



**Pathology and Laboratory Medicine
Nova Scotia Provincial Blood Coordinating Team**

**Nova Scotia Guideline for Blood
Component Utilization in Adults and
Pediatrics**

**September 2021
Version 2.1**

PROMOTING EXCELLENCE IN TRANSFUSION MEDICINE

<http://www.cdha.nshealth.ca/nova-scotia-provincial-blood-coordinating-team>

Developed by the Nova Scotia Appropriate Blood Components Working Group

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1. BACKGROUND

The Nova Scotia Provincial Blood Coordinating Team (NSPBCT) under the Pathology and Laboratory Medicine Program provides leadership in collaborating with healthcare providers across the province and Canadian Blood Services (CBS) to maximize the safe and appropriate management of blood and blood products for patients in Nova Scotia. The NSPBCT maintains a surveillance program for adverse events related to transfusion therapy while ensuring appropriate standards for blood-transfusion therapy are being implemented and maintained with Nova Scotia health-care facilities.

These guidelines were developed based on the advice of the Appropriate Blood Components Working Group (ABC Working Group) consisting of physicians with expertise in hematology, orthopedics, multi-organ transplant, emergency medicine, trauma, CBS, transfusion medicine, anesthesiology, surgery, critical care, general practitioners, pediatrics and obstetrics/gynecology. Appendix A provides the membership of this group.

The National Advisory Committee on Blood and Blood Products (NAC) consists of a national group of clinicians that collaborates with and provides advice on the utilization management of blood and blood products and transfusion medicine practice to the provincial and territorial (PT) Ministries of Health and Canadian Blood Services (CBS). In April 2013, NAC endorsed the guidelines set forth in the document Red Blood Cell Transfusion: A Clinical Practice Guideline from the AABB (formally known as the American Association of Blood Banks) as they were most reflective of the current practice in Canada and therefore would be most palatable to a Canadian physician. These AABB guidelines include recommendations for the pediatric setting. In 2016, the AABB published the Clinical Practice Guidelines from the AABB: Red Blood Cell Transfusion Thresholds and Storage. Revisions in the Nova Scotia Guideline for Blood Component Utilization in Adults and Pediatrics Version 2.0 are based on the AABB recommendations.

A review of published literature and an environmental scan of Canadian and international plasma and cryoprecipitate guidelines provided the recommendations in this guideline. The ABC Working Group was convened to provide expert opinion for the guideline and it was presented to stakeholders within Nova Scotia and their feedback was incorporated.

In 2014, AABB developed evidence based guidelines for the prophylactic use of platelets for adult patients who are candidates for platelet transfusion. The BC Medical Journal and the British Journal of Hematology both provide guidelines for platelet use. The ABC Working Group convened to review the evidence and developed guidelines for Nova Scotia.

2. INTRODUCTION

The Nova Scotia RBC Working Group was established in July 2013 with a goal to develop/adopt tools for the appropriate utilization of red blood cells in Nova Scotia. Based on the recommendations from NAC and Choosing Wisely Canada, that a single unit red cell transfusion should be the standard for non-bleeding, hospitalized patients; a retrospective audit was conducted. The results of the audit found 7.1% of the RBC units transfused were inappropriate. The NSPBCT supported implementation of one red cell unit at a time as per its strategic plan.

The ABC Working Group was formed in 2015 with an objective to develop guidelines that will provide standardized clinical guidance to healthcare professionals on best practice pertaining to the appropriate triggers and use of plasma, cryoprecipitate and platelet transfusions.

3. GUIDELINE DEVELOPMENT

The objective of these guidelines is to provide clinical guidance to healthcare professionals on best practice pertaining to the appropriate use of blood components and restrictive transfusion triggers for adults and children.

3.1. DEFINITIONS

Actively bleeding: the presence of an overt discharge of blood occurring either grossly (e.g. gastrointestinal bleeding) or internally (e.g. retroperitoneal bleeding seen on imaging).

Acute coronary syndrome: cardiac conditions where there is a sudden reduced flow of blood to the heart i.e. angina, myocardial infarction. (Mayo Clinic)

Adult: in this guideline, an adult is any person 17 years and older.

AFFP:(Apheresis Fresh Frozen Plasma): plasma collected by apheresis from the blood of an individual donor and frozen within 8 hours of collection.

Apheresis: “the process of withdrawing blood from a donor, separating specific blood components from the blood and returning the remaining blood components to the donor.”⁴

Blood component: a therapeutic component of blood intended for transfusion (e.g. red cells, granulocytes, platelets, plasma, etc.) that can be prepared using the equipment and techniques (centrifugation, filtration, freezing) available at a blood center.

Blood product: any therapeutic product, derived from blood or plasma, and produced by a manufacturing process that pools multiple units (usually more than 12) (e.g. human serum albumin, immunoglobulin preparations and coagulation products, etc.)

Cryoprecipitate: a plasma component prepared from slowly thawed frozen plasma and centrifuged to separate the insoluble cryoprecipitate. The cryoprecipitate is removed and then refrozen. Cryoprecipitate is a source of fibrinogen (greater than or equal to 150 mg/unit), coagulation factors VIII, XIII and von Willebrand factor.

Cryosupernatant Plasma (CSP): plasma from which cryoprecipitate has been removed. Cryosupernatant Plasma (CSP) is mentioned for specific indications only.

Fibrinogen Deficiency: types of deficiency

- a. **Afibrinogenemia:** complete absence of fibrinogen (less than 0.2 g/L of plasma)
- b. **Hypofibrinogenemia:** lower than normal fibrinogen level (between 0.2 g/L and 1.5 g/L)
- c. **Dysfibrinogenemia:** normal fibrinogen level (between 2 and 4 g/L), but the fibrinogen does not function properly.

FP (Frozen Plasma): plasma collected from the blood of an individual donor and frozen within 24 hours of collection.

INR (International Normalized Ratio): derived from prothrombin time (PT) which is calculated as a ratio of the patient’s PT to a control PT standardized for the potency of the thromboplastin reagent developed by the World Health Organization (WHO). 38

Life-threatening / major bleeding:

- a. hemorrhage resulting in airway compromise
- b. hemorrhage with a drop in Hgb of greater than or equal to 20 g/L or requiring transfusion of 2 units of RBC
- c. major trauma
- d. critical site bleeding (e.g. intracranial, retroperitoneal, intra-spinal, intra-ocular, intra-articular or pericardial, ruptured abdominal aortic aneurysm, acute dissection, intramuscular with compartment syndrome), or
- e. actual or impending hemodynamic compromise (e.g. massive or unstable gastrointestinal bleed not responding to initial resuscitation).

Minor Surgery/Invasive Procedure: major body cavities are not opened — surgery to superficial structures of the body or manipulative procedure. Minor surgery can involve the use of local, regional or general anesthesia.

Major Surgery/Invasive Procedure: involves opening a major body cavity, abdomen (laparotomy), chest (thoracotomy) or skull (craniotomy) and can stress vital organs.

One Unit at a Time Policy: hospital policies require a clinical reassessment followed by a repeat hemoglobin measurement, if required, for all hemodynamically stable patients before they may be transfused with a second or subsequent red blood cell unit. There are exemptions from this policy.

Pre-existing cardiovascular disease: having a prior history of cardiac disease i.e. myocardial infarction, coronary artery disease, arrhythmia, congestive heart failure, congenital heart defects. (Mayo Clinic)

Restrictive Transfusion Trigger: the hemoglobin value at which physicians in Nova Scotia may consider transfusion for stable hospitalized inpatients. The Nova Scotia Red Blood Cell Clinical Expert Working Group has set this level at 70 g/L. Not all patients will require transfusion at this level. Well compensated patients tolerate much lower hemoglobin levels while patients with symptoms of anemia may require a transfusion when hemoglobin is above this threshold.

S/D Plasma (Solvent Detergent-treated Plasma): plasma treated with solvent detergent reagents producing a virus inactivated product. The S/D process inactivates enveloped viruses (HIV, HBV and HCV) but has no effect on the non-enveloped viruses (HAV, parvovirus B19). S/D Plasma is mentioned for specific indications only.

4. GUIDELINES

4.1. RED BLOOD CELLS (RBCS)

Hemoglobin levels must be obtained within 24 hours of the request with the exception of outpatients which must be obtained within 96 hours of the request.

The following patient conditions are exempt from the RBC guideline:

- Actively bleeding, massively bleeding and suspected bleeding
- Acute coronary syndrome
- Pediatric patients less than four months (corrected age)
- Intrauterine transfusions
- Chronically transfused / Sickle Cell

The following indications and dosing recommendations are illustrated on the RBC Transfusion Pathway in Appendix B.

Adult Indications and Dosing

Hemoglobin Level and Indications	Recommendation and Dose
Less than or equal to 70 g/L	Transfuse 1 unit and re-check patient symptoms and hemoglobin prior to transfusing a 2 nd unit
Outpatient or a patient undergoing dialysis and hemoglobin less than or equal to 70 g/L	Transfuse as requested
Less than or equal to 80 g/L with one or more of the following: <ul style="list-style-type: none"> • Pre-existing cardiovascular disease • Hematology/Oncology patient with chemotherapy-induced cytopenia • Undergoing orthopedic surgery or cardiac surgery 	Transfuse as requested
Patient is undergoing radiation therapy and hemoglobin less than or equal to 100 g/L	Transfuse as requested
Obstetrical patient with a high risk of postpartum hemorrhage and hemoglobin is between 80 g/L and 100 g/L	Discuss with Medical Director or designate on call. Requests for RBCs may be appropriate

Indications and Dosing For Pediatric Patients Greater than 4 Months Corrected Age

Hemoglobin Level and Indications	Recommendation and Dose
Stable patient with hemoglobin greater than 50 g/L and up to 70 g/L	Transfuse 10-15 mL/kg PRBCs over a recommended time of 3.5 hours and re-check patient symptoms and hemoglobin prior to transfusing again
Stable patient with hemoglobin less than or equal to 50 g/L	Transfuse 10% of pre-transfusion hemoglobin level in mL/kg over a recommended time of 3.5 hours and re-check patient symptoms and hemoglobin prior to transfusing again (EXAMPLE: If pre-transfusion hemoglobin level is 40 g/L, then initial infusion rate is 4 mL/kg IV over a recommended time of 3.5 hours)
Patient is hematology/oncology patient with chemotherapy-induced cytopenias with hemoglobin less than or equal to 80 g/L	Transfuse 10-15 mL/kg PRBCs over a recommended time of 3.5 hours and re-check patient symptoms and hemoglobin prior to transfusing again
Patient is undergoing radiation therapy and hemoglobin less than or equal to 100 g/L	Transfuse as requested

- For hemodynamically stable patients (adult and pediatric) a transfusion threshold of 70 g/L is appropriate.
- For adult and pediatric hematology/oncology patients with chemotherapy-induced cytopenia, a transfusion threshold of 80 g/L is considered appropriate, until further evidence becomes available.
- Transfusion may not be required in well compensated patients, such as those with chronic anemia, vitamin B12 deficiency or iron deficiency anemia, or where other therapies are available even when hemoglobin levels are below 70 g/L.
- The ordering clinician shall be aware of recipient risk factors for transfusion associated circulatory overload (TACO) and tactics to reduce risk as outlined in appendix F in the [NSHA CL-BP-030, IWK-625 Blood Component and Blood Product Administration](#)

4.2. PLASMA

Exempted from the plasma guideline are massively bleeding patients and pediatric patients less than four months (corrected age).

Levels of factor V and factor VIII may be reduced in Frozen Plasma (FP) compared to Apheresis Fresh Frozen Plasma (AFFF). Both plasma components contain all clotting factors.

The following indications are illustrated on the *Ordering Algorithm for Plasma in Appendix C*.

Indication	Specific Criteria	Recommendation and Dose
Bleeding or requiring an invasive or operative procedure within 6 hours	<ul style="list-style-type: none"> – INR is greater than 1.7 – not on a vitamin K antagonist (e.g. Warfarin), low molecular weight heparin (LMWH), unfractionated heparin (UFH), direct oral anticoagulant (DOAC) or other anticoagulants 	<p>Adult dose: 10-15 mL/kg, e.g. a 75 kg adult would require 3-4 units of FP (250 mL/unit)</p> <p>Pediatric dose: 10-15 mL/kg</p>
	<p>NOTE:</p> <ul style="list-style-type: none"> – Plasma requirements may increase when a consumptive process is ongoing – Prothrombin Complex Concentrate (PCC) (octaplex® or Beriplex®P/N) are recommended for adult patients on vitamin K antagonists with an INR greater than or equal to 1.7 and are bleeding or require a surgery/invasive procedure within 6 hours. There is insufficient published evidence to recommend the routine use of PCCs in the pediatric population. Consultation with a pediatric hematologist/oncologist is required (Refer to the <i>Nova Scotia Guideline for the Use of Prothrombin Complex Concentrates in Patients on Vitamin K Antagonists and Direct Oral Anticoagulants</i>) – Protamine sulfate is the treatment for prolonged aPTT (activated partial thromboplastin time) from heparin (if the patient is bleeding or will be undergoing an invasive procedure) 	
Treatment of congenital or acquired thrombotic thrombocytopenic purpura	Dosing determined by patient’s plasma volume	

(TTP) and adult hemolytic uremic syndrome (HUS)	<p>NOTE:</p> <ul style="list-style-type: none"> – Plasma may also be indicated in therapeutic plasma exchange (TPE) if the INR is initially elevated or becomes elevated after repeated TPEs or when the TPE occurs shortly after a surgical procedure – CSP may be used for this indication – S/D plasma is indicated for patients who require a high volume of transfusions annually because they have TTP, HUS with associated factor H deficiency or clotting factor deficiencies for which specific licensed concentrates may not be readily available (e.g. factor V, factor XI, factor XIII) and who: <ul style="list-style-type: none"> <i>i. have experienced a severe allergic reaction to FP or</i> <i>ii. have a pre-existing lung disorder or</i> <i>iii. need FP but a blood group compatible product is not available in a timely manner</i> 	
Indication	Specific Criteria	Recommendation and Dose
Disseminated intravascular coagulopathy (DIC)	<ul style="list-style-type: none"> • INR greater than 1.7 • Life-threatening bleeding 	Adult dose – 10-15 mL/kg, Pediatric dose – 10-15 mL/kg
Coagulation factor replacement when a factor concentrate is not available (e.g. Factor II, Factor V, Factor X deficiency) or the factor concentrate is contraindicated (e.g. Factor XI deficiency in a patient with high thrombotic risks)	<ul style="list-style-type: none"> • INR greater than 1.7 or an aPTT greater than 1.5 times normal • bleeding or scheduled for an invasive or surgical procedure 	<p>Contact the Bleeding Disorder Clinic</p> <p>Adult: 902-473-5612 (after hours – contact the hematologist on call 902-473-2222)</p> <p>Pediatric: 902-470-8752 (after hours – contact the hematologist on call 902-470-8888)</p>

- The ordering clinician shall be aware of recipient risk factors for transfusion associated circulatory overload (TACO) and tactics to reduce risk as outlined in appendix F in the [NSHA CL-BP-030, IWK-625 Blood Component and Blood Product Administration](#).

NOTE:

The anticoagulant effect of the following antithrombotics will not be reversed by the administration of vitamin K or plasma – DO NOT transfuse plasma to reverse an elevated aPTT or INR.

- Direct thrombin inhibitors:
 - Argatroban (Argatroban®), Bivalirudin (Angiomax®), Dabigatran (Pradax®)
- Factor Xa inhibitors:
 - Direct – Apixaban (Eliquis®), Edoxaban (Lixiana®), Rivaroxaban (Xarelto®)
 - Indirect – Fondaparinux (Arixtra®)

4.3. CRYOPRECIPITATE

Exempt from the cryoprecipitate guideline are massively bleeding patients and pediatric patients less than four months (corrected age).

A fibrinogen level is required for cryoprecipitate appropriateness.

Cryoprecipitate provides a source of fibrinogen, coagulation factors VIII, XIII, von Willebrand factor (AHF-VWF) and fibronectin.

Indication	Specific Criteria	Recommendation
Congenital fibrinogen deficiency	<ul style="list-style-type: none"> • bleeding or the risk of bleeding AND fibrinogen concentrate is NOT available • fibrinogen level less than 1.5 g/L 	Consultation with the Bleeding Disorder Clinic is suggested Adult: 902-473-5612 (after hours – contact the hematologist on call 902-473-2222) Pediatric: 902-470-8752 (after hours – contact the hematologist on call 902-470-8888)
Acquired hypofibrinogenemia	<ul style="list-style-type: none"> • bleeding • fibrinogen levels less than 1.5g/L Note: Fibrinogen concentrate is an approved alternative for cryo in this situation	In bleeding Adults: 10 units will provide 1.2-1.8 g of fibrinogen. One unit of cryoprecipitate per 10 kg body weight will raise the plasma fibrinogen by approximately 0.5 g/L Pediatric dosing: 1 unit per 10 kg body weight or 6 units/m ²
Acquired hypofibrinogenemia with DIC	<ul style="list-style-type: none"> • bleeding • fibrinogen levels less than 1.5 g/L • if fibrinogen levels are greater than 1.5 g/L in the setting of active bleeding secondary to DIC, consider FP instead of cryoprecipitate to address the multiple factor deficiencies typical of DIC Note: Fibrinogen concentrate is an approved alternative for cryo in this situation	
Acquired hypofibrinogenemia in postpartum hemorrhage	<ul style="list-style-type: none"> • bleeding • <i>consider</i> fibrinogen replacement when the fibrinogen level is greater than or equal to than 2 g/L • <i>require</i> fibrinogen replacement when the fibrinogen level is less than 2 g/L 	

<p>Specific factor deficiencies:</p> <ul style="list-style-type: none"> • von Willebrand (vWD) disease • Hemophilia A (HA) • Factor XIII deficiency 	<ul style="list-style-type: none"> • Cryoprecipitate is not the first choice for treatment and should <u>ONLY be considered</u> if the specific factor product is <u>NOT</u> available <u>AND</u> bleeding or requiring an invasive procedure 	<p>Consultation with the Bleeding Disorder Clinic is suggested</p> <p>Adult: 902-473-5612 (after hours – contact the hematologist on call 902-473-2222)</p> <p>Pediatric: 902-470-8752 (after hours – contact the hematologist on call 902-470-8888)</p>
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Fibrinogen replacement therapy “plays an important role in the management of bleeding in cardiac surgery, trauma and obstetrical bleeding”²⁶ however there is limited evidence providing the optimal dose or the optimal replacement product (cryoprecipitate or fibrinogen concentrate).

4.4. PLATELETS

Exempt from the platelet guideline are massively bleeding patients and pediatric patients less than four months (corrected age).

Platelet counts must be obtained within 24 hours of the request with the exception of outpatients which must be obtained within 96 hours of the request.

There is a lack of evidence to suggest a special platelet threshold is required for antiplatelet therapy patients.

Indication	Platelet Count	ADULT Recommendation and Dose
<ul style="list-style-type: none"> • Immune thrombocytopenia purpura (ITP) with major bleeding • Bone marrow failure • Hematopoietic stem cell transplantation/chemotherapy • Therapy-induced hypoproliferative thrombocytopenia 	<p>Less than $10 \times 10^9/L^*$</p> <p>* Platelet counts less than $15 \times 10^9/L$ are appropriate where platelets are not stocked.</p>	<p>1 unit</p>
<p>NOTE – The trigger for platelet transfusion may be higher when the patient’s platelet count <u>must</u> be a specific level, as determined by the treatment protocol, for chemotherapy administration or concurrent anticoagulation.</p>		
<ul style="list-style-type: none"> • Elective central venous catheter placement in internal jugular vein or femoral vein • Non-surgical invasive procedures including paracentesis, thoracentesis other than epidural anesthesia or lumbar puncture 	<p>Less than $20 \times 10^9/L$</p>	<p>1 unit</p>
<p>NOTE – Interventional Radiology may require higher platelet level triggers/targets to perform a procedure.</p>		
<ul style="list-style-type: none"> • Elective central venous catheter placement in subclavian vein • Elective diagnostic lumbar puncture • Major elective non-neuraxial surgery • Other significant bleeding 	<p>Less than $50 \times 10^9/L$</p>	<p>1 unit</p> <p>If related to procedure, administer 1 unit immediately before procedure and recheck platelet count again before starting procedure</p>
<ul style="list-style-type: none"> • Head trauma or CNS hemorrhage • CNS surgery 	<p>Less than $100 \times 10^9/L$</p>	<p>1 unit and check platelet count</p>

Indication	Platelet Count	Pediatric Patients Greater Than 4 Months Corrected Age Recommendation and Dose
<ul style="list-style-type: none"> • Immune thrombocytopenia purpura (ITP) with major bleeding • Bone marrow failure • Hematopoietic stem cell transplantation/chemotherapy • Therapy-induced hypoproliferative thrombocytopenia 	<p>Less than $10 \times 10^9/L^*$</p> <p>* Platelet counts less than $15 \times 10^9/L$ are appropriate where platelets are not stocked.</p>	<p>Body weight less than or equal to 20 kg, give 10-15 mL/kg</p> <p>Body weight greater than 20 kg, give 1 unit of platelets</p>
<ul style="list-style-type: none"> • Severe mucositis • Sepsis • DIC in the absence of bleeding • Anticoagulant therapy • Risk of bleeding due to local tumor infiltration • Insertion of non-tunneled CVL 	<p>Less than or equal to $20 \times 10^9/L$</p>	<p>Body weight less than or equal to 20 kg, give 10-15 mL/kg</p> <p>Body weight greater than 20 kg, give 1 unit of platelets</p>
<ul style="list-style-type: none"> • Elective central venous catheter placement in subclavian vein • Elective diagnostic lumbar puncture • Major elective non-neuraxial surgery • Other significant bleeding 	<p>Less than or equal to $50 \times 10^9/L$</p>	<p>Give the following immediately before procedure and recheck platelet count again before starting procedure:</p> <p>Body weight less than or equal to 20 kg, give 10-15 mL/kg</p> <p>Body weight greater than 20 kg, give 1 unit of platelets</p>
<ul style="list-style-type: none"> • Head trauma or CNS hemorrhage • CNS surgery 	<p>Less than or equal to $100 \times 10^9/L$</p>	<p>Body weight less than or equal to 20 kg, give 10-15 mL/kg</p> <p>Body weight greater than 20 kg, give 1 unit of platelets</p>

- Platelet transfusions are indicated for prophylaxis against bleeding or for management of acute bleeding in patients with thrombocytopenia or platelet dysfunction
- In general 1 unit raises the platelet count by approximately $15-25 \times 10^9/L$

5. REFERENCES

1. American Red Cross (2002/2007) Practice Guidelines for Blood Transfusion-A compilation from Recent Peer-Reviewed Literature. Second Edition.
https://www.sld.cy/galerias/pdf/sitios/anestesiologia/practical_guidelines_blood_transfusion.pdf
2. O'Shaughnessy, DF., Atterbury, C., Bolton Maggs, P., Murphy, M., Thomas, D., Yates, S., & Williamson, LM. (2004). Guidelines for the use of fresh-frozen plasma, cryoprecipitate and cryosupernatant. *Br J Haematol.* 2004 Jul;126(1):11-28
doi:10.1111/j.1365-2141.2004.04972.x
3. Canadian Blood Services (2018) Circular of Information – Plasma Components (FFPA, FP CPD, Cryosupernatant CPD and Cryoprecipitate CPD)
https://www.blood.ca/sites/default/files/Plasma_COI_1000104990_2018-08-27.pdf
4. Canadian Standards Association (CSA) (2015) Blood and Blood Components – CAN/CSA-Z902-15 Toronto, Ontario
5. Carson, JL., Guyatt, G., Heddle, NM., Grossman, BJ., Cohn, CS., Fung, MK., ..., & Tobian, AA. (2016). Clinical Practice Guidelines from the AABB – Red Blood Cell Transfusion Thresholds and Storage. *JAMA* 2016 Nov 15;316(19):2025-2035
doi:10.1001/jama.2016.9185.
6. Clarke, G. (2017). Clinical Guide to Transfusion – Chapter 2 *Canadian Blood Services*
<https://professionaleducation.blood.ca/en/transfusion/clinical-guide-transfusion>
7. Choosing Wisely Canada (2017). Canadian Society for Transfusion Medicine: Ten things physicians and patients should question <https://www.choosingwiselycanada.org/transfusion-medicine/>
8. Collins, PW., Lilley, G., Bruynseels, D., Laurent, DB., Cannings-John, R., Precious, E., ..., & Collis, RE. (2014). Fibrin-based clot formation as an early and rapid biomarker for progression of postpartum hemorrhage: a prospective study. *BLOOD.* 2014 Sep 11;124(11):1727-36
doi:10.1182/blood-2014-04-567891
9. Cortet, M., Deneux-Tharoux, C., Dupont, C., Colin, C., Rudigoz, RC., Bouvier-Colle, MH., & Huissoud, C. (2012). Association between fibrinogen level and severity of postpartum haemorrhage: secondary analysis of a prospective trial. *Br J of Anaesth.* 2012 Jun;108(6):984–9
doi:10.1093/bja/aes096
10. Droubatchevskaia, N., Wong, MP., Chipperfield, KM., Wadsworth, LD., Ferguson, DJ., & Transfusion Medical Advisory Group of BC. (2007). Guidelines for cryoprecipitate transfusions. *BC Medical Journal BCMJ*, vol. 49, no. 8, October 2007, pages 441-445 Clinical Articles
11. Guidelines and Audit Implementation Network (GAIN) (March 2009) “Better Use of Blood in Northern Ireland: Guidelines for Blood Transfusion Practice”
<https://www.rquia.org.uk/RQIA/files/86/869407e5-fc5c-4eaa-b74a-ec0998fb6a08.pdf>

12. Recommendations for Red Blood Cell Transfusion. British Columbia Transfusion Medicine Advisory Group (2014)
https://pbco.ca/images/Blood_Products/Red_Blood_Cells/BC_Recommendations_for_RBC_Trans
13. New, HV., Berryman, J., Bolton-Maggs, PHB., Cantwell, C., Chalmers, EA., Davies, T., & Stanworth, SJ., on behalf of the British Committee for Standards in Haematology. (2016). Guidelines on transfusion for fetuses, neonates and older children. *British Journal of Haematology* Volume 175, Issue 5 December 2016, pages 784–828
14. Hunt, BJ. (2014). Bleeding and Coagulopathies in Critical Care. *New England Journal of Medicine* 2004;370:847-859
doi:10.1056/NEJMra1208626
15. Iorio, A., Basileo, M., Marchesini, E., Materazzi, M., Marchesi, M., Esposito, A., ..., & Silvani, CM. (2008). The good use of plasma. A critical analysis of five international guidelines. *Blood Transfus.* 2008 Jan;6(1):18-24
16. Kaufman, RM., Djulbegovic, B., Gernsheimer, T., Kleinman, S., Tinmouth, AT., Capocelli, KE., ..., & Tobian, AA. (2015) AABB Platelet Transfusion: A Clinical Practice Guideline from the AABB. *Ann Intern Med.* 2015 Feb 3;162(3):205-13
doi:10.7326/M14-1589
17. Labarinas, S., Arni, D., & Karam, O. (2013). Plasma in the PICU: why and when should we transfuse? *AnnIntensive Care.* 2013;3:16
doi:10.1186/2110-5820-3-16
18. Lauzier, F., Cook, D., Griffith, L., Upton, J., & Crowther, M. (2007). Fresh-frozen plasma transfusion in critically ill patients. *Crit Care Med.* 2007 Jul;35(7):1655-9
19. Levy, JH., & Goodnough, LT. (2015). How I use fibrinogen replacement therapy in acquired bleeding. *Blood.* 2015 Feb 26;125(9):1387-93
doi:10.1182/blood-2014-08-552000
20. Lin, Y., & Foltz, LM. (2005). Proposed Guidelines for Platelet Transfusion. *MJ*, Vol. 47, No. 5, June 2005; pages 245-248 Clinical Articles
21. Liumbruno, G., Bennardello, F., Lattanzio, A., Piccoli, P., Rossetti, G., & as Italian Society of Transfusion Medicine and Immunohaematology (SIMTI) Working Party. (2009). Recommendations for the transfusion of plasma and platelets. *Blood Transfus.* 2009 Apr; 7(2):132-150
doi:10.2450/2009.005-09
22. Factor I deficiency (Fibrinogen deficiency) – Canadian Hemophilia Society
<https://www.hemophilia.ca/factor-i-deficiency-fibrinogen-deficiency/>
23. NAC Companion Document to: “Red Blood Cell Transfusion: A Clinical Practice Guideline from the AABB” (2014) National Advisory Committee on Blood and Blood Products
<https://www.nacblood.ca/resources/guidelines/Companion-Documents-May-28-2014.pdf>
24. National Advisory Committee (NAC) on Blood and Blood Products (2015) Framework for Appropriate Use and Distribution of Solvent Detergent Treated Plasma in Canada

<https://www.nacblood.ca/resources/guidelines/downloads/SD%20Plasma/SD-plasma.pdf>

25. National Advisory Committee on Blood and Blood Products, http://www.nacblood.ca/resources/shortages-plan/National_Plan_October72015.pdf
26. National Advisory Committee on Blood and Blood Products (2018) NAC Statement on Fibrinogen Concentrate
https://www.nacblood.ca/resources/guidelines/downloads/NAC_fibrinogen_concentrate_FINAL.
27. Northrup, PG., & Caldwell, SH. (2013). Coagulation in Liver Disease: A Guide for the Clinician. *Clin GastroenterolHepatol* 2013 Sep;11(9):1064-74
doi:10.1016/j.cgh.2013.02.026
28. Nova Scotia Provincial Blood Coordinating Program (2016) *Guideline for Prothrombin Complex Concentrate Utilization in Nova Scotia Version 3.0*
<https://www.cdha.nshealth.ca/nova-scotia-provincial-blood-coordinating-program-7>
29. Nova Scotia Provincial Blood Coordinating Program (2013) *Guideline for the Appropriate Use of Blood Components/Products during a Massive Transfusion in Nova Scotia Version 2.0*
<https://www.cdha.nshealth.ca/nova-scotia-provincial-blood-coordinating-program-7>
30. Octapharma Canada, Inc. (2016) Octaplasma™ Product Monograph. Toronto, Ontario
https://www.octapharma.ca/fileadmin/user_upload/octapharma.ca/Product_Monographs/OCTAPLASMA-PM.pdf
31. Pinkerton, PH., & Callum, JL. (2010). Rationalizing the clinical use of frozen plasma *CMAJ* 2010 Jul 13;182(10):1019-1020
doi:10.1503/cmaj.081933
32. Roback, JD., Caldwell, S., Carson, J., Davenport, R., Drew, MJ., Eder, A., ..., & American Society of Hematology. (2010). Evidence-based practice guidelines for plasma transfusion *Transfusion* 2010 Jun;50(6):1227-39
doi:10.1111/j.1537-2995.2010.02632.x.
33. Rahe-Meyer, N., & Sørensen, B. (2011). Fibrinogen concentrate for management of bleeding. *J Thromb Haemost* 2011 Jan;9(1):1-5
doi:10.1111/j1538-7836.2010.04099.x.
34. Carson, JL., Guyatt, G., Heddle, NM., Grossman, BJ., Cohn, CS., Fung, MK., ..., & Tobian, AA. (2016). Clinical Practice Guideline from the AABB: Red Blood Cell Transfusion Thresholds and Storage. *JAMA*. 2016 Nov 15;316(19):2025-2035
doi:10.1001/jama.2016.9185.
35. Runyon, BA., & AASLD Practice Guidelines Committee. (2009). Management of Adult Patients with Ascites due to Cirrhosis: An Update. *Hepatology* 2009 Jun;49(6):2087-107
doi:10:1002/hep.22853
36. Scully, M., Hunt, BJ., Benjamin, S., Liesner, R., Rose, P., Peyvandi, F., ..., & British Committee for Standards in Haematology. (2012). Guidelines on the diagnosis and management of thrombotic thrombocytopenic purpura and other thrombotic microangiopathies. *Br J of Haematol*. 2012 Aug;158(3):323-35

doi:10.1111/j.1365-2141.2012.09167.x.

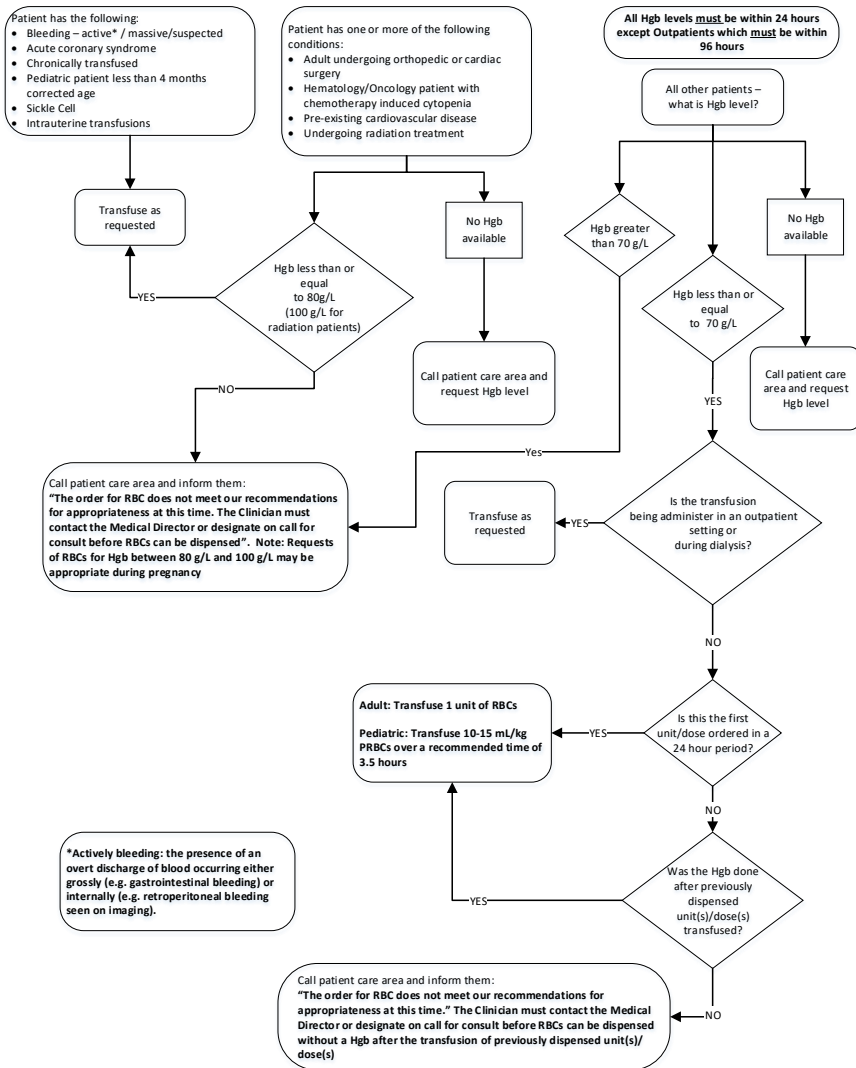
37. Shih, A., & Arnold, DM. (2015). Plasma transfusion trials and tribulations. *Transfusion* 2015;55:14-16
<https://onlinelibrary.wiley.com/doi/pdf/10.1111/trf.12886>
38. Shikdar, S., & Bhattacharya, P. (2019) International Normalized Ratio (INR)
<https://www.ncbi.nlm.nih.gov/books/NBK507707/>
39. Szczepiorkowski, ZM., & Dunbar, NM. (2013). Transfusion guidelines: when to transfuse. *Hematology Am Soc Hematol Educ Program*. 2013;2013:638-44
doi:10.1182/asheducation-2013.1.638
40. Tavares, M., DiQuattro, P., Nolette, N., Conti, G., & Sweeney, J. (2010). Reduction in plasma transfusion after enforcement of transfusion guidelines (CME) <https://doi.org/10.111/j.1537-2995.2010.02900.x>
41. Tinmouth, A. (2012). Evidence for a rationale use of frozen plasma for the treatment and prevention of bleeding. *Transfus Apher Sc* 2012 Jun;46(3):293-8 doi:10:1016/j.transci.2012.03.019.
42. Tinmouth, A., Thompson, T., Arnold, DM., Callum, JL., Gagliardi, K., Lauzon, D., ..., & Pinkerton, P. (2013). Utilization of frozen plasma in Ontario: a province wide audit reveals a high rate of inappropriate transfusions. *Transfusion* 2013 Oct;53(10):2222-9 doi:10.1111/trf.12231
43. Wong, MP., Droubatchevskaia, N., Chipperfield, KM., Wadsworth, LD., & Ferguson, DJ. (2007). Guidelines for frozen plasma transfusion. *BCMJ*, Vol. 49 (No. 6), 2007, 311-319

APPENDIX A – APPROPRIATE BLOOD COMPONENTS WORKING GROUP (ABC WG)

The Nova Scotia Provincial Blood Coordinating Team (NSPBCT) acknowledges the tremendous and diligent work of the provincial ABC Working Group for providing valuable expertise in the development of this guideline.

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APPENDIX B – NOVA SCOTIA RED BLOOD CELL TRANSFUSION PATHWAY



APPENDIX C – ORDERING ALGORITHM FOR PLASMA

