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BACKGROUND

This chapter focuses on the principles of safe blood transfusion practices. The aim of this chapter is to develop and support the knowledge of health-care professionals involved in prescribing and administering blood components and products. Several standards and guidelines define the minimum criteria required to maintain safety and enhance transfusion practices. These include the Canadian Standard Association's *CAN/CSA-Z902-15 - Blood and Blood Components*¹, the Canadian Society for Transfusion Medicine (*CSTM Standards for Hospital Transfusion Services*)², Health Canada's *Guidance Document: Blood Regulations*³, the *AABB Standards for Blood Banks and Transfusion Services*⁴ and the College of American Pathologists (*CAP Transfusion Medicine Accreditation Checklist*)⁵. These standards and guidelines establish the criteria for practices that support health-care providers, specifically the transfusion service, in defining the quality system requirements necessary for continuous improvement. Each health-care facility's policies and procedures must include mechanisms to ensure ongoing training and competency assessment of the theoretical and practical knowledge of all staff involved in the transfusion process, including the clinical decision to transfuse.

PRE-TRANSFUSION CONSIDERATIONS

Decision to transfuse

The prescribing of a blood component or plasma protein product (PPP) is a clinical decision made by a physician or authorized health care professional, based on evidence-based practice guidelines and often made in consultation with a Transfusion Medicine Specialist. Although pre-transfusion diagnostic test results may suggest transfusion is warranted, a clinical assessment of symptoms and consideration of outcome measures should be included in the decision to transfuse.

Informed consent

Informed consent is a standard blood safety requirement in Canada (see section 11.2 of *CSA-Z902*)¹. In the Commission of Inquiry on the Blood System in Canada, the Honourable Commissioner Justice Horace Krever emphasized the importance of informed consent for the administration of blood components and products.⁶ His recommendations included:

26. That the licensing bodies of the medical profession require in their standards of practice that the treating physician obtain the informed consent of the patient to the administration of blood and blood products, in such a way that patients in Canada, barring incompetency or an emergency surgical procedure, will be informed of the risks and benefits of, and alternatives to, allogeneic blood transfusion.

27. That risks, benefits, and alternatives be presented in language the patient will understand and in a manner that permits questions, repetitions, and sufficient time for assimilation.⁶

Discussion between the physician and the patient should take place well in advance of the surgical or therapeutic intervention if possible to allow the patient to investigate alternatives, if any, to an allogeneic blood transfusion.

The health-care facility is responsible for developing the policy and procedures for informed consent. The process to obtain informed consent from the recipient prior to the transfusion of blood products must include the following, according to Section 11.2.1 of *CSA-Z902*¹:

<https://professionaleducation.blood.ca/en/transfusion/guide-clinique/blood-administration>

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- A description of the blood component or PPP;
- The associated risks and benefits, including life-threatening risks; and
- Alternatives, if appropriate to clinical circumstances, including benefits and risks.

Furthermore, the prescriber must document in the medical chart the discussion of risks, benefits, and alternatives with the recipient.

Informed refusal

Patients have the right to refuse transfusion or treatments involving the use of blood components and PPPs. Such a decision should follow an informed discussion of the risks of refusal and the benefits of transfusion. Refusal should be clearly documented on the patient's medical record in accordance with the facility specific policies.

Jehovah's Witnesses forbid blood transfusion based on their interpretation of Biblical scripture.⁷ The use of recombinant human erythropoietin (r-HuEPO) and some plasma fractions (e.g. albumin, clotting factors and immune globulins) may be acceptable for some people. Each member of the faith is permitted to decide individually what is personally acceptable and the refusal documentation should clearly reflect the decision of the recipient. Additional information is available from the Jehovah's Witness Hospital Information Services (Canada) 24-hour emergency line at 1-800-265-0327 or online at JW.org.⁷

Patient blood management

Patient blood management (PBM) is an evidence-based interdisciplinary approach intended to avoid or reduce blood product transfusion. PBM should be considered as a standard of practice. The goal of a PBM program is to improve patient outcomes by avoiding unnecessary exposure to a blood component or PPP. This is done preoperatively by optimizing hemoglobin levels using iron and erythropoietin, as well as assessing the potential for correction of coagulation abnormalities.⁸ For non-surgical patients, alternatives to avoid or limit transfusion should also be considered whenever possible.

History of red blood cell antibodies

Patients can develop one or more antibodies to red blood cell antigens following a transfusion or pregnancy. The presence of antibodies can contribute to a complicated and time-consuming process to identify compatible red blood cells. If red blood cells are required urgently, the transfusion service should be notified immediately. In emergency situations, incompatible units and/or units untested for the respective antigens could be issued based on the health-care facility policies and procedures. Often emergency release occurs in consultation with a transfusion medicine physician and/or is based on facility protocol.

Transfusion orders

A physician or an authorized health professional can prescribe a transfusion as defined in their health-care facility policy (see Section 11.4.3 of CSA-Z902¹). The clinical indication should be documented in the recipient's chart.

The prescriber orders should include²:

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<ul style="list-style-type: none"> • Recipient’s first and last names • Unique patient identifier (defined by facility) • Type of product to be administered • Volume or amount to be transfused • Rate of infusion or duration (some institutions may reference a procedure that defines a standard administration rate) • Date and time of transfusion 	<ul style="list-style-type: none"> • Sequence in which multiple products are to be transfused • Use of pressure infusion devices when indicated • Use of blood warmers • Modifications, if any, to blood components • Special transfusion requirements, if any • Pre-, intra- or post-medication related to the transfusion if required
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Pre-medication may be considered if the patient has a documented history of previous moderate or severe transfusion reactions. Pre-medications are typically administered approximately 30 minutes prior to initiating the transfusion and often include diphenhydramine and/or acetaminophen.

Transportation and storage

It is important to refer to the health-care facility’s operating procedures related to transportation and storage in a monitored and validated blood product transport system or refrigerator (see Section 9.5.2.2 of CSA-Z902¹).

Blood components and PPP that are no longer required should be returned immediately to the transfusion service for inventory management. Blood components that have been outside of a designated temperature-controlled environment for more than 60 minutes cannot be placed back into inventory and will be discarded (see Section 10.10.5 of CSA-Z902¹). Blood components and PPP must be stored in a monitored blood storage refrigerator or a storage system that has been validated and approved by the transfusion service.

IV access

Blood components and products may be administered through a variety of central venous access devices (CVAD) or peripheral catheters. Considerations when choosing an IV site, either peripheral or central, include:

<ul style="list-style-type: none"> • Gauge or lumen size: this should be large enough to allow the flow of the component/product within the specified administration time and to prevent damage to the cells.² In adults, a 20–22 gauge or 3 French catheter is often recommended as the minimum size to infuse red blood cells (16–18 gauge for rapid transfusions). In pediatric patients the minimum size is a 22–25 gauge catheter.^{9, 10} • Confirmation of patency. • Availability of direct venous access so that the blood components and products can be easily disconnected while maintaining IV access. • For peripheral IVs, alternate IV sites should be used for other medications or IV fluids. Medications shall NOT be added to the blood products or tubing designated for a transfusion. 	<ul style="list-style-type: none"> • CVADs with multiple lumens may allow blood components or products to be given through one lumen while other medications or solutions infuse through other lumens. Medications that are frequently linked to hypersensitivity reactions should be used cautiously in conjunction with transfusion, since distinction between medication-related symptoms and a transfusion reaction can be difficult when they are infused simultaneously. • In emergency situations it may be necessary to administer various blood components and products concurrently. This should be done using separate IV access.
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Administration sets and infusion devices

Various blood administration sets are available on the market for gravity flow or for use with infusion devices. It is important to be familiar with the specific properties and instructions for use of the particular sets at the institution concerned. Blood administration sets must be sterile and pyrogen-free with a filter and drip chamber. Filters should be completely wet and the drip chamber one-third to half-full prior to initiating the transfusion.

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Many blood administration sets have two ports, one for the blood component and one for the saline priming solution.

The administration of blood components requires the use of a standard blood filter, which may range in pore size from 170 to 260 microns. These filters are intended to remove clots, cellular debris and coagulated protein. In consultation with transfusion medicine services, facilities should have policies defining types of administration sets, and frequency of filter or administration set changes. When there is a delay of an hour or more between transfused units, it is prudent to replace the administration set. A standard vented IV administration set should be used for administration of albumin and intravenous immune globulin (IVIg) products. For other blood products, refer to the product monograph or the issuing facility's transfusion service to determine what (if any) filtration is required.

Pressure infusion devices may be used to increase the rate of administration in gravity flow infusions. The pressure applied to the blood component should not exceed 300 mmHg as this may result in hemolysis or bag breakage. Infusion devices have been known to cause mechanical hemolysis¹¹; therefore, prior to implementing the use of an infusion device, confirmation of its safe use for transfusion should be obtained from the manufacturer. See Chapter 10 of this [Guide](#) for more information about the causes of mechanical hemolysis.

An approved process for ongoing inspection and validation should be established by the health-care facility. All equipment used in the transfusion process must be cleaned regularly, maintained in accordance with the manufacturer's instructions to ensure its continued safety, and, if applicable, confirmed by Health Canada and the manufacturer to be safe for transfusion use. See Section 23 of *CSA-Z902* for more information.¹

Leukoreduction filters

All cellular blood products issued to hospitals in Canada have undergone a leukocyte reduction by filtration process (see the Canadian Blood Services *Circular of Information*¹² and [Chapter 2](#) of this Guide for more information). This eliminates the need for the use of a leukocyte reduction filter during transfusion (bedside or post-storage leukoreduction).¹³

Blood warmers

Routine warming of blood may be indicated in the operating room or trauma setting¹⁴. In patients with cold agglutinin disease, warming the blood during infusion may prevent agglutination or hemolysis due to cold-reactive antibodies in the recipient. The blood warmer should be set at 37°C and must trigger an audible or visible alarm if the temperature exceeds 42°C. When a blood warmer is used, the temperature upon initiation and the unique identifier of the device (serial number) should be documented on the transfusion or recipient record for traceability. An approved process for ongoing inspection and validation should be established by the health-care facility.

TRANSFUSION

Blood group and antibody screen testing and positive patient identification

Patient misidentification and incorrect sample labeling contribute to ABO-incompatible blood administration and to the potential for hemolytic transfusion reactions.¹⁵ Misidentification can occur during patient specimen collection and testing, and during blood product request, issue and administration. It is imperative that blood samples be labeled at the time of draw, using two unique identifiers, and that sample identification occurs at the patient bedside using the patient's armband and unique identifying number. The identification process prior to initiating the transfusion is the final opportunity to prevent a transfusion error of this nature. This process includes checking the patient's identification band and, whenever possible, the patient or care provider should

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spell the patient name and state the date of birth.

Strategies for prevention of ABO-incompatible transfusion errors may include requirements or policies for ABO blood group confirmation of first time transfusion recipients, as well as positive patient identification technology utilized at the bedside to confirm donor unit and patient identifiers (CSA Standard 10.6.3.3 and CAP TRM.30575, Misidentification Risk).

Transfusion administration

Prior to obtaining a blood component or PPP for transfusion the patient record should be reviewed for consent and for the completed blood component or PPP order. In addition, a patent IV and legible identification band should be on the patient. Pre transfusion vital signs should be documented when clinically feasible. The appropriate facility procedures should be followed to obtain the product from the transfusion service or satellite blood refrigerator.

It is important to follow the facility-specific policies for confirmation of patient identification and product verification in the presence of the recipient (CSTM 5.8.2.3). This includes verifying:

- That the unique product identifiers on the product label match those on the accompanying transfusion service form/tag
- That the unique patient identifiers on the product match those of the intended recipient
- ABO and Rh compatibility of the product and recipient (see Tables 1 and 2)
- That the blood component or PPP has no clots, clumps, or discoloration (see Canadian Blood Services' [Visual Assessment Guide](#)); if present, notify the transfusion service and return the blood component or PPP.

Table 1: ABO compatibility

Blood group of recipient	Antigen(s) present on recipient red blood cells	Antibody present in recipient blood	Compatible red blood cells from groups	Compatible plasma from groups	May receive platelets from groups
A	A	Anti-B	A, O	A, AB	A, AB, B, O
B	B	Anti-A	B, O	B, AB	B, AB, A, O
AB	A, B	None	AB, O, A, B	AB	AB, A, B, O
O	None	Anti-A, B	O	A, B, AB, O	O, AB, A, B

Table 2: Rh compatibility of red blood cells

Rh of recipient	May receive from groups
Rh positive	Rh positive or Rh negative
Rh negative	Rh negative*
*It is important to refer to facility policies and procedures for the use of Rh positive red blood cells for emergency-release (i.e. uncrossmatched) situations in Rh negative recipients as Rh positive red blood cells may be transfused for women over 45 years old and for male patients.	

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Initiating transfusion

Depending on the blood component or PPP to be administered, there will be additional specific items to consider. See Table 3 for a summary of product-specific administration requirements.⁹

The following are the general steps for preparing for a blood transfusion:

1. Provide information to the patient regarding the planned transfusion.
2. Complete a patient assessment for potential risks of a transfusion reaction.
3. Administer pre-medication(s) if required.
4. Obtain baseline vital signs within 30 minutes pre-transfusion.
5. Confirm that the blood component or PPP matches the transfusion order.
6. Confirm the blood component or PPP expiration date and time.
7. Complete the patient/product identification verification process in the presence of the patient using the patient identification band; refer to the health-care facility policies and procedures.
8. **Blood component:** Prime the administration line and filter with the blood component or a compatible solution (e.g. sterile 0.9% sodium chloride (NaCl) solution for IV use). Note: flush NaCl from the line prior to initiating component. **PPP:** Refer to the facility procedures or manufacturer's product monograph to identify an appropriate administration set and compatible IV fluids. Note: flush IV fluid from the line prior to initiating transfusion of the blood component.
9. Initiate the transfusion.
10. Observe the patient for at least 5 minutes for signs and symptoms of reaction (hives, itchiness, feeling feverish or chills, difficulty breathing, pain, or any other significant change following the start of transfusion); instruct the patient or care provider to notify the nurse immediately if symptoms are observed.
11. Monitor and document vital signs according to facility-specific policies. Reassessment 15 minutes following initiation of transfusion is often recommended.
12. Identify and treat any signs or symptoms of a transfusion reaction that may occur. Stop the transfusion and inform the physician.

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Table 3: Initiating the transfusion

Blood component	Indication	Compatibility	Administration
Red blood cells	<ul style="list-style-type: none"> Anemia with impaired oxygen delivery 	<ul style="list-style-type: none"> Must be ABO and Rh compatible Crossmatch required 	<ul style="list-style-type: none"> Standard blood filter (170–260 µm) and tubing Rate is 1–2 ml/minute (60–120 ml/hour) for first 15 minutes. May be increased if well tolerated with no adverse reaction. One unit usually takes 1.5–2 hours to infuse, but may be infused over up to 4 hours in volume sensitive patients.
Platelets	<ul style="list-style-type: none"> Treatment/prevention of bleeding in patients with decreased or dysfunctional platelets 	<ul style="list-style-type: none"> Preferred ABO and Rh compatible with donor plasma Must have confirmed blood group. Rh compatibility important for Rh (D) negative women of child-bearing potential Rh immune globulin (Rhlg) administration may be considered if Rh positive platelets are given to an Rh negative patient, especially females of child-bearing potential 	<ul style="list-style-type: none"> Standard blood filter (170–260 µm) and tubing Transfuse slowly (60–120 ml/hour) for the first 15 minutes, where possible. Recommended infusion time is 60 minutes per dose. Maximum infusion time is 4 hours.
Plasma	<ul style="list-style-type: none"> Multiple clotting factor replacement Exchange transfusion Therapeutic apheresis 	<ul style="list-style-type: none"> Should be ABO compatible Rh compatibility not generally required. Confirmed blood group required 	<ul style="list-style-type: none"> Standard blood filter (170–260 µm) and tubing Transfuse slowly (60–120 ml/hour) for the 15 minutes, where possible. One unit usually takes 30 minutes – 2 hours to infuse. Maximum infusion time is 4 hours.
Cryoprecipitate	<ul style="list-style-type: none"> Diffuse microvascular bleeding and/or bleeding due to hypo-fibrinogenemia, or dys-fibrinogenemia 	<ul style="list-style-type: none"> ABO compatibility preferred but not required Confirmed blood group required 	<ul style="list-style-type: none"> Standard blood filter (170–260 µm) and tubing Recommended infusion time is 10–30 minutes per dose. Maximum infusion time is 4 hours.

Patient monitoring

Symptoms of serious transfusion reactions frequently appear within 15 minutes after blood enters the vein; therefore, observation of the patient during this time period is of the **utmost importance**. The patient should be monitored regularly during the transfusion and for a period of time following its completion. Assessment

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frequency and documentation requirements should be performed according to the health-care facility's standard policy. For example, typically the patient vital signs assessment would occur at 15 and 30 minutes following the start of transfusion and then hourly or more often thereafter, depending on the clinical condition of the patient and the specific transfusion orders.

If a transfusion reaction is suspected, immediately stop the transfusion and maintain vascular access with normal saline. The blood administration IV tubing should be disconnected from the IV cannula/CVAD to prevent further infusion of the blood component or product. Refer to the health-care facility policies and procedures and [Chapter 10](#) of this Guide for additional information.

Continuous infusion of coagulation factors

Coagulation factor replacement by continuous infusion is used in many centres across the country for the management or prevention of serious bleeding in patients with coagulation disorders. As this procedure falls outside recommendations in the product monograph, each institution is required to develop its own policies and procedures to direct and guide this practice. An excellent resource in developing these procedures is the *Factor Replacement by Continuous Infusion* document prepared by the Winnipeg Bleeding Disorders Program.¹⁵

POST-ADMINISTRATION

At the end of the transfusion, the following procedures should be followed to ensure full benefit from the administration of:

- Blood components: the blood administration tubing should be cleared with a maximum of 50 ml normal saline.
- PPP: the IV administration set should be cleared with a maximum of 50 ml compatible fluid to displace remaining product (see manufacturer's product monograph).

The completion of the transfusion should not be the end of patient monitoring. Continued monitoring is required to identify delayed adverse reactions that may occur. Generally, changes in the patient status or vital signs occurring within six hours of the transfusion should prompt consideration of the transfusion as a potential cause of the symptoms or signs and should be reported to the transfusion service.

Appropriate discharge instructions concerning possible adverse events shall be provided to the recipient or to a responsible caregiver if direct medical observation or monitoring of the recipient will not be available after transfusion (see Section 11.4.16 of CSA-Z902 and [Chapter 10](#) of this Guide). In addition, inpatients receiving blood components or products shall receive written notification of the transfusion as per institutional mechanisms (see Section 11.2.2 of CSA-Z902).

CONTINUING PROFESSIONAL DEVELOPMENT CREDITS

Fellows and health-care professionals who participate in the Canadian Royal College's Maintenance of Certification (MOC) Program can claim the reading of the Clinical Guide to Transfusion as a continuing professional development (CPD) activity under Section 2: Self-learning credit. The reading of one chapter is equivalent to **two credits**.

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review of the current version.

We're here to answer your questions about the Clinical Guide to Transfusion. We'd also appreciate your ideas on how to improve the Guide. Please contact us through the [Clinical Guide feedback form](#).

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