NATIONAL CLINICAL GUIDELINES FOR THE APPROPRIATE USE OF BLOOD AND BLOOD PRODUCTS

JULY 2011
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACRONYMS</td>
<td>4</td>
</tr>
<tr>
<td>FOREWORDS</td>
<td>5</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENT</td>
<td>6</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>7</td>
</tr>
<tr>
<td>1-GENERAL PRINCIPLES</td>
<td></td>
</tr>
<tr>
<td>1.1 Blood volume</td>
<td>8</td>
</tr>
<tr>
<td>1.2 Full blood normal values</td>
<td>8</td>
</tr>
<tr>
<td>1.3 Blood groups</td>
<td>8</td>
</tr>
<tr>
<td>1.4 Principles of transfusion</td>
<td>9</td>
</tr>
<tr>
<td>1.5 Donors</td>
<td>10</td>
</tr>
<tr>
<td>1.6 Designated donation</td>
<td>10</td>
</tr>
<tr>
<td>1.7 Autologous blood transfusion</td>
<td>10</td>
</tr>
<tr>
<td>2-ANAEMIA</td>
<td>12</td>
</tr>
<tr>
<td>2.1 Definition</td>
<td>12</td>
</tr>
<tr>
<td>2.2 Normal haemoglobin values</td>
<td>12</td>
</tr>
<tr>
<td>2.3 Iron</td>
<td>12</td>
</tr>
<tr>
<td>2.4 Causes of anaemia</td>
<td>12</td>
</tr>
<tr>
<td>2.5 Assessing anaemia</td>
<td>13</td>
</tr>
<tr>
<td>2.5.1 Clinical assessment</td>
<td>13</td>
</tr>
<tr>
<td>2.5.2 Laboratory investigations to assess the type of anaemia</td>
<td>14</td>
</tr>
<tr>
<td>2.6 Acute blood loss</td>
<td>14</td>
</tr>
<tr>
<td>2.7 Chronic blood loss</td>
<td>15</td>
</tr>
<tr>
<td>2.8 Prevention</td>
<td>16</td>
</tr>
<tr>
<td>2.9 Treatment</td>
<td>16</td>
</tr>
<tr>
<td>3-ALTERNATIVE OPTIONS TO BLOOD TRANSFUSION</td>
<td>17</td>
</tr>
<tr>
<td>3.1 Replacement fluids</td>
<td>17</td>
</tr>
<tr>
<td>3.2 Other infusion routes for crystalloids</td>
<td>19</td>
</tr>
<tr>
<td>4-BLOOD AND BLOOD PRODUCTS</td>
<td>20</td>
</tr>
<tr>
<td>4.1 Testing for Transfusion Transmitted Infections</td>
<td>20</td>
</tr>
<tr>
<td>4.2 Types of blood products and indications</td>
<td>20</td>
</tr>
<tr>
<td>5-TRANSFUSION</td>
<td>23</td>
</tr>
<tr>
<td>5.1 Legal aspects</td>
<td>23</td>
</tr>
<tr>
<td>5.2 Risks</td>
<td>23</td>
</tr>
<tr>
<td>5.3 Decision</td>
<td>24</td>
</tr>
<tr>
<td>5.4 Ordering blood components</td>
<td>24</td>
</tr>
<tr>
<td>5.5 Blood grouping and compatibility testing</td>
<td>25</td>
</tr>
<tr>
<td>5.6 Storage and transportation</td>
<td>25</td>
</tr>
<tr>
<td>5.6.1 Red Cells Concentrate/Suspension and whole blood</td>
<td>25</td>
</tr>
<tr>
<td>5.6.2 Platelet concentrate</td>
<td>25</td>
</tr>
<tr>
<td>5.6.3 Fresh Frozen Plasma</td>
<td>25</td>
</tr>
<tr>
<td>5.7 Identification of patient and blood unit to be transfused</td>
<td>26</td>
</tr>
</tbody>
</table>
5.8. Transfusion procedures
   5.8.1. Time limits for transfusion
   5.8.2. Infusion set
   5.8.3. Rate of infusion and warming of blood
   5.8.4. Administration of other pharmaceuticals during transfusion
   5.8.5. Recording the transfusion
   5.8.6. Monitoring the patient
   5.9. Use of “O” blood group
   5.10. Units not transfused
   5.11. Therapeutic phlebotomy
   5.12. Plasma Exchange
   5.13. Exchange transfusion
   5.14. Corrected Count Increment for platelet transfusion

6. ADVERSE REACTIONS
   6.1. Types of reaction
   6.2. Acute reactions
      6.2.1. Signs and symptoms of acute reactions
      6.2.2. Immediate management
      6.2.3. Management of most important acute reactions
         6.2.3.1. Acute haemolytic reactions
         6.2.3.2. Bacterial contamination
         6.2.3.3. Anaphylactic reactions
         6.2.3.4. TRALI
         6.2.3.5. TACO
   6.3. Delayed transfusion reactions
      6.3.1. Transfusion transmitted infections
      6.3.2. Delayed haemolytic reactions
      6.3.3. Post-transfusion purpura
      6.3.4. Graft-vs-host disease
      6.3.5. Iron overload
   6.4. Haemovigilance

7. PAEDIATRICS
   7.1. Causes of anaemia in children
   7.2. Decompensated anaemia
   7.3. Blood and plasma transfusion and procedures
   7.4. Indications for platelet transfusion
   7.5. Haemolytic disease of the newborn
   7.6. Exchange transfusion

8. GENERAL MEDICINE
   8.1. Anaemia
   8.2. Bleeding disorders
   8.3. Platelet transfusion

9. OBSTETRICS AND GYNAECOLOGY
   9.1. Chronic anaemia
      9.1.1. Causes
      9.1.2. Indications for transfusion
   9.2. Acute blood loss
   9.3. Management of acute blood loss
10-SURGERY
10.1. Assessment page 50
10.2. Estimating acceptable blood loss page 50

11-EMERGENCY SURGERY AND TRAUMA
11.1. Initial measures in any patient with acute blood loss page 52
11.2. Estimate the extent of hypovolaemia page 52
11.3. Acute Gastrointestinal bleeding page 53
11.4. Platelet transfusion page 50

12-BURNS
12.1. Estimating the extent of the burnt area page 54
12.2. Estimating the severity of burns page 55
12.3. Calculating fluid requirement and fluids to be used page 55
12.4. Monitoring page 56

13-REFERENCES

14-ANNEXES

INDEX OF TABLES AND FIGURES
Table 1.1. Normal values page 8
Table 2.1. Haemoglobin concentrations page 12
Table 2.2. Causes of anaemia page 13
Table 2.3. Clinical assessment of anaemia page 14
Table 2.4. Classification of hypovolaemia according to blood loss in adults page 15
Table 2.5. Classification of hypovolaemia according to blood loss in children page 15
Table 3.1. Replacement fluids page 17
Table 3.2. Advantages and disadvantages of crystalloids and colloids page 17
Table 3.3. Characteristics of replacement fluids page 18
Table 4.1. Blood and blood products page 21
Table 4.2. Content of coagulation factors in one unit of FFP page 22
Table 4.3. Characteristics of plasma derivatives page 22
Table 5.1. Use of O blood group page 28
Table 6.1. Types of reaction page 31
Table 6.2. Acute reactions page 32
Table 7.1. Common causes of anaemia in children page 38
Table 7.2. Signs of decompensated anaemia in children page 38
Table 8.1. Clinical presentation and management of anaemia-related conditions page 42
Table 8.2. Signs and symptoms suggestive for bleeding disorders page 44
Table 8.3. Signs of bleeding or blood loss page 44
Table 8.4. Management of acute bleed page 44
Table 8.5. Risk of bleeding according to platelet count page 45
Table 9.1. Indications for transfusion in chronic anaemia page 47
Table 9.2. Obstetrical and gynaecological causes of acute blood loss page 48
Table 10.1. Acceptable blood loss page 51
Figure 12.1. Rule of 9’s in adult page 54
Figure 12.2. Rule of 9’s in child page 55
Table 12.1. Types of burns page 55
Table 12.2. Management of burns page 56
ACRONYMS

AIDS  Acquired Immune Deficiency Syndrome
ANC  Ante Natal Care
BP  Blood Pressure
CJD and vCJD  Creutzfeldt-Jakob Disease and its variant
DIC  Disseminated Intravascular Coagulation
ELISA  Enzyme Linked Immuno Sorbent Assay
FFP  Fresh Frozen Plasma
FP  Family Planning
G6PD  Glucose-6-Phosphate Dehydrogenase
GI  Gastro Intestinal
GM  Growth Monitoring
Hb  Haemoglobin
HBV  Hepatitis B Virus
Hct  Haematocrit
HCV  Hepatitis C Virus
HDN  Haemolytic Disease of the Newborn
HIV 1 and 2  Human Immunodeficiency Virus
HLA  Human Leucocyte Antigen
HTLV I and II  Human T-Lymphotrophic Virus I and II
ITP  Idiopathic Autoimmune Thrombocytopenic Purpura
IV  Intra Venous
MCH  Mean Cell Haemoglobin
MCV  Mean Cell Volume
NAT  Nucleic Acid Test
ORS  Oral Rehydration Solution
PCC  Prothrombin Complex Concentrate
PPH  Post Partum Haemorrhage
PTP  Post Transfusion Purpura
RCC  Red Cell Concentrate
RBC  Red Blood Cells
SNBTS  Swaziland National Blood Transfusion Service
TACO  Transfusion-Associated Circulatory Overload
TRALI  Transfusion-Related Acute Lung Injury
TB  Tuberculosis
TTI  Transfusion Transmitted Infection
TTP  Thrombotic Thrombocytopenic Purpura
WBC  White Blood cells
WHO  World Health Organization
FOREWORDS

One of the most important steps in ensuring blood safety, and a pillar of the Ministry of Health strategy, is that blood is rationally used. Avoiding unnecessary transfusion of blood or blood products is not only ethical for the patient, because it avoids to expose it to unnecessary risks, but also ethical for the voluntary non-remunerated donor whose blood is not wasted.

Sometimes, when a patient is in critical conditions, it may be difficult to make a decision whether to transfuse blood. The access of facilities such as operating theatres and intensive care units, and the availability of quality medical and nursing care may influence the decision whether or not to transfuse. Moreover high pressure, on the clinician, can originate from relatives worried about the patient’s life.

Alternatives to blood transfusion should always be considered.

While clinician shoulder the responsibility of decision making regarding transfusion, all the Health Personnel involved in patient’s care also need to understand their role in the management of a transfusion.

The publications of these Clinical Guidelines for the appropriate use of blood and blood products, follows a consultative process that has involved the major role players.

A National Blood Transfusion Advisory Committee is being created to assist the Ministry of Health in all issues pertaining to blood transfusion.

However the Hospital Blood Transfusion Committees have the higher burden being the ones with the mandate of ensuring that the guidelines are followed and to make suggestions on their improvement. They have to liaise with the national committee and the SNBTS to ensure a safe, adequate, timely and quality transfusion service.
ACKNOWLEDGEMENT

We are indebted to Dr James van Hassel of Safe Blood For Africa Foundation, Dr Evan Bloch of Blood System Research Institute, and Dr Peter Ehrenkranz of PEPFAR for their crucial comments and suggestions.

A consensus workshop was convened on 28th and 29th July 2011 to finalize the draft guidelines. We recognize all participants belonging to the relevant professions and facilities through the country (alphabetic order):

- Dr. M. Almaviva MoH-CDC
- K. Byakera Pigg’s Peak Government Hospital
- S.Dlamini Mkhiwa Clinic
- S.Dlamini Emkhuzweni Health Centre
- P.Khumalo Good Shepard Hospital
- Dr M.Lawal Dwokolwako Health Centre
- Dr T. Mamvura Good Shepard Hospital
- Dr E.Mapeka Emkhuzweni Health Centre
- Dr C.Mapokolo Matsanjeni Health Centre
- S.Msibi Raleigh Fitkin Memorial Hospital
- Dr E.Majirja Hlatikulu Government Hospital
- B.Mabaso Hlatikulu Government Hospital
- C.Makhanya Mbabane Government Hospital
- Dr S.Mkhize Raleigh Fitkin Memorial Hospital
- S. Mtemeri SNBTS
- Dr E.Ngonyani Mbabane Government Hospital
- G.Nxumalo Nhlangano Health Centre
- Dr A.Shabangu Hlatikulu Government Hospital
- S.Sibanda Manzini Clinic
- L.Simelane TB Hospital
- Prof. H. Sukati SNBTS
- Dr D.Vambe Mankayane Government Hospital
- N.Vilakati Dwokolwako Health Centre

We also recognize the hard work and dedication of the Health personnel of all health facilities.

Last, but not least, we wish to thank our voluntary non remunerated blood donors whose solidarity and altruism are fundamental to save lives.
INTRODUCTION

Blood collection, testing, processing and transfusion are an essential part of the national Health System.

Transfusions can save lives; however blood can transmit infections and be accompanied by adverse reactions and complications.

Appropriate and rational use of blood products maximizes the effects of transfusion and contributes to avoiding unwanted complications.

Moreover early detection and proper care of unavoidable side-effects can minimize patient’s morbidity and mortality.

So it is imperative to avoid unnecessary transfusions putting in place other measures like prevention or treatment of anaemia or use of replacement fluids.

The Swaziland National Blood Transfusion Service (SNBTS) is responsible for collecting, testing, processing and distributing blood components. All donated blood is tested for Transfusion Transmitted Infections (TTIs) such as HIV, HBV, HCV, and Syphilis, since the end of ‘80s.

SNBTS aims to collect blood from regular voluntary non-remunerated donors which are the safest blood donors. The majority of blood is collected from school pupils during outreach visits to their schools.

These guidelines do not aim to replace definitive texts and specialized manuals or guidelines on Haematology and Transfusion Medicine.

The guidelines do intend to provide the clinicians who prescribe blood, with practical information for the appropriate and rational use of blood products.

Hospital Transfusion Committees should ensure the adherence to these guidelines.
1. GENERAL PRINCIPLES

1.1. BLOOD VOLUME

In an adult the blood volume (as both cells and plasma) circulating in the vascular system is about 7% of the body weight (or 70-75 ml/kg), which is approximately 4.5 to 5 litres of blood in an average adult.

In a child the blood volume is approximately 8% of the body weight.

Indicative blood volumes:
- Neonates 85-90 ml/kg
- Children 80 ml/kg
- Adults 70 ml/kg

1.2. FULL BLOOD NORMAL VALUES

The following values represent the standard in use at the National Clinical Laboratory:

<table>
<thead>
<tr>
<th>Table 1.1. Normal values</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEMALE</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>RBC</td>
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<tr>
<td>WBC</td>
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<tr>
<td>Hb</td>
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<td>Hct</td>
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<td>MCV</td>
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<td>MCH</td>
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<tr>
<td>PLATELETS</td>
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1.3. BLOOD GROUPS

In RED CELL OR WHOLE BLOOD transfusion a person with a given blood group should preferably receive blood of the same group. However it is possible to donate blood of a different group following these rules:

- Group O individuals can receive blood from group O donors only
- Group A individuals can receive blood from group A and O donors
- Group B individuals can receive blood from group B and O donors
- Group AB individuals can receive blood from AB donors as well as from A, B and O donors

Avoid giving Group 0 to group A neonates/infants due to risks of minor incompatibility

\[ \text{Group O RhD negative individuals are the UNIVERSAL DONORS} \]

\[ \text{Group AB positive individuals are UNIVERSAL RECIPIENTS} \]

In PLASMA transfusion practice each blood group should preferably receive plasma of the same group. However:

- Group AB plasma can be given to any ABO group patient
- Group A plasma can be given to group O and A patient
- Group B plasma can be given to group O and B patients
- Group O plasma can be given to group O patients only
In **platelet** transfusion practice platelets that are ABO compatible should be given whenever possible. In emergency situations patients can be given platelets not ABO matched.

**RhD:**
- RhD negative blood products should be given to RhD negative patients
- In emergency situation if RhD positive blood products are going to be transfused to an RhD negative woman of childbearing potential, it is recommended that anti-D immunoglobulins should be given (see box below).

**Anti-RhD Immunoglobulins:**
In general 1500-2000 IU of RhD Immunoglobulins are needed for about 15 ml of Red Cell Concentrate or suspension or 30 ml of whole blood. A dose of 250 IU is sufficient to cover up to 5 adult units of platelets.

**1.4. PRINCIPLES OF TRANSFUSION**

Blood and blood products transfusion can save lives; however, as with most clinical procedures, transfusion may result in adverse effects and in risk of transfusion-transmitted infections (TTIs).

For these reasons, the clinical use of blood and blood products needs to be appropriate. This means that it is imperative to avoid unnecessary transfusions and to follow the prescribed procedures.

**Here are some basic principles according to WHO (1998)**

1. Transfusion is only one element of the patient's management
2. Prescribing decisions should be based on the national guidelines on the clinical use of blood components, taking individual patient's needs into account
3. Blood loss should be minimized to reduce the patient’s need for transfusion
4. The patient with acute blood loss should receive effective resuscitation (IV fluids, oxygen, etc.) while the need for transfusion is being assessed
5. The patient's haemoglobin level, although important, should not be the sole deciding factor in starting transfusion. The decision should be supported by the need to relieve clinical signs and symptoms and prevent significant morbidity and mortality.
6. The clinician should be aware of the risks of TTIs in the blood components that are available for the individual patient
7. Transfusion should be prescribed only when the benefits to the patient are likely to outweigh the risks
8. The clinician should record the reason for transfusion clearly
9. A trained person should carefully monitor the transfused patient and respond immediately if any adverse effects occur.

Moreover the clinician should bear in mind that:
- An early diagnosis and treatment of anaemia can avoid the need of transfusion,
- Other replacement therapies (e.g. saline solutions, colloids) can avoid the use of blood,
- Careful surgical and anaesthetic management can assist to avoid transfusion,
- Although donors are non-remunerated volunteers, blood collection, processing and distribution is expensive, and Swaziland National Blood Transfusion Service (SNBTS) still sometimes experiences periodic shortage of blood.
1.5. DONORS

In 1972 the resolution 28.72 of World Health Assembly established the principle that blood donation should be voluntary and non-remunerated.

- In the Kingdom of Swaziland all blood is sourced from voluntary non-remunerated donors from low-risk populations.
- Most donors are high school students.
- All donors are screened, prior to the donation, by questionnaire and interview. The donated blood is tested for TTIs and the blood group is determined before distribution.

1.6. DESIGNATED DONATION

1-Donation by relatives is not encouraged, even in emergency situation, because of:

- the risk of graft-versus-host disease (1st and 2nd degree relatives have high likelihood),
- the higher incidence of TTIs in the general population (which includes family members) compared to low risk population of voluntary non-remunerated donors,
- difficulty in maintaining the confidentiality of the donor in case of TTIs,
- the possibility that the donor will deny risks factors during the interview. Additional difficulty may arise if the donor is deferred because of risk factors, then the family will ask questions about the reason for him/her not to be accepted,
- there is the need to test the donated blood regardless of its source.

An exception may be the bone marrow donation which is a carefully tested and monitored procedure.

2-A donation from mother to her baby may be considered, after testing the donated blood, but only in case of unusual blood group antibodies or bone marrow donation. However consider that:

- the mother can have antibodies to baby’s blood cells
- older children may have been sensitized against the mother’s blood cells (during passage from mother to baby during pregnancy)

3-Donation from father to his baby can be considered after testing the donated blood, only in case of unusual blood group antibodies or bone marrow donation; note that there could be reactions as baby may have inherited maternal antibodies.

4-Donation from regular blood donor to immediate family member (not a spouse of childbearing age) can be considered after testing the donated blood testing and after assessing that the last blood donation was more than 3 months before for a male and more than 4 months for a female donor.

1.7. AUTOLOGOUS BLOOD TRANSFUSION

- This procedure requires accurate planning and logistical support.
- Usually 2 to 4 units of blood are drawn, on separate occasions, from a patient when planned surgery may result in excessive blood loss.
- Units can be donated at weekly interval prior to surgery, the expiry date should be written on the unit.
- The last donation should be done at least 4 days before surgery.
- There is no indication to withdraw one unit only.
- The blood is stored until the surgery is performed. The blood is re infused during or after the operation.
• Autologous donation can be planned when the donor general conditions are suitable, Hb level is > 12g/dl, blood pressure and pulse rate are normal.
• Contraindications to autologous donation include severe cardiac, respiratory, cerebrovascular, and major systemic disease and infections.
• Pregnant women are accepted if there are no pregnancy complications and only in case of unusual blood group or other immunological condition presenting risk for allogenic transfusion.
• Blood should be tested for TTIs and if positive for HBV, HCV, HIV and syphilis should not be considered for autologous donation.
• The risk of re-infusing TTIs positive autologous blood can outweigh the benefits of autologous donation if a patient has certain conditions like multiple alloantibodies or antibodies to high frequency antigens.
2. ANAEMIA

2.1. DEFINITION

Anaemia is a condition where the haemoglobin concentration in blood is below the expected value considering factors like age, gender, conditions (e.g. pregnancy) and environmental factors. Anaemia is NOT a diagnosis and management should focus on investigation and treatment of the underlying cause.

Critical haemoglobin concentration is the level below which the oxygen delivery to tissues is inadequate.

2.2. NORMAL HAEMOGLOBIN VALUES

It is difficult to establish normal haemoglobin values because levels vary according to several conditions. Table 2.1. (proposed by WHO) gives an indication of normal range and anaemia threshold; however it is important to take into account that there are some individual differences. Because of this individual variation, the diagnosis of an anaemic patient should not be based on haemoglobin values alone, but evaluated in the context of other variables.

Table 2.1. Haemoglobin concentrations

<table>
<thead>
<tr>
<th>Age/Group</th>
<th>Normal Hb range (g/dl)</th>
<th>Anaemia if Hb less than (g/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth (full term)</td>
<td>13.5-18.5</td>
<td>13.5</td>
</tr>
<tr>
<td>Children 2-6 months</td>
<td>9.5-13.5</td>
<td>9.5</td>
</tr>
<tr>
<td>Children 6 months-6 years</td>
<td>11.0-14.0</td>
<td>11.0</td>
</tr>
<tr>
<td>Children 6-12 years</td>
<td>11.5-15.5</td>
<td>11.5</td>
</tr>
<tr>
<td>Adult males</td>
<td>13.0-17.0</td>
<td>13.0</td>
</tr>
<tr>
<td>Adult females non-pregnant</td>
<td>12.0-15.0</td>
<td>12.0</td>
</tr>
<tr>
<td>Adult females pregnant 1st trimester (0-12 weeks)</td>
<td>11.0-14.0</td>
<td>11.0</td>
</tr>
<tr>
<td>Adult females pregnant 2nd trimester (13-28 weeks)</td>
<td>10.5-14.0</td>
<td>10.5</td>
</tr>
<tr>
<td>Adult females pregnant 3rd trimester (29 weeks to term)</td>
<td>11.0-14.0</td>
<td>11.0</td>
</tr>
</tbody>
</table>

2.3. IRON

Iron is an essential mineral required by humans and in the body, is mostly contained in haemoglobin.

A normal diet provides about 10-15 mg of iron per day of which 1-2 mg are absorbed providing the necessary replacement.

However rapid or chronic loss or increased requirement can deplete the body’s limited storage of iron.

2.4. CAUSES OF ANAEMIA

Table 2.2. shows the major causes of anaemia. Iron deficiency is the most common cause of anaemia.
Table 2.2. Causes of anaemia

<table>
<thead>
<tr>
<th><strong>A- increased loss (evident or occult)</strong></th>
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<tbody>
<tr>
<td>- Acute (haemorrhage)</td>
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<tr>
<td>- Chronic (gastrointestinal, urinary or reproductive tract bleeding eg menorrhagia, parasites, malignancies, etc.)</td>
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<table>
<thead>
<tr>
<th><strong>B- decreased production</strong></th>
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<tr>
<td>- Nutritional deficiencies (iron, vitamin B₁₂, folate, malnutrition, malabsorption)</td>
</tr>
<tr>
<td>- Viral infections (HIV)</td>
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<tr>
<td>- Bone marrow failure (aplastic anaemia, malignant infiltration, leukaemia)</td>
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<tr>
<td>- Reduced erythropoietin production (chronic renal failure)</td>
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<tr>
<td>- Chronic or autoimmune diseases</td>
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<td>- Poisoning (lead)</td>
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<table>
<thead>
<tr>
<th><strong>C- increased red blood cells destruction</strong></th>
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<tr>
<td>- Infections (bacteria, viruses, parasites)</td>
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<tr>
<td>- Drugs (dapsone)</td>
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<tr>
<td>- Autoimmune disorders (warm and cold antibody haemolytic disease)</td>
</tr>
<tr>
<td>- Inherited disorders (sickle cell disease, thalassaemia, G6PD deficiency, spherocytosis)</td>
</tr>
<tr>
<td>- Haemolytic disease of the newborn (HDN)</td>
</tr>
<tr>
<td>- Disseminated intravascular coagulation (DIC)</td>
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<tr>
<td>- Haemolytic uraemic syndrome</td>
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<tr>
<td>- Thrombotic thrombocytopenic purpura (TTP)</td>
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<table>
<thead>
<tr>
<th><strong>D- increased demand</strong></th>
</tr>
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<tbody>
<tr>
<td>- Pregnancy</td>
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<td>- Lactation</td>
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2.5. ASSESSING ANAEMIA

A patient with anaemia may not present with symptoms especially if the anaemia is due to a chronic process. Therefore to evaluate anaemia and the need for blood transfusion we need to consider the body’s compensatory mechanisms.

2.5.1. Clinical assessment

History and physical examination may reveal underlying disorders. During this assessment the clinician must also consider the occurrence of Acute-on-Chronic anaemia. This refers to a situation where there is a sudden fall in haemoglobin concentration in a patient who is already chronically anaemic.

Table 2.3. shows signs, symptoms and findings on history that can be related to underlying disorders.
### Table 2.3. Clinical assessment of anaemia

<table>
<thead>
<tr>
<th>HISTORY</th>
<th>Findings related to underlying disorders</th>
</tr>
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<tbody>
<tr>
<td>Non specific signs and symptoms</td>
<td>Nutritional deficiency</td>
</tr>
<tr>
<td>• Tiredness and/or loss of energy</td>
<td>Pharmaceutical drugs</td>
</tr>
<tr>
<td>• Light-headedness</td>
<td>Family history</td>
</tr>
<tr>
<td>• Shortness of breath</td>
<td>High risk of exposure to HIV</td>
</tr>
<tr>
<td>• Ankle swelling</td>
<td>Fever</td>
</tr>
<tr>
<td>• Headache</td>
<td>Night sweats</td>
</tr>
<tr>
<td>Findings related to underlying disorders</td>
<td>History of malaria or travel in malarious areas</td>
</tr>
<tr>
<td>• Nutritional deficiency</td>
<td>Gynaecological and obstetric history</td>
</tr>
<tr>
<td>• Pharmaceutical drugs</td>
<td>Bleeding from urinary tract, mucosa, GI tract</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PHYSICAL EXAMINATION</th>
<th>Findings related to underlying disorders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signs of severe anaemia and clinical decompensation</td>
<td>Weight loss</td>
</tr>
<tr>
<td>• Pale mucous membranes</td>
<td>Underweight</td>
</tr>
<tr>
<td>• Tachypnoea</td>
<td>Angular stomatitis</td>
</tr>
<tr>
<td>• Tachycardia</td>
<td>Jaundice</td>
</tr>
<tr>
<td>• Raised jugular venous pressure</td>
<td>Purpura</td>
</tr>
<tr>
<td>• Heart murmurs</td>
<td>Enlarged lymph nodes</td>
</tr>
<tr>
<td>• Ankle oedema</td>
<td>Lower leg ulcers</td>
</tr>
<tr>
<td>• Postural hypotension</td>
<td>Skeletal deformities</td>
</tr>
<tr>
<td>Findings related to underlying disorders</td>
<td>Neurological signs</td>
</tr>
<tr>
<td>• Weight loss</td>
<td></td>
</tr>
<tr>
<td>• Underweight</td>
<td></td>
</tr>
<tr>
<td>• Angular stomatitis</td>
<td></td>
</tr>
<tr>
<td>• Jaundice</td>
<td></td>
</tr>
<tr>
<td>• Purpura</td>
<td></td>
</tr>
<tr>
<td>• Enlarged lymph nodes</td>
<td></td>
</tr>
<tr>
<td>• Lower leg ulcers</td>
<td></td>
</tr>
<tr>
<td>• Skeletal deformities</td>
<td></td>
</tr>
<tr>
<td>• Neurological signs</td>
<td></td>
</tr>
</tbody>
</table>

#### 2.5.2. Laboratory investigations to assess the type of anaemia

Basic tests to assess the type of anaemia are:
- full blood count,
- reticulocyte count
- examination of the blood film (e.g. Sickle Cells Disease, malaria),

Other tests can be performed according to clinical picture (e.g. G6PD).

#### 2.6. ACUTE BLOOD LOSS

In acute blood loss there is a rapid decrease of blood volume (hypovolaemia) and a decrease of haemoglobin.

The clinical picture of acute blood loss varies according to the volume lost and the patient’s capacity to activate compensatory mechanisms.

* A common clinical feature in acute blood loss, according to amount of loss are:
  - thirst,
  - tachycardia,
  - reduced blood pressure,
  - decreased pulse pressure,
  - cool, pale, sweaty skin, and poorly perfused extremities
  - tachypnoea,
  - reduced urine output,
  - restlessness or confusion.
B-Compensatory responses of the body to acute blood loss are:

- restoration of plasma volume,
- circulatory compensation,
- restoration of cardiac output,
- stimulation of ventilation,
- changes in oxygen dissociation curve,
- hormonal changes,
- synthesis of plasma proteins.
- Decrease in urine output

In Tables 2.4 and 2.5 there is the classification of hypovolaemia for adults and children.

Table 2.4. Classification of hypovolaemia according to blood loss in adults

<table>
<thead>
<tr>
<th>Blood loss Percentage Volume (70 kg adult)</th>
<th>Class I mild</th>
<th>Class II progressing</th>
<th>Class III severe</th>
<th>Class IV end stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 15% 750 ml</td>
<td>Normal</td>
<td>Normal</td>
<td>Reduced</td>
<td>Very low</td>
</tr>
<tr>
<td>15-30% 800-1500 ml</td>
<td>Reduced</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30-40% 1500-2000 ml</td>
<td>Reduced</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;40% &gt;2000 ml</td>
<td>Reduced</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic blood pressure</td>
<td>Normal</td>
<td>Normal</td>
<td>Reduced</td>
<td>Very low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100-120</td>
<td>120</td>
<td>&gt;120 (very thready)</td>
</tr>
<tr>
<td>Capillary refill</td>
<td>Normal</td>
<td>Normal</td>
<td>Very prolonged</td>
<td>Absent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prolonged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mental state</td>
<td>Alert</td>
<td>Anxious or aggressive</td>
<td>Confused</td>
<td>Drowsy or unconscious</td>
</tr>
<tr>
<td>Urinary flow</td>
<td>&gt;30 ml/h</td>
<td>20-30 ml/h</td>
<td>10-20 ml/h</td>
<td>&lt;10 ml/h</td>
</tr>
</tbody>
</table>

Table 2.5. Classification of hypovolaemia according to blood loss in children

<table>
<thead>
<tr>
<th>Blood loss (percentage)</th>
<th>Class I mild</th>
<th>Class II progressing</th>
<th>Class III severe</th>
<th>Class IV end stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;15%</td>
<td>Normal</td>
<td>Reduced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-25%</td>
<td>Normal</td>
<td>Reduced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-40%</td>
<td>Normal</td>
<td>Reduced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;40%</td>
<td>Normal</td>
<td>Increased</td>
<td>Slow sighing respiration</td>
<td>Absent</td>
</tr>
<tr>
<td>Systolic blood pressure</td>
<td>Normal</td>
<td>Increased</td>
<td></td>
<td>Slow sighing respiration</td>
</tr>
<tr>
<td></td>
<td>Reduced</td>
<td></td>
<td></td>
<td>Absent</td>
</tr>
<tr>
<td>Pulse rate</td>
<td>Increased</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capillary refill</td>
<td>Normal</td>
<td>Increased</td>
<td></td>
<td>Slow sighing respiration</td>
</tr>
<tr>
<td></td>
<td>Prolonged</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mental state</td>
<td>Normal</td>
<td>Increased</td>
<td></td>
<td>Comatose</td>
</tr>
<tr>
<td></td>
<td>Irritable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urinary flow</td>
<td>&lt;1 ml/kg/h</td>
<td>&lt;1 ml/kg/h</td>
<td>&lt;1 ml/kg/h</td>
<td>&lt;1 ml/kg/h</td>
</tr>
</tbody>
</table>

2.7. CHRONIC BLOOD LOSS

In chronic blood loss here is a continuous loss of blood over a long period of time.

While the circulatory blood volume is usually maintained (normovolaemia), an iron deficiency anaemia with microcythaemia and hypochromia usually results

Compensatory response to chronic blood loss is similar to the response to acute loss:

- cardiovascular compensation,
- changes in oxygen dissociation curve,
- hormonal changes,
- changes in blood viscosity.
When compensatory mechanisms fail, signs and symptoms will appear. Some will be non-specific, others will be related to decompensation (see Table 2.3).

2.8. PREVENTION

Prevention of anaemia is among the most important measures to avoid blood transfusion. Prevention should particularly target more vulnerable groups (e.g. children and pregnant women). Primary Care (in particular ANC, FP, GM) and community health programmes should be strengthened to prevent anaemia in children and in women of childbearing age.

Activities which may be implemented are:
- health education (nutrition, hygiene, sanitation, accidents, etc.),
- iron and folate supplementation,
- control of infectious diseases,
- food fortification.

2.9. TREATMENT

In case of acute haemorrhage see also chapters 10 and 11.

It is difficult to establish what is the level of haemoglobin should be under which there is need of transfusion. While each patient requires a careful evaluation, it is usually uncommon that transfusion is justified if the Hb level is over 10g/dl.

Transfusion should be strongly considered for haemoglobin level less than 6g/dl. However the clinical picture of the patient together with other factors (e.g. transfusion risks) have to be considered.

Basic principles of treatment of anaemia.
- Assess the degree of patient’s anaemia compensation or decompensation
- Diagnose and treat the underlying causes of anaemia (e.g. parasite infestation, bacterial infection, malaria, vitamin deficiencies, etc.).
- Provide oral iron therapy, if iron deficient.
- Improve the oxygen supply to the tissues by:
  - restoring cardiac output (e.g. fluid replacement),
  - give oxygen by mask,
  - transfuse if required.
3. ALTERNATIVE OPTIONS TO BLOOD TRANSFUSION

3.1. REPLACEMENT FLUIDS

Intravenous replacement fluids are life-saving first-line treatment in severe haemorrhage. They provide time to control bleeding and to get blood for transfusion if necessary.

Table 3.1. Replacement fluids

<table>
<thead>
<tr>
<th>CRYSTALLOIDS</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contain a sodium concentration similar to plasma</td>
<td>Few side-effects</td>
</tr>
<tr>
<td>Should be infused in a volume at least 3 times the loss as they quickly diffuse out of intracellular space. Common crystalloid solutions are: normal saline, balanced salt solution such as Ringer’s lactate or Hartmann’s solution. *</td>
<td>Low cost</td>
</tr>
<tr>
<td>Common crystalloid solutions are: normal saline, balanced salt solution such as Ringer’s lactate or Hartmann’s solution. *</td>
<td>Wide availability</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COLLOIDS</th>
<th>Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colloids have a much larger molecular weight than crystalloids. They mimic plasma proteins maintaining the colloid osmotic pressure of blood. Since they remain in the intracellular space slightly longer, they need to be initially infused in a volume equal to loss in combination with crystalloids. Common colloid solutions are: -natural colloid solutions (plasma, fresh frozen plasma, liquid plasma, freeze-dried plasma, albumin)** -synthetic colloid solutions (gelatines, dextran 60, dextran 70, hydroxyethyl starch)</td>
<td>Longer duration of action</td>
</tr>
<tr>
<td>*Dextrose solutions, that do not contain sodium, can be used only if there are no other alternatives **They should not be used as replacement fluid</td>
<td></td>
</tr>
</tbody>
</table>

As there is no evidence that either crystalloid or colloid solutions are superior, the choice depends on the clinician’s evaluation of characteristics and on the availability of products.

Table 3.2 shows advantages and disadvantages of crystalloids and colloids

Table 3.3 shows the characteristics of replacement fluids

<table>
<thead>
<tr>
<th>Crystalloids</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Few side-effects</td>
<td>Short duration of activity</td>
<td></td>
</tr>
<tr>
<td>Low cost</td>
<td>Greater quantity required</td>
<td></td>
</tr>
<tr>
<td>Wide availability</td>
<td>May cause oedema</td>
<td></td>
</tr>
<tr>
<td>Weighty and bulky</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Colloids</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longer duration of action</td>
<td>No evidence they are more effective</td>
<td></td>
</tr>
<tr>
<td>Less fluid required</td>
<td>Higher cost</td>
<td></td>
</tr>
<tr>
<td>Less weighty and bulky</td>
<td>May cause volume overload</td>
<td></td>
</tr>
<tr>
<td></td>
<td>May interfere with clotting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Risk of anaphylactic reactions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>May interfere with crossmatch reading</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normal saline</td>
<td>Balanced salt solution</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------</td>
<td>------------------------</td>
</tr>
<tr>
<td><strong>Storage</strong></td>
<td>Cool place</td>
<td>Cool place</td>
</tr>
<tr>
<td><strong>Plasma half-life</strong></td>
<td>± 45 min</td>
<td>± 45 min</td>
</tr>
<tr>
<td><strong>Indications</strong></td>
<td>Replacement of blood volume</td>
<td>Replacement of blood volume</td>
</tr>
<tr>
<td><strong>Precautions</strong></td>
<td>May cause heart failure and fluid overload</td>
<td>May cause heart failure and fluid overload</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Established renal failure</td>
<td>Established renal failure</td>
</tr>
<tr>
<td><strong>Side-effects</strong></td>
<td>Tissue oedema</td>
<td>Tissue oedema</td>
</tr>
<tr>
<td><strong>Dosage</strong></td>
<td>3 times the volume lost</td>
<td>3 times the volume lost</td>
</tr>
</tbody>
</table>

* = content should be: dextrose 2.5%; Sodium 60 mmol/l; Potassium 17 mmol/l; Chloride 52 mmol/l; Lactate 25 mmol/l
3.2. OTHER INFUSION ROUTES FOR CRYSTALLOIDS

If it is not possible to use the IV route, there are other administration routes such as:

- intraosseous,
- subcutaneous (fluids not containing dextrose),
- nasogastric,
- rectal.
4. BLOOD AND BLOOD PRODUCTS

4.1. TESTING FOR TRANSFUSION TRANSMITTED INFECTIONS (TTIs)

All donated blood must be tested, with up-to-date methods, for TTIs.

At SNBTS all blood collected from voluntary non-remunerated donors is tested for HIV 1 and 2, HBV, HCV, and syphili.

4.2. TYPES OF BLOOD PRODUCTS AND INDICATIONS

In modern Blood Transfusion Services the blood collected from donors is separated into components such as Red Cells Concentrate, Plasma (that is immediately frozen) and platelets. Moreover other derivatives are extracted from plasma (coagulation factors, albumin, etc.).

It has been demonstrated that there are more adverse reactions when transfusing whole blood than when transfusing Red Cells Concentrate.

The SNBTS supplies blood components which are preferable to the use of whole blood such as:
- Red Cells Concentrate
- Fresh Frozen Plasma
- Platelets Concentrate (by request)

By request paediatric Red Cells Suspension units can also be prepared.

Table 4.1. Describes the characteristics of blood and blood products (RCC and Leucocyte-depleted red cells are, presently, not available at SNBTS).
Table 4.2. estimates the content of coagulation factors in 1 unit of FFP.
Table 4.3. shows the characteristics of plasma derivatives (FFP only is, at the moment, provided by SNBTS).
### Table 4.1. Blood and blood products

<table>
<thead>
<tr>
<th>Description</th>
<th>Whole blood</th>
<th>Red Cell Concentrate</th>
<th>Red Cell – in additive solution</th>
<th>Platelet concentrate</th>
<th>Plasma (fresh frozen)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Whole blood</strong></td>
<td>450 ml donor blood</td>
<td>150-200 ml red cells with minimal plasma</td>
<td>150-200 ml red cells plus 100ml additive and minimal plasma</td>
<td>Contains &lt;5 x 10⁶ white cells per unit</td>
<td>At least 55x10⁹ platelets in 50-60 ml of plasma</td>
</tr>
<tr>
<td><strong>Red Cell Concentrate</strong></td>
<td>Same as whole blood</td>
<td>Same as whole blood</td>
<td>Same as whole blood</td>
<td>Up to 5 days with continuous agitation</td>
<td>Up to 3 years</td>
</tr>
<tr>
<td><strong>Red Cell – in additive solution</strong></td>
<td>Same as whole blood</td>
<td>Same as whole blood</td>
<td>Same as whole blood</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Platelet concentrate</strong></td>
<td>Red Cell – Leucocyte-depleted</td>
<td></td>
<td></td>
<td></td>
<td>200-300 ml of plasma separated within 6 hours and rapidly frozen</td>
</tr>
<tr>
<td><strong>Source</strong></td>
<td>1 donation</td>
<td>1 donation</td>
<td>1 donation</td>
<td>1 donation</td>
<td>1 donation</td>
</tr>
<tr>
<td><strong>Storage</strong></td>
<td>Depends on preservatives (#)</td>
<td>Same as whole blood</td>
<td>Same as whole blood</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Expiry</strong></td>
<td></td>
<td>Same as whole blood</td>
<td>Same as whole blood</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Indications</strong></td>
<td>Acute blood loss; Exchange transfusion; When RBC concentrates not available</td>
<td>Acute blood loss (with replacement fluids); anaemia; bone marrow failure; increased destruction</td>
<td>Same as red cell concentrate</td>
<td>Severe aplastic anaemia; foetal/neonatal transfusion</td>
<td>-Thrombocytopenia -Platelet dysfunction -Bone marrow failure -Liver failure -Warfarin overdosage -Depletion of coagulation factors -DIC -TTP</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Risk of volume overload</td>
<td>Not to be used as volume expander</td>
<td>Not advised for exchange transfusion in neonates</td>
<td>Do not prevent graft-vs-host disease</td>
<td>Not to be used as plasma expanders not to be used as nutritional support</td>
</tr>
<tr>
<td><strong>Administration</strong></td>
<td>-ABO and RhD compatible -complete within 4 hours -do not add any medication to the unit</td>
<td>-Same as whole blood</td>
<td>-Same as whole blood</td>
<td>-Use within 4 hours of issue -Not to be refrigerated -infuse over 20 minutes -One unit increase the platelet level by 20 x 10⁹/L</td>
<td>ABO compatible Pre-warm between +30 and +37°C Use within 6 hours after thawing</td>
</tr>
<tr>
<td><strong>Risks</strong></td>
<td>TTIs</td>
<td>TTIs</td>
<td>TTIs</td>
<td>TTIs; hypernatraemia and hypokalaemia in large volumes transfusion</td>
<td></td>
</tr>
</tbody>
</table>

@=available only on request; ^=not presently available at SNBTS

*= may be used in the attempt to control life-threatening haemorrhage; **= may be used if thrombocytopenia is associated

#=CPD(Citrate, Phosphate, Dextrose) + SAG-M(Saline, Adenine, Glucose +Mannitol):35 days; CPDA(Citrate, Phosphate, Dextrose, Adenine) + SAG-M:42 days (currently employed at SNBTS)
Table 4.2. Content of coagulation factors in a unit of FFP.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibrinogen</td>
<td>200 mg</td>
</tr>
<tr>
<td>Factor II</td>
<td>1.03 u/ml</td>
</tr>
<tr>
<td>Factor V</td>
<td>0.64 u/ml</td>
</tr>
<tr>
<td>Factor VII</td>
<td>1.21 u/ml</td>
</tr>
<tr>
<td>Factor VIII</td>
<td>0.85 u/ml</td>
</tr>
<tr>
<td>Factor IX</td>
<td>0.91 u/ml</td>
</tr>
<tr>
<td>Factor X</td>
<td>1.25 u/ml</td>
</tr>
<tr>
<td>Factor XI</td>
<td>0.79 u/ml</td>
</tr>
<tr>
<td>Antithrombin III</td>
<td>104%</td>
</tr>
<tr>
<td>Plasma Pseudo-Cholinesterase</td>
<td>3 000-10 000 iu/l</td>
</tr>
</tbody>
</table>

Table 4.3. Characteristics of plasma derivatives (not available at SNBTS)

<table>
<thead>
<tr>
<th>Description</th>
<th>Albumin</th>
<th>Coagulation factor VIII concentrate*</th>
<th>Prothrombin complex concentrate (PCC) and factor IX concentrate</th>
<th>Immunoglobulin (IVIG)</th>
<th>Cryoprecipitate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>Pools of donated plasma</td>
<td>Pools of donated plasma</td>
<td>Pools of donated plasma</td>
<td>1-normal 2-anti-RhD 3-against specific infectious agents</td>
<td>Contains about half of the factor VIII and fibrinogen in the donated whole blood</td>
</tr>
<tr>
<td>Source</td>
<td>Pools of donated plasma</td>
<td>Pools of donated plasma</td>
<td>Pools of donated plasma</td>
<td>1-Pools of donated blood 2-from previously immunized persons 3-from population exposed to specific infectious agents</td>
<td>Prepared from FFP by collecting the precipitate formed during controlled thawing and resuspending in 10-20ml plasma</td>
</tr>
<tr>
<td>Indications</td>
<td>- Hypoprotein induced oedema -burns -shock</td>
<td>-Haemophilia A -Von Willebrand disease: use intermediate purity preparations</td>
<td>-Haemophilia B -correction of coagulation disorders (prolonged Prothrombin time)</td>
<td>1- immunodeficiency 2-prevention of haemolytic disease of the RhD positive newborn from RhD negative mother 3-prevention of specific infections 4-ITP</td>
<td>Alternative to Factor VIII</td>
</tr>
</tbody>
</table>

* = Factor VIII prepared in vitro using recombinant DNA methods is available however it is expensive in comparison to the plasma derivitives.
5-TRANSFUSION

A summary of the steps and responsible persons is in Annex 1.

5.1. LEGAL ASPECTS

A-It is responsibility of the Medical Practitioner to ensure that the following ethical issues are addressed.

1. Each patient is treated with respect of his/her individual needs, religious beliefs and cultural background.
2. Transfusion is absolutely necessary.
3. Reasons for transfusion are properly explained to the patient (or parents/relatives/guardians) and the information should be possibly given in the patient’s own language.
4. When possible, written informed consent (Annex 2) is obtained from the patient. The clinician has to ensure that the patient understands the information given.
5. If the patient is not able to give consent and no relatives or other authorized decision makers are available, then the clinician should make a decision in the best interests of the patient. The process should be recorded in patient’s file.
6. In case of patients refusal to be transfused other options will be considered; however the patient (or parents/relatives/guardian) should sign the refusal form (see example in Annex 3). A patient can change mind and decide to be transfused. In this case the consent form has to be filled and the process recorded on patient’s record.
7. In case of refusal by parents/relatives/guardian to allow a child to be transfused the clinician has to follow the country’s laws and regulation in protection of the child’s right.

B-It is also responsibility of the Medical Practitioner to ensure that proper procedures are followed by the appropriate personnel.

1. The blood component request form is properly filled and signed by him/her (Annex 4)
2. Compatibility tests are done by the laboratory/blood bank
3. The unit is properly identified, together with the recipient, and checked for damage at patients bed(right unit for right patient)
4. The unit is not transfused after expiry date
5. The patient is monitored during the transfusion and data are recorded in patient’s file
6. The transfusion is stopped if signs of significant reaction are noticed
7. In case of significant adverse reaction:
   - a notification form (Annex 5) and the unit that reacted are sent to the hospital blood bank.
   - the hospital blood bank send a copy of the adverse reaction notification form to the SNBTS

5.2. RISKS

Transfusion, like all medical procedures has risks that need to be minimized.

Before proceeding with a transfusion the medical practitioner should weigh up the risks versus the benefits of the transfusion. The prescribing medical practitioner should take into account:
that even if voluntary non-paid donors are recruited from a low risk population, a small portion of them may carry infectious agents
that even if the donated blood is tested with modern technology, there is always a little chance that some infectious agents are not detected (e.g. window period of HIV infection)
that the transfusion of blood products can cause severe reactions
that blood products can become contaminated

5.3. DECISION

The decision to transfuse blood or blood products should always be based on a careful assessment of clinical and laboratory indications.

The medical practitioner should always consider individual patient needs, resources available for managing the patient, availability of blood and replacement fluids.

Factors to be assessed are:
• blood loss,
• haemolysis,
• cardiorespiratory state,
• anaemia,
• patient’s tolerance to blood loss/anaemia,
• other concomitant clinical conditions,
• need for blood.

In general, in patients of about 60kg of weight, one unit of blood (whole or Red Cells) usually increases the haemoglobin by 1g/dl.

Questions which may assist the clinician in deciding on transfusion:
• What improvement of patient’s clinical conditions do we want to achieve?
• Can the improvement be achieved without transfusion?
• Can blood loss be stopped or minimized to avoid transfusion?
• Is there any other alternative treatment that can be used other than transfusion?

5.4. ORDERING BLOOD COMPONENTS

Steps to be taken.
1. Inform the patient and/or relatives about the need for a transfusion and write the result of the discussion on patient’s record.
2. Obtain informed consent from the patient or from parents/relatives/guardian if the patient is a minor or is unconscious.
3. If the patient is unable to provide consent and there are no relatives the clinician should make a decision based on patient conditions and potential benefit of a transfusion (record the process).
4. Fill in the request form with positive identification of the patient by directly asking him/her/relatives:
• surname (what is your/patient surname? and not are you Mr/Ms/Mrs XXX?)
• name (what is your/patient name?),
• date of birth (what is your/patient birth date?)
• ward.
5. Patient’s file number should be registered as well and, if available, the bed number and patient identification number (e.g. Personal ID Number)

The clinician has to indicate when the blood has to be delivered as:
- extremely urgent: 10-15 minutes (see also 5.9.),
- very urgent: within 1 hour,
- urgent: within 3 hours,
- date when the blood component has to be supplied.

The hospital blood bank should return all incomplete or illegible forms and samples immediately to the wards because of the high risk of transfusing the wrong blood.

A standard request form is in Annex 4.

5.5. BLOOD GROUPING AND COMPATIBILITY TESTS

All blood should be tested before it is transfused to ensure that the red cells are compatible with the antibodies of the patient to avoid incompatibility reactions and triggering the production of new red cell antibodies from the patient (e.g. anti-RhD).

It is therefore mandatory that, before the transfusion, the ABO group and RhD type are known of both patient and the unit to be transfused. Only when blood is issued on emergency will the crossmatch be done after issue and the clinician will be notified if there is an incompatibility and need to stop the transfusion.

5.6. STORAGE AND TRANSPORTATION

5.6.1. Red Cells Concentrate and whole blood
- After collection red cells and whole blood must be stored at a temperature between +2°C and +6°C.
- They should be transported in a refrigerated box with controlled temperature and infused immediately. It is not recommended to store blood component in wards as buffer stock. However, if the transfusion cannot start immediately, then store at a temperature between +2°C and +6°C for short time.
- Never store red cells and whole blood near the freezer compartment in a domestic-like refrigerator (freezing will damage red cells and is potentially dangerous).
- After removal from the refrigerator the infusion of RCC/RCS/whole blood should start within 30 minutes.
- If a unit remained out of refrigerator for more than 30 minutes and there is no prospect of imminent transfusion, it must be discarded because of the possibility of bacterial contamination. Units that are discarded have to be registered.

5.6.2. Platelet Concentrate
- Platelet concentrate, after collection, must be kept at a temperature of +20 to +24°C on a platelet agitator (up to 5 days maximum) and be transported in a transport box that will keep the same temperature.
- After transportation they should be transfused immediately and never placed in a refrigerator.

5.6.3. Fresh Frozen Plasma (FFP)
- FFP should be stored, after separation, at -25°C or colder temperature.
- Before transfusion it should be thawed in a waterbath at a temperature between +30 and +37°C and infusion started within 30 minutes.
If the transfusion is delayed the unit should be stored at +2°C to +6°C but infused within 24 hours of being thawed.

5.7. IDENTIFICATION OF PATIENT AND BLOOD UNIT TO BE TRANSFUSED

Before starting the transfusion the blood unit and the patient’s identity have to be verified by a medical practitioner and a staff nurse or by two staff nurses.

The identification of the blood unit and patient should be done at patient’s bed; the donor’s and patient’s blood groups must be compatible.

The unit must be checked for signs of deterioration such as haemolysis, contamination:
- red cells should not look black or darker that the attached pilot segments,
- should not contain aggregates or pus,
- platelet should be yellowish or straw color and no aggregates,
- thawed FFP should be clear yellowish color.

If any of those signs of deterioration or bag damage are present, the unit should not be transfused but returned to the blood bank to be discarded.

One label with blood unit identification number should be stuck on the patient’s record.

Factors affecting identification are:
- staff turnover (e.g. nursing shift) between decision and transfusion,
- mislabelling of patient’s samples,
- inaccurate or incomplete filling in of request form,
- language barrier,
- communication barriers (e.g. coma),
- rushed patient’s identity check,
- insufficient staff training.

5.8. TRANSFUSION PROCEDURES

Transfusions have to be given under supervision of a clinician.

Needles or cannulae (which are preferable) must be sterile and not expired.

Recommended size:
- 18-20 G for adults
- 22-24 G for children

Needles/cannulae should never be reused. The infusion set should be changed at least every 12 hours.

5.8.1. Time limits for transfusion

Red cells and whole blood should start within 30 minutes from removing the unit from the refrigerator and completed within 4 hours.

Platelet concentrates should start immediately and completed within 20 minutes.

Fresh frozen plasma should start within 30 minutes and completed within 30 minutes.

5.8.2. Infusion set

Whole blood, red cells, plasma and cryoprecipitate should be infused through a 170-200µm filter.

A platelet filter should be used for platelet infusion, however also a 170-200µm filter can be used in emergency. Never transfuse platelets using a set already used for other blood components.

The filters should be almost ⅓ covered by the blood product to ensure that all filter area is used.
5.8.3. Rate of infusion and warming of blood

Red Cells
- The rate of infusion is determined according to the patient's condition.
- If there is no extreme urgency, a relatively slow drip (<5 ml/min) is recommended for the first 30 minutes; then the speed can be increased if there are no signs of adverse reaction.
- If external pressure device is used to infuse blood rapidly the pressure should not exceed 300 mm Hg.
- Warming blood prior the transfusion is not necessary with a non emergency slow infusion rate.
- If transfusion rate is greater than 50 ml/kg/hour in adults and 15 ml/kg/hour in children the blood should be warmed to decrease the possibility of cardiac arrest.
- Warming should be done using a blood warmer. The blood must never be placed in a container with hot water, oven or microwave (high risk of haemolysis).
- Frusemide should not be given routinely but only in particular cases (e.g. risk of cardiac failure).

Platelets
- One unit of apheresis platelet increases platelets by at least 20-40 x10^9/l.
- The transfusion rate is 10-20 ml/kg/h.

Plasma
The recommended dosage is 10-20 ml/kg infused at 10-20 ml/kg/h.

5.8.4. Administration of other pharmaceuticals during transfusion

If other IV fluid or drugs needs to be infused, these should be given through a separate IV line. If no other venous access can be found, and there is need of infusing drugs rapidly:
- stop the transfusion,
- wash the end of the line with normal saline,
- administer drug,
- wash with normal saline,
- restart the transfusion

Isotonic solutions only can be infused during blood transfusion using a Y device (blood infused via the lowest port).
- If pre-medications is required, it should be administered 30 minutes prior to starting transfusion.

5.8.5. Recording the transfusion

The following information must be recorded on the patient’s record:
- reasons for transfusion,
- correct information given,
- pre-transfusion check,
- blood unit identification and transfusion procedure,
- reactions

5.8.6. Monitoring the patient
The accurate and rapid detection of adverse effects is one of the major responsibility for doctors and nurses. The time of transfusion start and end, together with the total volume transfused should be recorded on patient’s record.

The patient should be closely monitored during the first 15 minute of the transfusion.

The patient vital parameters such as:
- temperature,
- blood pressure,
- pulse,
- respiratory rate,
- urinary output,
- visual observation

must be checked, and written on the patient’s record, at least:
- at baseline,
- at transfusion start,
- after 15 minutes from transfusion start,
- every hour,
- at the end of the transfusion,
- 4 hours after the end of the transfusion.

Patients at risk of circulatory overload must be observed closely for almost 12 hours after the end of the transfusion. Unconscious patients must be monitored with extra care.

5.9. USE OF “O” BLOOD GROUP

Each Hospital Blood Bank should have units of emergency group O RhD negative blood to be stored separately and identifiable in case of mandatory need or emergency as defined below. The blood should be used and replaced before the expiry date.

Group O blood can be transfused to all ABO groups RhD positive patients. For O RhD negative blood the recommendations are as in Table 5.1 below.

Table 5.1. Use of O blood group

<table>
<thead>
<tr>
<th>A-Mandatory use of O RhD negative blood</th>
</tr>
</thead>
<tbody>
<tr>
<td>• O RhD negative females of reproductive age</td>
</tr>
<tr>
<td>• O RhD negative patients</td>
</tr>
<tr>
<td>• Emergency in pre-menopausal females of unknown blood group</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B-Recommended use of O RhD negative blood</th>
</tr>
</thead>
<tbody>
<tr>
<td>• O RhD negative patient who is going to receive repeated transfusions or is going to be transfusion-dependent (e.g. haemoglobinopathies)</td>
</tr>
<tr>
<td>• Emergency situation while patient’s blood group is being established. Since grouping and compatibility test in urgency takes no more than 20 minutes, in most instances it will be sufficient to transfuse a maximum of 2 units of O RhD negative</td>
</tr>
<tr>
<td>• In neonates when suitable group specific blood is not available #</td>
</tr>
<tr>
<td>• Non-O RhD negative patients requiring special phenotype where group specific units are unavailable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C-Acceptable indications for use of O RhD negative blood</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Large volume replacement in females of non reproductive age, with no anti-D detectable, if limited or no stock of RhD negative blood available</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D-Use of O RhD positive blood for RhD negative patients</th>
</tr>
</thead>
</table>
• Adult males
• Female of non reproductive age and males, providing that anti-D are not detected on pre-transfusion test, if O RhD negative blood is not available
• Female of reproductive age, if O RhD negative blood is not available, with use of anti-D Immunoglobulin to reduce the risk of alloimmunization to the RhD antigen (see 1.3. for dosage)

#Because of the presence of maternal antibodies after birth, serological group typing is not performed in neonates. The determination of ABO group is then based on red cells only.

5.10. UNITS NOT TRANSFUSED

If a hospital blood bank is not likely to use a unit of blood product, the unit should be returned to SNBTS almost one week before expiry date.

5.11 THERAPEUTIC PHLEBOTOMY

This technique is the removal of blood or blood to improve patient’s conditions in case of diseases like haemochromatosis or polycythaemia. Blood is normally replaced with normal saline or 4% albumin. Therapeutic apheresis needs to be done following the procedures for regular blood donation and the blood. The blood bags need to be properly labelled and discarded. The SNBTS can supply empty bags by written and motivated request from a Medical Practitioner.

5.12. PLASMA EXCHANGE *

Plasma exchange is an extracorporeal processing of blood in order to remove, from the plasma, substances of large molecule size.

• Main indications are: myeloma, Waldenstrom’s macroglobulinaemia, Wegener’s granulomatosis. Goodpasture’s syndrome, progressive Glomerulo-nephritis, Guillain-Barré syndrome, TTP, auto-immune disorders, etc.
• In general 30-40 ml/kg of plasma are removed and replaced with albumin and normal saline or, in a few cases, with FFP (e.g. TTP).
• Complications are: volume overload, air embolism, haemolysis, coagulopathy, citrate toxicity, etc.

5.13. EXCHANGE TRANSFUSION *

Exchange transfusion consists in removing patient’s blood and replacing it with fresh donors’ blood.

Indications:
• Sickle Cell Disease
• TTP
• intoxications
• metabolic disorders
• neonatal jaundice (kernicterus)
• HDN

*= refer to specialized manuals for detailed methods
5.14 CORRECTED COUNT INCREMENT (CCI) FOR PLATELET TRANSFUSION

It is a more precise method for measuring the response to platelet transfusion.

\[
\text{CCI} = \frac{\text{count after one hour} - \text{baseline count}}{\text{Number of platelet transfused (x 10^{11}) \times body surface area (m^2)}}
\]

Example:

Baseline count = 2 (x 10^9)  
Count after transfusion= 30 (x 10^9)  
Body surface= 1.50 m²  
Number of platelet transfused (as appears in the bag label) = 4.5 (x 10^{11})

\[
\frac{(30-2)}{4.5} \times 1.50 = 9.3
\]

After a standard platelet transfusion a CCI of at least \( \frac{1}{\text{CCI}} \times 10^9 \) is expected.

Comment [PMK1]: In 5.8.3 you have said “One unit of platelet increases platelets by at least 20-40 x10^9/l. This is referring to a pool or apheresis unit where here is a single unit. I think we need to be more specific with regards platelet units and what the SNBTS is going to produce.
An adverse reaction can be defined as any sign or symptom which occurs after the start of a transfusion of blood or blood products.

Adverse reactions may occur in 1% of transfused patients. Severe reactions most commonly present less than 15 minutes after starting a transfusion.

Reactions can be due to:
- quality defect of the blood component,
- failure to administer the correct product to the right patient,
- reaction that are not possible to predict,

### 6.1. TYPES OF REACTION

Reactions can be acute or delayed. In the following table 6.1. the different types of reaction are described

<table>
<thead>
<tr>
<th>Table 6.1. Types of reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acute reactions</strong></td>
</tr>
<tr>
<td>1-Mild</td>
</tr>
<tr>
<td>-Allergic, urticarial reaction</td>
</tr>
<tr>
<td>2-Moderately severe</td>
</tr>
<tr>
<td>-Moderate hypersensitivity (severe urticarial lesions)</td>
</tr>
<tr>
<td>-Febrile non-haemolytic reactions (antibodies to white cells or platelets, antibodies to proteins including IgA</td>
</tr>
<tr>
<td>-Bacterial contamination</td>
</tr>
<tr>
<td>-Pyrogens</td>
</tr>
<tr>
<td>3-Life threatening reactions</td>
</tr>
<tr>
<td>-Acute intravascular haemolysis</td>
</tr>
<tr>
<td>-Bacterial contamination and septic shock</td>
</tr>
<tr>
<td>-Transfusion Associated Cardiac overload (TACO)</td>
</tr>
<tr>
<td>-Anaphylactic reactions</td>
</tr>
<tr>
<td>-Transfusion-associated lung injury (TRALI)</td>
</tr>
<tr>
<td><strong>Delayed complications</strong></td>
</tr>
<tr>
<td>1-transfusion-transmitted infections</td>
</tr>
<tr>
<td>-HIV-1 and 2,</td>
</tr>
<tr>
<td>-HTLV-I and II,</td>
</tr>
<tr>
<td>-viral hepatitis B and C</td>
</tr>
<tr>
<td>-cytomegalovirus, Epstein-Barr virus</td>
</tr>
<tr>
<td>-malaria, toxoplasmosis</td>
</tr>
<tr>
<td>-syphilis, and other bacteria (pseudomonas, staphylococcus)</td>
</tr>
</tbody>
</table>
2. Other complications
- Delayed haemolytic reaction
- Post-transfusion purpura
- Graft-versus-host diseases
- Iron overload (with repeated transfusions)

 Massive transfusion can also lead to complications. The major complications are:
  - coagulopathy
  - acidosis
  - hypothermia
  - citrate toxicity and hypocalcaemia
  - hyperkalaemia
  - depletion of platelets

Administering FFP and platelets should be considered for transfusion of more than 50% of blood volume.

6.2. ACUTE REACTIONS

6.2.1. Signs and symptoms of acute reactions

Fever is a common reaction to transfusion and a typical diagnosis is “febrile non-haemolytic reaction”. However it is important to consider other causes such as patient’s underlying conditions (e.g. malaria) and adverse reactions such as acute haemolysis and bacteraemia.

Acute reactions and possible causes are noted in Table 6.1

<table>
<thead>
<tr>
<th>TYPE OF REACTION</th>
<th>SIGNS AND SYMPTOMS</th>
<th>POSSIBLE CAUSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>- localized cutaneous reaction</td>
<td>- hypersensitivity</td>
</tr>
<tr>
<td></td>
<td>- itching</td>
<td></td>
</tr>
<tr>
<td>Moderately severe</td>
<td>- flushing</td>
<td>- hypersensitivity</td>
</tr>
<tr>
<td></td>
<td>- urticaria</td>
<td>- febrile non-haemolytic reaction</td>
</tr>
<tr>
<td></td>
<td>- chills/rigor</td>
<td>- possible contamination with pyrogens and/or bacteria</td>
</tr>
<tr>
<td></td>
<td>- fever</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- tachycardia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- restlessness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- anxiety</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- itching</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- palpitations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- headache</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- mild dyspnoea</td>
<td></td>
</tr>
<tr>
<td>Life-threatening</td>
<td>- rigors</td>
<td>- acute intravascular haemolysis</td>
</tr>
<tr>
<td></td>
<td>- fever</td>
<td>- bacterial contamination and septic shock</td>
</tr>
<tr>
<td></td>
<td>- restlessness</td>
<td>- fluid overload</td>
</tr>
<tr>
<td></td>
<td>- tachycardia</td>
<td>- anaphylaxis</td>
</tr>
<tr>
<td></td>
<td>- hypotension</td>
<td>- TRALI</td>
</tr>
<tr>
<td></td>
<td>- anxiety</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- chest pain</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- haemoglobinuria</td>
<td></td>
</tr>
</tbody>
</table>
6.2.2. Immediate management

Stop the transfusion and investigate. First check the blood unit labels and the patient’s identity to be sure that the patient receives the right blood.

If there is discrepancy remove the blood component unit and treat according to the type of reaction.

For all types of transfusion reactions, the blood bank should be notified so that they can double check the crossmatch & issue. If the product is discontinued it should be returned to the blood bank.

<table>
<thead>
<tr>
<th>Category 1-mild reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Stop transfusion</td>
</tr>
<tr>
<td>• Maintain venous access</td>
</tr>
<tr>
<td>• Administer antihistamines</td>
</tr>
<tr>
<td>• If no improvement within 30 minutes remove the unit and treat as Cat. 2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category 2-moderately severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Stop the transfusion</td>
</tr>
<tr>
<td>• Replace the infusions set and infuse normal saline to maintain the vein</td>
</tr>
<tr>
<td>• Treat symptoms (histamines, antipyretics, corticosteroids, etc.)</td>
</tr>
<tr>
<td>• If there is clinical improvement, restart the transfusion slowly with a new unit of blood (after crossmatching) and monitor carefully.</td>
</tr>
<tr>
<td>• If no improvement within 15 minutes treat as Category 3</td>
</tr>
</tbody>
</table>

If the patient is a regular transfusion recipient or has had 2 or more febrile non-haemolytic reactions in the past, then give an antipyretic 1 hour before starting the transfusion and repeat 3 hours after starting the transfusion and transfuse slowly.

<table>
<thead>
<tr>
<th>Category 3-Life-threatening</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Stop the transfusion immediately. Remove and replace the infusion set and infuse crystalloids or colloids to maintain systolic BP</td>
</tr>
<tr>
<td>• Maintain airway and give oxygen by mask</td>
</tr>
<tr>
<td>• Give drugs as necessary (e.g. adrenaline, corticosteroids, bronchodilators, diuretics, etc.)</td>
</tr>
<tr>
<td>• Check a fresh urine specimen for signs of macroscopic haemoglobinuria</td>
</tr>
<tr>
<td>• Start 24-hour urine collection and fluid balance (input and output)</td>
</tr>
<tr>
<td>• If bacteremia is suspected start broad spectrum antibiotics, including both gram positive and gram negative (especially for Pseudomonas species).</td>
</tr>
<tr>
<td>• If evidence of DIC give platelets and FFP if necessary</td>
</tr>
</tbody>
</table>

6.2.3. Management of most important acute reactions

6.2.3.1 Acute haemolytic reactions

Acute haemolytic reactions usually occur within 24 hours of a transfusion. It is caused by exposure of patient to incompatible donor red cells. The patient’s antibodies haemolyse transfused incompatible red cells. The reaction is most severe if a person with group O blood receives group A blood.
Acute haemolytic reactions are mostly due to mismatched ABO groups because of:
- taking blood sample from the wrong patient for grouping and compatibility test
- wrong labelling of the sample tube
- errors in filling the blood request form
- inaccurate checking of blood unit against patient’s blood group or identity

Signs and symptoms appear within 15 minutes from the start of the transfusion:
- tachycardia,
- hypotension,
- fever,
- flushing,
- restlessness,
- chills,
- dyspnoea,
- rigors,
- chest pain, low back pain,
- haemoglobinuria,
- oliguria,
- shock,
- increased bleeding tendency (DIC)

Management follows the recommendations in paragraph 6.2.2. category 3
It is also necessary to:
- prevent renal failure by inducing a diuresis with IV fluids and diuretics (e.g. frusemide),
- correct any coagulation disorders by administering blood components.

6.2.3.2 Bacterial contamination

Bacterial contamination is caused by contaminated blood products. *Pseudomonas* species and *Staphylococcus* species are the most frequent contaminants.
It affects about 0.4% of red cells and 2% of platelet concentrates.

Blood may be contaminated by:
- bacteria from the donor’s skin,
- bacteraemia present in donor’s blood at the time of collection,
- poor blood processing,
- poor cold chain management
- damage or manufacturing defects of the blood bag,
- warming blood or thawing frozen plasma in a contaminated waterbath,

Usually rapid onset of signs and symptoms. Most common are:
- high fever,
- chills,
- rigor,
- hypotension,
- shock.

Management follows the recommendations in paragraph 6.2.2. Category 3

6.2.3.3. Anaphylactic reactions
This is an uncommon complication. Anaphylaxis may be due to antibodies to IgA immunoglobulin (traces of IgA are present to any blood product) or due to cytokines or proteins of unknown origin. It usually occurs rapidly after starting the transfusion presenting with:
  - dyspnoea,
  - hypotension,
  - shock,
  - oedema,
  - gastrointestinal symptoms,
  - cardiac arrest.

Management follows the recommendations in paragraph 6.2.2.

6.2.3.4 Transfusion-Related Acute Lung Injury (TRALI)

Usually caused by donor plasma containing antibodies against patient’s leucocytes. Usually starts within 1-4 hours of starting transfusion and the patient presents with:
  - dyspnoea
  - hypoxaemia
  - fever
  - hypotension

Chest X-Ray reveals interstitial and alveolar infiltrates. Usually resolves in 24-72 hours

Management follows the recommendations in paragraph 6.2.2. Category 3

6.2.3.5 Transfusion Associated Circulatory Overload (TACO)

Due to impaired cardiac function or excessive rapid rate of transfusion. Patients over 60 years of age and infants are more susceptible. Presents with:
  - dyspnoea
  - orthopnea
  - cyanosis
  - tachycardia
  - hypertension

Management follows the recommendations in paragraph 6.2.2. Category 3. In those patients transfuse carefully over longer period (maximum 4 hours)

6.3. DELAYED TRANSFUSION REACTIONS

Delayed transfusion reactions occur between 24 hours and 28 days after a transfusion

6.3.1 Transfusion Transmitted Infections

Blood donors can carry infectious agents in their blood although they do not show any sign or symptom of infection (e.g. HBV or HCV asymptomatic carriers, HIV “window” period).

Moreover sometimes infectious agents are not detected by laboratory tests due to limitations of the method used for testing.
For example antibodies against HIV can be detected, with commonly used ELISA technique, only about 14 days after the exposure (this period, during which the infection may not be identified, is called the “pre-seroconversion window period”).

The SNBTS is in the process of establishing NAT for HIV and this will significantly reduce the “window period”.

Some of the infectious agents that can be transmitted by blood transfusion are (see also table 6.1.):
- HIV-1 and 2
- HTLV-I and II
- HBV and HCV
- Syphilis
- Malaria
- Cytomegalovirus
- Epstein-Barr virus
- Toxoplasma
- Bacteria (e.g. *Pseudomonas, Staphylococcus*)
- Variant Creutzfeldt- Jakob disease (vCJD) has been reported, mainly in the UK and Europe.

There is no strong evidence of transfusion-associated transmission of Creutzfeldt-Jakob disease (CJD) although there are documented cases of iatrogenic CJD such as dura mater transplant and surgical interventions.

6.3.2. Delayed haemolytic reactions

Caused by exposure to incompatible red cells in the presence of atypical antibodies eg Kell or Duffy Usually appear 5-10 days after the transfusion, most cases are mild:
- Fever,
- Anaemia,
- Jaundice.

Treatment consists of appropriate supportive measures (e.g. IV fluids, antipyretics, etc.)

6.3.3. Post-transfusion purpura

Caused by antibodies directed against platelets in the recipient. Appears 5-12 days after transfusion. Rare but potentially fatal. It causes acute, severe, thrombocytopenia and bleeding tendency.

The treatment includes:
- high dose of corticosteroids,
- IV Gammaglobulin (2 g/Kg for 2-5 days),
- plasma exchange in severe cases,
- platelet concentrate with same ABO type of patient.

6.3.4. Graft-vs-host disease

This is a very rare but potentially fatal condition. It can result from the transfusion of lymphocytes that share a Human Leucocyte Antigen (HLA) haplotype with the recipient.

It more likely occurs when the donor is a blood relative of the patient (see also 1.6).

Signs and symptoms, that usually appear 10-12 days after the transfusion, are:
• fever,
• rash and skin desquamation,
• diarrhoea,
• hepatitis,
• pancytopenia.

The mortality is very high. The treatment is supportive, no specific treatment. Chemotherapy, in specialized oncology unit, has been employed.

6.3.5 Iron overload

Occurs in patients receiving regular transfusions over a long period of time. In such situations iron can accumulate in tissues resulting in organ failure (liver and heart). Treatment consists of administering iron-binding agents (e.g. desferrioxamine) to minimize the accumulation of iron.

6.4. HAEMOVIGILANCE

Haemovigilance is a system which is aimed at recording and analysing each transfusion adverse reaction.

In case of moderately severe or life threatening reaction:
1. all transfusion reactions should be immediately reported to the doctor responsible for the patient,
2. write into the patient`s record: type of reaction, type of blood product and its identification number, time after start of transfusion when reaction occurs,
3. the doctor has to fill and sign the adverse reaction notification form to be sent to the Hospital Transfusion Committee or Blood Bank (see Annex 5 for a reporting form). Unit and patient`s blood groups must be re-verified,
4. send to laboratory the following:
   • two blood samples collected from the other arm (one clotted and one with anticoagulant)
   • a sample of freshly collected urine
   • the blood unit that reacted (plus empty bags already transfused) and infusion set

The laboratory has to test these samples urgently for:
• full blood count,
• urea,
• creatinine,
• electrolytes,
• coagulation,
• direct antiglobulin test,
• urine analysis.

A culture of the patient`s blood and blood from the transfused unit should be done if bacteraemia is suspected.

The blood unit and patient`s blood groups must be re-verified.

The Hospital Transfusion Committee or Blood Bank has to send a copy of the adverse reaction form to the SNBTS Quality Assurance Office.
7. PAEDIATRICS

Indications for transfusion in neonates and infants may differ from those in adults as they are at particular risk of severe anaemia. The majority of paediatric transfusions are administered to children under 3 years of age.

7.1. CAUSES OF ANAEMIA IN CHILDREN

The most common causes of anaemia in children are shown in Table 7.1. It is fundamental that, while treating anaemia, the medical practitioner also investigate the underlying diseases and treat them.

<table>
<thead>
<tr>
<th>Table 7.1. Common causes of anaemia in children</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Loss of red blood cells</strong></td>
</tr>
<tr>
<td>- Parasites (e.g. hookworm)</td>
</tr>
<tr>
<td>- Acute haemorrhage</td>
</tr>
<tr>
<td>- Surgery</td>
</tr>
<tr>
<td>- Unnecessary frequent blood withdrawn for testing</td>
</tr>
<tr>
<td><strong>Increased destruction of red blood cells</strong></td>
</tr>
<tr>
<td>- Infections (viruses, bacteria, parasites), young children are at particular risk of malaria</td>
</tr>
<tr>
<td>- Haemoglobinopathies (e.g. sickle cell disease, thalassaemia)</td>
</tr>
<tr>
<td>- Inherited diseases (e.g. G6PD deficiency, Spherocytosis)</td>
</tr>
<tr>
<td>- RhD or ABO incompatibility in the newborn</td>
</tr>
<tr>
<td>- Autoimmune disorders</td>
</tr>
<tr>
<td><strong>Decreased production of normal red blood cells</strong></td>
</tr>
<tr>
<td>- Nutritional deficiencies due to insufficient intake or absorption</td>
</tr>
<tr>
<td>- HIV infection</td>
</tr>
<tr>
<td>- Chronic disease or inflammation</td>
</tr>
<tr>
<td>- Poisoning (e.g. lead)</td>
</tr>
<tr>
<td>- Chronic renal disease</td>
</tr>
<tr>
<td>- Malignancies</td>
</tr>
</tbody>
</table>

7.2. DECOMPENSATED ANAEMIA
As with adults, a child’s body responds to anaemia with compensatory mechanisms. However, with underlying anaemia many factors can cause the child to decompensate and lead to life-threatening conditions (e.g. infections, fever, acute blood loss, etc.)

**Table 7.2. Signs of decompensated anaemia in children**

<table>
<thead>
<tr>
<th>Signs of decompensated anaemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Flaring of nostrils</td>
</tr>
<tr>
<td>• Laboured breathing with use of abdominal muscles and intercostal, subcostal and suprasternal retraction</td>
</tr>
<tr>
<td>• Tachypnoea</td>
</tr>
<tr>
<td>• Difficulty with feeding</td>
</tr>
<tr>
<td>• Poor peripheral perfusion</td>
</tr>
<tr>
<td>• Forced expiration</td>
</tr>
<tr>
<td>• Mental status changes</td>
</tr>
<tr>
<td>• Diminished peripheral pulse</td>
</tr>
<tr>
<td>• Congestive cardiac failure</td>
</tr>
<tr>
<td>• Hepatomegaly</td>
</tr>
</tbody>
</table>

The management of decompensated anaemia in children includes:

- improve ventilation (e.g. sitting position)
- give oxygen by mask
- control the temperature (e.g. antipyretics)
- diuretics if volume overload and cardiac failure
- treat underlying causes (e.g. malaria)
- transfusion

### 7.3. BLOOD AND PLASMA TRANSFUSION AND PROCEDURES

Carefully assess the clinical conditions and laboratory tests. Infants and children require small volumes of fluids and can easily suffer circulatory overload.

In neonates who may need repeated transfusion of red cells it is recommended to use paediatric units (usually 4-8 are prepared from one donor). Small red blood cells units can be prepared from a single donation (see 4.2.). A unit of Red Cell Suspension for infant: 120-140 ml; for neonate: 50-80 ml.

In neonates with chronic symptomatic anaemia top-up transfusion may be required.

In case of emergency if RhD negative girl needs to be transfused with RhD positive product, then she should receive anti-D immunoglobulins.

**Indications for blood transfusion are:**

- haemoglobin 4 g/dl or less regardless of the clinical conditions are,
- haemoglobin between 4 and 6 g/dl if there are:
  - malaria hyperparasitaemia
  - acidosis
  - impaired consciousness

**Procedure for a transfusion**

- Give sufficient blood to stabilize the patient.
- Where possible use a paediatric blood pack and a flow device to control the rate and volume of transfusion.
- 5 ml/kg of red cells will increase the Hb by 2-3 g/dl; recommended transfusion rate is 5 ml/kg/h. (if necessary infuse rapidly).
- If the patient is likely to develop cardiac failure and pulmonary oedema give frusemide by mouth or by slow IV injection.

Monitor the patient for:
• Cardiac failure.
• Fever.
• Respiratory distress.
• Tachypnoea.
• Hypotension.
• Acute transfusion reactions.
• Shock.
• Haemolysis.
• Bleeding (DIC).

### Paediatric Specific Transfusion Medicine Issues

1. **ABO Typing** - up till 4 months of age infants have immature cellular & humoral immune system and antibodies (IgG) from the mother passively cross over to the infant. For this reason the crossmatch can be done on the mothers sample.

2. **Use of Young(fresh) Blood vs Older Blood** – fresh blood is usually defined as < 5 days. As the blood ages the Potassium (K+) level increases; 2.3 DPG within RBC decreases. For large volume transfusions use the youngest blood i.e <5days.

3. **Use of citrate, phosphate, dextrose (CPD) vs Adenine Solution (mannitol, adenine).** For top up transfusions RBC with additive solutions may be used. For large volume transfusions eg exchange transfusion CPDA-1 is preferred due to concerns of additive solutions causing renal toxicity and fluid shift.

Plasma transfusion follows the same procedures used for adults. The dose is usually 10-15 ml/Kg.

### 7.4. INDICATIONS FOR PLATELET TRANSFUSION

Indications for platelet transfusion are (see also table 8.5):

- thrombocytopenia,
- platelet dysfunction,
- bone marrow failure.

Contraindications are:

- ITP
- TTP*;
- PTP*;
- DIC**;

- Thrombocytopenia associated with septicaemia until treatment has started

* may be used in the attempt to control life-threatening haemorrhage;

** may be used if thrombocytopenia is associated

Idiopathic Thrombocytopenic Purpura is usually self limited but can be treated with gammaglobulin and corticosteroids.
In case of severe bleeding due to thrombocytopenia platelet concentrates can be transfused as 10-20ml/kg, at transfusion rate of at 10-20ml/kg/h as:

- <15kg  1 platelet concentrate*
- 15-30 kg  2 platelet concentrate
- >30kg  4 platelet concentrate

*=one unit of adult concentrate contains about 60 x 10^9/l platelets

7.5. HAEMOLYTIC DISEASE OF THE NEWBORN

Due to ABO or RhD incompatibility between mother and baby.

In most severe cases:
- the foetus may die in utero,
- the newborn can suffer of severe anaemia,
- there may be severe neurological damage (due to high bilirubin level).

Exchange transfusion may be required.

Routine prophylaxis for all RhD negative pregnant women with anti-RhD IgG is recommended in some countries.

Post-partum (within 72 hours of delivery) administration of anti-RhD IgG remains the most used prophylaxis in RhD negative mothers who delivered an RhD positive baby.

7.6. EXCHANGE TRANSFUSION *

Main indications for Exchange Transfusion in neonates are:
- Neonatal jaundice (kernicterus),
- Sickle Cells Disease,
- HDN,
- Intoxications.

Replacing about 2 times the neonate’s blood volume is usually sufficient to manage neonatal jaundice. Blood for exchange transfusion must be warmed. Red cell concentrate with additive solutions are not recommended.

* = refer to specialized manuals for detailed methods

Comment [PMK4]: Is this available in Swaziland
8. GENERAL MEDICINE

This section highlights some of the major conditions observed in general medicine which might require transfusion of blood components.

8.1. ANAEMIA

Diagnosis and treatment of anaemia were discussed in previous chapters. 
Table 8.1 describes the clinical presentation and management of some particular conditions.

Table 8.1. Clinical presentation and management of anaemia-related conditions

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>SIGNS &amp; SYMPTOMS THAT CAN BE PRESENT ACCORDING TO SEVERITY</th>
<th>MANAGEMENT</th>
</tr>
</thead>
</table>

42
### Malaria
- Cannot be reliably distinguished from many other causes of fever
- Clinical manifestations partially modified by sub-therapeutic doses of antimalarial drugs or partial immunity

<table>
<thead>
<tr>
<th>Signs &amp; Symptoms</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>High fever</td>
<td>- Treat infection</td>
</tr>
<tr>
<td>Shivers</td>
<td>- Treat symptoms and complications</td>
</tr>
<tr>
<td>Jaundice</td>
<td>- Consider transfusion, according to clinical picture if Hb &lt; 6g/dl</td>
</tr>
<tr>
<td>Haemoglobinuria</td>
<td></td>
</tr>
<tr>
<td>Abnormal bleeding</td>
<td></td>
</tr>
<tr>
<td>Acute renal failure</td>
<td></td>
</tr>
<tr>
<td>Convulsions</td>
<td></td>
</tr>
<tr>
<td>Coma</td>
<td></td>
</tr>
<tr>
<td>Severe anaemia</td>
<td></td>
</tr>
<tr>
<td>Hypoglycaemia</td>
<td></td>
</tr>
<tr>
<td>Metabolic acidosis</td>
<td></td>
</tr>
<tr>
<td>Acute pulmonary oedema</td>
<td></td>
</tr>
</tbody>
</table>

### HIV/AIDS
- About 80% of AIDS patients will have Hb < 10g/dl. At some stage of illness

<table>
<thead>
<tr>
<th>Signs &amp; Symptoms</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaemia</td>
<td>- Decision to transfuse using the same criteria of any other patient</td>
</tr>
<tr>
<td>Haemoglobinuria</td>
<td></td>
</tr>
<tr>
<td>Jaundice</td>
<td></td>
</tr>
</tbody>
</table>

### G6PD deficiency
- Usually asymptomatic
- Anaemia and jaundice can be precipitated by infections, drugs (some antimalarials, sulphonamides, sulphones), broad beans, naphthalene, nalidixic acid.

<table>
<thead>
<tr>
<th>Signs &amp; Symptoms</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaemia</td>
<td>- Remove or treat the identified cause of crisis</td>
</tr>
<tr>
<td>Haemoglobinuria</td>
<td></td>
</tr>
<tr>
<td>Jaundice</td>
<td></td>
</tr>
</tbody>
</table>

### Bone marrow failure
- Causes:
  - Chemotherapy for malignancies
  - Malignant infiltration of marrow
  - Infections (TB, typhoid, viruses)
  - Myelo-dysplastic conditions
  - Aplastic anaemia
  - Drug e.g. ARVs and chemicals
  - Ionizing radiations

<table>
<thead>
<tr>
<th>Signs &amp; Symptoms</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usually pancytopenia that leads to infections</td>
<td>- Treat infections</td>
</tr>
<tr>
<td>Anaemia</td>
<td>- Maintain fluid balance</td>
</tr>
<tr>
<td>Bleeding</td>
<td>- Supportive treatment</td>
</tr>
</tbody>
</table>

### Sickle cells disease
- Affects more than 150000 newborn/year in Africa
- 80% in Africa
- Symptoms after 6 months from birth

<table>
<thead>
<tr>
<th>Signs &amp; Symptoms</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain (vaso-occlusive crises)</td>
<td>- Rehydration</td>
</tr>
<tr>
<td>Infections</td>
<td>- Treat systemic acidosis</td>
</tr>
<tr>
<td>Haemolytic crises (rarely)</td>
<td>- Correct hypoxia</td>
</tr>
<tr>
<td>Skeletal abnormalities</td>
<td>- Pain killers</td>
</tr>
<tr>
<td>Chronic renal failure</td>
<td>- Treat infections</td>
</tr>
<tr>
<td>Visual loss</td>
<td>- Transfusions as treatment and prevention of crises</td>
</tr>
<tr>
<td>Reduced lung function</td>
<td></td>
</tr>
<tr>
<td>Priapism</td>
<td></td>
</tr>
<tr>
<td>Hyposplenism</td>
<td></td>
</tr>
<tr>
<td>Neurological loss</td>
<td></td>
</tr>
</tbody>
</table>
### 8.2. BLEEDING DISORDERS

Patients with abnormalities in platelet function or of the coagulation system can suffer of severe bleeding spontaneous or following surgery or trauma. Defects may be congenital or induced by drugs or diseases.

<table>
<thead>
<tr>
<th>Table 8.2. Signs and Symptoms suggestive of bleeding disorders</th>
</tr>
</thead>
<tbody>
<tr>
<td>• History of relatives with bleeding disorders</td>
</tr>
<tr>
<td>• Excessive bleeding after minor scratches</td>
</tr>
<tr>
<td>• Development of purpura</td>
</tr>
<tr>
<td>• Nose bleeds</td>
</tr>
<tr>
<td>• Excessive bleeding after dental extraction or other surgery</td>
</tr>
<tr>
<td>• Heavy menstruations</td>
</tr>
<tr>
<td>• Perinatal haemorrhage</td>
</tr>
<tr>
<td>• Bloody stools</td>
</tr>
<tr>
<td>• Dark stools (melaena)</td>
</tr>
<tr>
<td>• Red urine</td>
</tr>
<tr>
<td>• Episodes of swollen, painful joints or muscles</td>
</tr>
</tbody>
</table>
• Poor wound healing
• Bleeding occurring hours or days after trauma

Table 8.3. Signs of bleeding or blood loss

<table>
<thead>
<tr>
<th>Condition</th>
<th>Clinical features</th>
<th>Management</th>
</tr>
</thead>
</table>
| Deficiency of factor VIII (haemophilia A) or IX (haemophilia B) | - Haemorrhage induced by minor trauma or spontaneous.  
- External or internal (e.g., joints) bleeding  | - Avoid anti-platelet agents  
- Do not give intramuscular injections  
- Administer coagulation factor concentrate or FFP (Preferably Group A)  
- Desmopressin  
- Do not incise or drain haematomas |
| Von Willebrand disease             | Epistaxis, easy bruising, menorrhagia, bleeding after dental extractions, post-traumatic bleeding | As haemophilia A                                                                                   |
| Disseminated Intravascular Coagulation | Haemorrhage, bruising, microvascular thrombi                                        | - Treat cause  
- Give supportive care  
- FFP for coagulation factors  
- Blood transfusion if needed  
- Platelet if less than 50 x 10^9/L  
- Cryo, if the fibrinogen is low ie less than 1 |
| Disorders of vitamin K-dependent coagulation factors (inadequate diet, malabsorption, warfarin, liver disease) | Bleeding form gastrointestinal or urogenital tract                                | - Stop anticoagulant  
- Treat malabsorption or dietary deficiency  
- FFP  
- Blood transfusion if needed |

Dosage of factor VIII concentrate or cryoprecipitate ranges from 14 IU/kg for mild bleed to 40 IU/kg for major bleed, every 8 – 12 hours.
Prophylaxis for major surgery requires dosage up to 60 IU/kg.
Dosage of factor IX ranges from 15 IU/kg for mild bleed to 40 IU/kg for major bleed, every 12 – 24 hours.

8.3. PLATELET TRANSFUSION
Platelet transfusion is indicated for the prevention and treatment of haemorrhage in patients with thrombocytopenia or platelet defects (see table 8.2).

However not all thrombocytopenias need to be treated with platelet infusion and in some conditions, transfusion is contraindicated.

A unit containing four to six single donor platelets (240x10^9/l increase the number by at least 20-40x10^9/l.

Table 8.5. Risk of bleeding according to platelet count

<table>
<thead>
<tr>
<th>Platelet count</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5 x 10^9/l</td>
<td>Heavy bleeding strongly possible</td>
</tr>
<tr>
<td>5-20 x 10^9/l</td>
<td>Increased possibility of spontaneous bleeding</td>
</tr>
<tr>
<td>20-50 x 10^9/l</td>
<td>Increased possibility of bleeding after trauma, surgery or GI ulcers</td>
</tr>
<tr>
<td>&gt;50 x 10^9/l</td>
<td>Rare occurrence of bleeding even during major surgery</td>
</tr>
</tbody>
</table>

A platelet count of less than 20 x 10^9/l is usually considered the limit for transfusion for patients with increased bleeding risk.

However in a stable patient the limit 10x10^9/l can sometimes be considered.

Between 20 and 50 x 10^9/l according to clinical picture or impending bleeding

Indications for platelet transfusion are:
- Thrombocytopenia,
- Platelet dysfunction,
- Bone marrow failure.

Contraindications are:
- ITP
- TTP*;
- PTP*;
- DIC**;
- Thrombocytopenia associated with septicaemia until treatment has started

*= may be used in the attempt to control life-threatening haemorrhage;

**= may be used if thrombocytopenia is associated

---

9. OBSTETRICS AND GYNAECOLOGY

Plasma volume increases by 40-50% during pregnancy (with a peak at 32nd week).

Red cell mass increases by 18-25%, but, because this process is slower than plasma increase, there is a natural reduction of haemoglobin concentration.

During the entire pregnancy there is an increased iron requirement to a total of 1300 mg. To meet this requirement, most women will benefit from an iron supplement.
Anaemia in pregnancy is defined as haemoglobin concentration of less than:

- 11.0 g/dl in 1st and 3rd trimester
- 10.5 g/dl in 2nd trimester

During normal vaginal delivery there is a blood loss of about 200 ml. During Caesarean section the amount is about 500 ml. This amount of loss rarely requires transfusion if haemoglobin is normal before delivery. Always consider alternatives to transfusion.

**Prevention**

- Proper nutrition such as adding vitamin C (orange, papaya, mango) to the diet, can double the absorption of non animal-originated iron
- Adequate pregnancy monitoring (e.g. to detect bleeding, infections, etc.)
- 180 mg elemental iron per day
- 2 mg folate per day

### 9.1. CHRONIC ANAEMIA

#### 9.1.1. Causes

In pregnancy anaemia can be due to causes listed in Table 2.2. In particular:

- iron deficiency (the most common cause)
- short birth intervals (contribute to iron deficiency)
- folate deficiency
- vitamin B₁₂ deficiency
- dilutional

In pregnancy malaria is more severe and dangerous for both mother and foetus

#### 9.1.2. Indications for transfusion

It is fundamental that the medical practitioner investigate and treat the causes of anaemia.

<table>
<thead>
<tr>
<th>Table 9.1. Indications for transfusion in chronic anaemia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A-pregnancy less than 36 weeks</strong></td>
</tr>
<tr>
<td>1. Hb ≤ 5.0 g/dl with or without signs of cardiac failure or hypoxia</td>
</tr>
<tr>
<td>2. Hb between 5.0 g/dl and 7.0 g/dl with:</td>
</tr>
<tr>
<td>- established or incipient cardiac failure or evidence of hypoxia</td>
</tr>
<tr>
<td>- serious bacterial infections (e.g. pneumonia)</td>
</tr>
<tr>
<td>- malaria</td>
</tr>
<tr>
<td>- pre-existing heart diseases</td>
</tr>
<tr>
<td><strong>B-pregnancy 36 weeks or more</strong></td>
</tr>
</tbody>
</table>

47
1. Hb 6.0 g/dl or below
2. Hb between 6.0 g/dl and 8.0 g/dl with:
   - established or incipient cardiac failure or evidence of hypoxia
   - serious bacterial infections (e.g. pneumonia)
   - malaria
   - pre-existing heart diseases

Ensure that 2 units of blood are available if Caesarean section is planned, where Hb is less than 8.0 g/dl, and there is history of:
- ante partum haemorrhage,
- postpartum haemorrhage,
- previous Caesarean section.

9.2. ACUTE BLOOD LOSS

Acute blood loss is one of the major causes of maternal mortality.

It is important to keep in mind that, because to physiological changes due to pregnancy, the patient may show only minimal or subtle signs of hypovolaemia. It is mandatory to investigate and address the cause and closely monitor patients with peri partum haemorrhage.

Table 9.2. describes the major causes of acute haemorrhage

<table>
<thead>
<tr>
<th>Table 9.2. Obstetrical and gynaecological causes of acute blood loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Incomplete abortion</td>
</tr>
<tr>
<td>2. Septic abortion</td>
</tr>
<tr>
<td>1. Tubal</td>
</tr>
<tr>
<td>2. Abdominal</td>
</tr>
</tbody>
</table>
C-Antepartum haemorrhage
1. Placenta praevia
2. Abruptio placentae
3. Ruptured uterus
4. Vasa praevia
5. Incidental haemorrhage from cervix or vagina

D-Traumatic lesions
1. Episiotomy
2. Laceration of perineum or vagina
3. Laceration of cervix
4. Ruptured uterus

E-Primary Post Partum Haemorrhage (more than 500 ml from genital tract within 24 hours of delivery)
1. Uterine atony
2. Retained products of conception
3. Traumatic lesions
4. Abnormally adherent placenta
5. Clotting defects

F-Secondary Post Partum Haemorrhage (from genital tract after 24 hours and within 6 weeks of delivery)
1. Puerperal sepsis
2. Retained products of conception
3. Tissue damage following obstructed labour
4. Breakdown of uterine wound after Caesarean section

G-DIC induced by
1. Intrauterine death
2. Amniotic fluid embolism
3. Sepsis
4. Pre-eclampsia
5. Abruptio placentae
6. Retained products of conception
7. Induced abortion
8. Excessive bleeding
9. Acute fatty liver

9.3. MANAGEMENT OF ACute BLOOD LOSS (see also chapter 11)

- Provide oxygen at high concentration and volume by mask.
- Raise legs in Trendelenburg position
- Establish venous access preferably with a large gauge cannula.
- Infuse crystalloids or colloids as rapidly as possible.
- Transfuse (in emergency give O RhD negative blood until group specific blood is crossmatched).
• Stop the bleeding.
• Monitor vital parameters.

10. SURGERY

10.1. ASSESSMENT

Careful assessment and management of patients prior to surgery will reduce morbidity and mortality (e.g. correction of pre-existing anaemia).

Blood loss during surgery can be minimized by using meticulous techniques. Patients should be kept warm particularly in the operating table.
Where possible use autologous transfusion if blood loss can be estimated.

A haemoglobin level of about 7-8 g/dl may be acceptable in a well compensated patient. However higher pre-operative levels will be needed if there are:
- inadequate compensation of anaemia,
- co-existing cardiorespiratory disease,
- significant blood loss expected (more than 10 ml/kg).

Other conditions to be assessed and controlled are:
- coagulation disorders including anticoagulant therapy,
- thrombocytopenia.

### 10.2. ESTIMATING ACCEPTABLE BLOOD LOSS

A healthy adult may be able to tolerate a loss of up to 30% of blood volume without requiring a blood transfusion (provided that blood volume is maintained).

It is essential that blood volume is maintained and the normal body temperature is maintained. Fluid losses through nasogastric aspirate or drainage need to be measured and added to the volume of replacement fluid.

There are two methods to calculate the acceptable blood loss: percentage method and haemodilution method.

These methods are just a guide as the decision to transfuse relies on careful patient assessment.

<table>
<thead>
<tr>
<th><strong>A-percentage method</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimates the acceptable blood loss as <strong>percentage of patient’s blood volume</strong></td>
</tr>
<tr>
<td>• Calculate the patient’s blood volume (see 1.1.)</td>
</tr>
<tr>
<td>• Decide on which percentage of blood volume can be lost but safely tolerated, provided that normovolaemia is maintained (table 10.1)</td>
</tr>
<tr>
<td>• During procedure replace blood loss up to the allowable volume with crystalloids or colloids to maintain normovolaemia</td>
</tr>
<tr>
<td>• If the acceptable blood loss is exceeded blood will be transfused</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>B-haemodilution method</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimates the acceptable blood loss by determining the <strong>lowest haemoglobin (or haematocrit)</strong> that could be safely tolerated by the patient</td>
</tr>
<tr>
<td>• Calculate the patient’s blood volume (see 1.1.) and do haemoglobin (or haematocrit) test</td>
</tr>
<tr>
<td>• Decide on lowest acceptable haemoglobin (or haematocrit) that could be tolerated by the patient.</td>
</tr>
<tr>
<td>• Apply the formula:</td>
</tr>
</tbody>
</table>
Blood volume x (preoperative Hb – lowest acceptable Hb)

(average of preoperative & lowest acceptable Hb)

- During procedure replace blood loss up to the allowable volume with crystalloids or colloids to maintain normovolaemia
- If the acceptable blood loss is exceeded blood will be transfused

Table 10.1 is a quick guidance on acceptable blood loss

<table>
<thead>
<tr>
<th>Method</th>
<th>Healthy patient</th>
<th>Average clinical conditions</th>
<th>Poor clinical conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Percentage</strong></td>
<td>30%</td>
<td>20%</td>
<td>Less than 10%</td>
</tr>
<tr>
<td>(acceptable loss of blood volume)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Haemodilution</strong></td>
<td>9 g/dl (Hct 27)</td>
<td>10 g/dl (Hct 30)</td>
<td>11 g/dl (Hct 33)</td>
</tr>
<tr>
<td>(lowest acceptable Hb or Hct)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Platelets**

The platelets concentration before surgery should be more than $50 \times 10^9/l$

For surgery in sites like eye or brain the platelet count should be $100 \times 10^9/l$

**11. EMERGENCY SURGERY AND TRAUMA**

Hypovolaemia is a major cause of mortality among patients presenting with acute massive blood loss. The rapidity of the initial assessment and resuscitation (in the first hour after the trauma) has a major role in influencing a favourable outcome.

For this reason the patient should be ideally managed by trained personnel in an appropriate setting. Although it may be difficult, one of the first steps is to assess the amount blood loss.
If the blood group of the patient is unknown and there is extreme urgency for transfusion then group O can be transfused, pending group determination and compatibility test, as (see also 5.9.):

- females of reproductive age should be transfused with O RhD negative
- it is acceptable to give O RhD positive (in absence of O RhD negative) to males and older females

Risk of errors in blood grouping or in blood type given to patient is higher in emergency situation
In case of emergency situation, where more patients need urgent transfusion, delegate one staff member to deal with transfusion for each patient

11.1. Initial measures in any patient with acute blood loss

First measures are aimed to stabilize the patient by:

A-Airway control and cervical spine stabilization
- Airway should be open (intubation, tracheostomy, etc. if necessary)
- Clear the mouth of any clot or debris

B-Breathing
- Give assisted ventilation and oxygen
- Check for pneumotorax or haemotorax or open chest wounds

C-Circulation
- Control haemorrhage
- Assess cardiovascular system
- Estimate blood loss including concealed bleeding
- Establish intravenous access

D-Disorders of the central nervous system
- Check the level of consciousness and pupils response to light

E-Remove clothing to examine the body for injuries

11.2. Estimate the extent of hypovolaemia

To adjust the treatment, the extent of hypovolaemia should be estimated considering also concealed bleeding (e.g. intra abdominal or retroperitoneal bleeding). The classification of hypovolaemia in adults and children shown in Tables 2.4 and 2.5 is a useful guide always taking into account the variability of individual patients.

Determine need for transfusion based on blood loss as:

- <15% loss: no need for transfusion unless pre-existing anaemia, or cardiac, or respiratory disease.
- 15-30% loss: infuse crystalloids (initial bolus of 20-30 ml/kg in 5 minutes) or colloids (10-20 mg/kg in 5 minutes)
- 31-40% loss: rapid replacement with crystalloids or colloids; blood transfusion may be required
- >40% loss: rapid volume replacement with crystalloids or colloids and blood transfusion.
Resuscitation measures for hypovolemic children are the same as for the adults. However some key points should be taken into account for children:

- normal blood volume is proportionally greater in children
  - neonate: 85-90 ml/kg
  - child 80 ml/kg
- recognition of hypovolaemia can be more difficult than in adult
- tachycardia is often the earliest response to hypovolaemia (differentiate from fear or pain-induced tachycardia)
- because the signs of hypovolaemia may only become apparent after 25% of the blood volume is lost, the initial fluid challenge in children should represent this amount. Therefore 20 ml/kg of crystalloids should be given initially if class II or greater hypovolaemia
- if transient or no response to the initial fluid challenge would require further crystalloids or blood transfusion
- hypothermia may interfere with the treatment, so maintain the body temperature
- because gastric dilation is often seen in seriously ill children, a nasogastric tube needs to be put in place.

11.3. Acute gastrointestinal bleeding

**Clinical features**
- Clinical features upper GI tract (e.g. peptic ulcer, oesophageal varices, gastric carcinoma)
  - anaemia
  - haematemesis or/and melaena
- Clinical features lower GI tract (Crohn's disease, intestinal cancer, ulcerative colitis)
  - fresh blood on faeces or
  - faecal occult blood test positive

**Management**
- Resuscitate
- Stop bleeding
- Give H₂ receptor blockers
- Fluids
- Blood transfusion

11.4. Platelets transfusion

It is advised that platelet count should not be less than 50 x 10⁹/l in acutely bleeding patient. Higher values of 75-100 x 10⁹/l are recommended in patients with multiple trauma or Central Nervous System injury.

12. BURNS

The early management of seriously burned patients is similar to the management of other trauma patients where the primary goal is to restore the circulating blood volume. Here we just provide indications for replacement fluids therapy.

Intravenous fluids are required if:
• Burns are >15% surface area in adults
• Burns are >10% surface area in children

12.1. Estimating the extent of the burnt area

In adults the “Rule of Nine” is commonly used to estimate the burnt surface as the body is divided in areas that represent 9% or its multiples. Because in children proportions are different the rule of nines can not be applied.

The Figure 12.1 and figure 12.2 provide an estimate of surface subdivision in adults and children.

From WHO: the clinical use of blood in Medicine, Obstetrics, Paediatrics, Surgery and Anaesthesia, Trauma and Burns; 2002
### 12.2. Estimating the severity of burns

In order to provide adequate care, it is also very important to assess the severity of burns. Table 12.1 shows the accepted classification.

#### Table 12.1 Types of burns

<table>
<thead>
<tr>
<th>Type</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st degree (superficial burn)</td>
<td>Erythema</td>
</tr>
<tr>
<td></td>
<td>Pain</td>
</tr>
<tr>
<td></td>
<td>Absence of blisters</td>
</tr>
<tr>
<td>2nd degree (partial thickness burn)</td>
<td>Red or mottles</td>
</tr>
<tr>
<td></td>
<td>Swelling and blisters</td>
</tr>
<tr>
<td></td>
<td>Pain</td>
</tr>
<tr>
<td>3rd degree (full thickness burn)</td>
<td>Dark and leathery</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
</tr>
<tr>
<td></td>
<td>Sensation only at edges</td>
</tr>
</tbody>
</table>

### 12.3. Calculating fluid requirement and fluids to be used

- Assess the severity of burns
- Oral fluids if burn surface is less than 15% in adult and less than 10% in children
- IV fluids if burn surface more than those percentages

There are several methods in use to calculate the amount of fluids necessary

As example the Parkland formula:

Total fluids = 4 x weight (kg) x % burns
Give half within 8 hours and half during following 16 hours
However in table 12.2, we show a more detailed management according to WHO

### Table 12.2. Management of burns

<table>
<thead>
<tr>
<th></th>
<th>ADULTS</th>
<th>CHILDREN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First 24 hours</strong></td>
<td>Fluids needed for burns (ml)= 3 x weight (kg) x % burned area</td>
<td>Fluids needed for burns (ml)= 3 x weight (kg) x % burned area</td>
</tr>
<tr>
<td></td>
<td>plus</td>
<td>plus</td>
</tr>
<tr>
<td></td>
<td>Maintenance fluids (ml)= 35 x weight</td>
<td>Maintenance fluids(ml)</td>
</tr>
<tr>
<td></td>
<td>Give half volume in the first 8 hours and the remaining within the remaining 16 hours</td>
<td>Give half volume in the first 8 hours and the other half over the remaining 16 hours</td>
</tr>
<tr>
<td><strong>Second 24 hours</strong></td>
<td>- Fluid for burn (ml)= 1 x weight (kg) x % burned area</td>
<td></td>
</tr>
<tr>
<td></td>
<td>plus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Fluid for maintenance (ml)= 35 x weight (kg)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Give over 24 hours</td>
<td></td>
</tr>
</tbody>
</table>

The use of crystalloids is safe and effective for burns resuscitation.
Whole plasma, colloids and human albumin solution may be used in burned patients.
However there is no clear evidence of their superiority to crystalloids.
Blood transfusion is not frequently necessary (e.g. bleeding).
If surgery is required (e.g. debridement) techniques to reduce blood loss should be used.

### 12.4. Monitoring

- Blood pressure.
- Fluid input/output (maintain urine output of 0.5 ml/k/h in adults and 1 ml/kg/h in children.
- Consciousness level.
- Pulse.
- Temperature.
- Respiratory rate.

### 13. REFERENCES


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7. CANADIAN BLOOD SERVICES: Clinical guide to transfusion; 2007

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22. WHO: The clinical use of blood, handbook; 2002


14-ANNEXES
Annex 1 Steps for requesting blood and for transfusion

Responsibilities at Hospital

1. The Blood Bank Supervisor is responsible for requesting blood components to the SNBTS.
2. The Blood Bank Supervisor is responsible for storage and delivery of blood component.
3. The Medical practitioner in charge of the patient is responsible for ordering blood and for filling the request form.
4. A phlebotomist (or nurse if there is no phlebotomist) is responsible for drawing blood for blood grouping and compatibility test, and to take the samples to the Hospital Blood Bank.
5. A registered nurse is responsible for collecting blood units from the blood bank verifying the blood group and the integrity of the unit before leaving the Blood Bank.

Steps

1. Apply standard protective measures when dealing with patient.
2. Check accurately the need for transfusion and report the reasons in the patient’s case sheet.
3. Check the patient transfusion history (side effects, known presence of antigens, etc.)
4. Positively identify the patient requiring transfusion by file number and asking directly about:
   - name
   - surname
   - date of birth
5. If the patient is unconscious and there are no relatives/friends, use the best way to identify him/her.
6. Accurately explain the procedure to the patient to obtain written informed consent to transfusion (ANNEX 2). In case of an unconscious patient or of a minor explain and ask parents, relatives or guardians for consent.
7. In case of patient’s or relative’s or guardian’s refusal of transfusion, the appropriate form has to be signed (ANNEX 3).
8. If nobody can be asked for the consent, then write the situation in the patient's record.
9. Prepare venous access maintaining the vein with saline solution.
10. Fill accurately the transfusion request form.
11. Collect blood for grouping and compatibility test.
12. Send samples, for grouping and compatibility, with the request form to the hospital Blood Bank.
13. Before leaving the blood bank with the unit/s check the unit is compatible with the patient’s blood group, the bag is intact and there are no signs of haemolysis or bacterial contamination.
14. Transport the unit to the ward with a box maintaining the appropriate temperature for the blood component.
15. A doctor and a staff nurse or 2 staff nurses should check the unit and the patient’s groups at patient’s bed.
16. Re-verify the integrity of the bag.
17. Check and write on patient’s record the baseline vital parameters.
18. Transfuse using a sealed proper transfusion set. Discard all expired sets or whose pack is not intact. Replace sets every 12 hours.
19. Do not add solutions or drugs to the transfusion unit or set.
20. Check: temperature, blood pressure, pulse, respiratory rate, urinary output, visual observation at transfusion start, after 15 minutes, every hour, at transfusion end, 4 hours after end.
21. In case of adverse reactions manage the patient according to Chapter 6.

Annex 2 informed consent

Comment [PMK5]: Not currently happening at any of the blood banks.
SWAZILAND NATIONAL BLOOD TRANSFUSION SERVICE

INFORMED CONSENT FOR BLOOD PRODUCTS TRANSFUSION

HOSPITAL/HEALTH CENTRE……………………..

| I have been informed by my/the patients doctor………………………………………… that the improvement of my/the patient’s conditions will be helped by receiving a transfusion of……………………. |
| The doctor has explained the potential benefits from receiving the transfusion as well as the risks connected. |
| I have understood that, although the blood was collected, tested and processed according to updated scientific rules, there is a very small chance of severe reactions and other complications like viral infections. |
| I have understood that mild allergic reactions are common but, usually, do not represent a threat for my/the patients life. |
| I had the opportunity to ask the doctor questions pertaining the transfusion and the answers were clear and satisfactory. |
| Therefore I agree to receive the transfusion/s. |

Patient’s Name and Surname…………………… Patient’s Signature……………………

<table>
<thead>
<tr>
<th>Patient’s parent/relative/guardian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name and Surname……………………. Signature…………………….</td>
</tr>
</tbody>
</table>

Date ………………………….. Time……………..

Witness

1) Name and Surname……………………. Signature…………………….

NOTE: THE FORM NEED TO BE TRANSLATED INTO SiSwati

Annex 3 transfusion refusal form
**SWAZILAND NATIONAL BLOOD TRANSFUSION SERVICE**

**TRANSFUSION REFUSAL FORM**

**HOSPITAL/HEALTH CENTRE:.............................................**

| I have been informed by my/the patients doctor.......................................................... that the improvement of my/the patient’s conditions will be helped by receiving a transfusion of............................... |
|---|---|
| The doctor has explained the potential benefits from receiving the transfusion as well as the risks connected. |
| Both benefits and risks are well known and properly understood by me. |
| I also know that, without transfusion, my/the patient’s conditions may further deteriorate. |
| However, for.................................................................................................................. |
| reasons, I do not consent I/the patient to be transfused accepting all the risks for my/the patient’s health connected to this refusal. |

| Patient’s Name and Surname................................. Patient’s Signature............................... |
|---|---|
| Patient’s parent/relative/guardian |
| Name and Surname................................. Signature............................... |
| Date ........................................... Time......................... |

**Witness**

1) Name and Surname................................. Signature...............................  

**NOTE: THE FORM NEED TO BE TRANSLATED INTO SiSwati**

**ANNEX 4 blood products request form**
## SNBTS LOGO

**Hospital Name**…………………………………. **Date**…………. **Time**………..

<table>
<thead>
<tr>
<th>Patient's Family Name</th>
<th>Patient's Name</th>
<th>Birth Date</th>
<th>Gender</th>
<th>Ward</th>
<th>Bed</th>
<th>Blood Group</th>
<th>RhD #</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Diagnosis**

**Hb** | **Ht** | **Doctor Requesting B Components (Capital Letters)** | **Signature**………………..

**Patient's Identity Verified, Blood Drawn** | **Previous Transfusions** | **N** | **Y** | **Pregnant** | **Y** | **N** |

**Specimen Labelled By**…………………………... | **Reactions** | **N** | **Y** | (Specify) | **Previous Pregnancies** | **Y** | **N** |

**Signature(s)**………………………. ……………………………………………..

- **Group, Screen and Hold Patient's Serum**
  - O Negative (Uncrossmatched)
  - O Positive (Uncrossmatched)

- **Provide Red Cell Suspension (Number)**
  - Extreme Urgency (10-15m)

- **Provide Fresh Frozen Plasma (Number)**
  - Very Urgent (1h)

- **Provide Platelets (Number)**
  - Urgent (3h)

**Type of Surgery**

**Date Requested For**…………………………..

## Laboratory Use Only

<table>
<thead>
<tr>
<th>Patient Group</th>
<th>RhD #</th>
<th>Date received</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Received by**………………………………… **Signature**…………………………………………..

<table>
<thead>
<tr>
<th>Batch Number</th>
<th>Blood Group</th>
<th>RhD #</th>
<th>Product</th>
<th>Date Match</th>
<th>Issued To (Capital Letters)</th>
<th>Date Issued</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**ANNEX 5 adverse reaction notification form**
**SWAZILAND NATIONAL BLOOD TRANSFUSION SERVICE**

**TRANSFUSION ADVERSE REACTIONS REPORTING FORM**

<table>
<thead>
<tr>
<th>HOSPITAL REPORTING OFFICER</th>
<th>CONTACT</th>
<th>DATE</th>
</tr>
</thead>
</table>

**PATIENT FAMILY NAME**

<table>
<thead>
<tr>
<th>PATIENT NAME</th>
<th>DATE OF BIRTH</th>
<th>GENDER</th>
</tr>
</thead>
</table>

**DIAGNOSIS**

<table>
<thead>
<tr>
<th>WARD</th>
<th>BED</th>
<th>BLOOD GROUP</th>
<th>RhD</th>
</tr>
</thead>
</table>

**PREGNANT**

<table>
<thead>
<tr>
<th>PREVIOUS TRANSFUSIONS</th>
<th>PREVIOUS REACTIONS</th>
</tr>
</thead>
</table>

**PATIENT TREATMENT ROUTE**

<table>
<thead>
<tr>
<th>DOSAGE</th>
<th>OTHER CONDITIONS AT THE MOMENT OF TRANSFUSION</th>
</tr>
</thead>
</table>

**BLOOD PRODUCT**

<table>
<thead>
<tr>
<th>GROUP NUMBER</th>
<th>EXPIRY DATE</th>
<th>GROUP NUMBER</th>
</tr>
</thead>
</table>

**TRANSFUSED DATE**

<table>
<thead>
<tr>
<th>TIME START</th>
<th>REACTION CODE/S (♦)</th>
<th>TIME AFTER START</th>
<th>DRUGS FOR GIVEN REACTION</th>
<th>OUTCOME (#)</th>
</tr>
</thead>
</table>

**INVESTIGATIONS DONE**

**PATIENT TRANSFERRED TO**

---

**Signs and symptoms coding**

- ♦ 1 RASH
- ♦ 2 PRURITUS
- ♦ 3 FLUSHING
- ♦ 4 FEVER
- ♦ 5 TACHICARDIA
- ♦ 6 TACHYPNOEA
- ♦ 7 ANXIETY
- ♦ 8 PALPITATIONS
- ♦ 9 HEADACHE
- ♦ 10 CHILLS
- ♦ 11 MILD DISPNOEA
- ♦ 12 RESPIRATORY DISTRESS
- ♦ 13 RIGORS
- ♦ 14 HYPERTENSION
- ♦ 15 CHEST PAIN
- ♦ 16 HAEMOGLOBINURIA
- ♦ 17 UNEXPECTED BLEEDING
- ♦ 18 OTHER (SPECIFY)...

**outcome coding**

- ♦ R= recovered
- ♦ F= fatal (date of death)
- ♦ U= Unknown

---

**SEND A COPY TO SNBTS QUALITY ASSURANCE OFFICE**

**FOR SNBTS USE ONLY**

<table>
<thead>
<tr>
<th>DATE RECEIVED</th>
<th>RECEIVED BY</th>
</tr>
</thead>
</table>

---

**FOLLOW UP**