

bloody easy

Blood Administration Version 3

A Handbook for Health Care Professionals

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The Bloody Easy Blood Administration Handbook is a comprehensive reference to support evidence-based, best practice, safe transfusion care for all patients in Ontario.

Resources central to the development of this handbook include:

- ▲ Health Canada's Blood Regulations governing blood collection, testing, processing, and distribution [1]
- ▲ The Canadian Standards Association, Standard CSA Z902 - Blood and Blood Components which details requirements to ensure safe transfusion practice [2]
- ▲ The Canadian Society for Transfusion Medicine published standards (aligning with Canadian Standards Association, Standard CSA Z902 - Blood and Blood Components) for hospital transfusion services [3]
- ▲ Canadian Blood Services, in addition to supplying blood components and blood products for all Canadians (except Quebec – Héma-Québec), provides information about their manufacturing processes, storage requirements and application in providing care to patients [4]
- ▲ Bloody Easy 4: Blood Transfusions, Blood Alternatives and Transfusion Reactions, fourth edition published in 2016 by Dr. J.L. Callum and expert Transfusion Medicine colleagues, endorses evidence-based transfusion practice [5]



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This handbook provides information to:

- ▲ Describe the production of blood components and blood products (plasma protein products)
- ▲ Explain the ABO and Rh(D) blood group systems and the significance of ABO and Rh(D) compatibility
- ▲ Identify the best practice steps for safe administration of blood
- ▲ Recognize transfusion reactions (potential complications of transfusion) and their management

Of Note:

- ▲ As this Handbook is used, to clarify terminology refer to Appendix 1: Glossary of Terms/ Abbreviations (page 90).

- ▲ Items denoted with **A L E R T** indicate essential information; it is important not to deviate from the recommended practice.



- ▲ The Hospital icon is a reminder to consult your hospital policy and procedure for information specific to your facility.

To order copies of this handbook, visit <https://inventory.transfusionontario.org/>

For the Bloody Easy Blood Administration e-Learning course and competency assessment, visit <https://nurses.transfusionontario.org/>

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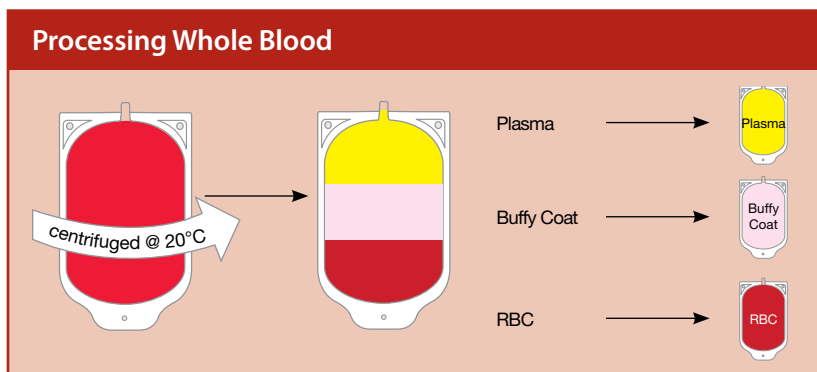
Blood Production

Blood production is a multifaceted process.

[4,5BE4(p11-3),6-7]

- ▲ Canadian Blood Services (CBS) collects blood and manufactures blood components.
- ▲ Volunteer blood donors are meticulously screened regarding their health, personal and travel history.
- ▲ At the venipuncture site, the blood donor’s skin is scrubbed with chlorhexidine and alcohol. The first 40 mL of blood is collected into a diversion pouch (the diverted blood is used for donor testing). These measures decrease the risk of bacterial contamination from the donor’s skin.
- ▲ Whole blood is collected into an anticoagulant solution (CPD [citrate, phosphate, dextrose]).
- ▲ After collection, each unit of whole blood is centrifuged or spun which creates 3 layers:
 - plasma
 - the buffy coat (contains platelets)
 - red blood cells

Each layer is then separated off and further processed to manufacture blood components.



- ▲ An additive solution, SAGM (saline, adenine, glucose, mannitol) is added to the red blood cells layer and the majority of white blood cells are removed by leukoreduction (a filtration process) to produce a RBC (red blood cell concentrate) unit for transfusion.

- ▲ The buffy coat layers from 4 ABO matched donors are pooled (combined) and resuspended in the plasma layer from 1 of the same 4 donors (a male donor; this is a component strategy to reduce TRALI [Transfusion Related Acute Lung Injury], for more information about TRALI refer to Acute Transfusion Reactions, section 3. Dyspnea [page 70]). The majority of white blood cells are removed by leukoreduction (a filtration process) to produce 1 adult dose of pooled platelets. All platelets are cultured for bacteria 36 hours after production. At the time platelets are issued to hospitals, the preliminary culture must be negative. If the culture becomes positive after issue, the hospital is notified.
- ▲ The plasma layer is frozen within 24 hours of the whole blood collection to produce frozen plasma (FP).
- ▲ FP can be slowly thawed and centrifuged to separate the insoluble proteins from the plasma. The supernatant plasma and insoluble proteins (along with about 5 mL of plasma) are refrozen to produce cryosupernatant plasma and cryoprecipitate.

Of Note:

- ▲ CBS must determine if platelets or cryoprecipitate will be manufactured from the collected whole blood; both platelets and cryoprecipitate cannot be manufactured from the same whole blood collection.
- ▲ Automated apheresis collection methods (individual component collected directly via a cell separator machine) are also used to collect apheresis platelets and apheresis plasma (apheresis fresh frozen plasma [AFFP]).
- ▲ Apheresis platelets are most often collected for patient specific requirements (human leukocyte antigen [HLA] or human platelet antigen [HPA] matched platelets).
- ▲ FP and AFFP can be used interchangeably.
- ▲ Blood components for transfusion include RBC, platelets, plasma, and cryoprecipitate.
- ▲ Plasma is also used to manufacture blood products (also called plasma protein products [PPP]) such as albumin, fibrinogen concentrate (FC), immunoglobulin: intravenous immunoglobulin (IVIg), immunoglobulin: subcutaneous immunoglobulin (SCIg), prothrombin complex concentrate (PCC), and Rh(D) immune globulin (RhIG).

Blood Group Systems

- ▲ Blood groups are genetically inherited. [4,9]
- ▲ In 1901, Dr. Karl Landsteiner identified antigens A and B on the surface of human red blood cells. He went on to classify the A, B, AB, and O blood groups and in 1937, the Rh(D) blood group (he was awarded a Nobel prize). [8]
- ▲ Determining the patient's ABO and Rh(D) group is essential to ensure compatible blood components are transfused. [4,9]

ABO Blood Group System

- ▲ The ABO blood group reflects the antigen(s) present on the surface of a person's red blood cells. [4,9]
- ▲ ABO antibodies are present in the plasma (these ABO antibodies are naturally acquired, starting at 4 months of age). [4,9]
- ▲ The ABO system [4,9]:
 - if the antigen is present on the surface of the red blood cells, then the corresponding antibody will NOT be in the plasma
 - if the antigen is NOT present on the red blood cells surface, then the corresponding antibody will be in the plasma

ABO Blood Group System			
ABO Blood Group	Population Frequency	ABO antigen on red blood cell surface	ABO antibody in plasma
O	45%	None	anti-A and anti-B
A	40%	A	anti-B
B	11%	B	anti-A
AB	4%	AB	None

ABO Compatibility

Anti-A and anti-B antibodies will hemolyse incompatible red blood cells (potentially fatal hemolytic transfusion reaction). [4,9]

A L E R T

For a compatible RBC transfusion [4,9]:

- The patient must receive RBC from an ABO blood group that does not have the antigen(s) to which that patient has an antibody(ies)
- The patient's plasma antibody(ies) will hemolyse the transfused RBC unit, if those red blood cells have the corresponding antigen(s) on their surface

A L E R T

For a compatible plasma transfusion [4,9]:

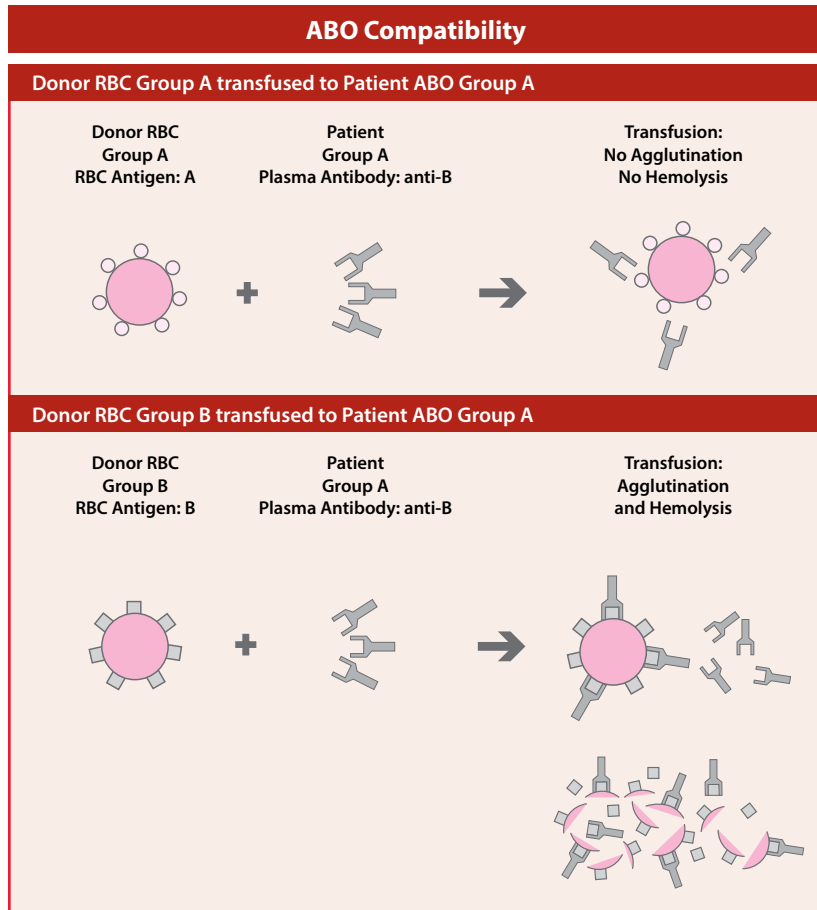
- The patient must receive plasma from an ABO blood group that does not have ABO antibody(ies) against the corresponding antigen(s) that is on the patient's red blood cells
- Antibody(ies) in the transfused plasma unit will hemolyse the patient's red blood cells, if the patient's red blood cells have the corresponding antigen(s)

Of Note:

- ▲ For platelets transfusion, the donor plasma in the platelets should be ABO compatible with patient's red blood cells. [4,9]

ABO Compatibility (cont'd)

A compatible RBC transfusion with no antigen/antibody agglutination or hemolysis as well as an incompatible transfusion with agglutination and hemolysis are reviewed in the diagram below. [10]



Rh(D) Blood Group System

The Rh(D) system, also known as the Rhesus system, is the second important blood group system.

The Rh(D) blood group system includes D, C, c, E, and e antigens. [4,9]

The most significant feature of a patient's Rh(D) blood group is the presence or absence of the D antigen on the surface of the red blood cells. [4,9]

- ▲ If the D antigen is present, the blood group is Rh(D) positive. [4,9]
- ▲ If the D antigen is absent, the blood group is Rh(D) negative. [4,9]

Rh(D) Compatibility

Unlike the ABO blood group system, in the Rh(D) blood group system, anti-D antibody develops in the plasma of an Rh(D) negative patient, ONLY if the patient is exposed to Rh(D) positive red blood cells. [4,9]

Exposure can occur through [4,9]:

- Transfusion of Rh(D) positive RBC
- Transfusion of Rh(D) positive platelets (platelets may contain small amounts of red blood cells)
- Pregnancy/Delivery of a Rh(D) positive fetus

Rh(D) Blood Group System			
Rh(D) Blood Group	Population Frequency	Rh(D) antigen on red blood cell surface	Rh(D) antibody in plasma
Rh(D) Positive	85%	D	None
Rh(D) Negative	15%	None	None, unless exposed to Rh(D) antigen (transfusion or pregnancy), then may produce anti-D

Plasma does not contain red blood cells and cannot expose recipients to the Rh(D) antigen. The Rh(D) blood group of plasma is not relevant for transfusion. [4,9]

For a compatible RBC transfusion, an Rh(D) negative patient should be transfused only Rh(D) negative RBC. [4,9]

A L E R T

Rh(D) Blood Group System and Pregnancy

- ▲ Pregnant Rh(D) negative females may develop the anti-D antibody through exposure to small amounts of blood from an Rh(D) positive fetus during pregnancy and at delivery. [4,9]
- ▲ Once present, anti-D antibody in the mother will cross the placenta and hemolyse the red blood cells of an Rh(D) positive fetus resulting in anemia, jaundice, brain damage, or death. This is known as Hemolytic Disease of the Fetus and Newborn (HDFN). [4,9]
- ▲ Pregnant Rh(D) negative females are given RhIG to prevent the development of anti-D antibody. [4,9]
For RhIG guidelines, refer to Appendix 4: Blood Components and Blood Products Table, section Rh(D) Immune Globulin (RhIG) (page 116).
- ▲ Rh(D) negative females age 45 years and under with childbearing potential should not be exposed to Rh(D) positive RBC to prevent the development of anti-D antibody. [2CSA(10.9.3.1)]

Urgent Transfusion (Bleeding Patient)

Urgent transfusion refers to clinical scenarios where transfusion is needed prior to completion of blood group and screen testing.

If a patient requires emergent/urgent RBC transfusion:

- Blood Bank/TML will issue Group O Rh(D) negative RBC for females age 45 years and under with childbearing potential until the patient's ABO and Rh(D) blood groups are determined [2CSA(10.9.3.1-2),3CSTM(5.3.7.4.4),11AC(20.10)]
- All males and females past childbearing potential will be issued Group O Rh(D) positive RBC until the patient's ABO and Rh(D) blood groups are determined [2CSA(10.9.3.1-2),3CSTM(5.3.7.4.4),11AC(20.10)]

The demand for Group O Rh(D) negative RBC often exceeds the supply, resulting in frequent supply shortages of Group O Rh(D) negative RBC.

Urgent Transfusion (Bleeding Patient) (cont'd)

Of Note:

- Females age 45 years and under with childbearing potential should be transfused antigen K (also known as K1 or Kell) negative RBC unless they are known to be K positive. [2CSA(10.7.4),11AC(20.8)]

For more information, refer to Transfusing RBC to Females age 45 years and under with Childbearing Potential (page 24).

If a patient requires emergent/urgent platelets transfusion:

- Blood Bank/TML will follow established policies for blood group based on available supply of platelets [2CSA(10.7.8),3CSTM(5.4.3.4),11AC(19.2)]

If a patient requires emergent/urgent plasma transfusion:

- Blood Bank/TML will issue Group AB plasma until the patient's ABO blood group is determined [2CSA(10.9.3.1-2),3CSTM(5.3.7.4.4),11AC(20.10)]

ABO and Rh(D) Blood Groups Summary

Refer to Appendix 2: ABO and Rh(D) Compatibility Chart for the summary (page 94).

Each ABO and Rh(D) blood group and the compatible blood groups for RBC, platelets, plasma, and cryoprecipitate transfusion are listed. [4,9,12]

Practice

To confirm your understanding, review Appendix 3: Practice your Learning: Blood Group Compatibility (page 96).

Patient situations are posed with opportunity to validate your responses.

A L E R T

Blood Components

Blood components (RBC, platelets, plasma, cryoprecipitate) are manufactured and provided to hospitals by CBS. [4]

RBC (Red Blood Cell Concentrate)

What [4,9]: Red blood cells transport oxygen from the lungs to the tissue cells. Oxygen is needed for tissue cells to carry out their functions in the body.

Platelets

What [4,9]: Platelets are another cellular component of blood suspended in plasma. They are the first responders in the clotting process to stop bleeding (form the platelet plug).

Plasma

What [4,9]: Plasma is the fluid part of the blood, comprising about 55% of whole blood. Plasma contains all the coagulation factors necessary for the clotting process to stop bleeding.

Cryoprecipitate

What [4,6 (Plasma Components 2019 Aug),9]: Cryoprecipitate is a component prepared from plasma. Cryoprecipitate contains fibrinogen, coagulation factors VIII and XIII, von Willebrand Factor, and Fibronectin. Fibrinogen is key to the clotting process (interacts with platelets and endothelial cells to form a blood clot) and stopping bleeding.

Blood Products

Blood products (also referred to as plasma protein products [PPP] or plasma derivatives) are manufactured from plasma that has been outsourced to commercial vendors. Blood products are then supplied to hospitals by CBS. [4]

Albumin

What [16-18]: Albumin is a manufactured solution of plasma protein (produced by the liver), that stabilizes blood volume and is a carrier of hormones, enzymes, and toxins.

Blood Products (cont'd)

Fibrinogen Concentrate (FC)

What [15,19,20]: FC is fibrinogen replacement manufactured from plasma. Fibrinogen is one of the specific plasma proteins which interacts with platelets and endothelial cells to form a blood clot to stop bleeding.

Immunoglobulin: Intravenous Immunoglobulin (IVIG)

What [21-26]: IVIG is a manufactured solution of human immunoglobulin proteins, with greater than 90% IgG. IVIG is administered intravenously. Several brands (most are a 10% solution; also, a lyophilized [powdered] 5% product) are available.

Immunoglobulin: Subcutaneous Immunoglobulin (SCIG)

What [27-30]: SCIG is a manufactured solution of human immunoglobulin proteins, with greater than 90% IgG. SCIG is administered subcutaneously, by patients in their home environment. Several brands (most are a 20% solution; also, a 16.5% solution product) are available.

Prothrombin Complex Concentrate (PCC)

What [31-3]: PCC is a manufactured plasma protein preparation containing all the essential vitamin K dependent coagulation factors (Factors II, VII, IX and X) and the thrombo-inhibitor proteins C and S; also contains anti-thrombin III and heparin.

Rh(D) Immune Globulin (RhIG)

What [36]: RhIG is a manufactured solution of the gamma globulin fraction of human plasma containing antibodies specific to the Rh(D) antigen.

Blood Components and Blood Products Summary

Refer to Appendix 4: Blood Components and Blood Products Table for main use, dose, lab tests, storage/expiration and administration information for the blood components and some blood products (page 98).

Informed Consent

Policies and procedures for informed consent are generally established by each hospital.

Often each hospital's informed consent policy and procedure incorporates [SBE4(p.14)]:

- ▲ Consent is obtained by the health care professional prescribing the treatment
- ▲ Consent is valid for the current course of treatment or hospital admission
- ▲ Documentation is completed on the patient's health record
- ▲ Defined criteria to determine the patient's capacity and possible need for a substitute decision maker. The legal age at which informed consent can be given is specific to each province's legislation.



Refer to your hospital's informed consent policy and procedure.

The Transfusion Medicine Standards for informed consent for blood component and blood product transfusion mandate that each hospital's specific policy and procedure is followed.

[2CSA(11.2.1),3CSTM(5.9.1.1),11AC(21.2)]

As well, standards necessitate that information is presented to the patient describing:

- ▲ The blood component or blood product to be transfused
- ▲ The reason the transfusion is needed, the benefits and risks of the proposed transfusion
- ▲ Any alternatives appropriate to the patient's clinical situation and their benefits and risks
- ▲ Potential consequences of not receiving the transfusion

An additional requirement is that opportunity is provided for the patient to ask questions and have any concerns addressed.

[2CSA(11.2.1),3CSTM(5.9.1.1),11AC(21.2)]

Of Note:

Refer to Appendix 5: Transfusion Risk Charts for information for health care professionals and for patients (page 118). [SBE4(p.42,44)]

Informed Consent (cont'd)

A L E R T

- ▲ **The transfusionist (regulated health care professional who administers blood transfusion, often a nurse) must confirm the informed consent policy and procedure has been fulfilled prior to beginning a transfusion.**

[2CSA(11.2.1),3CSTM(5.9.1.1),11AC(21.2)]

- ▲ In emergency situations of health threatening or life threatening bleeding, the health care professional prescribing the transfusion may declare that transfusion proceed without informed consent. This situation must be documented as soon as possible.

[2CSA(10.9.3.5),3CSTM(5.3.7.4.2),11AC(21.2)]

Transfusion Order

A transfusion must be prescribed by a physician or other authorized health care professional (physician assistant, nurse practitioner, midwife, dentist).

[2CSA(11.4.3-4),3CSTM(5.9.1.4),11AC(19.2-4)]

A L E R T

The Transfusion Medicine Standards require that the order include the following information:

[2CSA(11.4.3-4),3CSTM(5.9.1.4),11AC(19.2-4)]

- ▲ Patient's surname, first name and unique identification number
- ▲ Date the transfusion is to be given
- ▲ Blood component or blood product to be transfused
- ▲ Number of units or dose
- ▲ Rate or duration of infusion (may be included as a hospital's standard protocol for transfusions)
- ▲ Special modifications or requirements, if any (e.g., washed, irradiated)
- ▲ Medication orders related to the transfusion, if any (e.g., premedication or diuretic)
- ▲ Use of a blood warmer or rapid infusion device (exception: hospital clinical areas with an established protocol)
- ▲ Sequence in which multiple components or products are to be transfused (e.g., transfuse platelets first, then RBC)

Transfusion Order (cont'd)

Of Note:

- ▲ **CAUTION:** a hospital standard protocol specifying rate or duration of infusion DOES NOT SUPERCEDE pre-transfusion assessment of each patient for Transfusion Associated Circulatory Overload (TACO) risk factors and if indicated, follow up with the prescriber.

Refer to Preparing for Transfusion: The Patient (page 27) for more information about TACO.

- ▲ For orders for pediatric patients, weight will be needed for dose calculation.
- ▲ For some blood component/blood product orders, weight and/or a laboratory test result may be needed for dose calculation.
- ▲ **Blood Bank/TML requires all the information included in the order for transfusion to safely issue the blood to the clinical area.**

[2CSA(10.2.1-3),3CSTM(5.9.1.5),11AC(19.2-4)]

A L E R T

Transfusion Order (cont'd)

As the transfusionist, carefully review the transfusion order details. [37]

These factors are the transfusionist's accountability [37]:

- ▲ Does order include the required information?
- ▲ If an electronic order, is the order entered for the correct patient?
- ▲ If a paper-based order, is the copy for the Blood Bank/TML technologist legible?
- ▲ What is the indication for this transfusion (understand your patient's current history; assess your patient's signs and symptoms and laboratory test results)?
- ▲ Does the prescribed dose align with current best practice/transfusion guidelines?
- ▲ Does the patient have risk factors for Transfusion Associated Circulatory Overload (TACO)? If indicated, follow up with the prescriber.

Refer to Preparing for Transfusion: The Patient (page 27) for more information about TACO.

- ▲ Is post-transfusion laboratory testing needed to determine effect of the blood component/product? If so, is the test ordered and at what time point should it be drawn?
- ▲ Are you familiar with the blood component/blood product administration details (tubing/filter, compatible IV fluid, rate of infusion, reconstitution, discard by time, potential adverse effects)?

Refer to Appendix 4: Blood Components and Blood Products Table for main use, dose, lab tests, storage/expiration and administration information for the blood components and some blood products (page 98).

A L E R T

Group and Screen Testing

Test Information

Group and screen test results are necessary for transfusion of compatible blood components.

[2CSA(10.6.1.1,10.7.1),3CSTM(5.4.1.1),11AC(19.2)]

Group and Screen Testing

[2CSA(10.4.1,10.4.4-7),3CSTM(5.3.2.1,5.3.3.1,5.3.5.5),11AC(20.6-8)]

- ▲ Determines patient's **blood group: ABO** (O, A, B, AB) and **Rh(D)** (Rh(D) positive or negative).

Testing for the presence or absence of A, B, and Rh(D) antigens on the patient's red blood cells.

Testing for the presence or absence of anti-A and anti-B antibodies in the patient's plasma.

- ▲ Determines patient's **antibody screen**: Testing to rule out or to identify clinically significant antibody(ies) in the patient's plasma.

Negative = no clinically significant antibody(ies) in patient's plasma.

Positive = clinically significant antibody(ies) in patient's plasma.

Clinically significant antibody(ies) may lead to hemolysis if the patient is transfused corresponding antigen positive RBC.

- ▲ If antibody screen is positive, the precise antibody(ies) will be identified (if possible). In some cases, it is not possible to identify the antibody(ies) found in the patient's plasma (Blood Bank/TML reports as "unidentified" antibody).
- ▲ Most common clinically significant antibodies include [4,9]:
anti-D, anti-C, anti-c, anti-E, anti-e,
anti-K, anti-k,
anti-Jk^a, anti-Jk^b, anti-Fy^a, anti-Fy^b, anti-S, anti-s
- ▲ Blood Bank/TML uses the group and screen test results to crossmatch RBC units compatible for transfusion to that patient.
[2CSA(10.6.1.1),3CSTM(5.3.7.1),11AC(20.7)]

Group and Screen Testing (cont'd)

- ▲ If the antibody screen is negative, a group and screen test takes approximately 45 to 60 minutes to complete (from the time the blood sample was received in Blood Bank/TML).
- ▲ If the antibody screen is positive, depending on the antibody(ies) identified, it may take hours to days to locate and crossmatch RBC units compatible for transfusion to that patient.

Of Note:

- ▲ Transfusion Medicine Standards mandate that to issue non-group O, ABO compatible RBC, Blood Bank/TML requires 2 separate determinations of a patient's blood group.

One determination must be from a current blood sample.

The second blood group determination must be from:

- a) the patient's previous records
- b) testing of a separate sample collection
- c) retesting of the same sample where positive patient identification technology was used for sample collection

[2CSA(10.6.1.3),11AC(20.7)]

A second patient identification procedure for blood sample collection is the significant patient safety benefit of this requirement for 2 separate determinations of a patient's blood group to issue non-group O, ABO compatible RBC.

Blood Bank/TML maintains historical records of all blood group determinations (an additional, separate sample collection is not always necessary).



Refer to your hospital's group and screen test sample collection policy and procedure for the specific details.

Group and Screen Testing (cont'd)

Test Information (con't)

- ▲ The expiry or “outdate” of the group and screen test is defined by each hospital’s transfusion medicine service. After this time point, a new patient blood sample for repeat group and screen test is required to issue crossmatched blood.

[2CSA(10.4.2-3),3CSTM(5.2.3.5),11AC(20.6)]

- ▲ Transfusion Medicine Standards dictate that if a patient was transfused or pregnant within the preceding 3 months (or if this information is unknown or uncertain), the blood sample for crossmatching (compatibility testing) must be collected within 96 hours prior to transfusion. This blood sample can be used to crossmatch additional units within 96 hours of transfusion of the first unit.

This requirement ensures that the patient has not formed any new antibodies related to a recent transfusion or pregnancy. The time frame for potential antibody formation is from 3 days to 3 months post RBC transfusion or pregnancy.

[2CSA(10.4.2-3),3CSTM(5.2.3.3-4),4,9,11AC(20.5)]

- ▲ For neonates, during a single hospital admission, if the initial antibody screen is negative and ABO and Rh(D) compatibility has been confirmed, repeat group and screen testing is not needed until the neonate reaches the age of 4 months (it is rare for a baby under 4 months of age to develop antibodies).

[2CSA(10.9.1.4,10.9.1.7),3CSTM(5.5.2.3, 5.5.2.5),11AC(20.9)]

Group and Screen Testing (cont'd)

Uncrossmatched Blood

- ▲ In life threatening, bleeding patient situations if transfusion of blood components is required urgently, uncrossmatched blood can be administered.

[2CSA(10.9.3.1),3CSTM(5.3.7.4.1),11AC(20.10)]

RBC: group O Rh(D) negative for females age 45 years and under with childbearing potential

group O Rh(D) positive for all others

Females age 45 years and under with childbearing potential should be transfused antigen K (also known as K1 or Kell) negative RBC unless they are known to be K positive.

[2CSA(10.7.4),11AC(20.8)]

For more information, refer to Transfusing RBC to Females age 45 years and under with Childbearing Potential (page 24).

Platelets: Blood Bank/TML will follow established policies for blood group based on available supply of platelets

[2CSA(10.7.8),3CSTM(5.4.3.4),11AC(19.2)]

Plasma: group AB

[2CSA(10.9.3.1-2),3CSTM(5.3.7.4.4),11AC(20.10)]

- ▲ If uncrossmatched blood is transfused, the prescriber must document that the clinical situation justifies the transfusion. Compatibility testing (group and screen, crossmatch) should be completed as soon as possible and blood components of the appropriate group issued.

If any incompatibility is detected, the prescriber and the Blood Bank/TML Medical Director must be informed.

[2CSA(10.9.3.3),3CSTM(5.3.7.4.5),11AC(20.10)]

Group and Screen Testing (cont'd)

Transfusing RBC to Females age 45 years and under with Childbearing Potential

- ▲ Transfusion Medicine Standards advise that females age 45 years and under with childbearing potential should be transfused antigen K (also known as K1 or Kell) negative RBC unless they are known to be K positive. [2CSA(10.7.4),11AC(20.8)]



Refer to your hospital Blood Bank/TML's policy and procedure regarding antigen K negative RBC.

- ▲ When transfusing RBC to a female age 45 years and under with childbearing potential, check the CBS label (refer to Appendix 6: Canadian Blood Services Label [page 120]) in lower right section to confirm "K-" is listed (i.e., the RBC unit is antigen K negative).
- ▲ In clinical scenarios where RBC transfusion is urgent, massive hemorrhage protocol, and/or special RBC unit attributes are required (e.g., phenotype matched RBC) providing antigen K negative RBC units may not be possible.
- ▲ The rationale for this Transfusion Medicine Standard is to prevent development of anti-K antibody in females who may become pregnant. Anti-K antibody in the mother could cross the placenta and hemolyse the red blood cells of an antigen K positive fetus leading to Hemolytic Disease of the Fetus and Newborn (HDFN).

Group and Screen Testing (cont'd)

Collecting the Sample

Unequivocal (unmistakable) identification of the patient is mandatory.

[2CSA(10.2.6),3CSTM(5.2.2.1),11AC(19.5,22.2)]

Patient must be wearing an identification armband.

[2CSA(11.3.1),3CSTM(5.9.3.1,5.9.3.3),11AC(22.2)]

For patient safety the listed 3 steps MUST be followed to collect the group and screen sample:

1. In the presence of the patient, at the time the sample is being collected, confirm the patient's surname, first name and unique identification number on the patient's armband and the sample label are identical. [2CSA(10.3.2),3CSTM(5.2.3.1),11AC(20.3,22.2.1)]

Some hospitals utilize bar-code scanning (positive patient identification) systems for sample collection.



Refer to your hospital's sample collection policy and procedure.

If possible, include the patient in the identification process by asking them to spell their name and state their date of birth.

CAUTION: avoid questions that require only a yes/no answer, e.g., "is your name John Doe?"

Any discrepancy must be resolved before collecting the sample.

[2CSA(10.2.6),3CSTM(5.2.2.1),11AC(19.5,22.2)]

2. Immediately after you have collected the blood sample, place the label on the tube of blood at the patient's bedside. [2CSA(10.3.2),3CSTM(5.2.3.1),11AC(20.3)]

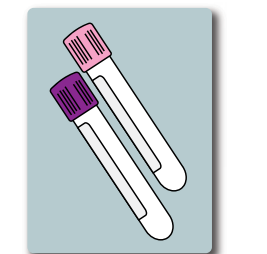
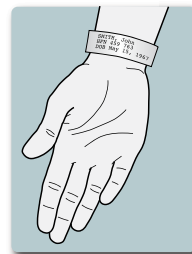
Labeling a sample away from the patient greatly increases the risk of mislabeling.

3. Document that you collected the sample. [2CSA(10.3.1),3CSTM(5.2.3.2),11AC(20.1)]

Do not sign for a sample collected by a co-worker.

You are documenting your accountability for unequivocal (unmistakable) patient identification.

A L E R T



A L E R T



A L E R T

Preparing for Transfusion

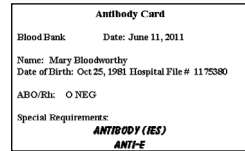
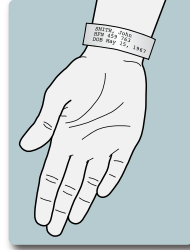
The Patient

- ▲ Patient must be wearing an identification armband. [2CSA(11.3.1),3CSTM(5.9.3.1,5.9.3.3),11AC(22.2)]
- ▲ The Informed Consent process has been completed:
 - Documented according to your hospital's policy and procedure
 - Patient's questions have been addressed [2CSA(11.2.1),3CSTM(5.9.1.1),11AC(21.2)]
- ▲ Inquire if the patient has had previous transfusion, if so:
 - Did any concerns arise, has the patient been advised of any "special" transfusion requirements or provided with a wallet card (if yes, notify Blood Bank/TML of this information)
 - Did a transfusion reaction occur; report significant history to the prescriber, premedication may be indicated
- ▲ Premedication [SBE4(p.54, 65)]

These strategies have been used with recurrent febrile non-hemolytic and minor allergic transfusion reactions but their efficacy is undetermined:

 - Premedication with antipyretics, antihistamines, and steroids
 - Additional component preparation (washed/plasma volume depleted, RBC/platelets)
- ▲ Premedication administration timing:
 - IV route – just prior to transfusion
 - PO route – 30 minutes prior to transfusion

A L E R T



Preparing for Transfusion (cont'd)

- ▲ Assess if the patient is at risk for TACO (Transfusion Associated Circulatory Overload). [SBE4(p.60-1)]
 - TACO risk factors include:
 - Advanced age
 - History of heart failure
 - History of myocardial infarction
 - Left ventricular dysfunction
 - Renal dysfunction
 - Positive fluid balance
 - Report significant risk factors to the prescriber.
 - TACO preventative management strategies are:
 - Do not transfuse more than 1 unit at a time
 - Transfuse slowly over longer time period (maximum is 4 hours after removal from temperature controlled environment)
 - Administer **pre-transfusion** diuretic
 - Blood Bank/TML to divide unit (if Blood Bank/TML equipment available, then transfuse each part of unit over maximum 4 hours after removal from temperature controlled environment)
- ▲ Inform the patient of what to expect during the transfusion:
 - Periodic observation/assessment and checking of vital signs
 - Symptoms indicative of a possible transfusion reaction
 - If any concerns/feeling different notify transfusionist ASAP

Preparing for Transfusion (cont'd)

The Equipment: IV Access

- ▲ Ensure IV access site for the transfusion is patent.
- ▲ IV needle gauge must be large enough to allow appropriate flow rates and avoid cell damage. [2CSA(11.4.1,11.4.3),3CSTM(5.9.5.2),11AC(22.0),13,38]



Refer to your hospital's policy and procedure regarding IV access.

Generally:

Blood Component/ Blood Product	IV Access
RBC	
Adults: routine transfusion	20 to 22 gauge
Adults: rapid transfusion	14 to 18 gauge
Pediatrics	22 to 25 gauge
Other Blood Components/ Blood Products	Any size is adequate
All Blood Components/ Blood Products	Central venous access device

- ▲ Central venous access devices with multiple lumens (adults and pediatrics): medications or other IV fluids can be infused through other lumens without affecting the blood component/blood product. [2CSA(11.4.1,11.4.3),3CSTM(5.9.1.3),11AC(22.0),13]
- ▲ IV access must be dedicated to transfusion; blood components/blood products must not come in contact with incompatible IV solutions or any IV medications. [2CSA(11.4.11),3CSTM(5.9.4.3-4),11AC(22.6-7)]

A L E R T

Preparing for Transfusion (cont'd)

The Equipment: IV Fluid/IV Medication

- ▲ Only 0.9% sodium chloride is compatible with RBC, platelets, plasma, and cryoprecipitate. [2CSA(11.4.11),3CSTM(5.9.4.4),11AC(22.6)]
- ▲ Some IVIG brands are compatible with 5% dextrose in water, NOT 0.9% sodium chloride. Refer to the manufacturer's product monograph to confirm compatible IV fluid. [20-26]
- ▲ Blood components/blood products must not come in contact with any IV medications (i.e., all medications are incompatible). [2CSA(11.4.11),3CSTM(5.9.4.3),11AC(22.7)]

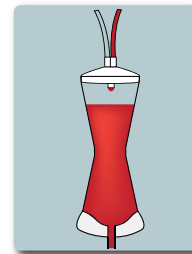
The Equipment: Tubing/Filter

- ▲ Ensure appropriate IV tubing is organized.
- ▲ RBC, platelets, plasma, and cryoprecipitate must be transfused through blood tubing with a 170 to 260 micron filter to capture any fibrin debris. [2CSA(11.4.8),3CSTM(5.9.4),11AC(22.6)]
- ▲ Platelets should be transfused through NEW/FRESH blood tubing/filter (if filter was previously used, the platelets will adhere to fibrin that has been captured in the filter). [3CSTM(5.9.4.7)]
- ▲ Blood tubing/filter must be changed after a maximum of 4 units of blood or 4 hours of time. [13]

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Preparing for Transfusion (cont'd)

The Equipment: Tubing/Filter (cont'd)

When determining the need to change blood tubing/filter, consider:

- If platelets are being transfused
- Number of units to be transfused
- Number of hours of time for the transfusion(s) to be completed

Example clinical scenarios:

1. Prescriber's order: Transfuse 1 dose platelets over 1 hour, then transfuse 1 unit RBC over 2 hours

The same blood tubing/filter can be used to first transfuse the platelets (as ordered) and then transfuse the RBC unit.

Rationale: Platelets will be transfused with a new/fresh tubing/filter. The blood tubing/filter will not be used for more than the maximum of 4 units of blood or 4 hours of time.

2. Prescriber's order: Transfuse 1 unit RBC over 2 hours, then transfuse 1 dose platelets over 1 hour.

The RBC unit should be transfused first (as ordered) with blood tubing/filter. Then the platelets should be transfused with new/fresh blood tubing/filter.

Rationale: Platelets will be transfused with a new/fresh blood tubing/filter.

3. Prescriber's order: Transfuse 2 units RBC, each unit over 1 hour, then transfuse 4 units plasma, each unit over 1 hour.

The 2 units RBC and 1 unit plasma can be transfused with the same blood tubing/filter. The remaining 3 units plasma can be transfused with a second blood tubing/filter.

Rationale: The blood tubing/filter will not be used for more than the maximum of 4 units of blood or 4 hours of time.

Preparing for Transfusion (cont'd)

- ▲ Blood tubing/filter may be primed with the blood component or with compatible IV fluid.

[2CSA(11.4.9),3CSTM(5.9.4.4),11AC(22.6)]

Follow the tubing/filter manufacturer's specific procedure (outlined on the packaging) for priming to avoid crushing/damaging the filter.

- ▲ Blood products in glass bottles (albumin, IVIG) do not require blood tubing and filter. Vented IV tubing is required for infusions directly from glass bottles.

[16-18,20-26]

- ▲ Be prepared for a potential transfusion reaction

[2CSA(18.1.1,18.2.1),3CSTM(5.9.4.11),11AC(26.0-1)]

by setting up IV tubing such that if the transfusion must be stopped abruptly, IV access can be maintained:

- Either 0.9% sodium chloride flush syringes and an IV line with any IV solution are on hand, ready to infuse TKVO
- Or 0.9% sodium chloride IV line is on hand, ready to infuse TKVO

[2CSA(11.4.11),3CSTM(5.9.4.4),11AC(22.6)]

Preparing for Transfusion (cont'd)

The Equipment: Devices: Infusion Pumps, Warmers, Rapid Infusers

- ▲ Infusion pumps, blood warmers and rapid infusers that have been approved as per Health Canada Medical Device Regulations can be used to transfuse blood components/ blood products.

[2CSA(11.4.2-3,23.1.3),3CSTM(3.5.1-4,5.9.4.2,5.9.4.8),11AC(22.6)]

- ▲ The use of all devices must be based on manufacturer's recommendations.

Refer to details found in the operator's manual of the specific device(s) used at your hospital.

[2CSA(23.1.2, 23.4.1-2),3CSTM(3.5.3),11AC(22.6),13]

Of Note:

- Platelets transfusion is contraindicated for some blood warmer and rapid infuser devices.
- Rapid infuser devices may also include warming of IV fluid and/or blood.
- ▲ Blood warmers must include a temperature sensing device and an audible alarm system. When in use, the temperature noted by the blood warmer device should be documented in the patient's health record.
[2CSA(11.5.1-2),3CSTM(3.5.4),11AC(22.6)]
- ▲ Blood warmers must be validated, calibrated, and maintained as part of an equipment quality control system (including the temperature alarm system).
[2CSA(11.5.1-2),3CSTM(5.9.4.8),11AC(22.6)]



Refer to hospital policy and procedure for details pertaining to the devices used at your hospital.

Preparing for Transfusion (cont'd)

Picking up blood from Blood Bank/TML: Information/Documentation

- ▲ Blood Bank/TML requires documentation of patient identification (surname, first name and unique identification number) to issue blood to the patient care area.
[2CSA(10.2.4),3CSTM(5.8.5.1),11AC(19.5)]

Many hospitals have a form (pick up slip) which includes the patient identification information that must be presented at Blood Bank/TML to pick up blood.



Refer to your hospital policy and procedure for specific blood pick up requirements.

Handling Blood Components outside of Blood Bank/TML

- ▲ Blood component (RBC, platelets, plasma, cryoprecipitate) transfusion must be completed within 4 hours of issue from Blood Bank/TML (removal from temperature controlled environment).
[2CSA(11.4.6),3CSTM(5.9.5.1),11AC(22.9)]
- ▲ Blood should NEVER be stored in medication or patient care area refrigerators (temperature is not monitored as per the requirements of Transfusion Medicine Standards).
[2CSA(9.4.1),3CSTM(3.2.1.2,3.2.2.1),11AC(17.6,22.4)]
- ▲ Some hospital Blood Bank/TML have storage containers (e.g., coolers, platelets transport bags) that are temperature validated for a specific time frame of storage outside of the Blood Bank/TML environment.



Refer to your hospital policy and procedure regarding use of storage containers.

A L E R T

For patient safety, ensure all preparation steps have been completed before picking up blood from Blood Bank/TML.

Checking Blood Components

This is the final check to ensure safe transfusion.

Many hospitals require 2 regulated health care professionals complete the checking blood steps.

Some hospitals have implemented bar-code scanning (positive patient identification) systems for checking blood procedures.



Refer to your specific hospital policy and procedure for checking blood.

Transfusion Medicine Standards mandate:

- ▲ During the transfusion process, 2 regulated health care professionals must be available at all times [3CSTM(5.9.2.3)]
- ▲ Checking blood steps must be carried out in the physical presence of the patient (at the bedside) [2CSA(11.3.1),3CSTM(5.9.3.3),11AC(22.3)]

Validate the blood component/blood product received from Blood Bank/TML matches the transfusion order.

[2CSA(11.4.3-4),3CSTM(5.9.1.4),11AC(19.2-4)]

Checking Blood Components (RBC, Platelets, Plasma, Cryoprecipitate)

Checking Blood Components: Steps 1 to 4

- Step 1: Patient Identification
- Step 2: ABO and Rh(D) Blood Group
- Step 3: Unit Number
- Step 4: Visual Inspection and Expiry Time

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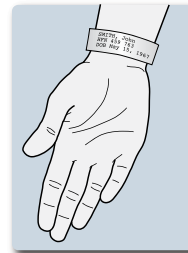


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Checking Blood Components (cont'd)

Checking Blood Components Step 1: Patient Identification

Unequivocal (unmistakable) identification of the patient is mandatory.

[2CSA(11.3.1),3CSTM(5.9.3.3),11AC(22.2-3)]

Patient must be wearing an identification armband.

[2CSA(11.3.1),3CSTM(5.9.3.1,5.9.3.3),11AC(22.2)]

Check the patient's surname, first name and unique identification number match on:

[2CSA(11.3.1),3CSTM(5.9.3.3),11AC(22.2-3)]

- Patient's armband
- Prescriber's order for the blood transfusion
- Blood component's transfusion label or tag
- "Chart" transfusion label or tag (the transfusion label or tag that will be added to the patient's health record to document the transfusion)

If possible, include the patient in the identification process by asking them to spell their name and state their date of birth (avoid questions that require only a yes/no answer e.g., "is your name John Doe?").

Any discrepancy must be resolved prior to transfusing.

[2CSA(11.3.2),3CSTM(5.9.3.4),11AC(22.3)]

The patient identification information must remain attached to the blood component for the duration of the transfusion.

[2CSA(11.3.3),3CSTM(5.9.3.5),11AC(22.8)]

Checking Blood Components Step 2: ABO and Rh(D) Blood Group

Confirm that the ABO and Rh(D) of the blood component issued from Blood Bank/TML are compatible with the patient's ABO and Rh(D) blood groups.

If not ABO and Rh(D) identical, review the ABO and Rh(D) Compatibility Chart (page 94) to confirm compatibility.

If questions, contact Blood Bank/TML.

[2CSA(10.7.1,10.7.3,10.7.5-7),3CSTM(5.4.2.1-3,5.4.3.1-4),11AC(20.8)]

Checking Blood Components (cont'd)

Checking Blood Components Step 2:
ABO and Rh(D) Blood Group (cont'd)

The **blood component's** ABO and Rh(D) blood groups are listed on the:

- CBS label
- Blood component's transfusion label or tag
- "Chart" transfusion label or tag (the transfusion label or tag that will be added to the patient's health record to document the transfusion)

The **patient's** ABO and Rh(D) blood groups are listed on the:

- Patient's health record – group and screen test results
- Blood component's transfusion label or tag
- "Chart" transfusion label or tag (the transfusion label or tag that will be added to the patient's health record to document the transfusion)

Any discrepancy must be resolved prior to transfusing.
[2CSA(11.3.2),3CSTM(5.9.3.4),11AC(22.3)]

Of Note: Patient Special Requirements

Blood Bank/TML provides these special requirements as available per inventory/transfusion urgency. If required component is delayed or not available, the prescriber is advised.

1. Antigen Negative RBC

If the patient's group and screen test identified a clinically significant antibody, then confirm on the CBS label the RBC unit is negative for the corresponding antigen e.g., patient has antibody anti-Jka, the RBC unit is antigen "Jka-"

Refer to Appendix 6: Canadian Blood Services Label, lower right hand section, (page 120)

2. K Negative RBC

If the patient is female, age 45 years and under with childbearing potential, then confirm on the CBS label the RBC unit is antigen "K-" (unless patient is known to be K positive)

For more information, refer to Transfusing RBC to Females age 45 years and under with Childbearing Potential (page 24).



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Checking Blood Components (cont'd)

3. Irradiated RBC or Platelets

If patient requires irradiated RBC or platelets, an irradiated label is included below the CBS label.

For more information, refer to Transfusion Associated Graft Versus Host Disease (page 78).

Checking Blood Components Step 3: Unit Number

Review that the unit number is an identical match.
[2CSA(10.7.1,10.7.3,10.7.5-7),3CSTM(5.4.2.1-3,5.4.3.1-4,5.9.3.2),11AC(20.8)]

The **blood component's** unit number is listed on the:

- CBS label
- Blood component's transfusion label or tag
- "Chart" transfusion label or tag (the transfusion label or tag that will be added to the patient's health record to document the transfusion)

Any discrepancy must be resolved prior to transfusing.
[2CSA(11.3.2),3CSTM(5.9.3.4),11AC(22.3)]

Checking Blood Components Step 4:
Visual Inspection and Expiry Time

Visual Inspection

Inspect the blood component for clots, unusual color, and any leaking from the ports.

If any concerns are identified, contact Blood Bank/TML.
[2CSA(10.10.2),3CSTM(5.8.1.1,5.9.1.3),11AC(18.2)]

Expiry Time

The CBS label includes the component expiry date in the mid-lower right section of the label (refer to Appendix 6: Canadian Blood Services Label [page 120]).

This expiry date is based on the component being stored in its required temperature controlled environment.

When a blood component is issued to a patient care area, it is no longer in a temperature controlled environment.

The transfusion must be completed within 4 hours of the time of issue (removal from the temperature controlled environment). If the transfusion is not completed within 4 hours of the time of issue, the remainder of the blood component must be discarded.
[2CSA(11.4.6),3CSTM(5.9.5.1),11AC(22.9)]

Checking Blood Products (Plasma Protein Products)

Checking Blood Products: Steps 1 to 3

Step 1: Patient Identification

Step 2: Lot Number

Step 3: Visual Inspection and Expiry Time

Of Note:

For Checking Blood Products, ABO and Rh(D) blood group compatibility is not relevant (blood products are manufactured in lots, from plasma combined from many donors of diverse ABO blood groups).

Checking Blood Products Step 1: Patient Identification

Unequivocal (unmistakable) identification of the patient is mandatory.

[2CSA(11.3.1,14.5),3CSTM(5.9.3.3),11AC(22.2-3)]

Patient must be wearing an identification armband.

[2CSA(11.3.1),3CSTM(5.9.3.1,5.9.3.3),11AC(22.2)]

Check the patient’s surname, first name and unique identification number match on the:

[2CSA(11.3.1,14.5),3CSTM(5.9.3.3),11AC(22.2-3)]

- Patient’s armband
- Prescriber’s order for the blood transfusion
- Blood product’s transfusion label or tag
- “Chart” transfusion label or tag (the transfusion label or tag that will be added to the patient’s health record to document the transfusion)

If possible, include the patient in the identification process by asking them to spell their name and state their date of birth (avoid questions that require only a yes/no answer e.g., “is your name John Doe?”).

Any discrepancy must be resolved prior to transfusing.

[2CSA(11.3.2,14.5),3CSTM(5.9.3.4),11AC(22.3)]

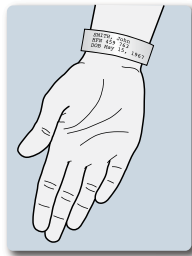
The patient identification information must remain attached to the blood product for the duration of the transfusion.

[2CSA(11.3.3,14.5),3CSTM(5.9.3.5),11AC(22.8)]

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Checking Blood Products Step 2: Lot Number

Review that the lot number is an identical match.

[2CSA(14.5),3CSTM(5.9.3.2),11AC(20.0)]

The blood product’s lot number is listed on the:

- Manufacturer’s product label affixed to the vial or bottle
- Blood product’s transfusion label or tag
- “Chart” transfusion label or tag (the transfusion label or tag that will be added to the patient’s health record to document the transfusion)

Any discrepancy must be resolved prior to transfusing.

[2CSA(11.3.2,14.5),3CSTM(5.9.3.4),11AC(22.3)]

Checking Blood Products Step 3: Visual Inspection and Expiry Time

Visual Inspection

Inspect the blood product to ensure the packaging/seal on the vial or bottle is intact.

If the product requires reconstitution, refer to the package insert monograph for the expected appearance post reconstitution.

[2CSA(14.4.1-2),3CSTM(5.8.1.1,5.9.1.3),11AC(14.1)]

If any concerns are identified, contact Blood Bank/TML.

Expiry Time

The product packaging includes the expiry date. The manufacturer’s product label affixed to the vial or bottle also displays the product’s expiry date. This expiry date is based on the date the product was manufactured and sealed in its packaging.

When the product packaging/seal is opened, the product should be administered without delay. [2CSA(14.6.1),11AC(14.1)]

Products in vials/glass bottles can be transfused for a maximum of 4 hours from the time that vial/ bottle was entered/spiked. If the transfusion is not completed within 4 hours of the time of entering/spiking the vial/bottle, the remainder of the blood product must be discarded.

[2CSA(14.6.1),16-18,22-26,28-30]

Administer reconstituted products without delay. Some reconstituted products may be stable for a specified time period. Refer to the package insert monograph.

[2CSA(14.6.1),19,20,32-3]

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Blood Products Requiring Reconstitution

Some blood products (e.g., FC, lyophilized IVIG, PCC) require reconstitution as per the manufacturer’s instructions.

Per Transfusion Medicine Standards, the name of the person who prepared the product and the date and time of preparation must be documented. [2CSA(14.4.1,14.5),19,20,32-3]

- ▲ Some Blood Banks/TMLs reconstitute blood products, document the reconstitution in the Blood Bank/TML system, and issue the reconstituted blood product to the clinical area.
 - The ordered dose of the reconstituted product is issued in a bag and labelled with a transfusion label or tag.
 - A “chart” transfusion label or tag is also provided and must be added to the patient’s health record to document the transfusion.
- ▲ Some Blood Banks/TMLs issue the blood product in the manufacturer’s packaging to be reconstituted by clinical area staff.
 - Education for clinical staff regarding reconstitution steps is provided.
 - Detailed reconstitution instructions are listed in product specific monograph enclosed in the packaging.
 - More than 1 package may be issued from Blood Bank/TML to provide the dose that was ordered.
 - Blood Bank/TML may provide a bag to infuse the reconstituted product, a transfusion label or tag and a “chart” transfusion label or tag.
 - The blood product must be appropriately labelled while it is being transfused.
 - The blood product transfusion must be documented on the patient’s health record.
 - The blood product preparation must be documented (name of the person who prepared the product and date/ time of preparation) on the patient’s health record.



Refer to your hospital policy and procedure for blood products requiring reconstitution.

Beginning and Monitoring Transfusion

Patient Education

Transfusion reactions occur and should be identified as soon as possible.

[2CSA(18.1.1),3CSTM(5.9.4.11),11AC(26.0)]

Remind your patient (if appropriate for the patient’s clinical status) to report ASAP if they experience:

- Feeling fevered or chills
- Hives or itching
- Difficulty breathing
- Back pain or pain at the infusion site
- Any concern or feeling different from usual

Baseline Patient Assessment and Vital Signs

Document baseline vital signs and patient assessment (within 30 minutes prior to beginning transfusion).

[2CSA(11.4.15-6),3CSTM(5.9.4.10),11AC(22.10)]

Suggested parameters include:

- Temperature
- Blood Pressure
- Pulse
- Respiratory Rate
- Oxygen (O₂) saturation



Refer to your hospital’s policy and procedure details regarding baseline patient assessment and vital signs.

A L E R T



Beginning and Monitoring Transfusion (cont'd)

Spiking Blood Components, Spiking Blood Products

Spiking Blood Components [39] (RBC, platelets, plasma, cryoprecipitate) suggested procedure:

- ▲ Separate the port cover so that the port is just exposed
- ▲ Position port covers away from open port to prevent contamination
- ▲ Holding the bag in one hand and the uncovered blood tubing spike in the other hand, insert the blood tubing spike into the port while turning clock-wise ¼ turns (turning motion only, pushing is not helpful)
- ▲ Continue clock-wise ¼ turns until the tip of the spike is just in the blood bag
- ▲ While spiking, it is advised not to hang the blood bag from the IV pole (functioning against force of gravity)
- ▲ To unspike/remove blood bag from tubing set: take the bag from the IV pole, pull gently while turning counter-clock-wise with ¼ turns.

CBS website Professional Education section provides a video demonstrating spiking blood component bags and also a poster detailing the steps for the blood bag spiking procedure. [39]

Spiking Blood Products

- ▲ Several brands of vented tubing are appropriate for infusing blood products in glass bottles (e.g., albumin, IVIG). [16-18,22-26]
- ▲ The manufacturers instructions for spiking the bottle and priming the tubing often need to be followed in precise sequence to infuse these products without difficulty.



Refer to the manufacturer's instructions for details about the brand of vented tubing used at your hospital.

A L E R T

Beginning and Monitoring Transfusion (cont'd)

Initial Rate of Infusion

If patient's clinical status permits (i.e., patient is stable and not bleeding; transfusion is not urgent) initiate each blood component cautiously and slowly.

[SBE4(p.21,30,35)]

- ▲ For the first 15 minutes, suggested rate is 50 mL/hour (Pediatrics: 1 mL/kg/hour to maximum of 50 mL/hour). [SBE4(p.21,30,35)]
- ▲ Assess patient and re-check vital signs 15 minutes after the infusion was started. [2CSA(11.4.15),3CSTM(5.9.4.10),11AC(22.10)]
- ▲ If no signs/symptoms of transfusion reaction are identified, increase to rate of infusion ordered.

Of Note:

- ▲ If the blood tubing was primed with 0.9% sodium chloride, re-priming the tubing with the blood component is required to ensure the initial slow infusion rate is actually infusing the blood component (the volume of blood tubing is 12 to 15 mL).
- ▲ Be prepared to stop the transfusion and maintain IV access in the event of a possible transfusion reaction. [2CSA(18.1.1,18.2.1),3CSTM(5.9.4.11),11AC(26.0-1)]



Per your hospital's policy and procedure, ensure an option is available:

- **Either** 0.9% sodium chloride flush syringes and an IV line with any IV solution are on hand, ready to infuse TKVO
- **Or** 0.9% sodium chloride IV line is on hand, ready to infuse TKVO [2CSA(11.4.11),3CSTM(5.9.4.4),11AC(22.6)]
- ▲ IVIG transfusion requires specific incremental infusion rates and patient monitoring to minimize reactions.



For IVIG rate of infusion, refer to your hospital's policy and procedure as well as the brand specific monograph [22-6] for details.

Beginning and Monitoring Transfusion (cont'd)

Ongoing Patient Assessment and Vital Signs

For safe transfusion (as per Transfusion Medicine Standards) for each blood component

[2CSA(11.4.15-6),3CSTM(5.9.4.10),5BE4(p.21,30,35),6,11AC(22.10),38]:

- Closely monitor/observe the patient during transfusion
- Patient assessment and re-check vital signs within 15 minutes after the start of transfusion and after the transfusion is completed

A L E R T



- ▲ More frequent assessment is advised for patients:
 - Unstable prior to beginning transfusion
 - With risk factors for TACO
 - With history of previous transfusion reactions



Refer to your hospital's policy and procedure for hospital specific frequency of patient assessment and re-check vital signs.

Completing Transfusion

- ▲ Comply with the expiry time specific to:

blood components: 4 hours from time of issue from Blood Bank/TML (removal from the temperature controlled environment)

[2CSA(11.4.6),3CSTM(5.9.5.1),11AC(22.9)]

blood products: per the product specific monograph

enclosed in the packaging [2CSA(14.6.1),11AC(14.1)]

If infused from its vial/glass bottle, 4 hours from the time that the vial/bottle was entered /spiked

[2CSA(14.6.1),16-18,22-26,28-30]

Outside the expiry time, discard the remainder.

- ▲ Per your hospital's policy and procedure, the blood component tubing should be flushed with 0.9% sodium chloride to ensure the entire unit is transfused.

[2CSA(11.4.11),3CSTM(5.9.4.4),11AC(22.6)]

For blood products given IV, flush (tubing or IV site) with compatible IV fluid

Completing Transfusion (cont'd)

- ▲ Assess the patient and re-check vital signs at the end of the transfusion as per Transfusion Medicine Standards. [2CSA(11.4.15-6),3CSTM(5.9.4.10),11AC(22.10)]
- ▲ Per your hospital's policy and procedure, assess the patient and re-check vital signs periodically post-transfusion and re-check vital signs up to 4 hours post-transfusion and for dyspnea reactions, up to 24 hours post transfusion). [2CSA(11.4.15-6),3CSTM(5.9.4.10),11AC(22.10)]

All possible transfusion reactions must be reported to Blood Bank/TML.

[2CSA(18.1.1,18.2.1),3CSTM(5.9.4.11,7.2.1.1),11AC(26.0)]

- ▲ Discontinue blood tubing when the transfusion has been completed (blood tubing can harbor bacteria).
- ▲ Per your hospital's policy and procedure, dispose of blood tubing and bags in biohazardous waste. [2CSA(4.5.2),3CSTM(5.9.4.12),11AC(22.0)]

Of Note:

Hospital policy and procedure may include returning the empty blood bag to Blood Bank/TML.

- ▲ Post-transfusion blood testing may be required. Review the prescriber's orders. Refer to Appendix 4: Blood Components and Blood Products Table for lab test information for the blood components and some blood products (page 98).
- ▲ Transfusion Medicine Standards require that post transfusion, **outpatients** or their care givers are provided with information detailing [2CSA(11.4.16),3CSTM(5.9.4.10),11AC(22.10)]:
 - Signs and symptoms of a transfusion reaction
 - What to do if experiencing a possible reaction and when to seek medical attention
 - Contact information for follow up if a possible transfusion reaction occurred

Documenting Transfusion

Transfusion Medicine Standards require the following information is entered on the patient's/recipient's health record:

[3CSA(11.1.2.2-4,11.4.17),3CSTM(5.9.6.1),11AC(24.4-5)]

- Recipient's name and identification number
- Recipient and donor ABO/Rh (as appropriate for component)
- Recipient compatibility status (as appropriate for component)
- Unit/lot number of component or product
- Type of blood component or blood product
- Volume/dose transfused
- Date and time of issue
- Start and finish date and time of transfusion
- Identity of the transfusionist



▲ Per these standards, most hospital's Blood Bank/TML will issue a "chart" transfusion label or tag with each blood component or blood product. This "chart" transfusion label or tag will include the required information as noted above. The transfusionist's identity as well as the transfusion start and finish date and time must be added to the "chart" transfusion label or tag to complete the documentation. The completed "chart" transfusion label or tag must be affixed to the recipient's health record.

▲ Ensure the start and finish date and time of the transfusion is documented.

[2CSA(11.1.2.4),3CSTM(5.9.6.1),11AC(24.4-5)]

This confirms the transfusion was administered safely, within the mandatory time frame; the start and finish time documentation also serve as reference points in the event of a possible transfusion reaction.

▲ The volume transfused must be noted on the patient's intake and output record and the vital signs and patient assessments recorded.

For blood components, check the CBS label for the volume.

Refer to Appendix 6: Canadian Blood Services Label to review the lower left section where the volume is noted (page 120).

Documenting Transfusion (cont'd)

▲ If a transfusion reaction is suspected, document signs and symptoms and patient care.

[2CSA(11.1.2.3,11.4.17,18.2.5),3CSTM(5.9.6.1,7.2.2.10),11AC(24.5,26.7)]

Refer to the Transfusion Reaction section of this handbook for more details (page 74).

▲ Some hospitals have implemented bar-code scanning (positive patient identification) systems for administration of blood procedures and include electronic documentation.

▲ Some hospital's policy and procedure details that a "transfusion record" form is completed and returned to the Blood Bank/TML.



Refer to your hospital's policy and procedure for transfusion documentation.

Massive Hemorrhage Protocol: the Bleeding, Unstable Patient ^[40]

- ▲ Management of the bleeding, unstable patient with hemorrhagic shock focuses on:
 - stabilizing the patient with rapid transfusion of blood components
 - timely recognition and treatment of the source of the bleeding
- ▲ Ontario has developed a provincial Massive Hemorrhage Protocol (MHP) template and toolkit to promote standardized, evidence-based care.

The MHP is adaptable based on the available resources in the province's varied health care settings (tertiary care, large hospitals as well as regional, small hospitals).

Each hospital's MHP should be developed by a multidisciplinary team with review and approval by the transfusion committee (or alternate relevant committee) and the medical advisory committee.
- ▲ Implementing the MHP is the first step to improve the care of massively bleeding patients. Additionally, training, simulations, checklists, and audit and feedback are needed to strengthen MHP team function and achieve optimal patient outcomes.

Specific quality metrics are described in the MHP toolkit (e.g., proportion of patients where RBC transfusion is initiated within 15 minutes of protocol activation) and should be tracked for all MHP activations. This feedback should be provided to front-line staff.
- ▲ For details included in the provincial MHP and the toolkit, refer to <https://transfusionontario.org/en/category/massive-hemorrhage-protocol/>

MHP steps: the 7Ts ^[40]

Each hospital will need to make minor modifications to align their hospital MHP with their available resources.

1. Triggering

- ▲ MHP should be activated when there is life threatening bleeding (e.g., if it is anticipated that the patient requires a minimum of 4 units of RBC as well as platelets, plasma, fibrinogen replacement).

Currently, there is a lack of evidence to endorse specific activation criteria; MHP activation criteria should be defined by each hospital as per the needs of the local patient population and available hospital resources.
- ▲ If the decision is made to transfer the patient to another hospital for definitive hemorrhage control, communication should be made to the transport service ASAP.
- ▲ If the hospital utilizes overhead paging for code announcements, the standardized term "Code Transfusion" should be used (per provincial MHP recommendation).
- ▲ When MHP is activated an interdisciplinary team should respond; also, specifically alert dedicated personnel responsible for the transport of blood components (i.e., Porter), and the Laboratory (Transfusion Medicine/Coagulation/Core Lab).
- ▲ If patient's identity is unknown, provide sex, approximate age, and assigned identifier.

Of Note:

Patient demographic information and assigned identifier should not be updated/modified for duration of MHP.

MHP steps: the 7Ts [40] (cont'd)**1. Triggering** (cont'd)

Each hospital's policy and procedure for assigning an identifier to an unidentified patient should be followed.

- ▲ On MHP activation, Blood Bank/TML prepares the first blood components and may also include (as per the resources available at the individual hospital):
 - Bag with 3 stickers for identification of the Lead clinician, Lead nurse, and Porter
 - Code Transfusion preprinted order form
 - Set of blood sample tubes with a paper lab requisition for baseline blood tests
 - Code Transfusion Phone to be given to the Lead nurse (to ensure Blood Bank/TML technologist can consistently communicate with Lead nurse). If patient is transferred within the hospital, the Code Transfusion phone must also be transferred to the receiving area.

MHP steps: the 7Ts [40] (cont'd)**2. Team**

- ▲ Interdisciplinary team mobilized; core team members are Lead clinician, Lead nurse, dedicated Porter, Laboratory technologist(s).
 - Lead clinician manages medical care (process for assigning Lead clinician should be defined in MHP protocol)
 - Lead nurse oversees all communications (manages Code Transfusion Phone)
 - Dedicated Porter transports blood samples for testing and blood components for transfusion
 - Laboratory technologist(s) tests blood samples and communicates results; prepares and issues blood components
- ▲ As hospital resources permit, further team members may include:
 - Additional nurses assigned to care for the patient and to document
 - Blood Bank/TML Lead technologist, Hematology/Coagulation lab technologist
 - Respiratory therapist
- ▲ As patient scenario indicates other team members might be paged e.g., anesthesia, obstetrics, neonatology, operating room, interventional radiology, endoscopy, social worker/spiritual advisor.
- ▲ Transfusion Medicine physician can support the team.

MHP steps: the 7Ts [40] (cont'd)**3. Tranexamic acid**

- ▲ Is an antifibrinolytic (pro-clotting) drug.
- ▲ Has been shown to reduce the rate of bleeding and improve survival rates in acute hemorrhage.

Every 15 minute delay to administration from onset of bleeding reduces the patient's survival by 10%.
- ▲ **PRIORITY!** Lead nurse should ensure that Tranexamic acid is ordered and administered ASAP; within 3 hours from time of injury or within 3 hours of MHP activation.
- ▲ Tranexamic acid adult dosing options (intravenous or intraosseous):
 - 1g bolus followed by a second 1g bolus, 1 hour apart
 - 1g bolus followed by 1g infusion over subsequent 8 hours
 - 2g bolus up-front (preferred if patient is to be transferred to another hospital or will be in transport or in another location [e.g., CT scan] at the 1 hour time point)
- ▲ Document medication administration as per hospital specific protocol.

MHP steps: the 7Ts [40] (cont'd)**4. Testing**

- ▲ At baseline when Code Transfusion is activated, draw a complete set of blood work (CBC, INR, PTT, fibrinogen, ionized calcium, lactate, electrolytes, arterial blood gas).
- ▲ Repeat complete set (exception: PTT at baseline only) of blood work hourly, at minimum.
- ▲ At baseline, draw a group & screen sample so that the patient can be provided with group specific blood components as quickly as possible.

If a blood group check second sample is required Blood Bank/TML will notify the Lead nurse.
- ▲ Ensure samples are drawn, labelled correctly, and given to the Porter for transport to the Laboratory STAT.
- ▲ Laboratory should communicate verbally (e.g., via Code Transfusion phone) all key hematology and coagulation results (hemoglobin, platelet count, INR, PTT, fibrinogen) and all critical chemistry results to Lead nurse for review with Lead clinician to guide decision making.

MHP steps: the 7Ts [40] (cont'd)**5. Transfusion**

- ▲ The Lead clinician is ordering therapy to maintain:

- Hemoglobin greater than 80 g/L
- Platelet count greater than $50 \times 10^9/L$
- INR less than 1.8
- Fibrinogen greater than 1.5 g/L
(greater than 2.0 g/L for Obstetrical hemorrhage)
- Ionized calcium greater than 1.15 mmol/L

- ▲ **Every 1 minute delay to the first transfusion is associated with a 5% increase in the odds of mortality.**

The provincial MHP recommendation is immediately begin with RBC transfusion (4 units) followed by transfusion of an RBC:plasma ratio of 2:1.

Transition to transfusion of blood components and products guided by laboratory test results ASAP.

- ▲ For hospitals where plasma is not available, refer to MHP statements [40] 36 and 37 to consider alternatives (PCC, FC [this information also noted in Appendix 4: Blood Components and Blood Products Table, section Prothrombin Complex Concentrate (PCC), page 114]).
- ▲ Keep all blood as packaged from Blood Bank/TML until needed (verbal order to transfuse from Lead clinician).
- ▲ Contact Blood Bank/TML via Code Transfusion phone if other blood products are requested by the Lead clinician.
- ▲ Nurse assigned to document records as blood components and products are checked and transfused (as well as recording medications and interventions).
- ▲ Lead nurse advises the Lead clinician of number of units of blood components and products transfused.

MHP steps: the 7Ts [40] (cont'd)

- ▲ Lead nurse sends the Porter to Blood Bank/TML for more blood to ensure blood continuously available.

Lead nurse provides Porter with a pickup slip for each pickup of blood from Blood Bank/TML after the initial automatic delivery.

Required information on the pickup slip is the patient's name and unique identification number (or if implemented, the assigned identifier).

- ▲ Porter should return empty coolers and platelets transport bags to Blood Bank/TML.

6. Temperature

- ▲ **Mild hypothermia is associated with a 22% increased need for transfusion.** It is critical to keep the patient warm.
- ▲ Target temperature: equal to or greater than $36^\circ C$.
- ▲ Record temperature within 15 minutes of patient arrival at hospital/MHP activation.
- ▲ Monitor and document temperature every 30 minutes, at minimum (continuous temperature monitoring, if available).
- ▲ Lead nurse to inform Lead clinician if temperature outside target.
- ▲ Apply warm blankets.
- ▲ Replace wet linens.
- ▲ Warmer device for IV fluids and blood (RBC, plasma) should be implemented ASAP.
The temperature displayed on the warmer must be monitored and documented to ensure it is functioning properly.
- ▲ If available, apply a forced-air warming blanket (e.g., Bair Hugger™) to prevent heat loss.

Background

- ▲ As with all medical interventions, transfusion encompasses potential benefits as well as potential risks. The potential risks may lead to complications. [SBE4(p.42-4)]
- ▲ *For details of current transfusion risks, refer to Appendix 5: Transfusion Risk Charts (page 118).*
- ▲ Viral, parasite and prion disease transmission by blood transfusion has been widely publicized in the past but is now essentially vanished. [SBE4(p.42,44,74-7)]
- ▲ In Canada, blood donor screening and testing of donated blood are extremely rigorous to minimize the risk of infection-related adverse events. [4]
- ▲ Non-infectious transfusion complications (transfusion reactions, acute and delayed) are of concern. These reactions must be identified, managed, and reported to ensure that transfusion is as safe as possible for patients. [SBE4(p.46)]

Why Report?

- ▲ The World Health Organization describes hemovigilance as surveillance procedures to monitor, report, investigate and analyze complication events from blood donation through to blood transfusion.
Patient safety is enhanced by learning from these events and taking action to minimize recurrence. [41]
- ▲ In Ontario, transfusion reactions are tabulated via the Ontario Transfusion Transmitted Injuries Surveillance System (TTISS-ON, launched in 2001). [42]
- ▲ Ontario hospitals with transfusion services **voluntarily** report moderate to severe transfusion reactions via TTISS-ON. Several sentinel hospitals report all transfusion reactions (including febrile non-hemolytic and minor allergic reactions) to TTISS-ON to provide baseline data. [42]

Why Report? (cont'd)

- ▲ TTISS-ON promotes education by supporting an annual conference and has developed educational tools to enhance blood transfusion safety. Refer to the TTISS-ON website for the comprehensive resource materials. [42]

Transfusion Medicine Standards require:

- ▲ Hospitals maintain policies and procedures for transfusion reaction reporting and follow up [2CSA(4.1.2,18.1.1),3CSTM(5.9.4.11,6.1.1-2),11AC(26.0-1)]
- ▲ All possible transfusion reactions are promptly reported to Blood Bank/TML [2CSA(18.1.1,18.2.1),3CSTM(5.9.4.11,7.2.1),11AC(26.0-1)]
- ▲ Blood Bank/TML must report some serious or unexpected blood component reactions to CBS and serious blood product reactions to the manufacturer of the product [2CSA(18.2.2-3),3CSTM(7.2.2.2-3,7.2.2.5,7.2.2.7),11AC(26.4)]
- ▲ If a patient develops an infection that might be related to blood component transfusion, Blood Bank/TML must **immediately** report to CBS all blood components transfused to that recipient [2CSA(18.4.1),3CSTM(7.2.2.5),11AC(26.3-4)]
- ▲ Blood Bank/TML must report serious blood component reactions related to a regulated activity (e.g., pooling, washing, irradiating) performed within their Blood Bank/TML to Canada Vigilance Program, Health Canada [1],[2CSA(18.2.2),3CSTM(7.2.2.4),11AC(26.4)]

In addition, for manufactured blood products (also known as PPP [plasma protein products]) effective December 16, 2019 per Vanessa's Law (Protecting Canadians from Unsafe Drugs Act; including amendments to the Food and Drug Act [Bill C-17]), it is **mandatory** that Blood Bank/TML report serious adverse reactions or a cluster of minor reactions to Canada Vigilance Program, Health Canada and to the manufacturer of the product. [43]

Acute Transfusion Reactions

Refer to Appendix 8: TTISS-ON Acute Transfusion Reactions Chart for a summary of the following information in chart format (page 124).

Signs and Symptoms

Every unexpected, unusual or serious symptom of a possible transfusion reaction must be reported to Blood Bank/TML for investigation.

[2CSA(18.1.1,18.2.1),3CSTM(5.9.4.11,7.2.1),11AC(26.0-1)]



Key signs and symptoms of a possible transfusion reaction are [5BE4(p.47-67),44-6]:

- 1. FEVER
- 2. URTICARIA (Hives)
- 3. DYSPNEA
- 4. HYPOTENSION

Additional signs and symptoms of a possible transfusion reaction include [5BE4(p.47-67),44-6]:

- Airway or facial edema
- Anxiety
- Coughing
- Diffuse bleeding/oozing
- Hemoglobinuria
- Hypertension
- Itching
- Nausea/vomiting
- Pain (back, headache, IV site)
- Rash
- Shaking chills/rigors
- Subjective chills
- Tachycardia
- Urine colour– dark/red
- Wheezing

Of Note:

Timing of Signs and Symptoms: may occur during the transfusion or within 4 hours following completion of the transfusion depending on the nature of the reaction. [47]

Exception: dyspnea may occur during or up to 24 hours following completion of transfusion. [48-50]

Acute Transfusion Reactions (cont'd)

Immediate actions

The following actions should be taken IMMEDIATELY if a possible acute transfusion reaction is suspected

[5BE4(p.47-67),44-6]:

1. Stop the transfusion
2. Maintain IV access:
 - Either flush IV site with 0.9% sodium chloride flush syringes and then infuse an IV line with any IV solution TKVO
 - Or infuse 0.9% sodium chloride IV line TKVO [2CSA(11.4.11),3CSTM(5.9.4.4),11AC(22.6)]
3. Check vital signs
4. Verify that patient armband identification matches the transfusion label or tag
5. Verify that the blood component unit number/ blood product lot number matches the transfusion label or tag
6. Notify the prescriber but remain with the patient
7. Provide patient care as ordered by the prescriber
8. Report every reaction to Blood Bank/TML. If clarification is needed call Blood Bank/TML. [2CSA(18.1.1,18.2.1),3CSTM(5.9.4.11,7.2.1),11AC(26.0-1)]
9. Document the possible reaction on the patient's health record [2CSA(11.1.2.3,11.4.17,18.2.5),3CSTM(5.9.6.1,7.2.2.10),11AC(24.5,26.7)]



Follow your hospital's policy and procedure for immediate actions if a transfusion reaction is suspected.

Key Signs and Symptoms and their Management

1. FEVER

[2CSA(18.3.1-3,18.4.1-3),3CSTM(7.3.1-3,7.4.1-3,7.4.5),5BE4(p.48-54),11AC(26.0,26.3),44-47,51-53]

Defined as:

Temperature of at least 38° C and an increase of at least 1° C from pre-transfusion **and/or** Shaking Chills/Rigors.

NOTE: Isolated symptom subjective chills, may consider as Low Risk.

1. a) Low Risk FEVER: 38° C to 38.9° C but NO other symptoms

Timing: During or up to 4 hours post transfusion.

Recommended Investigations: None required.

Suggested Treatment/Actions:

- Hold the transfusion and administer antipyretic
- With prescriber’s order and if blood still viable/in date, may resume transfusion with close patient assessment
- If recurrent reactions, possible trial of antipyretic premedication

Possible Etiology:

FEBRILE NON-HEMOLYTIC TRANSFUSION REACTION

1. b) High Risk FEVER:

- i) at least 38° C but with other symptoms
- or ii) 39° C or greater
- or iii) Shaking Chills/Rigors

Timing: Often within first 15 minutes. During or up to 4 hours post transfusion.

Key Signs and Symptoms (cont'd)

Recommended Investigations:

- Blood Bank/TML: group & screen, DAT
- Blood Bank/TML: blood component culture
- Patient blood culture (from a different peripheral site)
- Urinalysis (first void post-reaction)
- Hemolysis work-up: CBC, bilirubin, LDH, AST, haptoglobin, reticulocyte count, peripheral blood film
- If indicated, assess for:
 - AKI (acute kidney injury) [tests: electrolytes, creatinine]
 - DIC (disseminated intravascular coagulation) [tests: INR, PTT, fibrinogen, D-dimer]

Suggested Treatment/Actions:

- **DO NOT restart transfusion**
- Return blood to Blood Bank/TML for clerical check and culture
- Broad spectrum IV antibiotics; DO NOT wait for culture results
- Aggressive hydration; maintain good urine output
- Supportive care per prescriber’s discretion: IV fluid, vasopressors, oxygen, respiratory support
- Monitor for hypotension, renal dysfunction, DIC (disseminated intravascular coagulation)
- If severe rigors, consider meperidine (if no patient contraindications)
- **Serious reaction, call Blood Bank/TML immediately**

Possible Etiology:

FEBRILE NON-HEMOLYTIC TRANSFUSION REACTION

BACTERIAL CONTAMINATION (increased risk with platelets transfusion related to room temperature storage)

ACUTE HEMOLYTIC TRANSFUSION REACTION

(Refer to page 64 for more information)

Key Signs and Symptoms and their Management

1. FEVER (cont'd)

Of Note:

Acute Hemolytic Transfusion Reaction

[SBE4(p.51-2,68),52]

- ▲ May be associated with ABO, Rh(D) or other blood group incompatibility (transfused red blood cells are destroyed or hemolysed by antibodies in the patient’s plasma).
- ▲ Hemolysis causes the release of the normally intracellular hemoglobin from the red blood cells into the plasma.
- ▲ May be due to:
 - human (clerical) or system error (mislabeled group and screen sample; misidentified patient)
 - antibodies in patient’s plasma below level detected by the antibody screen
 - uncrossmatched blood transfused to a patient who has antibodies (is alloimmunized due to previous transfusion or pregnancy)
- ▲ Rarely, may occur if group O platelets with high titres of anti-A and/or anti-B antibodies are transfused to a non-group O patient (Blood Bank/TML specific policies are established to mitigate this risk).
[2CSA(10.7.8),3CSTM(5.4.3.4),11AC(20.8-9)]
- ▲ May also occur if:
 - Hypotonic IV solutions are transfused with RBC
 - Medical device (blood warmer, cell saver) malfunctions
 - Improper storage of RBC (e.g., inadvertent heating by placing on radiator, inadvertent freezing by placing directly on ice pack)
 - Transfusion of RBC under pressure through a small gauge needle
- ▲ Acute hemolytic transfusion reactions are most often benign, however life threatening hemolysis with severe anemia and renal failure can ensue.

Key Signs and Symptoms (cont'd)

2. URTICARIA (Hives)

[SBE4(p.62-5),44-7]

Includes rash or itching

2. a) URTICARIA (Hives), Rash or Itching: less than 2/3 of body surface, NO other symptoms

Timing: During or up to 4 hours post transfusion.

Recommended Investigations: None required.

Suggested Treatment/Actions:

- Hold the transfusion and administer antihistamine
- With prescriber’s order and if blood still viable/indate, may resume transfusion with close patient assessment
- If recurrent/severe reactions, possible trial of antihistamine premedication

Possible Etiology: MINOR ALLERGIC TRANSFUSION REACTION

2. b) URTICARIA (Hives), Rash or Itching: 2/3 or more of body surface, NO other symptoms

Timing: Often early in transfusion. During or up to 4 hours post transfusion.

Recommended Investigations: None required.

Suggested Treatment/Actions:

- DO NOT restart transfusion
- Antihistamine
- May require steroid if symptoms slow to resolve
- If recurrent/severe reactions, possible trial of antihistamine/steroid premedication
- If continued reactions with premedication, possible trial of washed/plasma depleted components

Possible Etiology:

MINOR ALLERGIC (EXTENSIVE)
TRANSFUSION REACTION

Key Signs and Symptoms and their Management

2. URTICARIA (Hives) (cont'd)

2. c) URTICARIA (Hives), Rash or Itching:
with other symptoms i.e., Airway or Facial Edema,
DYS/PNEA, HYPOTENSION

Timing: Often early in transfusion. During or up to 4 hours post transfusion.

Recommended Investigations:

- If also DYS/PNEA: chest x-ray,
- If also hypoxia: blood gases
- Suggest consult Transfusion Medicine physician, explore if indication for:
 - Blood Bank/TML: group & screen, DAT
 - Haptoglobin
 - IgA level (if pre-transfusion blood sample available)
 - Anti-IgA testing (performed via CBS, Blood Bank/TML will assist in sending samples)

Suggested Treatment/Actions:

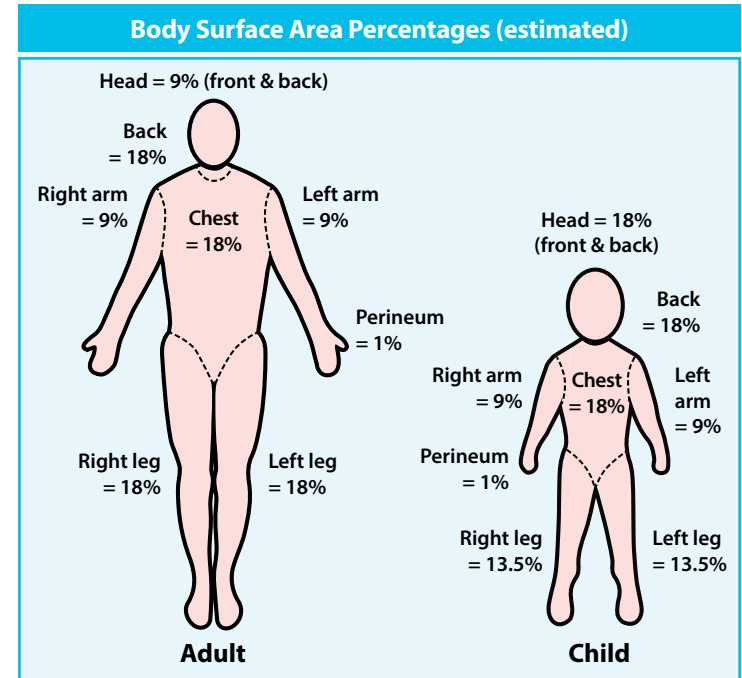
- **DO NOT restart transfusion**
- **Epinephrine;** consider steroid, antihistamine
- Return blood to Blood Bank/TML for clerical check
- Supportive care per prescriber's discretion: oxygen, respiratory support, vasopressors
- Pending outcome of investigations, washed/plasma depleted components
- **Serious reaction, call Blood Bank/TML immediately**

Possible Etiology: ANAPHYLACTOID REACTION/ANAPHYLAXIS

Key Signs and Symptoms (cont'd)

Of Note:

For 2. a) and 2. b) Urticaria (Hives), Rash or Itching, guidance for determining affected body surface [54]:



Body Part	Adult	Child
Entire Head	9%	18%
Entire Chest/Abdomen	18%	18%
Entire Back	18%	18%
Entire Right Arm	9%	9%
Entire Left Arm	9%	9%
Perineum	1%	1%
Entire Right Leg	18%	13.5%
Entire Left Leg	18%	13.5%

Key Signs and Symptoms and their Management

3. DYSPNEA

[SBE4(p.55-61),44-7]

Defined as:

Shortness of breath, laboured or difficult breathing

or SpO₂ (oxygen saturation) of 90% or less and a decrease of at least 5% from pre-transfusion

or Intervention required to maintain SpO₂ (oxygen saturation)

3. a) DYSPNEA with Hypertension, tachycardia, +/- FEVER

[SBE4(p.55,60-1),44-9,55]

Timing: During or up to 12 hours post transfusion

Recommended Investigations:

- Blood Bank/TML: group & screen, DAT
- Consider chest x-ray
Findings - pulmonary edema, kerley B lines, peri bronchial cuffing; may be pleural fluid
- Cardiac biomarkers (as available)

Suggested Treatment/Actions:

- DO NOT restart transfusion
- Oxygen, high fowler's position
- Diuretics (document fluid balance)

▲ Future transfusion:

- Do not transfuse more than 1 unit at a time
- Transfuse slowly over longer time period (maximum: 4 hours after removal from temperature controlled environment)
- Administer pre-transfusion diuretic
furosemide PO: onset of effect 30 to 60 minutes, maximal effect 1-2 hours, effect persists about 6-8 hours [56]
furosemide IV: onset of effect 5 minutes, maximal effect 20-60 minutes, effect persists about 2 hours [56]

Key Signs and Symptoms (cont'd)

- Blood Bank/TML to divide unit, as available (if Blood Bank/TML equipment available; then transfuse each part of unit over maximum 4 hours after removal from temperature controlled environment)

Possible Etiology:

TACO (Transfusion Associated Circulatory Overload)

Of Note:

TACO: sudden shortness of breath related to volume overload secondary to blood transfusion at a rate the specific patient's cardiac function is unable to tolerate.

Pre-transfusion assess for TACO risk factors: Advanced age, history heart failure, history myocardial infarction, left ventricular dysfunction, renal dysfunction, positive fluid balance

3. b) ACUTE DYSPNEA with HYPOTENSION, tachycardia, +/- FEVER

[2CSA(18.5),SBE4(p.55-9),44-7,50,57]

Timing: During or up to 6 hours post transfusion.

Recommended Investigations:

- Blood Bank/TML: group & screen, DAT
- Chest x-ray
Findings - bilateral interstitial/alveolar infiltrates without elevated pulmonary pressures
- If also hypoxia: blood gases
- CBS requires follow up information and patient blood tests, contact Blood Bank/TML, will assist in sending samples

Suggested Treatment/Actions:

- DO NOT restart transfusion
- Supportive care per prescriber's discretion: oxygen, respiratory support, vasopressors
(benefit uncertain for diuretics [document fluid balance], steroids, and bronchodilators)
- Serious reaction, call Blood Bank/TML immediately

Possible Etiology: TRALI (Transfusion Related Acute Lung Injury)

Key Signs and Symptoms and their Management

3. DYSPNEA (cont'd)

Of Note:

TRALI

[4,5BE4(p.55-9)]

- ▲ TRALI: Acute shortness of breath and hypoxia with evidence of bilateral lung infiltrates, often requiring mechanical ventilation and with hypotension
- ▲ At this time TRALI etiology is not completely defined, possible mechanisms include:
 1. Antibody-mediated: HLA or granulocyte antibodies passive transfer from the blood donor to the blood transfusion recipient or (less common) HLA or granulocyte antibodies in the recipient (antibodies are identified in the donor or the recipient in 80% of cases; antibodies are most common in multiparous females related to previous pregnancies)
 2. Neutrophil priming hypothesis: Biologic response modifiers (biologically active lipids) in the component that was transfused cause TRALI in a susceptible patient
- ▲ Component strategies to decrease the incidence of TRALI:
 - Plasma for transfusion is collected from predominantly male donors (plasma collected from multiparous female donors is directed to manufacturing plasma protein products)
 - Platelets pools are suspended in male donor plasma
 - Apheresis platelets are collected from male donors or never pregnant females
- ▲ Additional measures:
 - Blood donors confirmed to be implicated in a case of TRALI (found to have antibodies or implicated in multiple cases) are deferred
 - Follow evidence-based transfusion guidelines; avoid transfusion when it is not indicated

Key Signs and Symptoms (cont'd)

3. c) DYSPNEA with FEVER, +/- HYPOTENSION

Consider/Follow 1. b) FEVER, High Risk

Timing, Recommended Investigations and Suggested Treatment Actions

Possible Etiology:

BACTERIAL CONTAMINATION,
ACUTE HEMOLYTIC TRANSFUSION REACTION

3. d) DYSPNEA with URTICARIA (Hives),
Airway or Facial Edema, HYPOTENSION

Consider/Follow 2. c) URTICARIA (Hives), Rash or Itching
with other symptoms

Timing, Recommended Investigations and Suggested Treatment Actions

Possible Etiology: ANAPHYLACTOID REACTION/ANAPHYLAXIS

3. e) DYSPNEA Mild respiratory symptoms [47]

(slightly increased respiratory rate, slightly decreased O₂ saturation) that do not align with TACO or TRALI

Timing: During or up to 24 hours post transfusion.

Recommended Investigations:

- Consider chest x-ray
- Findings - normal/unchanged, no pulmonary edema, no bilateral interstitial/ alveolar infiltrates

Suggested Treatment/Actions:

- DO NOT restart transfusion
- Supportive care per prescriber's discretion: oxygen, respiratory support

Possible Etiology: TAD (Transfusion Associated Dyspnea)

Key Signs and Symptoms and their Management

4. HYPOTENSION

[SBE4(p.66-7),44-7,51]

Defined as:

SBP (Systolic blood pressure) 80 mmHg or lower

AND

from pre-transfusion SBP:

- 30 mmHg or greater absolute decrease
- or 15 to 25% or greater relative decrease
- or intervention required to maintain SBP

4. a) HYPOTENSION alone or with facial flushing

Timing: During or up to 4 hours post transfusion.

Recommended Investigations: None required.

Suggested Treatment/Actions:

- DO NOT restart transfusion
- Supportive care per prescriber’s discretion: IV fluids
- If taking ACE (angiotensin converting enzyme) inhibitor medication, consider an alternative anti-hypertensive agent prior to additional transfusion

Possible Etiology: BRADYKININ MEDIATED HYPOTENSION

Of Note:

Bradykinin is believed to have a major role in producing hypotension.

Patients taking ACE (angiotensin converting enzyme) inhibitor medication have decreased bradykinin degradation related to increased angiotensin converting enzyme.

Also some individuals have a genetic polymorphism leading to decreased bradykinin degradation.

Key Signs and Symptoms (cont’d)

4. b) HYPOTENSION with FEVER, +/- DYSPNEA

Consider/Follow 1. b) FEVER, High Risk

Timing, Recommended Investigations and Suggested Treatment Actions

Possible Etiology:

BACTERIAL CONTAMINATION,
ACUTE HEMOLYTIC TRANSFUSION REACTION

4. c) HYPOTENSION with URTICARIA (Hives), Airway or Facial Edema, DYSPNEA

Consider/Follow 2. c) URTICARIA (Hives), Rash or Itching with other symptoms

Timing, Recommended Investigations and Suggested Treatment Actions

Possible Etiology: ANAPHYLACTOID REACTION/ANAPHYLAXIS

4. d) HYPOTENSION with ACUTE DYSPNEA, tachycardia, +/- FEVER

Consider/Follow 3. b) ACUTE DYSPNEA with HYPOTENSION, tachycardia, +/- FEVER

Timing, Recommended Investigations and Suggested Treatment Actions

Possible Etiology: TRALI (Transfusion Related Acute Lung Injury)

Of Note [SBE4(p.47-67),44-6]:

- ▲ When unexpected signs and symptoms manifest during or following transfusion, it is often difficult to distinguish a minor reaction from a serious reaction.
- ▲ The initial presenting sign/symptom may evolve, if so re-contact Blood Bank/TML.
- ▲ Close patient monitoring is essential.

Key Signs and Symptoms and their Management

Of Note: (cont'd)

- ▲ Target patient care (recommended investigations and suggested treatment/actions) as per the key symptom(s) rather than considering the possible etiology.

In patient scenarios that include multiple signs and symptoms, several patient care strategies might be implemented to manage various possible etiologies.

The role of the Blood Bank/TML Medical Director, in collaboration with the patient’s attending prescriber, is to determine etiology.
- ▲ Hypotension with other symptom(s) is indicative of a serious transfusion reaction.
- ▲ Consider the possible transfusion reaction in the context of the patient’s underlying medical conditions and the patient’s clinical status prior to transfusion.
- ▲ Consider the blood component or blood product transfused and any risks specific to that component or product.
- ▲ **Following a possible transfusion reaction, if returning the blood to Blood Bank/TML:**
 - Ensure all roller clamps on the blood tubing are securely closed (to prevent leaking)
 - When the blood is disconnected from the patient’s IV site, cap the blood tubing with a sterile cap (to avoid contamination)
 - Return intact and sealed in a bag, the materials used for transfusion (the blood and the 0.9% sodium chloride IV bag, both attached to the Y connector tubing of the blood tubing; the capped blood tubing)
- ▲ **Documentation** of details of a possible transfusion reaction is important for patient care and Blood Bank/TML Medical Director’s investigation to determine etiology and potential implications for subsequent transfusions (for this patient and for blood donated by this donor).

[2CSA(11.1.2.3,11.4.17,18.2.5),3CSTM(5.9.6.1,7.2.2.10),11AC(24.5,26.7)]

Document signs and symptoms, transfusion start time and stop time, volume transfused, all treatment provided and patient’s response to treatment.



Delayed Transfusion Reactions: Manifestation, Treatment, Prevention

Refer to Appendix 8: TTISS-ON Acute Transfusion Reactions to review acute transfusion reaction information in summary chart format (page 124).

To confirm your understanding, refer to Appendix 9: Practice your Learning: Acute Transfusion Reactions (page 132). Patient scenarios are posed with opportunity to validate your responses.

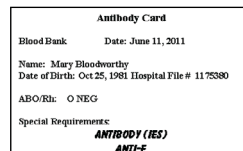
Delayed Hemolytic Transfusion Reaction

[SBE4(p.68-9),52]

- ▲ Occurs when the patient has formed antibody(ies) (to previously transfused red cell alloantigens or from red blood cell antigen exposure during previous pregnancy) and the antibody(ies) were below the level of detection on the initial, pre-reaction group and screen testing.
- ▲ Can also occur with malaria or babesiosis transmitted by transfusion.
- ▲ Patient presents 3 days to 4 weeks after receiving blood transfusion with hemolytic anemia (low hemoglobin, high bilirubin, high reticulocyte count, spherocytes on blood film, high LDH, group and screen testing positive antibody screen and DAT).
- ▲ Most often is benign, however life threatening hemolysis with severe anemia and renal failure can occur.

Treatment/Prevention:

- For future transfusions, patient requires antigen negative RBC units (e.g., patient developed anti-Jk^a, then Blood Bank/TML will provide RBC units where the red blood cells do not have Jk^a antigen on their surface)
- The patient should be counseled about the antibody. Blood Bank/TML may provide an antibody card (to be shown each time patient seeks medical attention at a hospital and that hospital’s Blood Bank/TML notified).



**Delayed Transfusion Reactions:
Manifestation, Treatment, Prevention (cont'd)**

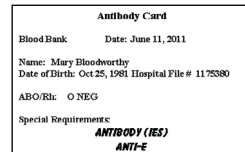
Delayed Serologic Transfusion Reaction

[46-7]

- ▲ Occurs when the patient has formed antibody (ies) as in a delayed hemolytic transfusion reaction.
- ▲ With a delayed **serologic** transfusion reaction, no clinical or lab test indications of hemolysis were found.
- ▲ This is also referred to as alloimmunization.

Treatment/Prevention:

- For future transfusions, patient requires antigen negative RBC units (e.g., patient developed anti-Jk^k, then Blood Bank/TML will provide RBC units where the red blood cells do not have Jk^k antigen on their surface)
- The patient should be counseled about the antibody. Blood Bank/TML may provide an antibody card (to be shown each time patient seeks medical attention at a hospital and that hospital's Blood Bank/TML notified).



Post-Transfusion Purpura (PTP)

[5BE4(p.72-3),46]

- ▲ Occurs when platelet antigen-positive RBC, platelets or plasma is transfused to a patient who lacks that same platelet antigen (occurs mean of 9 [range of 1 to 24] days post-transfusion).
- ▲ Most often (75%) occurs in patient who is human platelet antigen-1b (HPA-1b) homozygous (2 identical, matching alleles) and is transfused a blood component that is HPA-1a positive.
- ▲ About 3% of North Americans are HPA-1b homozygous but only about 28% appear to be able to form anti-HPA-1a.
- ▲ Patient's own platelets are destroyed, mechanism is unknown.
- ▲ Approximately 5 times more frequent with female patients due to sensitization from previous pregnancies.
- ▲ Mortality is 8% (most often related to intracranial hemorrhage).

**Delayed Transfusion Reactions:
Manifestation, Treatment, Prevention (cont'd)**

Signs and Symptoms of PTP:

- Bruising, bleeding, platelet count < 10 x10⁹/L
- Challenging to differentiate from platelet alloimmunization; consider PTP if a platelet refractory patient does not respond to transfusion of HLA-matched platelets

To diagnose:

- Blood test for platelet-specific antibodies (testing performed at CBS)

Treatment:

- IVIG 1 g/kg daily for 2 days
- Platelet count should begin to increase about 4 days after starting treatment

Prevention:

- Require antigen-negative RBC or platelets transfusions
- Affected patients and their relatives are at risk of Neonatal Alloimmune Thrombocytopenia (NAIT); family should be tested and counseled about anti-platelet antibodies, PTP and NAIT

Of Note:

Neonatal Alloimmune Thrombocytopenia (NAIT)

- ▲ When a female has anti-platelet antibodies (most often anti-HPA-1a) and is pregnant with an antigen positive fetus, at birth the baby can have severe thrombocytopenia and at times intracranial hemorrhage.
- ▲ Antepartum IVIG treatment is given preventatively.
- ▲ Family should be tested and counseled about PTP and NAIT.

Delayed Transfusion Reactions: Manifestation, Treatment, Prevention (cont'd)

Transfusion Associated Graft Versus Host Disease (TA-GvHD)

[5BE4(p.70-1),46,58]

- ▲ Reported in immunocompromised (most at risk) and immunocompetent patients transfused a fresh (less than 14 days old) blood component where the blood donor and the recipient (patient) Human Leukocyte Antigen (HLA) relationships are similar (specifically, donor is homozygous [2 identical, matching alleles] and recipient is heterozygous [2 different alleles] for the same HLA haplotype)
- ▲ This similarity leads to the recipient's immune system not recognizing the donor's lymphocytes as foreign and not eliminating them. The viable donor lymphocytes then respond against the recipient's cells; donor lymphocytes engraft and damage the recipient's tissues.
- ▲ HLA relationships where donor and recipient HLA are similar include primary relatives (parents, siblings) and HLA matched components (e.g., HLA matched platelets).
- ▲ Pre-storage leukoreduction (filtering of RBC and platelets) removes leukocytes (including lymphocytes). It is postulated that the number of viable donor lymphocytes transfused plays a role in TA-GvHD
- ▲ TA-GvHD is very rare, however mortality is > 90% (related to overwhelming infections)
- ▲ Factors leading to TA-GvHD are not fully understood; likely under recognized and under reported, may be mild forms

Delayed Transfusion Reactions: Manifestation, Treatment, Prevention (cont'd)

Signs and Symptoms of TA-GvHD:

- Fever, rash, liver dysfunction and diarrhea beginning about 2 weeks after transfusion; subsequently pancytopenia (low white blood cells, red blood cells, and platelets)

To diagnose:

- Biopsy of skin, liver, bone marrow

Treatment:

- Immunosuppressive therapy, though rarely is effective

Prevention:

- Patients at risk must be transfused irradiated cellular blood components (i.e., RBC and platelets)
- The National Advisory Committee on Blood and Blood Products provides guidance for use of irradiated blood components [58]
- Patients requiring irradiated cellular blood components should be counseled. Blood Bank/TML may provide a card (to be shown each time patient seeks medical attention at a hospital and that hospital's Blood Bank/TML notified). [58]

Patient care implications for delayed transfusion reactions

- ▲ Specific treatment and prevention strategies as described.
- ▲ During pre-transfusion assessment the transfusionist should inquire if the patient has had previous transfusion. If so, focused further inquiry: did any concerns arise, has the patient been advised of any "special" transfusion requirements or provided with a wallet card. If information is identified, notify Blood Bank/TML.

The transfusion checklist is a summary of the transfusionist's accountability. [37]



Always refer to your hospital's policy and procedure for hospital specific details.

Of Note:

The following information is a summary, for complete details refer to the specific section of this handbook.

For a 1 page quick review format, refer to Appendix 10: Transfusion Checklist (page 136).

Pre-Transfusion

✓ **Informed Consent**

[2CSA(11.2.1),3CSTM(5.9.1.1),11AC(21.2)]

- ▲ Validate informed consent policy and procedure has been fulfilled.
- ▲ Ensure patient questions have been addressed.
- ▲ In emergency situations of health threatening or life threatening bleeding, the health care professional prescribing the transfusion may declare that transfusion proceed without informed consent.
[2CSA(10.9.3.5),3CSTM(5.3.7.4.2),11AC(21.2)]

✓ **Transfusion Order**

[2CSA(11.4.3-4),3CSTM(5.9.1.4),11AC(19.2-4)]

- ▲ Is the blood appropriate for the patient's diagnosis?
- ▲ What is the indication for transfusion (laboratory test results, patient signs and symptoms)?
- ▲ Are there any other treatment options/alternatives?
- ▲ Does the dose align with current best practice/transfusion guidelines?

Pre-Transfusion (cont'd)

- ▲ Does the order include all required information?
 - Patient's surname, first name, unique identification number
 - Date to be given
 - Blood component/blood product
 - Number of units/doses
 - Rate/duration of infusion (or hospital standard protocol)
 - Special modifications or requirements, if any (washed/irradiated)
 - Medication orders, if any (premedication or diuretic)
 - Blood warmer/rapid infusion device, if needed (or hospital established protocol)
 - Sequence for transfusion of multiple components/products

✓ **Group and Screen Testing**

- ▲ Group and screen test results are necessary for transfusion of compatible blood components.
[2CSA(10.6.1.1,10.7.1),3CSTM(5.4.1.1),11AC(19.2)]
- ▲ Determines ABO and Rh(D) blood groups and antibody screen (clinically significant antibodies).
[2CSA(10.4.1,10.4.4-7),3CSTM(5.3.2.1,5.3.3.1,5.3.5.5),11AC(20.6-8)]
- ▲ **Unequivocal (unmistakable) identification of the patient is mandatory for sample collection for group and screen testing.**
[2CSA(10.2.6),3CSTM(5.2.2.1),11AC(19.5,22.2)]
- ▲ **Patient must be wearing a patient identification armband.**
[2CSA(10.3.2),3CSTM(5.2.3.1),11AC(20.3,22.2.1)]
- ▲ Surname, first name and unique identification number must match identically on
[2CSA(10.3.2),3CSTM(5.2.3.1),11AC(20.3,22.2.1)]:
 - Patient's armband
 - Label for blood sample
- ▲ Immediately after collecting the blood sample, place the label on the tube of blood at the patient's bedside.
[2CSA(10.3.2),3CSTM(5.2.3.1),11AC(20.3)]

Pre-Transfusion (cont'd)✓ **Prepare the Patient**

- ▲ Patient must be wearing a patient identification armband. [2CSA(10.3.2),3CSTM(5.2.3.1),11AC(20.3,22.2.1)]

- ▲ Education: what to expect during the transfusion (periodic assessments and vital sign checks, symptoms indicative of a transfusion reaction).

▲ **Assessment:**

History of previous transfusions (if so, special requirements, antibody card, transfusion reactions)? If indicated, follow up with prescriber and Blood Bank/TML

Is patient at risk for TACO (Transfusion Associated Circulatory Overload)? [5BE4(p.60-1)]

- Screen for and as indicated, follow up with prescriber
TACO risk factors: advanced age, history of heart failure, history of myocardial infarction, left ventricular dysfunction, renal dysfunction, positive fluid balance
- Implement TACO preventative management strategies as ordered

✓ **Prepare the Equipment**

- ▲ Dedicated IV access site; confirmed patent (peripheral IV site or central venous line [if a multiple lumen central line, a specific lumen must be used for only the blood transfusion]). [2CSA(11.4.11),3CSTM(5.9.4.3-4),11AC(22.6-7)]

- ▲ **IV Fluid:** Blood is compatible with 0.9% sodium chloride. [2CSA(11.4.11),3CSTM(5.9.4.4),11AC(22.6)]

Exception – IVIG, some brands are compatible with only 5% Dextrose in water; refer to IVIG brand specific product monograph. [20-6]

- ▲ Do not infuse any medication concurrently with blood. [2CSA(11.4.11),3CSTM(5.9.4.3),11AC(22.7)]

Pre-Transfusion (cont'd)▲ **IV Tubing/Filter:**

- Transfuse RBC, platelets, plasma, and cryoprecipitate through blood tubing with a 170 to 260 micron filter to capture any fibrin debris [2CSA(11.4.8),3CSTM(5.9.4),11AC(22.6)]

- Transfuse each unit of platelets through new/fresh blood tubing/filter set [3CSTM(5.9.4.7)]

- Change blood tubing/filter set after a maximum of 4 units or 4 hours [13]

- Blood tubing/filter can be primed with the blood component/blood product or with compatible IV fluid [2CSA(11.4.9),3CSTM(5.9.4.4),11AC(22.6)]

- Set up IV tubing such that if the transfusion must be stopped abruptly, IV access is maintained [2CSA(11.4.11),3CSTM(5.9.4.4),11AC(22.6)]:

Either 0.9% sodium chloride flush syringes and an IV line with any IV solution are on hand, ready to infuse TKVO

Or 0.9% sodium chloride IV line is on hand, ready to infuse TKVO

- ▲ Infusion pumps, blood warmers and rapid infusers devices approved as per Health Canada Medical Device Regulations can be used to transfuse. [2CSA(11.4.2-3,23.1.3),3CSTM(3.5.1-4,5.9.4.2,5.9.4.8),11AC(22.6)]

✓ **Pick Up Blood from Blood Bank/TML**

- ▲ Blood Bank/TML requires the order information and documentation of patient identification (surname, first name, unique identification number) to issue blood to the patient care area. [2CSA(10.2.4),3CSTM(5.8.5.1),11AC(19.5)]

- ✓ **For patient safety, ensure all preparation steps have been completed before picking up blood from Blood Bank/TML.**

Transfusion

✓ Checking Blood Components/Blood Products

- ▲ The blood component/blood product received from Blood Bank/TML must match the transfusion order.
[2CSA(11.4.3-4),3CSTM(5.9.1.4),11AC(19.2-4)]
- ▲ Must occur at the bedside, in the physical presence of the patient.
[2CSA(10.3.2),3CSTM(5.2.3.1),11AC(20.3)]
- ▲ Any discrepancy must be resolved prior to transfusing.
[2CSA(11.3.2,14.5),3CSTM(5.9.3.4),11AC(22.3)]

Step 1: Patient Identification

- ▲ **Unequivocal (unmistakable) identification of the patient is mandatory for administering blood.**
[2CSA(11.3.1),3CSTM(5.9.3.3),11AC(22.2-3)]
- ▲ **Patient must be wearing a patient identification armband.**
[2CSA(10.3.2),3CSTM(5.2.3.1),11AC(20.3,22.2.1)]
- ▲ Surname, first name and unique identification number must **match identically** on
[2CSA(10.3.2),3CSTM(5.2.3.1),11AC(20.3,22.2.1)]:
 - Patient's armband
 - Prescriber's order for the blood transfusion
 - Blood component/blood product transfusion label or tag
 - "Chart" transfusion label or tag (the transfusion label or tag that will be added to the patient's health record to document the transfusion)
- ▲ The patient identification information must remain attached to the blood component/blood product for the duration of the transfusion.
[2CSA(11.3.3, 14.5),3CSTM(5.9.3.5),11AC(22.8)]

Transfusion (cont'd)

Step 2: ABO and Rh(D) Blood Group

For checking blood components only;

For checking blood products, ABO and Rh(D) blood group compatibility is not relevant

- ▲ Check patient and component ABO and Rh(D) blood groups information on:
 - Patient's health record – group and screen test results
 - CBS label
 - Blood component's transfusion label or tag
 - "Chart" transfusion label or tag (the transfusion label or tag that will be added to the patient's health record to document the transfusion)
- ▲ For **RBC and platelets**, validate the patient and component ABO and Rh(D) blood groups are **identical/compatible**.
[2CSA(10.7.1,10.7.3,10.7.5-7),3CSTM(5.4.2.1-3,5.4.3.1-4),11AC(20.8)]
- ▲ For **plasma**, validate the patient and component ABO blood group is **identical/compatible**.
[2CSA(10.7.1,10.7.3,10.7.5-7),3CSTM(5.4.2.1-3,5.4.3.1-4),11AC(20.8)]
- ▲ For **cryoprecipitate**, all patients may be transfused any ABO group. [2CSA(10.7.7),11AC(20.8)]
- ▲ To confirm compatibility if not ABO and Rh(D) identical, *refer to Appendix 2: ABO and Rh(D) Compatibility Chart.* (page 94)
- ▲ Females age 45 years and under with childbearing potential should be transfused with antigen K (also known as K1 or Kell) negative RBC units unless they are known to be K positive. [2CSA(10.7.4),11AC(20.8)]

Transfusion (cont'd)**Step 3: Unit number (blood components)/
Lot number (blood products)**

▲ Check the

Unit number

[2CSA(10.7.1,10.7.3,10.7.5-7),3CSTM(5.4.2.1-3,5.4.3.1-4,5.9.3.2),11AC(20.8)] /

Lot number [2CSA(14.5),3CSTM(5.9.3.2),11AC(20.0)] are an **identical match** on:

- CBS label (blood components)/
Manufacturer's label (blood products)
- Transfusion label or tag
- "Chart" transfusion label or tag (the transfusion label or tag that will be added to the patient's health record to document the transfusion)

Step 4: Visual Inspection and Expiry▲ **Blood Components:**

- Inspect for clots, unusual color, any leaking from the ports.
If any concerns, contact Blood Bank/TML.
[2CSA(10.10.2),3CSTM(5.8.1.1,5.9.1.3),11AC(18.2)]
- Transfusion must be completed within 4 hours of the time of issue (removal from the temperature controlled environment).
[2CSA(11.4.6),3CSTM(5.9.5.1),11AC(22.9)]
If not completed within 4 hours of the time of issue, the remainder must be discarded.

Transfusion (cont'd)▲ **Blood Products:**

- Inspect for intact packaging/seal on the vial or bottle. Refer to manufacturer's monograph enclosed in the packaging for expected colour and appearance. If any concerns, contact Blood Bank/TML.
[2CSA(14.4.1-2),3CSTM(5.8.1.1,5.9.1.3),11AC(14.1)]

- When packaging/seal is opened, administer without delay. [2CSA(14.6.1),11AC(14.1)]

Products in vials/glass bottles can be transfused for a maximum of 4 hours from the time that vial/glass bottle was entered/spiked.

If not completed within 4 hours of the time of entering/spiking the vial/glass bottle, the remainder must be discarded.

[2CSA(14.6.1),16-18,22-26,28-30]

▲ **NOTE:** Blood Products requiring Reconstitution

Blood Bank/TML may issue reconstituted, ready to transfuse or may issue in the manufacturer's packaging to be reconstituted by clinical area staff.

✓ **Patient Assessment and Vital Signs**

[2CSA(11.4.15-6),3CSTM(5.9.4.10),5BE4(p.21,30,35),6,11AC(22.10),38]

- ▲ Transfusion Medicine Standards require close patient monitoring/observation.
- ▲ Perform, at minimum: within 30 minutes of starting transfusion, 15 minutes after the start and upon completion of the transfusion.
- ▲ Include: temperature, blood pressure, pulse, respiratory rate, oxygen (O₂) saturation, chest auscultation (especially if at risk for TACO)
- ▲ Remind patient to report ASAP any symptoms indicative of a transfusion reaction.

Transfusion (cont'd)✓ **Infusion Rate**

[2CSA(11.4.15-6),3CSTM(5.9.4.10),5BE4(p.21,30,35),6,11AC(22.10)]

- ▲ For stable patients, begin blood component transfusion slowly, at 50 mL/hour for first 15 minutes.
- ▲ If the tubing was primed with 0.9% sodium chloride, re-priming with the blood component is required to ensure the initial slow infusion rate is actually infusing the blood component (the volume of blood tubing is 12 to 15 mL).
- ▲ Assess patient and re-check vital signs 15 minutes after the infusion was started.
- ▲ If no signs/symptoms of transfusion reaction are identified, increase to rate of infusion ordered.
- ▲ NOTE: IVIG transfusion requires specific incremental infusion rates and patient monitoring. Refer to the brand-specific monograph [22-6] for details.

✓ **Possible Transfusion Reaction**

[2CSA(18.1.1,18.2.1),3CSTM(5.9.4.11,7.2.1),5BE4(p.47-67),11AC(26.0-1),44-6]

- ▲ Key signs and symptoms include: fever, urticaria (hives), dyspnea, hypotension.
All unexpected, unusual or serious symptom(s) must be identified, managed and reported to Blood Bank/TML for investigation
- ▲ If a possible acute transfusion reaction is suspected immediate actions include:
 - STOP the transfusion
 - Maintain IV access
 - Check vital signs
 - Verify patient armband identification matches transfusion label/tag
 - Notify prescriber
 - Patient care per order
 - Report to Blood Bank/TML; Document all details
- ▲ Refer to Appendix 8: TTISS-ON Acute Transfusion Reaction Chart for detailed information (page 124).

Post-Transfusion✓ **Completing the Transfusion**

- ▲ Comply with the expiry time specific to blood component/ blood product being transfused. Outside the expiry time, discard any remainder.
- ▲ Blood component tubing should be flushed with 0.9% sodium chloride to ensure the entire unit is transfused. [2CSA(11.4.11),3CSTM(5.9.4.4),11AC(22.6)]
- ▲ Blood products given IV: flush (tubing or IV site) with compatible IV fluid
- ▲ Discontinue blood tubing when the transfusion has been completed (blood tubing can harbor bacteria).
- ▲ Some hospital's policy and procedure include returning the empty blood bag to Blood Bank/TML. Otherwise dispose of blood tubing and bags in biohazardous waste. [2CSA(4.5.2),3CSTM(5.9.4.12),11AC(22.0)]
- ▲ Assess the patient and re-check vital signs at the end of the transfusion. [2CSA(11.4.15-6),3CSTM(5.9.4.10),11AC(22.10)]
- ▲ Assess patient and re-check vital signs periodically post-transfusion (reactions may occur up to 4 hours post-transfusion; for dyspnea reactions up to 24 hours post transfusion).

✓ **Documentation**

[2CSA(11.1.2.2-4,11.4.17),3CSTM(5.9.6.1),11AC(24.4-5)]

- ▲ File the completed "chart" transfusion label or tag for each blood component or blood product transfused on the patient's health record to document the transfusion (including start and stop times).
- ▲ Ensure the volume transfused is recorded on the patient's intake and output record and that vital signs and patient assessments are recorded.
- ▲ If a transfusion reaction is suspected, document signs and symptoms and patient care. [2CSA(11.1.2.3,11.4.17,18.2.5),3CSTM(5.9.6.1,7.2.2.10),11AC(24.5,26.7)]

Appendix 1: Glossary of Terms/Abbreviations

Agglutination: the clumping and sticking together of normally free cells or bacteria or other small particles forming visible aggregates [10]

Blood Component: a therapeutic part of blood intended for transfusion (e.g., RBC, platelets, granulocytes, plasma, cryoprecipitate)
[3CSTM(Glossary p.96)]

Blood Product: a therapeutic product derived from human blood or plasma and produced by a manufacturing process, also referred to as plasma protein product (e.g., albumin, coagulation products, factor concentrates, immunoglobulins)
[3CSTM(Glossary p.96)]

Clinically Significant Antibodies: are antibodies with the potential to cause harm to transfused patients or to affect their management and treatment; include antibodies capable of causing acute and delayed hemolytic transfusion reactions (HTR) or hemolytic disease of the newborn (HDN) [59]

Crossmatch: when RBC transfusion is ordered and group and screen testing completed, the Blood Bank/TML procedure to detect any incompatibilities between recipient and donor
[3CSTM(Glossary p.97)]

Computer (electronic) crossmatch — computerized procedure that is used in place of a serologic crossmatch to detect ABO incompatibility (applicable only if antibody screen is negative) [3CSTM(Glossary p.97)]

Serologic crossmatch — in vitro test performed between donor red cells (from a segment removed from the RBC unit) and recipient's serum or plasma (from the group and screen blood sample) to determine compatibility [3CSTM(Glossary p.97)]

Direct Antiglobulin Test (DAT): a blood test that determines if there is in vivo binding of immunoglobulin or complement on the red blood cells (in vivo sensitization). It is used for detection and differential diagnosis of several forms of immune hemolysis (such as hemolytic transfusion reactions). Interpreting the clinical significance of a DAT result includes considering the patient's clinical history as well as other laboratory test results. [9]

Dispense: release of blood components or blood products from Blood Bank/TML (temperature controlled environment) to the clinical area, synonymous with issue.
[3CSTM(Glossary p.99)]

Health Care Professional: a person associated with either a specialty or a discipline and who is qualified and allowed by regulatory bodies to provide a healthcare service to a patient.
[60]

Issue: release of blood components or blood products from Blood Bank/TML (temperature controlled environment) to the clinical area, synonymous with dispense.
[3CSTM(Glossary p.99)]

Plasma Protein Product: a therapeutic product derived from human blood or plasma and produced by a manufacturing process, also referred to as blood product (e.g., albumin, coagulation factor concentrates, immunoglobulins)
[3CSTM(Glossary p.96)]

Positive Patient Identification Technology: refers to a computerized system that scans a barcode, radiofrequency identification (RFID) or another electronically readable element on a patient's identification band to confirm identity.
[2CSA(10.6.1.3)]

Prescriber: for this handbook, refers to health care professionals who are authorized to order transfusion of blood components and blood products (physicians, physician assistants, nurse practitioners, midwives, dentists).

Red Blood Cells: the cellular component of blood that transports oxygen from the lungs to the tissue cells. Oxygen is needed for tissue cells to carry out their functions in the body. [4,9]

Transfusion Medicine Laboratory: also known as the Blood Bank or Transfusion Service.

Transfusionist: Regulated health care professional who administers a blood transfusion.
[3CSTM(Glossary p.102)]

Appendix 2: ABO and Rh(D) Compatibility Chart

The ABO and Rh(D) Blood Group Systems Compatibility Chart lists each ABO and Rh(D) blood group and the compatible blood groups for RBC, platelets, plasma, and cryoprecipitate transfusion.

[2CSA(10.7.1,10.7.3,10.7.5-7),3CSTM(5.4.2.1-3,5.4.3.1-4),4,9,11AC(20.8),12]

Patient ABO/Rh(D) Blood Group	Compatible Blood Group for Transfusion			
	RBC (Red Blood Cell Concentrate)	Platelets*	Plasma***/Cryosupernatant Plasma***	Cryoprecipitate ****
O Positive	O Rh(D) positive or negative	O preferred** Rh(D) positive or negative	O, A, B, AB	Any Group
O Negative	O Rh(D) negative 1st choice*	O preferred** Rh(D) negative 1st choice*	O, A, B, AB	
A Positive	A, O Rh(D) positive or negative	A preferred** Rh(D) positive or negative	A, AB	
A Negative	A, O Rh(D) negative 1st choice*	A preferred** Rh(D) negative 1st choice*	A, AB	
B Positive	B, O Rh(D) positive or negative	B preferred** Rh(D) positive or negative	B, AB	
B Negative	B, O Rh(D) negative 1st choice*	B preferred** Rh(D) negative 1st choice*	B, AB	
AB Positive	AB, A, B, O Rh(D) positive or negative	AB preferred** Rh(D) positive or negative	AB	
AB Negative	AB, A, B, O Rh(D) negative 1st choice*	AB preferred** Rh(D) negative 1st choice*	AB	

* In urgent bleeding patient situations or during times of short supply, Rh(D) negative patients may need to receive Rh(D) positive RBC and platelets. [2CSA(10.7.3)]



Refer to your hospital policy and procedure regarding RhIG administration if Rh(D) positive RBC or platelets are transfused to an Rh(D) negative patient.

[2CSA(11.9.7),3CSTM(5.4.4.5.8),11AC(22.1)]

** The donor plasma in **platelets** should be ABO compatible with patient's red blood cells. In urgent bleeding patient situations or during times of short supply, Blood Bank/TML will follow established policies for ABO group substitution for platelets. [2CSA(10.7.8),3CSTM(5.4.3.4),11AC(19.2)]

*** Rh(D) of plasma and cyrosupernatant plasma is not relevant.

**** Rh(D) of cryoprecipitate is not relevant. All patients may be transfused any ABO group of cryoprecipitate. [2CSA(10.7.7),11AC(20.8)]

Note: Cryoprecipitate is interchangeable with FC for fibrinogen replacement. [15]

A L E R T

RBC – urgent bleeding patient transfusion:

O Rh(D) negative for females age 45 years and under with childbearing potential

[2CSA(10.9.3.1-2),3CSTM(5.3.7.4.4),11AC(20.10)]

O Rh(D) positive for all others

[2CSA(10.9.3.1-2),3CSTM(5.3.7.4.4),11AC(20.10)]

Plasma – urgent bleeding patient transfusion: AB

[2CSA(10.9.3.1-2),3CSTM(5.3.7.4.4),11AC(20.10)]

Of Note: Females age 45 years and under with childbearing potential should be transfused antigen K (also known as K1 or Kell) negative RBC unless they are known to be K positive. [2CSA(10.7.4),11AC(20.8)]

For more information, refer to Transfusing RBC to Females age 45 years and under with Childbearing Potential (page 24).

Appendix 3: Practice your Learning: Blood Groups and Compatibility

For guidance, refer to:

ABO Blood Group System table (page 8)

Rh(D) Blood Group System table (page 11)

Appendix 2: ABO and Rh(D) Compatibility Chart (page 94)


Patient Example # 1:

Name: Benjamin Dare

Gender: Male **Age:** 72 years

To be transfused: RBC

ABO Group: AB **Rh(D) Group:** Rh(D) positive

- ABO and Rh(D) system antigens on the surface of Benjamin's red blood cells: _____
- ABO system antibodies Benjamin has in his plasma: _____
- ABO groups compatible for Benjamin's RBC transfusion: _____
- Rh(D) groups compatible for Benjamin's RBC transfusion: _____

Patient Example # 2:

Name: Florence Tough

Gender: Female **Age:** 35 years

To be transfused: RBC

ABO Group: O **Rh(D) Group:** Rh(D) negative

- ABO and Rh(D) antigens on the surface of Florence's red blood cells: _____
- ABO system antibodies Florence has in her plasma: _____
- ABO groups compatible for Florence's RBC transfusion: _____
- Rh(D) groups compatible for Florence's RBC transfusion: _____

Patient Example # 3:

Name: Joseph Louis

Gender: Male **Age:** 56 years

To be transfused: plasma

ABO Group: B **Rh(D) Group:** Rh(D) negative

- ABO and Rh system antigens on the surface of Joseph's red blood cells: _____
- ABO system antibodies Joseph has in his plasma: _____
- ABO groups compatible for Joseph's plasma transfusion: _____
- Rh(D) groups compatible for Joseph's plasma transfusion: _____

Appendix 3: Answers:**Patient Example # 1:**

- Answer:** A, B, Rh(D)
- Answer:** None
- Answer:** AB, A, B, O
- Answer:** Rh(D)-positive, Rh(D)-negative

Patient Example # 2:

- Answer:** none
- Answer:** Anti-A, Anti-B
- Answer:** O
- Answer:** Rh(D) negative

Patient Example # 3:

- Answer:** B
- Answer:** Anti-A
- Answer:** B, AB
- Answer:** Rh(D) group is irrelevant for plasma transfusion

Appendix 4: Blood Components and Blood Products Table

BLOOD COMPONENTS - ADULTS					
RBC (CBS Circular of Information)		[2CSA(11.4.8-9),3CSTM(5.9.4,5.9.4.4),5BE4(p.21-6),6(Red Blood Cells, Leukocytes Reduced (LR) 2018 Nov),11AC(22.6),14,40]			
MAIN USES	DOSE	LAB TESTS		STORAGE/EXPIRATION	ADMINISTRATION
Major Bleeding, Massive Hemorrhage Protocol	As needed to stabilize, maintain Hb > 80 g/L	1 RBC = about 10 g/L Hb increase If urgent re-assessment needed, test Hb 15 minutes after RBC transfused		Up to 42 days at 1-6° C in approved, monitored refrigerator Use or discard by 4 hours after removal from temperature controlled environment	Tubing/Filter Blood tubing with 170-260 micron filter Change after a maximum of 4 units of blood or 4 hours of time [13]
					IV Fluid 0.9% sodium chloride
Non-bleeding: Hb < 70 g/L Hb 70 to 80 to 90 g/L with impaired tissue oxygen delivery (tachycardia, hypotension, cardiac ischemia, syncope, pre-syncope)	1 unit, then re-assess: patient symptoms and Hb				Rate of Infusion 50 mL/hr for 1st 15 minutes, [5BE4(p.21)] then usually over 2 hours, slower if patient at risk for circulatory overload (Refer to Pre-Transfusion: Preparing for Transfusion: The Patient: TACO –Transfusion Associated Circulatory Overload [page 27])

Appendix 4: Blood Components and Blood Products Table (cont'd)

PLATELETS (CBS Circular of Information)		[2CSA(11.4.8-9),3CSTM(5.9.4,5.9.4.4),5BE4(p.28-32),6(Pooled Platelets LR CPD, Apheresis Platelets 2018 Aug),11AC(22.6),14,40]			
Note: Availability of all ABO/Rh(D) blood groups may be limited					
MAIN USES	DOSE	LAB TESTS		STORAGE/EXPIRATION	ADMINISTRATION
Major Bleeding, Massive Hemorrhage Protocol	As needed, to maintain PLT count > 50x10 ⁹ /L; if head* trauma maintain PLT count > 100x10 ⁹ /L	About 15-25x10 ⁹ /L increase in PLT count at 10 to 60 minutes post transfusion		Up to 7 days at 20-24° C on an agitator Use or discard by 4 hours after removal from temperature controlled environment	Tubing/Filter NEW/FRESH [3CSTM(5.9.4.7)] Blood tubing with 170-260 micron filter
	Prevent or control bleeding: PLT count If < 10x10 ⁹ /L, prophylactic transfusion If < 20x10 ⁹ /L, pre-procedures not associated with significant blood loss If < 30x10 ⁹ /L, on anticoagulants that should not be stopped If < 50x10 ⁹ /L, pre-procedures or surgery associated with major blood loss; epidural anesthesia, lumbar puncture If < 100x10 ⁹ /L, head* trauma or pre-neurosurgery Any PLT count, if bleeding and platelet dysfunction i.e., - medications: aspirin, clopidogrel (plavix) - post cardiopulmonary bypass Of Note: Immune thrombocytopenia (ITP) with life threatening bleeding, clinical situation specific with hematology consultation				1 dose, then re-assess PLT count As pre-procedure treatment, transfuse immediately prior to procedure
					Rate of Infusion 50 mL/hr for 1st 15 minutes, [5BE4(p.30)] then usually over 60 minutes
* exception: intracranial hemorrhage, not requiring surgery, patient taking anti-platelet agents - increased morbidity				Platelet Refractoriness: If poor PLT count increments (< 7.5x10 ⁹ increase in PLT count at 10 to 60 minutes post transfusion) investigation is required. [5BE4(p.31)]	

Appendix 4: Blood Components and Blood Products Table (cont'd)

PLASMA (CBS Circular of Information)		[2CSA(11.4.8-9),3CSTM(5.9.4,5.9.4.4),5BE4(p.34-8),6(Plasma Components 2019 Aug),11AC(22.6),14,40]			
MAIN USES	DOSE	LAB TESTS		STORAGE/EXPIRATION	ADMINISTRATION
Major Bleeding, Massive Hemorrhage Protocol	As needed to maintain INR < 1.8	If clinical status indicates, check INR, PTT 10 to 60 minutes following plasma transfusion One dose of plasma increases coagulation factors by about 20 % for approximately 6 hours		<p>Frozen: up to 1 year</p> <p>Thawed: AFFP (sodium citrate): Use or discard by 24 hours after thawing, stored at 1-6° C Volume is about 500 mL.</p> <p>FP and AFFP (ACD-A [acid citrate dextrose – Solution A]): Use or discard by 120 hours after thawing, stored at 1-6° C Volume is about 250 mL.</p> <p>ALL thawed plasma: Use or discard by 4 hours after removal from temperature controlled environment</p>	<p>Tubing/Filter Blood tubing with 170-260 micron filter</p> <p>Change after a maximum of 4 units of blood or 4 hours of time [13]</p>
Active bleeding or prior to major procedure/surgery in patient with INR ≥ 1.8** due to multiple coagulation factor deficiency (if no coagulation factor concentrates or alternatives available)	10-15 mL/kg Small adult: 3 units Large adult: 4 units				<p>IV Fluid 0.9% sodium chloride</p>
					<p>Rate of Infusion 50 mL/hr for 1st 15 minutes, [5BE4(p.35)] then usually over 30 minutes to 2 hours</p> <p>Plasma transfusion poses a high risk for circulatory overload</p> <p>(Refer to Pre-Transfusion: Preparing for Transfusion: The Patient: TACO –Transfusion Associated Circulatory Overload [page 27])</p>
** Liver disease patients have conserved thrombin generation despite increased INR levels; often correction of abnormal INR is not needed before procedures					

Appendix 4: Blood Components and Blood Products Table (cont'd)

CRYOPRECIPITATE <small>(CBS Circular of Information)</small> <small>[2CSA(11.4.8-9),3CSTM(5.9.4,5.9.4.4),5BE4(p.40-1),6(Plasma Components 2019 Aug),11AC(22.6),14,15,40]</small>					
<small>(For Main Uses is interchangeable with FC; refer to Fibrinogen Concentrate (FC) (page 108) for its specific Dose, Lab Tests, Storage/Expiration, Administration)</small>					
MAIN USES	DOSE	LAB TESTS		STORAGE/EXPIRATION	ADMINISTRATION
Massive Hemorrhage Protocol To control bleeding: Fibrinogen < 1.0 g/L in bleeding patient Fibrinogen < 2.0 g/L in Obstetrical bleed Acute promyelocytic leukemia: Fibrinogen < 1.5 g/L	As needed to maintain fibrinogen > 1.5 g/L (> 2.0 g/L in Obstetrical bleed)	Each dose will increase fibrinogen level by 0.5 g/L in a bleeding patient Effective immediately post-transfusion		Frozen: up to 1 year Thawed: Use or discard by 4 hours after thawing, stored at 20-24° C	Tubing/Filter Blood tubing with 170-260 micron filter Change after a maximum of 4 units of blood or 4 hours of time [13]
	Adult Dose: 10 units (on average contains 4 g of fibrinogen)		IV Fluid 0.9% sodium chloride		
	10 single units are thawed and pooled for 1 adult dose		Rate of Infusion 1 adult dose (10 units) usually over 10 -30 minutes		

Appendix 4: Blood Components and Blood Products Table (cont'd)

BLOOD PRODUCTS - ADULTS						
Albumin 5% and Albumin 25%						[SBE4(p.102-7),16-18]
Alburex® monograph Plasbumin®-5 monograph Plasbumin®-25 monograph						
MAIN USES	DOSE	LAB TESTS		STORAGE/EXPIRATION	ADMINISTRATION	
<p>5% Albumin</p> <ol style="list-style-type: none"> 1. Plasma Exchange 2. Thermal injury (burns) involving > 50% total body surface area, if unresponsive to crystalloid (only after transfer to specialized burn centre). <p>25% Albumin</p> <ol style="list-style-type: none"> 1. Liver failure patients with ascites undergoing large volume paracentesis 2. In conjunction with specific medications in Type 1 hepatorenal syndrome 3. Current evidence – not superior to crystalloid for resuscitation 	<p>Specific to indication</p> <p>Caution with patients at risk of circulatory overload.</p> <p>Alert: Administering 25% albumin instead of 5% albumin in error could lead to circulatory overload</p>	<p>If large volumes given, monitor electrolytes, blood coagulation factors</p> <p>Of Note: volume response:</p> <p>500 mL 5% Albumin: = 25 g Albumin leading to 500 mL increase intravascular volume</p> <p>100 mL 25% Albumin: = 25 g Albumin leading to 450 mL increase in intravascular volume</p>		<p>Room temperature up to 30° C</p> <p>Store in its box to protect from light</p> <p>Expiry date noted on packaging</p> <p>Use or discard by 4 hours after glass bottle was entered/spiked</p>	Tubing/Filter	Vented IV tubing No filter required
					IV Fluid	0.9% sodium chloride
					Rate of Infusion	50 mL/hr for 1st 15 minutes, then
					<p>5% Albumin Maximum 300 mL/hr</p> <p>25% Albumin Maximum 60 to 120 mL/hr</p> <p>Caution with patients at risk of circulatory overload</p> <p>(Refer to Pre-Transfusion: Preparing for Transfusion: The Patient: TACO –Transfusion Associated Circulatory Overload [page 27])</p>	

Appendix 4: Blood Components and Blood Products Table (cont'd)

Fibrinogen Concentrate (FC) [5BE4(p.41),15,19,20,40]						
(For Main Uses is interchangeable with cryoprecipitate; refer to Cryoprecipitate (page 104) for its specific Dose, Lab Tests, Storage/Expiration, Administration) FIBRYGA® monograph RiaSTAP® monograph						
MAIN USES	DOSE	LAB TESTS		STORAGE/EXPIRATION	ADMINISTRATION	
Refer to cryoprecipitate MAIN USES, (page 104) (is interchangeable)	Adult Dose: 4 g (4 of 1 g vials) reconstituted volume - 200 mL, approximately 20 mg/mL	An adult dose will increase fibrinogen level by about 1.2 g/L Effective immediately post-transfusion		Refrigerator/Room Temperature storage requirements are specific for each brand, refer to brand monograph Store in its box to protect from light Expiry date noted on packaging Reconstitution by Blood Bank/TML or clinical area staff as per hospital specific policy (Refer to Administering Transfusion: Blood Products Requiring Reconstitution, page 40) Reconstitute at room temperature following manufacturer's instructions (enclosed in the package). Each 1 g package includes a vial of FC as a powder and 50 mL of diluent to be used for reconstitution. Use or discard by 4 hours after reconstitution and stored at 20 - 25° C (some brands have longer shelf-life post-reconstitution, refer to specific brand monograph)	Tubing/Filter	IV tubing No filter required. Do not mix with other medicinal products or IV admixtures
					IV Fluid	Flush infusion site with 0.9% sodium chloride prior to and following administration
					Rate of Infusion	RiaSTAP®: slow intravenous infusion, not exceeding 5 mL per minute (300 mL/hour) FIBRYGA®: For patients with acquired fibrinogen deficiency (i.e., bleeding patient) - maximum rate of 20 mL per minute (1,200 mL/hour) Other indications (congenital afibrinogenemia, hypofibrinogenemia) - slow intravenous infusion, not exceeding 5 mL per minute (300 mL/hour)

Appendix 4: Blood Components and Blood Products Table (cont'd)

Immunoglobulin: Intravenous Immunoglobulin (IVIG) [5BE4(p.108-23),21-26]					
<small>Gammagard Liquid® monograph Gamunex® monograph IGLVnex® monograph Panzyga® monograph Privigen® monograph</small>					
MAIN USES	DOSE	LAB TESTS		STORAGE/EXPIRATION	ADMINISTRATION
<p>For Ontario patients, refer to Immune Globulin Toolkit for Ontario</p> <p>For indications outside these MOHLTC guidelines, Transfusion Medicine Physician review and approval is advised</p>	<p>Dose is specific to indication, refer to Immune Globulin Toolkit for Ontario</p> <p>Patient's height and weight are required for Dose Calculator</p> <p>Dose Calculator Exceptions:</p> <ul style="list-style-type: none"> - Patients with height < 152.4 cm (5 feet) - Pediatric patients 	<p>Prior to IVIG treatment, suggest ABO blood group testing</p> <p>If clinical signs and symptoms of hemolytic anemia, hemolysis investigation (CBC, bilirubin, LDH, AST, haptoglobin, reticulocyte count, peripheral blood film)</p>		<p>Refrigerator/Room Temperature storage requirements are specific for each brand, refer to brand monograph</p> <p>Store in its box to protect from light</p> <p>Expiry date noted on packaging</p> <p>Use or discard by 4 hours after glass bottle was entered/spiked</p>	<p>Tubing/Filter</p> <p>Vented IV tubing No filter required</p>
					<p>IV Fluid</p> <p>5% Dextrose in water</p>
					<p>Rate of Infusion</p> <p>Calculated mL/kg/hr; infusion pump required Rate is specific to brand, refer to brand monograph; Do not exceed maximum recommended rate of infusion</p> <p>Slow initial rate for first 30 minutes, then requires specific incremental infusion rates Vital signs and monitoring for each rate increase</p> <p>With faster rates of infusion, reactions are more likely</p>

Appendix 4: Blood Components and Blood Products Table (cont'd)

Immunoglobulin: Subcutaneous Immunoglobulin (SCIG) [27-30]						
Cutaquig® monograph Cuvitru® monograph Hizentra® monograph						
MAIN USES	DOSE	LAB TESTS		STORAGE/EXPIRATION	ADMINISTRATION	
Subcutaneous administration by patients in their home environment For Ontario patients, refer to Immune Globulin Toolkit for Ontario • Primary Immune Deficiency • Secondary Immune Deficiency • Neurology indications	As per IVIG (page 110)	As per IVIG (page 110)		Refrigerator/Room Temperature storage requirements are specific for each brand, refer to brand monograph Store in its box to protect from light Expiry date noted on packaging Use or discard by 4 hours after vial was entered/punctured Single Use vial	Self administered Patient training provided by each brand's manufacturer	
					Tubing/Filter	Tubing specific for type of Infusion pump (e.g., EMED pump) No filter required
					IV Fluid	None required
					Rate of Infusion	Rate is specific to brand (set rate using Flow Rate Controller), refer to brand monograph

Appendix 4: Blood Components and Blood Products Table (cont'd)

Prothrombin Complex Concentrate (PCC)		[5BE4(p.124-8),31-3,40]																			
Octaplex® monograph Beriplex® monograph																					
MAIN USES	DOSE	LAB TESTS	STORAGE/EXPIRATION	ADMINISTRATION																	
<p>Emergency reversal of warfarin: INR > 1.5 AND</p> <ul style="list-style-type: none"> • “life or limb” threatening bleeding • Emergency surgery, within 6 hours <p>Consider if Vitamin K alone may be effective [5BE4(p.126)]:</p> <table border="1"> <thead> <tr> <th>Clinical Setting</th> <th>Vitamin K Dose / Route</th> </tr> </thead> <tbody> <tr> <td>INR > 8-10, not bleeding</td> <td>2 mg PO</td> </tr> <tr> <td>Surgery > 6 hours later</td> <td>10 mg IV</td> </tr> <tr> <td>Non-critical bleeding</td> <td>1 mg IV</td> </tr> </tbody> </table> <p>Off-Label use of PCC:</p> <p>1. Critical bleeding in patients taking Direct Oral Anticoagulants Refer to Bloody Easy [45BE4(p.127)] and Thrombosis Canada NOACs/DOACs: Management of Bleeding [34]</p> <p>2. Massive Hemorrhage Protocol AND hospital lacks resources to issue plasma [40]</p> <p>PCC 2000 IU can be substituted for coagulation factor replacement. Fibrinogen replacement should be given simultaneously unless fibrinogen level is known to be ≥ 1.5 g/L</p>	Clinical Setting	Vitamin K Dose / Route	INR > 8-10, not bleeding	2 mg PO	Surgery > 6 hours later	10 mg IV	Non-critical bleeding	1 mg IV	<p>National Advisory Committee [31] recommends INR based dosing:</p> <table border="1"> <thead> <tr> <th>INR</th> <th>PCC Dose (IU)</th> </tr> </thead> <tbody> <tr> <td>< 3</td> <td>1,000</td> </tr> <tr> <td>3-5</td> <td>2,000</td> </tr> <tr> <td>> 5</td> <td>3,000</td> </tr> </tbody> </table> <p>If INR unknown with major bleeding: 2,000 IU (40 mL)</p> <p>National Advisory Committee [31] guidelines also include alternative dosing (combined INR and weight based)</p> <p>Vitamin K give 10 mg IV (not SC or IM) at the same time as PCC to avoid rebound anticoagulation</p> <p>Vitamin K IV effects achieved in 4 to 6 hours and half-life of PCC is 6 hours</p>	INR	PCC Dose (IU)	< 3	1,000	3-5	2,000	> 5	3,000	<p>Confirm dose was effective: check INR about 10 to 30 minutes after PCC was given</p> <p>If INR is not < 1.5 AND there is not enough time to wait for Vitamin K to take effect, a subsequent dose of PCC may be needed if clinical bleeding continues</p>	<p>Refrigerator/Room Temperature storage at 2-25° C</p> <p>Store in its box to protect from light</p> <p>Expiry date noted on packaging</p> <p>Reconstitution by Blood Bank/TML or clinical area staff as per hospital specific policy (Refer to Administering Transfusion: Blood Products Requiring Reconstitution, page 40)</p> <p>Reconstitute at room temperature Each 500 IU or 1000 IU vial dose is packaged as Mix2Vial® format to reconstitute</p> <p>Ideally use immediately after reconstituted</p> <p>Use or discard by 3 hours after reconstituted stored at 20 -25° C (some brands have longer shelf-life post reconstitution, refer to specific brand monograph)</p>	<p>Tubing/Filter</p> <p>IV tubing No filter required.</p> <p>Do not mix with other medicinal products or IV admixtures</p>	<p>IV Fluid</p> <p>0.9% sodium chloride</p>
Clinical Setting	Vitamin K Dose / Route																				
INR > 8-10, not bleeding	2 mg PO																				
Surgery > 6 hours later	10 mg IV																				
Non-critical bleeding	1 mg IV																				
INR	PCC Dose (IU)																				
< 3	1,000																				
3-5	2,000																				
> 5	3,000																				
				<p>Rate of Infusion</p> <p>50 mL/hr for 1st 15 minutes, then usually over 15 to 30 minutes</p> <p>Octaplex®: Maximum 180 mL/hour (3 mL/minute)</p> <p>Beriplex®: Maximum 480 mL/hour (8 mL/minute)</p>																	

Appendix 4: Blood Components and Blood Products Table (cont'd)

Rh(D) Immune Globulin (RhIG) [5BE4(p.128-9),35-6]					
WinRho® monograph					
MAIN USES	DOSE	LAB TESTS		STORAGE/EXPIRATION	ADMINISTRATION
<p>Rh(D) negative patients: to prevent immunization (forming anti-D)</p> <ul style="list-style-type: none"> • During pregnancy • Following exposure to Rh(D) positive RBC or platelets <p>Immune Thrombocytopenia (ITP): Specific clinical situations, with Hematology consultation Refer to monograph for DOSE, LAB TESTS, STORAGE/EXPIRATION, ADMINISTRATION</p>	<p>Pregnancy Prophylaxis at 28 weeks: 300 µg IV/IM</p> <p>Post-Partum: if newborn is Rh(D) positive, 300 µg IV/IM within 72 hours of delivery (if > 72 hours, give as soon as possible)</p> <p>If fetomaternal hemorrhage present, refer to hospital specific policy for possible additional doses of RhIG</p> <p>Complications of Pregnancy: Specific to several clinical situations, refer to hospital specific policy/Obstetric guidelines</p> <p>Following exposure to Rh(D) positive RBC or Platelets Based on patient's clinical status, Hematology Consultation is suggested</p>	<p>Rh(D) blood group of mother and newborn</p> <p>If indicated, testing (refer to hospital specific laboratory policy) to quantitate fetomaternal hemorrhage</p>		<p>At 2-8° C in approved, monitored refrigerator</p> <p>Store in its box to protect from light</p> <p>Expiry date noted on packaging</p> <p>Bring to room temperature prior to injection</p> <p>Use or discard by 4 hours after vial was entered/punctured</p> <p>Single Use vial</p>	<p>Tubing/Filter</p> <p>No filter required If IV: standard tubing or butterfly If IM: per hospital specific IM injection policy and procedure</p>
					<p>IV Fluid</p> <p>IV: if dilution is preferred, use 0.9% sodium chloride as diluent</p>
					<p>Rate of Infusion</p> <p>IV: 300 µg over 5 to 15 seconds IM: per hospital specific IM injection policy and procedure</p>

Appendix 5: Transfusion Risk Charts [5BE4(p.42,44)]

All of these risk frequencies are likely to have quite wide confidence intervals.

Transfusion Risk Chart for Health Care Professionals

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 1 in 100 (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
1 in 200,000	Death from bacterial sepsis per pool of platelets
1 in 250,000	Symptomatic bacterial sepsis per unit of RBC
1 in 500,000	Death from bacterial sepsis per unit of RBC
<1 in 1,000,000	Transmission of West Nile Virus
1 in 4,000,000	Transmission of Chagas disease per unit of component
1 in 7,500,000	Transmission of hepatitis B virus per unit of component
1 in 7,600,000	Transmission of HTLV per unit of component
1 in 13,000,000	Transmission of hepatitis C virus per unit of component
1 in 21,000,000	Transmission of human immunodeficiency virus (HIV) per unit of component

Transfusion Risk Chart for Patients

RISK OF EVENT	EVENT
1 in 13	Red blood cell antibodies that can complicate future pregnancies or transfusion
1 in 100	Hives (itchy skin rash)
1 in 100	Heart failure
1 in 300	Fever from red cell transfusion
1 in 7,000	Delayed hemolysis. Hemolysis is when your red blood cells are destroyed
1 in 10,000	Lung injury
1 in 10,000	Symptomatic bacterial sepsis per pool of platelets. Sepsis is when you get an infection in your bloodstream or tissue
1 in 40,000	Wrong ABO (blood) group, per unit of red blood cells
1 in 40,000	Anaphylaxis, which is an extreme sensitivity to a drug or substance that can result in death
1 in 200,000	Death from bacterial sepsis, per pool of platelets
1 in 250,000	Symptomatic bacterial sepsis, per unit of red blood cells
1 in 500,000	Death from bacterial sepsis, per unit of red blood cells
<1 in 1,000,000	Transmission of West Nile Virus
1 in 4,000,000	Transmission of Chagas Disease. Chagas Disease is a parasite that can be transmitted through transfusion
1 in 7,500,000	Hepatitis B Virus (HBV) transmission per unit of component
1 in 7,600,000	Human T-cell lymphotropic virus (HTLV) transmission, per unit of component. HTLV is a virus that can be transmitted by exposure to blood or sexual contact, and can cause a form of cancer of the blood
1 in 13,000,000	Hepatitis C Virus (HCV) transmission, per unit of component
1 in 21,000,000	Human Immunodeficiency Virus (HIV) transmission, per unit of component

Appendix 7: Massive Hemorrhage Protocol: 7T's Summary ^[40]

(Each hospital will need to make minor modifications to align their MHP with their available resources)

1. TRIGGERING

Activate if life-threatening bleeding; follow hospital specific triggering criteria.
If overhead paging system, use term "Code Transfusion".
Alert staff who will transport blood (i.e., dedicated Porter) & Laboratory (TML [Transfusion Medicine], Coagulation, Core Labs).
If decision is made to transfer to another facility for definitive hemorrhage control, communicate to transport service ASAP.
Blood Bank/TML will prepare/send first blood components + Code Transfusion Phone, sample tubes, requisitions, pre-printed order.

2. TEAM

Interdisciplinary team mobilized, core team members:

Lead clinician manages medical care

Lead nurse oversees all communications
(Code Transfusion Phone)

Dedicated Porter transports blood samples for testing and blood components and products for transfusion

Laboratory technologist(s) tests blood samples/
communicates results and
prepares/issues blood
components and products

Other members as per hospital resources and clinical scenario.

3. TRANEXAMIC ACID ****PRIORITY****

IV / Intraosseous dose options (give within 3 hours of injury or MHP activation):

1g bolus then second 1g bolus 1 hour apart

1g bolus then by 1g infusion over subsequent 8 hours

2g bolus up-front (preferred if patient to be transferred to another hospital or will be in another location [e.g. CT scan] at the 1 hour time point)

4. TESTING

Baseline: CBC, INR, PTT, fibrinogen, ionized calcium, lactate, electrolytes, arterial blood gas. **Repeat tests:** hourly, at minimum; exception, PTT only if clinically indicated.

ASAP group & screen (for group specific blood).

Laboratory communicates test results to Lead nurse (Code Transfusion Phone) for review with Lead clinician to guide decision making.

5. TRANSFUSION

Therapy to maintain: **Hemoglobin** > 80 g/L
Platelet count > 50 x 10⁹/L
INR < 1.8
Fibrinogen > 1.5 g/L (> 2.0 g/L if Obstetrical bleed)
Ionized calcium > 1.15 mmol/L

Transfuse: First RBC, then RBC:plasma ratio 2:1, transition to guided by laboratory test results ASAP.

Porter needs pickup slip for each blood pickup.

Keep all blood as packaged per Blood Bank/TML until needed (verbal order per Lead clinician).

6. TEMPERATURE

Target: ≥ 36° C

Record within first 15 minutes. Monitor/Document: every 30 minutes at minimum (monitor continuously, if available).

Tools to keep patient warm:

Warm blankets, Replace wet linen

Warmer device: IV fluid & blood (RBC, plasma only)

Forced-air warming blanket (e.g., Bair Hugger™)

7. TERMINATE

Lead clinician informs Lead nurse when Code Transfusion is over.

Provide Porter with any remaining blood components and products, properly packaged for immediate return to Blood Bank/TML.

Document: time of termination, totals of blood components and products transfused.

Appendix 8: TTISS-ON Acute Transfusion Reaction Chart [42]



IMMEDIATE ACTIONS!

1. **STOP** the transfusion
2. Maintain **IV access**
3. Check **vital signs**
4. Verify **patient ID matches** transfusion label/tag
5. **Notify physician**
6. **Patient care** per order, **report every reaction to Transfusion Medicine Lab (TML), document** per policy

SIGNS AND SYMPTOMS

- FEVER, URTICARIA, DYSPNEA, HYPOTENSION
- Airway or Facial Edema, Anxiety, Coughing,
Diffuse bleeding/oozing, Hemoglobinuria, Hypertension, Itching, Nausea/Vomiting,
Pain (Back, Headache, IV site), Rash,
Shaking Chills/Rigors, Subjective chills,
Tachycardia, Urine colour– dark/red, Wheezing

Consider Recommended Investigations and Suggested Treatment and Actions in the context of each patient’s specific clinical scenario and blood component/product transfused.

The initial presenting sign/symptom may evolve, if so re-contact TML. Close patient monitoring is essential. For additional assistance, call TML at extension: _____

SIGNS & SYMPTOMS		TIMING	POSSIBLE ETIOLOGY		RECOMMENDED INVESTIGATIONS	SUGGESTED TREATMENT AND ACTIONS
<p>FEVER: Temperature of at least 38° C and an increase of at least 1° C from pre-transfusion</p> <p>and/or</p> <p>Shaking Chills/Rigors</p> <p>NOTE: Isolated symptom subjective chills, may consider as Low Risk</p>	<p>Low Risk: 38° C to 38.9° C but NO other symptoms</p>	<p>During or up to 4 hours post transfusion.</p>	<p>Febrile non-hemolytic transfusion reaction</p>		<p>No testing required</p>	<ul style="list-style-type: none"> • Antipyretic • With physician order and if blood still viable, may resume transfusion with close patient assessment • If recurrent reactions, possible trial of antipyretic premedication
	<p>High Risk: a) at least 38° C but with other symptoms</p> <p>or</p> <p>b) 39° C or greater</p> <p>or</p> <p>c) Shaking Chills/Rigors</p>	<p>Often within first 15 minutes. During or up to 4 hours post transfusion.</p>	<p>Febrile non-hemolytic transfusion reaction</p> <p>Bacterial contamination</p> <p>Acute hemolytic transfusion reaction</p>		<ul style="list-style-type: none"> • TML: Group & Screen, DAT • TML: Blood component culture • Patient blood culture (from a different peripheral site) • Urinalysis (first void post-reaction) • Hemolysis work-up: CBC, bilirubin, LDH, AST, haptoglobin, reticulocyte count, blood film • If indicated, assess for <ul style="list-style-type: none"> - AKI {Acute Kidney Injury} (electrolytes, creatinine) - DIC {Disseminated Intravascular Coagulation} (INR, PTT, fibrinogen, D-dimer) 	<p>DO NOT restart transfusion</p> <ul style="list-style-type: none"> • Return blood to TML for clerical check & culture • Broad spectrum IV antibiotics; DO NOT wait for culture results • Aggressive hydration; maintain good urine output • Supportive care per physician’s discretion: IV fluid, vasopressors, oxygen, respiratory support • Monitor for hypotension, renal dysfunction, DIC {Disseminated Intravascular Coagulation} • If severe rigors, consider meperidine (if no patient contraindications) • Serious reaction, call TML immediately

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Appendix 8: TTISS-ON Acute Transfusion Reaction Chart [42] (cont'd)



SIGNS & SYMPTOMS		TIMING	POSSIBLE ETIOLOGY		RECOMMENDED INVESTIGATIONS	SUGGESTED TREATMENT AND ACTIONS
URTICARIA (Hives) Rash or Itching	Less than 2/3 body surface but NO other symptoms	During or up to 4 hours post transfusion.	Minor allergic		No testing required	<ul style="list-style-type: none"> • Antihistamine • With physician order and if blood still viable, may resume transfusion with close patient assessment • If recurrent/severe reactions, possible trial of antihistamine premedication
	2/3 body surface or more but NO other symptoms	Often early in transfusion. During or up to 4 hours post transfusion.	Minor allergic (Extensive)		No testing required	<p>DO NOT restart transfusion</p> <ul style="list-style-type: none"> • Antihistamine; may require steroid if symptoms slow to resolve • If recurrent/severe reactions, possible trial of antihistamine /steroid premedication • If continued reactions with premedication, possible trial of washed/plasma depleted components
	With other symptoms, i.e., Airway or Facial Edema, DYSPNEA, HYPOTENSION	Often early in transfusion. During or up to 4 hours post transfusion.	Anaphylactoid reaction /Anaphylaxis		<ul style="list-style-type: none"> • If also DYSPNEA: chest x-ray, • If also hypoxia: blood gases • Suggest consult Transfusion Medicine physician: explore if indication for <ul style="list-style-type: none"> - TML: Group & Screen, DAT - Haptoglobin - IgA level (if pre-transfusion sample available) - Anti-IgA testing (performed via Canadian Blood Services, TML will assist in sending samples) 	<p>DO NOT restart transfusion</p> <ul style="list-style-type: none"> • Epinephrine; consider steroid, antihistamine • Return blood to TML for clerical check • Supportive care per physician's discretion: oxygen, respiratory support, vasopressors • Pending outcome of investigations, washed/plasma depleted components • Serious reaction, call TML immediately

Appendix 8: TTISS-ON Acute Transfusion Reaction Chart [42] (cont'd)



SIGNS & SYMPTOMS		TIMING	POSSIBLE ETIOLOGY		RECOMMENDED INVESTIGATIONS	SUGGESTED TREATMENT AND ACTIONS
<p>DYSPNEA</p> <p>or</p> <p>SpO₂ (oxygen saturation) of 90% or less and a decrease of at least 5% from pre-transfusion</p> <p>or</p> <p>intervention required to maintain SpO₂ (oxygen saturation)</p>	<p>With Hypertension, tachycardia, +/- FEVER</p>	<p>During or up to 12 hours post transfusion</p>	<p>TACO* (Transfusion Associated Circulatory Overload)</p>		<ul style="list-style-type: none"> TML: Group & Screen, DAT Consider chest x-ray: Findings - pulmonary edema, Kerley B lines, peri bronchial cuffing; may be pleural fluid Cardiac biomarkers (as available) 	<p>DO NOT restart transfusion</p> <ul style="list-style-type: none"> Oxygen, high fowler's position, diuretics (document fluid balance) Future transfusion: Slow transfusion rate Pre-transfusion diuretics ** Consider TML to divide unit (as available)
	<p>ACUTE DYSPNEA With HYPOTENSION, tachycardia, +/- FEVER</p>	<p>During or up to 6 hours post transfusion</p>	<p>TRALI (Transfusion Related Acute Lung Injury)</p>		<ul style="list-style-type: none"> TML: Group & Screen, DAT Chest x-ray: Findings – bilateral interstitial / alveolar infiltrates without elevated pulmonary pressures If also hypoxia: blood gases Canadian Blood Services requires follow up information & patient blood tests, contact TML, will assist in sending samples 	<p>DO NOT restart transfusion</p> <ul style="list-style-type: none"> Supportive care per physician's discretion: oxygen, respiratory support, vasopressors <p>(benefit uncertain for diuretics {document fluid balance}, steroids, and bronchodilators)</p> <ul style="list-style-type: none"> Serious reaction, call TML immediately
	<p>With FEVER +/- HYPOTENSION</p>	<p>Possible Etiology: Bacterial contamination, Acute hemolytic transfusion reaction</p>			<p>Consider/Follow FEVER, High Risk: Timing, Recommended Investigations, Suggested Treatment and Actions</p>	
	<p>With URTICARIA, Airway or Facial Edema, HYPOTENSION</p>	<p>Possible Etiology: Anaphylactoid reaction / Anaphylaxis</p>			<p>Consider/Follow URTICARIA, With other symptoms: Timing, Recommended Investigations, Suggested Treatment and Actions</p>	
	<p>Mild respiratory symptoms that do not align with TACO or TRALI</p>	<p>During or up to 24 hours post transfusion</p>	<p>TAD (Transfusion Associated Dyspnea)</p>		<ul style="list-style-type: none"> Consider chest x-ray: Findings - normal/unchanged, no pulmonary edema, no bilateral interstitial/alveolar infiltrates 	<p>DO NOT restart transfusion</p> <ul style="list-style-type: none"> Supportive care per physician's discretion: oxygen, respiratory support

* **TACO: Pre-transfusion assess patients for TACO risk factors:** advanced age, history heart failure, history myocardial infarction, left ventricular dysfunction, renal dysfunction, positive fluid balance

** **Pre-transfusion diuretics:**

Furosemide PO: onset 30 to 60 minutes, maximal effect 1-2 hours, effect persists about 6-8 hours
 Furosemide IV: onset 5 minutes, maximal effect 20-60 minutes, effect persists about 2 hours

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Appendix 8: TTISS-ON Acute Transfusion Reaction Chart [42] (cont'd)



SIGNS & SYMPTOMS		TIMING	POSSIBLE ETIOLOGY		RECOMMENDED INVESTIGATIONS	SUGGESTED TREATMENT AND ACTIONS
<p>HYPOTENSION</p> <p>SBP (Systolic blood pressure) 80 mmHg or lower</p> <p>AND</p> <p>from pre-transfusion SBP:</p> <ul style="list-style-type: none"> - 30 mmHg or greater absolute decrease <p>or</p> <ul style="list-style-type: none"> - 15 to 25% or greater relative decrease <p>or</p> <ul style="list-style-type: none"> - intervention required to maintain SBP 	Alone or with facial flushing	During or up to 4 hours post transfusion	***Bradykinin mediated hypotension		No testing required	<p>DO NOT restart transfusion</p> <ul style="list-style-type: none"> • Supportive care per physician's discretion: IV fluids • If taking ACE (angiotensin converting enzyme) inhibitor medication, consider an alternative anti-hypertensive agent prior to additional transfusion
	With FEVER, +/- DYSPNEA	Possible Etiology: Bacterial contamination, Acute hemolytic transfusion reaction			Consider/Follow FEVER, High Risk: Timing, Recommended Investigations, Suggested Treatment and Actions	
	With URTICARIA, Airway or Facial Edema, DYSPNEA	Possible Etiology: Anaphylactoid Reaction / Anaphylaxis			Consider/Follow URTICARIA, With other symptoms: Timing, Recommended Investigations, Suggested Treatment and Actions	
	With ACUTE DYSPNEA, tachycardia +/- FEVER	Possible Etiology: TRALI			Consider/Follow ACUTE DYSPNEA: Timing, Recommended Investigations, Suggested Treatment and Actions	

***** Bradykinin mediated hypotension**

Bradykinin is believed to have a major role in producing hypotension. Patients taking ACE {angiotensin converting enzyme} inhibitor medication - decreased bradykinin degradation related to increased angiotensin converting enzyme. Also, some individuals have genetic polymorphism leading to decreased bradykinin degradation.

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Appendix 9: Practice your Learning: Acute Transfusion Reactions

For guidance, refer to Appendix 8: Acute Transfusion Reactions Chart (page 124).

Patient Example A

Peter Cotton is a 76-year-old male admitted 3 days ago with pneumonia (improved with intravenous antibiotic therapy). This morning he developed gastrointestinal bleeding, underwent endoscopy and is receiving a proton pump inhibitor infusion. He also received a fluid bolus and was transfused 2 units RBC this morning. Repeat hemoglobin was 66 g/L.

Transfusion of 1 additional RBC unit was started 45 minutes ago. Peter's wife comes to the nurses' desk stating he is feeling short of breath.

1. Your immediate actions are: (Select all correct actions)

- Stop the transfusion
- Maintain IV access by infusing 5% Dextrose TKVO with an alternate IV set
- Check Peter's vital signs
- Verify Peter's Identification by asking "Is your name Peter Cotton?"
- Verify that RBC unit number on the CBS label matches Transfusion label
- Ask your co-worker to help by calling Peter's prescriber

Peter's vital signs are:

Temperature 36.5° C; pulse 98; BP 160/90; respirations 28/minute; O₂ saturation 89%
His chest auscultation reveals diffuse crackles.

2. Peter's prescriber is likely to order: (Select all likely orders)

- Oxygen at 2 - 4 lpm, to maintain O₂ saturation 92%
- Antihistamine (diphenhydramine 50 mg) IV STAT
- Discontinue the RBC transfusion

Yesterday Peter's urine output was 1800 mL following IV furosemide. The oxygen was discontinued. Today his hemoglobin is 69 g/L. He has had no further bleeding.

His prescriber has ordered: Transfuse 1 unit RBC over 1 hour.

Give furosemide 40 mg PO 30 minutes
prior to starting transfusion

3. True or False:

Peter's nurse should ask the prescriber to change the RBC transfusion to over 3.5 hours.

Patient Example B

Susan Brocade is a 28 year-old woman undergoing chemotherapy treatment for leukemia, today receiving outpatient RBC and platelets for increased bruising and bleeding from her gums (blood work results: hemoglobin 70 g/L; platelet count < 5 x 10⁹/L)

After completing the RBC transfusion, Susan complains of itching on her back and you observe 6 large hives on her back. No itching or hives on any other part of her body.

Susan's vital signs are:

Temperature 36.5° C; pulse 76; BP 106/52; respirations 20/minute; O₂ saturation 98%

4. True or False:

Susan's prescriber is likely to order IV antihistamine (diphenhydramine 25 mg).

Susan's itching and hives resolved within 45 minutes. The prescriber ordered to proceed with the platelets transfusion.

5. True or False:

The platelets transfusion can be administered via the same blood administration tubing and filter as the RBC. It has only been 3.5 hours since the start of the RBC transfusion.

Susan's pre platelets transfusion vital signs are:

Temperature 36.3° C; pulse 74; BP 100/50; respirations 20/minute; O₂ saturation 98%

After 15 minutes of the platelets transfusion, Susan complains of chills and feeling unwell; her vital signs are:

Temperature 39.3° C; pulse 114; BP 70/30; respirations 28/minute; O₂ saturation 86%
After stopping the transfusion, Susan's nurse asks a co-worker to call the prescriber STAT.

6. True or False:

There is no need to notify Blood Bank/TML of this reaction.

7. Susan's prescriber is likely to order: (Select all correct actions)

- IV fluid bolus
- Oxygen 40% face mask
- Blood tests: group & screen, DAT
Hemolysis work-up: CBC, bilirubin, LDH, AST, haptoglobin, reticulocyte count, blood film
- Urinalysis (next void)
- Antibiotic (cefuroxime 1 g IV) STAT
- Discontinue the platelets transfusion
- Critical care consult

Appendix 9: Answers:

1. Answer: a, c, e, f

- b – IV access should be maintained; however, blood components are compatible with 0.9% sodium chloride only; 5% Dextrose is not compatible with blood components
- d – It is important to verify patient identification matches the transfusion label on the blood component or blood product in the event of a transfusion reaction. However, questions requiring only yes/no answers are not appropriate to verify identification. Verify the patient's armband identification matches that on the transfusion label on the blood

2. Answer: a, c

- b – Antihistamine is more likely to be ordered for symptoms of urticaria, rash or hives. In the setting of dyspnea with hypertension and positive fluid balance, furosemide IV is a more likely order.

3. Answer: True

Peter is stable. RBC transfusion for stable patients is usually administered over 2 hours, slower if at risk for circulatory overload. Given Peter's condition today and his history of Transfusion Associated Circulatory Overload yesterday, a slower rate of transfusion would be appropriate. Also note, transfusion must be completed within 4 hours of the RBC unit being issued from Blood Bank/TML (removed from temperature controlled environment).

4. Answer: True

Antihistamine is likely to be ordered for symptoms of urticaria, rash or hives. A typical diphenhydramine dose is 25 to 50 mg IV. If symptoms are minor, a small dose may be initially prescribed and response assessed (drowsiness is a common side effect of diphenhydramine).

5. Answer: False

Blood tubing and filter must be changed after a maximum of 4 units of blood or 4 hours of time. Platelets should be transfused through a new/fresh filter (if filter was previously used, platelets will adhere to fibrin that has been captured in the filter).

6. Answer: False

Susan's signs and symptoms are indicative of a serious transfusion reaction. Blood Bank/TML must be notified immediately of all serious transfusion reactions. In this setting, Blood Bank/TML would immediately notify CBS of this serious reaction to this platelets transfusion.

7. Answer: a, b, c, d, e, f, g

All orders listed are appropriate for this serious transfusion reaction. However additional orders are necessary; before administering the IV antibiotics, Susan requires blood cultures to be drawn from a peripheral site and the remainder of the platelets must be returned to Blood Bank/TML to be sent for culture and for clerical check.

Following a possible transfusion reaction, if returning the blood to Blood Bank/TML:

Ensure all roller clamps on the blood tubing are securely closed (to prevent leaking)

When the blood is disconnected from the patient's IV site, cap the blood tubing with a sterile cap (to avoid contamination)

Return intact and sealed in a bag, the materials used for transfusion (the blood and the 0.9% sodium chloride IV bag, both attached to the Y connector tubing of the blood tubing; the capped blood tubing)

Appendix 10: Transfusion Checklist

Unequivocal (unmistakable) identification of the patient is mandatory.

Patient must be wearing a patient identification armband.

Patient identification information must remain attached to the blood for the duration of the transfusion.

PRE-TRANSFUSION

✓ Informed Consent

- Per policy/procedure, questions addressed
- Exception: emergent, life-threatening bleed

✓ Transfusion Order

- Indication supported: labs, signs, symptoms
- Complete, required information included

✓ Group & Screen Testing

- Required for compatible blood components
- ABO, Rh(D) blood groups, antibody screen (clinically significant antibodies)
- Label tube of blood at patient's bedside

✓ Prepare the Patient

- Educate: symptoms indicative of reaction
- Assess for transfusion history and TACO risk factors; follow up if indicated

✓ Prepare the Equipment

- Dedicated, patent IV (peripheral or central)
- Compatible IV fluid (only 0.9% NaCl [sodium chloride] for blood components)
- Blood components – tubing/filter (170–260 microns); change after 4 units or 4 hours
- Platelets – always NEW/FRESH tubing/filter
- Prime tubing/filter: blood or compatible IV fluid
- IV setup to stop abruptly & maintain TKVO:
0.9% NaCl flush syringes + any fluid IV line or 0.9% NaCl IV line
- Infusion Devices: if Health Canada approved

✓ Pick Up Blood from Blood Bank/TML

- Patient identification (surname, first name, unique identification number) and order required for blood pick up

TRANSFUSION

✓ Checking Blood Components/Blood Products

- Blood received matches transfusion order
 - At bedside, in physical presence of patient
- 1. Patient Identification:** surname, first name, unique identification number **identical** on armband, order, transfusion + chart label/tag

- 2. ABO, Rh(D) Blood Groups (only for Components):** identical/compatible on Group & screen test, CBS (Canadian Blood Services) label, transfusion + chart label/tag

- 3. Unit (Components) / Lot (Products) Number:** identical on CBS label (Components) / manufacturer label (Products), transfusion + chart label/tag

- 4. Visual Inspection & Expiry: Components:** no clots, usual colour, ports intact, expires 4 hours after issue from Blood Bank/TML **Products:** packaging/seal intact, colour as per manufacturer, vials/glass bottles – once entered, expires after 4 hours

✓ Patient Assessment and Vital Signs (for each unit)

- Close monitoring/observation required
- Minimum: within 30 minutes of starting, 15 minutes after starting, upon completion
- Temp, BP, pulse, respiratory rate, oxygen saturation; if TACO risk - chest auscultation

✓ Infusion Rate (for each unit)

- 50 mL/hour for first 15 minutes; can be deferred if acute bleeding
- Re-check after 15 minutes, if no indication of reaction then increase to rate as ordered

✓ Possible Transfusion Reaction

- If any adverse/unexpected/serious symptoms, **STOP** transfusion; refer to [Reaction Chart](#)

POST-TRANSFUSION

✓ Completing the Transfusion

- Comply with expiry time specific for blood component/blood product
Outside the expiry time, discard remainder
- Component tubing: flush with 0.9% NaCl
- Products given IV: flush (tubing/IV site) with compatible IV fluid
- Some hospitals require returning the empty blood bag to Blood Bank/TML.
Otherwise dispose of blood tubing/bags in biohazardous waste
- Re-assess patient and re-check vital signs: – at end of transfusion
– periodically post-transfusion (reactions may occur 4 hours post-transfusion; for dyspnea reactions up to 24 hours post transfusion)

✓ Documentation

- File completed “chart” label/tag for each component or product transfused on patient's health record (include start and stop times)
- Some hospitals require a completed “transfusion record” form returned to the Blood Bank/TML
- Record volume transfused, vital signs and patient assessments
- If a transfusion reaction is suspected, document signs and symptoms, patient care

Refer to Summary: Transfusionist's Accountability - Transfusion Checklist (page 80)

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