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BACKGROUND

This chapter focuses on the principles of safe blood transfusion practice. The aim of this chapter is to develop and support the knowledge of health-care professionals involved in prescribing or administering blood components (red blood cells, platelets, plasma) and plasma protein products (PPP). Several standards and guidelines define the minimum criteria required to maintain safety and enhance transfusion practices. These include the Canadian Standard Association's *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 Each healthcare 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.

PRE-TRANSFUSION CONSIDERATIONS

Patient blood management

Patient blood management (PBM) is an evidence-based interdisciplinary approach that aims to improve patient outcomes by avoiding or reducing unnecessary transfusion during the course of a patient's treatment.⁶ This may be accomplished pre-operatively by optimizing hemoglobin levels using iron and erythropoietin, as well as assessing the potential for correction of coagulation abnormalities.⁷ For non-surgical patients, alternatives to avoid or limit transfusion should also be considered whenever possible.

Decision to transfuse

The prescribing of a blood component or PPP is a clinical decision made by a health-care provider (i.e., physician or other health-care professional authorized to order transfusion) based on evidence-based practice guidelines and often made in consultation with a physician with transfusion medicine expertise. 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 for transfusion is a standard safety requirement.⁸ 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 PPP.⁹ His recommendations included:

- "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." (p. 1133, Appendix A)⁹
- "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." (p. 1133, Appendix A)⁹

The health-care facility is responsible for developing the policy and procedures for obtaining informed consent prior to the transfusion of blood components or PPP. These must include the following:⁸

<https://profedu.blood.ca/en/transfusion/clinical-guide/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 their benefits and risks.

Discussion between the health-care provider and the patient should take place well in advance of the surgical or therapeutic intervention, if possible, to allow time for the patient to consider their options.

The health-care provider must document the discussion of risks, benefits, and alternatives with the patient, in accordance with facility-specific policies.

Informed refusal

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

Patients may choose to refuse treatment involving the use of blood components and PPPs for personal or religious reasons. Jehovah's Witnesses often refuse transfusion, though use of recombinant human erythropoietin and some PPPs may be acceptable to some individuals.¹⁰ Each member of the faith decides individually what is personally acceptable and the refusal documentation should clearly reflect the details of the patient's decision. 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.¹⁰

Transfusion orders

The health-care provider documents the orders for administration of a blood component or PPP and documents the clinical indication. The provider's orders should include:²

- Patient's full name
- Unique patient identifier (defined by facility)
- Type of product to be administered
- Volume or amount to be administered
- Rate of infusion or duration (some institutions may reference a procedure that defines a standard administration rate)
- Date and time of transfusion
- Sequence in which products are to be transfused (when multiple products are ordered together)
- Use of pressure infusion devices when indicated
- Use of blood warmers when indicated
- Modifications, if any, to blood components
- Special transfusion requirements, if any
- Pre-, intra- or post-medication related to the transfusion if required, including dosage, route and time to administer.
 - E.g., Pre-medication, such as diphenhydramine and/or acetaminophen, may be considered if the patient has a documented history of previous transfusion reactions. Pre-medication should be administered at a suitable time to allow for effectiveness before transfusion.
 - E.g., Intra- or post-medication, such as furosemide, may be considered if the patient is at increased risk for fluid overload complications.

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Pre-transfusion testing

Pre-transfusion testing is completed to ensure compatibility between the patient and a blood component for transfusion.

Patient misidentification and incorrect sample labeling contribute to the administration of ABO-incompatible blood and the potential for hemolytic transfusion reactions.¹¹ Misidentification can occur at several points during the transfusion process, including during patient specimen collection and testing, blood product request, issue and administration. It is imperative that positive patient identification is maintained through the entire process.

Pre-transfusion blood samples are labelled at the time of draw at the patient's bedside, using at least two unique identifiers. Positive patient identification must occur at this time, using the patient's armband to confirm the patient's name and unique identifying number. Whenever possible, the accuracy of the patient's armband should be confirmed by asking the patient to spell their name and state date of birth.

To prevent ABO-incompatible transfusion errors, health-care facility policy may require ABO blood group confirmation for first-time transfusion patients or use of positive patient identification technology to confirm donor unit and patient identifiers at the bedside.¹

For more on pre-transfusion testing, including patient identification and sample labelling, see [Chapter 8](#) of this Guide.

Pre-transfusion sample testing and identification of compatible red cells is typically straightforward but can be a complicated and time-consuming process when antibodies are present. If red blood cells are required urgently before pre-transfusion testing is complete, the transfusion service should be notified immediately. In emergency situations, red cell units could be issued prior to completion of testing based on health-care facility policies and procedures and/or transfusion medicine and attending physician consultation.

IV access

Blood components and PPP may be administered through a variety of central venous access devices (CVAD) or peripheral intravenous catheters. Considerations for selection of appropriate IV access include:

- Gauge or lumen size: this should be large enough to allow the flow of the blood component or PPP within the specified administration time and to prevent damage to the cells.²
 - 20–22 gauge for routine transfusions in adults.¹²
 - 16–18 gauge for rapid transfusions in adults.¹²
 - In adult patients with fragile or difficult veins, a smaller gauge can be used, but may restrict the flow rate.¹³
 - 22–25 gauge is recommended for pediatrics.^{14, 15}
- A dedicated line for the administration of blood components or PPP. Do not co-infuse medications with blood components or PPP.
- CVADs with multiple lumens allow blood components or PPP products to be given through one lumen while other medications or solutions infuse through other lumens.
- Do not administer medications that are known to cause adverse reactions at the same time as a blood component or PPP, where possible, because distinguishing between symptoms and signs of a medication-related adverse reaction and transfusion reaction is challenging.

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- In emergency situations it may be necessary to administer various blood components and products concurrently. This should be done using separate IV access.

Administration sets

Administration set requirements vary for blood components and PPPs. These requirements are outlined in facility-specific policy, which should be developed in consultation with the transfusion service.

Sets for blood components

The administration of blood components requires the use of a standard blood filter, which may range in pore size from 170 to 260 microns. The filter, which must be completely covered with the blood component, is intended to remove clots, cellular debris and coagulated protein.

A leukocyte reduction filter is no longer required during transfusion, as all blood components issued in Canada have undergone leukocyte reduction by filtration during preparation (see the Canadian Blood Services *Circular of Information*¹⁶ and [Chapter 2](#) of this *Guide* for more information).¹⁷

Blood components must be transfused within 4 hours of issue. If the transfusion is interrupted for any reason, administration must be discontinued after 4 hours even if the transfusion is not complete. Facilities should follow the manufacturer's recommendations and local policy for changing the blood administration sets. If there is a delay between units in a multiple unit transfusion, the administration set should be changed to minimize the likelihood of bacterial growth.

Sets for PPPs

The administration of PPPs requires varied supplies, differing by product type and brand. PPPs for intravenous administration may require use of a standard, vented or filtered set or may be administered by direct intravenous push. Other PPPs are administered by intramuscular or subcutaneous route. Facilities should refer to the product monograph and local policy to determine what, if any, filtration is required during reconstitution or administration.

Infusion devices

All equipment used in the transfusion process must be approved by Health Canada and the manufacturer and be maintained in accordance with the manufacturer's specifications for continued safety. Health-care facilities must have an approved process for ongoing inspection and validation for all infusion devices.

Infusion devices have been known to cause mechanical hemolysis;¹⁸ therefore, prior to implementing the use of an infusion device, confirmation that it has been approved for use in transfusing blood components should be obtained from the manufacturer. See [Chapter 10](#) of this *Guide* for more information about the causes of mechanical hemolysis.

Infusion devices may be used to transfuse blood components (e.g., infusion pumps, rapid infusers, blood warmers and pressure devices). The use of infusion devices must always adhere to the health-care facility policy.

Pressure infusion devices

A pressure infusion device may be used for rapid administration of blood components. The pressure applied to the blood component should not exceed 300 mm Hg as this may result in hemolysis or bag breakage.

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Blood warmer devices

A blood warmer device may be used to prevent hypothermia during rapid administration of cold blood components, such as in the operating room or trauma setting.^{12,19}

A blood warmer device may be used in routine transfusion for a patient with cold agglutinin disease; however there is limited evidence for the efficacy of this strategy and warming the patient is more likely to be feasible and just as likely to be beneficial.²⁰ Blood warmer devices should have a temperature alarm system if the temperature exceeds 42°C. When a blood warmer is used, the temperature upon initiation and the unique identifier of the device (e.g., serial number) should be documented.

Baseline Patient Assessment

Pre-transfusion patient assessment and a measurement of baseline vital signs must be documented within 30 minutes prior to transfusion. Identify any potential risks of a transfusion reaction or any pre-existing symptoms that could later to be mistaken for a transfusion reaction (e.g., pre-existing rash).

If the patient is able to participate, education should be provided so the patient understands the importance of immediately reporting any new onset symptoms during or after transfusion.

Any pre-medications required should be prepared and administered as ordered (e.g., 30 minutes prior to initiation, immediately prior to initiation).

Transportation and storage

Blood components and PPP must be stored in monitored blood storage and transported in a validated system. Storage and transport systems are validated and monitored by the transfusion service.⁸

A blood component or PPP should only be obtained from storage when all preparation for administration is complete. Prior to obtaining a blood component or PPP, confirm that a transfusion order exists and informed consent is documented.

Follow health-care facility procedures when obtaining a blood component or PPP from the transfusion service or satellite blood refrigerator. It is imperative that positive patient identification is confirmed again at this time and the right product is obtained for the right patient.

If the retrieved blood component or PPP is no longer required, it should be returned immediately to the transfusion service to maintain safe storage conditions and prevent waste. Local policies may dictate the timing and/or temperature requirements for returning blood components or PPPs to the transfusion service.

TRANSFUSION

Pre-transfusion safety check

The pre-transfusion safety check includes checking the blood component or PPP and verifying positive patient identification on the product to the patient. All identifying information linking the patient to the blood component or PPP must be matched. Verification of patient and product identification shall be completed in the presence of the patient using the patient's identification band.

There are several key points in the pre-transfusion safety check:

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- Confirm that the blood component or PPP matches the provider's order to transfuse. Confirm any special requirements for preparation were performed.
- Check the blood component or PPP information on the label matches the accompanying transfusion service form and tag. Confirm the blood component or PPP expiration date and time.
 - Sites should have a policy in place for use of near-expiry blood components. One practical approach used by many transfusion services is to ensure the start of transfusion before expiry and ensure completion of transfusion within 4 hours of the start time.²¹
- Check that ABO and Rh of the blood component and patient are compatible (see Tables 1 and 2). Check that the blood group on the blood component tag matches the component label and that the crossmatch test was compatible.
- Inspect the appearance of the blood component or PPP. Confirm there are 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. For PPP prepared as a lyophilized powder, inspect the solution after reconstitution.
- Confirm that the unique patient identifiers on the blood component or PPP match the patient's identification band.

Always follow facility-specific policies for confirming patient identification and 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, Anti-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*

* Refer to facility-specific 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.

Depending on the blood component or PPP to be administered, there will be additional considerations. See Table

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3 for a summary of administration requirements.¹⁴

As mentioned previously, misidentification can occur at several points during the transfusion process and it is imperative that positive patient identification is maintained through the entire process. The safety check immediately prior to administration of a blood component or PPP is the last opportunity to prevent an identification error from reaching the patient.

Initiating the transfusion

The following list summarizes the general steps included in preparing for and initiating a blood transfusion.

1. Review provider's order to transfuse.
2. Confirm consent for transfusion.
3. Provide information to the patient regarding the planned transfusion (e.g. preparation and monitoring required, symptoms to immediately report).
4. Confirm pre-transfusion testing or collect pre-transfusion sample (if applicable).
5. Assemble required equipment.
6. Complete a patient assessment and obtain baseline vital signs within 30 minutes pre-transfusion.
7. Administer pre-medication(s) if required.
8. Obtain the blood component or PPP from storage or the transfusion medicine laboratory.
9. Complete pre-transfusion checks. Refer to facility-specific policies and procedures.
10. Document the pre-transfusion checks, including date and time and the identity of the persons completing the checks.
11. Prepare to initiate the blood component or PPP:
 - 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).
 - PPP: Reconstitute if applicable. Refer to facility procedures or manufacturer's product monograph to identify appropriate administration supplies for intravenous, intramuscular or subcutaneous route of administration

Table 3: Initiating requirements summary

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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 administration set and filter (170–260 µm) Transfuse slowly for the first 15 minutes.^{14, 19} <ul style="list-style-type: none"> Adults: 50 mL/hr Pediatrics: 1 mL/kg/h, up to 50 mL/h May be increased if well tolerated with no adverse reaction for the first 15 minutes. One unit usually takes 1.5–2 hours to infuse but may be infused over a maximum of 4 hours in volume-sensitive patients. Maximum infusion time is 4 hours.
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 is important for Rh (D)-negative women of child-bearing potential. Rh immune globulin (RhIg) 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 administration set and filter (170–260 µm). New set recommended. Transfuse slowly for the first 15 minutes, where possible.^{14, 19} <ul style="list-style-type: none"> Adults: 50 mL/h Pediatrics: 1 mL/kg/h, up to 50 mL/h May be increased if well tolerated with no adverse reaction for the first 15 minutes. Recommended infusion time is 60 minutes per dose. Maximum infusion time is 4 hours

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Blood component	Indication	Compatibility	Administration
Plasma	<ul style="list-style-type: none"> Multiple clotting factor replacement Exchange transfusion Therapeutic apheresis 	<ul style="list-style-type: none"> Must be ABO compatible* Confirmed blood group required <p>* In an emergency or massive hemorrhage setting, some transfusion services may have specific policies that allow use of group A plasma to recipients with unknown blood group.</p>	<ul style="list-style-type: none"> Standard blood administration set and filter (170–260 µm) Transfuse slowly for the first 15 minutes, where possible. ^{14, 19} <ul style="list-style-type: none"> Adults: 50 mL/h Pediatrics: 1 mL/kg/h, up to 50 mL/h May be increased if well tolerated with no adverse reaction for the first 15 minutes. 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 not required Confirmed blood group required 	<ul style="list-style-type: none"> Standard blood administration set and filter (170–260 µm) Transfuse slowly for the first 15 minutes, where possible. ^{14, 19} <ul style="list-style-type: none"> Adults: 50 mL/h Pediatrics: 1 mL/kg/h, up to 50 mL/h May be increased if well tolerated with no adverse reaction for the first 15 minutes. Recommended infusion time is 10–30 minutes per dose. Maximum infusion time is 4 hours.
Plasma protein products	<ul style="list-style-type: none"> Varies by product type See Chapter 3, Albumin; Chapter 4, Immune Globulin Products; Chapter 5, Concentrates for Hemostatic Disorders and Hereditary Angioedema 	<ul style="list-style-type: none"> ABO compatibility not required 	<ul style="list-style-type: none"> Reconstitution, filter and tubing requirements vary per product type/brand. Gradual rate increases may apply. Maximum rate varies by product type/brand. Rate requirements are typically the same for adults and pediatrics.

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Patient monitoring

Serious and life-threatening reactions can occur unpredictably and progress rapidly; therefore, patients must be closely monitored. Follow the facility-specific policy for patient monitoring during transfusion and post-transfusion. Remain with, or be in a position to closely observe, the patient for the first 5 to 15 minutes following the start of each unit. Observe the patient 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. Reassess the patient and repeat vital signs after 15 minutes and increase flow rate if no reaction is observed.¹²

Patient monitoring and vital sign recording should be based on the patient's clinical condition and performed according to facility-specific policies for the duration of the transfusion.

If a transfusion reaction is suspected, immediately stop the transfusion and maintain vascular access with normal saline. Follow facility-specific procedure or physician's orders for management of the suspected transfusion reaction. See Chapter 10 of this Guide for additional information.

POST-ADMINISTRATION

At the end of the transfusion, the administration set may be flushed:

- Blood components: may flush with sterile 0.9% sodium chloride (NaCl) solution; use minimal volumes for fluid-restricted patients.
- PPP: may flush the intravenous administration set with a compatible fluid (see manufacturer's product monograph); use minimal volumes for fluid-restricted patients.

The empty blood component or PPP container and any administration supplies should be safely discarded as per facility-specific policy.

Document the transfusion event according to facility-specific policy and procedures. Documentation includes date, start and finish times, blood component or PPP transfused, unit or lot number, names or persons starting and monitoring the transfusion, vital signs, volume transfused, and all interventions related to the transfusion. In addition, inpatients receiving blood components or PPP should receive notification of the transfusion as per facility-specific mechanisms.⁸

For outpatients, review post-transfusion care with the patient or caregiver. Provide the patient with written information outlining the signs and symptoms of transfusion reactions, what to do in case of a transfusion reaction, and contact information for reporting a transfusion reaction.

Continue to monitor the patient post-transfusion for signs and symptoms of a transfusion reaction. Generally, changes in the patient's status or vital signs occurring within six hours of the transfusion should be considered a potential adverse outcome of the transfusion and should be reported to the transfusion service. Report any suspected transfusion reaction to the transfusion service.

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.

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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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