates and premature infants, p. 70.							
Co-trimoxazole (trimethoprim-sulfamethoxazole)	4 mg/kg trimethoprim and 20 mg/kg sulfamethoxazole twice a day	Oral: adult tablet (80 mg trimethoprim + 400 mg sulfamethoxazole)	¼	½	1	1	1
		Oral: paediatric tablet (20 mg trimethoprim + 100 mg sulfamethoxazole)	1	2	3	3	4

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Co-trimoxazole (trimethoprim-sulfamethoxazole *(continued)*		Oral: syrup (40 mg trimethoprim + 200 mg sulfamethoxazole per 5 ml)	2 ml	3.5 ml	6 ml	8.5 ml	—
Note: *For interstitial pneumonia in children with HIV, give 8 mg/kg trimethoprim and 40 mg/kg sulfamethoxazole three times a day for 21 days. For an infant < 1 month, give co-trimoxazole (half paediatric tablet or 1.25 ml syrup) twice a day. Avoid co-trimoxazole in neonates who are premature or jaundiced.*							
Deferoxamine For iron poisoning	15 mg/kg per h IV to max of 80 mg/kg in 24 h, or IM: 50 mg/kg every 6 h. Maximum dose, 6 g/day	500-mg ampoule	2	2	2	2	2
Dexamethasone For severe viral croup	Oral: 0.6 mg/kg single dose	0.5-mg tablets					
		IM: 5 mg/ml	0.5 ml	0.9 ml	1.4 ml	2 ml	3 ml
For meningitis	IV: 0.15 mg/kg/dose every 6 h for the first 2–4 days						
Diazepam For convulsions	Rectal: 0.5 mg/kg	10 mg/2 ml solution	0.4 ml	0.75 ml	1.2 ml	1.7 ml	2.5 ml
	IV: 0.2–0.3 mg/kg		0.25 ml	0.4 ml	0.6 ml	0.75 ml	1.25 ml
For sedation before procedures	0.1–0.2 mg/kg IV						
Give phenobarbital (20 mg/kg IV or IM) instead of diazepam to neonates. If convulsions continue, give 10 mg/kg IV or IM after 30 min. The maintenance dose of oral phenobarbital is 2.5–5 mg/kg.							

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Digoxin	These doses are for oral digoxin. Give as an initial loading dose followed by twice daily maintenance doses, starting 6 h after the loading dose:						
	Loading dose: 15 µg/kg, once only	62.5-µg tablets	¾–1	1½–2	2½–3½	3½–4½	–
		125-µg tablets	–	–	1-1½	1¾–2	2½–3
	Maintenance dose: (Start 6 h after loading dose) 5 µg/kg every 12 h (max, 250 µg per dose)	62.5-µg tablets	¼–½	½–¾	¾–1	1¼–1½	1½–2¼
Dobutamine For treatment of shock that is unresponsive to fluids	2–20 µg/kg per min	250 mg/20 ml ampoule Dilute to 250 mg in 250 ml of 0.9% sodium chloride with 5% glucose to 1000 µg/ml	Calculate **exact** dose based on body weight and required rate of infusion.				
Diluted solutions may be stored for a maximum of 24 h.							
Dopamine For treatment of shock that is unresponsive to fluids	2–20 µg/kg per min	200 mg/5 ml ampoule Dilute to 250 mg in 250 ml of 0.9% sodium chloride with 5% glucose to 1000 µg/ml	Calculate **exact** dose based on body weight and required rate of infusion.				
Efavirenz (see separate table for antiretrovirals, p. 372)							
Erythromycin (estolate)	Oral: 12.5 mg/kg four times a day for 3 days	250-mg tablet	¼	½	1	1	1½
Must not be given with theophylline (aminophylline) because of risk of serious adverse reactions.							

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Fentanyl	IV injection: 1-4 µg/kg every 2–4 h	Injection: 50 µg/ml	–	Calculate **exact** dose based on body weight, and tailor dose to relieve pain.			
	Infusion: initial IV dose 1–2 µg/kg, then 0.5–1 µg/kg per h		–	Calculate **exact** dose based on body weight and required rate of infusion.			
Fluconazole	3–6 mg/kg once a day	50 mg/5 ml oral suspension	–	–	5 ml	7.5 ml	12.5 ml
For cryptococcal meningitis	6–12 mg/kg once a day	50-mg capsule	–	–	1	1–2	2–3
Flucloxacillin (see Cloxacillin)							
Furazolidone	1.25 mg/kg 4 times a day for 3 days	Oral: 100-mg tablet	–	–	¼	¼	¼
Furosemide (frusemide) For cardiac failure	Oral or IV: 1–2 mg/kg every 12 h	20-mg tablets IV 10 mg/ml	¼–½	½–1	½–1	1–2	1¼–2½
			0.4–0.8 ml	0.8–1.6 ml	1.2–2.4 ml	1.7–3.4 ml	2.5–5 ml
Gentamicin	Calculate **exact** dose based on body weight, and use the doses below only when this is not possible.						
	7.5 mg/kg once a day	IM/IV: vial containing 20 mg (2 ml at 10 mg/ml) undiluted	2.25–3.75 ml	4.5–6.75 ml	7.5–10.5 ml	–	–
		IM/IV: vial containing 80 mg (2 ml at 40 mg/ml) mixed with 6 ml sterile water	2.25–3.75 ml	4.5–6.75 ml	7.5–10.5 ml	–	–

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Gentamicin *(continued)*		IM/IV: vial containing 80 mg (2 ml at 40 mg/ml) undiluted	0.5–0.9 ml	1.1–1.7 ml	1.9–2.6 ml	2.8–3.5 ml	3.75–5.4 ml
Risk for adverse effects when given with theophylline. In administering an aminoglycoside (gentamicin, kanamycin), it is preferable to avoid use of undiluted 40 mg/ml gentamicin.							
For dosage and dosage intervals in neonates and premature infants, see p. 71.							
Gentian violet: Topical application to skin							
Hydromorphone	0.1–0.2 mg/kg every 4 h for two or three doses, then every 6–12 h	Tablet: 2 or 4 mg	–	Calculate **exact** dose based on body weight, and tailor dose to relieve pain.			
		Oral liquid: 1 mg/ml	–				
	0.015–0.02 mg/kg every 3–6 h	IV: 1 or 2 or 4 mg/ml	–	Calculate **exact** dose based on body weight and required rate of infusion.			
Ibuprofen	5–10 mg/kg orally every 6–8 h to a max total daily dose of 40 mg/kg	200-mg tablet	–	¼	¼	½	¾
		400-mg tablet	–	–	–	¼	½
Iron	Once a day for 14 days	Iron–folate tablet (ferrous sulfate 200 mg + 250 µg folate = 60 mg elemental iron	–	–	½	½	1
		Iron syrup (ferrous fumarate, 100 mg per 5 ml = 20 mg/ml elemental iron)	1 ml	1.25 ml	2 ml	2.5 ml	4 ml

Drug	Dosage	Form	Dose according to body weight 3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Kanamycin	Calculate **exact** dose based on body weight. Use the doses below only if this is not possible.						
	IM/IV: 20 mg/kg once a day	250 mg vial (2 ml at 125 mg/ml)	0.5–0.8 ml	1–1.5 ml	1.6–2.2 ml	2.4–3.0 ml	3.2–4.6 ml
For dosage and dosage intervals in neonates and premature infants, see p. 71.							
Ketamine For anaesthesia in major procedures	Calculate **exact** dose based on body weight.						
	IM: Loading dose: 5–8 mg/kg		20–35 mg	40–60 mg	60–100 mg	80–140 mg	125–200 mg
	IM: Further dose: 1–2 mg/kg (if required)		5–10 mg	8–15 mg	12–25 mg	15–35 mg	25–50 mg
	IV: Loading dose: 1–2 mg/kg		5–10 mg	8–15 mg	12–25 mg	15–35 mg	25–50 mg
	IV: Further dose: 0.5–1 mg/kg(if required)		2.5–5 mg	4–8 mg	6–12 mg	8–15 mg	12–25 mg
For light anaesthesia in minor procedures	IM: 2–4 mg/kg						
	IV: 0.5–1 mg/kg						
Dose details and method of administration are given on p. 258.							
Lamivudine (see separate table for antiretrovirals, p. 372)							
Lidocaine	Apply topically (see p. 307) Local injection: 4–5 mg/kg per dose as local anaesthetic						
Mebendazole	100 mg twice a day for 3 days	100-mg tablet	–	–	1	1	1
	500 mg once only	500-mg tablet	–	–	1	1	1
Not recommended for children < 5 months of age owing to limited information.							

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Metoclopramide For nausea and vomiting	0.1–0.2 mg/kg every 8 h as required (maximum dose: 10 mg/dose)	10-mg tablets	–	–	¼	¼	½
		Injection: 5 mg/ml	–	–	0.5 ml	0.7 ml	1 ml
Metronidazole	Oral: 7.5 mg/kg three times a day for 7 days	200-mg tablet	–	¼	½	½	1
		400-mg tablet	–	–	¼	¼	½
For the treatment of giardiasis, and for amoebiasis, 10 mg/kg.							
Morphine	Calculate **exact** dose based on weight of the child. Oral: 0.2–0.4 mg/kg every 4–6 h; increase if necessary for severe pain IM: 0.1–0.2 mg/kg every 4–6 h IV: 0.05–0.1 mg/kg every 4–6 h, or 0.005–0.01 mg/kg per h by IV infusion						
Nevirapine (see separate table for antiretrovirals, p. 373)							
Nystatin	Oral: 100 000–200 000 U into the mouth	Oral suspension 100 000 units/ml	1–2 ml	1–2 ml	1–2 ml	1–2 ml	1–2 ml
Oxacillin (see Cloxacillin)							
Paracetamol	10–15 mg/kg, up to six times a day	100-mg tablet	–	1	1	2	3
		500-mg tablet	–	¼	¼	½	½

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
PENICILLIN							
Benzathine benzylpenicillin	50 000 U/kg once a day	IM: vial of 1 200 000 U mixed with 4 ml sterile water	0.5 ml	1 ml	2 ml	3 ml	4 ml
Benzylpenicillin (penicillin G) General dosage	IV: 50 000 U/kg every 6 h						
		Vial of 600 mg mixed with 9.6 ml sterile water to give 1 000 000 U/10 ml	2 ml	3.75 ml	6 ml	8.5 ml	12.5 ml
	IM:	Vial of 600 mg (1 000 000 U) mixed with 1.6 ml sterile water to give 1 000 000 U/2 ml	0.4 ml	0.75 ml	1.2 ml	1.7 ml	2.5 ml
For meningitis	100 000 U/kg every 6 h	IV	4 ml	7.5 ml	12 ml l	17 ml	25 ml
		IM	0.8 ml	1.5 ml	2.5 ml	3.5 ml l	5 m
For dosage and dosage intervals in neonates and premature infants, see p. 71.							
Procaine benzylpenicillin	IM: 50 000 U/kg once a day	3-g vial (3 000 000 U) mixed with 4 ml sterile water	0.25 ml	0.5 ml	0.8 ml	1.2 ml	1.7 ml
Phenobarbital	IM: Loading dose: 15 mg/kg	200 mg/ml solution	0.4 ml	0.6 ml	1.0 ml	1.5 ml	2.0 ml
	Oral or IM: Maintenance dose: 2.5–5 mg/kg		0.1 ml	0.15 ml	0.25 ml	0.35 ml	0.5 ml
Give phenobarbital (20 mg/kg IV or IM) instead of diazepam to neonates. If convulsions continue, give 10 mg/kg IV or IM after 30 min.							

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Potassium Chloride	2–4 mmol/kg per day		Calculate **exact** dose				
Prednisolone	Oral: 1 mg/kg twice a day for 3 days	5-mg tablet	1	1	2	3	5
1 mg prednisolone is equivalent to 5 mg hydrocortisone or 0.15 mg dexamethasone.							
Quinine (mg/kg expressed as mg of quinine hydrochloride salt)	IV: Loading dose: 20 mg salt/kg given slowly over 2–4 h after dilution in 10 ml/kg of IV fluid		Loading dose is double the maintenance dose given below. Infusion rate should not exceed a total of 5 mg quinine dihydrochloride salt/kg per h.				
	IV: Maintenance dose: 10 mg salt/kg given slowly over 2 h after dilution in 10 ml/kg of IV fluid	IV (undiluted): quinine dihydrochloride injection 150 mg/ml (in 2-ml ampoules)	0.3 ml	0.6 ml	1 ml	1.2 ml	2 ml
		IV (undiluted): quinine dihydrochloride injection 300 mg/ml (in 2-ml ampoules)	0.2 ml	0.3 ml	0.5 ml	0.6 ml	1 ml
	If IV infusion is not possible, quinine dihydrochloride can be given at the same dosages IM	IM quinine dihydrochloride (diluted): in normal saline to a concentration of 60 mg salt/ml	1 ml	1.5 ml	2.5 ml	3 ml	5 ml
		Oral: quinine sulfate 200-mg tablet	¼	½	¾	1	1½

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Quinine *(continued)*		Oral: quinine sulfate 300-mg tablet	–	–	½	½	1
Note: *At 8 h after the start of the loading dose, give the maintenance dose listed here over 2 h. Repeat every 8 h. Give a full dose of oral artemisinin combination therapy treatment when the child is able to take orally to complete treatment.*							
Ritonavir (see Lopinavir/ritonavir in separate table for antiretrovirals, p. 373)							
Salbutamol	**Inhaler with spacer:** two doses contain 200 µg	Metered dose inhaler containing 200 doses					
	Nebulizer: 2.5 mg/dose	5 mg/ml solution, 2.5 mg in 2.5 ml single-dose units					
Silver sulfadiazine: apply topically to area of affected skin							
Spectinomycin For neonatal ophthalmia	IM: 25 mg/kg single dose (max, 75 mg)	2-g vial in 5 ml diluent	0.25 ml	–	–	–	–
Tetracaine, adrenaline, cocaine: Apply topically before painful procedures.							
Tetracycline	12.5 mg/kg four times a day for 3 days	250-mg tablet	–	½	½	1	1
Give to children only for treatment of cholera, because permanently stains teeth.							
Vitamin A	Once a day for 2 days	200 000 IU capsule	–	½	1	1	1
		100 000 IU capsule	½	1	2	2	2
		50 000 IU capsule	1	2	4	4	4
Zidovudine (see separate table for antiretrovirals, p. 372)							

Antituberculous antibiotics

Calculate **exact** dose based on body weight

Essential anti-TB drug (abbreviation)	Mode of action	Daily dose: mg/kg (range)
Isoniazid (H)	Bactericidal	10 (10–15)
Rifampicin (R)	Bactericidal	15 (10–20)
Pyrazinamide (Z)	Bactericidal	35 (30–40)
Ethambutol (E)	Bacteriostatic	20 (15–25)
Streptomycin (S): use only for MDR TB treatment	Bactericidal	15 (12–18)

Antiretrovirals

Drug	Dosage	Form	Dose according to surface area or body weight (morning and evening) 3–5.9 kg	6–9.9 kg	10–13.9 kg	14–19.9 kg	20–24.9 kg	25–34.9 kg
Fixed-dose combinations								
Zidovudine/ lamivudine (AZT/3TC)	AZT: 180–240 mg/m^2 twice a day 3TC: 4 mg/kg twice a day	AZT 60 mg + 3TC 30 mg	1	1.5	2	2.5	3	–
		AZT 300 mg + 3TC 150 mg	–	–	–	–	–	1
Zidovudine/ lamivudine /nevirapine (AZT/3TC/ NVP)	AZT: 180–240 mg/m^2 twice a day 3TC: 4 mg/kg twice a day NVP: 160–200 mg/m^2	AZT 60 mg + 3TC 30 mg + NVP 50 mg	1	1.5	2	2.5	3	–
		AZT 300 mg + 3TC 150 mg + NVP 200 mg	–	–	–	–	–	1

Drug	Dosage	Form	Dose according to surface area or body weight (morning and evening) 3–5.9 kg	6–9.9 kg	10–13.9 kg	14–19.9 kg	20–24.9 kg	25–34.9 kg
Fixed-dose combinations (*continued*)								
Abacavir/ zidovudine / lamivudine (ABC/ AZT/3TC)	ABC: 8 mg/kg twice a day AZT: 180–240 mg/ m^2 twice a day 3TC: 4 mg/kg twice a day	ABC 60 mg + AZT 60 mg + 3TC 30 mg	1	1.5	2	2.5	3	–
		ABC 300 mg + AZT 300 mg + 3TC 150 mg	–	–	–	–	–	1
Abacavir/ lamivudine (ABC/3TC)	Abacavir: 8 mg/kg twice a day Lamivudine: 4 mg/kg twice a day	Paediatric: ABC 60 mg + 3TC 30 mg	1	1.5	2	2.5	3	–
		Adult: ABC 600 mg + 3TC 300 mg	–	–	–	–	–	½
Adult ABC/3TC fixed-dose combination tablets are not scored; a tablet cutter would be required to divide these tablets. Consider giving one tablet daily.								
Stavudine/ lamivudine (d4T/3TC)	d4T: 1 mg/kg twice a day 3TC: 4 mg/kg twice a day	d4T 6 mg + 3TC 30 mg or d4T 30 mg + 3TC 150 mg	1 – –	1.5 – –	2 – –	2.5 – –	3 – –	– 1 –
Stavudine/ lamivudine/ nevirapine (d4T/3TC/ NVP)	d4T: 1 mg/kg twice a day 3TC: 4 mg/kg twice a day NVP: 160–200 mg/m^2	d4T 6 mg + 3TC 30 mg + NVP 50 mg or d4T 30 mg + 3TC 150 mg + NVP 200 mg	1 – –	1.5 – –	2 – –	2.5 – –	3 – –	– 1 –
NVP, maximum dose of 200 mg twice a day								
Lopinavir/ritonavir (LPV/RTV) (see protease inhibitors p. 373)								

Drug	Dosage	Form	Dose according to surface area or body weight (morning and evening) 3–5.9 kg	6–9.9 kg	10–13.9 kg	14–19.9 kg	20–24.9 kg	25–34.9 kg
Nucleoside reverse transcriptase Inhibitors (NRTIs)								
Abacavir (ABC)	8 mg/kg per dose twice a day	Liquid: 20 mg/ml	3 ml	4 ml	6 ml	–	–	–
		Tablet: 60 mg	1	1½	2	2½	3	–
		Tablet: 300 mg	–	–	–	½	1	1
Lamivudine (3TC)	4 mg/kg per dose twice a day	Liquid: 10 mg/ml	3 ml	4 ml	6 ml	–	–	–
		Tablet: 150 mg	–	–	–	½	1	1
Tenofovir (TDF)	8 mg/kg once a day (max 300 mg)	Oral powder scoops	–	–	2.5	3.5	4.5	6.0
		Tablet: 150 mg	–	–	–	1	–	–
		Tablet: 200 mg	–	–	–	–	1	–
		Tablet: 250 mg	–	–	–	–	–	1
Zidovudine (AZT or ZDV)	Oral: 180–240 mg/m^2 per dose given twice a day (total daily dose 360–480 mg/m^2)	Liquid: 10 mg/ml	6 ml	9 ml	–	–	–	–
		Tablet: 60 mg	1	1½	2	2½	3	–
Non-nucleoside reverse transcriptase Inhibitors (NNRTIs)								
Efavirenz	15 mg/kg per day once a day	Tablet: 200 mg	Insufficient data on dosing for children < 3 years or weighing < 10 kg		1 daily	1.5 daily	1.5 daily	2 daily

Higher doses of LPV/RTV may be required when co-administered with enzyme-inducing drugs such as nevirapine, efavirenz, fos-amprenavir and rifampicin.

Drug	Dosage	Form	Dose according to surface area or body weight (morning and evening)					
			3–5.9 kg	6–9.9 kg	10–13.9 kg	14–19.9 kg	20–24.9 kg	25–34.9 kg
Nevirapine	160–200 mg/m² to maximum of 200 mg twice a day	Liquid: 10 mg/ml	5 ml	8 ml	10 ml	–	–	–
		Tablet: 50 mg	1	1½	2	2½	3	
		Tablet: 200 mg	–	–	–	½	1 & ½	1

Divided into unequal doses, give one dose in the morning and the other in the evening.

Drug	Dosage	Form	Dose according to surface area or body weight (morning and evening)					
			3–5.9 kg	6–9.9 kg	10–13.9 kg	14–19.9 kg	20–24.9 kg	25–34.9 kg
Protease inhibitors								
Lopinavir/ ritonavir (LPV/RTV)	230–350 mg/m² twice a day	Liquid: (LPV 80 mg + RTV 20 mg)/ml	1 or 1.5 ml	1.5 ml	2 ml	2.5 ml	3 ml	–
		Paediatric tablet: LPV 100 mg/RTV 25 mg	–	–	2	2	2	3
		Adult tablet: LPV 200 mg/RTV 50 mg	–	–	1	1	1	1½

Higher doses of LPV/RTV may be required when co-administered with enzyme-inducing drugs such as nevirapine, efavirenz, fos-amprenavir and rifampicin.

Notes

ANNEX 3

Equipment sizes

Appropriate sizes of paediatric equipment according to age (weight) of child

Equipment	0–5 months (3–6 kg)	6–12 months (4–9 kg)	1–3 years (10–15 kg)	4–7 years (16–20 kg)
AIRWAY AND BREATHING				
Laryngoscope	Straight blade	Straight blade	Child Macintosh	Child Macintosh
Uncuffed tracheal tube	2.5–3.5	3.5–4.0	4.0–5.0	5.0–6.0
Stylet	Small	Small	Small/ medium	Medium
Suction catheter (French gauge)	6	8	10/12	
CIRCULATION				
IV cannula	24/22	22	22/18	20/16
Central venous cannula	20	20	18	18
OTHER EQUIPMENT				
Nasogastric tube[a]	8	10	10–12	12
Urinary catheter[a]	5 feeding tube	5 feeding tube/F8	Foley 8	Foley 10

[a] Sizes in French gauge or Charrière, which are equivalent and indicate the circumference of the tube in millimetres.

Notes

ANNEX 4

Intravenous fluids

The following table gives the composition of IV fluids that are commercially available and commonly used for neonates, infants and children. For a decision on which fluid to use in particular circumstances, see the disease-specific chapters, e.g. for shock (pp. 13–14), for neonates (p. 57), for severely malnourished children (p. 204), for surgical procedures (p. 261) and for general supportive therapy (p. 304). Please note that none of the fluids contains sufficient calories for the long-term nutritional support of children, but that some fluids contain less than others. When feed and fluids can be given by mouth or nasogastric tube, this is the safest, preferable route.

	Composition						
	Na+	K+	Cl–	Ca++	Lactate	Glucose	Calories
IV fluid	mmol/l	mmol/l	mmol/l	mmol/l	mmol/l	g/l	cal/l
Ringer's lactate (Hartmann's)	130	5.4	112	1.8	27	–	–
Normal saline (0.9% NaCl)	154	–	154	–	–	–	–
10% glucose	–	–	–	–	–	100	400
0.45 NaCl/5% glucose	77	–	77	–	–	50	200
Darrow's solution	121	35	103	–	53	–	–
Half-strength Darrow with 5% glucose[a]	61	17	52	–	27	50	200
Half-strength Ringer's lactate with 5% glucose	65	2.7	56	1	14	50	200
0.18% NaCl/4% glucose[b]	31	–	31	–	–	40	160
5% glucose[b]	–	–	–	–	–	50	200

[a] Half-strength Darrow's solution often comes without glucose, and glucose must be added before use.

[b] These fluids can be used mainly in the first few days of life but not in other infants or children.

A4.1 Choice of intravenous fluids

The risk for hyponatraemia may be increased with use of solutions containing very low sodium in paediatric patients, in comparison with fluids with a sodium content of 75–150 mmol/litre. Solutions containing low sodium, such as 0.18% sodium chloride with 4% glucose, or 5% glucose in water, should not be used for rehydration or fluid maintenance. Appropriate sodium-containing IV maintenance fluids should contain glucose to avoid hypoglycaemia and starvation ketosis in children who are unable to feed orally or by nasogastric tube.

- **Resuscitation:** Children who are severely dehydrated or with signs of shock should be resuscitated with isotonic IV solutions (normal saline 0.9% or Ringer's lactate).
- **Intravenous maintenance fluid:** Children who require IV fluids for maintenance should be managed with Ringer's lactate solution with 5% dextrose or 0.9% normal saline with 5% glucose or half-normal saline (0.45% sodium chloride) with 5% glucose.

Notes

ANNEX 5

Assessing nutritional status

A5.1 Calculating a child's weight-for-age

To calculate a child's weight-for-age, use the tables below or the charts on pp. 384–5.

In the table:

- Locate the appropriate table for boys or girls.
- Locate the row containing the child's age in the left column.
- Note where the child's weight lies with respect to the weights recorded in this row.
- Look up the column to read the weight-for-age of the child.

Example 1: Boy aged 5 months weighing 5.3 kg. His weight-for-age is –3 SD.

Example 2: Girl aged 27 months weighing 6.5 kg. Her weight-for-age is < –3 SD.

The lines in the charts on pp. 384–5 correspond to –2 (low weight-for-age) and –3 SD (very low weight-for-age). Please note that you should use tables in section A5.2, pp. 386–402 for weight-for-height to determine whether a child has severe acute malnutrition.

Table A5.1.1 Weight-for-age from birth to 5 years: Boys

Months	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
0	2.1	2.5	2.9	3.3	3.9	4.4	5.0
1	2.9	3.4	3.9	4.5	5.1	5.8	6.6
2	3.8	4.3	4.9	5.6	6.3	7.1	8.0
3	4.4	5.0	5.7	6.4	7.2	8.0	9.0
4	4.9	5.6	6.2	7.0	7.8	8.7	9.7
5	5.3	6.0	6.7	7.5	8.4	9.3	10.4
6	5.7	6.4	7.1	7.9	8.8	9.8	10.9
7	5.9	6.7	7.4	8.3	9.2	10.3	11.4
8	6.2	6.9	7.7	8.6	9.6	10.7	11.9

Months	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
9	6.4	7.1	8.0	8.9	9.9	11.0	12.3
10	6.6	7.4	8.2	9.2	10.2	11.4	12.7
11	6.8	7.6	8.4	9.4	10.5	11.7	13.0
12	6.9	7.7	8.6	9.6	10.8	12.0	13.3
13	7.1	7.9	8.8	9.9	11.0	12.3	13.7
14	7.2	8.1	9.0	10.1	11.3	12.6	14.0
15	7.4	8.3	9.2	10.3	11.5	12.8	14.3
16	7.5	8.4	9.4	10.5	11.7	13.1	14.6
17	7.7	8.6	9.6	10.7	12.0	13.4	14.9
18	7.8	8.8	9.8	10.9	12.2	13.7	15.3
19	8.0	8.9	10.0	11.1	12.5	13.9	15.6
20	8.1	9.1	10.1	11.3	12.7	14.2	15.9
21	8.2	9.2	10.3	11.5	12.9	14.5	16.2
22	8.4	9.4	10.5	11.8	13.2	14.7	16.5
23	8.5	9.5	10.7	12.0	13.4	15.0	16.8
24	8.6	9.7	10.8	12.2	13.6	15.3	17.1
25	8.8	9.8	11.0	12.4	13.9	15.5	17.5
26	8.9	10.0	11.2	12.5	14.1	15.8	17.8
27	9.0	10.1	11.3	12.7	14.3	16.1	18.1
28	9.1	10.2	11.5	12.9	14.5	16.3	18.4
29	9.2	10.4	11.7	13.1	14.8	16.6	18.7
30	9.4	10.5	11.8	13.3	15.0	16.9	19.0
31	9.5	10.7	12.0	13.5	15.2	17.1	19.3
32	9.6	10.8	12.1	13.7	15.4	17.4	19.6
33	9.7	10.9	12.3	13.8	15.6	17.6	19.9
34	9.8	11.0	12.4	14.0	15.8	17.8	20.2
35	9.9	11.2	12.6	14.2	16.0	18.1	20.4
36	10.0	11.3	12.7	14.3	16.2	18.3	20.7
37	10.1	11.4	12.9	14.5	16.4	18.6	21.0
38	10.2	11.5	13.0	14.7	16.6	18.8	21.3
39	10.3	11.6	13.1	14.8	16.8	19.0	21.6

Months	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
40	10.4	11.8	13.3	15.0	17.0	19.3	21.9
41	10.5	11.9	13.4	15.2	17.2	19.5	22.1
42	10.6	12.0	13.6	15.3	17.4	19.7	22.4
43	10.7	12.1	13.7	15.5	17.6	20.0	22.7
44	10.8	12.2	13.8	15.7	17.8	20.2	23.0
45	10.9	12.4	14.0	15.8	18.0	20.5	23.3
46	11.0	12.5	14.1	16.0	18.2	20.7	23.6
47	11.1	12.6	14.3	16.2	18.4	20.9	23.9
48	11.2	12.7	14.4	16.3	18.6	21.2	24.2
49	11.3	12.8	14.5	16.5	18.8	21.4	24.5
50	11.4	12.9	14.7	16.7	19.0	21.7	24.8
51	11.5	13.1	14.8	16.8	19.2	21.9	25.1
52	11.6	13.2	15.0	17.0	19.4	22.2	25.4
53	11.7	13.3	15.1	17.2	19.6	22.4	25.7
54	11.8	13.4	15.2	17.3	19.8	22.7	26.0
55	11.9	13.5	15.4	17.5	20.0	22.9	26.3
56	12.0	13.6	15.5	17.7	20.2	23.2	26.6
57	12.1	13.7	15.6	17.8	20.4	23.4	26.9
58	12.2	13.8	15.8	18.0	20.6	23.7	27.2
59	12.3	14.0	15.9	18.2	20.8	23.9	27.6
60	12.4	14.1	16.0	18.3	21.0	24.2	27.9

Table A5.1.2 Weight-for-age from birth to 5 years: Girls

Months	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
0	2.0	2.4	2.8	3.2	3.7	4.2	4.8
1	2.7	3.2	3.6	4.2	4.8	5.5	6.2
2	3.4	3.9	4.5	5.1	5.8	6.6	7.5
3	4.0	4.5	5.2	5.8	6.6	7.5	8.5
4	4.4	5.0	5.7	6.4	7.3	8.2	9.3
5	4.8	5.4	6.1	6.9	7.8	8.8	10.0
6	5.1	5.7	6.5	7.3	8.2	9.3	10.6

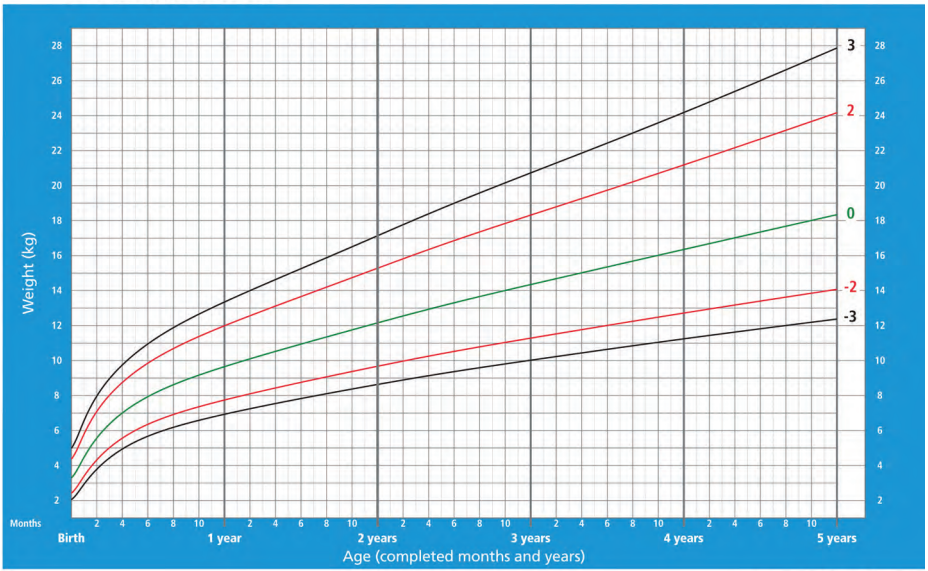
Months	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
7	5.3	6.0	6.8	7.6	8.6	9.8	11.1
8	5.6	6.3	7.0	7.9	9.0	10.2	11.6
9	5.8	6.5	7.3	8.2	9.3	10.5	12.0
10	5.9	6.7	7.5	8.5	9.6	10.9	12.4
11	6.1	6.9	7.7	8.7	9.9	11.2	12.8
12	6.3	7.0	7.9	8.9	10.1	11.5	13.1
13	6.4	7.2	8.1	9.2	10.4	11.8	13.5
14	6.6	7.4	8.3	9.4	10.6	12.1	13.8
15	6.7	7.6	8.5	9.6	10.9	12.4	14.1
16	6.9	7.7	8.7	9.8	11.1	12.6	14.5
17	7.0	7.9	8.9	10.0	11.4	12.9	14.8
18	7.2	8.1	9.1	10.2	11.6	13.2	15.1
19	7.3	8.2	9.2	10.4	11.8	13.5	15.4
20	7.5	8.4	9.4	10.6	12.1	13.7	15.7
21	7.6	8.6	9.6	10.9	12.3	14.0	16.0
22	7.8	8.7	9.8	11.1	12.5	14.3	16.4
23	7.9	8.9	10.0	11.3	12.8	14.6	16.7
24	8.1	9.0	10.2	11.5	13.0	14.8	17.0
25	8.2	9.2	10.3	11.7	13.3	15.1	17.3
26	8.4	9.4	10.5	11.9	13.5	15.4	17.7
27	8.5	9.5	10.7	12.1	13.7	15.7	18.0
28	8.6	9.7	10.9	12.3	14.0	16.0	18.3
29	8.8	9.8	11.1	12.5	14.2	16.2	18.7
30	8.9	10.0	11.2	12.7	14.4	16.5	19.0
31	9.0	10.1	11.4	12.9	14.7	16.8	19.3
32	9.1	10.3	11.6	13.1	14.9	17.1	19.6
33	9.3	10.4	11.7	13.3	15.1	17.3	20.0
34	9.4	10.5	11.9	13.5	15.4	17.6	20.3
35	9.5	10.7	12.0	13.7	15.6	17.9	20.6
36	9.6	10.8	12.2	13.9	15.8	18.1	20.9
37	9.7	10.9	12.4	14.0	16.0	18.4	21.3

Months	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
38	9.8	11.1	12.5	14.2	16.3	18.7	21.6
39	9.9	11.2	12.7	14.4	16.5	19.0	22.0
40	10.1	11.3	12.8	14.6	16.7	19.2	22.3
41	10.2	11.5	13.0	14.8	16.9	19.5	22.7
42	10.3	11.6	13.1	15.0	17.2	19.8	23.0
43	10.4	11.7	13.3	15.2	17.4	20.1	23.4
44	10.5	11.8	13.4	15.3	17.6	20.4	23.7
45	10.6	12.0	13.6	15.5	17.8	20.7	24.1
46	10.7	12.1	13.7	15.7	18.1	20.9	24.5
47	10.8	12.2	13.9	15.9	18.3	21.2	24.8
48	10.9	12.3	14.0	16.1	18.5	21.5	25.2
49	11.0	12.4	14.2	16.3	18.8	21.8	25.5
50	11.1	12.6	14.3	16.4	19.0	22.1	25.9
51	11.2	12.7	14.5	16.6	19.2	22.4	26.3
52	11.3	12.8	14.6	16.8	19.4	22.6	26.6
53	11.4	12.9	14.8	17.0	19.7	22.9	27.0
54	11.5	13.0	14.9	17.2	19.9	23.2	27.4
55	11.6	13.2	15.1	17.3	20.1	23.5	27.7
56	11.7	13.3	15.2	17.5	20.3	23.8	28.1
57	11.8	13.4	15.3	17.7	20.6	24.1	28.5
58	11.9	13.5	15.5	17.9	20.8	24.4	28.8
59	12.0	13.6	15.6	18.0	21.0	24.6	29.2
60	12.1	13.7	15.8	18.2	21.2	24.9	29.5

Weight-for-age BOYS

Birth to 5 years (z-scores)

World Health Organization

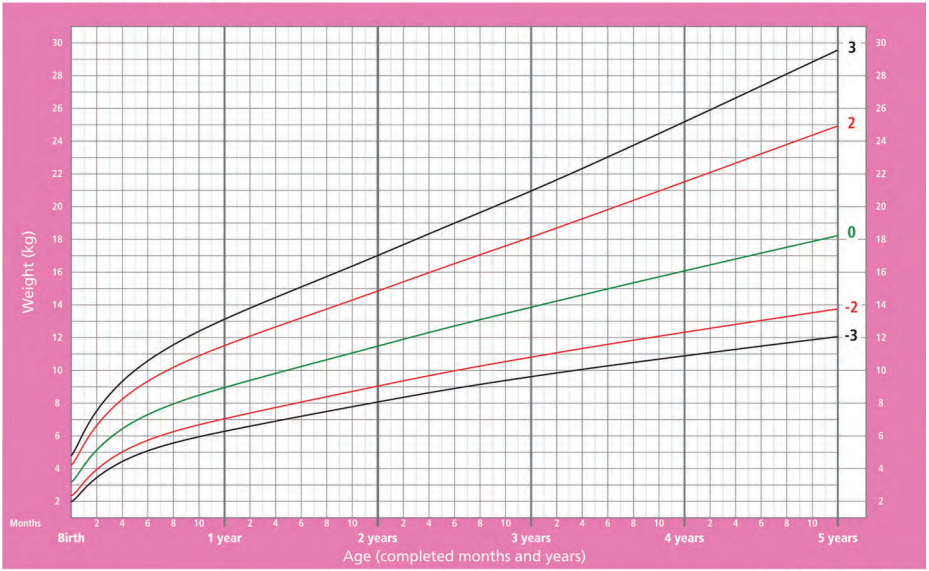


WHO Child Growth Standards

Weight-for-age GIRLS

Birth to 5 years (z-scores)

World Health Organization



WHO Child Growth Standards

A5.2 Calculating a child's weight-for-length or -height

Tables A5.2.1 and A5.2.2 on pp. 386, 391 give the WHO normalized reference weight-for-length (45–110 cm) and A5.2.3 and A5.2.4 on pp. 395–9 weight-for-height (65–120 cm), by sex.

The interpretation of a fixed percentage of the median value varies by age and height, and generally the two scales cannot be compared. The approximate percentage of the median values for –1 and –2 SD are 90% and 80% of the median, respectively.[1]

'Length' in most cases is measured for a child < 85 cm, and 'height' for a child ≥ 85 cm. Recumbent length is on average 0.5 cm greater than standing height, although the difference is of no importance for the individual child. A correction may be made by deducting 0.5 cm from all lengths > 84.9 cm if standing height cannot be measured.

In the tables:

- Locate the appropriate table for boys or girls.
- Locate the row containing the child's length in the left column.
- Note where the child's weight lies with respect to the lengths recorded in this row.
- Look up the column to read the weight-for-length of the child.

Example 1: Boy: length 61 cm, weight 5.3 kg. His weight-for-length is –2 SD.

Example 2: Girl: length 67 cm, weight 4.3 kg. Her weight-for-length is < –3SD.

Table A5.2.1 Weight-for-length from birth to 2 years: Boys

Length (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
45.0	1.9	2.0	2.2	2.4	2.7	3.0	3.3
45.5	1.9	2.1	2.3	2.5	2.8	3.1	3.4
46.0	2.0	2.2	2.4	2.6	2.9	3.1	3.5
46.5	2.1	2.3	2.5	2.7	3.0	3.2	3.6
47.0	2.1	2.3	2.5	2.8	3.0	3.3	3.7
47.5	2.2	2.4	2.6	2.9	3.1	3.4	3.8
48.0	2.3	2.5	2.7	2.9	3.2	3.6	3.9
48.5	2.3	2.6	2.8	3.0	3.3	3.7	4.0

[1] Gorstein J et al. Issues in the assessment of nutritional status using anthropometry. *Bulletin of the World Health Organization*, 1994, 72:273–283.

Length (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
49.0	2.4	2.6	2.9	3.1	3.4	3.8	4.2
49.5	2.5	2.7	3.0	3.2	3.5	3.9	4.3
50.0	2.6	2.8	3.0	3.3	3.6	4.0	4.4
50.5	2.7	2.9	3.1	3.4	3.8	4.1	4.5
51.0	2.7	3.0	3.2	3.5	3.9	4.2	4.7
51.5	2.8	3.1	3.3	3.6	4.0	4.4	4.8
52.0	2.9	3.2	3.5	3.8	4.1	4.5	5.0
52.5	3.0	3.3	3.6	3.9	4.2	4.6	5.1
53.0	3.1	3.4	3.7	4.0	4.4	4.8	5.3
53.5	3.2	3.5	3.8	4.1	4.5	4.9	5.4
54.0	3.3	3.6	3.9	4.3	4.7	5.1	5.6
54.5	3.4	3.7	4.0	4.4	4.8	5.3	5.8
55.0	3.6	3.8	4.2	4.5	5.0	5.4	6.0
55.5	3.7	4.0	4.3	4.7	5.1	5.6	6.1
56.0	3.8	4.1	4.4	4.8	5.3	5.8	6.3
56.5	3.9	4.2	4.6	5.0	5.4	5.9	6.5
57.0	4.0	4.3	4.7	5.1	5.6	6.1	6.7
57.5	4.1	4.5	4.9	5.3	5.7	6.3	6.9
58.0	4.3	4.6	5.0	5.4	5.9	6.4	7.1
58.5	4.4	4.7	5.1	5.6	6.1	6.6	7.2
59.0	4.5	4.8	5.3	5.7	6.2	6.8	7.4
59.5	4.6	5.0	5.4	5.9	6.4	7.0	7.6
60.0	4.7	5.1	5.5	6.0	6.5	7.1	7.8
60.5	4.8	5.2	5.6	6.1	6.7	7.3	8.0
61.0	4.9	5.3	5.8	6.3	6.8	7.4	8.1
61.5	5.0	5.4	5.9	6.4	7.0	7.6	8.3
62.0	5.1	5.6	6.0	6.5	7.1	7.7	8.5
62.5	5.2	5.7	6.1	6.7	7.2	7.9	8.6
63.0	5.3	5.8	6.2	6.8	7.4	8.0	8.8
63.5	5.4	5.9	6.4	6.9	7.5	8.2	8.9
64.0	5.5	6.0	6.5	7.0	7.6	8.3	9.1

Length (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
64.5	5.6	6.1	6.6	7.1	7.8	8.5	9.3
65.0	5.7	6.2	6.7	7.3	7.9	8.6	9.4
65.5	5.8	6.3	6.8	7.4	8.0	8.7	9.6
66.0	5.9	6.4	6.9	7.5	8.2	8.9	9.7
66.5	6.0	6.5	7.0	7.6	8.3	9.0	9.9
67.0	6.1	6.6	7.1	7.7	8.4	9.2	10.0
67.5	6.2	6.7	7.2	7.9	8.5	9.3	10.2
68.0	6.3	6.8	7.3	8.0	8.7	9.4	10.3
68.5	6.4	6.9	7.5	8.1	8.8	9.6	10.5
69.0	6.5	7.0	7.6	8.2	8.9	9.7	10.6
69.5	6.6	7.1	7.7	8.3	9.0	9.8	10.8
70.0	6.6	7.2	7.8	8.4	9.2	10.0	10.9
70.5	6.7	7.3	7.9	8.5	9.3	10.1	11.1
71.0	6.8	7.4	8.0	8.6	9.4	10.2	11.2
71.5	6.9	7.5	8.1	8.8	9.5	10.4	11.3
72.0	7.0	7.6	8.2	8.9	9.6	10.5	11.5
72.5	7.1	7.6	8.3	9.0	9.8	10.6	11.6
73.0	7.2	7.7	8.4	9.1	9.9	10.8	11.8
73.5	7.2	7.8	8.5	9.2	10.0	10.9	11.9
74.0	7.3	7.9	8.6	9.3	10.1	11.0	12.1
74.5	7.4	8.0	8.7	9.4	10.2	11.2	12.2
75.0	7.5	8.1	8.8	9.5	10.3	11.3	12.3
75.5	7.6	8.2	8.8	9.6	10.4	11.4	12.5
76.0	7.6	8.3	8.9	9.7	10.6	11.5	12.6
76.5	7.7	8.3	9.0	9.8	10.7	11.6	12.7
77.0	7.8	8.4	9.1	9.9	10.8	11.7	12.8
77.5	7.9	8.5	9.2	10.0	10.9	11.9	13.0
78.0	7.9	8.6	9.3	10.1	11.0	12.0	13.1
78.5	8.0	8.7	9.4	10.2	11.1	12.1	13.2
79.0	8.1	8.7	9.5	10.3	11.2	12.2	13.3
79.5	8.2	8.8	9.5	10.4	11.3	12.3	13.4

Length (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
80.0	8.2	8.9	9.6	10.4	11.4	12.4	13.6
80.5	8.3	9.0	9.7	10.5	11.5	12.5	13.7
81.0	8.4	9.1	9.8	10.6	11.6	12.6	13.8
81.5	8.5	9.1	9.9	10.7	11.7	12.7	13.9
82.0	8.5	9.2	10.0	10.8	11.8	12.8	14.0
82.5	8.6	9.3	10.1	10.9	11.9	13.0	14.2
83.0	8.7	9.4	10.2	11.0	12.0	13.1	14.3
83.5	8.8	9.5	10.3	11.2	12.1	13.2	14.4
84.0	8.9	9.6	10.4	11.3	12.2	13.3	14.6
84.5	9.0	9.7	10.5	11.4	12.4	13.5	14.7
85.0	9.1	9.8	10.6	11.5	12.5	13.6	14.9
85.5	9.2	9.9	10.7	11.6	12.6	13.7	15.0
86.0	9.3	10.0	10.8	11.7	12.8	13.9	15.2
86.5	9.4	10.1	11.0	11.9	12.9	14.0	15.3
87.0	9.5	10.2	11.1	12.0	13.0	14.2	15.5
87.5	9.6	10.4	11.2	12.1	13.2	14.3	15.6
88.0	9.7	10.5	11.3	12.2	13.3	14.5	15.8
88.5	9.8	10.6	11.4	12.4	13.4	14.6	15.9
89.0	9.9	10.7	11.5	12.5	13.5	14.7	16.1
89.5	10.0	10.8	11.6	12.6	13.7	14.9	16.2
90.0	10.1	10.9	11.8	12.7	13.8	15.0	16.4
90.5	10.2	11.0	11.9	12.8	13.9	15.1	16.5
91.0	10.3	11.1	12.0	13.0	14.1	15.3	16.7
91.5	10.4	11.2	12.1	13.1	14.2	15.4	16.8
92.0	10.5	11.3	12.2	13.2	14.3	15.6	17.0
92.5	10.6	11.4	12.3	13.3	14.4	15.7	17.1
93.0	10.7	11.5	12.4	13.4	14.6	15.8	17.3
93.5	10.7	11.6	12.5	13.5	14.7	16.0	17.4
94.0	10.8	11.7	12.6	13.7	14.8	16.1	17.6
94.5	10.9	11.8	12.7	13.8	14.9	16.3	17.7
95.0	11.0	11.9	12.8	13.9	15.1	16.4	17.9

Length (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
95.5	11.1	12.0	12.9	14.0	15.2	16.5	18.0
96.0	11.2	12.1	13.1	14.1	15.3	16.7	18.2
96.5	11.3	12.2	13.2	14.3	15.5	16.8	18.4
97.0	11.4	12.3	13.3	14.4	15.6	17.0	18.5
97.5	11.5	12.4	13.4	14.5	15.7	17.1	18.7
98.0	11.6	12.5	13.5	14.6	15.9	17.3	18.9
98.5	11.7	12.6	13.6	14.8	16.0	17.5	19.1
99.0	11.8	12.7	13.7	14.9	16.2	17.6	19.2
99.5	11.9	12.8	13.9	15.0	16.3	17.8	19.4
100.0	12.0	12.9	14.0	15.2	16.5	18.0	19.6
100.5	12.1	13.0	14.1	15.3	16.6	18.1	19.8
101.0	12.2	13.2	14.2	15.4	16.8	18.3	20.0
101.5	12.3	13.3	14.4	15.6	16.9	18.5	20.2
102.0	12.4	13.4	14.5	15.7	17.1	18.7	20.4
102.5	12.5	13.5	14.6	15.9	17.3	18.8	20.6
103.0	12.6	13.6	14.8	16.0	17.4	19.0	20.8
103.5	12.7	13.7	14.9	16.2	17.6	19.2	21.0
104.0	12.8	13.9	15.0	16.3	17.8	19.4	21.2
104.5	12.9	14.0	15.2	16.5	17.9	19.6	21.5
105.0	13.0	14.1	15.3	16.6	18.1	19.8	21.7
105.5	13.2	14.2	15.4	16.8	18.3	20.0	21.9
106.0	13.3	14.4	15.6	16.9	18.5	20.2	22.1
106.5	13.4	14.5	15.7	17.1	18.6	20.4	22.4
107.0	13.5	14.6	15.9	17.3	18.8	20.6	22.6
107.5	13.6	14.7	16.0	17.4	19.0	20.8	22.8
108.0	13.7	14.9	16.2	17.6	19.2	21.0	23.1
108.5	13.8	15.0	16.3	17.8	19.4	21.2	23.3
109.0	14.0	15.1	16.5	17.9	19.6	21.4	23.6
109.5	14.1	15.3	16.6	18.1	19.8	21.7	23.8
110.0	14.2	15.4	16.8	18.3	20.0	21.9	24.1

Table A5.2.2 Weight-for-length from birth to 2 years: Girls

Length (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
45.0	1.9	2.1	2.3	2.5	2.7	3.0	3.3
45.5	2.0	2.1	2.3	2.5	2.8	3.1	3.4
46.0	2.0	2.2	2.4	2.6	2.9	3.2	3.5
46.5	2.1	2.3	2.5	2.7	3.0	3.3	3.6
47.0	2.2	2.4	2.6	2.8	3.1	3.4	3.7
47.5	2.2	2.4	2.6	2.9	3.2	3.5	3.8
48.0	2.3	2.5	2.7	3.0	3.3	3.6	4.0
48.5	2.4	2.6	2.8	3.1	3.4	3.7	4.1
49.0	2.4	2.6	2.9	3.2	3.5	3.8	4.2
49.5	2.5	2.7	3.0	3.3	3.6	3.9	4.3
50.0	2.6	2.8	3.1	3.4	3.7	4.0	4.5
50.5	2.7	2.9	3.2	3.5	3.8	4.2	4.6
51.0	2.8	3.0	3.3	3.6	3.9	4.3	4.8
51.5	2.8	3.1	3.4	3.7	4.0	4.4	4.9
52.0	2.9	3.2	3.5	3.8	4.2	4.6	5.1
52.5	3.0	3.3	3.6	3.9	4.3	4.7	5.2
53.0	3.1	3.4	3.7	4.0	4.4	4.9	5.4
53.5	3.2	3.5	3.8	4.2	4.6	5.0	5.5
54.0	3.3	3.6	3.9	4.3	4.7	5.2	5.7
54.5	3.4	3.7	4.0	4.4	4.8	5.3	5.9
55.0	3.5	3.8	4.2	4.5	5.0	5.5	6.1
55.5	3.6	3.9	4.3	4.7	5.1	5.7	6.3
56.0	3.7	4.0	4.4	4.8	5.3	5.8	6.4
56.5	3.8	4.1	4.5	5.0	5.4	6.0	6.6
57.0	3.9	4.3	4.6	5.1	5.6	6.1	6.8
57.5	4.0	4.4	4.8	5.2	5.7	6.3	7.0
58.0	4.1	4.5	4.9	5.4	5.9	6.5	7.1
58.5	4.2	4.6	5.0	5.5	6.0	6.6	7.3
59.0	4.3	4.7	5.1	5.6	6.2	6.8	7.5
59.5	4.4	4.8	5.3	5.7	6.3	6.9	7.7

Length (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
60.0	4.5	4.9	5.4	5.9	6.4	7.1	7.8
60.5	4.6	5.0	5.5	6.0	6.6	7.3	8.0
61.0	4.7	5.1	5.6	6.1	6.7	7.4	8.2
61.5	4.8	5.2	5.7	6.3	6.9	7.6	8.4
62.0	4.9	5.3	5.8	6.4	7.0	7.7	8.5
62.5	5.0	5.4	5.9	6.5	7.1	7.8	8.7
63.0	5.1	5.5	6.0	6.6	7.3	8.0	8.8
63.5	5.2	5.6	6.2	6.7	7.4	8.1	9.0
64.0	5.3	5.7	6.3	6.9	7.5	8.3	9.1
64.5	5.4	5.8	6.4	7.0	7.6	8.4	9.3
65.0	5.5	5.9	6.5	7.1	7.8	8.6	9.5
65.5	5.5	6.0	6.6	7.2	7.9	8.7	9.6
66.0	5.6	6.1	6.7	7.3	8.0	8.8	9.8
66.5	5.7	6.2	6.8	7.4	8.1	9.0	9.9
67.0	5.8	6.3	6.9	7.5	8.3	9.1	10.0
67.5	5.9	6.4	7.0	7.6	8.4	9.2	10.2
68.0	6.0	6.5	7.1	7.7	8.5	9.4	10.3
68.5	6.1	6.6	7.2	7.9	8.6	9.5	10.5
69.0	6.1	6.7	7.3	8.0	8.7	9.6	10.6
69.5	6.2	6.8	7.4	8.1	8.8	9.7	10.7
70.0	6.3	6.9	7.5	8.2	9.0	9.9	10.9
70.5	6.4	6.9	7.6	8.3	9.1	10.0	11.0
71.0	6.5	7.0	7.7	8.4	9.2	10.1	11.1
71.5	6.5	7.1	7.7	8.5	9.3	10.2	11.3
72.0	6.6	7.2	7.8	8.6	9.4	10.3	11.4
72.5	6.7	7.3	7.9	8.7	9.5	10.5	11.5
73.0	6.8	7.4	8.0	8.8	9.6	10.6	11.7
73.5	6.9	7.4	8.1	8.9	9.7	10.7	11.8
74.0	6.9	7.5	8.2	9.0	9.8	10.8	11.9
74.5	7.0	7.6	8.3	9.1	9.9	10.9	12.0
75.0	7.1	7.7	8.4	9.1	10.0	11.0	12.2

Length (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
75.5	7.1	7.8	8.5	9.2	10.1	11.1	12.3
76.0	7.2	7.8	8.5	9.3	10.2	11.2	12.4
76.5	7.3	7.9	8.6	9.4	10.3	11.4	12.5
77.0	7.4	8.0	8.7	9.5	10.4	11.5	12.6
77.5	7.4	8.1	8.8	9.6	10.5	11.6	12.8
78.0	7.5	8.2	8.9	9.7	10.6	11.7	12.9
78.5	7.6	8.2	9.0	9.8	10.7	11.8	13.0
79.0	7.7	8.3	9.1	9.9	10.8	11.9	13.1
79.5	7.7	8.4	9.1	10.0	10.9	12.0	13.3
80.0	7.8	8.5	9.2	10.1	11.0	12.1	13.4
80.5	7.9	8.6	9.3	10.2	11.2	12.3	13.5
81.0	8.0	8.7	9.4	10.3	11.3	12.4	13.7
81.5	8.1	8.8	9.5	10.4	11.4	12.5	13.8
82.0	8.1	8.8	9.6	10.5	11.5	12.6	13.9
82.5	8.2	8.9	9.7	10.6	11.6	12.8	14.1
83.0	8.3	9.0	9.8	10.7	11.8	12.9	14.2
83.5	8.4	9.1	9.9	10.9	11.9	13.1	14.4
84.0	8.5	9.2	10.1	11.0	12.0	13.2	14.5
84.5	8.6	9.3	10.2	11.1	12.1	13.3	14.7
85.0	8.7	9.4	10.3	11.2	12.3	13.5	14.9
85.5	8.8	9.5	10.4	11.3	12.4	13.6	15.0
86.0	8.9	9.7	10.5	11.5	12.6	13.8	15.2
86.5	9.0	9.8	10.6	11.6	12.7	13.9	15.4
87.0	9.1	9.9	10.7	11.7	12.8	14.1	15.5
87.5	9.2	10.0	10.9	11.8	13.0	14.2	15.7
88.0	9.3	10.1	11.0	12.0	13.1	14.4	15.9
88.5	9.4	10.2	11.1	12.1	13.2	14.5	16.0
89.0	9.5	10.3	11.2	12.2	13.4	14.7	16.2
89.5	9.6	10.4	11.3	12.3	13.5	14.8	16.4
90.0	9.7	10.5	11.4	12.5	13.7	15.0	16.5
90.5	9.8	10.6	11.5	12.6	13.8	15.1	16.7

Length (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
91.0	9.9	10.7	11.7	12.7	13.9	15.3	16.9
91.5	10.0	10.8	11.8	12.8	14.1	15.5	17.0
92.0	10.1	10.9	11.9	13.0	14.2	15.6	17.2
92.5	10.1	11.0	12.0	13.1	14.3	15.8	17.4
93.0	10.2	11.1	12.1	13.2	14.5	15.9	17.5
93.5	10.3	11.2	12.2	13.3	14.6	16.1	17.7
94.0	10.4	11.3	12.3	13.5	14.7	16.2	17.9
94.5	10.5	11.4	12.4	13.6	14.9	16.4	18.0
95.0	10.6	11.5	12.6	13.7	15.0	16.5	18.2
95.5	10.7	11.6	12.7	13.8	15.2	16.7	18.4
96.0	10.8	11.7	12.8	14.0	15.3	16.8	18.6
96.5	10.9	11.8	12.9	14.1	15.4	17.0	18.7
97.0	11.0	12.0	13.0	14.2	15.6	17.1	18.9
97.5	11.1	12.1	13.1	14.4	15.7	17.3	19.1
98.0	11.2	12.2	13.3	14.5	15.9	17.5	19.3
98.5	11.3	12.3	13.4	14.6	16.0	17.6	19.5
99.0	11.4	12.4	13.5	14.8	16.2	17.8	19.6
99.5	11.5	12.5	13.6	14.9	16.3	18.0	19.8
100.0	11.6	12.6	13.7	15.0	16.5	18.1	20.0
100.5	11.7	12.7	13.9	15.2	16.6	18.3	20.2
101.0	11.8	12.8	14.0	15.3	16.8	18.5	20.4
101.5	11.9	13.0	14.1	15.5	17.0	18.7	20.6
102.0	12.0	13.1	14.3	15.6	17.1	18.9	20.8
102.5	12.1	13.2	14.4	15.8	17.3	19.0	21.0
103.0	12.3	13.3	14.5	15.9	17.5	19.2	21.3
103.5	12.4	13.5	14.7	16.1	17.6	19.4	21.5
104.0	12.5	13.6	14.8	16.2	17.8	19.6	21.7
104.5	12.6	13.7	15.0	16.4	18.0	19.8	21.9
105.0	12.7	13.8	15.1	16.5	18.2	20.0	22.2
105.5	12.8	14.0	15.3	16.7	18.4	20.2	22.4
106.0	13.0	14.1	15.4	16.9	18.5	20.5	22.6

Length (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
106.5	13.1	14.3	15.6	17.1	18.7	20.7	22.9
107.0	13.2	14.4	15.7	17.2	18.9	20.9	23.1
107.5	13.3	14.5	15.9	17.4	19.1	21.1	23.4
108.0	13.5	14.7	16.0	17.6	19.3	21.3	23.6
108.5	13.6	14.8	16.2	17.8	19.5	21.6	23.9
109.0	13.7	15.0	16.4	18.0	19.7	21.8	24.2
109.5	13.9	15.1	16.5	18.1	20.0	22.0	24.4
110.0	14.0	15.3	16.7	18.3	20.2	22.3	24.7

Table A5.2.3 Weight-for-height from 2 to 5 years: Boys

Height (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
65.0	5.9	6.3	6.9	7.4	8.1	8.8	9.6
65.5	6.0	6.4	7.0	7.6	8.2	8.9	9.8
66.0	6.1	6.5	7.1	7.7	8.3	9.1	9.9
66.5	6.1	6.6	7.2	7.8	8.5	9.2	10.1
67.0	6.2	6.7	7.3	7.9	8.6	9.4	10.2
67.5	6.3	6.8	7.4	8.0	8.7	9.5	10.4
68.0	6.4	6.9	7.5	8.1	8.8	9.6	10.5
68.5	6.5	7.0	7.6	8.2	9.0	9.8	10.7
69.0	6.6	7.1	7.7	8.4	9.1	9.9	10.8
69.5	6.7	7.2	7.8	8.5	9.2	10.0	11.0
70.0	6.8	7.3	7.9	8.6	9.3	10.2	11.1
70.5	6.9	7.4	8.0	8.7	9.5	10.3	11.3
71.0	6.9	7.5	8.1	8.8	9.6	10.4	11.4
71.5	7.0	7.6	8.2	8.9	9.7	10.6	11.6
72.0	7.1	7.7	8.3	9.0	9.8	10.7	11.7
72.5	7.2	7.8	8.4	9.1	9.9	10.8	11.8
73.0	7.3	7.9	8.5	9.2	10.0	11.0	12.0
73.5	7.4	7.9	8.6	9.3	10.2	11.1	12.1
74.0	7.4	8.0	8.7	9.4	10.3	11.2	12.2
74.5	7.5	8.1	8.8	9.5	10.4	11.3	12.4

Height (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
75.0	7.6	8.2	8.9	9.6	10.5	11.4	12.5
75.5	7.7	8.3	9.0	9.7	10.6	11.6	12.6
76.0	7.7	8.4	9.1	9.8	10.7	11.7	12.8
76.5	7.8	8.5	9.2	9.9	10.8	11.8	12.9
77.0	7.9	8.5	9.2	10.0	10.9	11.9	13.0
77.5	8.0	8.6	9.3	10.1	11.0	12.0	13.1
78.0	8.0	8.7	9.4	10.2	11.1	12.1	13.3
78.5	8.1	8.8	9.5	10.3	11.2	12.2	13.4
79.0	8.2	8.8	9.6	10.4	11.3	12.3	13.5
79.5	8.3	8.9	9.7	10.5	11.4	12.4	13.6
80.0	8.3	9.0	9.7	10.6	11.5	12.6	13.7
80.5	8.4	9.1	9.8	10.7	11.6	12.7	13.8
81.0	8.5	9.2	9.9	10.8	11.7	12.8	14.0
81.5	8.6	9.3	10.0	10.9	11.8	12.9	14.1
82.0	8.7	9.3	10.1	11.0	11.9	13.0	14.2
82.5	8.7	9.4	10.2	11.1	12.1	13.1	14.4
83.0	8.8	9.5	10.3	11.2	12.2	13.3	14.5
83.5	8.9	9.6	10.4	11.3	12.3	13.4	14.6
84.0	9.0	9.7	10.5	11.4	12.4	13.5	14.8
84.5	9.1	9.9	10.7	11.5	12.5	13.7	14.9
85.0	9.2	10.0	10.8	11.7	12.7	13.8	15.1
85.5	9.3	10.1	10.9	11.8	12.8	13.9	15.2
86.0	9.4	10.2	11.0	11.9	12.9	14.1	15.4
86.5	9.5	10.3	11.1	12.0	13.1	14.2	15.5
87.0	9.6	10.4	11.2	12.2	13.2	14.4	15.7
87.5	9.7	10.5	11.3	12.3	13.3	14.5	15.8
88.0	9.8	10.6	11.5	12.4	13.5	14.7	16.0
88.5	9.9	10.7	11.6	12.5	13.6	14.8	16.1
89.0	10.0	10.8	11.7	12.6	13.7	14.9	16.3
89.5	10.1	10.9	11.8	12.8	13.9	15.1	16.4
90.0	10.2	11.0	11.9	12.9	14.0	15.2	16.6

Height (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
90.5	10.3	11.1	12.0	13.0	14.1	15.3	16.7
91.0	10.4	11.2	12.1	13.1	14.2	15.5	16.9
91.5	10.5	11.3	12.2	13.2	14.4	15.6	17.0
92.0	10.6	11.4	12.3	13.4	14.5	15.8	17.2
92.5	10.7	11.5	12.4	13.5	14.6	15.9	17.3
93.0	10.8	11.6	12.6	13.6	14.7	16.0	17.5
93.5	10.9	11.7	12.7	13.7	14.9	16.2	17.6
94.0	11.0	11.8	12.8	13.8	15.0	16.3	17.8
94.5	11.1	11.9	12.9	13.9	15.1	16.5	17.9
95.0	11.1	12.0	13.0	14.1	15.3	16.6	18.1
95.5	11.2	12.1	13.1	14.2	15.4	16.7	18.3
96.0	11.3	12.2	13.2	14.3	15.5	16.9	18.4
96.5	11.4	12.3	13.3	14.4	15.7	17.0	18.6
97.0	11.5	12.4	13.4	14.6	15.8	17.2	18.8
97.5	11.6	12.5	13.6	14.7	15.9	17.4	18.9
98.0	11.7	12.6	13.7	14.8	16.1	17.5	19.1
98.5	11.8	12.8	13.8	14.9	16.2	17.7	19.3
99.0	11.9	12.9	13.9	15.1	16.4	17.9	19.5
99.5	12.0	13.0	14.0	15.2	16.5	18.0	19.7
100.0	12.1	13.1	14.2	15.4	16.7	18.2	19.9
100.5	12.2	13.2	14.3	15.5	16.9	18.4	20.1
101.0	12.3	13.3	14.4	15.6	17.0	18.5	20.3
101.5	12.4	13.4	14.5	15.8	17.2	18.7	20.5
102.0	12.5	13.6	14.7	15.9	17.3	18.9	20.7
102.5	12.6	13.7	14.8	16.1	17.5	19.1	20.9
103.0	12.8	13.8	14.9	16.2	17.7	19.3	21.1
103.5	12.9	13.9	15.1	16.4	17.8	19.5	21.3
104.0	13.0	14.0	15.2	16.5	18.0	19.7	21.6
104.5	13.1	14.2	15.4	16.7	18.2	19.9	21.8
105.0	13.2	14.3	15.5	16.8	18.4	20.1	22.0
105.5	13.3	14.4	15.6	17.0	18.5	20.3	22.2

Height (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
106.0	13.4	14.5	15.8	17.2	18.7	20.5	22.5
106.5	13.5	14.7	15.9	17.3	18.9	20.7	22.7
107.0	13.7	14.8	16.1	17.5	19.1	20.9	22.9
107.5	13.8	14.9	16.2	17.7	19.3	21.1	23.2
108.0	13.9	15.1	16.4	17.8	19.5	21.3	23.4
108.5	14.0	15.2	16.5	18.0	19.7	21.5	23.7
109.0	14.1	15.3	16.7	18.2	19.8	21.8	23.9
109.5	14.3	15.5	16.8	18.3	20.0	22.0	24.2
110.0	14.4	15.6	17.0	18.5	20.2	22.2	24.4
110.5	14.5	15.8	17.1	18.7	20.4	22.4	24.7
111.0	14.6	15.9	17.3	18.9	20.7	22.7	25.0
111.5	14.8	16.0	17.5	19.1	20.9	22.9	25.2
112.0	14.9	16.2	17.6	19.2	21.1	23.1	25.5
112.5	15.0	16.3	17.8	19.4	21.3	23.4	25.8
113.0	15.2	16.5	18.0	19.6	21.5	23.6	26.0
113.5	15.3	16.6	18.1	19.8	21.7	23.9	26.3
114.0	15.4	16.8	18.3	20.0	21.9	24.1	26.6
114.5	15.6	16.9	18.5	20.2	22.1	24.4	26.9
115.0	15.7	17.1	18.6	20.4	22.4	24.6	27.2
115.5	15.8	17.2	18.8	20.6	22.6	24.9	27.5
116.0	16.0	17.4	19.0	20.8	22.8	25.1	27.8
116.5	16.1	17.5	19.2	21.0	23.0	25.4	28.0
117.0	16.2	17.7	19.3	21.2	23.3	25.6	28.3
117.5	16.4	17.9	19.5	21.4	23.5	25.9	28.6
118.0	16.5	18.0	19.7	21.6	23.7	26.1	28.9
118.5	16.7	18.2	19.9	21.8	23.9	26.4	29.2
119.0	16.8	18.3	20.0	22.0	24.1	26.6	29.5
119.5	16.9	18.5	20.2	22.2	24.4	26.9	29.8
120.0	17.1	18.6	20.4	22.4	24.6	27.2	30.1

Table A5.2.4 Weight-for-height from 2 to 5 years: Girls

Height (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
65.0	5.6	6.1	6.6	7.2	7.9	8.7	9.7
65.5	5.7	6.2	6.7	7.4	8.1	8.9	9.8
66.0	5.8	6.3	6.8	7.5	8.2	9.0	10.0
66.5	5.8	6.4	6.9	7.6	8.3	9.1	10.1
67.0	5.9	6.4	7.0	7.7	8.4	9.3	10.2
67.5	6.0	6.5	7.1	7.8	8.5	9.4	10.4
68.0	6.1	6.6	7.2	7.9	8.7	9.5	10.5
68.5	6.2	6.7	7.3	8.0	8.8	9.7	10.7
69.0	6.3	6.8	7.4	8.1	8.9	9.8	10.8
69.5	6.3	6.9	7.5	8.2	9.0	9.9	10.9
70.0	6.4	7.0	7.6	8.3	9.1	10.0	11.1
70.5	6.5	7.1	7.7	8.4	9.2	10.1	11.2
71.0	6.6	7.1	7.8	8.5	9.3	10.3	11.3
71.5	6.7	7.2	7.9	8.6	9.4	10.4	11.5
72.0	6.7	7.3	8.0	8.7	9.5	10.5	11.6
72.5	6.8	7.4	8.1	8.8	9.7	10.6	11.7
73.0	6.9	7.5	8.1	8.9	9.8	10.7	11.8
73.5	7.0	7.6	8.2	9.0	9.9	10.8	12.0
74.0	7.0	7.6	8.3	9.1	10.0	11.0	12.1
74.5	7.1	7.7	8.4	9.2	10.1	11.1	12.2
75.0	7.2	7.8	8.5	9.3	10.2	11.2	12.3
75.5	7.2	7.9	8.6	9.4	10.3	11.3	12.5
76.0	7.3	8.0	8.7	9.5	10.4	11.4	12.6
76.5	7.4	8.0	8.7	9.6	10.5	11.5	12.7
77.0	7.5	8.1	8.8	9.6	10.6	11.6	12.8
77.5	7.5	8.2	8.9	9.7	10.7	11.7	12.9
78.0	7.6	8.3	9.0	9.8	10.8	11.8	13.1
78.5	7.7	8.4	9.1	9.9	10.9	12.0	13.2
79.0	7.8	8.4	9.2	10.0	11.0	12.1	13.3
79.5	7.8	8.5	9.3	10.1	11.1	12.2	13.4

Height (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
80.0	7.9	8.6	9.4	10.2	11.2	12.3	13.6
80.5	8.0	8.7	9.5	10.3	11.3	12.4	13.7
81.0	8.1	8.8	9.6	10.4	11.4	12.6	13.9
81.5	8.2	8.9	9.7	10.6	11.6	12.7	14.0
82.0	8.3	9.0	9.8	10.7	11.7	12.8	14.1
82.5	8.4	9.1	9.9	10.8	11.8	13.0	14.3
83.0	8.5	9.2	10.0	10.9	11.9	13.1	14.5
83.5	8.5	9.3	10.1	11.0	12.1	13.3	14.6
84.0	8.6	9.4	10.2	11.1	12.2	13.4	14.8
84.5	8.7	9.5	10.3	11.3	12.3	13.5	14.9
85.0	8.8	9.6	10.4	11.4	12.5	13.7	15.1
85.5	8.9	9.7	10.6	11.5	12.6	13.8	15.3
86.0	9.0	9.8	10.7	11.6	12.7	14.0	15.4
86.5	9.1	9.9	10.8	11.8	12.9	14.2	15.6
87.0	9.2	10.0	10.9	11.9	13.0	14.3	15.8
87.5	9.3	10.1	11.0	12.0	13.2	14.5	15.9
88.0	9.4	10.2	11.1	12.1	13.3	14.6	16.1
88.5	9.5	10.3	11.2	12.3	13.4	14.8	16.3
89.0	9.6	10.4	11.4	12.4	13.6	14.9	16.4
89.5	9.7	10.5	11.5	12.5	13.7	15.1	16.6
90.0	9.8	10.6	11.6	12.6	13.8	15.2	16.8
90.5	9.9	10.7	11.7	12.8	14.0	15.4	16.9
91.0	10.0	10.9	11.8	12.9	14.1	15.5	17.1
91.5	10.1	11.0	11.9	13.0	14.3	15.7	17.3
92.0	10.2	11.1	12.0	13.1	14.4	15.8	17.4
92.5	10.3	11.2	12.1	13.3	14.5	16.0	17.6
93.0	10.4	11.3	12.3	13.4	14.7	16.1	17.8
93.5	10.5	11.4	12.4	13.5	14.8	16.3	17.9
94.0	10.6	11.5	12.5	13.6	14.9	16.4	18.1
94.5	10.7	11.6	12.6	13.8	15.1	16.6	18.3
95.0	10.8	11.7	12.7	13.9	15.2	16.7	18.5

Height (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
95.5	10.8	11.8	12.8	14.0	15.4	16.9	18.6
96.0	10.9	11.9	12.9	14.1	15.5	17.0	18.8
96.5	11.0	12.0	13.1	14.3	15.6	17.2	19.0
97.0	11.1	12.1	13.2	14.4	15.8	17.4	19.2
97.5	11.2	12.2	13.3	14.5	15.9	17.5	19.3
98.0	11.3	12.3	13.4	14.7	16.1	17.7	19.5
98.5	11.4	12.4	13.5	14.8	16.2	17.9	19.7
99.0	11.5	12.5	13.7	14.9	16.4	18.0	19.9
99.5	11.6	12.7	13.8	15.1	16.5	18.2	20.1
100.0	11.7	12.8	13.9	15.2	16.7	18.4	20.3
100.5	11.9	12.9	14.1	15.4	16.9	18.6	20.5
101.0	12.0	13.0	14.2	15.5	17.0	18.7	20.7
101.5	12.1	13.1	14.3	15.7	17.2	18.9	20.9
102.0	12.2	13.3	14.5	15.8	17.4	19.1	21.1
102.5	12.3	13.4	14.6	16.0	17.5	19.3	21.4
103.0	12.4	13.5	14.7	16.1	17.7	19.5	21.6
103.5	12.5	13.6	14.9	16.3	17.9	19.7	21.8
104.0	12.6	13.8	15.0	16.4	18.1	19.9	22.0
104.5	12.8	13.9	15.2	16.6	18.2	20.1	22.3
105.0	12.9	14.0	15.3	16.8	18.4	20.3	22.5
105.5	13.0	14.2	15.5	16.9	18.6	20.5	22.7
106.0	13.1	14.3	15.6	17.1	18.8	20.8	23.0
106.5	13.3	14.5	15.8	17.3	19.0	21.0	23.2
107.0	13.4	14.6	15.9	17.5	19.2	21.2	23.5
107.5	13.5	14.7	16.1	17.7	19.4	21.4	23.7
108.0	13.7	14.9	16.3	17.8	19.6	21.7	24.0
108.5	13.8	15.0	16.4	18.0	19.8	21.9	24.3
109.0	13.9	15.2	16.6	18.2	20.0	22.1	24.5
109.5	14.1	15.4	16.8	18.4	20.3	22.4	24.8
110.0	14.2	15.5	17.0	18.6	20.5	22.6	25.1
110.5	14.4	15.7	17.1	18.8	20.7	22.9	25.4

Height (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
111.0	14.5	15.8	17.3	19.0	20.9	23.1	25.7
111.5	14.7	16.0	17.5	19.2	21.2	23.4	26.0
112.0	14.8	16.2	17.7	19.4	21.4	23.6	26.2
112.5	15.0	16.3	17.9	19.6	21.6	23.9	26.5
113.0	15.1	16.5	18.0	19.8	21.8	24.2	26.8
113.5	15.3	16.7	18.2	20.0	22.1	24.4	27.1
114.0	15.4	16.8	18.4	20.2	22.3	24.7	27.4
114.5	15.6	17.0	18.6	20.5	22.6	25.0	27.8
115.0	15.7	17.2	18.8	20.7	22.8	25.2	28.1
115.5	15.9	17.3	19.0	20.9	23.0	25.5	28.4
116.0	16.0	17.5	19.2	21.1	23.3	25.8	28.7
116.5	16.2	17.7	19.4	21.3	23.5	26.1	29.0
117.0	16.3	17.8	19.6	21.5	23.8	26.3	29.3
117.5	16.5	18.0	19.8	21.7	24.0	26.6	29.6
118.0	16.6	18.2	19.9	22.0	24.2	26.9	29.9
118.5	16.8	18.4	20.1	22.2	24.5	27.2	30.3
119.0	16.9	18.5	20.3	22.4	24.7	27.4	30.6
119.5	17.1	18.7	20.5	22.6	25.0	27.7	30.9
120.0	17.3	18.9	20.7	22.8	25.2	28.0	31.2

Notes

ANNEX 6

Job aids and charts

A pocket book does not allow the reproduction in a readable size of job aids and charts that people might find useful in their daily work. Several job aids can be found in the manual *Management of the child with a serious infection or severe malnutrition* (**http://www.who.int/maternal_child_adolescent/documents/fch_cah_00_1/en/**). In addition, the charts listed below can be downloaded in PDF format from the website of the WHO Department of Maternal, Newborn, Child and Adolescent Health and Development (**http://www.who.int/maternal_child_adolescent/en/**):

- Monitoring chart
- Mother's card
- Weight chart
- 24-h food intake chart
- Daily ward feed chart

Notes

Index

A

Abacavir 234, 236, 372
Abdominal distension 54, 62, 146, 265
Abdominal pain 281
Abdominal tenderness 151, 181
Abdominal wall defects 67, 266
Abscess 155, 287
  brain 182
  drainage of 288
  lung 89, 110
  mastoid 182
  retropharyngeal 21, 102
Acetylcysteine 31
Acidosis 162
Activated charcoal 28, 30, 31
Acyanotic, heart disease 78
Adrenaline 99, 104, 109, 355
Aids, see HIV/AIDS 223, 225
Airway obstruction 8
Airway management 113, 252
Albendazole 208
Aminophylline 61, 69, 100, 355
Amoebiasis 145, 366
Amoxicillin 95, 183, 207, 257, 356
Amphotericin 246, 356
Ampicillin 69, 82, 88, 169, 180, 356
Anaemia 160, 218, 307, 308
Anaesthetics 307
Analgesics 306
Anaphylaxis 103, 108
Antipyretic 58, 305
Antiretroviral, therapy 232, 233
  drugs 233–4, 370–3
  side effects 235–6
Antiseptic 338
Antituberculosis antibiotics 357
Antivenom 35
Apnoea 52, 61
Appendicitis 282
Artemether 158, 357
Artemisinin-based combination 164
  artemether/lumefantrine 164, 357
  artesunate/amodiaquine 164
  artesunate/mefloquine 165, 357
  artesunate plus sulfadoxine 164
  dihydroartemisinin/piperaquine 165
Artesunate 158, 357
Arthritis, septic 152, 186, 289, 290
Asphyxia 25
Asthma 93, 96, 99, 110
Atazanavir 234, 236
Atropine 30, 217
AVPU 18
Azithromycin 112, 114, 181

B

Bacterial infection 54, 207
BCG 50, 68, 116, 238, 326
  HIV disseminated BCG disease 241
Benzathine penicillin 72, 367
Benzylpenicillin 71, 95, 169, 207, 367

Birth trauma 25
Bitot's spots 199
Bleeding in shock 22,
dengue 189
wounds 279
Blood transfusion 161, 308
Borreliosis 156
Bowel obstruction 265, 283
Breastfeeding 50, 294, 296
HIV transmission 248
Bronchiectasis 110
Bronchiolitis 93, 94
Bronchodilator, rapid acting 92, 98, 355
Brucellosis 155
Budesonide 103
Bupivacaine 258, 279
Burns 269
surface area (%) 270

C

Caffeine citrate 61, 69
Candidiasis, oral and oesophageal 246
Carbon monoxide poisoning 33
Cardiac failure 78
Cardiac shock 22
Catch-up growth feeding 210
Cefalexin 358
Cefotaxime 56, 70, 169, 358
Ceftriaxone 56, 66, 70, 82, 144, 169, 180, 358
Chest drainage 88, 348
Chest injuries 38, 273
Chest wall indrawing 81, 97
Chest X-ray 82, 85
Chloramphenicol 169, 171, 359
Chloroquine 165
Chlorphenamine 35, 36, 312, 359
Choking infant or child 7, 8, 119
Cholera 126, 127, 130
Ciprofloxacin 144, 181, 184, 360
Circulation assessment for shock 4, 21
Cleft lip and palate 67, 264
Cloxacillin 70, 82, 88, 187, 360
Coma 2, 6, 18, 159
Congenital heart disease 78, 120
Congenital malformations 67
Congenital syphilis 67
Conjunctivitis, neonatal 66
measles conjunctivitis 176, 178
Convulsions 15, 18, 23–25, 53, 54, 160
Corneal clouding 175, 217
Corneal ulceration 199, 200, 208
Cotrimoxazole 84, 183, 241, 245, 360
Cough 75, 77, 81
chronic cough 109, 110
Counselling 322
HIV and breast feeding 249
HIV counselling and testing 228
nutrition and home care 323, 324
Croup 21, 79, 103
measles 176
severe viral croup 102
Cryptococcal meningitis 172, 246
Cyanosis 4, 80
Cytomegalovirus infection 232

D

Dapsone 242
Darrow's solution 14, 204, 266, 285
Decontamination, gastric 27
Deferoxamine 32, 361
Dehydration 2, 17, 128, 203
assessment 18, 128
in severe acute malnutrition 203, 205

some dehydration 132
no dehydration 134
severe dehydration 17, 129
Dengue, 22, 188
severe 188
shock syndrome 189
shock treatment 190
Dengue haemorrhagic fever 23, 153
Dexamethasone 61, 103, 170, 172, 361
Dextran 190
Dextrostix 350
Diabetic ketoacidosis 25
Diarrhoea 6, 125
acute watery 127
persistent 127, 137, 142
in severe acute malnutrition 219
Diarrhoea treatment, plan A 138
Plan B 135
Plan C 131
Diazepam 15, 361
Diets, low lactose 141
free lactose 141, 219
Digoxin 362
Diphtheria 21, 79, 103, 105
antitoxin 105
toxoid 107
Diuretics 121
Dobutamine 362
Dopamine 180, 362
DPT 114, 325–6
Drug dosages, children 353–373
neonates 69–72
Dysentery 127, 143

E

Ear infections 182
acute 183
chronic 184
wicking 183
Efavirenz 233–4, 236, 372
Electrolyte imbalance 206
Electrolyte/mineral solution 205, 212
Emergency signs 2, 3, 5
Empyema 78, 88
Emtricitabine 234, 236, 240
Encephalitis 25, 167, 177
Encephalopathy 25, 232
Endocarditis, infective 121, 123, 155
Endotracheal tube sizes 259
Envenoming 34, 37, 38
Epiglottitis, acute 103, 107
Epilepticus, status 15
Equipment, paediatric sizes 375
Erythromycin 112, 114, 362
Ethambutol 116, 172, 370
Eye problems 176, 217

F

F-75 refeeding 209, 212–13
F-100 refeeding 212–13
Failure to thrive 78, 109, 110, 216
Fentanyl 307, 363
Ferrous sulfate 364
Fever 15, 58, 83, 149
lasting 7 days or less 150, 151
lasting > 7 days 153, 155
management 305
with localized signs 152
with rash 153
without localized signs 151
relapsing fever 153
Flucloxacillin 363
Fluconazole 363
Fluid management 57, 190, 261, 304
Fluid overload 191
Folate 141, 161, 166, 364
Follow-up care 327
Food intake chart 403
Foreign body inhalation 5, 21, 102, 119

Fractures 275–9
Fungal infection, HIV 246
Furazolidone 363
Furosemide 121, 159, 192, 363

G

Gallows traction 277
Gastric lavage 32
Gentamicin 56, 71, 82, 88, 180, 184, 186, 363
Gentian violet 177, 218, 252, 364
Giardiasis 219, 366
Glomerulonephritis, acute 25, 121
Glucose 16, 53, 350
Growth charts 384–5

H

Haemolytic disease, newborn 25, 64
Haemolytic-uraemic syndrome 143, 146
Haemophilus influenzae type b 76, 179, 241
Haemorrhagic rash 150
Haemothorax 274
Hartmann's solution 129
Head injury 272
Heart failure 120
Heimlich manoeuvre 8
Hepatitis 152, 326
Hernia 285, 286
Herpes zoster 227
Hirschsprung disease 265
HIV/AIDS 115, 116, 223, 225, 321
  breastfeeding 247–8
  clinical diagnosis 226
  co-trimoxazole prophylaxis 241
  counselling 228
  discharge and follow-up 249, 250
  management of related conditions 243
  pain control 250
  palliative care 250–3
  testing 229
  treatment 232
  vaccination 240
Hookworm infestation 166, 307
Hydrocoele 285, 286
Hydrocortisone 99, 311, 312, 368
Hydromorphone 307, 364
Hyperinflated chest, X-ray appearance 85
Hyperparasitaemia, malaria 157
Hypoglycaemia 16, 53, 157, 161, 173, 201, 260
Hyponatraemia 378
Hypothermia, newborn 59,
  severe acute malnutrition 202
Hypoxic ischaemic encephalopathy 51

I

Ibuprofen 180, 251, 305, 306, 364
IMCI 41
Immunization status 325, 326
Indian ink 172, 246
Injections, giving 335
Intraosseous infusion 340
Intussusception 127, 284
Ipecacuanha 28
Iron, anaemia, treatment 307
  dosage 364
  malnutrition 208–9
  newborn supplement 61
  poisoning 32, 361
Isoniazid 68, 172, 370
  preventive therapy 118,
  preventive therapy in HIV 244
IV fluids 12, 14, 17, 131, 378

J

Jaundice, neonatal 64
Joint infections 186
Jones criteria 194

K

Kanamycin 67, 71, 364
Kangaroo mother care 59
Kaposi sarcoma 246
Keratomalacia 199
Ketamine 258, 333, 365
Kwashiorkor 198, 200, 218

L

Lactose intolerance 219
Lactose-free 141
Lamivudine 234, 236, 240, 372
Laryngoscope, size 375
Lethargy 23, 24, 25, 126
Lopinavir/ritonavir 233–4, 236, 371
Low-birth-weight 58, 61
Lumbar puncture 169, 346
Lung abscess 89

M

Magnesium sulfate 99
Malaria 151, 156
  cerebral 159
  uncomplicated 163
  severe 156
  treatment 157, 164
Malnutrition, emergency treatment 19
  severe acute malnutrition 197
  plan of inpatient care 200
Mantoux test 79, 116, 154, 219
Marasmus 198
Mastoiditis 152, 182
Measles 153, 174
  complications 176–7
  non-severe 178
  severe complicated 175
Mebendazole 166, 287, 365
Meningitis 25, 55, 167
  bacterial 55, 167
  cryptococcal 172
  fluid management 173
  meningococcal 170
  tuberculous 171
Meningococcal infection 150, 170
Metoclopramide 252, 366
Metronidazole 139, 177, 219, 257, 366
Micronutrient deficiencies 208
Mid-Upper-Arm Circumference (MUAC) 198, 220
Miliary tuberculosis, X-ray 85
Monitoring 221, 319
  chart 320
  fluid intake 304
  procedures 319
Morphine 40, 262, 366
  poisoning 32
Mortality audit 221
Mother's card 322, 403
Mouth ulcers 177, 252
Mult-drug reistant TB 117, 172, 370
Multivitamins 141
Myelomeningocoele 267
Myocarditis 105, 107, 120

N

Naloxone 32, 71
Nasal catheter 11, 314
Nasal prongs 11, 58, 82, 314
Nasogastric tube insertion 345
Nasopharyngeal catheter 314
Necrotizing enterocolitis 62, 265
Neonatal problems, common 64
Neonatal resuscitation 46–49
Neonatal sepsis 54, 62

Neonatal tetanus 25
Nevirapine 234, 236, 373
Nutrition, assessing status 379
  breastfeeding 294
  counselling 323
Nutritional management 294
Nystatin 246, 297, 366

O

Ophthalmia neonatorum 66
Opisthotonus 23, 168
Oral polio vaccine 326
Oral rehydration solution 129, 135, 204
Oral thrush 227, 246, 252
Osteomyelitis 152, 186, 288
Otitis media 152
  acute 183
  chronic 184
Oxacillin 360
Oxygen therapy 58, 77, 82, 113, 312

P

Pain control 250, 262, 306
Palmar pallor 78, 166
  severe 160
Paracetamol 251, 272, 305, 366
  poisoning 31
Parenteral fluids 338
Parotitis, chronic 110, 227
PCP (*pneumocystis jiroveci* pneumonia) 241, 244
Penicillin, benzathine 367
  benzylpenicillin 71, 367
  procaine 72, 367
Pentamidine 245
Pericarditis 120
Peritonitis 282
Persistent diarrhoea 137
Pertussis 79, 110, 111
Phenobarbital 15, 54, 72, 367
Phenytoin 15, 359
Phototherapy 65
Plasmodium falciparum 156
Play therapy 215, 315
Pleural effusion 77, 88
Pneumococcal vaccine 241, 326
Pneumonia 21, 80, 93, 152
  aspiration 162
  complications 88
  lobar on X-ray 85
  pneumocystis (PCP) 241, 244
  severe 80
  staphylococcal 83
Pneumothorax 79, 85, 90, 349
Poisoning 26–29
  aspirin 31
  carbon monoxide 33
  corrosive compounds 29
  iron 32
  morphine/opiates 32
  organophosphorus/carbamates 30
  paracetamol 31
  petroleum compounds 30
Potassium 122, 368
Practical procedures 333
  giving injections 335
  giving parenteral fluids 338
  insertion of a chest drain 348
  insertion of a nasogastric tube 345
  insertion of peripheral vein cannula 338
  intraosseous infusion 340
  lumbar puncture 345
  measuring blood glucose 350
  supra-pubic aspiration 350
  umbilical vein catheterization 344
  venous cut-down 343

Prednisolone 99, 245, 368
Primaquine 165
Priority signs 3, 6, 19
Pupil size 168
Pyelonephritis 185, 186
Pyomyositis 291
Pyrazinamide 116, 172, 370

Q

Quinine 158, 368

R

Rectal prolapse 146, 287
Refeeding formulas 212–3
Relactation 135
Relapsing fever 153, 156
Resomal 204–5
Respiratory distress 6
  acidosis 162
  severe 4, 80
  syndrome, newborn 61
Rheumatic fever 120, 122, 193
Rheumatic heart disease 122
Rifampicin 116, 172, 370
Ringer's lactate solution 378
Rotavirus vaccine (rotarix) 326
Rubella vaccine 326

S

Salbutamol 92, 97-8, 101, 369
Salmonella 155, 179, 181, 288
Scorpion sting 37
Sepsis 26, 54, 67
Septic shock 13, 22
Septicaemia 88, 151, 179
Shigella 143, 145
Shock 2, 13, 18, 21, 22, 179, 189, 204
Silver sulfadiazine 369
Sinusitis 152
Skin infection 152
  lesions in kwashiorkor 218
Skin pinch, in dehydration 128
Snake bite 34
Spacer device 99
Spectinomycin 369
Stavudine 234, 236, 371
Steroids 99
Streptomycin 117, 370
Stridor 102, 103
Subconjunctival haemorrhage 111, 112, 114
Sublingual sugar 16, 161
Supportive care 293
  HIV positive children 240
  meningitis 172
  measles 178
  severe dengue 192
  severe pneumonia 83
  snake bite 36
Suprapubic aspiration 350
Surgical problems
  anaeasthesia 258
  fluid management 261
  postoperative care 260
  preoperative care 256
Syndrome of inappropriate antidiuretic hormone 173

T

TAC (Tetracaine, adrenaline, cocaine) 369
Talipes equinovarus 67, 268
Tenofovir 234, 236, 372
Testicular torsion 286
Tetanus, neonatal 25
Tetracycline 369
  eye ointment 176, 217
Thoracocentesis 349
Toys and play therapy 315

Tracheostomy 104, 106
Transfusion reactions 310
Trauma 38, 269
Trimethoprim-sulfamethoxazole 360
Tuberculosis 68, 79, 115, 219, 243
  miliary 85, 155
  treatment 116–7
Tuberculous, meningitis 171
  osteomyelitis 187
Typhoid fever 151, 180
  treatment 181
Typhus fever 153, 181

U

Umbilical sepsis 54
Unconscious child 12, 23–4, 159, 173
Underwater seal drainage 349
Urinary tract infection 179, 184

V

Vaccination, 325
Viral croup 102
Viral infections 90, 153
Vitamin A 176, 178, 217, 369
Vitamin D 61
Vitamin K 50

W

Weight-for age chart
  boys 384
  girls 385
Weight-for-age tables
  boys 379
  girls 381
Weight-for-height tables
  boys 395
  girls 399
Weight-for-length tables
  boys 386
  girls 391
Wheeze 91, 93, 101
Wound care, principles 279

X

Xerophthalamia 175

Y

Yellow fever vaccine 241, 325, 326

Z

Zidovudine (zdv) 234, 236, 372
Ziehl-Neelsen 115
Zinc supplement, acute malnutrition 208, 218
  diarrhoea 136, 138

DAILY MONITORING CHART

Date:	**Hospital Record number:**
1. Child's name:	**Mother's name:**
Age:	Weight on admission:
2. Diagnoses:	**Main problems:**
1)	
2)	
3)	
4)	

3. Vital signs	**DAY 1**	**DAY 2**	**DAY 3**	**DAY 4**
• Consciousness level (AVPU)				
• Temperature				
• Respiratory rate				
• Pulse rate				
4. Fluid balance (record volumes and times)				
IV				
By nasogastric tube				
Oral				
Fluid output				
5. Treatments given (sign on chart when given)				
Name of treatment: Dose:				
1)				
2)				
3)				
4)				
6. Feeding/Nutrition				
Child breastfed				
Drink taken				
Food taken				
Feeding problems (give details)				
Weight				

7. Outcome (circle one of the following): Discharged well / Absconded / Transferred / Died

The *Pocket Book* is for use by doctors, nurses and other health workers who are responsible for the care of young children at the first level referral hospitals. This second edition is based on evidence from several WHO updated and published clinical guidelines. It is for use in both inpatient and outpatient care in small hospitals with basic laboratory facilities and essential medicines. In some settings, these guidelines can be used in any facilities where sick children are admitted for inpatient care.

The *Pocket Book* is one of a series of documents and tools that support the Integrated Management of Childhood Illness (IMCI). The guidelines require the hospital to have (1) the capacity to carry out certain essential investigations, such as pulse oximetry, blood glucose, blood smear examinations for malaria parasites, estimation of haemoglobin, packed cell volume and full blood count, blood group and cross-match, and basic microscopy of cerebrospinal fluid and urine; and where possible blood and urine culture, ultrasound and basic x-rays; (2) essential medicines for the care of seriously ill children. Advanced and high care treatment options, such as intensive care or mechanical ventilation, are not described.

These guidelines focus on the management of the major causes of childhood mortality in most developing countries, such as newborn problems, pneumonia, diarrhoea, malaria, meningitis, septicaemia, measles and related conditions, severe acute malnutrition and paediatric HIV/AIDS. It also covers some common surgical conditions that can be managed in small hospitals.

Details of the evidence on which the *Pocket Book* is based can be found on WHO website from the published guidelines provided in the bibliography. These guidelines are applicable in most areas of the world and may be adapted to suit country specific circumstances. The online version will be updated regularly as new evidence emerges.

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