



Transfusing Wisely: Appropriate Blood Use in Patient Care

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Disclosures

Relationships with financial sponsors:

- **Grants/Research Support:** None
- **Speakers Bureau/Honoraria:** Canadian Blood Services
- **Consulting Fees:** Takeda, Celgene, Octapharma
- **Patents:** None
- **Other:** None

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Mitigating Potential Bias:

- Specific brand names may be used as examples of blood product or drug classes without specific preference for any manufacturer.

Literature discussed in this presentation focuses on the adult population.

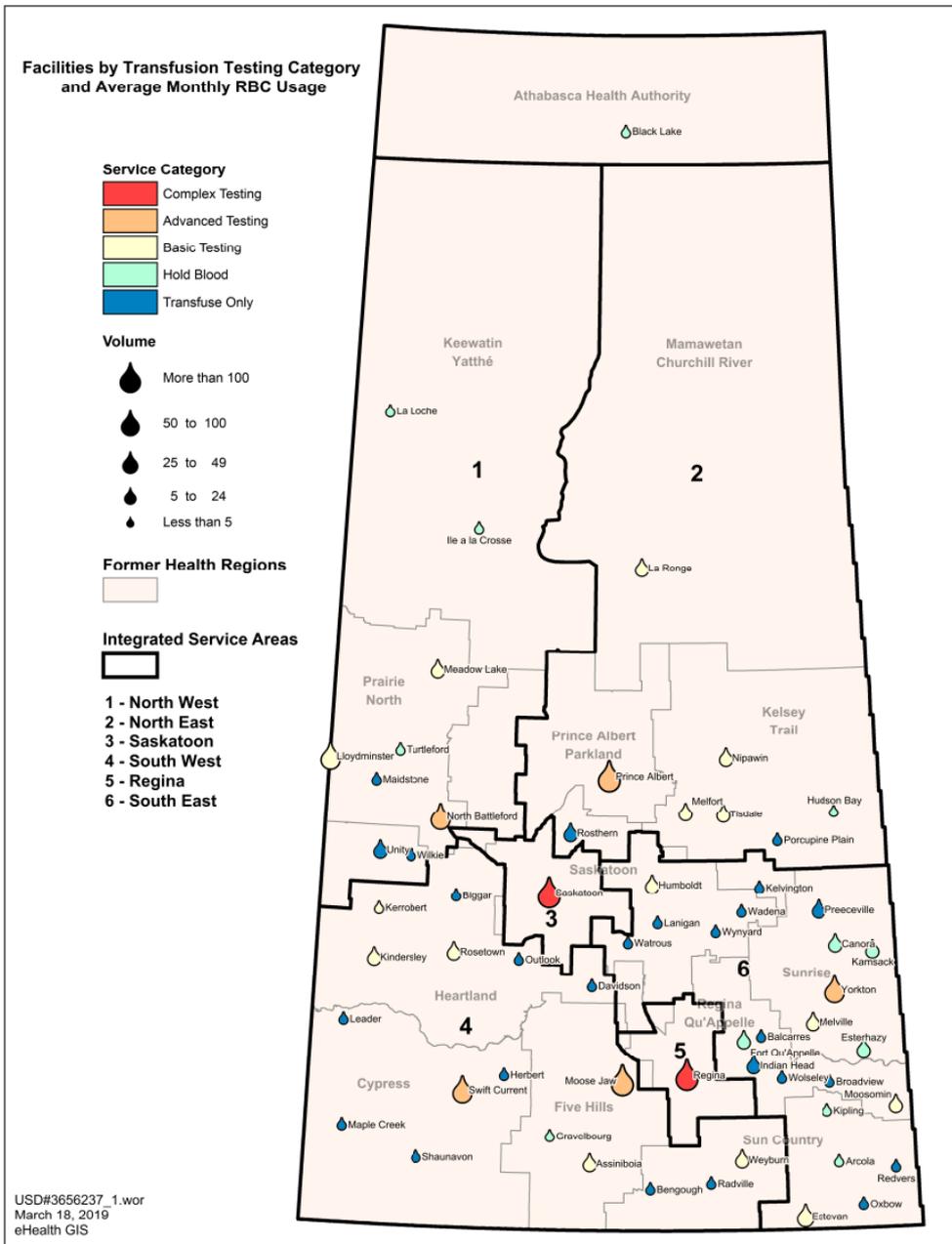


Objectives

- Summarize the rationale for using a restrictive transfusion strategy in patient care;
- Determine when it is appropriate to transfuse blood components (red blood cells, platelets and plasma);
- Review the indications for use of Prothrombin Complex Concentrate (PCC) and Fibrinogen Concentrate (FC)

<https://saskblood.ca/transfusion-best-practice-recommendations/>

Saskatchewan “Blood Drop Map”



- All ‘drop’ sites can transfuse blood or plasma protein products
- Any blood components not stocked on-site can be ordered from Canadian Blood Services
- **Blue** sites do not store blood, but have trained staff to transfuse blood to patients when ordered
- **Red, Orange, Yellow** and **Green** sites hold at least 2 Units RBC at all times
- Plasma is stocked at all **Orange** and **Red** sites
- Platelets are stocked at **Red** sites only
- Local inventory information:
<https://saskblood.ca/resources/blood-bank-contact-and-stock-information/>

Blood Components at the Hospital

COMPONENT	APPROX. VOLUME	STORAGE LIMIT	STORAGE TEMP.	PRE-TRANSFUSION PREPARATION TIME*
Red blood cells	300 mL	42 days	1-6 °C	10-45 minutes
Buffy coat derived platelets (from 4 units)	350 mL	7 days	20-24 °C	5 minutes
Apheresis platelets	330 mL	7 days	20-24 °C	5 minutes
Frozen plasma	290 mL	1 year	-18 °C or colder	30 minutes

- Blood component transfusion must be completed within **4 hours** of release from the Transfusion Medicine Laboratory
- *Consider the component volume per unit being transfused and the patient clinical condition with a transfusion order!*

Transfusion Medicine: A Specialty on Both Sides of the Fence

Transfusion Medicine

Clinical Medicine

- Blood products administered as therapies
- Monitoring, adverse reaction recognition and management



Laboratory Medicine

- Pre-transfusion Testing
- Inventory management
- Product tracking
- Adverse reaction work-up and recommendation

Blood Transfusion

- Transfusion is the most commonly employed medical **procedure** for hospital inpatients → requires informed consent
 - **Blood Components** – Red Blood Cells (RBC), platelets, plasma
 - **Plasma Protein Products** – human protein fractions derived from plasma
- Cellular blood component transfusion (RBC, platelet) is a temporary **liquid tissue transplant**
 - Live blood cells from a human donor are infused into a recipient
- Blood transfusion not address the underlying cause of cytopenias or coagulopathy
- Documentation of the rationale and indication justifying the decision to transfuse is essential
 - The potential benefit of the transfusion **must** outweigh the risk

Blood Transfusion: Definitions



▪ Blood Transfusion

Administration of a Blood Component(s) or Plasma Protein Product given by intravenous, subcutaneous or intramuscular route

Allogeneic Blood

- Cellular components or plasma products donated from another individual for transfusion

Autologous Blood

- Blood donated by the patient, for use by the patient
 - Intraoperative cell salvage common to reduce allogeneic transfusion
 - Preoperative autologous donation now discouraged (with rare exception)

Blood Transfusion and Risk

- There is a growing body of evidence that transfusion carries **less benefit and more harm** than previously believed
- Transfusion adverse reactions are **risks** of receiving blood
 - Infectious risks → significantly minimized in the Canadian blood supply, less than 1/7.5 million chance of HBV, HCV or HIV
 - Non-infectious risks → Relatively common, less than 1/20 overall
 - Can affect multiple organ systems
 - Associated with worse patient outcomes, including **risk of death in 1/360,000** component units transfused)
- **Every unit** transfused carries an independent risk of transfusion adverse reaction
- **Avoiding** transfusion is the best prevention against reactions

Transfusion Adverse Events

- To justify transfusion administration, the potential benefit to the patient must outweigh the risk

RISK OF EVENT	EVENT
1 in 13	Red cell sensitization, increasing risk of hemolytic transfusion reaction and hemolytic disease of the fetus and newborn ⁷⁰
1 in 20	Febrile non-hemolytic transfusion reaction per pool of platelets ⁷¹
1 in 100	Transfusion-associated circulatory overload per transfusion episode ⁷²
1 in 100	Minor allergic reactions (urticaria)
1 in 300	Febrile non-hemolytic transfusion reaction per unit of RBC (1 'donor exposure')
1 in 7,000	Delayed hemolytic transfusion reaction
1 in 10,000	Transfusion-related acute lung injury (TRALI)
1 in 10,000	Symptomatic bacterial sepsis per pool of platelets
1 in 40,000	ABO-incompatible transfusion per RBC transfusion episode
1 in 40,000	Serious allergic reaction per unit of component
1 in 100,000	Post-transfusion purpura

Transfusion Best Practice

- Restrictive transfusion approach:

- a) Follows evidence based care
- b) Minimizes potential harm
- c) Reduces healthcare costs

- Cost of one RBC unit (collection to infusion): **\$522-1183 USD¹**
- Canadian Blood Services costs (collection only):
 - RBC - \$422 CAD
 - Platelet -
 - Apheresis: \$504 CAD
 - Pooled: \$178 CAD
 - Frozen Plasma - \$109 CAD



¹ Shander et al. *Transfusion* 2010;50:753-65

Gap Between Evidence and Practice

- RBC transfusion audits demonstrate 3-57% inappropriate transfusion practice – wide variance!¹⁻³
 - Ontario Study: 1 in 5 transfusions inappropriate⁴⁻⁵
- Single unit transfusion can decrease RBC use 10-41%⁶

**WHY GIVE
2 WHEN 1
WILL DO?**

**Especially now, to help
conserve the blood supply.**

- Don't transfuse more than one red cell unit at a time in non-bleeding patients.
- Don't transfuse red blood cells in asymptomatic, non-bleeding patients with hemoglobin greater than 70 g/L.
- Don't transfuse blood if other therapies (e.g. iron) would be effective.

Choosing Wisely Canada

For more information, visit:
www.choosingwiselycanada.org/transfusion-medicine



¹Barr PJ et al. *Transfusion* 2011;51:1684-94.

²French CJ et al. *Med J Aust* 2002; 177:548-51.

³Joy PJ et al. *Ann R Coll Surg Engl* 2012;94:201-3.

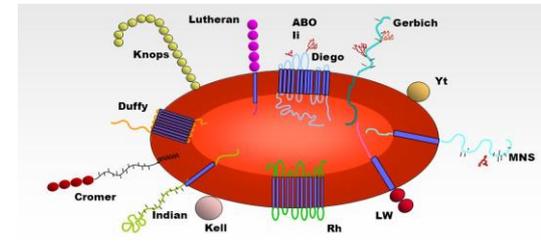
⁴Spradbrow J et al. *Transfusion* 2016; 56:2466-76.

⁵Kron A et al. *Transfusion* 2021;61:410-22.

⁶Shih A et al *Transfusion* 2018; 58:2841-60.

RBC Transfusion Indications

- RBC augment the oxygen carrying capacity of blood in patients with anemia who have evidence of impaired oxygen delivery
 - 1 unit RBC raises the Hb by ~10 g/L
- Appropriate uses:
 - Treatment of symptomatic anemia
 - Prophylaxis in life-threatening anemia
 - Restoration of oxygen carrying capacity in cases of hemorrhage with signs of tissue hypoxemia
 - RBC exchange transfusion (ex. sickle cell crisis, severe parasitemia)



Symptoms of Anemia Justifying RBC

- Hypotension or orthostatic hypotension
- Presyncope or syncope
- Tachycardia (sustained)
- Chest pain or evidence of cardiac strain
 - Ischemic changes on ECG, positive troponin
- Tachypnea (sustained)
- Dyspnea at rest or on exertion
- Severe fatigue preventing usual activity*
 - Measured by a validated scale (ex. FACT-An)
 - *Fatigue alone is not a sufficient symptom of anemia to justify transfusion

Restrictive RBC Transfusion Principles

- Utilize alternatives to transfusion for anemia correction whenever possible
- Administer **1 unit** at a time to a non-bleeding inpatient
 - Outpatients: no more than 2 units RBC in one day
- Consider transfusion in asymptomatic, non-bleeding patients at **restrictive hemoglobin thresholds**



Restrictive RBC Transfusion is Safe

- Non-inferiority of restrictive transfusion is repeatedly demonstrated in hospitalized patients:
 - Critical care patients – TRICC Trial¹ → *paradigm shifting!*
 - Elderly patients
 - Hip fracture surgery – FOCUS Trial²
 - Cardiac surgery patients older than 75 – TRICS III Trial³
 - Acute upper GI bleeding patients⁴

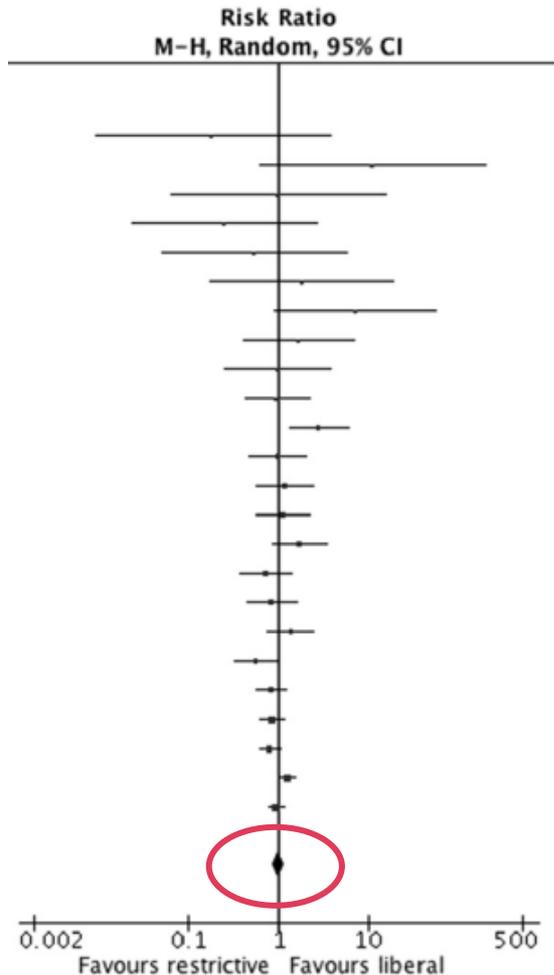
¹ Hébert PC, et al. *N Engl J Med* 1999;340:409-417.

² Carson JL et al. *N Engl J Med* 2011;365:2453-5462.

³ Mazer CD et al. *N Engl J Med* 2017; 377:2133-2144.

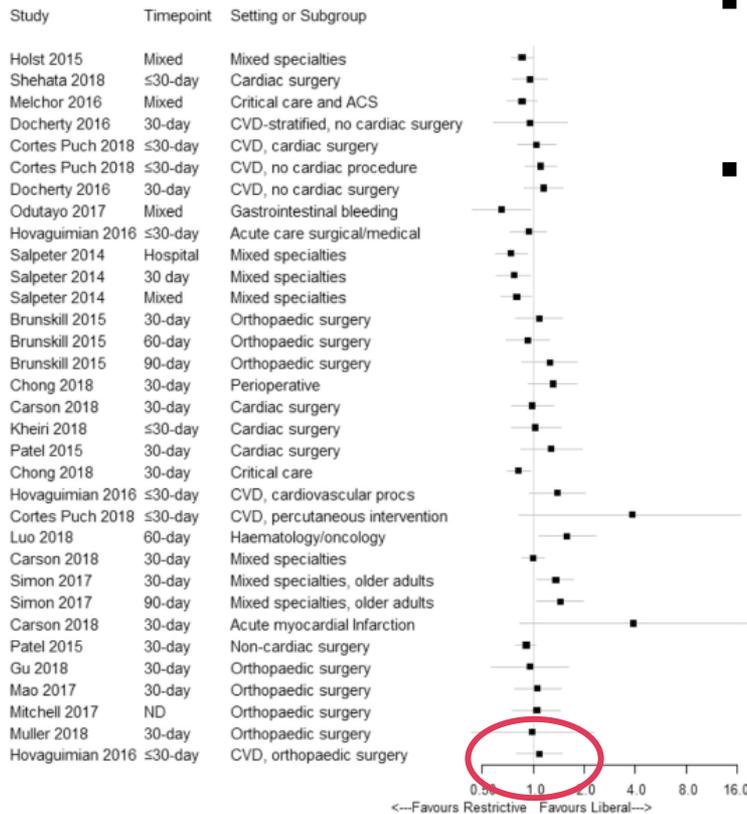
⁴Villanueva C. *N Engl J Med* 2013; 368:11-21.

Mortality – Restrictive vs Liberal Transfusion



- Systematic review
- 26 trials of restrictive (Hb 70-80 g/L) vs liberal hemoglobin thresholds
 - Total 15 681 patients
 - All trials included used single unit transfusion
 - **30 day mortality OR 1.00 (95% CI 0.86-0.16)**
 - No significant differences in secondary outcomes of CV disease subgroup

Mortality – Restrictive vs Liberal Transfusion



- Systematic review of systematic reviews (overview) – 19 included
- 33 meta-analyses of restrictive vs liberal hemoglobin thresholds
 - 16 high- to moderate-quality → 12 (75%) = no mortality difference, 4 (25%) = *lower* mortality in the restrictive transfusion group
 - **30 day mortality OR 1.09 (95% CI 0.80-1.49)**

Guidance for Transfusing RBC

Hb < 90 g/L

Clear signs and symptoms of impaired tissue oxygen delivery

Hb < 80 g/L

Cardiac disease; elderly peri-orthopedic surgery; outpatient transfusion (by convention)

Hb < 75 g/L

Cardiac surgery patients

Hb < 70 g/L

Transfusion likely appropriate although younger patients may tolerate lower Hb (i.e. Hb < 60 g/L)

Hb < 60 g/L

Table 1. Clinical Recommendations: Preoperative Anemia

Clinical Recommendation	Level of Evidence
CR1–Detection and management of preoperative anemia early enough before major elective surgery	Strong recommendation, low certainty in the evidence of effects
CR2–Use of iron supplementation to reduce red blood cell transfusion rate in adult preoperative patients with iron-deficient anemia undergoing elective surgery	Conditional recommendation, moderate certainty in the evidence of effects
CR3– <i>Do not</i> use erythropoiesis-stimulating agents routinely in general for adult preoperative patients with anemia undergoing elective surgery	Conditional recommendation, low certainty in the evidence of effects
CR4–Consider short-acting erythropoietins in addition to iron supplementation to reduce transfusion rates in adult preoperative patients with hemoglobin concentrations <13 g/dL undergoing elective major orthopedic surgery	Conditional recommendation, low certainty in the evidence of effects

Abbreviation: CR, clinical recommendation.

Table 2. Clinical Recommendations: Red Blood Cell Transfusion Thresholds

Clinical Recommendation	Level of Evidence
CR5–Restrictive RBC transfusion threshold (hemoglobin concentration <7 g/dL) in critically ill but clinically stable intensive care patients	Strong recommendation, moderate certainty in the evidence of effects
CR6–Restrictive RBC transfusion threshold (hemoglobin concentration <7.5 g/dL) in patients undergoing cardiac surgery	Strong recommendation, moderate certainty in the evidence of effects
CR7–Restrictive transfusion threshold (hemoglobin concentration <8 g/dL) in patients with hip fracture and cardiovascular disease or other risk factors	Conditional recommendation, moderate certainty in the evidence of effects
CR8–Restrictive transfusion threshold (hemoglobin concentration 7-8 g/dL) in hemodynamically stable patients with acute gastrointestinal bleeding	Conditional recommendation, low certainty in the evidence of effects

Abbreviations: CR, clinical recommendation; RBC, red blood cell.

Table 3. Clinical Recommendations: Implementation of Patient Blood Management Programs

Clinical Recommendation	Level of Evidence
CR9–Implementation of PBM programs to improve appropriate RBC utilization	Conditional recommendation, low certainty in the evidence of effects
CR10–Computerized or electronic decision support systems to improve appropriate RBC utilization	Conditional recommendation, low certainty in the evidence of effects

Abbreviations: CR, clinical recommendation; PBM, patient blood management; RBC, red blood cell.

Choosing Wisely Recommendations



<https://choosingwiselycanada.org/recommendations/>

1 Don't transfuse blood if other non-transfusion therapies or observation would be just as effective.

Blood transfusion should not be given if other safer non-transfusion alternatives are available. For example, patients with iron deficiency without hemodynamic instability should be given iron therapy.

2 Don't transfuse more than one Red cell unit at a time when transfusion is required in stable, non-bleeding patients.

Indications for red blood transfusion depend on clinical assessment and the cause of the anemia. In a stable, non-bleeding patient, often a single unit of blood is adequate to relieve patient symptoms or to raise the hemoglobin to an acceptable level. Transfusions are associated with increased morbidity and mortality in high-risk hospitalized inpatients. Transfusion decisions should be influenced by symptoms and hemoglobin concentration. Single unit red cell transfusions should be the standard for non-bleeding, hospitalized patients. Additional units should only be prescribed after re-assessment of the patient and their hemoglobin value.

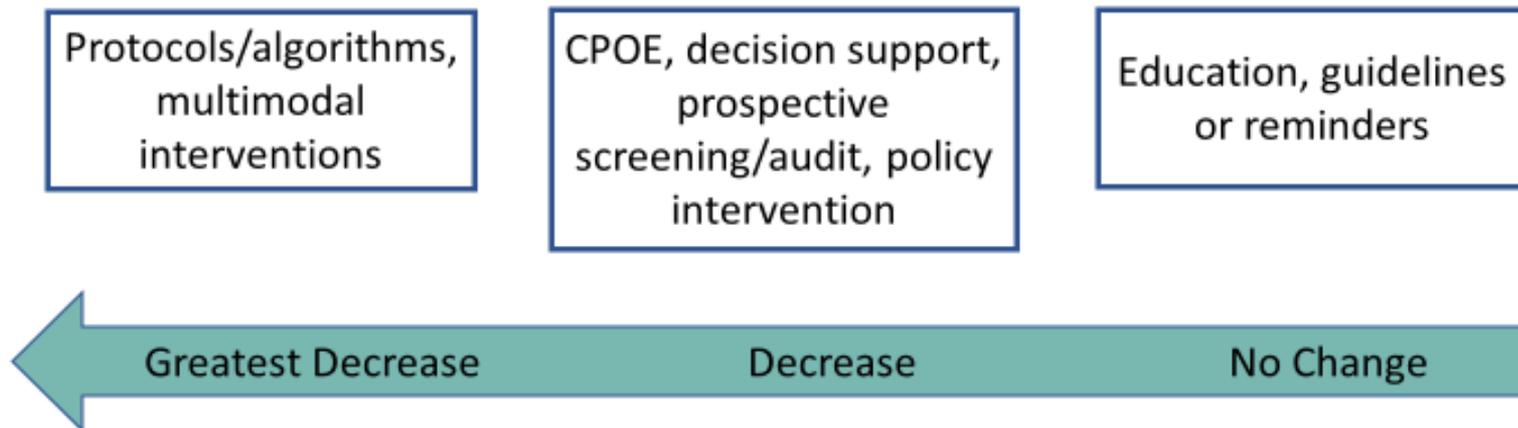
CCCS: Critical Care

- ⑤ Don't routinely transfuse red blood cells in hemodynamically stable ICU patients with a hemoglobin concentration greater than 70 g/L (a threshold of 80 g/L may be considered for patients undergoing cardiac or orthopedic surgery and those with active cardiovascular disease).**

Driving Change is Hard:

Interventions - Literature review

- Systematic review 84 studies on behavioral interventions to reduce RBC transfusion (Soril et al, BMJ 2018)



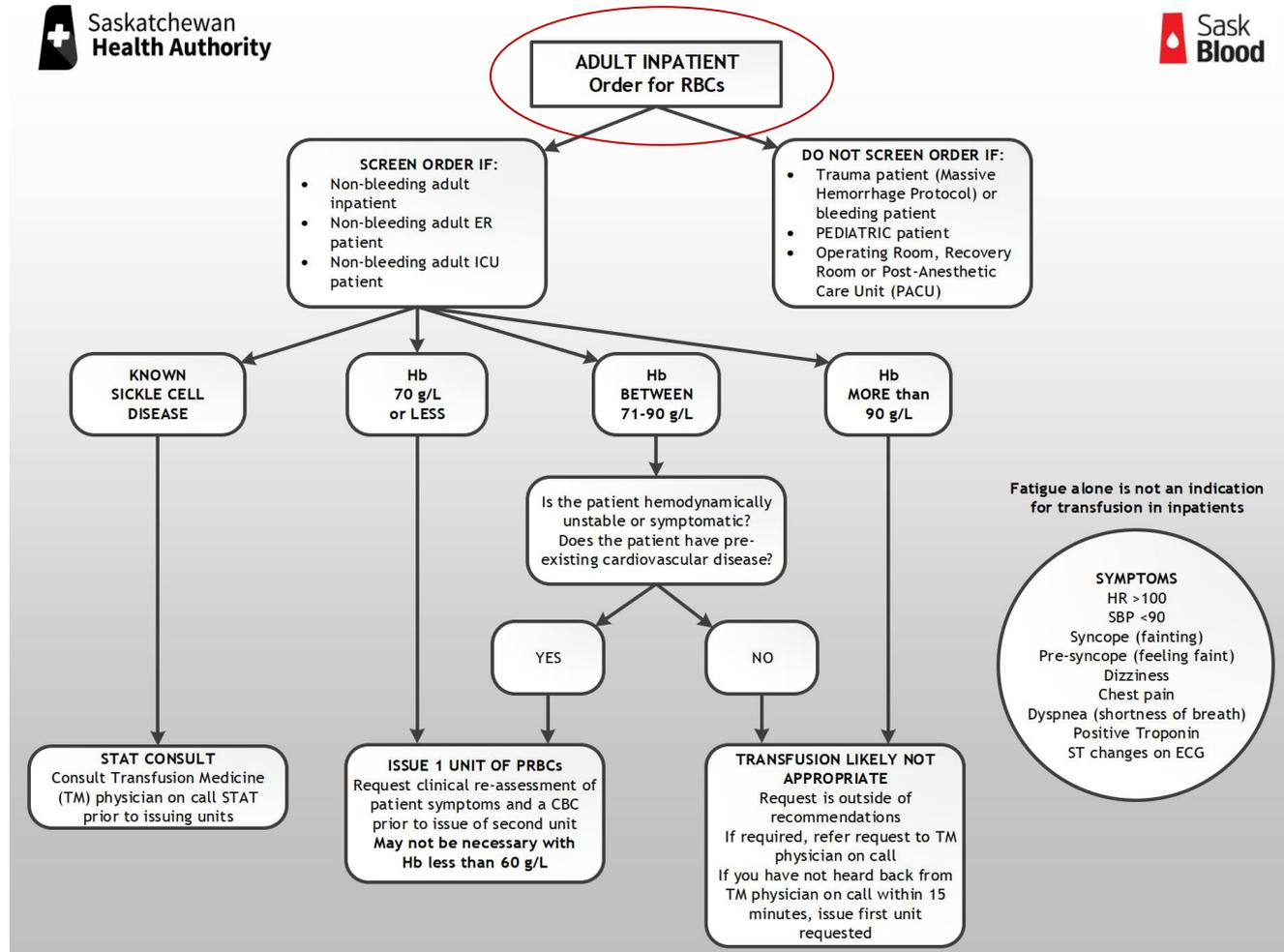
**Using
Blood
Wisely.**



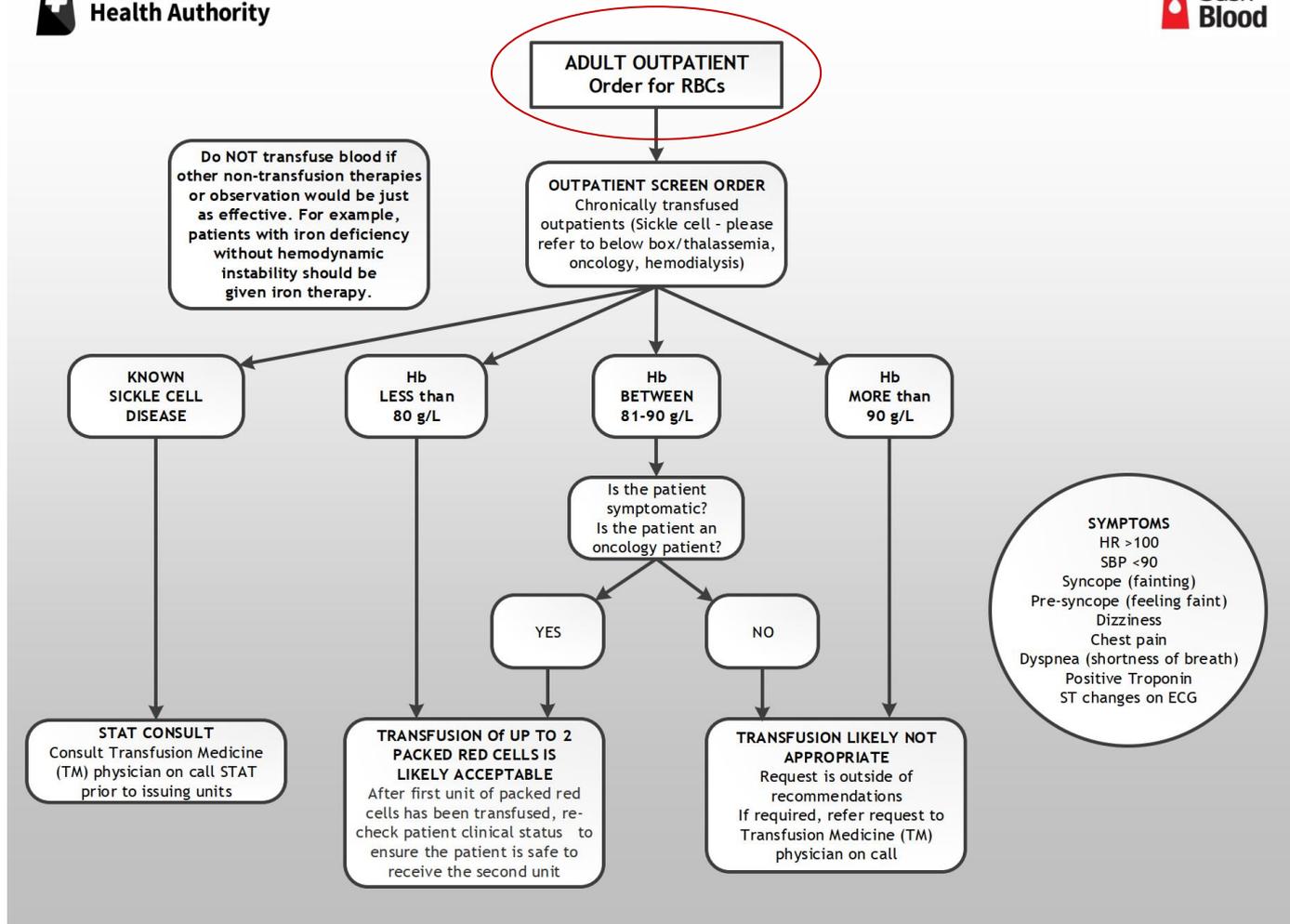
Technologist RBC Order Screening

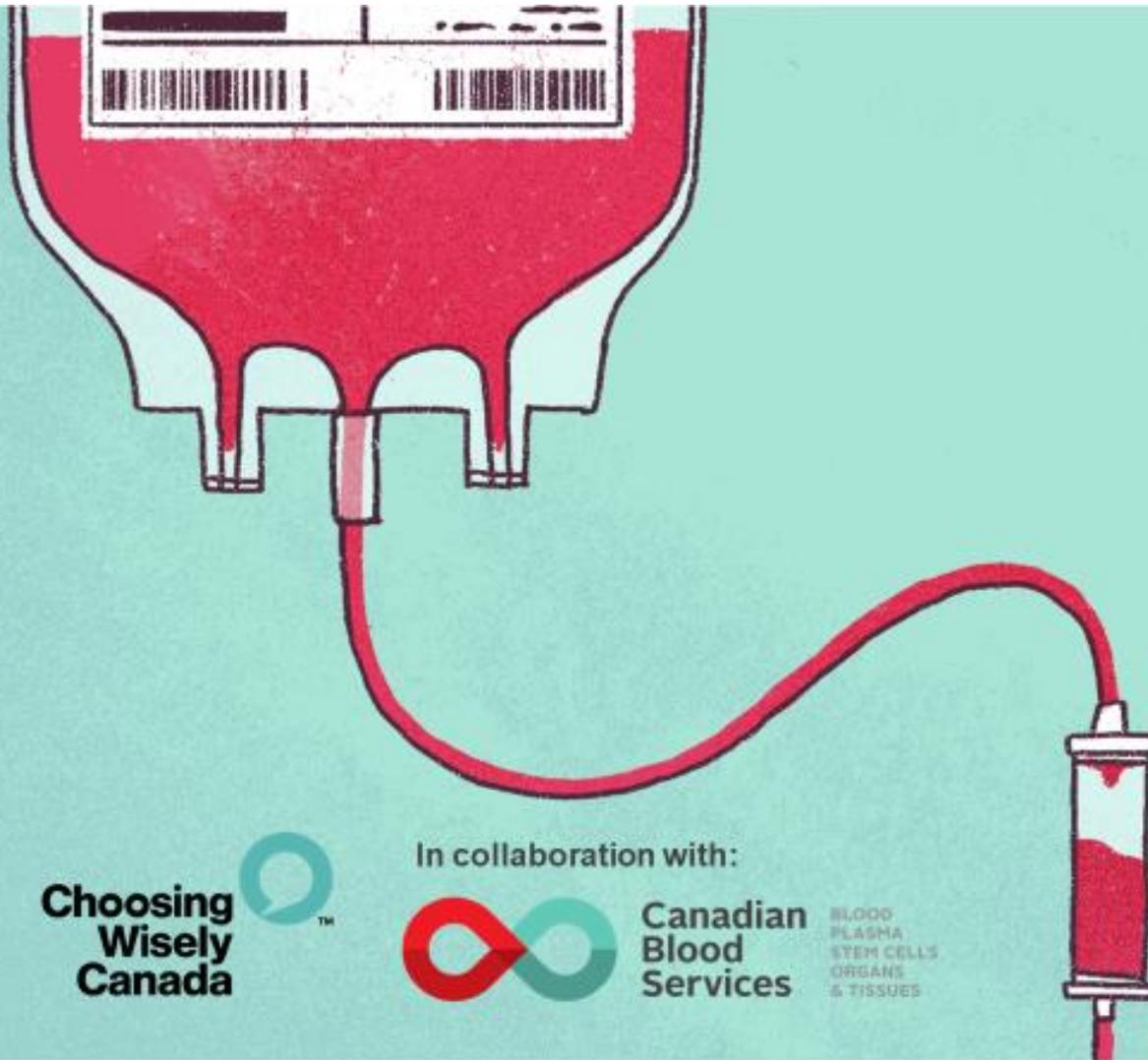
- START Study: 2,877 RBC tx audited from 1,950 patients at 13 Canadian sites (included Saskatoon RUH & SPH; Regina RGH)
 - Overall RBC transfusion appropriateness increased → 73.5% to 85.0% for the pre- vs post-intervention phase, respectively (p<0.0001)
 - Single unit transfusions increased from 46.2% to 68.2% (p<0.0001)
 - Decrease in # of RBCs transfused/month → average 458 units/mo ($8.6 \pm 3.7\%$) or for all 13 sites combined
 - **~\$225,000 saved/mo!!**

Technologist RBC Order Screening



Technologist RBC Order Screening





Using Blood Wisely

www.UsingBloodWisely.ca

Choosing
Wisely
Canada



In collaboration with:



Canadian
Blood
Services

BLOOD
PLASMA
STEM CELLS
ORGANS
& TISSUES

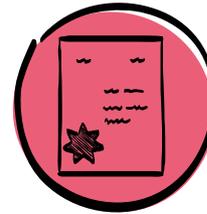
What is Using Blood Wisely (UBW)?

- **Using Blood Wisely** is a national initiative of Choosing Wisely Canada, in collaboration with Canadian Blood Services.
- **Aim:** To decrease inappropriate red blood cell (RBC) transfusions in Canada by:
 - a) Implementing interventions and measurement to decrease inappropriate RBC transfusions
 - b) Increasing engagement of hospitals in RBC transfusion quality improvement work

Saskatchewan – all sites with inpatient care services were asked to participate by the Provincial Transfusion Medicine Discipline Committee

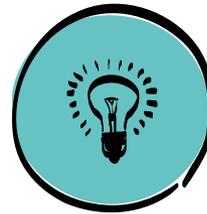
Meeting UBW Benchmarks

- **At least 65%** of red blood cell transfusion episodes are single unit



If met and sustained, you may qualify for the Using Blood Wisely Hospital Designation!

- **At least 80%** of inpatient red blood cell transfusions have a pre-transfusion Hb 80 g/L or less



If not met, enrol in this quality improvement initiative to help your hospital achieve these results

Celebrating Success!



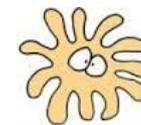
CELEBRATING THE HOSPITALS THAT HAVE RECEIVED THEIR UBW DESIGNATION

Southeast Integrated Care Centre, Moosomin, SK
Pasqua Hospital, Regina, SK
Regina General Hospital, Regina, SK
Royal University Hospital, Saskatoon, SK
St. Paul's Hospital, Saskatoon, SK

PARTNERING FOR BEST TRANSFUSION CARE IN SASKATCHEWAN

- UBW Certificates granted **April 2021**, following submission of 4 month audit results meeting benchmarks
- RBC Order Screening practices have helped facilitate benchmark achievement
- Data collection ongoing in all participating SK sites to obtain certification!

Platelet Transfusion Indications



- Treatment of bleeding due to:
 - Thrombocytopenia
 - Hypoproliferation, dilution, consumption/destruction
 - Platelet dysfunction
 - Acquired causes (medication, uremia), Congenital causes (rare)
- Prevention of bleeding due to:
 - Hypoproliferative thrombocytopenia with count $<10 \times 10^9/L$
 - Pre-procedure, in specific settings
- Apheresis single donor and pooled (buffy coat of 4 donors) platelets are clinically equivalent in terms of effectiveness
 - *Exception:* Cases of alloimmune platelet refractoriness requiring HLA or HPA matched apheresis platelets

Platelet Transfusion

- Patients requiring platelet transfusion have increased risks of:
 - Alloimmunization to platelet antigens
 - Transfusion associated complications
- Platelet microparticles appear to have a significant role in transfusion related immune modulation (TRIM) and may increase tumor progression and metastatic potential
- Short platelet shelf life (7 days) precludes routine stock outside of tertiary care centers
 - Limited product availability
 - Complex logistics of redistribution



Clinical Guidelines | February 3, 2015

Platelet Transfusion: A Clinical Practice Guideline From the AABB

Richard M. Kaufman, MD , Benjamin Djulbegovic, MD, PhD, Terry Gernsheimer, MD, ... [See More +](#)[Author, Article and Disclosure Information](#)<https://doi.org/10.7326/M14-1589>

PDF



ELSEVIER

FIGURES REFERENCES RELATED DETAILS

February 3, 2015 •
Volume 162, Issue 3

Page: 205-213

Contents lists available at [ScienceDirect](#)

Transfusion Medicine Reviews

journal homepage: www.tmreviews.com

Original Articles

Guidance on Platelet Transfusion for Patients With Hypoproliferative Thrombocytopenia

[See Editorial, pages 1-2](#)Susan Nahirniak ^{a,*}, Sherrill J. Slichter ^b, Susano Tanael ^c, Paolo Rebulla ^d, Katerina Pavenski ^e, Ralph Vassallo ^f, Mark Fung ^g, Rene Duquesnoy ^h, Chee-Loong Saw ⁱ, Simon Stanworth ^j, Alan Tinmouth ^k, Heather Hume ^l, Arjuna Ponnampalam ^m, Catherine Moltzan ⁿ, Brian Berry ^o, Nadine Shehata ^p, for the International Collaboration for Transfusion Medicine Guidelines (ICTMG)**bjh** guideline

Guidelines for the use of platelet transfusions

Lise J. Estcourt,¹ Janet Birchall (Writing Group Chair)², Shubha Allard (BCSH Task Force Member)³, Stephen J. Bassey,⁴ Peter Hersey,⁵ Jonathan Paul Kerr,⁶ Andrew D. Mumford,⁷ Simon J. Stanworth⁸ and Hazel Tinegate⁹ on behalf of the British Committee for Standards in Haematology

¹NHSBT and Radcliffe Department of Medicine, University of Oxford, Oxford, ²NHSBT and Department of Haematology, North Bristol NHS Trust, Bristol, ³NHSBT and Department of Haematology, Royal London Hospital, London, ⁴Department of Haematology, Royal Cornwall Hospital Trust, Cornwall, ⁵Department of Critical Care Medicine & Anaesthesia, City Hospitals Sunderland NHS Foundation Trust, Sunderland, ⁶Department of Haematology, Royal Devon & Exeter NHS Foundation Trust, Exeter, ⁷School of Cellular and Molecular Medicine, University of Bristol, Bristol, ⁸NHSBT and Department of Haematology, John Radcliffe Hospital, Oxford and ⁹NHSBT, Newcastle upon Tyne, UK

Platelet Transfusion Threshold (x 10 ⁹ /L)	Clinical Setting
n/a	Asymptomatic thrombocytopenia with chronic bone marrow failure where recovery is not anticipated (incl. patients taking oral chemotherapy or azacitidine)
<10	Hypoproliferative, non-immune thrombocytopenia with reversible bone marrow failure where recovery is anticipated (prophylactic transfusion)
<20-30	Central line placement (tunnelled or untunnelled)
<30-50	Patients on anticoagulants that should not be stopped
<50	Lumbar puncture, major procedure with high bleeding risk
<50	Major surgery; Bleeding (non-neuraxial)
<80	Epidural or spinal anesthesia
<100	Neurosurgery; Head trauma
Any platelet count (even normal!)	Deficient platelet function (congenital or acquired) and significant bleeding <i>Exception: antiplatelet medications with ICH and no surgery planned</i>

Escourt LJ, et al. *British J Haem.* 2017;176:365-94.
Schiffer CA, et al. *J Clin Oncol.* 2018;36:283-299.

Kaufman RM et al. *Ann Intern Med.* 2015;162(3):205-213.
Patel JJ, et al. *J Vasc Interv Radiol.* 2019; 30:1168-84

Platelet Transfusion Increments

- Platelets should be given 1 unit at a time
- Expected increment is an increase in platelet count by $\geq 5-10 \times 10^9/L$ (within 60 minutes post-transfusion)
 - Response should not be assumed – especially if patient is pending a procedure
 - Poor increment on 2 consecutive transfusions suggests alloimmune platelet refractoriness and must be investigated
- Alloimmune platelet transfusion refractoriness is associated with inferior clinical outcomes
 - Costly → requires apheresis platelets from HLA-A and HLA-B (or HPA) matched donors

Indications for Irradiated Blood



Special Requirement	Eligible Patients
Irradiated Cellular Blood Components	<ul style="list-style-type: none"> • Low birth weight premature newborns (<1200 g) until 4 months of age • Intrauterine transfusion (<i>not available in Saskatchewan</i>) • History of intrauterine transfusion, until 6 months after the initial expected delivery date (40 weeks gestational age) • Neonatal exchange transfusion • Directed donations • HLA matched components • Allogenic stem cell/bone marrow transplant recipients (from start of conditioning chemotherapy, for life after transplant) • Autologous stem cell/bone marrow transplant recipients (from 7 days before the start of stem cell mobilization, until 6 months post-transplant) • Allogenic stem cell donors (7 days prior to collection and during the collection process only) • Congenital T-cell immune deficiency (DiGeorge syndrome, SCID) • Hodgkin's Lymphoma, for life • Patients receiving or who have received the following (for life, from the time of drug initiation): <ul style="list-style-type: none"> • Anti-thymocyte globulin (ATG; Thymoglobulin, Atgam) <ul style="list-style-type: none"> ▪ If given for severe aplastic anemia or conditioning prior to allogeneic bone marrow transplant • Alemtuzumab (Campath) • Bendamustine (Treakisym, Ribomustin, Levact and Treanda) • Cladribine/2-CDA (Leustatin) • Clofarabine (Clolar) • Deoxycoformicin (Pentostatin) • Fludarabine (Fludara)

Plasma Transfusion Indications

- Non-cellular blood component containing plasma proteins, including coagulation factors
 - Plasma = generic name for fresh-frozen plasma (FFP) or frozen plasma (FP) → relates to production method; *clinically equivalent*
- Indications:
 - Treatment or peri-procedure prevention of clinically significant bleeding due to deficiency of single or multiple coagulation factors, when no factor concentrates or alternatives are available
 - **In general:** INR ≥ 1.8 and/or PTT $\geq 1.5x$ normal
 - Microvascular bleeding or massive hemorrhage protocol and patient clinical status precludes waiting for coagulation factor results
 - Plasma exchange in thrombotic thrombocytopenic purpura (TTP)

INR is not affected by plasma if <1.8

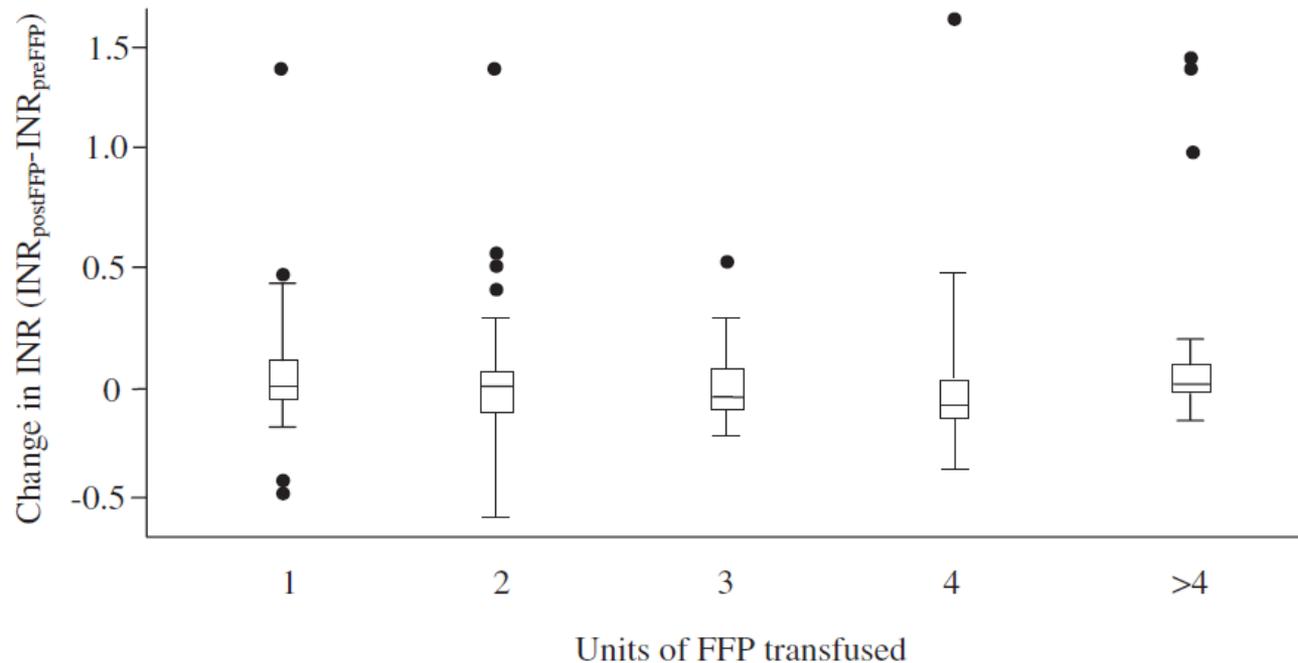


Fig. 1. Box-and-whiskers plot of the effect of FFP transfusion (n = 324 units) on the change in INR based on number of units of FFP transfused per patient among patients (n = 121) with mild abnormalities of coagulation.

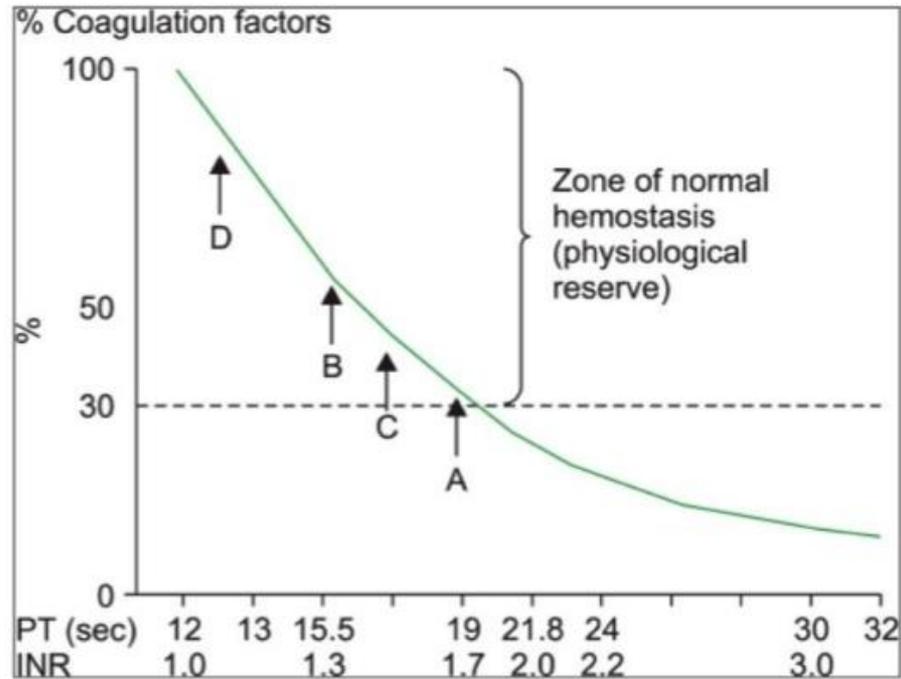


Fig. 1

Theoretical relationship between concentration of coagulation factors and PT/INR. Based on the experience with single factor deficiencies, coagulation proceeds normally until the concentration of factors drops below 30%. Thus there is a significant reserve of clotting factors (the physiologic reserve). Also note that abnormal clotting times can occur while the levels of clotting factors are still within the physiologic reserve, another reason why the PT/INR does not necessarily predict peri-operative bleeding. Refer to text for explanation of the labels. Modified and reprinted from reference [23], with permission from the AABB.

Plasma Transfusion

- Decision to transfuse can be challenging because there is little solid evidence to firmly guide transfusion thresholds
- Plasma transfusion is generally appropriate in:
 - Disseminated intravascular coagulation (DIC) or liver cirrhosis with marked abnormalities of both INR and PTT and bleeding or before major procedure
- Plasma dose = 10-15 ml/kg (~**3-4 units** in an adult); should raise the factor activity by ~15-20% in the recipient circulation
- Efficacy timeline of transfusion will be dependent on the **half-life** of the deficient factor(s) requiring replacement
 - The biological half life of plasma coagulation factors **varies**:
 - Factor VII – 3-6 hours (shortest)
 - Factor II and X – 2-3 days (longest)
- Transfusion **rate** should be chosen based on patient clinical condition

Clinical Cautions

- Consider why an INR and PTT is being ordered and possible causes of abnormalities in the patient
 - Not every prolonged INR or PTT is because of factor deficiency! (ex. Anti-PL antibody)
- **Plasma transfusion is not appropriate:**
 - As a volume expander in resuscitation without bleeding
 - For single factor deficiency if recombinant or plasma derived virally inactivated products available
 - Pre-procedure or pre-operatively if the INR is <1.8 and PTT is normal
 - INR of Plasma is ~ 1.5 ; transfusing plasma will not cause correction to normal
 - Mildly high INR due to acquired FVII deficiency does not cause bleeding
 - For treatment of an isolated high INR without bleeding (regardless of the number) with liver disease and platelets >50 prior to a low risk procedure
 - Warfarin reversal due to bleeding if prothrombin complex concentrate (PCC) is available

Prothrombin Complex Concentrates (PCC)

- Human source concentrate of factors
 - II, VII, IX, X
 - Protein C
 - Protein S
 - Small amount of Heparin
- PCC brand names:
 - Octaplex (Octapharma), Beriplex (CSL Behring)



PCC Indications



National Advisory Committee
on Blood and Blood Products

Indications:

Recommended in:

A. Rapid reversal of warfarin therapy or vitamin K deficiency in patients exhibiting major bleeding manifestations.

B. Rapid reversal of warfarin therapy or vitamin K deficiency in patients requiring urgent (< 6 hours) surgical procedures.

Please note: The 6 hour time frame in this recommendation reflects the half life of the product and is not a statement regarding the urgency of the surgery.

Contraindicated in:

A. Patients with a history of heparin induced thrombocytopenia

Off-label indications:

- Management of bleeding in the setting of a direct factor Xa inhibitor (rivaroxaban [Xarelto[®]], apixaban [Eliquis[®]]) – 25-50 IU/kg
- Management of massive bleeding when plasma is unavailable prior to transfer to larger center, if given together with Fibrinogen Concentrate (FC)

<https://nacblood.ca/resources/index.html> - Prothombin Complex Concentrates Version 2014, Accessed June 5, 2021.

<https://treatthebleed.org/> Accessed June 5, 2021.

Callum JL et al. *CMAJ Open* 2019. [DOI:10.9778/cmajo.20190042](https://doi.org/10.9778/cmajo.20190042).

PCC Dosing for Warfarin Reversal

2. INR based dosing: The 2011 NAC recommendation based the dosing of prothrombin complex concentrate on the INR as per the table below but stated that if the INR is unknown and major bleeding is present, 2000 IU (80 mL) should be administered.

	PCC dose if INR > 5	PCC dose if INR 3-5	PCC dose if INR <3
Dose	3000 IU (120 mL)	2000 IU (80 mL)	1000 IU (40 mL)

- **MUST give concurrent Vitamin K 10 mg IV for sustained reversal effect**
 - Vitamin K is the true reversal for Warfarin, but takes 4-6 hours for effect
- Order PCC in number of Units (not vials)
 - Both 500 IU and 1000 IU sizes exist
- Recheck INR as soon as 5-10 min after administration
 - Goal = INR <1.5; if not met, re-dose may be required
- PCC half-life is 6 hours
 - Dependent on Factor VII – shortest $T_{1/2}$ of factors present
- Max dose in 24 hours = 3000 IU

Plasma vs PCC Comparison in the Management of Warfarin Associated Coagulopathy

	Plasma	PCC
Time to obtain product	At least 40 min → Requires blood group (unless AB), thaw of product	Immediate – no blood group or thaw required, reconstituted at bedside
Volume administered	10-15 mL/kg → 3-4 Units (800-1000 mL)	Up to 120 mL (3000 IU)
Time to complete infusion	Hours	Minutes (3 mL/min)
Time to target INR within 15 min of infusion completion	Few	At least half
Factor dosing	Variable	Consistent
Transfusion Reaction Risk	Moderate – allergic reaction, TRALI, TACO (2.5x higher vs PCC), thrombosis (1-3:100) transmissible disease <u>per unit</u>	Minimal – virally inactivated; Allergy, thrombosis (1-3:100) per dose
Cost (product only)	\$432 for 4 Units FP	\$610 per 1000 IU

TRALI = Transfusion Associated Lung Injury; TACO = Transfusion Associated Circulatory Overload

Fibrinogen Replacement

- Fibrinogen replacement should be guided by a fibrinogen measurement in a bleeding or pre-operative patient
- Sources of Fibrinogen:
 - Frozen Plasma → contains ~3 g Fibrinogen/unit, but should not be used solely for fibrinogen replacement
 - Cryoprecipitate → 0.4 g Fibrinogen/unit, *falling out of favor*
 - Unmodified, human plasma derived; stored in the freezer
 - Multiple donor exposures per dose (8-12 Units on average for 1 adult)
 - Inconsistent fibrinogen concentration
 - Requires freezer storage, thaw and pooling in the lab
 - Fibrinogen Concentrate → 1 g per vial

Fibrinogen Concentrate (FC)

- Brands available: RiaSTAP (CSL Behring); Fibryga (Octapharma)
 - **Advantages**
 - Plasma protein product, virally inactivated during fractionation
 - Easy reconstitution at bedside with sterile water
 - Relatively fast administration – up to 1 g in 2.5 minutes
 - Reliable dose
 - Fridge or room temp storage
 - 3-5 year shelf-life (brand dependent)
 - Consult the Product Monographs for further details
 - FC has been shown to be non-inferior to cryoprecipitate in terms of clinical effectiveness (FIBRES study)

Fibrinogen Indications

- In a bleeding patient with acquired hypofibrinogenemia, fibrinogen replacement is recommended if:
 - Fibrinogen <2.0 g/L in an obstetrical hemorrhage
 - Fibrinogen <1.5 g/L for all others

Off-label indication:

- Management of massive bleeding when plasma is unavailable prior to transfer to larger center, if given together with PCC
- Recommended FC dose = 4 g
 - 4 grams FC \approx 10 Units Cryoprecipitate in terms of fibrinogen content
 - Expected rise in serum fibrinogen 0.5-1.0 g/L (depends on consumption), can be tested within 1 hour post-dose

Congenital Bleeding Disorders



Remember... FactorFirst

PROMPT INFUSION will halt bleeding, minimize long-term complications and can save life. If bleeding persists, follow the guidelines for life or limb-threatening bleeds and call the:

Hemophilia Treatment Centre

Physician: _____
Nurse: _____
Day Phone: _____
Night Phone: _____

Delay in the restoration of hemostasis to the patient with hemophilia or von Willebrand disease may be life or limb-threatening.

- **PROMPT TRIAGE AND ASSESSMENT.**
- Determine the severity of the bleed.
- Recognize that bleeding in the head, spine, abdomen or pelvis may initially be occult and potentially life-threatening.
- **TREAT FIRST AND INVESTIGATE LATER – “FACTOR FIRST”.**
- Avoid invasive procedures such as arterial punctures unless the patient has factor replacement.
- **NO IM injections and NO ASA.**
- The patient or guardian may be your most important resource, so do ask about specific treatment protocols.
- Contact the patient’s Hemophilia Treatment Centre where a hematologist is always on call.
- Provide clear discharge instructions and arrange a follow-up plan or admit to hospital if necessary.

Use Universal Precautions

Patient information:

Name: _____
Date of Birth: _____
Diagnosis: _____
Severity: _____ Level: _____
Response to desmopressin (DDAVP): no yes to _____ %
Inhibitors: no yes
Other Medical Information: _____
Date of Recommendation: ____/____/____
Signature of Physician _____

Recommended Treatment:

Product and Dose/kg for Life or Limb-threatening Bleeds:

Product and Dose/kg for Moderate/Minor Bleeds:

LIFE OR LIMB-THREATENING BLEEDS

- Head (intracranial) and neck
- Chest, abdomen, pelvis, spine
- Iliopsoas muscle and hip
- Massive vaginal hemorrhage
- Extremity muscle compartments
- Fractures or dislocations
- Any deep laceration
- Any uncontrolled bleeding

MODERATE/MINOR BLEEDS

- Nose (epistaxis)
- Mouth (including gums)
- Joints (hemarthroses)
- Menorrhagia
- Abrasions and superficial lacerations

TREATMENT FOR LIFE OR LIMB-THREATENING BLEEDS

PATIENT MUST RECEIVE PRODUCT URGENTLY

Hemophilia A: (all severities)
Recombinant factor VIII concentrate 40-50 units/kg
Hemophilia B: (all severities)
Recombinant factor IX concentrate 100-120 units/kg >15 yrs
Recombinant factor IX concentrate 135-160 units/kg <15 yrs
The dosage for recombinant factor IX is substantially higher because of its lower recovery, particularly in children.
Von Willebrand Disease:
A VWF factor concentrate containing factor VIII such as Humate-P 60-80 Ristocetin cofactor units/kg

It is critical to raise the factor level to 80-100% urgently for all life or limb-threatening bleeds.

TREATMENT FOR MODERATE/MINOR BLEEDS

PATIENT MUST RECEIVE PRODUCT WITHIN 30 MINUTES WHENEVER POSSIBLE

Hemophilia A: (severe/moderate)
Recombinant factor VIII concentrate 20-30 units/kg
Hemophilia A: (mild)
Desmopressin (Octostim/DDAVP) 0.3 mcg/kg (max. 20 mcg) –SC/IV
Hemophilia B: (severe/moderate/mild)
Recombinant factor IX concentrate 35-50 units/kg >15 yrs
Recombinant factor IX concentrate 50-70 units/kg <15 yrs
The dosage for recombinant factor IX is substantially higher because of its lower recovery, particularly in children.
Von Willebrand Disease:
Type 1 and Type 2A or 2B known to have used desmopressin safely and effectively – (Octostim/DDAVP) 0.3 mcg/kg (max. 20 mcg) –SC/IV
For patients not responding to desmopressin (such as Type 3 or Type 2B) use a VWF factor concentrate containing factor VIII such as Humate-P 60-80 Ristocetin cofactor units/kg
For mucosal bleeds in all above add:
Tranexamic Acid (Cyklokapron) 25 mg/kg po tid 1-7 days (contraindicated if hematuria)

Dosages are patient specific – these are general guidelines only. Round doses up to the nearest vial. If the products listed are not available, please call the nearest Canadian Blood Services or Hema-Québec Centre.

GUIDELINES FOR EMERGENCY MANAGEMENT OF HEMOPHILIA AND VON WILLEBRAND DISEASE

FactorFirst



Canadian Hemophilia Society
Help Stop the Bleeding



Association of Hemophilia Clinic Directors of Canada

www.hemophilia.ca/emergency

Proper Blood Transfusion Order

- According to *Transfusion Medicine Standards* all blood transfusion orders must include:
 - Indication for transfusion
 - Dose (volume/number of units) and route
 - Infusion duration (precise rate)
 - Consider component type, patient volume status; over maximum 4 hours
 - Special requirements, if applicable
 - Modifications or attributes (ex. irradiated, washed, HLA matched)
 - Sequence of component transfusion
 - Infusion device (rapid infuser, warmer)
- Consider premedication orders based on clinical profile and transfusion history

Transfusion Order Examples

- Not acceptable: 

“Transfuse 1 Unit RBC” or “Transfuse 1 Unit Platelets”

- Acceptable: 

“Transfuse **1 Unit irradiated RBC IV** over **3 hours**, per standard protocol. Indication = symptomatic anemia”

“Transfuse **Octaplex 2000 Units IV** over **10 minutes**, per standard protocol. Indication = acute warfarin reversal, INR 3.9”

SK Transfusion Best Practice Recommendations

TRANSFUSION BEST PRACTICE RECOMMENDATIONS



These documents summarize best practice recommendations for patients receiving transfusion of blood components, which include red blood cells (RBC), platelets, plasma and cryoprecipitate. The transfusion triggers listed are in alignment with evidence-based transfusion medicine practices and reflect published clinical practice guidelines. The decision to order a blood transfusion should be made carefully, ensuring that transfusion benefits, risks and alternatives have been considered.

Resources

Document Name	Date of Original Publication	Date Revised	
Transfusion Best Practice Recommendations for Pediatric Patients - Saskatchewan	October 19, 2020	October 19, 2020	DOWNLOAD
Transfusion Best Practice Recommendations in Adult Patients - Saskatchewan	August 29, 2018	November 16, 2020	DOWNLOAD

RESOURCES

[ARCHIVES](#)

[AUDITS](#)

[BLOOD EASY RESOURCES](#)

[BLOOD BANK CONTACT AND STOCK INFORMATION](#)

[BLOOD SHORTAGE PLAN](#)

[CHOOSING WISELY CANADA](#)

[CORRESPONDENCE 2019](#)

[INFORMED CONSENT FOR BLOOD AND BLOOD PRODUCTS](#)

[MAJOR EVALUATED RISKS OF BLOOD TRANSFUSION](#)

[MIX2VIAL - A NEEDLELESS TRANSFER DEVICE](#)

[SASKATCHEWAN CLINICAL GUIDELINES FOR ELECTIVE COMMUNITY TRANSFUSION](#)

[SASKATCHEWAN TRANSFUSION COMMITTEE RESOURCE BOOK](#)

[TRANSFUSION ADVERSE EVENTS](#)

[TRANSFUSION BEST PRACTICE RECOMMENDATIONS](#)



CLINICAL CASE EXAMPLES

Transfusion Review Case 1

- 23 year old woman presenting for an initial prenatal appointment. She is 18 weeks gestational age (second trimester) and is feeling well. She is fit and jogs daily for about 30 min before work. On exam, she appears pale but is otherwise normal.
- Bloodwork results:
 - Hb is 65 g/L (N 120-157)
 - Platelets $485 \times 10^9/L$ (N 150-400)
 - INR 1.0 (N 0.8-1.2)
 - PTT 32 sec (N 28-38)
- Would you transfuse any blood components at this time? If so, what would you recommend?

Transfusion Review Case 1 - Answer

- RBC transfusion is not necessary.
- Hb is low, but the patient is asymptomatic. Due to the risk of alloimmunization (formation of antibodies against foreign RBC antigens), transfusion in women of childbearing potential should be avoided if at all possible
- Prudent to investigate iron studies and ferritin
 - If iron deficient = IV iron supplementation.
- Platelets and plasma transfusion are not indicated → no bleeding
 - Platelets are high, likely as a reactive phenomenon in the setting of probable iron deficiency anemia
 - Coags are normal

Transfusion Review Case 2

- 86 year old man with known coronary artery disease presents to hospital with a left hip fracture. He is known to be on ASA 81 mg daily.
- Bloodwork results:
 - Hb 76 g/L (N 130-170)
 - Platelets $65 \times 10^9/L$ (N 150-400)
 - INR 1.1 (N 0.8-1.2)
 - PTT 34 sec (N 28-38)
 - Creatinine is 350 $\mu\text{mol/L}$ (N 70-120)
- Would you transfuse? If so, what would you recommend?

Transfusion Review Case 2 - Answer

- Presence of significant CAD history pending hip surgery in this elderly man. According to available evidence, he should be optimized to a Hb if > 80 pre-op. Transfusion of 1 unit of RBC is appropriate.
- Platelet count is >50 , so no transfusion is indicated at present. However, it is important to consider that his platelets may be dysfunctional due to uremia, and if he is oozy in the OR, an intraoperative transfusion may be appropriate. (Uremic platelets pose a risk of bleeding, but this is not an absolute. Some patients seem to be more affected than others).
- Plasma transfusion is not required as PTT and INR are normal.

Transfusion Review Case 3

- 55 year old male presenting to ER with a complaint of hematemesis at home. He has known liver cirrhosis. He is on no medication. Vital signs are stable and he complains of abdominal pain only.
- Bloodwork results:
 - Hb is 92 g/L (N 130-170)
 - Platelets $68 \times 10^9/L$ (N 150-400)
 - INR 1.7 (N 0.8-1.2)
 - PTT normal
- Would you transfuse any blood components at this time? If so, what would you recommend?

Transfusion Review Case 3 - Answer

- No transfusions are necessary.
- Vital signs are stable, which suggests the degree of bleeding is not profuse. Hb is >70 g/L in the setting of a GI bleed.
 - It would be important to identify his baseline (with historical bloodwork results, if these exist), which would also provide an idea of how much his hemoglobin may have dropped.
- Platelet count is low but sufficient for hemostasis (he could go to OR at this current level).
- INR is <1.8 with a normal PTT = no plasma necessary



Transfusion Review Case 4

- Michael is a 70 year old male who presents to ER with frank hematemesis. He has atrial fibrillation and is currently anticoagulated with warfarin. Routine bloodwork two days ago demonstrated a therapeutic of INR 3.8. Vital signs presently include HR 120 bpm, BP 100/68, RR 22/min on RA, Temp 37.2°C.
- How do you acutely manage his warfarin associated coagulopathy?

Transfusion Review Case 4 - Answer

- Tachycardia and soft blood pressure in the setting of frank hematemesis and ongoing bleeding with over-anticoagulation = life threatening
- Give PCC 2000 Units **and** Vitamin K 10 mg IV
 - INR was 3.0-5.0 range 2 days ago (likely reliable); this dose is correct for unknown INR anyway
 - PCC acutely provides deficient factors, Vitamin K reverses warfarin effect
 - *You should be aware of whether your blood bank has PCC!
- Draw CBC, repeat INR – can do 5-10 min after PCC given to guide further management
- *Plasma is not appropriate if PCC are available*



Thank you for your attention and for
transfusing wisely!

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Email: oksana.prokopchuk-gauk@saskhealthauthority.ca

Transfusion Medicine On-Call 24/7:

- Saskatoon/North SK – 306-655-1000
- Regina/South SK – 306-766-4444

Transfusion Medicine Resources

TOP 3 HIGHLY RECOMMENDED:

- **Bloody Easy 4:** http://transfusionontario.org/en/documents/?cat=bloody_easy
- **Clinical Guide to Transfusion:**
<https://professionaleducation.blood.ca/en/transfusion/clinical-guide-transfusion>
- **Saskatchewan Transfusion Best Practice Recommendations:**
<https://saskblood.ca/transfusion-best-practice-recommendations/>

- **SaskBlood Provincial Blood Office:** <http://saskblood.ca/>
- **Informed Consent for Blood and Blood Products (for various former RHAs):**
<http://saskblood.ca/resources/informed-consent-for-blood-and-blood-products/>
- **Transfusion Orders from the Physician/Authorized Health Practitioner: *Guideline SK 02***
<http://saskblood.ca/sk-transfusion-resource-manual/>

Component Dosing Reference

Component	Transfusion Dose	Transfusion Time per Unit	Expected Increment
RBC	Adult: 1 Unit (3-5 ml/kg) Child or Neonate: 10-15 ml/kg	2 h typical, max 4 h [5 ml/kg/h, up to 150 ml/h]	Adult: 1 U → ~10 g/L Child: 15 ml/kg → ~20 g/L
Platelet	1 Adult Dose Child or Neonate: 5-10 ml/kg	60 min typical, max 4h	Adult: 25-50 x 10 ⁹ /L at 1h post transfusion CBC (may be less if there is a consumption)
Plasma	Adult: 10-15 ml/kg Child or Neonate: 10-15 ml/kg	30-120 min, max 4h	Factor activity increased by 15-20% per transfusion dose
Cryoprecipitate	Adult or Child: 1 unit/10 kg Neonate: 5-10 ml/kg	10-30 min per dose, max 4h	1 dose (based on 10 ml/kg) → fibrinogen increase 0.5 g/L

General Acute Reaction Management

- **STOP THE TRANSFUSION**
- **Assess the patient and institute supportive care**
 - ABCs, vital signs
 - Maintain IV access with normal saline
 - Recheck identification of the patient and blood component or product
 - Supportive care to maintain organ function if evidence of compromise
 - Order investigations based on clinical picture and symptoms
 - Bloodwork → CBC, chemistry, ABG; bacterial culture
 - Imaging → CxR
 - Consider treatments for symptom relief:
 - Acetaminophen (Tylenol) for fever
 - Anti-histamine (Benadryl) for rash/itch
 - Diuretics (Lasix) for fluid overload
- **Inform the transfusion medicine lab (even if blood is restarted!)**
 - Send product and tubing back to the lab for testing if the decision is made not to continue the transfusion

Appendix 7: Transfusion Reaction Chart

IMMEDIATE NURSE / TRANSFUSIONIST ACTIONS!

1. **Stop** the transfusion
2. Maintain IV access
3. Check vital signs
4. **Re-check** patient ID band and product label
5. **Notify** attending physician
6. **Notify** Transfusion Laboratory

IMMEDIATE TSL ACTIONS!

1. Perform Lab Clerical Check
2. Perform Visual Plasma Check
3. Collect post-transfusion sample where required
4. Initiate serological testing where required

Signs & Symptoms	Usual Timing	Possible Etiology	Recommended Investigations	Suggested Treatment and Actions	
Fever $\geq 38^{\circ}\text{C}$ and \uparrow of at least $\geq 1^{\circ}\text{C}$ from baseline	38°C to 38.9°C but NO other symptoms	During or up to 4 hours post transfusion	Febrile non-hemolytic transfusion reaction	Lab Clerical Check and Visual Plasma Check only - Antipyretic - With physician approval transfusion may be resumed cautiously if product not expired (still <4 hrs from start of original transfusion)	
	38°C to 38.9°C AND with one or more symptoms* or 39°C or more	Usually within the first 15 minutes but may be later	Febrile non-hemolytic transfusion reaction	- Blood Group & Antibody Screen, DAT	Do not restart transfusion - Antipyretic to reduce fever symptoms - Consider Demerol (Meperidine) for significant rigors - Return blood products to Transfusion Laboratory
			Bacterial contamination	- Aerobic and anaerobic blood cultures and gram stain on returned blood product - Aerobic and anaerobic blood cultures on patient	- If sepsis is suspected, antibiotics should be started immediately
			Acute hemolytic transfusion reaction	- Urinalysis - CBC, direct and total bilirubin, urea, creatinine, electrolytes, INR, PTT, fibrinogen, D-dimer, haptoglobin	- If hemolysis is suspected (e.g. red urine or plasma), monitor for hypotension, renal failure by measuring urine output/hour and DIC (oozing blood from IV line or mucosal sites) - For additional assistance, contact on-call SK TM Physician
Urticaria (hives) Itching or Rash	< ¼ body affected but NO other symptoms	During or up to 4 hours post transfusion	Minor allergic	Lab Clerical Check and Visual Plasma Check only - Antihistamine - With physician approval transfusion may be resumed cautiously if product not expired (still <4 hrs from start of original transfusion)	
	> ¼ body affected or more but NO other symptoms	Usually early in transfusion	Severe allergic	Lab Clerical Check and Visual Plasma Check only Do not restart transfusion - Antihistamine - May require IV corticosteroid	
	Accompanied by one or more serious symptoms*	Usually early in transfusion	Anaphylaxis	- Blood Group & Antibody Screen, DAT - Chest X-ray (if dyspneic) - Blood gases (if dyspneic) - Haptoglobin, IgA level - Mild to moderate reaction with stable V/S: corticosteroids (e.g. hydrocortisone <u>Adults</u> : 500 mg IV, <u>Peds</u> : 10mg/kg IV, to a max of 500 mg IV); antihistamine (e.g. diphenhydramine 25-50 mg IV/po) per MD order - Severe anaphylactoid reaction and/or unstable V/S: IM epinephrine (1:1000), <u>Adults</u> : 0.3-0.5 mL, <u>Peds</u> : 0.01mL/kg, (refer to product insert for max dose), a bolus of Normal Saline (<u>Adult</u> : 500 – 1000 mL, <u>Peds</u> : 20 mL/kg) – per MD order - Continuous monitoring (pulse, BP, respiratory rate, O2 sats) - May require washed/depleted blood products pending investigation (consult Transfusion Medicine Physician on call) - Return blood products to Transfusion Laboratory - For additional assistance, contact on-call SK TM Physician	
Dyspnea (shortness of breath) or \downarrow in SpO ₂ , %	Typically with Hypertension	Within several hours of transfusion	Transfusion associated circulatory overload (TACO)	Do not restart transfusion - Diuretics, oxygen, sit patient upright (bed at 80° to 90° angle) - Return blood products to Transfusion Laboratory - Slow transfusion rate with diuretics for future transfusions	
	Typically with Hypotension	Within 6 hours of transfusion	Transfusion related acute lung injury (TRALI)	- Blood Group & Antibody Screen, DAT - Urinalysis - Chest X-ray - Blood gases	Do not restart transfusion - Assess chest x-ray for bilateral pulmonary infiltrates - If TRALI may require vasopressors and respiratory support
		Usually within first 15 minutes but may be later	Bacterial contamination	- Aerobic and anaerobic blood cultures and gram stain on returned blood component - Aerobic and anaerobic blood cultures on patient	- If sepsis is suspected, antibiotics should be started immediately
			Acute hemolytic transfusion reaction	- Urinalysis - CBC, direct and total bilirubin, urea, creatinine, electrolytes, INR, PTT, fibrinogen, D-dimer, haptoglobin	- If hemolysis suspected (e.g. red urine or plasma), monitor for hypotension, renal failure by measuring urine output/hour and DIC (oozing blood from IV line or mucosal sites)
			Anaphylaxis	- Haptoglobin, IgA level	- If anaphylaxis suspected, IM epinephrine
				- Return blood products to Transfusion Laboratory - For additional assistance, contact on-call SK TM Physician	

* See Table 1 on Page 2

Reminder to *Give Life!*



Visit www.blood.ca to book an appointment

NEW location of the Saskatoon CBS donor center:
1406 Emerson Drive (off 8th Street)