ALBERTA PRECISION LABORATORIES
Leaders in Laboratory Medicine

Red Blood Cells
Leukocytes Reduced

APPLICABILITY: This document applies to APL, AHS, Covenant Health, and all other health care professionals involved in the transfusion of blood components and products in Alberta.	***OTHER NAMES:*** *Packed Red Blood Cells, Red Cell Concentrate* ***Company:*** *Canadian Blood Services (CBS)* ***Class:*** *Human blood component, derived from whole blood*

ROUTES	Intravenous	Subcutaneous	Intramuscular	Intraosseous
Acceptable Routes*	Yes	No	No	Yes

* Administration of blood components and blood products is a restricted activity. For specific conditions that apply to a profession's authorization to administer blood components and blood products, consult the applicable discipline-specific regulation under the Health Professions Act (Alberta). Health care professionals with this authorization require the applicable education, training and competency.

DESCRIPTION:

- **Standard red cell units have an average volume of 287 mL, hemoglobin of 55g/unit, and hematocrit of 0.67**
  - Red Blood Cells (RBC) is a red cell concentrate prepared from approximately 480mL of whole blood collected from volunteer donors in 70mL of CPD anticoagulant. The unit is plasma reduced by centrifugation, platelet reduced by either centrifugation or filtration and leukocyte reduced by filtration. RBC units are resuspended in approximately 110mL of SAGM.
- Donor is screened and blood is tested for:
  - Antibodies to human immunodeficiency virus (HIV-1 and HIV-2), hepatitis C virus (HCV), human T-cell lymphotropic virus, type I and II (HTLV-I/II), hepatitis B core antigen (HBcore).
  - Hepatitis B surface antigen (HBsAg)
  - Presence of viral DNA (Hepatitis B Virus (HBV))
  - Syphilis
- RBC are also tested for ABORH, other red cell antigens, and clinically significant antibodies.
- All RBC units are CMV safe due to leukofiltration.
- **Not guaranteed to be latex-free**.

PRETRANSFUSION TESTING & COMPATIBILITY:

PRETRANFUSION TESTING

- A **Type and Screen** is required for the provision of **crossmatched RBC**. If delaying RBC transfusion would be life-threatening, unmatched RBC may be provided.
- If unmatched RBC are required, the Type and Screen should be collected as soon as possible, preferably prior to transfusion.
- Type and Screen specimens must be collected using the **Transfusion Service Identification Number (TSIN) system**. Specimens not meeting collection requirements will be rejected without exception.
- The patient must have had their blood group tested twice, once on the current Type and Screen, and once on a separately collected specimen, in order to provide RBC other than group O. This second test may include previous testing.

COMPATIBILITY:

- ABO compatible RBC may not be ABO identical with the patient. See the *ABORH Compatibility Chart.*
- Rh positive patients may receive Rh positive or Rh negative RBC.
- Rh negative patients should receive Rh negative RBC, if available. Rh negative patients without childbearing potential may receive Rh positive red cells if Rh negative RBC are not available, or Rh negative inventory is low.
- If you are unsure about patient-specific RBC compatibility, contact your transfusion medicine laboratory prior to initiating transfusion.

AVAILABILITY:

- Supplied by Canadian Blood Services.
- Contact your local transfusion service/laboratory regarding stock availability on site.

INDICATIONS:

- RBC transfusions should be administered primarily to prevent or alleviate signs and symptoms of inadequate tissue oxygen delivery.
- There is no single value of hemoglobin concentration that justifies or requires transfusion.
- An evaluation of the patient's clinical situation should be the major factor in the decision to transfuse.

Red Blood Cell Screening

- RBC orders for paediatric patients and patients with active bleeding will not be screened.
- APL Transfusion Medicine (TM) screens orders for RBC for adult patients based on the criteria outlined in Tables 1 and 2 below.
- Any order for blood on a patient that do not meet the criteria (Tables 1 and 2) will require approval from a TM Physician. It is the responsibility of the clinical team to obtain that approval.
- Hemoglobin (Hgb) must have been performed **within the last 24 hours.**

Table 1: Stable, Non-Bleeding Adult Inpatient or Emergency Department Patient Transfusion Recommendations

Hgb (g/L)	Adult Transfusion Recommendation
Hgb less than 60	• Transfusion likely appropriate. • Transfuse 1 unit and reassess Hb and clinical symptoms.
Hgb 60-69	• Transfusion likely appropriate. • Transfuse 1 unit and reassess Hb and clinical symptoms.
Hgb 70 – 80	• Likely appropriate in active ischemic cardiovascular disease patients. • Likely appropriate if there are signs and symptoms of impaired tissue oxygenation. • Transfuse 1 unit and reassess Hb and clinical symptoms.
Hgb greater than 80	• Likely inappropriate unless there are signs and symptoms of impaired tissue oxygenation. • Ordering physician to consult TM Physician. • Indication for transfusion must be clearly documented in patient's chart. • Transfuse 1 unit **if approved by TM Physician**.
Hgb greater than 90	• Transfusion Likely inappropriate. • Ordering physician to consult TM Physician.

Booked Outpatients

- Applies to patients with scheduled transfusions, including chronic transfusion recipients.
- Hemoglobin (Hgb) must have been performed **within the last 96 hours**.
- Chronic transfusion recipients with requirements outside the allowances in Table 2 must have their patient-specific transfusion parameters approved by a TM physician.

Table 2. Outpatient Transfusion Allowances

Hgb (g/L)	Appropriate RBC Orders
Hgb less than 70	Up to three (3) RBC units
Hgb 70 - 85	Up to two (2) RBC units
Hgb 86-90	One (1) RBC unit
Hgb greater than 90	Requires TM Physician approval

Don't Misuse My Blood Project
DMMB Clinical Decision Support Tools (albertahealthservices.ca)

CONTRAINDICATIONS:

- RBC are not suitable for clinical situations where limited oxygen-carrying capacity is not due to red blood cell deficiency or dysfunction, or where other non-transfusion therapies or observation would be just as effective.
- RBC should **not** be given for volume replacement or for any other reason other than correction of **symptomatic** anemia (acute or chronic) when non-transfusion alternatives have been assessed and excluded.
- Patients with anemia due to Hematinic (iron, vitamin B12, folic acid) deficiency should only be transfused in the setting of severe symptoms or organ dysfunction. The Hematinic deficiency should be treated aggressively.

WARNINGS:

- RBC must be ABO compatible with the recipient.
- As compatibility testing in the setting of unmatched RBC is not complete, unmatched RBC may contain non-ABO antigens to which the patient has antibodies, potentially resulting in hemolytic transfusion reaction.
- Transfusion of ABO incompatible RBC due to patient misidentification is the most common cause of life-threatening acute hemolytic transfusion reaction. Refer to AHS Transfusion of Blood Components and Blood Products Policy PS-59.

DOSE:

- Decisions to transfuse should be based on assessment of an individual patient including their symptoms and underlying cause of anemia, and not based solely on achieving an arbitrary hemoglobin threshold.
- Single unit RBC transfusions are the standard for non-bleeding, hospitalized patients over 25kg.
- Evaluate the patient for further transfusion after each unit.
  - Repeat Hgb and evaluate patient symptoms
- RBC units may be split into multiple smaller volume bags (aliquots) to facilitate small doses and reduced donor exposure. Contact your local laboratory/transfusion service regarding availability of split units/aliquots.

- **Adults:** One unit of RBCs will increase hemoglobin approximately 10g/L in a hemodynamically stable 70kg adult

- **Pediatrics and Neonates:** Common pediatric dosing is **10-15mL per kg body weight**.

- Alternatively, the following formula could be used for all patients:

  Volume to transfuse (mL) = 0.5 x (desired Hb (g/L) – current Hb (g/L)) x patient weight (kg)

ADMINISTRATION:

Administer the transfusion per the AHS Transfusion of Blood Components and Blood Products Policy PS-59.

In non-urgent/non-bleeding/inpatient settings, blood components should be transfused during daytime hours (for patient safety) and transfused one unit at a time**.**

Confirm signed consent has been obtained and documented prior to requesting blood components or products (human-source) from lab/transfusion service where possible. *Refer to AHS Consent to Treatment/Procedure(s) Policy Suite.*

Pre-Infusion:

- Ensure recent patient weight and height is on file.
- Ensure pertinent labs are available as required (i.e. Hgb & Type and Screen).
- Ensure any ordered pre-medications have been given (antihistamines, antipyretics prn).
- Perform pre-transfusion checks per AHS Transfusion of Blood Components and Blood Products Policy PS-59.
  - **Pediatrics and Neonates** – confirm correct weight-based dosing.
- Report any new onset acute illness to the authorized prescriber prior to commencing infusion.
- Perform a visual inspection of the unit. Refer to the CBS Visual Inspection Tool.

Access:

- RBC can be given via CVAD, peripheral venous line, intraosseous device, or umbilical venous catheter.
- Use an IV catheter suitable for the size of vein and purpose of transfusion.

ADMINISTRATION cont'd:

Equipment:

- Administer through a standard blood transfusion set (170 – 260 micron filter).
- Air eliminating micron filters **are NOT compatible** with RBC transfusions.
- Change set as needed, but at minimum every 8 hours or per manufacturer's recommendation.
- A pull/push device or 3-way-stopcock system or custom neonatal transfusion set is acceptable for delivering partial aliquots. Blood component aliquots must be filtered (as above) and should not stand in the syringe.
- RBC may be infused using a blood warmer, pressure infusion device, or syringe pump as ordered by the authorized prescriber or as defined by an approved protocol.
- Rapid infusers and other pressure infusion devices must not exceed 300mmHg.

Compatible IV Solutions:

- 0.9% Sodium Chloride (Normal Saline) solution.
- Blood components should be administered one unit at a time, however if required, co-administration of ABO compatible platelets, plasma, or 5% albumin may be performed at the discretion of the MRHP.

Other Solutions:

- Studies in Alberta have shown other IV solutions to be compatible with citrated blood components. *
- These solutions should only be considered in situations where the use of 0.9% Sodium Chloride would lead to undesirable metabolic abnormalities.
- Only isotonic, calcium-free IV solutions should come in contact with blood products. Calcium may bind with the citrate anticoagulant and promote clotting in the tubing. Excess glucose and/or dextrose causes hemolysis and shortens red cell survival.
- Solutions meeting these criteria include:
  - Plasma-Lyte A®: Contains Sodium 140mEq/L, Potassium 5mEq/L, Magnesium 3mEq/L and Chloride 98mEq/L at pH 7.4.
  - Other isotonic, calcium and glucose/dextrose free commercial electrolyte solutions (i.e. Normosol®-R)
  - Ringer's Lactate (LR). **Note:** Studies have shown LR to be compatible with citrated blood components. However, additional studies around the safe use of LR as a citrated blood component diluent are needed.

***** This information differs from the Canadian Blood Services circular of information. As studies in Alberta have shown compatibility with the listed IV solutions, their inclusion within this document is in compliance with CSA Standards.

Medications:

- Medications **must NOT** be added to the blood component bag.
- If it is necessary to administer medications simultaneously with blood components, it is safest to use an alternate site for the medication.
- If administration using a separate site is not possible:
  - Pause the blood component transfusion and flush the IV line with 0.9% Sodium Chloride.
  - Administer the medication.
  - Flush the IV line again with 0.9% Sodium Chloride before resuming the transfusion.
- Heparin:
  - Co-administration of heparin with RBCs can be considered as a last resort for continuous anti-coagulation requirements.
  - The heparin infusion line should be connected to the port most proximal to the patient and distal from the RBC container.
- Consideration for co-administration of any other medication with RBCs as a last resort must be approved by the TM physician.

Infusion Rate:

- Rate should be specified by the MRHP after patient assessment.
- Infusion rate depends on the patient's blood volume, cardiac status and hemodynamic condition

Table 3. Recommended rates for routine transfusion as stated by policy

Patient Weight	Infusion Rate: For the First 15 Minutes	Infusion Rate: After the First 15 Minutes
Greater than 25 kg	50 millilitres per hour (mL/h), if possible	For all patient weights: Continue transfusion at the prescribed rate as per the authorized prescriber's order, as long as it does not exceed four (4) hours from the time of blood component removal from the approved storage device / location
Less than or equal to 25 kg	1 millilitre per kilogram per hour (mL/kg/h)* or slower for the first 15 minutes, if possible	

***** Program pump as 0.25mL/ kg (millilitre per kilogram) or slower for the first 15 minutes, if possible.

POTENTIAL HAZARDS WITH PARENTERAL ADMINISTRATION:

- Potential adverse events or reactions related to a blood transfusion range in severity from minor with no sequelae to life-threatening.
- All adverse events occurring during a transfusion should be evaluated to determine whether or not the transfusion can be safely continued/restarted.
- All adverse events suspected to be related to a transfusion (whether during or after a transfusion) should be reported to your local transfusion service and documented in the patient chart.
- Refer to the *Acute Transfusion Reaction Chart* for symptoms indicative of transfusion reaction.

NURSING IMPLICATIONS:

Table 4. Patient Vital Signs and Monitoring:

	Pre Transfusion Vitals?	Stay At Patient Bedside?			Vital Signs During Transfusion		Post Transfusion Monitoring
		First 5 min	First 10 min	First 15 min	After 15 min	Remainder of transfusion	
All Patients	**Yes**	**Yes**	**NO**, but must be immediately available*		**Yes**	**q1h**	Set of vital signs Monitor for minimum of 15 minutes post transfusion **

*Defined as performing non-dedicated tasks with the patient in view.
**If patient has had a previous adverse reaction to component transfusion, or this is the first time the patient is receiving that component type, monitor for 30 to 60 minutes.

Note: Vital signs/patient monitoring may be conducted more frequently, or continuously, as determined by clinical condition of patient.

Patients receiving blood product transfusions must be observed closely for signs of any unexpected or untoward reactions. These reactions may occur during or after the infusion of blood or blood products. For follow up instructions to a transfusion reaction, go to *Transfusion Reactions | Alberta Health Services*.

Documentation:
Ensure documentation is completed as per AHS Transfusion of Blood Components and Blood Products Policy PS-59.

- Patient tolerability should be documented in appropriate flow chart or clinical record (electronic or paper).
- Document vital signs as required in the appropriate flow chart or clinical record (electronic or paper).
- Provide patient notification documentation.

STORAGE & STABILITY

- Store at 1 - 6^0C in an approved temperature-controlled environment.
- Do not place in a medication fridge or other or unapproved cold storage device.
- Shelf life is up to 42 days from date of collection.
- Product manipulation may alter shelf life (i.e. irradiation, washing)
- Do not freeze.
- Do not use expired product.

CONTACT INFORMATION:

Approved By: APL Transfusion Medicine Discipline Council
For questions or comments please contact: Transfusion.SafetyTeam@aplabs.ca

REFERENCES

Canadian Blood Services Circular of Information for the Use of Human Blood Components. Red Blood Cells, Leukocytes Reduced (LR). January 2021. Available at Canadian Blood Services circular of Information

Canadian Blood Services. Visual Inspection Tool. CBS Visual Inspection Tool January 2024

Ten Things Physicians and Patients Should Question. Canadian Society for Transfusion Medicine. Available from choosingwiselycanada.org

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