1.7 Safe blood transfusion practice

Introduction
Blood or blood products should be transfused only when they are needed to save life or to prevent major morbidity.

The risk of transmission of infection is a major concern in countries with limited resources and poorly organised blood transfusion services.

Blood must be stored safely, or a bank of adequately screened donors must be available 24 hours a day, especially for obstetric emergencies or major trauma.

When giving a blood transfusion, care must be taken to ensure that the blood is compatible with that of the recipient, is infection free and is given safely.

Clinical situations that require blood transfusion
Normal haemoglobin (Hb) levels (after the neonatal period) are around 129 g/L (12.9 g/dL). Children with severe anaemia have Hb levels of 50 g/L or less. An Hb level of 50 g/L is widely accepted as the level at which transfusion might be indicated, and less than 40 g/L if there is severe malnutrition.

Note: g/L divided by 10 = g/dL.

The WHO defines anaemia as any Hb level below 110 g/L. However, in pregnancy, normal haemodilution means that a cut-off value of less than 10 g/dL is more appropriate. In a pregnant woman, transfusion may be considered at an Hb level of 60–70 g/L, taking into account other factors.

In addition to Hb level, the following factors must be taken into account when considering transfusion:

- Heart rate. If it is rapid, this will favour the decision to transfuse. Remember that normal values for heart rate and respiratory rate vary with the age of the child.
- Respiration rate. If it is rapid, this will favour the decision to transfuse.
- Is the patient grunting? If so, this will favour the decision to transfuse.
- Is the patient already in circulatory collapse (shock)? If so, the need for transfusion is very urgent.

Some patients will not show any of these features, and it might then be justifiable to delay transfusion and use haematinics (i.e. iron and folic acid). Some patients may show the above features and have an Hb level higher than 50 g/L. It will also be necessary to transfuse such patients if their symptoms are caused or significantly worsened by the anaemia and not an alternative pathology only (e.g. heart failure).

After birth, the haemoglobin level drops to less than 100 g/L in term infants at 6 weeks. (Oxygen delivery is well maintained because of rising levels of haemoglobin A, which releases oxygen more freely than haemoglobin F, which is found in the fetus.)

Causes of anaemia in neonates
- Hypovolaemic shock can result from acute blood loss, as for example in premature separation of the placenta or feto–maternal haemorrhage, twin-to-twin transfusion, and other causes of fetal or neonatal haemorrhage.
- Neonates may lose a considerable blood volume as a result of sampling for laboratory tests. Therefore samples should be minimised.
- Reduce the need for transfusion in neonates by providing adequate antenatal care, to reduce the risks of premature delivery and when possible prevent nutritional anaemia in the mother.
- Encourage breastfeeding.
- Ensure that there is early provision of vitamin K prophylaxis, iron, vitamins and other haematinics, especially in premature babies.

Causes of anaemia in children
These include the following:
- surgery
- haematological malignancies
- malaria
- sickle-cell disease
- congenital haemolytic anaemias (thalassaemia, glucose-6-phosphate dehydrogenase deficiency)
- burns
- major trauma.
- malnutrition (see Section 5.10.B).

Causes of anaemia in pregnancy
These include the following:
- obstetric emergencies such as antepartum and post-partum haemorrhage
- severe anaemia that is untreated or unresponsive to haematinics
- major trauma.

Transfusion policies and guidelines
- In hypovolaemic shock, erythrocyte-free volume expanders may be used to maintain tissue perfusion. Oxygen and top-up blood transfusion (10–20 mL/kg, over 5–10 minutes) may be required when tissue oxygenation is compromised.
- Transfuse for anaemia only when there are clinical signs, such as tachycardia, tachypnoea, recurrent apnoea, failure to thrive or early signs of anaemia-induced heart failure.
- When possible, provide malaria prophylaxis, particularly in pregnant women and children (see Sections 2.8.D and 6.3.A.d) with sickle-cell disease. Early treatment of clinical malaria reduces the profound haemolysis that is a major reason for transfusion in endemic areas.
- Anaemia due to malaria responds to treatment with antimalarial drugs and folic acid.
- Blood transfusion is not required for sickle-cell disease in the steady state. It may be indicated in severe anaemia with incipient or established cardiac failure,
acute splenic enlargement, sequestration crisis with rapidly falling haemoglobin levels, aplastic crisis, acute chest syndrome, stroke, and sometimes as exchange transfusion for severe priapism (see Section 5.11.B on sickle-cell disease).

- National programmes for thalassaemia and other congenital haemolytic disorders, such as glucose-6-phosphate dehydrogenase deficiency, help to reduce transfusion requirements.

In situations where blood transfusion is unavailable or potentially unsafe, the following recommendations have been made:

- Transfusion is not necessary if the Hb level is more than 50 g/L.
- Transfusion may be necessary if the Hb level is less than 50 g/L and there is incipient cardiorespiratory distress (air hunger, hypotension, tachycardia and oedema).
- Transfusion may be necessary if the Hb level is less than 40 g/L and complicated by malaria or bacterial infection, even without incipient cardiac failure.
- Transfusion may be necessary if the Hb level is less than 30 g/L, with no apparent complications.

In situations where blood transfusion is safe and available, recommendations for its use are as follows.

**Neonates and infants less than 4 months old**

- Blood loss of more than 15% over 2 days.
- Haemoglobin level of less than 70 g/L with clinical manifestations of anaemia.

**Infants aged 4 months or older**

- Acute blood loss that is unresponsive to crystalloid and colloid infusions.
- Intra-operative blood loss of more than 15% of total blood volume and post-operative haemoglobin level of less than 80 g/L with clinical symptoms.
- Haemoglobin level of less than 110 g/L with severe pulmonary disease.
- Acute haemolysis with haemoglobin level of less than 80 g/L with signs of anaemia.
- To suppress endogenous haemoglobin in sickle-cell disease crises and thalassaemic syndrome.

**Red-cell-free components**

- Fresh frozen plasma (FFP) is only recommended when a specific haemostatic defect has been identified. In the absence of specific testing, consider administering FFP to a patient with signs of disseminated intravascular coagulation who is acutely unwell, as it may be life-saving.
- Freeze-dried plasma is now available, and its advantages include a long shelf life and the lack of need for refrigeration.
- Platelets are prepared from fresh blood using a special, simple centrifugation method, and the remaining blood can be given back to the donor. Once extracted by this method, platelets can last for up to 5 days at room temperature (around 23°C). Platelets should not be stored in a refrigerator. Transfused platelets survive only briefly, and repeated infusion may be required for active bleeding, or before essential procedures such as a lumbar puncture in a child with severe thrombocytopenia.

**Blood donation and provision**

- Ideally blood is obtained by routine whole blood collection from an established panel of blood donors with quality standards for testing, processing and distribution.
- Most transfusions are required and given as an emergency procedure. Ideally, emergency collection of blood for paediatric use should not be necessary (see below).
- Safe transfusion is enhanced by the following measures:
  - collection of blood from repeat regular donors screened using a standard health-check questionnaire, and who are found negative for all markers for transfusion-transmissible infection
  - collection in a multi-pack which allows each donation to be divided into small volumes, in a closed sterile system to reduce wastage and donor exposure
  - multiple, small-volume packs can be used for multiple transfusions in one child or neonate without having to repeat the pre-transfusion tests.
- Group O rhesus-negative small-volume packs facilitate transfusion across the ABO barrier. They must be checked for high-titre anti-A or anti-B by a suitable antiglobulin method.
- Establish a routine procedure for collection, testing and processing which should cover routine and emergency transfusions.
- Maternal blood is not recommended for transfusing into the newborn infant, even in an emergency, although theoretically it can be used after compatibility testing with the recipient’s serum.

**Pre-transfusion testing**

*Minimum acceptable tests on blood prior to transfusion*

1. ABO and Rhesus D grouping.
2. Screening for hepatitis B antigen and antibodies to HIV-1 and -2, hepatitis C virus and syphilis.
3. Additional tests for locally prevalent infections, such as malaria and Chagas disease.

- 0.1–0.2 mL blood in an EDTA bottle is required for grouping, and 2 mL of clotted blood in a plain bottle for compatibility testing.
- In infants under 4 months of age, maternal blood testing for compatibility is always required: 4 mL of EDTA plus 5 mL of clotted blood.
- Blood group the neonate using a cord, capillary or small venous sample (2–3 drops and specific standard reagents Anti-A, Anti-B, Anti-A+B and Anti-RhD). Red cells only are used, because antibody levels in the sera of neonates are too low to be of significant value.
- The inclusion of control A, B, O, RhD-positive and RhD-negative cells in the procedure is part of good laboratory practice, and should be part of the testing method.
- If possible, two methods should be used for grouping, to ensure reliability.
- For neonates and infants up to 4 months of age, compatibility testing is not required if the mother’s serum is negative for allo-antibodies. Compatibility between the mother’s serum and red cells to be transfused is required only if the mother has antibodies or if there is a previous history of haemolytic disease of the newborn.
The most suitable method for compatibility is the anti-human globulin technique at 37°C for 1 hour. Agglutination should be read before and after the addition of the anti-human globulin reagent.

**Blood groups**

There are four major blood groups: A, B, AB and O. To avoid ABO incompatibility, the blood group of both the donor and the receiver must be known. Blood can only be donated in the direction of the arrows shown in Figure 1.7.1.

![Figure 1.7.1](image)

**FIGURE 1.7.1** Safe transfusion of ABO blood groups.

- Donors with blood group O can donate to patients (receivers) with blood group A, B, AB or O.
- Donors with blood group A can donate to patients with blood group B or AB.
- Donors with blood group B can donate to patients with blood group A or AB.
- Donors with blood group AB can donate only to patients with blood group AB.

Blood is also categorised according to its rhesus status. Therefore:

- Rhesus-negative donors can give to Rhesus-positive and Rhesus-negative patients.
- Rhesus-positive donors can only give to Rhesus-positive patients.

If the blood group is unknown and blood is required before a cross-match can be performed, give O-Rhesus-negative blood if this is available.

**Exchange transfusion**

- This is used for haemolytic disease of the newborn with severe anaemia and/or severe hyperbilirubinaemia (see Section 3.4). Exchange of double the neonate's blood volume is often required using 160–180 mL/kg of whole blood and/or plasma reduced red cells. The latter are prepared by removing approximately 100 mL of plasma to create a haematocrit of 0.5–0.6.
- Patients with sickle-cell anaemia and acute chest syndrome or impending cerebrovascular episodes may benefit from exchange transfusion (see Section 2.5.8).
- Blood should be fresh (less than 5 days old), and also screened for HbS if it is issued for sickle-cell disease.

Use Rhesus-negative blood, group O or the same ABO group as the infant compatible with maternal and infant serum.

The blood should be warmed with a heating coil or stood for 1 hour at room temperature or under the mother’s clothing.

**Exchange transfusion: indications and technique**

**Indications**

- Severe haemolytic anaemia: use double volume exchange.
- Severe hyperbilirubinaemia: use double volume exchange.
- Polycythaemia: use partial exchange with Ringer-lactate or Hartmann’s or 0.9% saline (see Section 3.4).

\[
\text{Double volume exchange (mL)} = 2 \times 80 \times \text{weight (kg)}.
\]

<table>
<thead>
<tr>
<th>weight (kg)</th>
<th>actual haematocrit</th>
<th>desired haematocrit</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>actual haematocrit</td>
<td>desired haematocrit</td>
</tr>
</tbody>
</table>

\[
\text{80} \times \text{weight (kg)} \times (\text{actual haematocrit} – \text{desired haematocrit}) \div \text{actual haematocrit}
\]

**Technique**

1. Exchange transfusion should preferably be through umbilical or peripheral venous and arterial catheters so that simultaneous withdrawal and transfusion of blood volume occurs. If this is not possible, a single large-bore venous cannula may be used with a three-way tap to allow alternate withdrawing and transfusing of aliquots. An aseptic technique must be maintained.

2. Use a 5- or 10-mL syringe to draw 5- or 10-mL aliquots (depending on the baby’s weight) from the baby via the arterial line over a 3-minute cycle, and discard them. Simultaneously infuse 5- or 10-mL aliquots through the venous line over a 3-minute cycle.

3. The baby’s temperature, pulse, respiratory rate and blood pressure must be monitored as for transfusions, and in addition blood glucose levels must be monitored every 30 minutes.

4. Use a nasogastric tube to evacuate the stomach contents, and keep the patient nil by mouth.

5. Use a separate IV line to administer dextrose solution to maintain blood glucose levels and hydration.

6. Check the baby’s haemoglobin, bilirubin, glucose and calcium levels at the beginning and end of the procedure.

7. Check a blood film, Coombs’ test, and if possible coagulation and arterial or capillary blood gas at the beginning of the procedure.

Potential complications include hypoglycaemia, electrolyte disturbance, thrombocytopenia, coagulopathy, sepsis, air embolus, circulatory overload and gastrointestinal complications (e.g. acute dilatation of stomach, intestinal ischaemia).

**Bedside transfusion**

A child’s body contains 80 mL of blood for every kg of body weight. For example, a 3-year-old weighing 12 kg will have 960 mL of blood in their body.

A pregnant mother’s body contains 100 mL of blood for every kg of body weight.

- Venous access for bedside transfusion should be chosen with no smaller than a 22- to 24-gauge vascular catheter, and a much larger one in pregnant mothers.
- Blood is usually cleaned and filtered in the lab, so when transfusing it to a patient the only filter that needs to be used is the usual on-line filter in a standard giving set.
- Blood should be treated like any other IV fluid, and given using an accurate measurement of rate and time. A burette should be used for infants or in children for whom
Blood transfusion reactions
Blood transfusion can be life-saving and provides great clinical benefit to many patients. However, it is not without risks, which include the following:
- Immunological complications
- Errors and “wrong blood” episodes
- Infections (bacterial and viral).

Causes of acute complications of transfusion

Acute haemolytic transfusion reaction
- Incompatible transfused red cells react with the patient’s own anti-A or anti-B antibodies or other alloantibodies (e.g. anti-rhesus (Rh) D) to red-cell antigens. Complement can be activated and may lead to disseminated intravascular coagulation (DIC).
- Infusion of ABO-incompatible blood is almost always a result of errors in labelling sample tubes and/or request forms, or inadequate checks at the time of transfusion. When red cells are mistakenly administered, there is about a 1 in 3 risk of ABO incompatibility and a 10% risk of mortality, with the most severe reaction seen in a group O individual receiving group A red cells.
- Non-ABO red cell antibody haemolytic reactions tend to be less severe.

Infecive shock
- Bacterial contamination can be fatal.
- Acute onset of tachycardia, low pulse pressure, hypotension, rigors and collapse rapidly follows the transfusion.

Transfusion-related acute lung injury (TRALI)
- TRALI is a form of acute respiratory distress due to donor plasma containing antibodies against the patient’s leukocytes.
- Transfusion is followed within 6 hours of transfusion by the development of a prominent non-productive cough, breathlessness, hypoxia and frothy sputum. Fever and rigors may be present.
- Chest X-ray if available shows multiple perihilar nodules with infiltration of the lower lung fields.

Fluid overload
- This occurs when too much fluid is transfused or it is transfused too quickly, leading to pulmonary oedema and acute respiratory failure.
- Patients at particularly high risk are those with severe or chronic anaemia, or severe malnutrition and who have normal blood volumes (i.e. who are not bleeding), and those with symptoms of cardiac failure prior to transfusion.
- These patients should receive packed cells rather than whole blood via slow transfusion, with diuretics if required.

Non-haemolytic febrile reactions to transfusion of platelets and red cells
- Fivers (more than 1°C above baseline) and rigors may develop during transfusion due to the patient’s antibodies to transfused white cells.

Severe allergic reaction or anaphylaxis
- Allergic reactions occur when patients have antibodies that react with proteins in transfused blood components.
- Anaphylaxis occurs when an individual has previously been sensitised to an allergen present in the blood, and subsequently, on re-exposure, releases immunoglobulin E (IgE) or IgG antibodies. Patients with anaphylaxis become acutely dyspnoeic due to bronchospasm and laryngeal oedema, and may complain of chest pain, abdominal pain and nausea.
- Urticaria and itching are common within minutes of starting a transfusion.
- These symptoms are usually controlled by slowing the transfusion and giving antihistamine, and the transfusion may be continued if there is no progression at 30 minutes.
- Pre-treatment with an antihistamine should be given if the patient has experienced repeated allergic reactions to transfusion.
- For treatment of anaphylaxis, see Sections 2.7.C and 5.1.B.

Presentation
Symptoms or signs may occur after only 5–10 mL of transfusion of incompatible blood, so patients should be observed very closely at the start of each blood unit transfused.

Symptoms
These include the following:
- A feeling of apprehension or that “something is wrong”
- Flushing
- Chills
- Pain at the venepuncture site
- Muscle aches
- Nausea
- Pain in the abdomen, loins or chest
- Shortness of breath.

Signs
These include the following:
- Fever (a rise in temperature of 1.5°C or more) and rigors
- Hypotension or hypertension
- Tachycardia
- Respiratory distress
- Oozing from wounds or puncture sites
- Haemoglobinemia
- Haemoglobinuria.

Investigations and management
- If a serious acute transfusion reaction is suspected, stop the transfusion, take down the donor blood bag and giving set, and send the donor bag back to the blood bank with notification of the event. Set up a new giving set with Ringer Lactate, Hartmann’s or 0.9% saline solution.
- To detect a haemolytic reaction, send post-transfusion
TABLE 1.7.1 Investigations for blood transfusion reactions

<table>
<thead>
<tr>
<th>Type of reaction</th>
<th>Investigation findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute haemolytic reactions</td>
<td>- Visual inspection of centrifuged plasma: pink-red discoloration (haemoglobinemia) indicates significant intravascular haemolysis</td>
</tr>
<tr>
<td></td>
<td>- Visual inspection of centrifuged urine: red discoloration indicates haemoglobinuria</td>
</tr>
<tr>
<td></td>
<td>- Retyping of donor and recipient red blood cells (RBCs): any discrepancy suggests that the transfusion has been mismatched and blood samples have been mixed up</td>
</tr>
<tr>
<td></td>
<td>- Direct antiglobulin (‘Coombs’) test (DAT): ABO-related acute transfusion reactions usually cause a positive DAT test</td>
</tr>
<tr>
<td></td>
<td>- Evidence of increased RBC destruction (e.g. a fall in haemoglobin and/or rise in bilirubin levels)</td>
</tr>
<tr>
<td></td>
<td>- There may be evidence of DIC</td>
</tr>
<tr>
<td></td>
<td>- Negative blood cultures</td>
</tr>
<tr>
<td>Febrile non-haemolytic reactions</td>
<td>- Visual inspection of the recipient’s plasma and urine is normal</td>
</tr>
<tr>
<td></td>
<td>- Retyping shows no incompatibility</td>
</tr>
<tr>
<td></td>
<td>- DAT test is negative</td>
</tr>
<tr>
<td>Allergic and anaphylactic reactions</td>
<td>- Urticaria, itching and dyspnoea (for symptoms and signs of anaphylaxis, see Section 2.7.C)</td>
</tr>
<tr>
<td>TRALI</td>
<td>- Pulse oximeter shows hypoxaemia</td>
</tr>
<tr>
<td></td>
<td>- Chest X-ray (if available) shows bilateral lung infiltrates</td>
</tr>
<tr>
<td></td>
<td>- Full blood count frequently shows low white blood cell count and high eosinophil count</td>
</tr>
<tr>
<td>Transfusion-transmitted bacterial infection</td>
<td>- Blood cultures are positive and congruent for both donor and recipient blood</td>
</tr>
</tbody>
</table>

Management

- Where the only feature is a rise in temperature of less than 1.5°C from baseline, or urticaria, recheck that the correct blood is being transfused, give paracetamol and antihistamine, reset the transfusion at a slower rate and observe the patient more frequently.
- Although fever or rigors are not uncommon in response to a transfusion and may represent a non-haemolytic febrile reaction, they may also be the first sign of a severe adverse reaction.
- Where the reaction is more severe:
  - Stop the transfusion and call a doctor urgently to review the patient.
  - Vital signs (temperature, blood pressure, pulse, respiratory rate and oxygen saturation levels) and respiratory status (dyspnoea, tachypnoea, wheeze and cyanosis) should be checked and recorded. Look for signs of heart failure (basal lung crepitations and enlarged liver).
  - Check the patient’s identity and recheck against details on the blood unit and compatibility label or tag.
- Initial management if ABO incompatibility is suspected is as follows:
  - Take down the blood bag and the giving set with blood in it.
  - Keep the IV line open with Ringer-lactate or Hartmann’s solution.
  - Give oxygen and fluid support.
  - Monitor urine output, usually following catheterisation, and maintain it at more than 2 mL/kg/hour in infants, > 1 mL/kg/hour in children and > 30 mL/hour in pregnancy, giving furosemide if it falls below this.
  - Consider inotropic support if hypotension is prolonged.
- Where bacterial contamination is suspected, send blood cultures from the patient and also bag remnants.
- If the patient is dyspnoeic, obtain a chest X-ray if possible and check for fluid overload and pulmonary oedema.

TRALI improves within 2–4 days in over 80% of cases if there is adequate management and respiratory support.

- If fluid overload is suspected:
  - Give IV furosemide and high-concentration oxygen.

Delayed complications of transfusion

- In those who have previously been immunised to a red cell antigen during pregnancy or by transfusion, the level of antibody to the blood group antigen may be so low as to be undetectable in the pre-transfusion sample.
- However, after transfusion of red cells bearing that antigen, a rapid secondary immune response raises the
antibody level dramatically, leading to the rapid destruction of transfused cells.
- At 5–10 days post-transfusion, patients present with fever, falling haemoglobin levels (or an unexpectedly poor rise in haemoglobin levels), jaundice and haemoglobinuria.
- A rise in bilirubin levels and positive direct antiglobulin test (DAT) will also be present.

**Development of antibodies to red cells in the patient’s plasma (alloimmunisation)**
- Transfusion of red cells of a different phenotype to that of the patient will cause alloimmunisation (e.g., development of anti-RhD in RhD-negative patients who have received RhD-positive cells).
- This is dangerous if the patient later receives a red cell transfusion, and can cause haemolytic disease of the newborn (HDN).

**Iron overload**
- Each unit of blood contains 250 mg of iron, and those receiving red cells over a long period of time may develop iron accumulation in cardiac and liver tissues.
- Chelation therapy (with desferrioxamine) is used to minimise iron accumulation in those most at risk.

**Infection**
- The risk of becoming infected with HIV, hepatitis B or hepatitis C from transfusion is now small. However, since there is always the potential for unrecognised or unknown infection to be spread via transfusion, all non-essential transfusions should be avoided.
- Blood must be stored at the correct temperature at all times (at 1–6°C for up to 35 days if using citrate-phosphate-dextrose adenine anticoagulant or up to 21 days if using citrate-phosphate-double dextrose). Ideally each blood bag should be labelled with a temperature-sensitive strip that changes colour when the correct temperature for storage has been exceeded for a clinically significant period of time.

**Improving safety**

**Reducing transfusion errors**
- Introduce robust hospital transfusion protocols.
- Provide training for all staff involved in blood administration/taking samples for cross-matching.
- An understanding of transfusion medicine should be a core curricular component for all doctors in training.
- Improved information technology, such as use of a unique barcode on the patient’s wristband/blood sample and prepared blood, is important.
- Appoint specialist transfusion practitioners.

**Reducing unnecessary transfusion**
- Transfusion risks related to the use of allogeneic blood can be eliminated by the use of autologous blood (whereby patients collect and store their own blood for use in planned surgery). However, this practice is not risk-free.
- Ensure that blood products are only used when the patient is judged more likely to benefit from than be harmed by a transfusion.
- Always record in the patient’s notes the indication for giving blood.
- Adopt procedures such as checking for and correcting anaemia prior to planned surgery, stopping anticoagulants and antiplatelet drugs before surgery, minimising the amount of blood taken for laboratory samples, and using a simple protocol to guide when haemoglobin should be checked and when red cells should be transfused.
- Accept a lower haemoglobin concentration as a trigger for transfusion.
- Accept a lower post-transfusion target haemoglobin level.

### 1.8 Essential laboratory services

**Basic services provided in the laboratory and on the ward**

Whenever possible, the regional or central laboratory should procure the chemicals, prepare the reagents and standards, and distribute them with the necessary controls and approved testing procedure to district laboratories. Details on how to prepare the required reagents, standards and controls can be found in the 1995 WHO publication *Production of Basic Diagnostic Laboratory Reagents*.  

For all small hospitals, the WHO recommends six basic investigations as an absolute minimum:
- haemoglobin or packed cell volume
- blood smear for malaria
- blood glucose levels
- microscopy of cerebrospinal fluid (CSF) and urine
- blood grouping and cross-matching
- for newborn care, blood bilirubin levels.

**Tests that can be performed on the wards**

These include the following:
- blood grouping
- rapid diagnostic test for *Plasmodium falciparum* (or urgent thick blood film for malarial parasites)
- urine microscopy (see Sections 5.6.A and 8.5)
- HIV rapid screening test
- HBsAg screening test
- “hot stool” examination (for *Entamoeba histolytica*)
- rapid haemoglobin (WHO paper-based method)