

Blood Component Information

An Extension of Blood Component Labels

June 2020



Australian Red Cross
Lifeblood

Customer contacts

We provide general customer service and specialist medical support 24-hours a day for health professionals.

For our full list of contact details visit **transfusion.com.au/contact**

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Australian governments fund Australian Red Cross Lifeblood to provide blood, blood products and services to the Australian community.

Additional information and resources for health professionals regarding blood products and transfusion practice can be found on the Lifeblood website for health professionals, **transfusion.com.au**

If you have any comments please contact the Transfusion Policy and Education team at: **transfusion@redcrossblood.org.au**

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Important information

Blood Component Information: An Extension of Blood Component Labels is provided in accordance with the regulations of the Therapeutic Goods Administration (TGA).

The document as a whole or in part cannot be considered or interpreted as an expressed or implied warranty of the safety or fitness of blood components when used for their intended purpose.

Careful donor selection and laboratory testing significantly reduces but does not totally eliminate all potential hazards of blood transfusion. There remains risk of transmitting infectious agents, including bacteria, viruses, parasites and the agent of variant Creutzfeldt-Jakob disease. In addition, blood components may contain immunising agents other than those indicated on the label. For example, a unit of platelets also contains residual red blood cells and white blood cells. Serious transfusion reactions although rare may be life-threatening.

To prevent inappropriate transfusions, clinicians are encouraged to adopt the principles of patient blood management (PBM) and prescribe blood components based on appropriate clinical indications and guidelines. PBM is the timely application of evidence-based medical and surgical practices designed to maintain haemoglobin concentration, optimise haemostasis and minimise blood loss. As a consequence of better management, patients usually require fewer transfusions thus reducing the risk of transfusion-associated complications.

Alternatives to blood transfusion including iron therapy or blood conservation techniques, such as intra-operative cell salvage, should be considered when appropriate, to reduce the potential risks of disease transmission and immune reactions. It should be noted, however, that routine use of preoperative autologous blood donation is not recommended. The risks of under (or not) transfusing should also be considered.

Correctly identifying the patient throughout the transfusion process is vital if 'wrong blood' episodes are to be avoided. ABO-incompatible transfusions are usually due to identification errors. Safe transfusion practice also involves monitoring the patient closely during and after the transfusion and ensuring that clinical staff are available to detect any untoward effects and respond appropriately.



Introduction

The purpose of the *Blood Component Information* book is to describe the blood components produced by Australian Red Cross Lifeblood.

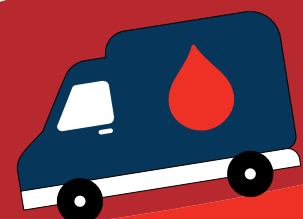
It includes a description of the blood collection process, method of manufacture, critical manufacturing steps, clinical indications for use, and administration methods. The *Blood Component Information* booklet is considered an extension of blood component labels since space on these labels is limited.

Blood and blood components are biological products, and in the form of cellular products are living human tissue intended for use in the treatment of patients. Professional judgment based on clinical evaluation determines the selection of components, the dosage, the rate of administration and decisions in situations not covered in this general statement. Informed consent should be obtained and documented for all transfusions of blood components in accordance with national standards and guidelines, and local institutional informed consent policies.

Lifeblood's purpose "*Life-giving blood, plasma, transplantation and biological products for world-leading health outcomes. Through the power of humanity*" is achieved through its critical role in health care in the provision of a safe, secure and cost-effective supply of quality blood products, essential services and leading-edge research.

The manufacturing activities of Lifeblood are regulated by the Therapeutic Goods Administration under the *Therapeutic Goods Act 1989* and the following applicable standards:

- *Therapeutic Goods (Manufacturing Principles)*
- *Australian Code of Good Manufacturing Practice for Human Blood and Blood Components, Human Tissues and Human Cellular Therapy Products* Version 1.0 May 2013 (cGMP)
- Council of Europe – *Guide to the Preparation, Use and Quality Assurance of Blood Components* (CoE Guide) 19th edition
- *Therapeutic Goods Order No. 88 – Standards for Donor Selection, Testing, and Minimizing Infectious Disease Transmission via Therapeutic Goods That are Human Blood and Blood Components, Human Tissues and Human Cellular Therapy Products* (TGO 88).
- *Therapeutic Goods Order No. 102 – Standard for Blood and Blood Components* (TGO 102)



Blood donor selection, collection and processing of blood

Donor selection and collection

Blood is collected from voluntary, non-remunerated donors within guidelines based on recommendations from the World Health Organization (WHO), International Society of Blood Transfusion (ISBT), and the International Federation of Red Cross and Red Crescent Societies. In exceptional circumstances, Lifeblood will also collect autologous or directed donations.

Donors attend permanent and mobile collection centres across Australia. Blood is collected either as a whole blood donation or by apheresis for donations of plasma or platelets. Prior to their donation donors will have:

- satisfactorily completed a confidential interview and donor declaration regarding high-risk behaviour, practices and circumstances which would prevent them from donating
- satisfactorily completed a health assessment that includes a questionnaire on past and present medical conditions
- satisfied minimum physiological criteria, and
- been told to contact Lifeblood, including after their donation, if they have any health issues or other information which may affect the suitability of their donation.

In identifying suitable donors and the decision to accept their blood donations, ensuring the safety of both the donor and the eventual recipient of the blood and its components are paramount.

Testing of donor blood

All blood donations are tested in order to:

- enable appropriate and safe selection of blood for transfusion, for example the importance of correctly determining the donor's blood group in ensuring ABO compatible transfusions, and
- prevent (where possible) transfusion transmission of infectious agents which can cause diseases in transfusion recipients.

In Australia, the following mandatory tests are performed on all blood donations used for fresh components: blood group (ABO and RhD), red cell antibody screen and infectious disease screening for human immunodeficiency virus (HIV) 1 and 2, hepatitis B virus (HBV), hepatitis C virus (HCV) and syphilis. New donors, and donors of leucocyte components, are also tested for human T-cell leukaemia virus (HTLV) types 1 and 2. Donations collected exclusively for plasma fractionation undergo infectious diseases screening for HIV, HBV and HCV but are not tested for HTLV 1/2, syphilis or a blood group, and an antibody screen is only performed if the donor was transfused or pregnant since last donating.

All tests are performed in licensed facilities, according to the principles of good manufacturing and laboratory practice (GMP/GLP), and following the manufacturers' instructions and strict Lifeblood guidelines and standard operating procedures.

Only donations that pass mandatory testing and meet the necessary specifications are released for clinical use or further processing. If an infectious disease screening test is confirmed positive, the donation is destroyed.

Bacterial contamination of platelets is recognised as the most significant residual infectious risk of transfusion in developed countries. In order to minimise this risk, Lifeblood screens all platelet components for bacterial contamination.

Processing blood into components

Blood components are an effective and efficient use of donated whole blood and other resources. Component therapy means patients can receive treatment tailored to their particular clinical situation or condition.

Blood components are prepared from whole blood donations using various methods of physical separation, such as centrifugation. Lifeblood uses centralised processing facilities where standardised procedures, based on a pharmaceutical production model and good manufacturing and laboratory practice (GMP/GLP), support the controlled and cost-effective production of high quality, consistent and safe blood components.

Blood component therapy

General principles of blood component therapy include:

- The decision to transfuse should be based (wherever possible) on an appropriate clinical and laboratory diagnosis.
- The decision to transfuse must take into account the risks and benefits to the patient.
- Transfusion can effectively and efficiently provide or replace missing or malfunctioning elements of the blood or immune systems.
- Transfusion therapy can provide short or long-term support.
- Before making the decision to transfuse, consideration should be given to availability, cost and the importance of appropriately using a valuable, freely given community resource.

Whole blood is now rarely used for transfusion and most patients receive specific blood component therapy. As with other medicines, each blood component has specific clinical indications, known benefits, and potential risks. The need for transfusion should take into account the patient's unique circumstances, and the chosen component(s) and dose should be tailored to their clinical situation.

Clinicians are encouraged to adopt the principles of patient blood management (PBM) and related clinical guidelines. PBM is a coordinated healthcare approach to patient care that focuses on strategies to reduce or avoid the need for a blood transfusion where possible, alongside the appropriate use of blood components when a transfusion is needed. The National Blood Authority (NBA) has published the national Patient Blood Management Guidelines – see **Appendix I** (page 32).¹

The National Safety and Quality Health Service *Standard 7: Blood Management Standard* requires that: “*Leaders of a health service organisation describe, implement and monitor systems to ensure the safe, appropriate, efficient and effective care of patients’ own blood, as well as other blood and blood products.*”²

Hospital transfusion (or patient blood management) committees play an important role in monitoring adherence to national standards and guidelines, developing local institutional clinical transfusion practice policies and procedures, and supervising educational, training and audit activities and the reporting of adverse reactions.

Guidance with respect to the establishment and responsibilities of hospital transfusion committees is provided within the:

- Australian and New Zealand Society of Blood Transfusion (ANZSBT) *Guidelines for Transfusion and Immunohaematology Laboratory Practice*³
- Australian and New Zealand Society of Blood Transfusion and Australian College of Nursing *Guidelines for the Administration of Blood Products*⁴
- Australian Red Cross Lifeblood *Patient Blood Management Committee Handbook*⁵.



Blood component labelling

In November 2018, Lifeblood changed its component labelling from Codabar to the widely used Information Standard for Blood and Transplant 128 (ISBT 128) labelling format.

Current ISBT 128 transition labelling

ISBT 128 is a global standard for the identification, labelling and information transfer of Medical Products of Human Origin (MPHO). It aims to achieve international consistency in the information provided on MPHO labels through global registration of product codes through the International Council for Commonality in Blood Banking Automation (ICCBBA).

The standard has been adopted by hospitals, blood centres, tissue and cellular therapy facilities and plasma fractionators in more than 75 countries. Adopting this standard provides a unique identifier for Australian blood components and will prevent worldwide duplication of donation identification numbers within a 100-year-period.

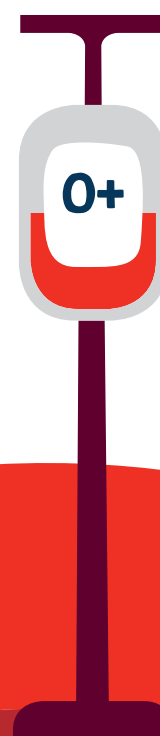
To facilitate the changeover to ISBT 128 labelling, Lifeblood is using a 'transition label' for its blood components. This will allow customers who are not yet 'ISBT 128 capable' to continue managing their Codabar labelled inventory without disruption. The upper portion of the transition label has the ISBT 128 barcodes and the lower portion has a distinct transition zone that provides the existing Codabar barcodes (see right).

When components with clinically important special attributes such as irradiation, modifiers, and additional testing are required for transfusion, only those where the desired characteristic is confirmed on the label should be selected. A list of modifier texts and their explanations is provided in **Appendix III** (page 36).

Further information about ISBT 128 labelling and data structures, including *The Australian Guidelines for the Labelling of Blood Components using ISBT 128*, can be found on our website at transfusion.com.au

Legacy Codabar labelling

Frozen blood components with extended expiry collected prior to the implementation of ISBT 128 labelling, and in particular frozen red cells, will continue to be labelled using the original Codabar standard. Further information about Codabar labels can be found on our website at transfusion.com.au



Current ISBT 128 Transition Label

Transfusion instructions, warning and infectious diseases statement

Collection date
(eye-readable)
The collection date of the donation from which the component was made, or the preparation date of a pooled component.

Component code
(barcode and eye-readable)
Component proper name and other information, such as anticoagulant or additive.

Component description

Contents or volume

Storage conditions

Modifier area
List of component modifiers, or special attributes that are not part of the component code.

Indicative manufacturing cost

Donation identification number
(barcode and eye-readable)
Donation number of the component, or pool number in the case of a pooled component.

ABO and RhD blood group code
(barcode and eye-readable)

ABO and RhD blood group text
(eye-readable)

Expiry date and time
(barcode and eye-readable)

Special testing barcode for phenotype
Information unique to ISBT 128 label

Special test result area
(eye-readable)
For example, red cell, platelet and HLA phenotype and/or genotype information for the component.

Transition zone with Codabar barcodes
The eye-readable 7-digit Donation Identification Number for both Label #A and Label #D is identical. If scanning, Label #A barcode has "A" start and stop codes and Label #D barcode has "D" start and stop codes.

Legacy Codabar Label

Collection date
(eye-readable)
The collection date of the donation from which the component was made, or the preparation date of a pooled component.

Component description

Component code
(barcode and eye-readable)
Component proper name and other information, such as anticoagulant or additive.

Storage conditions

Contents or volume

Modifier area
List of component modifiers, or special attributes that are not part of the component code.

Indicative manufacturing cost

Donation identification number
(barcode and eye-readable)
Donation number of the component, or pool number in the case of a pooled component.

Expiry date and time
(barcode and eye-readable)

ABO and RhD blood group code
(barcode and eye-readable)

ABO and RhD blood group text
(eye-readable)

Special test result area
(eye-readable)
For example, red cell, platelet and HLA phenotype and/or genotype information for the component.

Transfusion instructions and warning

Infectious diseases statement

Anticoagulants

Whole blood collections

CPD (citrate phosphate dextrose)
Macopharma

66.5 mL \pm 10% per pack of whole blood

Constituents	g/L	Total per pack (g)
Sodium citrate dihydrate	26.3	1.75
Citric acid monohydrate	3.27	0.22
Monobasic sodium phosphate dihydrate	2.51	0.17
Dextrose monohydrate	25.5	1.70

Platelet apheresis collections

ACD-A (acid citrate dextrose)
Terumo BCT

750 mL Mixed ~ 1:11 with whole blood

Constituents	g/L
Dextrose monohydrate	24.5
Sodium citrate dihydrate	22.0
Citric acid monohydrate	8

Plasma apheresis collections

4% sodium citrate
Haemonetics Corporation

250 mL mixed ~ 1:16 with whole blood

Constituents	g/L
Sodium citrate dihydrate	40



Additive solutions

Red cells additive solution

SAG-M (saline adenine glucose mannitol) Macopharma

105 ± 10% mL of SAG-M is used as the additive solution for resuspension of standard red cell components and washing of washed red cell components.

Constituents	g/L	Total per pack (g)
Sodium chloride	8.77	0.92
Adenine	0.169	0.02
Dextrose monohydrate	9.0	0.95
Mannitol	5.25	0.55

Washed red cells additive solution

SAG-M2 (saline adenine glucose mannitol) Terumo Penpol

100 mL ± 10% of SAG-M2 is used as the additive solution for resuspension of washed red cell components.

Constituents	g/L	Total per pack (g)
Sodium chloride	8.77	0.877
Adenine	0.3	0.03
Dextrose monohydrate	8.18	0.818
Mannitol	5.25	0.525

Platelet additive solution (PAS)

SSP+* Macopharma

The volume of platelet additive solution contained in each unit of platelets pooled in platelet additive solution leucocyte depleted is approximately 70% of the total component volume.

The volume of platelet additive solution contained in each unit of platelets apheresis in platelet additive solution leucocyte depleted is approximately 60% of the total component volume.

*Note: PAS-E is the generic nomenclature adopted by ICCBBA to describe platelet additive solutions in terms of their active ingredients: citrate, phosphate, acetate, magnesium and potassium. This nomenclature allows for solutions with the same active ingredients from different commercial sources to be coded in the same manner. SSP+ is one of the PAS-E Platelet Additive Solutions.

Constituents	mg/ 100 mL
Sodium chloride	405
Sodium acetate trihydrate	442
Sodium citrate dihydrate	318
Sodium dihydrogenophosphate	105
Di-sodium hydrogenophosphate	305
Potassium chloride	37
Magnesium chloride	30



Storage, transport and handling

Blood components must be stored and transported at controlled temperatures in accordance with the requirements shown in the table.

All components

Keep blood components in an appropriately monitored temperature-controlled environment until administered.

Transfuse blood components as soon as possible after removal from temperature-controlled storage.

Minimise the amount of time blood components are outside of temperature-controlled storage to ensure that the specified temperature limits are not exceeded.

Handling and storage must minimise the possibility of product tampering.

Red cells

On each occasion, the amount of time red cell components are outside of temperature-controlled storage but not transfused should be restricted to less than 30 minutes.^{4,7}

Frozen components

Thaw frozen blood components using an approved method such as a temperature-controlled waterbath maintained between 30°C and 37°C or in an approved microwave device.

Prevent water contamination of entry ports during thawing, for example using a watertight protective plastic over-wrap. Do not thaw frozen components in a domestic microwave oven or using hot water directly from a tap.



Component	Storage temperature	Transport temperature	Comments
Red cells	2°C to 6°C	2°C to 10°C	Blood refrigerators including those in theatre and other wards or remote locations, must be managed in accordance with AS3864-Part 2 (2012). ⁶
Platelets	20°C to 24°C	20°C to 24°C	Must be agitated gently and continuously in a single layer on a platelet agitator.
Fresh frozen plasma Cryoprecipitate Cryodepleted plasma	-25°C or below	-25°C or below	Freezers must be managed in accordance with AS3864-Part 2 (2012). ⁶

Administration of blood components

Lifeblood recommends that transfusing facilities promulgate guidelines with the support of their clinical, scientific, and other key staff.

All clinical staff involved in ordering, preparing, issuing, and transfusing blood components must be trained in the correct procedures, and must be familiar with the general and institutional requirements for transfusion practice.

Resources

In developing institutional guidelines, there are a wide range of resources including:

- National Blood Authority *Patient Blood Management Guidelines*¹
- Australian Commission on Safety and Quality in Health Care (ACSQHC) *Standard 7 – Blood Management Standard*²
- Australian and New Zealand Society of Blood Transfusion *Guidelines for Transfusion and Immunohaematology Laboratory Practice*³
- Australian and New Zealand Society of Blood Transfusion and Australian College of Nursing *Guidelines for the Administration of Blood Products*⁴
- National Pathology Accreditation Advisory Council (NPAAC) *Requirements for Transfusion Laboratory Practice*⁸
- World Health Organization *The Clinical Use of Blood in Medicine, Obstetrics, Paediatrics, Surgery and Anaesthesia, Trauma and Burns*,⁹ and
- British Society for Haematology *Guideline on the Administration of Blood Components*.¹⁰

The ANZSBT guidelines and NPAAC requirements provide guidance especially in the areas of sample identification, compatibility testing, issue and transfusion of blood components, and investigation of transfusion reactions.

Patient identification

To ensure the correct blood component is administered, the intended recipient must be properly identified at each stage of the transfusion process, from collection and labelling of the sample and request form through to commencement of the transfusion.

When a blood component is received for transfusion, the patient and pack details must be confirmed according to approved procedures. The checking procedure must be performed independently by two appropriately qualified staff, with each independently carrying out and taking responsibility for the procedure.

Documentation

The decision to transfuse must be clearly documented in the patient's medical record and on the request form, and include the prescribed component, clinical indication for transfusion, number of packs (or volume/dose required) and special requirements. The identity and signatures of staff members performing the identity checks and administering the transfusion must be recorded. The unique donation number of each pack being transfused, the start and finish times, the patient's observations, as well as other relevant details, must be recorded in the patient's medical record. Records should be retained for as long as required by local policies and state/territory and national regulations.

Inspection of components

Whenever being handled, prior to issue from the laboratory and before transfusion, check the appearance of the blood component. **Do not transfuse** if there is any evidence of haemolysis, clot formation, significant colour change in the contents (e.g. in the red cells compared to crossmatch segments), tampering or any other reason that the blood component appears unsuitable for use. Return the affected blood component to the Transfusion Service Provider or Lifeblood for further evaluation.

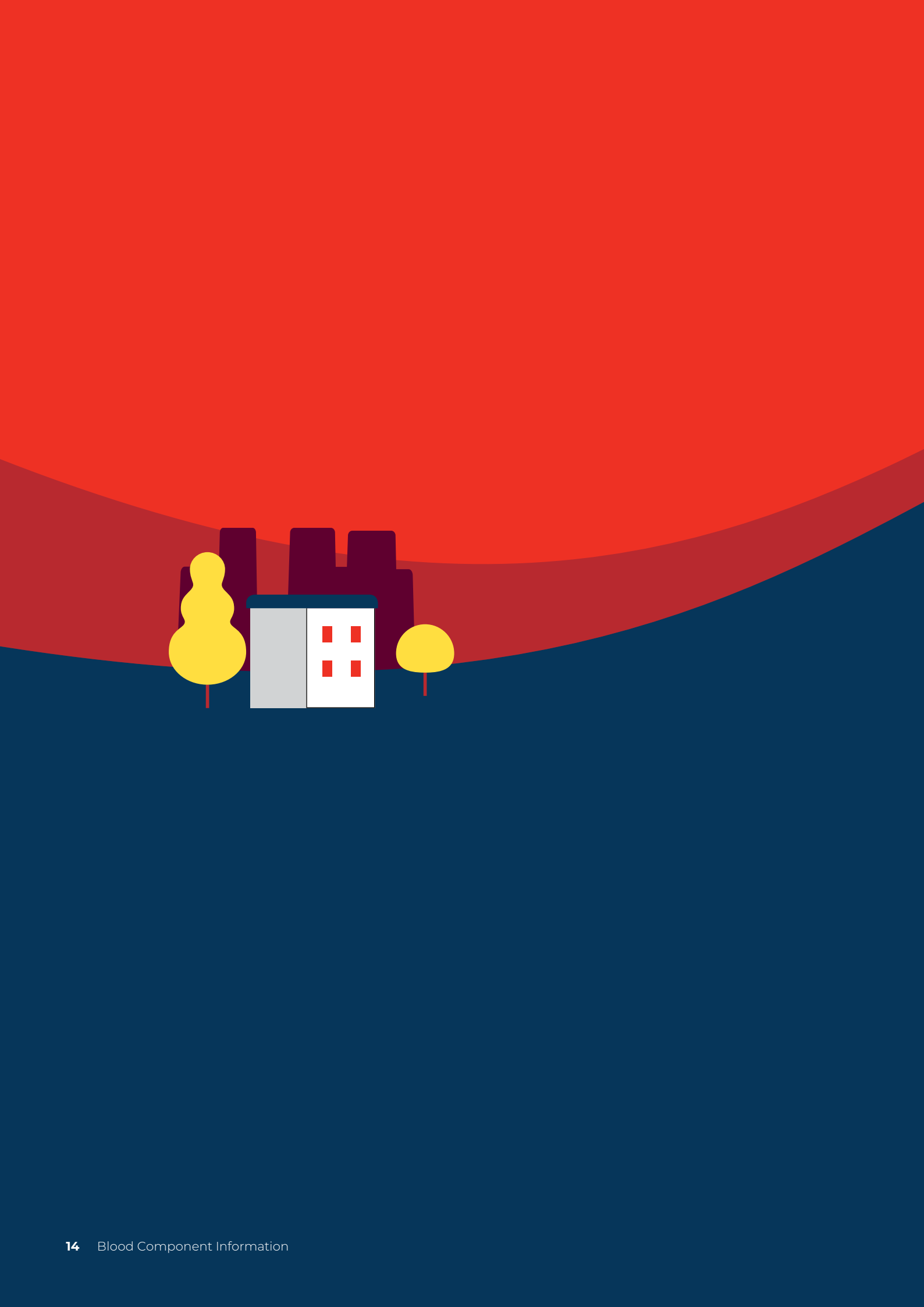
Administration procedures

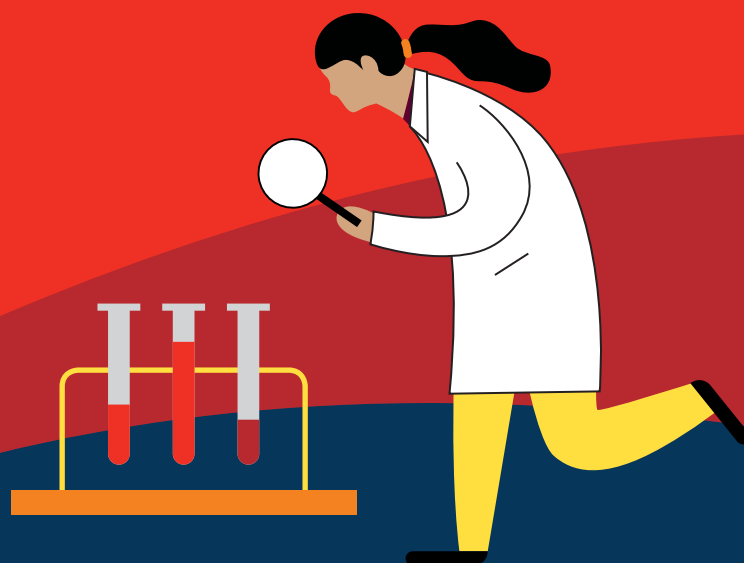
Transfusion of blood components should only be undertaken where appropriate staff and facilities are available to identify and manage any potential adverse transfusion reaction. Local policies and procedures should always be followed. Detailed guidance is provided by the ANZSBT/ACN Guidelines for the Administration of Blood Products.⁴

- Blood components are prepared in a sterile closed system to minimise the risk of bacterial contamination. Once opened or 'spiked' the blood component should be transfused within four hours of opening if maintained at room temperature (20–24°C).
- Blood components should be transfused through an approved blood administration set incorporating a standard (170–200 µm) filter to remove clots and aggregates. Bedside leucocyte filters are not required because all components are leucocyte depleted.
- Blood components should be thoroughly mixed by inversion before use.
- Only one type of blood component should be administered at a time, unless in an emergency situation. Multiple packs of the same type of blood component (e.g. red cells) can be administered consecutively through the same giving set, according to the manufacturer's recommendations.
- Medication must not be added to the blood component bag or blood giving set or intravenous (IV) line. IV fluids must not be co-administered with blood components unless there is sufficient data to ensure compatibility. The only IV fluid universally compatible with blood components is 0.9% sodium chloride. Red cells are compatible with ABO-compatible plasma and 4% albumin. Electrolyte and colloid solutions containing calcium (such as Hartmann's solution, lactated Ringer's solution and Haemaccel®) may cause clots to form in the blood component in the presence of citrate anticoagulant.
- Blood components may be warmed just prior to or during transfusion, if clinically indicated. Only approved blood warming devices should be used.
- Where clinically appropriate, the infusion should start slowly. The patient should be closely observed for the initial 15 minutes of the infusion as life-threatening reactions may occur after infusion of only a small volume. After 15 minutes the rate of infusion may be increased to the maximum prescribed rate, provided there are no signs or symptoms of an adverse reaction.
- Transfusion of each pack should be completed prior to the labelled expiry or within four hours of removal from temperature-controlled storage, whichever is sooner.

Adverse transfusion reactions

- Frequent visual observation of the patient before, during and after the transfusion is essential to identify possible adverse reactions. If an adverse transfusion reaction occurs, stop the transfusion immediately and initiate appropriate therapy. The transfusion should not be restarted unless the patient receives a satisfactory clinical review.
- All significant adverse transfusion reactions, including possible bacterial contamination of a blood component, suspected disease transmission or transfusion-associated acute lung injury (TRALI) should be immediately reported to the transfusion service provider. The remainder of any implicated blood components should be retained for further investigation. If an adverse reaction has blood component safety or quality implications and may require donor investigations and/or recall of associated blood components it should also be reported to Lifeblood.
- Further information about adverse transfusion reactions is provided in **Appendix IV** (page 37) and also on our website for health professionals at **transfusion.com.au**





Component information and specifications

Blood components are manufactured to specifications mandated by the Council of Europe (COE) ***Guide to the Preparation, Use and Quality Assurance of Blood Components*** (19th Edition; 2017).

Component quality and processing methods are monitored using statistical process control (SPC). The testing protocol takes into account all major production variables with sampling plans reflecting these.

The sampling rate is set to ensure statistical validity and as a general principle, guidelines require the monitoring of 1% (or 10 products per month, whichever is greater) although, for some parameters in specific component types, all packs will be tested. Lifeblood requires a minimum of 90% of components tested meet specifications.

Red cells

leucocyte depleted

Description	A red cell component obtained by removing most of the plasma after centrifuging whole blood collected into anticoagulant. The red cells may be resuspended in other additives (e.g. SAG-M) to prolong storage and are filtered to remove most leucocytes. May be irradiated.		
Indications	For treatment of clinically significant anaemia with symptomatic deficit of oxygen carrying capacity, and replacement of traumatic or surgical blood loss.		
Contraindications	Depending upon the condition of the patient, transfusion of red cells may not be necessary even with low haemoglobin concentration. Do not use red cells if anaemia can be treated with specific medications such as iron, vitamin B12, folic acid or erythropoietin and the clinical condition of the patient permits sufficient time for these to promote erythropoiesis.		
Typical unit content Data from: 1 January 2018 to 31 December 2018	Parameter	Mean (\pm 1 SD)	Specification
	Volume (mL)	260 \pm 15	> 220
	Haemoglobin (g/unit)	48 \pm 5	\geq 40
	Haematocrit (L/L)	0.58 \pm 0.03	0.50–0.70
	Haemolysis (% at expiry)	0.3 \pm 0.1	< 0.8
	Leucocyte count ($\times 10^6$ /unit)	0.02 \pm 0.07	< 1.0
Availability	Available in group O, A, B and AB; and RhD positive and RhD negative.		
Shelf life	42 days with the appropriate additives.		
Storage temperature	2°C to 6°C. Time outside of controlled storage conditions prior to commencing transfusion should not exceed 30 minutes. ^{4,7}		
Dosage	Each unit raises haemoglobin concentration by approximately 10 g/L. Transfuse one unit and reassess patient.		
Administration	Transfuse through blood administration set incorporating a standard (170–200 μ m) filter. Transfusion of each unit should be completed within four hours of removal from approved controlled storage.		
Transfusion reactions	See Appendix IV: Transfusion reactions (page 37).		
Modifications	Phenotyped, CMV seronegative, irradiated. See Appendix II: Clinical indications for blood components which have been further manufactured or tested (page 33).		
Comments	Whenever possible, blood of identical ABO and RhD group to the recipient should be used. However, group O (normally RhD negative) red cells must be used in an emergency when the recipient's blood group is unknown. ³ In this situation, a blood sample should be taken for pretransfusion testing prior to commencing transfusion.		

Red cells paediatric

leucocyte depleted

Description	A leucocyte depleted red cell component divided into four packs of equal volume for the purpose of reducing donor exposure for small paediatric transfusions and to minimise product wastage. May be irradiated.		
Indications	For treatment of clinically significant anaemia with symptomatic deficit of oxygen carrying capacity in infants and young children. May also be used for intrauterine transfusion.		
Contraindications	See Red cells leucocyte depleted (page 16).		
Typical unit content Data from: 1 January 2018 to 31 December 2018	Parameter	Mean (\pm 1 SD)	Specification
	Volume (mL)	60 \pm 4	25–100
	Haemoglobin (g/unit)	N/A	Initial unit prior to splitting \geq 40
	Haematocrit (L/L)	0.61 \pm 0.04	0.50–0.70
	Haemolysis (% at expiry)	0.2 \pm 0.1	< 0.8
	Leucocyte count ($\times 10^6$ /unit)	N/A	Initial unit prior to splitting < 1.0
Availability	Must be requested in advance, unless by local arrangement.		
Shelf life	35 days with the appropriate additives.		
Storage temperature	2°C to 6°C. Time outside of controlled storage conditions prior to commencing transfusion should not exceed 30 minutes. ^{4,7}		
Dosage	In neonates and children < 20 kg, transfusion volume should be calculated based on weight and prescribed in mL. In children > 20 kg use one adult unit and reassess patient. Common paediatric dosing is 10–15 mL/kg, alternatively the following formula can be used: Volume required = weight (kg) \times Hb rise required (g/L) \times 0.5		
Administration	Transfuse through blood administration set incorporating a standard (170–200 μ m) filter. Transfusion of each unit should be completed within four hours of removal from approved controlled storage.		
Transfusion reactions	See Appendix IV: Transfusion reactions (page 37).		
Modifications	Phenotyped, CMV seronegative, irradiated. See Appendix II: Clinical indications for blood components which have been further manufactured or tested (page 33).		
Comments	Whenever possible, blood of identical ABO and RhD group to the recipient should be used.		

Red cells washed

leucocyte depleted

Description	Red cells leucocyte depleted (page 16) are washed with sterile SAG-M (saline adenine glucose mannitol) solution using a manual process to remove the majority of unwanted plasma proteins, antibodies and electrolytes. The washed red cells are resuspended in SAG-M2 additive solution. May be irradiated.		
Indications	See Red cells leucocyte depleted (page 16). Indicated for patients requiring red cells with a low protein supernatant, such as those experiencing reactions to transfused plasma e.g. patients who have IgA deficiency and antibodies to anti-IgA. Washed red cells may reduce the incidence of severe recurrent febrile, urticarial and possible anaphylactic reactions in multi-transfused recipients. May also be considered for patients with paroxysmal nocturnal haemoglobinuria (PNH) who experience reactions despite receiving group-specific leucocyte depleted fresh red cells; and rarely for patients with T-activation when units with low anti-T titres are unavailable or severe autoimmune haemolytic anaemia where excess complement may worsen red cell destruction.		
Contraindications	See Red cells leucocyte depleted (page 16).		
Typical unit content Data from: 1 May 2018 to 31 December 2018	Parameter	Mean (\pm 1 SD)	Specification
	Volume (mL)	258 \pm 18	> 130
	Haemoglobin (g/unit)	48 \pm 5	\geq 40
	Haematocrit (L/L)	0.62 \pm 0.03	0.50–0.70
	Haemolysis (% at expiry)	0.1 \pm 0.1	< 0.8
	Leucocyte count ($\times 10^6$ /unit)	N/A	Initial unit prior to splitting < 1.0
	Last wash supernatant (total protein g/unit)	0.02 \pm 0.03	< 0.5
Availability	Must be requested in advance.		
Shelf life	28 days. Washed red cells may be irradiated at any time up to 14 days after collection, and thereafter post-irradiation shelf life is 14 days.		
Storage temperature	2°C to 6°C. Time outside of controlled storage conditions prior to commencing transfusion should not exceed 30 minutes. ^{4,7}		
Dosage	Each unit raises haemoglobin concentration by approximately 10 g/L. Transfuse one unit and reassess patient.		
Administration	Transfuse through blood administration set incorporating a standard (170–200 μ m) filter. Transfusion of each unit should be completed within four hours of removal from approved controlled storage.		
Transfusion reactions	See Appendix IV: Transfusion reactions (page 37).		
Modifications	Phenotyped, CMV seronegative, irradiated. See Appendix II: Clinical indications for blood components which have been further manufactured or tested (page 33).		
Comments	As there is some loss of red cells during processing, the increment in haemoglobin from one unit of washed red cells is less than expected from an unwashed unit. Whenever possible, blood of identical ABO and RhD group to the recipient should be used.		

Platelets apheresis

in platelet additive solution, leucocyte depleted

Description	<p>One, two or three adult doses of platelets prepared from a single apheresis platelet donation. The donor's blood is separated into components with retention of the platelets and a portion of plasma. Red and white blood cells and the majority of the plasma are either returned to the donor or collected for preparation of the appropriate component types. Leucocyte depletion is performed during the collection. A platelet additive solution is added to achieve the pre-determined final platelet concentration.</p> <p>This component is irradiated prior to issue.</p>		
Indications	<p>For treatment of bleeding due to either severely decreased platelet production or functionally abnormal platelets (e.g. antiplatelet agents). They may also be used in treating some patients with bleeding due to platelet consumption or dilutional thrombocytopenia.</p> <p>Platelets may be useful if given prophylactically to patients with rapidly falling or low platelet counts (usually $< 10 \times 10^9/L$ secondary to cancer or chemotherapy). May also be useful in selected cases of postoperative bleeding (e.g. platelet count $< 50 \times 10^9/L$).</p>		
Contraindications	<p>Should not be used if bleeding is unrelated to decreased numbers of platelets or abnormally functioning platelets.</p> <p>Do not use in patients with destruction of endogenous and exogenous platelets, such as in immune thrombocytopenic purpura (ITP), thrombotic thrombocytopenic purpura (TTP) or heparin-induced thrombocytopenia (HIT), unless the patient has a life-threatening haemorrhage.</p>		
Typical unit content Data from: 29 March 2019 to 21 April 2019	Parameter	Mean (± 1 SD)	Specification
	Volume (mL)	209 \pm 21	100–400
	Platelet count ($\times 10^9/\text{unit}$)	277 \pm 42	> 200 to ≤ 450
	pH (at expiry)	7.2 \pm 0.1	> 6.4
	Leucocyte count ($\times 10^6/\text{unit}$)	0.2 \pm 0.2	< 1.0
Availability	Available in group O, A and B; and RhD positive and negative. Group AB must be requested in advance.		
Shelf life	Five days after collection.		
Storage temperature	<p>20°C to 24°C.</p> <p>Platelets components must be gently and continuously agitated in a single layer on a platelet agitator.</p>		
Dosage	<p>One unit would be expected to increase the platelet count of a 70 kg adult by $20\text{--}40 \times 10^9/L$. The number of units prescribed depends on the patient's clinical situation.</p> <p>The usual dose in an adult is one unit. For prophylaxis, this dose may need to be repeated in one to three days because of the short life span of transfused platelets.</p> <p>Both immune and non-immune mechanisms may contribute to reduced platelet recovery and survival.</p>		
Administration	<p>Transfuse through blood administration set incorporating a standard (170–200 μm) filter.</p> <p>Transfusion of each unit may proceed as fast as tolerated but should be completed within four hours of removal from approved controlled storage.</p> <p>When RhD positive platelets are transfused to an RhD negative female of childbearing potential, prevention of RhD immunisation by use of RhD Immunoglobulin should be considered. One 250 IU dose of RhD Immunoglobulin, given intramuscularly, provides sufficient cover for six weeks of platelet transfusions.¹² If intravenous RhD Immunoglobulin administration is required, Rhophylac® should be used.</p>		
Transfusion reactions	See Appendix IV: Transfusion reactions (page 37).		

Platelets apheresis continued

in platelet additive solution, leucocyte depleted

Modifications	<p>Irradiated, CMV seronegative, HLA-compatible, phenotyped, low anti-A/B.</p> <p>See Appendix II: Clinical indications for blood components which have been further manufactured or tested (page 33) and Appendix III: Explanation of blood component label modifier text (page 36).</p>
Comments	<p>In addition to platelet-specific HPA (human platelet antigen) system antigens, platelets carry HLA class I antigens. Residual white blood cells which may be present in platelet units express both HLA class I and II antigens.</p> <p>Refractoriness to platelet transfusion may occur following HLA, or less commonly HPA, alloimmunisation. When transfused to a patient with an antibody specific to an expressed antigen, the survival time of the transfused platelets may be markedly shortened, and the patient may become either temporarily or permanently refractory to platelet transfusion. HLA-compatible or HPA-matched platelets may be indicated.</p> <p>Compatibility testing is not necessary in routine platelet transfusion. Platelet components should be ABO and RhD type compatible with the recipient. However, ABO-incompatible platelets may be used if ABO-compatible platelets are not available. In some patients (particularly children), residual plasma present in platelet units which are ABO-incompatible with the recipient's red cells may cause a positive direct antiglobulin test and possible low-grade haemolysis due to isoagglutinins present in the plasma.</p> <p>Re-suspension of platelets in platelet additive solution rather than plasma reduces the risk associated with transfusion of large volumes of ABO-incompatible plasma and the incidence of adverse reactions to plasma proteins. Apheresis platelets that have low titre anti-A and/or anti-B pose a lower risk of haemolysis when transfusing ABO incompatible platelets. In addition, group A platelets with the A² subgroup do not express significant amounts of A antigen and are therefore preferable to other group A platelets when transfusing group O and B recipients. Immunisation to donor red cell antigens may occur because of the presence of small but variable numbers of red cells in platelet units.</p>

Platelets paediatric apheresis

in platelet additive solution, leucocyte depleted

Description	<p>An adult dose apheresis platelet pack that is divided into three packs of equal volume for the purpose of reducing donor exposure in paediatric recipients and to minimise component wastage.</p> <p>This component is irradiated.</p>		
Indications	See Platelets apheresis in platelet additive solution leucocyte depleted (page 19). Clinically indicated for small volume transfusions in infants and children.		
Contraindications	See Platelets apheresis in platelet additive solution leucocyte depleted (page 19).		
Typical unit content Data from: 29 March 2019 to 21 April 2019	Parameter	Mean (\pm 1 SD)	Specification
	Volume (mL)	56 \pm 2	40–60
	Platelet count ($\times 10^9$ /unit)	75 \pm 10	> 50
	pH (at expiry)	7.0 \pm 0.1	> 6.4
	Leucocyte count ($\times 10^6$ /unit)	N/A	Initial unit prior to splitting < 1.0
Availability	Contact local Lifeblood centre regarding availability.		
Shelf life	Five days after collection.		
Storage temperature	<p>20°C to 24°C.</p> <p>Platelets components must be agitated gently and continuously in a single layer on a platelet agitator.</p>		
Dosage	<p>One unit would be expected to increase the platelet count of an 18 kg child by 20×10^9/L. The number of units prescribed depends on the patient's clinical situation.</p> <p>For prophylaxis, this dose may need to be repeated in one to three days because of the short life span of transfused platelets. Both immune and non-immune mechanisms may contribute to reduced platelet recovery and survival.</p>		
Administration	<p>Transfuse through blood administration set incorporating a standard (170–200 μm) filter.</p> <p>Transfusion of each unit may proceed as fast as tolerated but should be completed within four hours of removal from approved controlled storage.</p> <p>When RhD positive platelets are transfused to an RhD negative female of childbearing potential, prevention of RhD immunisation by use of RhD Immunoglobulin should be considered. One 250 IU dose of RhD Immunoglobulin, given intramuscularly, provides sufficient cover for six weeks of platelet transfusions.¹² If intravenous RhD Immunoglobulin administration is required, Rhophylac® should be used.</p>		
Transfusion reactions	See Appendix IV: Transfusion reactions (page 37).		
Modifications	<p>Irradiated, CMV seronegative, HLA-compatible, phenotyped, low anti-A/B.</p> <p>See Appendix II: Clinical indications for blood components which have been further manufactured or tested (page 33) and Appendix III: Explanation of blood component label modifier text (page 36).</p>		
Comments	See Platelets apheresis in platelet additive solution leucocyte depleted (page 19).		

Platelets pooled

in platelet additive solution, leucocyte depleted

Description	An adult dose of platelets obtained from a pool of buffy coats from ABO identical donors and resuspended in a platelet additive solution. The pool is then filtered to remove most leucocytes. This component is irradiated.		
Indications	See Platelets apheresis in platelet additive solution leucocyte depleted (page 19).		
Contraindications	See Platelets apheresis in platelet additive solution leucocyte depleted (page 19).		
Typical unit content Data from: 1 January 2018 to 31 December 2018	Parameter	Mean (\pm 1 SD)	Specification
	Volume (mL)	367 \pm 16	> 160
	Platelet count ($\times 10^9$ /pool)	288 \pm 49	> 200
	pH (at expiry)	7.0 \pm 0.1	> 6.4
	Leucocyte count ($\times 10^6$ /pool)	0.02 \pm 0.06	< 1.0
Availability	Available in group O, A and B, and RhD positive and negative.		
Shelf life	Five days after collection.		
Storage temperature	20°C to 24°C. Platelets components must be gently and continuously agitated in a single layer on a platelet agitator.		
Dosage	One unit would be expected to increase the platelet count of a 70 kg adult by 20–40 $\times 10^9$ /L. The number of units prescribed depends on the patient's clinical situation. The usual dose in an adult is one pooled unit. For prophylaxis, this dose may need to be repeated in one to three days because of the short life span of transfused platelets. Both immune and non-immune mechanisms may contribute to reduced platelet recovery and survival.		
Administration	Transfuse through blood administration set incorporating a standard (170–200 μ m) filter. Transfusion of each unit may proceed as fast as tolerated but should be completed within four hours of removal from approved controlled storage. When RhD positive platelets are transfused to an RhD negative female of childbearing potential, prevention of RhD immunisation by use of RhD Immunoglobulin should be considered. One 250 IU dose of RhD Immunoglobulin, given intramuscularly, provides sufficient cover for six weeks of platelet transfusions. ¹² If intravenous RhD Immunoglobulin administration is required Rhophylac® should be used.		
Transfusion reactions	See Appendix IV: Transfusion reactions (page 37).		
Modifications	Irradiated, CMV seronegative. See Appendix II: Clinical indications for blood components which have been further manufactured or tested (page 33) and Appendix III: Explanation of blood component label modifier text (page 36).		
Comments	See Platelets apheresis in platelet additive solution leucocyte depleted (page 19).		

Fresh frozen plasma

Description	<p>Clinical fresh frozen plasma (FFP) is either separated from a single unit of whole blood or collected by apheresis where the plasma is retained and the remaining elements are either returned to the donor or harvested for the appropriate component types.</p> <p>All apheresis-derived clinical FFP is split into two or three units of equal volume prior to freezing. Freezing of whole blood plasma must commence within 18 hours of collection and freezing of apheresis plasma must commence within six hours of collection.</p> <p>Contains all coagulation factors including approximately 200 IU of Factor VIII plus the other labile plasma coagulation factor, Factor V.</p>		
Indications	<p>For patients with a coagulopathy who are bleeding or at risk of bleeding where a specific therapy such as vitamin K or factor concentrate is not appropriate or unavailable.</p> <p>May be indicated in bleeding patients who require replacement of labile plasma coagulation factors such as in massive transfusion, cardiac bypass, liver disease or acute disseminated intravascular coagulation (DIC). It also may be indicated in cases of warfarin overdose with life-threatening bleeding in addition to Prothrombin Complex Concentrates (vitamin K dependent factor concentrates, e.g. Prothrombinex-VF).²⁰</p> <p>FFP may be indicated for patients with thrombotic thrombocytopenic purpura (TTP).</p>		
Contraindications	<p>Do not use FFP when coagulopathy can be corrected more effectively with specific therapy, such as vitamin K, cryoprecipitate, Factor VIII or other specific factor concentrates.</p> <p>Do not use FFP when blood volumes can be safely and adequately replaced with other volume expanders such as 0.9% Sodium Chloride solution, Hartmann's Solution, or appropriate colloids.</p>		
Typical unit content Data from: 1 January 2018 to 31 December 2018	WHOLE BLOOD DERIVED		
	Parameter	Mean (\pm 1 SD)	Specification
	Volume (mL)	278 \pm 13	250–310
	FVIIIc (IU/mL)	1.09 \pm 0.19	\geq 0.70
	APHERESIS DERIVED		
	Parameter	Mean (\pm 1 SD)	Specification
	Volume (mL)	271 \pm 8	250–310
	FVIIIc (IU/mL)	1.24 \pm 0.15	\geq 0.70
Availability	Available in all ABO groups.		
Shelf life	12 months.		
Storage temperature	<p>–25°C or below.</p> <p>Once thawed, should be transfused immediately or stored at 2°C to 6°C for up to five days in accordance with ANZSBT guidelines.^{14,15,16,17}</p>		
Dosage	The volume transfused depends on the clinical situation and patient size, and should be guided by laboratory assays of coagulation function.		
Administration	<p>Thaw using an approved method. See Storage, transport and handling (page 10).</p> <p>Mix thoroughly by inversion before use and transfuse through a blood administration set incorporating a standard (170–200 μm) filter.</p> <p>Transfusion of each unit may proceed as fast as tolerated but should be completed within four hours of removal from approved controlled storage.</p>		
Transfusion reactions	See Appendix IV: Transfusion reactions (page 37).		

Fresh frozen plasma continued

Modifications	<p>IgA deficient, low anti-T, secretor plasma Le(b+).</p> <p>See Appendix III: Explanation of blood component label modifier text (page 36).</p>
Comments	<p>Compatibility tests before transfusion are not necessary.</p> <p>Plasma should be ABO compatible with the recipient's red cells. Group O plasma should be restricted to group O recipients. Plasma components that have low titre anti-A or anti-B pose a lower risk of haemolysis when transfusing ABO incompatible components. Group AB plasma products, although suitable for patients of all ABO groups and typically used when the patient's group is unknown, are often in short supply and use may be restricted, for example to neonates. In emergencies or trauma situations when the patient's ABO group is unknown, group A plasma products may be used for adults as an alternative to group AB (unless the product is known to have high-titre anti-B). Matching for RhD type is not necessary.</p>

Fresh frozen plasma paediatric

Description	<p>Clinical fresh frozen plasma (FFP) from a single unit of whole blood is divided into four packs of equal volume for the purpose of reducing donor exposure in paediatric recipients and to minimise component wastage.</p> <p>Freezing of the plasma is commenced within 18 hours after collection of the whole blood.</p> <p>Contains all coagulation factors including the labile plasma coagulation factors VIII and V.</p>		
Indications	<p>See Fresh frozen plasma (page 23).</p> <p>Clinically indicated for small volume transfusions in infants and children.</p>		
Contraindications	See Fresh frozen plasma (page 23).		
Typical unit content	Parameter	Mean (\pm 1 SD)	Specification
Data from: 1 January 2018 to 31 December 2018	Volume (mL)	67 \pm 4	60–80
	FVIIIc (IU/mL)	1.09 \pm 0.19	\geq 0.70
Availability	Available in all ABO groups.		
Shelf life	12 months.		
Storage temperature	<p>–25°C or below.</p> <p>Once thawed, should be transfused immediately or stored at 2°C to 6°C for up to five days in accordance with ANZSBT guidelines.^{14,15,16,17}</p>		
Dosage	The volume transfused depends on the clinical situation and patient size, and should be guided by laboratory assays of coagulation function. Common paediatric dose is 10–15 mL/kg.		
Administration	<p>Thaw using an approved method. See Storage, transport and handling (page 10).</p> <p>Mix thoroughly by inversion before use and transfuse through a blood administration set incorporating a standard (170–200 μm) filter.</p> <p>Transfusion of each unit may proceed as fast as tolerated but should be completed within four hours of removal from approved controlled storage.</p>		
Transfusion reactions	See Appendix IV: Transfusion reactions (page 37).		
Modifications	See Fresh frozen plasma (page 24).		
Comments	See Fresh frozen plasma (page 24).		

Cryodepleted plasma

Description	<p>Cryodepleted plasma is the supernatant remaining after cryoprecipitate has been removed from whole blood derived FFP used for cryoprecipitate production.</p> <p>Contains most clotting factors in similar amounts to FFP but is deficient in Factor VIII, von Willebrand factor (VWF; the high molecular weight multimers are more thoroughly removed than the smaller multimers), fibrinogen, Factor XIII and fibronectin.</p>		
Indications	<p>Cryodepleted plasma may be used for plasma exchange in thrombotic thrombocytopenic purpura (TTP). It may also be used as an alternative to FFP for the treatment of coagulopathy where there is no significant reduction in Factor VIII, fibrinogen, Factor XIII or VWF e.g. for rapid temporary warfarin reversal in patients requiring emergency surgery and in warfarin overdose with life-threatening bleeding (in addition to prothrombin complex concentrates (vitamin K dependent factor such as Prothrombinex®-VF).</p> <p>For extended warfarin reversal, vitamin K may be recommended.</p>		
Contraindications	<p>Do not use cryodepleted plasma when coagulopathy can be corrected more effectively with specific therapy, such as vitamin K or specific factor concentrates.</p> <p>Do not use cryodepleted plasma when blood volumes can be safely and adequately replaced with other volume expanders such as 0.9% Sodium Chloride solution, Hartmann's Solution, or appropriate colloids.</p>		
Typical unit content Data from: 1 January 2018 to 31 December 2018	Parameter	Mean (± 1 SD)	Specification
	Volume (mL)	242 ± 13	215–265
Availability	Available in all ABO groups.		
Shelf life	12 months.		
Storage temperature	<p>–25°C or below.</p> <p>Once thawed, should be transfused immediately or stored at 2°C to 6°C for up to five days (unpublished Lifeblood data) in accordance with ANZSBT guidelines.^{14,15,16,17}</p>		
Dosage	The volume transfused depends on the clinical situation and patient size, and should be guided by laboratory assays of coagulation function.		
Administration	<p>Thaw using an approved method. See Storage, transport and handling (page 10).</p> <p>Mix thoroughly by inversion before use and transfuse through a blood administration set incorporating a standard (170–200 µm) filter.</p> <p>Transfusion of each unit may proceed as fast as tolerated but should be completed within four hours of removal from approved controlled storage.</p>		
Transfusion reactions	See Appendix IV: Transfusion reactions (page 37).		
Modifications	None.		
Comments	See Fresh frozen plasma (page 24).		

Cryodepleted plasma apheresis

Description	<p>Cryodepleted plasma apheresis is the supernatant remaining after cryoprecipitate has been removed from apheresis derived FFP used for cryoprecipitate production.</p> <p>Contains most clotting factors in similar amounts to FFP but is deficient in Factor VIII, von Willebrand factor (VWF; the high molecular weight multimers are more thoroughly removed than the smaller multimers), fibrinogen, Factor XIII and fibronectin.</p> <p>Apheresis-derived cryodepleted plasma obtained from a single donor yields the equivalent of approximately two units of whole blood derived cryodepleted plasma. This reduces the number of donor exposures for recipients. Cryodepleted plasma apheresis may also be manufactured from split units of apheresis-derived FFP.</p>		
Indications	See Cryodepleted plasma (page 26).		
Contraindications	See Cryodepleted plasma (page 26).		
Typical unit content Data from: 3 December 2018 to 31 March 2019	Parameter	Mean (\pm 1 SD)	Specification
	Volume (mL)	755 \pm 6	675–825
Availability	Available in all ABO groups.		
Shelf life	12 months.		
Storage temperature	<p>–25°C or below.</p> <p>Once thawed, should be transfused immediately or stored at 2°C to 6°C for up to five days (unpublished Lifeblood data) in accordance with ANZSBT guidelines.^{14,15,16,17}</p>		
Dosage	The volume transfused depends on the clinical situation and patient size, and should be guided by laboratory assays of coagulation function.		
Administration	<p>Thaw using an approved method. See Storage, transport and handling (page 10).</p> <p>Mix thoroughly by inversion before use and transfuse through a blood administration set incorporating a standard (170–200 μm) filter.</p> <p>Transfusion of each unit may proceed as fast as tolerated but should be completed within four hours of removal from approved controlled storage.</p>		
Transfusion reactions	See Appendix IV: Transfusion reactions (page 37).		
Modifications	None.		
Comments	See Fresh frozen plasma (page 24).		

Cryoprecipitate

Description	<p>Cryoprecipitate is prepared by thawing whole blood derived FFP used for cryoprecipitate production and recovering the precipitate. The cold-insoluble precipitate is refrozen.</p> <p>Contains most of the original Factor VIII, von Willebrand factor (VWF), fibrinogen, Factor XIII and fibronectin.</p>		
Indications	Indicated in the treatment of fibrinogen deficiency or dysfibrinogenaemia when there is clinical bleeding, an invasive procedure, trauma or disseminated intravascular coagulation (DIC).		
Contraindications	Should not be used to treat haemophilia, von Willebrand's disease or deficiencies of Factor XIII or fibronectin unless alternative therapies are unavailable.		
Typical unit content Data from: 1 January 2018 to 31 December 2018	Parameter	Mean (\pm 1 SD)	Specification
	Volume (mL)	36 \pm 2	30–40
	Fibrinogen (mg/unit)	357 \pm 110	\geq 140
	FVIIIc (IU/unit)	151 \pm 30	\geq 70
	VWF (IU/unit)	294 \pm 69	> 100
Availability	Available in all ABO groups.		
Shelf life	12 months.		
Storage temperature	<p>–25°C or below.</p> <p>Thawed cryoprecipitate should be maintained at 20°C to 24°C until transfused.^{14,18} Once thawed, should be used within six hours if it is a closed single unit, or within four hours if it is an open system or units have been pooled.^{14,18}</p>		
Dosage	<p>Typically, one unit per 5–10 kg body weight would be expected to increase the fibrinogen concentration by 0.5–1.0 g/L.</p> <p>The volume transfused depends on the clinical situation and patient size, and should be guided by laboratory assays of coagulation function. A typical adult dose is 10 units of whole blood-derived cryoprecipitate, approximately equivalent to a fibrinogen dose of 3–4g.</p> <p>In the steady state, the half-life of fibrinogen is three to five days. Dosing schedules of cryoprecipitate infusions every three days may be appropriate for patients with congenital hypofibrinogenemia.</p>		
Administration	<p>Thaw using an approved method. See Storage, transport and handling (page 10).</p> <p>For pooling, the precipitate in each concentrate should be mixed well with 10–15 mL of diluent to ensure complete removal of all material from the container. The preferred diluent is 0.9% Sodium Chloride Injection (USP).</p> <p>Mix thoroughly by inversion before use and transfuse through a blood administration set incorporating a standard (170–200 μm) filter.</p> <p>Transfusion of each unit may proceed as fast as tolerated but should be completed within four hours of removal from approved controlled storage.</p>		
Transfusion reactions	See Appendix IV: Transfusion reactions (page 37).		
Modifications	None.		
Comments	<p>Compatibility tests before transfusion are not necessary. Preferably ABO compatible with the recipient's red cells; however, ABO-incompatible cryoprecipitate can be used with caution, particularly with large volumes.</p> <p>If a large volume of ABO-incompatible cryoprecipitate is used, the recipient may develop a positive direct antiglobulin test and, very rarely, mild haemolysis. Plasma components that have low titre anti-A or anti-B pose a lower risk of haemolysis. Matching for RhD type is not necessary.</p>		

Cryoprecipitate apheresis

Description	<p>Cryoprecipitate apheresis is prepared by thawing apheresis-derived FFP used for cryoprecipitate production and recovering the precipitate. The cold-insoluble precipitate is refrozen.</p> <p>Contains most of the original Factor VIII, von Willebrand factor (VWF), fibrinogen, Factor XIII and fibronectin.</p> <p>For patients who receive large amounts of cryoprecipitate, may be of benefit in reducing the number of donor exposures, as well as reducing the risk of allergic reaction to plasma proteins and transmission of infectious agents.</p>		
Indications	See Cryoprecipitate (page 28).		
Contraindications	See Cryoprecipitate (page 28).		
Typical unit content Data from: 1 January 2018 to 31 December 2018	Parameter	Mean (\pm 1 SD)	Specification
	Volume (mL)	60 \pm 2	54–66
	Fibrinogen (mg/unit)	906 \pm 268	\geq 140
	FVIIIc (IU/unit)	347 \pm 57	\geq 70
	VWF (IU/unit)	897 \pm 152	> 100
Availability	Contact Lifeblood regarding availability.		
Shelf life	12 months.		
Storage temperature	<p>–25°C or below.</p> <p>Thawed cryoprecipitate should be maintained at 20°C to 24°C until transfused.^{14,18} Once thawed, should be used within six hours if it is a closed single unit, or within four hours if it is an open system or units have been pooled.^{14,18}</p>		
Dosage	<p>Typically, one unit per 10–20 kg body weight would be expected to increase the fibrinogen concentration by 0.5–1.0 g/L.</p> <p>The volume transfused depends on the clinical situation and patient size, and should be guided by laboratory assays of coagulation function.</p> <p>A typical adult dose is five units of apheresis-derived cryoprecipitate, approximately equivalent to a fibrinogen dose of 3–4g. In the steady state, the half-life of fibrinogen is three to five days. Dosing schedules of cryoprecipitate infusions every three days may be appropriate for patients with congenital hypofibrinogenemia.</p>		
Administration	<p>Thaw using an approved method. See Storage, transport and handling (page 10).</p> <p>For pooling, the precipitate in each concentrate should be well mixed with 10–15 mL of diluent to ensure complete removal of all material from the container. The preferred diluent is 0.9% Sodium Chloride Injection (USP).</p> <p>Mix thoroughly by inversion before use and transfuse through a blood administration set incorporating a standard (170–200 μm) filter.</p> <p>Transfusion of each unit may proceed as fast as tolerated but should be completed within four hours of removal from approved controlled storage.</p>		
Transfusion reactions	See Appendix IV: Transfusion reactions (page 37).		
Modifications	None.		
Comments	<p>Compatibility tests before transfusion are not necessary. Preferably ABO compatible with the recipient's red cells; however, ABO-incompatible cryoprecipitate can be used with caution, particularly with large volumes.</p> <p>If a large volume of ABO-incompatible cryoprecipitate is used, the recipient may develop a positive direct antiglobulin test and, very rarely, mild haemolysis. Matching for RhD type is not necessary.</p>		



Appendices



Appendix I

Patient Blood Management Guidelines

The National Blood Authority has produced a set of six Patient Blood Management (PBM) Guidelines as part of a comprehensive evidence-based national patient blood management strategy.¹

PBM is driven by a number of factors including:

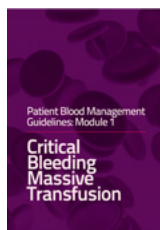
- risks associated with blood transfusion
- rising costs (both direct and indirect) associated with provision and transfusion of allogeneic blood, and
- challenges of maintaining an adequate blood supply in the face of increased demand due to ageing population.

PBM optimises the use of donor blood and reduces transfusion-associated risk. If blood components are likely to be indicated, transfusion should not be a default decision. Instead, the decision on whether to transfuse should be carefully considered, taking into account the full range of available therapies, and balancing the evidence for efficacy and improved clinical outcome against the potential risks.

PBM incorporates proactive treatment regimens which are tailored to suit individual patients, using a multidisciplinary team approach to conserve a patient's own blood. Consideration should be given to the use of pharmaceutical agents and medical devices to reduce the need for allogeneic blood transfusion.

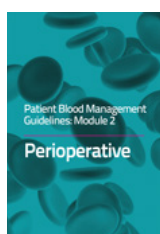
Organisations which have adopted PBM report:

- increased patient satisfaction
- decrease in the need for transfusion
- improved patient outcomes, and
- cost-savings.



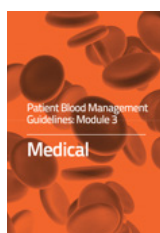
Module 1 Critical Bleeding/Massive Transfusion

To assist and guide healthcare professionals in making clinical decisions when managing patients with critical bleeding who require, or are likely to require, massive transfusion.



Module 2 Perioperative

To inform healthcare practitioners, health educators, and health service managers and policy-makers about the pre, intra and postoperative care of patients undergoing surgery or invasive procedures, particularly those in which blood loss is anticipated.



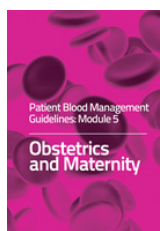
Module 3 Medical

To assist and guide clinical decisions and coordination of healthcare across the primary, secondary and tertiary care settings for patients with acute or chronic medical conditions requiring haematological intervention.



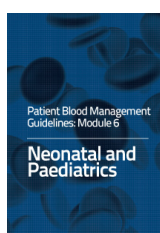
Module 4 Critical Care

To assist and guide healthcare professionals in making clinical decisions when managing patients requiring critical care.



Module 5 Obstetrics and Maternity

To assist and guide healthcare professionals in making clinical decisions when managing pregnant and postpartum women.



Module 6 Neonatal and Paediatrics

To assist and guide healthcare professionals in making clinical decisions about blood management in neonatal and paediatric patients.

Appendix II

Clinical indications for blood components which have been further manufactured or tested

CMV seronegative

Description	<p>Transmission of CMV disease is associated with cellular blood components. CMV seronegative red cells and platelets are identified by testing selected donations for CMV antibodies, using a CMV test approved for donor screening.</p> <p>FFP, cryoprecipitate and other plasma-derived blood components do not transmit CMV, therefore CMV testing is not required for these components.</p>
Clinical indications	CMV seronegative recipients at risk of severe CMV disease.
Patient groups	<p>CMV seronegative products should be used for the following clinical indications: pregnant women regardless of CMV status who require regular elective transfusions during pregnancy (but not during delivery); recipients of intrauterine transfusion (IUT); neonates (up to 28 days post expected date of delivery); granulocyte transfusions for CMV negative patients.</p> <p>For other groups, leucodepleted blood products are considered CMV safe, with the decision use such products dictated by local clinical policies: solid organ transplants; haemopoietic stem cell transplants (HSCT); haematology and oncology patients; immunodeficient patients, including those with HIV.</p>
Comments	<p>Where CMV seronegative blood components are indicated, select CMV seronegative components whenever possible.</p> <p>If not available, leucodepleted components are considered to offer a high level of safety in preventing CMV transmission, but are not universally believed to be equivalent to CMV seronegative components. At-risk patients should be closely monitored for CMV infection and disease.</p> <p>Whether using a combination of leucocyte depletion and CMV seronegative components provides any additional safety benefits is unknown.</p>

Frozen red cells

Description	<p>Glycerol is added to red cells as a cryoprotectant before freezing at between -65°C and -80°C. Frozen red cells may be stored for up to 10 years, although longer periods may be possible if there is a particular need for specific units.</p>
Clinical indications	Treating anaemia or blood loss.
Patient groups	Patients with rare red cell phenotypes, or multiple red cell antibodies and for autologous collections when liquid-preserved blood cannot fulfil demands.
Comments	<p>Prior to transfusion, glycerol must be removed from the thawed component by washing the cells with sodium chloride. After washing, the red cells are resuspended in additive solution or and must be used within 24 hours. There will be some loss of red cells during the freezing and thawing process.</p> <p>When requesting frozen red cells it should be noted that thawing and processing time is several hours.</p>

Appendix II continued

Clinical indications for blood components which have been further manufactured or tested

Irradiation²³

Description	<p>Gamma irradiation is used to inactivate viable T-lymphocytes found in red cells, platelets and granulocytes which are the immediate cause of transfusion-associated graft versus host disease (TA-GVHD), a rare, but almost universally fatal complication of transfusion.</p> <p>The minimum irradiating dose should be 25 Gy, with no part of the component receiving greater than 50 Gy. A Radsure® label will be attached to the pack to indicate that irradiation was performed.</p>
Clinical indications	Prevention of TA-GVHD in susceptible recipients.
Patient groups	<p>Indications for irradiated blood components include:</p> <p>Definite indications</p> <p>Directed donations (from blood relatives); intrauterine transfusion (IUT) and all subsequent neonatal exchange transfusions; congenital cellular immunodeficiency disorders; allogeneic and autologous haematopoietic stem cell transplantation; Hodgkin lymphoma; patients receiving nucleoside analogues for malignant or non-malignant disorders; patients receiving alemtuzumab for malignant or non-malignant disorders and transplantation.</p> <p>Possible indications</p> <p>Premature infants and infants weighing < 1300 g, all newborn infants, acute leukaemia, non-Hodgkin lymphoma, patients with B cell malignancy receiving non-nucleoside analogue-containing chemotherapy and/or radiotherapy leading to lymphopenia < 0.5 x 10⁹/L, T cell malignancies, patients receiving high doses of chemotherapy and/or irradiation causing lymphopenia < 0.5 x 10⁹/L, patients receiving long-term or high-dose steroids as therapy for malignancies, aplastic anaemia receiving immunosuppressive therapy.</p> <p>The possible indication for using irradiated blood components in massive transfusion for trauma remains uncertain.</p>
Comments	<p>Gamma irradiation of red cells increases the rate of efflux of extracellular potassium. In considering the clinical significance of this, both the speed and volume of the transfusion, as well as the age of the blood, must be considered.</p> <p>Red cells (and washed red cells) may be irradiated at any time up to 14 days after collection, and post irradiation shelf life is 14 days.</p> <p>Red cells for IUT and exchange transfusion must be less than five days old at irradiation and once irradiated must be used within 24 hours.</p> <p>Irradiated red cells for neonatal and infant small volume transfusion must be less than 14 days at irradiation and once irradiated must be used within 48 hours.</p> <p>Platelets can be irradiated at any stage during their five-day shelf life without any change to their original five day expiry date.</p> <p>Granulocytes for all recipients should be irradiated as soon as possible after production, and transfused with minimal delay.</p>

Phenotyped red cells or platelets

Description	For patients requiring specific antigen-negative red cell or platelet components due to alloimmunisation.
Clinical indications	Prevention or management of alloimmunisation to red cell or platelet (HPA or HLA) antigens.
Patient groups	Patients with red cell or platelet alloantibodies, patients receiving long-term transfusion support, patients with warm autoimmune haemolytic anaemia (AIHA), patients receiving anti-CD38 (or similar) therapies.

Red cells for intrauterine transfusion (IUT)

Description	<p>A hyper-concentrated red cell component less than five days old with a haematocrit of 0.70–0.85 obtained by removing most of the plasma/additive solution. The red cells may be resuspended in additive solution to achieve the desired haematocrit. The final volume is printed on the component label.</p> <p>Red cells for IUT must be irradiated.</p>
Clinical indications	Treatment of fetal anaemia primarily associated with haemolytic disease of the fetus and newborn (HDFN).
Patient groups	Fetuses at risk of anaemia.
Comments	<p>ABO, RhD compatible with both mother and fetus, K negative. Should be antigen-negative for maternal alloantibodies, IAT crossmatch compatible with the maternal plasma and CMV seronegative. If the fetal blood group is unknown use group O, RhD negative red cells.</p> <p>Once irradiated the component must be used within 24 hours.</p>

Appendix III

Explanation of blood component label modifier text

Modifier text	Explanation
Autol release – see disclaimer	This autologous component has tested positive for one or more viral markers but has been released upon request by the patient's physician. A disclaimer form will accompany these components.
CMV negative	The originating donor sample/donation has been tested for CMV antibody and is negative.
For intrauterine transfusion	A hyper concentrated red cell component with a haematocrit of 0.70–0.85. After preparation the expiry is reduced to 48 hours and the component must be irradiated before use. Once irradiated the component must be used within 24 hours.
IgA deficient	The originating donor sample/donation has been tested and is IgA deficient.
Low Anti-A/B	The originating donor sample/donation has low levels of anti-A/B haemolysins.
Low Anti-T	The originating donor sample/donation has been tested and anti-T was not detected.
Not for neonatal use	The component has been deemed unsuitable for neonatal use due to the presence of red cell antibodies (low titre only). It should not be transfused to a neonate.
Not NAT tested	Due to extenuating circumstances, (e.g. machine failure or specific clinical demand) this component has been released without nucleic acid technology (NAT) testing being performed. A disclaimer form will accompany these components.
Phenotype reserve	The originating donor sample/donation or previous testing of donor has had an extended phenotype performed and forms part of a panel of cells reserved for patients with antibodies or where antigen negative blood is otherwise specifically required.
Secretor plasma Le(b+)	The component is from an Le(a-b+) donor and contains soluble H and Lewis antigens (and A or B antigens if the donor is group A or B). May be used to neutralise a recipient's Lewis or A or B antibodies. Suitable for transfusion.
Suitable for research	The component is deemed unsuitable for clinical use, but may be used for research purposes. (Note that these components will never be issued for transfusion).

Appendix IV

Transfusion reactions

Adverse reactions associated with transfusion of blood and blood components may be broadly classified as acute or delayed, and immunological or non-immunological.

Transfusion reactions

- 38** Acute haemolytic transfusion reaction
- 38** Allergic reaction
- 39** Anaphylaxis or anaphylactoid reaction
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- 42** Transfusion-associated graft-versus-host disease (TA-GVHD)
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Resources

Further information on aetiology, incidence, diagnosis, management, and prevention of transfusion reactions can be found in a variety of sources, including:

- Lifeblood website for health professionals **transfusion.com.au**
- Lifeblood *iTransfuse App*, available from the App Store and Google Play
- Popovsky M, ed. *Transfusion Reactions*²⁴
- *Serious Hazards of Transfusion (SHOT)* available at shotuk.org
- *AABB Technical Manual*^{25,26}
- *The Clinical Use of Blood in Medicine, Obstetrics, Paediatrics, Surgery and Anaesthesia, Trauma and Burns*⁹ by the World Health Organization, and
- Australian and New Zealand Society of Blood Transfusion and Royal College of Nursing of Australia *Guidelines for the Administration of Blood Products*.⁴

Residual risk estimates for transfusion-transmitted infections

Current residual risk estimates for transfusion-transmitted infection in Australia are provided in **Appendix V** (page 47) and are also available on the Lifeblood website for health professionals **transfusion.com.au**

Appendix IV continued

Transfusion reactions

Acute haemolytic transfusion reaction (AHTR)

Usual aetiology	<p>Immunologic incompatibility between transfused red cells and a recipient red cell antibody causing haemolysis or accelerated clearance of transfused red cells.</p> <p>Most severe reactions are associated with transfusion of ABO incompatible blood due to clerical errors, patient identification errors such as improper sample labelling, testing errors or administering blood to the wrong patient.</p> <p>Occasionally transfusion of platelets or plasma components containing high titre anti-A and/or anti-B antibodies may cause clinically significant haemolysis if the plasma is incompatible with the recipient's red cells.</p> <p>May also be due to non-immune haemolysis, e.g. physical or chemical damage to transfused red cells, effects of drugs or hypotonic solutions co-administered with transfusion, effects of bacterial toxins, thermal injury due to freezing or overheating etc.</p>
Incidence	1:40,000 for ABO/RhD incompatible transfusion, 1:76,000 for acute haemolytic reaction, 1:1,800,000 for fatal haemolytic reaction. ²⁶
Main clinical features	<p>Most commonly fever, chills and haemoglobinuria; symptoms may also include tachycardia, dyspnoea, chest, back or flank pain, renal failure, abnormal bleeding or shock.</p> <p>Instability of blood pressure is frequent. In anaesthetised patients, hypotension and evidence of disseminated intravascular coagulation (DIC) may be the first sign.</p>
Investigation	<p>Clinical assessment to exclude other clinical or physical causes of haemolysis or shortened red cell survival. Clerical check of ABO typing of patient and unit.</p> <p>Blood group, antibody screen, crossmatch and direct antiglobulin test (DAT) on pre and post transfusion specimens, renal function, tests for haemolysis (e.g. lactate dehydrogenase [LDH], haptoglobin, bilirubin) etc.</p>
Intervention	Stop transfusion immediately. Seek urgent assistance. Maintain blood pressure and renal output. Inform the Transfusion Service Provider.

Allergic reaction

Usual aetiology	Unclear; hypersensitivity to allergens or plasma proteins, rarely to donor medication.
Incidence	1–3% of transfusions of plasma-containing components. ^{24,26}
Main clinical features	Urticarial lesions, but may also include pruritus, erythema, flushing, or mild upper respiratory symptoms (cough, wheezing), nausea, vomiting, abdominal cramps or diarrhoea.
Investigation	Usually none.
Intervention	Stop transfusion. Give antihistamine. Continue transfusion at a slower rate when the reaction abates. Consider premedication and/or washed red cells if recurrent.

Anaphylaxis or anaphylactoid reaction

Usual aetiology	The majority of these reactions have been reported in IgA deficient patients who have anti-IgA (of IgE class). May be due to IgE-mediated allergy to other plasma proteins, rarely to donor medication, etc.
Incidence	1:20,000–50,000 transfusions. ^{24,26}
Main clinical features	Often rapid onset. Reactions usually begin within 1–45 minutes after the start of the transfusion. Symptoms include severe hypotension, hypoxia, coughing, bronchospasm, laryngospasm, angioedema, urticaria, nausea, abdominal cramps, vomiting, diarrhoea, shock and loss of consciousness. May be fatal.
Investigation	Test pre-transfusion sample for IgA and IgA antibodies. Consider tryptase testing.
Intervention	Stop transfusion immediately. Maintain airway and IV line, support blood pressure. Administer oxygen and adrenaline. The benefit of corticosteroids in anaphylaxis is unproven. Consult a haematologist before administering additional blood products. Use IgA deficient or washed components if patient is confirmed IgA deficient and future transfusion is required.

Delayed haemolytic transfusion reactions (DHTR)

Usual aetiology	Usually occur in patients previously alloimmunised to red cell antigens by transfusion or pregnancy. The red cell alloantibody is typically too weak to be detectable in pretransfusion testing. Transfusion of antigen-positive red cells provokes an anamnestic response and a rapid rise in antibody titre. Usual timeframe is two to 14 days after transfusion.
Incidence	Variously reported as 1:2,500–11,000 or 1:71,667. ^{24,26}
Main clinical features	Signs may include unexplained fever, unexplained decrease in haemoglobin, jaundice and development of a positive DAT.
Investigation	DAT and red cell antibody screen. Liver function tests. Markers of haemolysis (urinary haemosiderin, reticulocyte count, bilirubin, LDH, haptoglobin, etc).
Intervention	Most delayed haemolytic reactions have a benign course and require no treatment. Provide antigen negative blood if further transfusion is needed.

Appendix IV continued

Transfusion reactions

Febrile non-haemolytic transfusion reaction (FNHTR)

Usual aetiology	Accumulation of soluble factors (e.g. cytokines) during storage of cellular components; or recipient antibodies to white blood cell or other antigens.
Incidence	0.1–1% of transfusions with universal leucocyte depletion. ²⁶ Most frequently in patients alloimmunised by transfusion or pregnancy.
Main clinical features	Pyrexia (temperature of $\geq 38^{\circ}\text{C}$ and rise of $\geq 1^{\circ}\text{C}$ from baseline) shortly after transfusion in the absence of any other pyrexia stimulus. May be associated with chills, rigors, nausea, vomiting, and headache.
Investigation	FNHTR is a diagnosis of exclusion. Similar symptoms may occur in other serious transfusion reactions e.g. acute haemolytic reaction, bacterial contamination and TRALI.
Intervention	Stop transfusion. Consider and exclude other causes. Give antipyretic. Recommencement of the transfusion, at a slow rate, is possible if other causes of a fever have been excluded.

Iron overload

Usual aetiology	Long-term complication of repeated red cell transfusions with iron deposition in organs. Each transfusion contributes about 250 mg of iron.
Incidence	Evidence of iron overload with organ dysfunction may occur after 50–100 red cell units, while evidence of iron overload requiring chelation therapy may occur after 10–20 units. ²⁶
Main clinical features	Symptoms and signs of organ damage or failure, especially hepatic and cardiac, and arthropathy.
Investigation	Patient history of chronic red cell transfusions. Serum ferritin and transferrin saturation. Organ imaging and/or liver biopsy.
Intervention	Iron chelating agents for treatment and for prevention where anticipated.

Massive transfusion complications

Usual aetiology	Rapid infusion of large volumes of cold blood can depress the body temperature and result in metabolic complications such as acidosis, hyperkalaemia, hypocalcaemia, etc. Rarely seen outside the massive transfusion setting. Trauma-induced haemostatic changes may further exacerbate complications of massive transfusion.
Incidence	Variable.
Main clinical features	Depends on clinical situation. Complications include metabolic and haemostatic abnormalities.
Investigation	Blood gas analysis (including acid-base balance, pH, electrolytes, ionised calcium), monitoring of coagulation profiles, possible thromboelastography and cardiac monitoring.
Intervention	Massive transfusion should follow the national <i>Patient Blood Management Guidelines: Module 1 Critical Bleeding</i> and institutional protocols. Use blood warmers where appropriate. Consider calcium replacement and tranexamic acid infusions.

Post-transfusion purpura (PTP)

Usual aetiology	Alloimmunisation to platelet-specific antigens, most often Human Platelet Antigen 1a (HPA-1a); however antibodies to other HPA antigens have also been implicated. While the immune specificity may be to a platelet-specific antigen the patient lacks, both autologous and allogeneic platelets are destroyed.
Incidence	Rare.
Main clinical features	Development of dramatic, sudden and self-limiting thrombocytopenia sufficient to cause purpura, petechiae, and clinically significant bleeding. Occurs typically seven to 10 days after a blood transfusion, usually in a patient with a history of sensitisation by either pregnancy or transfusion.
Investigation	Demonstrate antiplatelet antibody.
Intervention	Intravenous immunoglobulin. Antigen-negative platelets may be indicated if platelet transfusion is required but this is controversial.

Appendix IV continued

Transfusion reactions

Transfusion-associated circulatory overload (TACO)

Usual aetiology	Volume overload due to rapid or large volume transfusion in patients with diminished cardiac reserve or chronic anaemia (usually children or elderly patients).
Incidence	Approximately 1% of patients receiving transfusions. ^{24, 26}
Main clinical features	Includes dyspnoea, orthopnoea, cyanosis, tachycardia, increased venous pressure and pulmonary oedema. May develop within one to two hours of transfusion.
Investigation	Clinical assessment, including a chest x-ray to check for presence of pulmonary oedema, although findings may be confused with TRALI. Raised levels of brain natriuretic peptide (BNP) may be informative.
Intervention	Stop transfusion. Administer oxygen, diuretics and keep patient upright. In susceptible patients, further transfusions should be administered slowly.

Transfusion-associated graft-versus-host disease (TA-GVHD)

Usual aetiology	<p>Viable T lymphocytes in the transfused component proliferate in the recipient, engraft and mount a destructive immune response against the recipient's tissues.</p> <p>Pathogenesis is unclear. Immunocompromised recipients may be at increased risk but also seen in immunocompetent recipients, typically individuals heterozygous for an HLA haplotype for which the donor is homozygous, for example genetically homogeneous populations such as the Japanese, recipients of HLA-matched components or blood from a close relative. However, in many cases particularly in immunocompetent individuals, there may be no identifiable differences between donor and recipient HLA types.</p>
Incidence	Rare.
Main clinical features	Develops four to 30 days after transfusion. Characteristically fever, rash, gastrointestinal symptoms, liver injury and pancytopenia. Leads to profound marrow aplasia. Usually fatal.
Investigation	Biopsy of involved tissue (skin, liver, gut and possibly bone marrow), HLA typing (patient and donor) and chimerism studies. Demonstrate engraftment or chimerism of donor lymphocytes.
Intervention	<p>Supportive care. Immunosuppressive or immunomodulatory drugs commonly used and in some cases stem cell transplants. However there is currently no effective treatment and disorder is nearly always fatal.</p> <p>For at-risk patients ensure gamma irradiation of any cellular blood components.</p>

Transfusion-related acute lung injury (TRALI)

Usual aetiology	<p>The most widely held pathogenesis theory is that human leucocyte antigen (HLA) or human neutrophil antigen (HNA) antibodies found in the donor's plasma are directed against the recipient's leucocyte antigen.</p> <p>The antigen-antibody reaction activates neutrophils in the lung microcirculation, releasing oxidases and proteases that damage blood vessels resulting in leakage. Biological response modifiers, such as biologically active lipids can accumulate in some cellular components during storage and may also induce TRALI in susceptible patients.</p>
Incidence	Variously reported. 1:1,200–190,000 transfusions. ²⁶ TRALI is thought to be the most common cause of transfusion-associated fatalities.
Main clinical features	Onset of fever, tachycardia, hypotension, hypoxia ($\text{PaO}_2/\text{FiO}_2 \leq 300$ or $\text{SpO}_2 < 90\%$ on room air) and pulmonary oedema leading to respiratory failure during or within six hours of transfusion.
Investigation	<p>Clinical assessment and investigation (e.g. chest x-ray, oxygen saturation and laboratory investigations). TRALI is a clinical diagnosis.</p> <p>Diagnosis may be supported by demonstration of HLA or HNA antibodies in the donor together with a positive crossmatch.</p>
Intervention	<p>Stop transfusion immediately. Provide cardiovascular and respiratory support.</p> <p>Inform Lifeblood.</p>

Transfusion-related immune modulation (TRIM)

Usual aetiology	A transient immunosuppression in recipients which may occur following transfusion of allogeneic blood, however the exact mechanism is yet to be elucidated. Possibly mediated by donor white cells releasing cytokines during storage, which leads to immune modulation.
Incidence	Not known.
Main clinical features	No specific signs or symptoms. Suggested increased risk of post-operative bacterial infection and tumour recurrence in cancer patients.
Investigation	No specific investigation process has been defined.
Intervention	Leucodepletion may have possible benefits.

Appendix IV continued

Transfusion reactions

Transfusion-transmitted bacterial infection (TTBI)

Usual aetiology	<p>Bacteria may enter the blood during collection or preparation of components. Occasionally bacteria may enter due to contamination of ports whilst thawing frozen components in a waterbath.</p> <p>Both gram-positive and gram-negative organisms have been implicated with serious morbidity and mortality occurring most frequently with gram-negative bacteria. Organisms capable of multiplying at low temperatures and those using iron as a nutrient are most often associated with red cell contamination, especially <i>Yersinia enterocolitica</i>. Greatest risk is for platelets stored at room temperature.</p> <p>To minimise the risk of bacterial contamination of platelets, Lifeblood screens all platelet components using an automated microbial detection system.</p>
Incidence	<p>For clinically apparent reactions, variously reported in the international literature to be at least 1:100,000 for platelets and at least 1:500,000 for red cells.^{24,27,28}</p> <p>In comparison, Australian data show clinically apparent reactions occur at a rate of approximately 1:250,000 for platelets and approximately 1:2,500,000 for red cells.²⁹</p>
Main clinical features	<p>Onset of high fever, severe chills, rigors, hypotension, tachycardia, dyspnoea or circulatory collapse during or soon after transfusion should suggest the possibility of bacterial contamination and/or endotoxin reaction.</p> <p>Can be acute, severe and life-threatening. In severe cases, patient may develop shock with accompanying renal failure and DIC. This reaction may be fatal.</p>
Investigation	<p>Clinical assessment. Blood cultures from the patient. Culture and Gram stain of blood component. Keep blood bag and giving set (sealed) for further investigation.</p>
Intervention	<p>Stop transfusion immediately. Seek urgent medical assistance as this may become an emergency. Provide cardiovascular support. Start broad spectrum antibiotics once cultures have been taken. Send blood pack to Transfusion Service Provider.</p> <p>Inform Lifeblood to ensure quarantining and testing of related components from the same donation/donor.</p>

Transfusion-transmitted malaria

Usual aetiology	<p>Malaria is transmitted to humans through the bite of a mosquito infected with a parasite species of the <i>Plasmodium</i> genus or through blood transfusion from a donor infected with malaria.</p> <p>Although rare, transfusion-transmitted malaria continues to pose a risk. In order to minimise this risk, all potential blood donors are subjected to stringent screening procedures, including collection of a comprehensive medical and travel history as part of the donor assessment process.</p> <p>Lifeblood also performs malarial antibody screening on donors with a potential malarial exposure risk.</p>
Incidence	<p>Estimated residual risk per unit for malaria is less than 1 in 1 million units transfused.³⁰</p>
Main clinical features	<p>Patients can present with fever, headache, nausea, vomiting and hypotension.</p>
Investigation	<p>Clinical assessment. Laboratory investigation including preparation of thick and thin blood films.</p>
Intervention	<p>Treat specific diagnosis. Treat specific parasite with antimalarial drugs.</p> <p>Inform Lifeblood.</p>

Transfusion-transmitted viral infection

Usual aetiology	<p>Transfusion-transmitted viral infections, such as hepatitis, HIV and HTLV may occur through donations made by donors in the window period of their infection.</p> <p>There are also some viruses for which there are no routine tests available in Australia, such as Dengue Virus (Dengue Fever) and Parvovirus B19 (B19 viral infection).</p> <p>In addition, Lifeblood does not test donors for some viruses. For example, Chikungunya virus is such a low risk, that travel deferrals are an effective precaution.</p>
Incidence	<p>The risk per unit for HIV, hepatitis B, hepatitis C and HTLV I/II are all less than 1:1,000,000. For more information refer to Appendix V (page 47).</p>
Main clinical features	Variable severity from asymptomatic to fatal. Features of specific clinical infection.
Investigation	Clinical assessment. Liver function tests. Specific testing for viral markers.
Intervention	<p>Treatment for specific diagnosis, if available.</p> <p>The risk of CMV transmission may be reduced by requesting CMV seronegative blood components for specific at risk patient groups.</p> <p>Inform Lifeblood.</p>

Transfusion-transmitted infections - Other (TTI)

Usual aetiology	<p>Lifeblood's mandatory testing includes the screening of donations for the presence of <i>Treponema pallidum</i> (syphilis). Other non-viral infectious agents are also potentially transmissible by blood transfusion. However there are some infectious agents for which there are no routine tests available to prevent the disease from being transmitted by transfusion. For example, <i>Trypanosoma cruzi</i> (Chagas Disease) and the bovine spongiform encephalopathy (BSE) causing prion responsible for variant Creutzfeldt-Jakob Disease.</p> <p>To minimise the risk of transmitting infectious agents to patients, all donors are subjected to stringent screening procedures.</p>
Incidence	Variable.
Main clinical features	Features of specific clinical infection.
Investigation	Clinical assessment. Microbiological investigation.
Intervention	<p>Treat specific diagnosis.</p> <p>Inform Lifeblood.</p>

Appendix IV continued

Transfusion reactions

Variant Creutzfeldt-Jakob Disease (vCJD)

Usual aetiology	<p>A prion disease affecting the central nervous system due to consumption of beef products from cattle infected with the BSE-causing prion.</p> <p>Risk of vCJD is possible, but not yet reported in Australia. As a precaution, people who have spent a cumulative period of six months or more in the UK between 1 January 1980 and 31 December 1996 and/or have received a transfusion in the UK since 1 January 1980 are not accepted as blood donors.</p>
Incidence	<p>To date, there have been no reported cases of vCJD in Australia. In the UK, there have been a small number of reported cases of putative transfusion transmission since 2004.</p> <p>There have been no reported cases of transmission by transfusion of classical Creutzfeldt-Jakob Disease (cCJD), and retrospective studies suggest that the possibility of such transmission of cCJD is remote.¹⁸</p>
Main clinical features	<p>Patients with vCJD frequently show prominent sensory disturbances and psychiatric symptoms with a minority having psychosis. A small proportion initially present with neurologic symptoms, including an early onset of sensory abnormalities.</p>
Investigation	<p>There are currently no routinely available tests to predict or prevent vCJD. Clinically assess for neurodegenerative signs and symptoms. MRI is the most useful noninvasive test for a positive diagnosis. Immediately consult with experts.</p>
Intervention	<p>Seek expert advice.</p> <p>Inform Lifeblood.</p>

Appendix V

Residual risk estimates for transfusion-transmitted infections

Australia has one of the safest blood supplies in the world in terms of viral safety. Lifeblood publishes estimates of the residual risks of transfusion-transmissible infection as a guide for clinicians in transfusion decision-making and informed consent processes.

Lifeblood residual risk estimates for transfusion-transmissible viral infections (shown in the table below) have been derived using published models and are updated periodically.

Agent and testing standard	Window period	Estimate of residual risk 'per unit' ^(a)
HIV (antibody/p24Ag + NAT)	6 days	Less than 1 in 1 million ^{32,33}
HCV (antibody + NAT)	3 days	Less than 1 in 1 million ^{32,33}
HBV (HBsAg + NAT; including OBI risk)	16 days	Less than 1 in 1 million ^{32,33,34}
HTLV-1 and HTLV-2 (antibody)	51 days	Less than 1 in 1 million ^(b)
vCJD (No testing)		Possible (not yet reported in Australia)
Malaria (antibody)	7–14 days	Less than 1 in 1 million ³⁰

***Notes:** vCJD = variant Creutzfeldt-Jakob Disease; (a) HIV, HCV and HBV WP risk estimates are based on Lifeblood data from 1 January 2017 to 31 December 2018. The HBV OBI risk is based on Lifeblood data from 1 January 2018 to 31 December 2018. (b) No HTLV incident donors were recorded for the period with the residual risk estimate derived from a single model using first-time and repeat donor calculation and based on Lifeblood data from 1 January 2015 to 31 December 2018.

There have been no reported cases of transmission by transfusion of classical Creutzfeldt-Jakob Disease (cCJD) and retrospective studies suggest the possibility of such transmission is remote.³¹ To date there have been no reported cases of vCJD in Australia. In the UK, there have been a small number of reported cases of putative transfusion transmission since 2004.³⁵ In Australia, as a precaution, people who spent a cumulative period of at least 6 months in the UK between 1 January 1980 and 31 December 1996 and/or who have received a transfusion in the UK since 1 January 1980 are not accepted as blood donors.

When considering the significance of specific risks, it is helpful to compare them to risks associated with everyday living. The relative risks of acquiring a transfusion-transmitted infection are very small when compared to other health-related risks as shown in the chart on the following page.

Risks of transfusion

The following chart explains the likelihood of various risks.

Magnitude of risk	Risks of transfusion
Less than 1:1,000,000	<ul style="list-style-type: none"> Septic reaction from red cells Transfusion-transmitted Human Immunodeficiency Virus (HIV) Transfusion-transmitted Hepatitis B Virus (HBV) Transfusion-transmitted Hepatitis C Virus (HCV)
1:250,000	<ul style="list-style-type: none"> Septic reaction from platelets
1:190,000	<ul style="list-style-type: none"> Transfusion-related acute lung injury (TRALI)
1:50,000	<ul style="list-style-type: none"> Anaphylaxis
1:1000	<ul style="list-style-type: none"> Febrile non-haemolytic transfusion reaction (FNHTR)

References

1. National Blood Authority. Patient Blood Management Guidelines. Canberra: NBA (Available at: <http://www.blood.gov.au/pbm-guidelines>)
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