

Primer of Blood Administration

(Revised September 2012)



Advancing Transfusion and
Cellular Therapies Worldwide

AABB

**Primer of
Blood Administration**

(Revised September 2012)

Chapter 1

Introduction to Transfusion

**Chapter
Objectives**

Upon completion of this unit, the learner will be able to:

1. Explain the ABO and Rh systems and their importance in transfusion.
2. Define antigen and antibody.
3. List available blood components.
4. Explain indications for use.
5. Determine blood group compatibilities.
6. Discuss transfusion alternatives.
7. Explain special transfusion needs of select patients.

Review of Blood Components

Blood Components

Red Blood Cells (RBCs)

- RBCs carry oxygen from the lungs to the tissues, and carbon dioxide from the tissues to the lungs.
 - Using packed red cell products raises the patient's hematocrit and hemoglobin levels without significantly increasing blood volume.
 - Indicated when the patient's red cell mass must be increased to deliver oxygen. Examples:
 - Acute anemia due to trauma.
 - Surgical blood loss.
 - Chemotherapy.
 - Cardiovascular decompensation of chronic anemia.
 - Must be kept refrigerated. Transfuse within 30 minutes of receipt or return to the transfusion service.
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Platelets

- Platelets are used by the body to stop small vessel bleeding into the tissue.
 - Indicated in the treatment of thrombocytopenia and platelet function abnormalities. Examples:
 - Thrombocytopenia caused by marrow hypoplasia, such as chemotherapy.
 - Congenital and acquired platelet disorders.
 - Maintain at room temperature. Do not refrigerate. Pooled platelets must be transfused by time indicated on label.
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Cryoprecipitated Antihemophilic Factor (AHF, Factor VIII)

- Cryoprecipitated AHF is used when no factor-specific concentrate is available to treat deficiencies of the proteins found in cryoprecipitate. Examples:
 - Correct low fibrinogen levels.
 - Improve poorly functioning fibrinogen (dysfibrinogenemia).
 - Sometimes used to treat von Willebrand disease
 - Correct low Factor VIII, XIII or fibronectin levels.
 - Product requires pooling. Allow 30 minutes after order placed. Product must be infused within 4 hours to prevent product waste.
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Plasma

- Frozen plasma is available as a number of different available products, all of which preserve most labile plasma coagulation factors and other proteins.
 - The common indications are listed below. Frozen plasma is often transfused inappropriately.
 - “Incorrect” Uses of FFP:
 - Volume expansion.
 - Protein nutritional deficiency.
 - Abnormal coagulation tests without bleeding or plans for invasive procedure.
 - Bleeding without coagulopathy.
 - Heparin-induced bleeding.
 - “Correct” Uses of FFP:
 - Temporary warfarin reversal.
 - Liver disease with protein synthetic defect.
 - Dilutional coagulopathy.
 - Abnormal coagulation tests before invasive procedures.
 - Factor deficiency if concentrate unavailable (ie, Factor XI deficiency).
 - Consumptive coagulopathy (questionable).
 - Plasma exchange (especially for TTP).
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Granulocytes (white cells)

- May be indicated for infections that are unresponsive to antibiotic therapy in patients with low granulocyte counts (<500 WBC/ ul) for prolonged periods but whose marrow is expected to recover.
 - Must be transfused within 24 hours after collection, and have to be specifically collected for patient.
 - Currently available granulocytes may have relatively small numbers of granulocytes to what is needed to treat an adult’s infection.
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Blood Groups

Blood groups are determined by the inheritance of certain genes that affect red cell antigens, usually one gene in each system from each parent.

ABO Blood Group System

- The ABO group is the most important blood group in transfusion medicine because the corresponding antibody is found universally and can rapidly destroy the transfused red blood cells.

- The population can be divided into four major ABO groups: A, B, AB, and O.
 - ABO antigens are also found on other types of blood cells and on tissues throughout the body.
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Compatibility

ABO-Compatible

- Recipient is given an ABO group lacking antigens against which he/she has antibodies.
 - Suitable for RBC transfusion.
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ABO Group-Specific (ABO-Identical)

- Recipient is given the same ABO blood group as his/her own blood.
 - Required for Whole Blood transfusion.
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Selecting an ABO Group for Transfusion

- Generally, the transfusion service provides group-specific blood to patients.
 - May not be possible because of inventory management for products such as platelets. Alternate selections can be made in some instances to reduce waste of a precious resource.
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Basic Rules

- Red cells transfused must lack the antigens to which the patient has the antibody. See Table 1-1.
- Plasma transfused must lack the antibodies against the patient's antigen(s).

TABLE 1-1. ABO Antigens and Antibodies

Blood Group	Antigens Present on Red Cells	Antibody in Plasma
A	A	Anti-B
B	B	Anti-A
AB	A and B	No anti-A or anti-B
O	No A or B	Anti-A and anti-B

AABB Standard**5.14 Selection of Compatible Blood and Blood Components for Transfusion**

5.14.1 *Recipients shall receive ABO group-specific Whole Blood or ABO group-compatible Red Blood Cell components.*

5.14.5 *The red cells in Apheresis Granulocytes and Platelets shall be ABO-compatible with the recipient's plasma and be crossmatched as in Standard 5.15 unless the component is prepared by a method known to result in a component containing <2 mL of red cells. The donor blood cells for the crossmatch may be obtained from a sample collected at the time of donation.*

5.25.1 *Recipients whose ABO group is not known shall receive group O Red Blood Cells. Standard 5.13.1 applies.*

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

Rh Blood Group System

- The Rh system is the second most important blood group in transfusion medicine, and it is especially important in obstetrics due to the effect of maternal anti-Rh on fetal anemia.
- Individuals are described as Rh positive or Rh negative based on the presence or absence of the D antigen. See Table 1-2.
- There are multiple antigens in the Rh family, the most important of which is D. Other Rh antigens include the E, e, C, and c antigens

and these may be matched if patients have formed antibodies against the antigens.

TABLE 1-2. Rh Types

Rh Type	Antigen on RBCs	Incidence (Caucasian population)
Rh Positive	D Present	85%
Rh Negative	D Absent	15 %

The D antigen is found on 99% of red blood cells in the Asian and Native American population and 92% of Blacks. Although Rh-positive patients can receive Rh-negative blood, Rh-negative patients should receive only Rh-negative blood. Rare exceptions may be made in patients not at risk for future pregnancies. This choice should be made only under doctor's orders.

AABB Standard

5.14.2 *Rh-negative recipients shall receive Rh-negative Whole Blood or Red Blood Cell components.*

5.14.2.1 *The transfusion service shall have a policy for the use of Rh-positive red-cell-containing components in Rh-negative recipients. Standard 5.28 applies.*

5.28 Rh Immune Globulin

The transfusion service shall have a policy for Rh Immune Globulin prophylaxis for Rh-negative patients who have been exposed to Rh-positive red cells.

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

Distribution of Blood Groups

Table 1-3 details the approximate distribution of the ABO and Rh blood types in the US population.

**TABLE 1-3. Distribution of ABO/Rh in the US.
Source: AABB Web Site**

Rh Positive	%	Rh Negative	%
A Positive (A+)	34	A Negative (A-)	6
O Positive (O+)	38	O Negative (O-)	7
B Positive (B+)	9	B Negative (B-)	2
AB Positive (AB+)	3	AB Negative (AB-)	1

TABLE 1-4. Summary Chart of Blood Components

Components	RBCs Leukocyte-Reduced RBCs	FFP	Liquid Plasma and Plasma
Major Indications	<ul style="list-style-type: none"> • Symptomatic anemia. • Leukocyte reduction reduces risks of WBC alloimmunization. 	<ul style="list-style-type: none"> • Deficit of stable and non-stable plasma coagulation factors. • TTP. 	Deficit of stable coagulation factors.
Action	Restoration of oxygen-carrying capacity.	Source of stable and non-stable plasma factors.	Source of stable factors.
Not Indicated for...	Pharmacologically treatable anemia Coagulation deficiency.	Conditions responsive to volume replacement.	<ul style="list-style-type: none"> • Deficit of non-stable coagulation factors. • Volume replacement.
Special Precautions	Must be ABO-compatible.	Should be ABO-compatible.	Should be ABO-compatible.
Hazards	<ul style="list-style-type: none"> • Infectious disease. • Septic/toxic, allergic, febrile reactions (unless plasma also removed, eg, by washing). • GVHD. • TRALI. • Hemolytic transfusion reactions. • Delayed hemolytic transfusion reaction. • Febrile reactions from leukocyte antibodies and cellular products released during storage (cytokines). 	<ul style="list-style-type: none"> • Infectious disease. • Allergic reactions. • Circulatory overload. • TRALI. 	<ul style="list-style-type: none"> • Infectious diseases. • Allergic reactions. • TRALI. • Circulatory overload.
Rate of Infusion per Unit	As patient can tolerate, but less than 4 hours. <u>Usual</u> : 1 ½ to 4 hours.	<u>Usual</u> : 30 to 60 minutes.	Less than 4 hours. <u>Usual</u> : 30 to 60 minutes.

TABLE 1-4. Summary Chart of Blood Components (cont'd)

Components	Cryoprecipitated AHF	Platelets / Apheresis Platelets	Granulocytes
Major Indications	<ul style="list-style-type: none"> • Hemophilia A. • von Willebrand disease. • Factor XIII deficiency. • Fibrinogen replacement. 	Bleeding from thrombocytopenia or platelet function abnormality.	Neutropenia with infection.
Action	Provides Factor VIII, fibrinogen, vWF, Factor XIII.	Improves Hemostasis.	Provides granulocytes.
Not Indicated for...	Conditions not deficient in Factor VIII, fibrinogen, vWF, Factor XIII.	Plasma coagulation defects and some conditions with rapid platelet deconstruction (eg, ITP or TTP).	Infections responsive to antibiotics. Patients with normal marrow function.
Special Precautions	Frequent repeat doses may be necessary.	Should not use microaggregate filters (check manufacturer's instructions).	<ul style="list-style-type: none"> • Must be ABO-compatible. • Do not use depth-type microaggregate filters. • Do not administer within 4 to 6 hours before or after giving amphotericin, an antifungal and antiparasitic agent, to minimize the possibility of reported pulmonary side effects. • Must be irradiated.
Hazards	<ul style="list-style-type: none"> • Infectious diseases. • Allergic reactions. • TRALI. 	<ul style="list-style-type: none"> • Infectious diseases. • Septic/toxic, allergic, febrile reactions. • GVHD. • TRALI. 	<ul style="list-style-type: none"> • Infectious disease. • Allergic reactions. • GVHD. • Hemolytic.
Rate of Infusion per Unit	Less than 4 hours. <u>Usual</u> : 15 to 30 minutes.	Less than 4 hours. <u>Usual</u> : 15 to 30 minutes.	One unit over a 2- to 4-hour period (closely observe for reactions).
AHF = antihemophilic factor; GVHD = graft-vs-host disease; ITP = idiopathic thrombocytopenic purpura; TTP = thrombotic thrombocytopenic purpura; vWF = von Willebrand Factor; TRALI = transfusion-related acute lung injury.			

TABLE 1-5. Red Blood Cell Transfusion Selection
(for RBCs only—not Whole Blood)

DONOR	PATIENT							
	O+	A+	B+	AB+	O-	A-	B-	AB-
O+	+	+	+	+				
A+	-	+	-	+				
B+	-	-	+	+				
AB+	-	-	-	+				
O-	+	+	+	+	+	+	+	+
A-	-	+	-	+	-	+	-	+
B-	-	-	+	+	-	-	+	+
AB-	-	-	-	+	-	-	-	+

+ = compatible for transfusion; - = not compatible (incompatible).

Other Blood Group Antigens

There are literally hundreds of other antigens that are present on red cells. Fortunately, most of these are found universally or extremely rarely so do not stimulate antibodies.

The transfusion service does an antibody screen prior to any transfusion to see if the patient has made antibodies to any of these other antigens.

If: No unexpected antibodies are found.

Then: The patient can safely be transfused with any ABO-compatible unit as in the table above.

If: Unexpected antibodies are found.

Then: - The patient must receive crossmatched blood, typically typed as negative for the corresponding antigen unless otherwise stated by the blood bank.

- This will add time to the provision of blood, in some cases requiring the blood center to recruit donors nationally specifically for the patient. It will be important to communicate with the transfusion service.

AABB Standard

5.14.3 *When clinically significant red cell antibodies are detected or the recipient has a history of such antibodies, Whole Blood or Red Blood Cell components shall be prepared for*

transfusion that do not contain the corresponding antigen and are serologically crossmatch-compatible.

- 5.14.5** *The red cells in Apheresis Granulocytes and Platelets shall be ABO-compatible with the recipient's plasma and be crossmatched as in Standard 5.15 unless the component is prepared by a method known to result in a component containing <2 mL of red cells. The donor blood cells for the crossmatch may be obtained from a sample collected at the time of donation.*

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

The HLA System

- The antigens of the HLA system have been referred to as:
 - Histocompatibility locus antigens.
 - Human leukocyte antigens.
 - Tissue antigens.
 - The HLA system is very diverse with hundreds of antigens in loci A, B, C, DR, DQ, and DP.
 - White cells (especially lymphocytes) are used for typing of HLA antigens, whereas red cells are used for typing of ABO and Rh antigens.
- Antigens are present on surface membranes of all body cells that have a nucleus:
 - Solid tissues.
 - Lymphocytes.
 - Granulocytes.
 - Monocytes.
 - Platelets.

NOTE: Mature red cells have no nucleus and, therefore, lack clinically significant HLA antigens.

What Is the Significance of the HLA System?

HLA antigens are significant in:

- Solid organ and hematopoietic cell transplantation.
- Platelet transfusions.

- Parentage testing.

Transplantation

- The HLA system is more important than the ABO system in influencing survival of transplanted hematopoietic cells, but the ABO system is more important in the immediate survival of vascularized solid organ transplants (eg, livers and kidneys).
 - The immune system recognizes differences in HLA antigens as the first step in rejection of a transplanted tissue.
 - Development of HLA antibodies may lead to transplant rejection.
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Red Blood Cell Transfusions

- Each unit of Whole Blood or RBCs contains lymphocytes and exposes the recipient to foreign HLA antigens on the WBC.
 - Leukocyte-reduced RBCs have removed a substantial number of the WBCs to reduce the incidence of febrile, non-hemolytic reactions and/or platelet refractoriness in multiply transfused patients (WBC number must be less than 5×10^6).
 - HLA antigens are strongly immunogenic; therefore, antibody production in transfusion recipients is frequent.
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Platelet Transfusions

- As many as 70% of patients receiving repeated nonleukocyte-reduced platelet or RBC transfusions (such as leukemic patients) will become refractory to further platelet transfusions.
- Refractory/refractoriness: donor platelets are destroyed primarily by HLA antibodies quickly after transfusion.
- The patient will not have an adequate, sustained rise in post-transfusion platelet count, no matter how many units of platelets are transfused once they become refractory.
- HLA-matched platelets:
 - Are obtained via apheresis procedures from a donor with an HLA type similar to the patient's HLA type.
 - Can benefit patients who do not respond to transfusion with non-HLA-matched (random-donor) platelets.
 - Should be irradiated before transfusion to prevent GVHD.
 - Will be leukocyte reduced before transfusion.
 - Platelets can also be crossmatched for patients with antibodies to either HLA antigens or platelet antigens. Platelet

crossmatches are frequently performed by the same labs as doing HLA typing.

Leukocyte- Reduced Cellular Blood Components

Indications

- To prevent febrile and other types of nonhemolytic transfusion reactions caused by donor white cell cytokines (cellular products) released during storage (leukocyte reduction must be performed before storage).
- To reduce the risk of HLA alloimmunization in patients for whom long-term hemotherapy is anticipated.
- Advisable for patients (such as those with leukemia) who are expected to need multiple blood transfusions.
- Involves the use of special *leukocyte reduction* filters that remove white cells (with HLA antigens).
- The blood is filtered at the blood center during manufacturing to provide maximum benefit.
- In certain cases, a filter may also be used at the bedside.

AABB Standard

5.7.4.1 Leukocyte Reduction

Leukocyte-reduced blood and blood components shall be prepared by a method known to reduce the leukocyte number to $<5 \times 10^6$ for Apheresis Platelets and Red Blood Cells and to $<8.3 \times 10^5$ for whole-blood-derived Platelets. Validation and quality control shall demonstrate that at least 95% of units sampled meet this criterion.*

**FDA Memorandum, May 29, 1996, "Recommendations and Licensure Requirements for Leukocyte-Reduced Blood Products."*

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

Other Component Modifications

Washing

Performed by the blood collection center or hospital transfusion service before blood release.

- Requires an additional hour or more of processing time. Order should be placed only when transfusion is scheduled. Allow delivery time if coming from outside facility.
- Removes fewer white cells than leukoreduction and most of the plasma.
- Removal of plasma:
 - Decreases soluble plasma allergens that usually cause allergic reactions.
- Washed blood must be kept refrigerated and generally must be transfused within 24 hours of processing. This is because the washing is considered an open system and can have bacterial growth if held for longer periods and because the RBCs are no longer in an anticoagulant solution designed to preserve RBC function.
 - Newer systems are available that allow units to be held for 14 days. The transfusion service will indicate the appropriate outdate on the unit.

AABB Standard

5.7.5.5

WASHED RED BLOOD CELLS

Washed Red Blood Cells shall be prepared by a method known to ensure that the red cells are washed with a volume of compatible solution that will remove almost all of the plasma.

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

Irradiated Blood Components

Composition

Cellular blood components contain lymphocytes capable of replication and this may cause posttransfusion graft-vs-host disease (GVHD) in some patients receiving blood components containing viable white cells.

- Common indications for gamma irradiated blood:
 - Hodgkin or non-Hodgkin lymphoma.
 - Acute leukemia.
 - Congenital immunodeficiency disorders.
 - Low-birthweight neonates.
 - Intrauterine transfusions.
 - Other immunosuppressive therapy (eg, fludarabine).
 - Transfusion from a closely related donor.

AABB Standard**5.17.3 Irradiation**

The blood bank or transfusion service shall have a policy regarding the transfusion of irradiated components.

5.17.3.1 *At a minimum, cellular components shall be irradiated when:*

5.17.3.1.1 *A patient is identified as being at risk for transfusion-associated graft-vs-host disease.*

5.17.3.1.2 *The donor of the component is a blood relative of the recipient.*

5.17.3.1.3 *The donor is selected for HLA compatibility, by typing or crossmatching.*

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

Special Considerations

- Irradiation is performed by the blood collection center or hospital transfusion service before release of a unit.
NOTE: An “**IRRADIATED**” label is placed on the bag.
 - There is *no radiation risk* to transfusionist or recipient.
 - Components that contain no *viable* white cells do not require irradiation. Examples:
 - Fresh Frozen Plasma.
 - Cryoprecipitated AHF.
-

Hemoglobin S

- Sickle cell patients and neonates may require blood tested as negative for Hemoglobin S. If the blood is tested for the patient, it will be indicted on the label of the unit.

AABB Standard**5.17.4 Hemoglobin S**

The blood bank or transfusion service shall have a policy regarding indications for the transfusion of Red Blood Cells or Whole Blood known to lack hemoglobin S.

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

Alternatives to

Blood from the Community Blood Supply

- Preoperative autologous blood donation.
 - Perioperative autologous blood collection:
 - Intraoperative blood recovery.
 - Acute normovolemic hemodilution.
 - Postoperative blood collection.
 - Allogeneic directed donation from a donor named by the patient, typically a relative.
 - This unit must meet all of the standard requirements of a standard blood product and the patient must understand that the unit will not be transfused if positive for any testing or is not the right blood type.
 - Data shows that directed units are not any safer than those from volunteer blood donors, but may have peace-of-mind benefits for the patient.
-

Preoperative Autologous Blood Transfusion

- The process of collection and storage of the patient's own blood before a scheduled procedure likely to cause significant bleeding.

Advantages

- Minimizes the risk of:
 - Infectious disease transmission (except bacterial sepsis).
 - Alloimmunization to red cell, platelet, and leukocyte antigens.
- Can provide a source of blood for persons who have rare blood types or antibodies that make it difficult to find compatible blood.
- Some persons who refuse blood from donors because of religious or other beliefs may be willing to accept their own blood.

Considerations

- The doctor may determine that donation of autologous blood would not be beneficial as the patient has insufficient RBC mass and might become *more likely* to require a transfusion.
- Patients must understand that involvement in such a program does not guarantee transfusion with their own blood exclusively. There may be:
 - An unexpected blood loss.
 - An inability to collect the desired number of units.
 - An emergent need for more units than collected.

- There still may be rare adverse effects associated with autologous blood transfusion that include:
 - Septic transfusion reactions secondary to bacteria that can multiply during storage.
 - Nonhemolytic transfusion reactions secondary to cytokine release from white cells during storage.
 - Mistakes in recipient identification before transfusion with the risk of hemolytic transfusion reactions or transfusion-transmitted disease.

Acceptance/Deferral Criteria

- It is the responsibility of the blood bank medical director to evaluate carefully the safety of patient blood donation.
- Some states will not allow shipment of units drawn from HIV-positive patients.
- The doctor may elect not to use units from patients testing positive for infectious diseases or with a current infection.
- No specific age requirements; elderly patients and children less than 17 years of age can participate.
- If the patient weighs less than 110 pounds, it may be necessary to reduce the volume of blood drawn at each donation.
- Patients with concurrent medical problems may not be acceptable candidates for preoperative autologous donation.
- Sepsis or likelihood of bacteremia is a contraindication to autologous donation. Some hospitals collect their own autologous blood and as long as it never leaves that facility, it does not require any infectious disease testing. Universal precautions should always apply in handling blood products, but especially for these units.

AABB Standard

5.4.4 Autologous Donor Qualification

Because of the special circumstances related to autologous blood transfusion, rigid criteria for donor selection are not required. In situations where requirements for allogeneic donor selection or collection are not applied, alternate requirements shall be defined and documented by the medical director. Standard 1.3.2 applies. Autologous donor qualification requirements shall include:

- 5.4.4.1** *A medical order from the patient's physician to collect blood for autologous use.*

- 5.4.4.2** *The hemoglobin concentration of the autologous donor's blood shall be ≥ 11 g/dL or the hematocrit, if used, shall be $\geq 33\%$. Blood obtained by earlobe puncture shall not be used for this determination.*
- 5.4.4.3** *All blood collections from the autologous donor shall be completed more than 72 hours before the time of anticipated surgery or transfusion.*
- 5.4.4.4** *An autologous donor shall be deferred when he or she has a clinical condition for which there is a risk of bacteremia.*
- 5.4.4.5** *The unit shall be reserved for autologous transfusion.*

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

Transfusion

- All concerned departments should be made aware of the availability of the autologous units. Examples:
 - Transfusion service.
 - Surgery.
 - Nursing unit.
- The ABO group and Rh type of the patient and autologous units should be confirmed before infusion.

AABB Standard

5.13.4 Pretransfusion Testing for Autologous Transfusion

Pretransfusion testing for autologous transfusion shall include ABO group and Rh type on the patient sample. Standard 5.11 applies.

5.12 Serologic Confirmation of Donor Blood ABO/Rh (including autologous units)

Before transfusion, the ABO group of each Whole Blood and Red Blood Cell component and the Rh type of such units labeled as Rh negative shall be confirmed by a serologic test from an integrally attached segment. Confirmatory testing for weak D is not required.

5.8.5 Tests Intended to Prevent Disease Transmission by Autologous Donations

Autologous blood or components that will be transfused outside the collection facility shall be tested for HBsAg, anti-HBc, anti-HCV, HCV RNA, anti-HIV-1/2, HIV-1 RNA, anti-HTLV-I/II, WNV RNA, and syphilis by a serologic test. Each donor shall be tested at least once for antibodies to

T. cruzi. These tests shall be performed before shipping on at least the first unit collected during each 30-day period.[‡]
[‡]21 CFR 610.40(d).

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

Perioperative Blood Collection

- An approach to blood conservation that involves blood collected intraoperatively from the operative site or from an extracorporeal circuit.
- Patients can receive their own blood that has been recovered from the operative field, minimizing the need for allogeneic blood transfusion.
- Various types of devices are available for retrieval of blood from the operative site and apheresis-type devices are available for intraoperative component preparation.

AABB Standard (Perioperative)

5.1.5 Sterility

Aseptic methods shall be employed to minimize the risk of microbial contamination of blood and blood components. Equipment and solutions that come into direct contact with blood or blood components shall be sterile and pyrogen-free. Single-use equipment shall be used whenever possible.

5.1.6 Identification and Traceability

The perioperative program shall ensure that all perioperative products and critical materials used in their processing, as well as laboratory samples and patient records, are identified and traceable.

5.1.6.2.2

Each unit collected perioperatively shall be labeled with the patient's first name, last name, and hospital identification number; the date and time of initiation of collection; and, if applicable, the time of, or conditions for, expiration. Reference Standards 5.1.8A and 5.1.8B apply.

5.1.7.1 Final Inspection

The perioperative program shall have a process to ensure that finished perioperative products are acceptable before issue or delivery. Standards 5.4.2.1 and 7.1.1 apply.

5.1.8 Handling, Storage, and Transportation

The perioperative program shall have a process to ensure

that perioperative products are handled, stored, and transported in manner that prevents damage, limits deterioration, and meets requirements contained in Reference Standards 5.1.8A, Handling, Storage, and Expiration of Perioperative Autologous Red Cell Blood Products, and 5.1.8B, Handling, Storage, and Expiration of Perioperative Autologous Non-Red-Cell Blood Products. Standard 1.3.1 applies.

5.2 Consents, Approvals, and Notifications

The perioperative program medical director shall participate in the development of policies, processes, and procedures regarding recipient consent for collection and use of perioperative products.

5.2.1 *At a minimum, elements of consent shall include all of the following:*

- 1) *A description of the risks, benefits, and treatment alternatives.*
- 2) *The opportunity to ask and receive answers to questions.*
- 3) *The right to accept or refuse treatment.*

5.2.3 *There shall be a physician's order when blood is to be collected from the patient. There shall be a process to define the communication and documentation of orders.*

—AABB Standards for Perioperative Autologous Blood Collection and Administration, 4th Edition

Contraindications

Instances that present a risk of the blood being contaminated with bacteria, tumor cells, or other harmful substances.

Considerations

Blood recovered by intraoperative collection:

- Cannot be transfused to other patients.
- Must be filtered.
- Must be reinfused in the surgery suite or recovery room within a finite period of time defined by the system used. Blood without correct labeling should never be infused.
- AABB *Perioperative Standards* apply to intraoperative blood recovery and should be followed at all times.

AABB Standard

5.4.1 Patient Identification

Perioperative products shall be administered only to the patient who donated them. There shall be positive identification of the patient and the product.

5.4.5 Administration Protocol

The perioperative program shall have a protocol for the administration of perioperative products, including the use of infusion devices and ancillary equipment.

5.4.5.1 *Perioperative products intended for transfusion shall be transfused through a filter designed to retain particles that are potentially harmful to the patient.*

5.4.5.2 *For perioperative products intended for transfusion, the patient's medical record shall contain the date and time of administration, pre- and postadministration vital signs, the amount administered, and the identification of the individual administering the perioperative product. For products that are not used, records of their disposition shall be maintained. Records of adverse reaction shall be maintained. Standards 5.1.5 and 10.3 apply.*

—AABB Standards for Perioperative Autologous Blood Collection and Administration, 4th Edition

Acute Normovolemic Hemodilution

Another form of perioperative blood collection, not requiring the recovery of shed blood via suction so can be used in less vascular surgeries.

- In preparation for cardiopulmonary bypass or other surgery, units of the patient's blood can be removed and stored in approved plastic blood collection bags.
- The blood removed is replaced with crystalloid and/or colloid solutions.
 - These dilute the remaining cells in a larger volume of fluid.
 - The result is that blood lost during surgery has a lower hematocrit.
- The patient's own blood is reinfused perioperatively.

Advantages

- Helps maintain the individual's red cell mass.

- Provides viable platelets and clotting factors, because the blood has been stored for only a few hours.
- Doesn't require suctioning of shed blood.

Considerations

- Close patient monitoring is required to:
 - Ensure maintenance of normovolemia.
 - Guard against fluid overload.
 - The techniques used must ensure that the blood is:
 - Collected in a sterile manner.
 - Properly labeled and stored.
-

**Postoperative
Blood Recovery****Blood Recovery**

- Examples: blood obtained from:
 - Chest tube.
 - Joint cavity drainage.
 - This blood is defibrinated and does not clot. It contains high titers of fibrinogen-fibrin degradation products.
 - The collected blood is filtered and reinfused with or without cell washing.
-

SPECIAL TRANSFUSION CONSIDERATIONS**Hemolytic Disease
of the Fetus and
Newborn (HDFN)****Pathophysiology of HDFN**

- Fetal red cells may contain blood group antigens inherited from the father that are lacking in the mother.
- Fetomaternal hemorrhage, whether microscopic or significant, can expose the mother to the fetus's red cells.
- The mother's body may make blood group antibodies against these paternally derived antigens before or after birth.
- As these maternal antibodies are transported across the placenta, they can cause hemolysis of fetal red cells. HDFN can vary in severity from hydropic death in utero to sensitization of fetal red cells without apparent hemolysis.

Identified Causes

- The most common cause of clinically significant HDFN is anti-D. Other antibodies implicated in severe HDFN include anti-c, anti-E, and anti-K.
- Any antibody capable of crossing the placenta can cause HDFN. Many antibodies are IgM or a type of IgG that cannot cross the placenta.
- Clinically significant HDFN resulting from ABO incompatibility between mother and fetus is uncommon, although this serologic situation occurs frequently.
- Mothers can also produce antibody against the platelets of the fetus. This is called neonatal alloimmune thrombocytopenia and occurs in approximately 1:4000 births. Therapy may be required if the fetus or neonate has such a low platelet count that there is a risk of a cranial bleed.

Incidence

- The incidence of Rh HDFN is declining as a result of:
 - The use of antenatal Rh Immune Globulin (RhIG), ie, passive anti-D.
 - Additional prophylaxis with RhIG provided at delivery for Rh-negative mothers with Rh-positive infants.

**Antibody
Screening of
Obstetric Patients**

- Purposes:
 - To identify Rh-negative women who have not made anti-D and should receive RhIG.
 - To monitor those women with blood group antibodies capable of causing HDFN.
- At an early prenatal visit, pregnant women should undergo an ABO and Rh type/antibody screen designed essentially to detect those antibodies known to cause HDFN.
- If initial antibody screen is negative, Rh-negative women should have a repeat antibody screen at 26 to 28 weeks' gestation in association with the administration of antenatal RhIG therapy if, by that time, they have not made anti-D.
- Rh-negative females should receive postpartum RhIG following:
 - Delivery of an Rh-positive infant.
 - Abortion, amniocentesis, ectopic pregnancy, fetal death in

utero, and other events associated with fetomaternal bleeding.

Transfusion in Neonatal Patients

Because the survival rate of immature infants has improved, the number of RBC transfusions given in neonatal intensive care units has increased.

Types of Anemia in Premature Infants

- Related to blood volume:
 - Occurs soon after birth.
 - Results from the multiple blood sampling needed for laboratory monitoring of critically ill premature infants whose total blood volume is very small.

- Related to hemoglobin concentration:
 - Develops a few weeks after birth.
 - Physiologic decline in hemoglobin concentration (anemia of prematurity) is a result of multiple factors (the primary factor is inadequate production of erythropoietin in response to the degree of anemia).

Indications for Transfusion

Indications in neonates vary from indications in adults, as a result of the infant's physiologic immaturity, small blood volume, and inability to tolerate minimal stress.

Decision to Transfuse

- Usually based on multiple parameters, including:
 - Calculated blood loss over a given period (generally 10% of total blood volume).
 - Expected hemoglobin levels and clinical status (examples: dyspnea, apnea, respiratory distress, and poor weight gain).

NOTE: There are conflicting data on the usefulness of clinical signs (tachycardia, tachypnea, apnea, etc) in an assessment of the need for RBC transfusions in the premature infant.

Neonatal Transfusion Components

RBCs are the most common components transfused to neonates. Relatively few other blood components are transfused.

Red Cells

- Most RBC additive solutions have been shown to be safe for small-volume transfusions. Their longer shelf life helps prevent excess donor exposure in dedicated-unit transfusion programs when compared to using the traditional CPDA-1 storage media.

- Exchange transfusions use packed RBCs which may be washed, in combination with ABO-compatible plasma.
- For neonatal and pediatric use, red cells can be collected into special multiple-bag units (bags with several small attached satellite bags). Single bag units may have small portions removed through the use of an FDA-approved sterile connecting device that preserves the closed system. A pediatric patient can be transfused with a small volume multiple times from the same donor over the entire shelf life of the RBC unit (reducing the risk of disease agents or exposure to multiple antigens from different donors) compared to using a different donor every 24 hours when a single unit is opened to use only a small aliquot.

NOTE:

- It has been estimated that the amount of potassium or metabolic toxins released during storage that would be infused in a small-volume transfusion, even from units stored for up to 42 days, is minimal and unlikely to be clinically significant to most neonates.
- There is concern about high potassium in older blood in large volume transfusions given over a short period of time, especially through large bore catheters in the right atrium close to the sino-atrial node.

Fresh Frozen Plasma (FFP) or Plasma Frozen Within 24 Hours After Phlebotomy (FP24)

- In general, the primary use of FFP or FP24 is in the treatment of coagulation disorders, such as necrotizing enterocolitis.
- In neonates, it may be used to replace dilutional coagulopathy, particularly in exchange transfusions.
- Neonatal ECMO programs may use frozen plasma and cryoprecipitate to maintain fibrinogen levels and also provide antithrombin, a necessary cofactor for heparin which is required for the extracorporeal circuitry.

Platelets

- Neonatal platelet transfusion practice varies, and depends on clinical factors to guide the platelet transfusion trigger, platelet dose, and target platelet count.
- The most controversial issue is determining the platelet level at which prophylactic transfusion should be given to sick premature infants.

Granulocytes

The efficacy of granulocyte transfusions in the septic and neutropenic neonate is still not fully established.

Pretransfusion Serologic Testing

Infants less than 4 months old rarely produce antibodies against blood group antigens. Consequently, standards for testing are different from those for older infants, children, and adults.

- In performing an ABO group, Rh type, and antibody screen before any neonatal transfusion, maternal serum may be used for the antibody screen because blood group antibodies (IgG) are passively transferred from mother to infant during gestation. For newborns, the maternal sample is preferred as maternal antibodies will be circulating.
- In infants less than 4 months old, further typing and compatibility testing may be omitted if:
 1. Initial antibody screen is negative, and
 2. Donor RBCs that are used for transfusion are:
 - a) Either ABO-*identical* or group O
 - or**
 - b) ABO-*compatible* with *both* the mother and child *and* either the same Rh type as the infant or Rh-negative.
- Procedures must be in place to ensure that infants do not receive transfusion of any blood component containing a clinically significant unexpected antibody.
 - If a clinically significant antibody is present, RBCs that do not contain the corresponding antigen should be prepared for transfusion for as long as the antibody persists in the infant's circulation.
 - Procedures should be in place to provide cytomegalovirus (CMV)-reduced-risk cellular components to neonates who may be vulnerable to transfusion-transmitted CMV infection.
 - Over half the donor population is CMV-seropositive.
 - Neonates weighing less than 1200 g, born to mothers who lack CMV antibodies, or whose antibody status is unknown, are presumed to be at increased risk for CMV infection.
- Special indications for irradiation of units for the neonatal and pediatric population include:
 - Intrauterine transfusion.
 - Exchange transfusion.
 - Extracorporeal membrane oxygenation.

AABB Standard

5.16.1 *An initial pretransfusion sample shall be tested to*

determine ABO group and Rh type. For ABO, only anti-A and anti-B reagents are required. The Rh type shall be determined as in Standard 5.13.2. The serum or plasma of either the neonate or the mother may be used to perform the test for unexpected antibodies as in Standard 5.13.3.

- 5.16.1.1** *Repeat ABO grouping and Rh typing may be omitted for the remainder of the neonate's hospital admission or until the neonate reaches the age of 4 months, whichever is sooner.*
- 5.16.1.2** *If the initial screen for red cell antibodies is negative, it is unnecessary to crossmatch donor red cells for the initial or subsequent transfusions. Repeat testing may be omitted for the remainder of the neonate's hospital admission or until the neonate reaches the age of 4 months, whichever is sooner. Standard 5.16.2 applies.*
- 5.16.1.3** *If the initial antibody screen demonstrates clinically significant unexpected red cell antibodies, units shall be prepared for transfusion that either do not contain the corresponding antigen or are compatible by antiglobulin crossmatch until the antibody is no longer demonstrable in the neonate's serum or plasma.*
- 5.16.2** *If a non-group-O neonate is to receive non-group-O Red Blood Cells that are not compatible with the maternal ABO group, the neonate's serum or plasma shall be tested for anti-A or anti-B.*
 - 5.16.2.1** *Test methods shall include an antiglobulin phase using either donor or reagent A₁ or B red cells. Standard 5.13.3.4 applies.*
 - 5.16.2.2** *If anti-A or anti-B is detected, Red Blood Cells lacking the corresponding ABO antigen shall be transfused.*

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

Transfusion in Older Infants and Children

- The decision to transfuse RBCs or other blood components to older infants and children is based on indications similar to those used for adults, taking into consideration the differences in:
 - Blood volume.
 - Ability to tolerate blood loss.
 - Normal hemoglobin and hematocrit levels for the appropriate age group.
-

Sickle Cell Anemia

These patients may be transfused to treat an acute episode or prophylactically to prevent further crises, often as RBC exchange, where an apheresis device is used to remove the hemoglobin S positive cells and replace them with cells with normal hemoglobin.

- Sickle cell patients require transfusion with blood tested as negative for sickle cell trait (hemoglobin S).
 - Sickle cell patients often get blood tested as negative for certain red cell antigens that they are lacking to decrease antibody formation, since making transfusion-related antibodies often leads to worsening autologous destruction of the patients' red cells, as well as leading to difficulty in obtaining compatible blood.
-

AABB

**Primer of
Blood Administration**

(Revised September 2012)

Chapter 2

Pretransfusion Activities

Chapter Objectives**Chapter 2 Objectives**

Upon completion of this chapter the learner will be able to...

1. List items to be included in patient education.
 2. Review current risks of transfusion-transmitted diseases.
 3. List elements of a recipient consent.
 4. Discuss situations that require a recipient's consent to be documented in the medical record.
 5. Describe religious and cultural beliefs that may affect the use of blood components.
 6. Identify appropriate resource individuals for patients who refuse blood components.
 7. List elements of a valid prescription for blood component therapy.
-

**Patient
Education****General Concepts**

- The informed patient and family can aid in the early detection of problems.
 - The transfusionist is responsible for describing details of the transfusion procedure to the patient.
-

**Teaching
Process****Assessment**

Assess the patient's previous knowledge and understanding of the procedure. If patient is a disoriented or unconscious adult, the family can be instructed and asked to observe for any signs of an untoward reaction.

Planning

- Develop a teaching plan.
- Set objectives based on data gathered in the assessment process.
- Set criteria for evaluating the outcome of the objectives.
- Determine the desired level of outcome (eg, correctly answer 8 out of 10 oral questions).

Content

Content must be directly related to the corresponding objectives and include the:

- Complete sequence of events, such as:
 - Compatibility testing.
 - IV line.
 - Activity limitations, if any.
 - Reasons for transfusion.
- Benefits related to transfusion, such as:
 - Improved oxygen-carrying capacity of red cells (eg, treatment of symptomatic anemia).
 - Provision of coagulation factors and prevention or control of bleeding.
- Risks related to transfusion, such as:
 - Immunologic complications (hemolytic and nonhemolytic reactions).
 - Transmission of infectious disease or disease agents.
 - Fluid overload (congestive heart failure).
 - Sepsis.

- Pulmonary edema.
 - What to expect during and after the transfusion.
- Signs and symptoms that may be associated with complications of component therapy. Table 2-1 lists warning signs to explain to the patient.
 - Minimize risks by making patient more alert to changes.
 - Avoid explaining signs too graphically (may cause patient to “feel” symptoms of a reaction before the transfusion is even begun).
 - Ask patient to report any “different” sensations after transfusion has been initiated.

TABLE 2-1. Patient Teaching

Warning Signs
<ul style="list-style-type: none"> • Vague uneasy feeling. • Onset of pain (especially at IV site, back, chest). • Breathing difficulties. • Chills/flush/fever. • Nausea/dizziness. • Rash, urticaria. • Dark or red urine.

Methodology/Teaching Strategies

- Describe specific teaching methods used for each content area/topic.
- Methods may include discussion with demonstration and explanation to patient/family.

Evaluation

The evaluation is based on criteria that:

- Must be measurable.
- May take the form of oral questions and answers.

Preparing a Child for Transfusion

- Factors that determine how a nurse should prepare a child for component therapy include:
 - The reason for the transfusion.
 - The age and cognitive development of the child.
 - Previous experience, as a guide.

- The transfusion procedure must also be explained to the parent(s) or guardian(s). They must be legally qualified to give consent for the required therapy.

- When teaching the child, it is imperative to use only terms that the child can understand. Table 2-2 suggests explanations that can be given.

TABLE 2-2. Suggested Explanations to a Child on Use of Blood

Component	Explanation
Red Blood Cells	<ul style="list-style-type: none"> • Carry the oxygen that you breathe from your lungs to all parts of your body. • Take the carbon dioxide and other wastes away, back to the lungs, so that you can breathe the wastes out.
Platelets	<ul style="list-style-type: none"> • Are small parts of cells that help to make bleeding stop. • Help your body to stop bleeding when you get cut, by forming a plug over the hurt area.
Plasma	<ul style="list-style-type: none"> • Is the liquid portion of blood. • Contains proteins called clotting factors that help turn the plug into a clot so that the cut will heal.

**Adverse Effects
of Blood
Transfusion**

Transfusion of blood and blood components has long been regarded as an effective therapy for the correction of various hematologic disorders. However, the possibility of acquiring an infectious disease, specifically AIDS, from transfused blood has led the lay public as well as the medical profession to a more critical evaluation of transfusion practices. As a consequence of this scrutiny, there is greater interest in all possible deleterious effects of blood transfusion.

Incidence

About 5% to 6% of all blood transfusion recipients suffer a recognizable adverse effect as a result of the transfusion.

Occurrence

Adverse effects of transfusion can be classified by the time of occurrence.

- **Immediate transfusion reactions** become manifest during the procedure or within 1 to 2 hours of transfusion.

- **Delayed transfusion reactions** may become apparent days, months, or even years later.

Relationship to Immunologic Factors

- Immunologic reactions:
 - Are characterized by antibody formation.
 - Can include immediate or delayed hemolysis as well as nonhemolytic events.

 - Nonimmunologic reactions:
Examples:
 - Infectious complications.
 - Those related to physical or chemical factors.
-

**Infectious
Complications
of Blood
Transfusion**

A number of potentially serious infectious diseases can be transmitted by blood transfusion. Table 2-3 lists current risks of transfusion-transmitted diseases.

To reduce the risk of transfusion-transmitted infectious diseases:

- Blood donors are questioned extensively about symptoms or history that might suggest they carry transmissible infections.
- Tests, including those listed in Table 2-4, are performed on all donor blood.

TABLE 2-3. Current Estimated Risks of Transfusion-Transmitted Diseases in the United States^{1,2}

Disease	Level of Risk per Unit of Blood
HIV	1:2,000,000 ³
Hepatitis B	1:150,000 ³
Hepatitis C	1:1,600,000 ³
Human T-cell lymphotropic virus (HTLV-I/II)	1:641,000 ⁴
Malaria	<1:1,000,000 ³
Chagas disease	<1:1,000,000 ³
Babesiosis	<1:1,000,000 ³
Yersinia	<1:1,000,000 ^{5(p638)}
Cytomegalovirus (CMV)	<1:100 of the components from CMV-seropositive donors (approximately 50% of donors) can transmit this infection, but generally it is significant only in immune-incompetent recipients ^{5(p686)}
West Nile virus	<1:8,000,000 ⁶
Febrile nonhemolytic reaction	1:200 ⁷
Delayed hemolytic reaction	1:2,500 (red cell transfusions) ⁷
Circulatory overload	1:10,000 ⁷
Transfusion-related acute lung injury (TRALI)	1:1,300 to 2,400 (other ALI risk factors excluded) or 1:370 to 1:1000 (other ALI risk factors included) ^{8,9}
Acute hemolytic transfusion reaction	1:25,000 (red cell transfusions) ⁷

1. There may be some geographic variation in rates for some infectious diseases, and rates change as new research data are published.
2. Risks of transfusion-transmitted bacterial septicemia currently are being assessed.
3. Bianco C. Infectious risks of blood transfusion (audioconference presentation). Bethesda, MD: AABB, 2002.
4. Schreiber G, Busch MP, Kleinman SH, Korelitz JJ for the Retrovirus Epidemiology Donor Study. The risk of transfusion-transmitted viral infections. *N Engl J Med* 1996;334:1685-90.
5. Brecher ME, ed. Technical manual, 15th edition. Bethesda, MD: AABB, 2005.
6. Kleinman SH, Williams JD, Robertson G, et al. West Nile virus testing experience in 2007: Evaluation of different criteria for triggering individual-donation nucleic acid testing. *Transfusion* 2009;49:1160-70.
7. Walker RH. Special report: Transfusion risks. *Am J Clin Pathol* 1987;88:374-8.
8. Finlay HE, Cassorla L, Feiner J, Toy P. Designing and testing a computer-based screening system for transfusion-related acute lung injury. *Am J Clin Pathol* 2005;124:601-9.
9. Rana R, Fernandez-Perez ER, Khan SA, et al. Transfusion-related acute lung injury and pulmonary edema in critically ill patients: A retrospective study. *Transfusion* 2006;46:1478-83.

TABLE 2-4. Tests Performed on Donor Blood

Test	Infectious Viral Agent and/or Disease
Hepatitis B surface antigen (HBsAg)	Hepatitis B virus
Antibodies to Hepatitis B core antigen (HBc)	Hepatitis B virus
Antibodies to hepatitis C virus (HCV)	HCV
HCV RNA	HCV
Antibodies to HIV-1/2	HIV infection including AIDS
HIV-1 RNA	HIV infection including AIDS
Serologic test for syphilis (STS)	Syphilis
Antibodies to Human T-cell lymphotropic virus (HTLV-I/II)	HTLV-I/II
Antibodies to Cytomegalovirus (CMV)*	CMV*
West Nile virus (WNV) nucleic acid amplification test	WNV
Chagas test for 1 st time donors	

*CMV testing usually is performed for any cellular blood component intended for an immunocompromised recipient, eg, a CMV-seronegative low birth weight neonate or a patient receiving immunosuppressive therapy.

AABB Standard



5.8.4 Tests Intended to Prevent Disease Transmission by Allogeneic Donations

A sample of blood from each allogeneic donation shall be tested for HBsAg, anti-HBc, anti-HCV, HCV RNA, anti-HIV-1/2, HIV-1 RNA, anti-HTLV-I/II, WNV RNA, and syphilis by a serologic test. Each donor shall be tested at least once for antibodies to Trypanosoma cruzi. Blood and blood components shall not be distributed or issued for transfusion unless the results of these tests are negative, except in the case of a test for syphilis that has been shown to have a biological false-positive result. Units with biological false-positive results shall be labeled in accordance with FDA requirements. Standard 5.2.4 applies.*



5.2.4 Donor Notification of Abnormal Findings and Test Results

The medical director shall establish the means to notify all donors (including autologous donors) with any medically

*FDA memorandum, December 12, 1991, "Clarification of FDA Recommendations for Donor Deferral and Product Distribution Based on the Results of Syphilis Testing."

*significant abnormality detected during the predonation evaluation or as a result of laboratory testing or recipient follow-up. In the case of autologous donors, the referring physician shall also be notified. Appropriate education, counseling, and referral shall be offered.**

*21 CFR 630.6

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

Recipient Consent

Basics of Recipient Consent

- Before ordering the necessary blood components for elective transfusion, the physician should discuss the need for transfusion with the patient or surrogate.
- The choice whether or not to undergo transfusion belongs to the patient.
- The recipient or surrogate must be alerted to:
 - Indications for component therapy.
 - Benefits and risks, including fatal risks, of component therapy.
 - Alternative therapies, if any.
 - Risks if the patient or surrogate chooses to refuse component therapy.
 - The probable number of transfusions or the transfusion course.
- The recipient or surrogate must have the opportunity to ask questions or ask for clarifications.
- Documentation that the patient understands the benefits and risks of transfusion therapy should be in the medical record, along with documentation that he or she:
 - Consents to the transfusion.
 - Refuses the transfusion.
- Recipient consent is **required** for transfusion of these blood components and plasma products:
 - Red Blood Cells.
 - Fresh Frozen Plasma (FFP).
 - Plasma Frozen Within 24 Hours After Phlebotomy.
 - Platelets.
 - Cryoprecipitated AHF.
 - Factor concentrates:
 - Factor VIII.
 - Factor IX complex.
 - activated factors or factor complexes.

*21 CFR 630.6

- Recipient consent is **recommended** for:
 - Immune globulins:
 - Rh immunoglobulin (RhIG).
 - Hepatitis B immune globulin (HBIG).
 - Intravenous immune globulin (IVIG).
 - Fibrin sealant.
 - Albumin.
 - Pharmaceuticals related to blood products, eg, recombinant activated Factor VII.

**Recipient
Consent:
The Adult
Patient**

Giving Consent

- Legally competent adults are capable of:
 - Reviewing the information provided.
 - Making a decision about therapy.
 - Giving consent for the transfusion.
- If the adult is unable to give consent because of mental status or physical condition, the information needed for giving informed consent must be provided to a surrogate, ie:
 - Next of kin or
 - A legal guardian or
 - The court.

AABB Standard



5.26.1 Recipient Consent

The blood bank or transfusion service medical director shall participate in the development of policies, processes, and procedures regarding recipient consent for transfusion.

5.19.1.1 *At a minimum, elements of consent shall include all of the following:*

- 1) *A description of the risks, benefits, and treatment alternatives (including nontreatment).*
- 2) *The opportunity to ask questions.*
- 3) *The right to accept or refuse transfusion.*

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

**Recipient
Consent:
The Pediatric
Patient**

Pediatric transfusions pose a unique set of circumstances, because pediatric patients are not capable of providing *legal* consent for therapy.

Involving the Pediatric Patient

- The patient should be included in the discussion.
- The therapy should be explained in terms that the child can understand.
- The child's cooperation should be enlisted.
- The child should be asked to sign the consent form along with the parents or legal guardian.

Age Constraints

- Most states consider age 18 the age at which a child becomes an adult.
- Facility policy should be consistent with state law for age of consent.
- Check state law for legal age of consent.

Religious Beliefs Religion and Transfusion Therapy

- The majority of organized religions do not prohibit the use of blood components by their members when a medical need exists.
- Jehovah's Witnesses and Christian Scientists include prohibitions in their teachings against transfusion therapy, although some believers of these and other faiths accept some blood components.

Asking the Patient or Surrogate

- All patients should be given the opportunity to discuss their beliefs regarding blood transfusion.
- During the pretransfusion preparation, verify that the patient's religious beliefs do not prohibit blood component therapy.

Managing Refusal of Therapy

- If a patient refuses blood components, the nurse should:
 - Refer to the facility's policy and procedure on refusal of blood.
 - Notify the attending physician.
 - Document refusal in the patient's record.
 - Refusal should be handled in a manner consistent with pertinent laws and regulations.
-

Transfusion Request Forms

Blood request forms must contain sufficient information for positive patient identification.

- Forms are unacceptable if they:
 - Lack the required information.
 - Contain illegible information.
- Computer-transmitted requests are acceptable as long as the required information is complete.
- Telephone requests should be documented by notation of the:
 - Caller's name.
 - Time request is received.
 - Patient's name and identification number.
 - Subsequently submitted and properly completed blood request form.

Information on Blood Request Forms

- Required Information (see excerpt from *Standards* below):
 - Patient's first and last names.
 - An identification number unique to the patient.
 - Blood component and amount ordered.
 - Name of the responsible physician.
- Additional Information (helpful in resolving problems that may occur):
 - Gender and age of patient.
 - Diagnosis.
 - Transfusion history.
 - Pregnancy history.
 - Special blood component or service needs.
 - Date and time the blood sample is collected.

AABB Standard**5.11 Samples and Requests**

Identifying information for the patient and the blood sample shall correspond and be confirmed at the time of collection using two independent identifiers.

5.11.1 Requests

Requests for blood, components, tissue, and derivatives and records accompanying blood samples from the patient shall contain sufficient information to uniquely identify the patient, including two independent identifiers. The transfusion service shall accept only complete, accurate, and legible requests.

—AABB *Standards for Blood Banks and Transfusion Services*, 28th Edition.

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**Primer of
Blood Administration**

(Revised September 2012)

Chapter 3

Patient/Specimen Identification Verification

**Chapter
Objectives**

Chapter 3 Objectives

Upon completion of this chapter the learner will be able to:

1. Describe the proper patient identification process.
 2. List the requirements of a valid specimen.
 3. Identify mechanisms to obtain a blood specimen.
-

Patient and Sample Identification

The collection of a properly labeled blood sample from the correct patient is critical to safe blood transfusion. Obtaining a blood sample for compatibility testing from the wrong patient can result in serious morbidity or mortality.

Patient Identification**Patient's Name**

- If patient is conscious and rational, ask, "What is your name?"
- If patient is unable to state his or her name, the patient's identity should be confirmed, whenever possible, with a family member or other person familiar with patient.

Patient's Unique Identification NumberAssigning a Number

- If the usual admission or transfusion number is available, it should be used.
- When pretransfusion testing is done *before* admission, a unique identification number *must* be assigned to the patient.
- Alternatively, another unique number system *must* be used. Examples:
 - Computer-generated number.
 - Commercial number system designed for this purpose.

Identifying Patients in the Emergency Department

Special problems may be encountered when the patient's name is not known and no identification number has been assigned.

- A unique number *must* be assigned by emergency department personnel or transfusion service personnel.
- Fictitious names ("John Doe," "Jane Doe," etc) may be used if no other patients are assigned the same name during the same time, but a unique identification number must be assigned as well.

Patient's Identification Band

- Before drawing the blood sample, the phlebotomist *must* compare and match the patient information on the request form, *item by item*, with the information on the patient's identification band.
- Discrepancies in information on either the identification band or the request form *must* be corrected before a blood sample is drawn.

Sample Identification

The information required on the blood sample label continues the process of unmistakably identifying the potential recipient.

Specimens for blood grouping, typing, and compatibility testing *must* be obtained in stoppered tubes.

Blood Sample Label

- Labels *must* be firmly attached to the sample tubes.
- The blood sample label *must* have:
 - At least two independent identifiers (such as name and medical record number) sufficient for positive identification.
 - The date the sample was collected.
- Before leaving the patient's bedside, the phlebotomist *must* compare and match the patient's name and identification number on the identification band with those on the labeled tubes.

Identification in the Blood Bank

- When a sample is received in the laboratory, a qualified member of the staff must confirm that the information on the label and the information on the transfusion request form are identical.
- If there is any unresolved discrepancy or doubt about the identity of the patient, a new sample *must* be obtained.
- It is unacceptable for anyone to correct an incorrectly labeled sample.
- Each facility should establish policies and procedures on sample identification.

Phlebotomist Identification

- The identity of the phlebotomist *must* be recorded in order to establish accountability for correct patient identification.
 - Mechanisms for identifying phlebotomists include *one* of the following:
 - Phlebotomist's signature/initials/code number on the patient sample label and/or request form.
 - A manual or computer-prepared log of all venipunctures performed and the responsible phlebotomist.
-

**AABB Standards
for Sample
Labeling****5.11 Samples and Requests**

Identifying information for the patient and the blood sample shall correspond and be confirmed at the time of collection using two independent identifiers.

5.11.1 Requests

Requests for blood, blood components, tests, tissue, and derivatives and records accompanying blood samples from the patient shall contain sufficient information to uniquely identify the patient, including two independent identifiers. The transfusion service shall accept only complete, accurate, and legible requests.

5.11.1.1 *A physician or other authorized health professional shall order blood, blood components, tests, tissue, and derivatives.*

5.11.2 Patient Samples

Blood samples shall be identified with an affixed label bearing sufficient information for unique identification of the patient, including two independent identifiers.

5.11.2.1 *The completed label shall be attached to the tube before the person who drew the sample leaves the side of the patient.*

5.11.2.2 *There shall be a mechanism to identify the date of sample collection and the individual who drew the blood from the patient.*

5.11.2.3 *The transfusion service shall accept only those specimens that are completely, accurately, and legibly labeled.*

5.11.3 Identifying Information

The transfusion service shall confirm that all identifying information on the request is in agreement with that on the sample label. In case of discrepancy or doubt, another sample shall be obtained.

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

→ NOTE:

Refer to the transfusion facility's policies and procedures for sample labeling.

Nature of Specimens**Nature of Specimens**

- Serum or plasma may be used for pretransfusion testing. (This will vary depending upon the techniques used; refer to institutional protocol.)
- Hemolyzed samples should not be used; free serum hemoglobin may mask antibody-induced hemolysis.

Specimen Collection SiteInfusion Line:

- It is permissible to collect blood from an infusion line.
- Because residual intravenous fluid within the line may interfere with serologic testing:
 - The tubing should be flushed with saline.
 - An appropriate amount of blood should be withdrawn and discarded before collecting the sample.

Peripheral Venipuncture:

When drawing a sample from a peripheral venipuncture, ensure that intravenous fluids infusing through the same arm are shut off during venipuncture.

Age of Specimens**Age of Specimens for Compatibility Testing**

Blood samples *must* be collected within 3 days of RBC transfusions if:

- The patient has been pregnant within the preceding 3 months.
- The patient has been transfused within the preceding 3 months.
- The patient's history is uncertain or unavailable.

Age of Specimens from Neonates

Standards for compatibility testing for neonates are different from those for adults because the immunologic system of the newborn is immature and relatively unresponsive to antigenic stimulation during the first 4 months of life.

- Antibody detection and crossmatching tests can be omitted throughout the neonatal period if:
 - There are no unexpected antibodies detected by initial tests **and**
 - The infant receives no blood components containing unexpected, clinically significant antibodies.

- The serum or plasma of either the mother or the infant may be used for initial testing.
 - After the infant's ABO and Rh types have been determined, further ABO and Rh typing may be omitted if all RBCs transfused are:
 - ABO compatible **and**
 - Rh negative or the child's original Rh type.
-

AABB Standard

5.16 Special Considerations for Neonates

5.16.1 *An initial pretransfusion sample shall be tested to determine ABO group and Rh type. For ABO, only anti-A and anti-B reagents are required. The Rh type shall be determined as in Standard 5.13.2. The serum or plasma of either the neonate or the mother may be used to perform the test for unexpected antibodies as in Standard 5.13.3.*

5.13.2 Rh Type

Rh type shall be determined with anti-D reagent. The test for weak D is unnecessary when testing the patient.

5.13.3 Unexpected Antibodies to Red Cell Antigens

Methods of testing shall be those that demonstrate clinically significant antibodies. They shall include incubation at 37 C preceding an antiglobulin test using reagent red cells that are not pooled.

5.16.1.1 *Repeat ABO grouping and Rh typing may be omitted for the remainder of the neonate's hospital admission or until the neonate reaches the age of 4 months, whichever is sooner.*

5.16.1.2 *If the initial screen for red cell antibodies is negative, it is unnecessary to crossmatch donor red cells for the initial or subsequent transfusions. Repeat testing may be omitted for the remainder of the neonate's hospital admission or until the neonate reaches the age of 4 months, whichever is sooner. Standard 5.16.2 applies.*

5.16.1.3 *If the initial antibody screen demonstrates clinically significant unexpected red cell antibodies, units shall be prepared for transfusion that either do not contain the corresponding antigen or are compatible by antiglobulin crossmatch until the antibody is no longer demonstrable in the neonate's serum or plasma.*

5.16.2 *If a non-group-O neonate is to receive non-group-O Red Blood Cells that are not compatible with the maternal ABO group, the neonate's serum or plasma shall be tested for anti-A or anti-B.*

5.16.2.1 *Test methods shall include an antiglobulin phase using either donor or reagent A₁ or B red cells. Standard 5.13.3.4 applies.*

5.16.2.2 *If anti-A or anti-B is detected, Red Blood Cells lacking the corresponding ABO antigen shall be transfused.*

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

Biological Hazards

- Blood is the single most important source of human immunodeficiency virus type 1 (HIV-1) and hepatitis B virus (HBV) in the occupational setting.
- Risks to health-care personnel have been estimated for acquiring infection following a needle puncture contaminated with blood from a person infected with the viruses.
 - A non-vaccinated person's risk of acquiring the hepatitis B virus ranges from 6% to 30%.
 - The risk of acquiring HIV-1/2 infection by this route is estimated at 0.4% or less.
- Potential contacts with blood or body fluids include:
 1. Needlestick or puncture with a contaminated needle, lancet, test tube, etc.
 2. Broken, abraded, or nonintact skin in contact with blood or a blood-contaminated object.
 3. Mucous membranes of the eye, nose, or mouth in contact with blood from a splash, aerosolization, or direct contact.

Universal Precautions

Universal precautions should be used for contact with all Patients.

- Follow the Centers for Disease Control and Prevention (CDC) guidelines on universal precautions when in contact or potential contact with blood, blood components, and body fluids and tissues that may transmit HIV-1 and HBV.
- Universal precautions are intended to prevent parenteral, mucous membrane, and nonintact skin exposures of health-care workers to blood-borne pathogens.
- Universal precautions for routine infection control

include:

- Hand washing.
- Using gloves (latex/vinyl/rubber).
- Isolation precautions.

→ **NOTE:**

- Everyone needs to wash his or her hands.
- Hand washing is the most effective way to stop the spread of infections.

Protective Equipment

- Protective equipment:
 - Should be used for administering blood transfusions.
 - Always includes gloves.
 - May also include masks, eyewear, or gowns.
- **Gloves** should be changed...
 - If torn or soiled.
 - Between patients to prevent cross infection.
- **Masks, Eyewear, and Gowns:**
 - Not needed unless blood or potentially infectious fluids are present.
 - Masks and eyewear are worn together if splashes are anticipated.
 - A gown or apron is worn to avoid soaking of clothes.

Response to Exposure

Exposure

If you are exposed to blood or body fluids:

- Wash the affected area immediately.
- Report the incident.
- Be examined by the proper medical authority for assessment and counseling.

Contamination and Spills

- Equipment contaminated with blood or other body fluids should be decontaminated and cleaned before storage or use with another patient.
- Immediately clean blood spills with an appropriate disinfectant solution.
- Immediately and thoroughly wash hands and other skin surfaces that are contaminated with blood, body fluids containing visible blood, or other body fluids to which universal precautions apply.

Injury Prevention Injuries are prevented by careful handling of needles, scalpels, and other sharp instruments or devices during procedures, cleaning, and disposal.

Needles

- Do not recap, bend, break, or remove needles by hand.
- Dispose of needles in a puncture-resistant container (located near the area of use) immediately after use.
- Report needlestick exposures immediately to a supervisor.

Specimen Collection/Transport

- Avoid contaminating the outside of the container and the laboratory form with blood or other body fluids.
 - Place the specimen in a well-constructed container with a secure lid for transport.
-

AABB

**Primer of
Blood Administration**

(Revised September 2012)

Chapter 4

Role of the Blood Bank

Chapter Objectives**Chapter 4 Objectives**

Upon completion of this chapter the learner will be able to:

1. Explain specimen testing requirements and rationale.
 2. Describe compatibility testing.
 3. Discuss blood component preparation and storage.
 4. List the steps to obtain blood from the blood bank.
 5. Differentiate procedures for the emergency release of blood components.
 6. Define massive transfusion.
-

Serologic Testing

Transfusion Testing

- The ABO group and Rh type of the intended recipient must be determined before blood is issued for transfusion (exceptions can be made in emergent situations).
- The recipient's serum must be tested for clinically significant unexpected antibodies and for serologic compatibility with the donor's red cells when transfusing the following components:
 - Whole Blood (WB).
 - Red Blood Cells (RBCs), including washed or deglycerolized components.
 - Granulocytes.
 - Platelets containing ≥ 2 mL of red cells.

Red Blood Cells

Tests to detect serologic incompatibility must be performed before all red cell transfusions.

Donor Blood Unit

Donor blood unit label accuracy is verified by repeat testing of the donor's:

- ABO group.
- Rh type, if Rh-negative.

AABB Standard



5.12 Serologic Confirmation of Donor Blood ABO/Rh (including autologous units)

Before transfusion, the ABO group of each Whole Blood and Red Blood Cell component and the Rh type of such units labeled as Rh negative shall be confirmed by a serologic test from an integrally attached segment.

Confirmatory testing for weak D is not required.

5.12.1 *Discrepancies shall be reported to the collecting facility and shall be resolved before issue of the blood for transfusion purposes. Standards 7.1.1 and 7.1.2 apply.*

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

Recipient Sample

- Tested for ABO type, Rh type, and significant unexpected antibodies.
- Results are checked against historical records.

Crossmatch

- Donor cells are tested against the patient's serum.
- If the recipient has been pregnant or transfused within the past

3 months, or if this information is uncertain, the patient sample used in testing must be collected within 3 days of transfusion to allow detection of antibodies that may have formed as a result of this sensitizing event (day 0 is day of draw).

AABB Standard

5.13 Pretransfusion Testing of Patient Blood

Pretransfusion tests for allogeneic transfusion shall include ABO group and Rh type. In addition, for Whole Blood, Red Blood Cell, and Granulocyte components, pretransfusion testing for unexpected antibodies to red cell antigens shall be performed.

5.13.1 ABO Group

The ABO group shall be determined by testing the red cells with anti-A and anti-B reagents and by testing the serum or plasma for expected antibodies with A₁ and B reagent red cells. If a discrepancy is detected and transfusion is necessary before resolution, only group O Red Blood Cells shall be issued.

5.13.2 Rh Type

Rh type shall be determined with anti-D reagent. The test for weak D is unnecessary when testing the patient.

5.13.3 Unexpected Antibodies to Red Cell Antigens

Methods of testing shall be those that demonstrate clinically significant antibodies. They shall include incubation at 37 C preceding an antiglobulin test using reagent red cells that are not pooled.

5.13.3.1 *When clinically significant antibodies are detected, additional testing shall be performed.*

5.13.3.2 *If the patient has been transfused in the preceding 3 months with blood or a component containing allogeneic red cells, if the patient has been pregnant within the preceding 3 months, or if the history is uncertain or unavailable, a sample shall be obtained from the patient within 3 days of the scheduled transfusion. Day 0 is the day of draw.*

5.13.3.3 *In patients with previously identified clinically significant antibodies, methods of testing shall be those that identify additional clinically significant antibodies.*

5.13.3.4 *A control system appropriate to the method of testing shall be used. Standard 5.1.3 applies.*

5.1.3 Quality Control

A program of quality control shall be established that is sufficiently comprehensive to ensure that reagents, equipment, and methods function as expected.

Chapter 9, Process Improvement Through Corrective

and Preventive Action, applies.

 **5.15.1 Serologic Crossmatch**

Before issue, a sample of the recipient's serum or plasma shall be crossmatched against a sample of donor cells from an integrally attached Whole Blood or Red Blood Cell segment. The crossmatch shall use methods that demonstrate ABO incompatibility and clinically significant antibodies to red cell antigens and shall include an antiglobulin test as described in Standard 5.13.3.

- 5.15.1.1** *If no clinically significant antibodies were detected in tests performed in Standard 5.13.3 and there is no record of previous detection of such antibodies, at a minimum, detection of ABO incompatibility shall be performed.*

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

Electronic Crossmatch

Some transfusion services will omit a serologic crossmatch and choose ABO-compatible units selected by a validated on-site computer system if:

- No clinically significant antibodies were detected in tests performed
- and**
- Two determinations of the recipient's ABO group are made:
 - One on a current sample.
 - Second determination by one of the following methods:
 - Retesting the same sample.
 - Testing of a second current sample.
 - Comparison with previous records.

AABB Standard

5.15.2 Computer Crossmatch

If a computer system is used to detect ABO incompatibility, the following requirements shall be met:

- 5.15.2.1** *The computer system has been validated on site to ensure that only ABO-compatible Whole Blood or Red Blood Cell components have been selected for transfusion.*
- 5.15.2.2** *Two determinations of the recipient's ABO group as specified in Standard 5.13.1 are made, one on a current sample and the second by one of the following methods: by retesting the same sample, by testing a second current sample, or by*

comparison with previous records. Standard 5.11 applies.

- 5.15.2.3** *The system contains the donation identification number, component name, ABO group, and Rh type of the component; the confirmed unit ABO group; the two unique recipient identifiers; recipient ABO group, Rh type, and antibody screen results; and interpretation of compatibility.*
- 5.15.2.4** *A method exists to verify correct entry of data before release of blood or components.*
- 5.15.2.5** *The system contains logic to alert the user to discrepancies between the donor ABO group and Rh type on the unit label and those determined by blood group confirmatory tests and to ABO incompatibility between the recipient and the donor unit.**

**FDA Guidance for Industry, April 28, 2011, “Computer Crossmatch’ (Computer Analysis of the Compatibility between the Donor’s Cell Type and the Recipient’s Serum or Plasma Type).”*

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

Testing Time Frames

- Pretransfusion testing may take 15 minutes to 1 hour, depending on the methods used.
- Transfusionists must be aware of the protocols in their institutions because this time is added to the preparation time of all red cell components.
- Additional steps and time may be needed if there are unexpected antibodies or other unexpected results in initial testing.
- If a significant antibody is detected during pretransfusion testing, additional testing is required to:
 - Identify the antibody.
 - Crossmatch blood that is negative for the corresponding antigen.

Platelets

Compatibility Testing

Standard pretransfusion compatibility testing is not performed for platelet transfusions.

- Documentation of a patient's ABO and Rh is needed to make appropriate selection decisions.
- Crossmatching is required for Apheresis Platelets containing ≥ 2 mL of red cells.
- HLA typing may be indicated when patients become refractory to platelets after multiple transfusions.
 - The most likely source of compatible donors is the patient's family.
 - Some blood collection centers maintain records of donor HLA types.
 - HLA matching does not guarantee good platelet increments in some patients.
 - No response or increase has been seen in the posttransfusion platelet count in 25% of HLA-compatible transfusions.

Crossmatch Procedures

Platelet crossmatch procedures are being evaluated for their usefulness as compatibility tests: aggregometry, lymphocytotoxicity, enzyme-linked immunoassay, radioimmunoassay, immunofluorescence, and solid-phase testing.

ABO Compatibility

In cases when an ABO antigen is present on the platelet membrane:

- It is ideal to give ABO-identical platelets; however, few transfusion services have the inventory to support this practice.
- When prompt transfusion is more important to patient therapy than waiting for compatible platelet products:
 - Patients may be given any ABO group.
 - Donor plasma in Platelets should be ABO-compatible with the recipient's red cells, especially when the component is to be transfused to an infant.

Rh Compatibility

In cases when there is no D antigen on the platelet membrane:

- Rh-negative recipients are at small risk of becoming sensitized to D antigen by red cells present in Rh-positive platelet products.
- Rh-negative platelets are preferred for Rh-negative females of

childbearing potential. If this group must receive Rh-positive platelets, the physician may consider giving Rh Immune Globulin.

Plasma

Compatibility testing is not performed for plasma transfusions. The patient's ABO group must be known before component selection to make sure that the A or B antibodies in the plasma are compatible with the patient's red cells.

- This is especially important for infants with a small blood volume.
 - If the patient's blood group is not known, group AB Fresh Frozen Plasma (FFP) or Plasma Frozen Within 24 Hours After Phlebotomy (FP24) can be given safely.
 - Plasma bags are pre-labeled with the donor's Rh type.
 - Rh type need not, however, be considered in plasma selection.
-

Cryoprecipitated AHF

Cryoprecipitated AHF is essentially free of red cells, but commonly has a very small volume of plasma antibodies.

- Compatibility testing is not performed.
 - ABO and Rh matching are not required.
-

Granulocytes

ABO and Rh antigens are thought not to be present on granulocytes.

- Most preparations contain many red cells. If the component contains ≥ 2 mL of red cells, it must be:
 - ABO-compatible with the recipient's plasma.
 - Crossmatched using standard techniques.
 - ABO-identical components are preferred because of the plasma volume. ABO/Rh compatibility guidelines are the same as those for red cell components.
 - Rh Immune Globulin therapy may be indicated when Rh-positive granulocytes must be given to Rh-negative females of childbearing potential.
-

Component Separation

A unit of blood may be kept as whole blood or separated into its component parts:

- Red cells.
- Platelets.
- Plasma.
- Derivatives of plasma (eg, immune globulin, coagulation factor

concentrates).

Advantages of Component Separation

1. Separation permits each component to be stored for maximum preservation, because not all components have the same storage requirements. Table 4-1 describes storage, transportation, and expiration requirements for the various components.
2. Component production allows several patients to benefit from one donation and conserves a valuable resource.

TABLE 4-1. Storage Requirements and Expiration Times for Components

Component	Storage	Transport	Expiration
Red Blood Cells (RBCs)	1-6 C	1-10 C	ACD/CPD/CP2D: 21 days CPDA-1: 35 days Additive Solutions: 42 days Open system: 24 hours
Deglycerolized RBCs	1-6 C	1-10 C	Open system: 24 hours Closed system: 14 days or as FDA approved
Frozen RBCs 40% Glycerol	≤-65 C if 40% Glycerol	Maintain frozen state	10 years Develop policy if rare frozen units are to be retained beyond 10 years
RBCs Irradiated	1-6 C	1-10 C	Original expiration or 28 days from date of irradiation, whichever is sooner
RBCs Leukocytes Reduced	1-6 C	1-10 C	ACD/CPD/CP2D: 21 days CPDA-1: 35 days Additive solutions: 42 days Open system: 24 hours
Rejuvenated RBCs	1-6 C	1-10 C	CPD, CPDA-1: 24 hours AS-1: freeze after rejuvenation
Deglycerolized Rejuvenated RBCs	1-6 C	1-10 C	24 hours or as approved by FDA
Frozen Rejuvenated RBCs	≤-65 C	Maintain frozen state	CPD, CPDA-1: 10 years AS-1: 3 years Develop policy if rare frozen units are to be retained beyond these times
Washed RBCs	1-6 C	1-10 C	24 hours
Apheresis RBCs	1-6 C	1-10 C	CPDA-1: 35 days Additive solution: 42 days

Component	Storage	Transport	Expiration
			Open system : 24 hours
Apheresis RBCs Leukocytes Reduced	1-6 C	1-10 C	CPDA-1: 35 days Additive solution: 42 days Open system : 24 hours
Platelets	20-24 C with continuous agitation	20-24 C (as close as possible to this range)	24 hours to 5 days, depending on collection system; maximum time without agitation, 24 hours
Platelets Irradiated	20-24 C with continuous gentle agitation	20-24 C (as close as possible to this range)	No change from original expiration date
Platelets Leukocytes Reduced	20-24 C with continuous gentle agitation	20-24 C (as close as possible to this range)	Open system: 4 hours Closed system: No change in expiration
Pooled Platelets Leukocytes Reduced	20-24 C with continuous gentle agitation	20-24 C (as close as possible to this range)	Open system: within 4 hours of opening the system Closed system: 4 hours after pooling or 5 days following collection (storage beyond 4 hours requires an FDA-cleared system)
Pooled Platelets (or open system)	20-24 C with continuous gentle agitation	20-24 C (as close as possible to this range)	Open system: 4 hours
Apheresis Platelets	20-24 C with continuous gentle agitation	20-24 C (as close as possible to this range)	24 hours to 5 days, depending on collection system
Apheresis Platelets Irradiated	20-24 C with continuous gentle agitation	20-24 C (as close as possible to this range)	No change from original expiration date
Apheresis Platelets Leukocytes Reduced	20-24 C with continuous gentle agitation	20-24 C (as close as possible to this range)	Open system: within 4 hours of opening the system Closed system: 5 days
Apheresis Granulocytes	20-24 C	20-24 C (as close as possible to this range)	24 hours
Apheresis Granulocytes Irradiated	20-24 C	20-24 C (as close as possible to this range)	No change from original expiration date
Cryoprecipitated AHF	≤-18 C	Maintain frozen state	12 months from original collection
Pooled Cryoprecipitated AHF (before freezing)	≤-18 C	Maintain frozen state	12 months from earliest date of collection of product in pool
Cryoprecipitated AHF (after thawing)	20-24 C	20-24 C (as close as possible to this range)	Open system or pooled: 4 hours Single unit: 6 hours
Fresh Frozen Plasma (FFP)	≤-18 or ≤-65 C	Maintain frozen state	≤-18 C: 12 months ≤-65 C: 7 years

Component	Storage	Transport	Expiration
FFP (after thawing)	1-6 C	1-10 C	If issued as FFP: 24 hours
Plasma Frozen Within 24 Hours After Phlebotomy	≤-18 C	Maintain frozen state	12 months
Plasma Frozen Within 24 Hours After Phlebotomy (after thawing)	1-6 C	1-10 C	If issued as FFP: 24 hours
Thawed Plasma	1-6 C	1-10 C	5 days from date original product was thawed
Plasma Cryoprecipitate Reduced	≤-18 C	Maintain frozen state	12 months from original collection
Plasma Cryoprecipitate Reduced (after thawing)	1-6 C	1-10 C	24 hours
Thawed Plasma Cryoprecipitate Reduced	1-6 C	1-10 C	5 days
Liquid Plasma	1-6 C	1-10 C	5 days after expiration of Whole Blood
Recovered Plasma, liquid or frozen	Refer to short supply agreement	Refer to short supply agreement	Refer to short supply agreement
Tissue	Conform to source facility's written instructions	Conform to source facility's written instructions	Conform to source facility's written instructions
Derivatives	Conform to manufacturer's written instructions	Conform to manufacturer's written instructions	Conform to manufacturer's written instructions

ACD = acid-citrate-dextrose; CPD = citrate-phosphate-dextrose; CP2D = citrate-phosphate-dextrose-dextrose; CPDA = citrate-phosphate-dextrose-adenine; AS-1 = additive solution (Adsol).

Issuing Units

Blood should be issued from the blood bank only to adequately trained personnel.

AABB Standard



5.20 Final Inspection Before Issue

Blood, blood components, tissue, and derivatives shall be inspected at the time of issue.

5.20.1 Transfusion Recipient Blood Container

Identification

A blood container shall have an attached label or tie tag indicating:

- 1) The intended recipient's two independent identifiers.*
- 2) Donation identification number or pool number.*

3) *Interpretation of compatibility tests, if performed.*

5.21 **Issue of Blood and Blood Components**

At the time a unit is issued, there shall be a final check of transfusion service records and each unit of blood or component. Verification shall include:

- 1) *The intended recipient's two independent identifiers, ABO group, and Rh type.*
- 2) *The donor identification number, the donor ABO group, and, if required, the Rh type.*
- 3) *The interpretation of crossmatch tests, if performed.*
- 4) *Special transfusion requirements, if applicable.*
- 5) *The expiration date and, if applicable time.*
- 6) *The date and time of issue.*

5.23 **Discrepancy Resolution**

The blood bank or transfusion service shall have a process to confirm agreement of the identifying information, the records, the blood or blood component, and the request. Discrepancies shall be resolved before issue.

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

➔ **NOTE:**

Refer to the blood transfusion facility's policies and procedures.

Return of Unused Blood

Refrigerated components may not be returned to inventory if they have been warmed to more than 10 C.

➔ **NOTE:**

To meet this requirement, most transfusion services consider 30 minutes to be the maximum allowable time out of temperature-monitored storage.

AABB Standard

5.24 Reissue of Blood, Blood Components, Tissue, and Derivatives

Blood, blood components, tissue, or derivatives that have been returned to the blood bank or transfusion service shall be accepted into inventory for reissue only if the following conditions have been observed:

- 1) *The container closure has not been disturbed.*
- 2) *The appropriate temperature has been maintained.*
- 3) *For Red Blood Cell components, at least one sealed segment of integral donor tubing has remained attached to the container. Removed segments shall be reattached only after confirming that the tubing identification numbers on both the removed segment(s)*

and the container are identical.

- 4) *The records indicate that the blood, blood component, tissue, or derivative has been inspected and that they are acceptable for reissue.*

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

Urgent Requirement for Blood and Components

Urgent Requirement for Red Cell Transfusion

- Defined as the need to transfuse RBCs before the completion of all standard tests, because:
 - A delay in transfusion could be detrimental to the patient.
 - Oxygen-carrying capacity needs to be reestablished.

- Group-specific or group-compatible RBCs should be transfused as soon as they are available, even though pretransfusion compatibility testing may not have been completed.

- The patient's physician must sign an "emergency release request" to acknowledge that the clinical situation was sufficiently urgent to require the release of blood before completion of compatibility testing or infectious disease testing.

→ NOTE:

These forms are available in all transfusion services.

When the Patient's Blood Group Is Known

- Transfusion of uncrossmatched (but ABO-compatible) Whole Blood or RBCs carries a very low risk of being incompatible if:
 - The patient has been tested previously by the transfusion service
 - and**
 - The antibody screen is negative.

- This margin of safety is dependent on the correct identification of three things:
 - 1) Patient.
 - 2) Pretransfusion blood sample.
 - 3) Blood components to be transfused.

→ NOTE:

It is important to remember that the approach to emergency transfusion in a patient who has continually been receiving

blood and for whom multiple specimens have been tested is different from that in a patient who has no previous transfusion record and for whom no blood specimens were analyzed.

When the Patient's Blood Group Is Unknown

- Group O RBCs should be transfused.
- Whenever possible, Rh-negative RBCs should be used for females of childbearing potential to avoid the possibility of sensitization to the D antigen.

AABB Standard

5.25 Urgent Requirement for Blood and Blood Components


The blood bank or transfusion service shall have a process for the provision of blood and blood components before completion of tests listed in Standards 5.8.4, 5.13, 5.13.1, 5.13.2, 5.13.3, and 5.15 when a delay in transfusion could be detrimental to the patient. Standards 5.8.4.1, 5.12, and 7.0 to 7.2 apply.

5.25.1 *Recipients whose ABO group is not known shall receive group O Red Blood Cells. Standard 5.13.1 applies.*

5.25.2 *If blood is issued before completion of compatibility testing, recipients whose ABO group has been determined as in Standard 5.13.1 by the transfusing facility shall receive only ABO group-specific Whole Blood or ABO group-compatible Red Blood Cell components.*

5.25.3 *The container tie tag or label shall indicate in a conspicuous fashion that compatibility and/or infectious disease testing was not completed at the time of issue.*

5.25.4 *Compatibility testing shall be completed expeditiously using a patient sample collected as early as possible in the transfusion sequence. Standard 5.17.5 applies.*

 **5.25.5** *The records shall contain a signed statement from the requesting physician indicating that the clinical situation was sufficiently urgent to require release of blood before completion of compatibility testing or infectious disease testing.*

—AABB Standards for Blood Banks and Transfusion Services, 28th Edition

Massive Transfusion

Massive Transfusion

- Typically defined as the replacement of one or more blood

volumes within 24 hours.

- A blood volume is estimated as 70 mL/kg or about 5000 mL (10 or more units of Whole Blood) in a 70-kg adult.
- RBCs in combination with crystalloid or colloid solutions are adequate for restoring blood volume and oxygen-carrying capacity.
- Whole Blood is rarely used anymore.

Criteria for Transfusion

- The urgency with which red cell support is given is determined by the patient's:
 - History.
 - Vital signs.
 - Clinical situation.
 - Hematocrit.
- The decision to administer plasma and platelet support should typically be based on both:
 - The presence or absence of microvascular (not surgical) bleeding
 - and**
 - The results of hemostasis screening tests: prothrombin time, partial thromboplastin time, and platelet count. (Fibrinogen concentration and thrombin time also may be useful.) It may be necessary to administer these components empirically before test results are available.

Complications

- Most complications attributed to massive transfusion result from tissue damage or hypoperfusion secondary to trauma or hemorrhage.
 - The transfusion of large quantities of stored red cells may contribute to metabolic complications.
 - Red cells do not contain platelets or significant quantities of coagulation factors. During massive transfusion, dilutional coagulopathy and thrombocytopenia may exacerbate other causes of reduced levels of coagulation factors and platelets. As noted, it may be necessary to transfuse plasma and platelets empirically before laboratory results are available.
-

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**Primer of
Blood Administration**

(Revised September 2012)

Chapter 5

Blood Administration Practices

Chapter Objectives**Chapter 5 Objectives**

Upon completion of this chapter the learner will be able to:

1. Determine if the order for transfusion includes all required elements.
 2. Assess patient readiness for transfusion.
 3. Discuss appropriate venous access devices for blood transfusions.
 4. Explain the process to match the patient with the corresponding blood component.
 5. Describe the process for blood component inspection.
 6. Explain the rationale for, and describe the use of, filters and infusion devices for blood components.
 7. List intravenous solutions that are compatible with blood.
 8. Describe signs and symptoms of transfusion reactions.
 9. List the required documentation for blood transfusion.
 10. State the requirements for disposal of blood transfusion materials and devices.
-

Questions to Ask To maximize the effectiveness and safety of a transfusion, the transfusionist should consider the following questions:

- Why is the blood or component being given?
- What is in the product?
- How is it handled and stored?
- Is it ABO and Rh compatible?
- How should it be administered?
- What adverse reactions may develop?

Before transfusion, the nurse must consider the following questions:

- Have physician's orders been issued?
 - Has patient consent been obtained?
 - Have the patient's cultural and religious beliefs been considered? (See Chapter 2.)
-

Preparation of the Patient

The first steps in preparing for component therapy include:

- Ensuring there is adequate venous access.
 - Obtaining baseline vital signs.
 - Ascertaining that signed consent (if necessary) and a physician's order have been obtained.
-

Determination of Needle Size

Red Cell Components

A large-gauge needle is preferred.

- Adults:
 - 18- to 20-gauge needles are recommended for a good rate of flow, without undue discomfort for the patient.
- Chronically transfused or pediatric patients:
 - When adequate venous access is difficult to maintain, the largest possible needle should be used.
 - Red Blood Cells (RBCs) can be safely administered through 23- to 25-gauge needles; however, the flow rate will be slower.

Non-Red-Cell-Containing Blood Components

- Examples: Platelets, Fresh Frozen Plasma (FFP), Plasma Frozen Within 24 Hours After Phlebotomy (FP24), and Cryoprecipitated AHF.
 - Can be rapidly administered through small-gauge needles.
-

Peripheral Venous Access**Starting a Peripheral Line**

- Adults:
 - When possible, the nondominant hand should be used.
 - This method allows the patient the comfort of having the dominant hand free from restraint.
- Young children who are not yet walking:
 - The feet can be used.
 - This method allows freedom of the hands to explore the environment.
- Children who are walking:
 - The nondominant hand should be considered.

Assessing the Peripheral Line

- An arm board may be necessary to stabilize the extremity.
 - When a pre-existing intravenous site is being used, assess the patency of the line; this includes examining the infusion site for signs of swelling, redness, pain, differences in color, or slowed infusion rate.
 - A blood return in the tubing does not always indicate that the venous access is adequate.
-

Central Venous Catheters

A central venous catheter is an acceptable venous access option for blood transfusion.

- An issue of concern in using multilumen catheters is that blood is allowed to mix with incompatible solutions and medications as they exit the catheter tips.
- The experience of many practitioners indicates that the circulation achieved through a blood vessel suitable for central line placement rapidly dilutes the solutions, and no harmful effects have been reported.

Vascular Access in Neonates

- Vascular access is often difficult to achieve in:
 - Tiny newborns.
 - Infants requiring long-term or repeated intravenous infusions.
 - The umbilical artery may be cannulated in newborns. Thereafter, a vein should be chosen for blood administration that is large enough to accommodate a:
 - 23- or 25-gauge needle or
 - 22- or 24-gauge vascular catheter.
 - Constant-rate syringe delivery pumps are satisfactory for transfusion of RBCs through small-gauge needles.
 - Usually, it is not necessary to warm units for small-volume transfusions that are given slowly.
-

Solutions and Drugs**Saline Solution**

- Administration set should be primed with normal saline solution (0.9% sodium chloride).

Plasma-Lyte 148

- Also FDA-approved as compatible with blood components.
- May be administered prior to or following the infusion of blood through the same administration set (ie, as a priming solution).
- May be added to or infused concurrently with blood components.
- May be used as a diluent in the transfusion of RBCs.

Plasma-Lyte 148 Injection and 0.9% sodium chloride Injection, USP are equally compatible with blood or blood components.

Other Solutions

- Solutions with dextrose:
Prolonged contact between red cells and dextrose solutions can result in a loss of water from the red cell and subsequent destruction.
- Solutions with calcium:
 - Have been shown to interfere with the anticoagulant used in the RBC container.
 - Example: lactated Ringer's.

Medications

- Medications should never be mixed with blood components unless approved by the Food and Drug Administration (FDA) for such use, or unless there is documentation with sufficient empirical data to show that its addition to a component is safe and efficacious.
- Rationale for prohibiting addition of drugs:
 - Their effect on blood components is unpredictable.
 - If a reaction were to occur, it would be difficult to ascertain whether the drug or the blood component was responsible for the adverse effect.
 - If the transfusion were to be interrupted for any reason, it would be impossible to calculate the amount of the drug received.
- If a patient will require intravenous medications during transfusion, a separate intravenous line should be started for the administration of blood components. This way, a patient can receive the therapeutic effects of both the blood component and the medication simultaneously.

AABB Standard**5.26.9 Addition of Drugs and Solutions**

With the exception of 0.9% sodium chloride (USP), drugs or medications shall not be added to blood or components unless one of the following conditions are met:

- 1) *They have been approved for this use by the FDA.*
- 2) *There is documentation available to show that the addition is safe and does not adversely affect the blood or component.*

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➔ NOTE:

Refer to the blood transfusion facility's policies and procedures for the addition of drugs and solutions.

Patient Assessment

Thorough assessment of the patient's condition should be the final step before initiating transfusion therapy.

Baseline Measurements

- Immediately before initiating transfusion, obtain vital signs:
 - Temperature.
 - Pulse.
 - Respirations.
 - Blood pressure.
- These provide a baseline measurement against which any changes during the transfusion can be compared.
- Measurements of all vital signs should be recorded in the patient record and be available for comparison.
- The patient should be questioned about any symptoms that may later be mistaken for a transfusion reaction, such as chills, itching, rashes, hematuria, muscle aches, or difficulty breathing.

Fever:

- May be cause for delaying the transfusion.
 - Could mask a symptom of an acute transfusion reaction.
 - May compromise the efficacy of platelet transfusions.
-

Pre-medication

Pre-medication may be required if the patient has a history of adverse reactions.

- The patient's medication regimen should be reviewed before transfusion. Certain drugs such as antifungal agents or chemotherapy may not be recommended for infusion during a blood transfusion.
- In many cases, **febrile reactions** can be prevented by administering acetaminophen.
- Prophylactic administration of **antihistamines and/or steroids** may be required for patients with a history of allergic reactions.
- Meperidine hydrochloride may prevent or treat **chills or rigors** accompanying granulocyte transfusions.

- Administration:
 - To ensure effectiveness, oral medication should be administered 30 minutes before starting a transfusion.
 - Intravenous medication may be given immediately before starting a transfusion.
-

Patient Comfort

A non-emergent transfusion of a single unit of RBCs will take about 1½ to 2 hours and should be completed within 4 hours.

- The patient should be assisted to the bathroom and made comfortable at the transfusion site before transfusion is begun.
 - The patient may prefer a chair rather than a bed. This will result in fewer manipulations of the blood and tubing during the course of blood administration.
 - Diversional activities should be offered to the patient (eg, reading materials, TV, radio, or games).
-

Obtaining the Blood

The procedure for obtaining blood components from the hospital blood bank and delivering them to patients for transfusion varies for each institution.

Essential guidelines that must be adhered to, regardless of the institution, include the following:

- Wear gloves when handling blood component unit bags.
- Transfusion must begin within 30 minutes (less if so-stated in the institutional policy) after the component is released from the blood bank. If transfusion cannot be started in this timeframe, the unit should be returned to the transfusion service for reissue. AABB Standard 5.18.4 applies (see Chapter 4, page 11).
- The blood component and the recipient must be properly identified and required compatibility testing completed.
- The blood component should be handled carefully while in transit. Wear gloves or transport blood component units in a container or overlay bag that prevents direct contact.

→ NOTE:

If transfusion is delayed, the component should be returned to the blood bank within 30 minutes or less from the time of issue for proper temperature-monitored storage.

Identification

- Accurate identification and verification of the donor's blood and the intended recipient may be the single most important step in ensuring transfusion safety.
 - If the blood component unit identification and intended recipient do not match, **DO NOT TRANSFUSE**. Return blood to transfusion service for resolution of clerical issues on tag or unit.
 - Most fatal hemolytic transfusion reactions occur because ABO-incompatible RBCs were administered inadvertently.
 - Plasma, platelets, and blood derivatives also are capable of causing serious transfusion reactions.
-

Identification at Time of Release from the Blood Bank

Those responsible for identification of components are:

- The transfusion service personnel who issue the blood.
 - The clinical representatives who receive the unit.
-

Identification at the Bedside

The transfusionist who administers the blood is the last person who can detect identification errors before the patient is transfused.

- Two qualified employees verify and match the patient identifiers, along with other items before transfusion. This may be required by state law.
- Review provider orders for preparation of the blood component and for the administration of that blood component.

➔ NOTE:

An order to prepare a blood component does not necessarily indicate that a transfusion is ordered. Orders for blood component administration should at least include a start time and rate of transfusion.

- Evidence that informed consent for blood component

transfusion was obtained from the intended recipient should be verified before all non-emergent administration of blood components. The following AABB Standards apply.

 **5.26.1 Recipient Consent**

The blood bank or transfusion service medical director shall participate in the development of policies, processes, and procedures regarding recipient consent for transfusion.

5.26.1.1 *At a minimum, elements of consent shall include all of the following:*

- 1) *A description of the risks, benefits, and treatment alternatives (including nontreatment).*
- 2) *The opportunity to ask questions.*
- 3) *The right to accept or refuse transfusion.*

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- Before beginning the transfusion, the transfusionist(s) must:
 - Verify all identifying information in the presence of the intended recipient.
 - Record on the transfusion form that this information has been checked **and found to be correct**.

Items to be verified include:

1. Recipient Identification

The two independent identifiers on the patient's wristband *must* be identical to those on the form attached to the donor unit.

➔ NOTE:

Patient/unit identification verification *must* be performed INDEPENDENTLY by each employee.

For example, each of two nurses *independently* compares the patient's name and medical record number from the ID band on the patient with the name and medical record on the form attached to the blood component unit.

It is no longer recommended that one nurse spells the patient's name aloud from the ID band while the other nurse follows along reading the form attached to the blood component unit. Errors occur when the employee reading the form attached to the unit becomes distracted.

2. Unit Identification

The unit identification number on the blood component unit bag *must* match with that recorded on the form attached to the blood component unit.

3. ABO/Rh

- The ABO and Rh type on the primary label on the blood component unit *must* agree with that recorded on the form attached to the unit.
- The recipient ABO and Rh type *must* be recorded on the form attached to the blood component unit.

→ NOTE:

ABO and Rh on the blood component unit label and attached form must be compatible with the recipient ABO and Rh, *but MAY NOT be identical* (see #5 below).

4. Expiration

The expiration date of the blood component unit should be verified as acceptable before transfusion.

5. Compatibility

- The interpretation of compatibility testing (if performed) must be recorded on the form attached to the unit.
- If blood was issued before compatibility tests were completed, this fact must be indicated conspicuously on the form.

6. Appearance of blood component unit

Inspection of the blood component should be performed by both employees to look for:

- Leaks.
- Abnormal color.
- Clots.
- Excessive air or bubble.
- Unusual odor.

Blood components that appear abnormal should not be transfused without further investigation. Contact the blood bank for an explanation of the abnormal appearance. Request a replacement blood component unit, if necessary.

→ NOTE:

All identification attached to the container should remain attached until the transfusion has been terminated.

AABB Standard**5.26 Administration of Blood and Blood Components**

There shall be a protocol for the administration of blood and blood components, including the use of infusion devices and ancillary equipment, and the identification, evaluation, and reporting of adverse events related to transfusion. The medical director shall participate in the development of these protocols. The protocol shall be consistent with the Circular of Information for the Use of Human Blood and Blood Components. Standard 7.4 applies.

7.4 Adverse Events Related to Transfusion

There shall be a process for the administration of blood and components that includes the recognition, evaluation, and reporting of suspected transfusion-related adverse events. The medical director shall participate in the development of protocols used by the transfusing staff to identify, evaluate, and report adverse events related to transfusion. Standards 1.1.1 and 5.25 apply.

5.26.4 *The transfusionist and one other individual (or an electronic identification system) shall, in the presence of the recipient positively identify the recipient and match the blood component to the recipient through the use of two independent identifiers.*


5.26.5 *All identification attached to the container shall remain attached until the transfusion has been terminated.*

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Documentation

- After checking all the identifying information, the transfusionists must sign the transfusion form to:
 - Indicate that the identification was correct.
 - Document who started the transfusion.
- Other items that may also be required on the transfusion form include:
 - Notation of the date and time of the transfusion.
 - Name and volume of the component.
 - Blood component's identification number.

AABB Standard

-  **5.27.1** *The patient's medical record shall include the transfusion order, documentation of patient consent, the name of the component, the donor identification number, the date and*

time of transfusion, pre- and posttransfusion vital signs, the amount transfused, the identification of the transfusionist, and, if applicable, transfusion-related adverse events.

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Blood Infusion Equipment and Devices

Many devices are available to increase the safety of transfusion. Special filters, electromechanical devices, and blood warmers are frequently used at the bedside. The transfusionist(s) should be familiar with how and why special equipment is used.

Blood Administration Set

Most blood components should be infused through administration sets designed specifically for this use.

- The set usually contains a 170-micron filter designed to trap fibrin clots and other debris that accumulate during blood storage.
 - Most standard filters have a four-unit maximum capacity. (Check the manufacturer's instructions.)
 - If the first unit requires ≥ 4 hours for infusion, the filter should not be reused.
 - Tubing is available in two basic configurations:
 - Straight:
 - Usually has a medication injection site a few inches from the hub.
 - If an adverse reaction develops, a "keep-vein-open" saline drip initiated at this site will maintain IV patency but avoid exposure to the 30 to 50 mL of blood remaining in the tubing and filter.
 - y-type:
 - Simplifies the process of adding normal saline to red cells (if necessary).
 - Provides ready access to a saline flush if the blood component remaining in the tubing at the end of the transfusion.
-

Filters

Standard Component Filter

- A patient's physician or nurse may determine that a standard blood component filter is not adequate in certain clinical situations.

Leukocyte Reduction Filters

- May be recommended by a transfusion service to decrease the risk of transfusion complications if a prestorage leukocyte-reduced blood unit is not available.

- Most blood centers offer prestorage leukocyte-reduced Red Blood Cell units and Platelets, eliminating the need for leukocyte reduction filters at the bedside. This ensures the process control and removal of white cells before byproducts are released.

- It is critically important to follow instructions exactly, from sources such as:
 - The manufacturer's insert found inside the packaging.
 - The manufacturer's instructions printed on the exterior of the packaging container.
 - The hospital's policies and procedures.

Microaggregate Filters

- Not appropriate for use when administering routine transfusions to adults, children, or neonates.

- Not appropriate for granulocyte infusions.

- May be indicated for use with ECMO circuits, preparation of intra-operative blood recovery collections, or infusion of wound drainage collections.

AABB Standard

5.26.8 *Blood and components shall be transfused through a sterile, pyrogen-free transfusion set that has a filter designed to retain particles potentially harmful to the recipient.*

5.26.10 Granulocytes

Leukocyte reduction filters or microaggregate filters shall not be used. Standard 5.26.8 applies.

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Infusion Devices Several types of infusion devices are available to regulate and monitor the flow of intravenous solutions.

Basic Types

- Infusion Controllers:
 - Monitor flow by gravity.
 - May be used with all blood components if they are designed to function with opaque solutions.
- Infusion Pumps deliver solutions at a controlled rate and measurement.

→ NOTE:

It is imperative that machines tested and approved for the infusion of blood components be used exactly as recommended by the manufacturer.

Manual Pressure Cuffs

- Used to increase red cell flow rate.
- Pressure should not exceed 300 mm Hg.
- Standard sphygmomanometers should *not* be used for this purpose because they do not exert uniform pressure against all parts of the bag.

Blood Warmers

Blood warmers may be used to prevent hypothermia that can be induced by rapid infusion of large volumes of refrigerated blood.

Clinical Situations Indicating Possible Use of a Warmer

- Neonatal exchange transfusion.
- Plasma exchange.
- Surgery.
- Trauma.
- Cold agglutinin disease:
 - The disease occurs in patients with antibodies that react at temperatures under 37 C.
 - Systemic circulatory cooling can cause intravascular agglutination and hemolysis. This is especially true in extremities that may be colder than core body temperature and that may not be effectively warmed by “bear huggers” or warming blankets.
 - Warming transfused units in cold agglutinin hemolysis is an adjunct to keeping the patient in a warm environment.

Limitations of Conventional Blood Warmers

- The rate of infusion can be impeded by the additional tubing and blood warming bags required for conventional warming devices.
- Blood warmers require substantial priming volumes, making them inappropriate for small-volume transfusions.
- Quality control should be performed and documented on these devices to ensure temperature monitoring and alarms are functioning accurately and appropriately.

➔ **NOTE:**

Care must be taken to use only those blood warming devices that have been tested and approved for use with blood components.

AABB Standard

3.0 **Equipment**

The blood bank or transfusion service shall identify the equipment that is critical to the provision of blood, blood components, tissue, derivatives, and/or services. The blood bank or transfusion service shall have policies, processes, and procedures to ensure that calibration, maintenance, and monitoring of equipment conforms to these BB/TS Standards and other specified requirements.

3.1 **Selection of Equipment**

The blood bank or transfusion service shall have a process to define the selection criteria for equipment.

3.2 **Qualification of Equipment**

All equipment shall be qualified for its intended use, including Food and Drug Administration (FDA)-cleared or approved devices.

3.3 **Use of Equipment**

Equipment shall be used in accordance with the manufacturer's written instructions.

3.4 **Unique Identification of Equipment**

Equipment shall have unique identification. Standard 5.1.6.2 applies.

3.5 **Equipment Monitoring and Maintenance**

The blood bank or transfusion service shall have a process for scheduled monitoring and maintenance of equipment that at a minimum is in accordance with manufacturer's written instructions. The process shall include frequency of checks, check methods, acceptance criteria, and actions to be taken for unsatisfactory results.

3.5.1 Calibration of Equipment

Calibrations and/or adjustments shall be performed using equipment and materials that have adequate accuracy and precision. At a minimum, calibrations and/or adjustments shall be performed:

- 1) *Before use.*
- 2) *After activities that may affect the calibration.*
- 3) *At prescribed intervals.*

3.5.1.1 *There shall be safeguards to prevent equipment from adjustments that would invalidate the calibrated setting. Standard 5.1.3 applies.*

3.5.2 Investigation and Follow-up

Investigation and follow-up of equipment malfunctions, failures, or adverse events shall include:

- 1) *Assessment of blood, components, tissue, derivatives, and services provided when equipment is found to be out of calibration.*
- 2) *Assessment of the effect on donor eligibility and donor and patient safety.*
- 3) *Steps to ensure that the equipment is removed from service.*
- 4) *Investigation of the malfunction, failure, or adverse event.*
- 5) *Steps for requalification of the equipment.*
- 6) *Reporting the nature of the malfunction, failure, or adverse event to the manufacturer, when indicated.*

Chapter 7, Deviations, Nonconformances, and Adverse Events, applies.

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Patient Monitoring

Immediate Transfusion Reactions

The first 10 to 15 minutes of any transfusion are the most critical.

→ NOTE:

It is recommended that all routine non-emergent transfusions be started slowly, and under the close observation of clinical personnel.

- If a major ABO incompatibility exists or a severe allergic reaction such as anaphylaxis occurs, results usually appear before the first 50 mL of the unit has been transfused.
- If a reaction occurs, stop the transfusion and notify the physician immediately.

- If no evidence of a reaction is noted within the first 15 minutes, flow can be increased to the prescribed rate according to the provider's order.

Patient Instructions

Before leaving the patient unattended, instruct him or her to report anything "unusual" immediately (see Chapter 2).

Vital Signs

It is advisable to take and record vital signs:

- Within 30 minutes before transfusion begins.
- Fifteen minutes after the start of the transfusion.
- Any time throughout the transfusion if warranted by clinical observation of the patient.
- At the end of the transfusion.
- One hour after the transfusion has been discontinued. Many facilities will ask for a platelet count to be drawn concurrently with the 1 hour vital sign check. This allows physicians to assess the efficacy of the transfusion.

Patient Observations

Clinical personnel specifically educated to recognize transfusion reactions (RN or MD) must observe the patient periodically (eg, at least every 30 minutes) throughout the transfusion to identify initial signs or symptoms of a possible transfusion reaction.

Record observations of the patient:

- Fifteen minutes after the start of the transfusion.
- Periodically throughout the transfusion (eg, at least every 30 minutes).
- At the end of the transfusion.
- One hour after the transfusion has been discontinued.

AABB Standard

5.26.6 *The patient shall be observed for potential adverse events during the transfusion and for an appropriate time thereafter. Standard 7.4 applies.*

5.26.7 *Specific written instructions concerning possible adverse events shall be provided to the patient or a responsible caregiver when direct medical observation or monitoring of the patient will not be available after transfusion.*

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7.4 Adverse Events Related to Transfusion

There shall be a process for the administration of blood and blood components that includes the recognition, evaluation, and

reporting of suspected transfusion-related adverse events. The medical director shall participate in the development of protocols used by the transfusing staff to identify, evaluate, and report adverse events related to transfusion. Standards 1.1.1 and 5.25 apply.

7.4.1 Recognition and Response to Immediate Transfusion Reactions

There shall be processes and procedures for the transfusing staff for the recognition of and response to immediate transfusion reactions and for the recording of relevant information in the patient's medical record.

7.4.1.1 The process shall include:

- 1) Definition of signs and symptoms of suspected transfusion reactions.
- 2) Indications for interruption or discontinuation of the transfusion.
- 3) Evaluation and the timely clinical management of the patient.

7.4.1.2 When the transfusion is discontinued the following shall be performed immediately:

- 1) The label on the blood containers and records shall be examined to detect errors in identifying the patient, blood, or component.
- 2) The blood bank or transfusion service and recipient's physician shall be notified. Signs and symptoms suggestive of mild allergic reactions (eg, urticaria) need not be reported to the blood bank or transfusion service.
- 3) The blood container (whether or not it contains any blood) shall be sent to the blood bank or transfusion service with, whenever possible, the attached transfusion set and intravenous solutions.
- 4) A posttransfusion sample shall be obtained from the patient and sent to the blood bank or transfusion service.

7.4.2 Laboratory Evaluation and Reporting of Immediate Transfusion Reactions


The blood bank or transfusion service shall have policies, processes, and procedures for the evaluation and reporting of suspected transfusion reactions, including prompt evaluation, review of clerical information by the blood bank or transfusion service, and notification of the blood bank or transfusion service medical director.

7.4.2.1 For suspected hemolytic transfusion reactions the evaluation shall include the following:


- 1) The patient's posttransfusion reaction serum or plasma shall be inspected for evidence of hemolysis. Pretransfusion samples shall be used for comparison.

- 2) *A repeat ABO group determination shall be performed on the posttransfusion sample.*
- 3) *A direct antiglobulin test shall be performed on the posttransfusion sample. If the result is positive, the most recent pretransfusion sample shall be used for comparison.*
- 4) *The blood bank or transfusion service shall have a process for indicating under what circumstances additional testing shall be performed and what that testing shall be.*
- 5) *Review and interpretation by the medical director.*

7.4.2.2 *The blood bank or transfusion service shall have a process for evaluation for suspected nonhemolytic transfusion reactions including, but not limited to, febrile reactions, possible bacterial contamination, and TRALI.*

 **7.4.2.3** *Interpretation of the evaluation by the medical director shall be recorded in the patient's medical record and, if suggestive of hemolysis, bacterial contamination, TRALI, or other serious adverse event related to transfusion, the interpretation shall be reported to the patient's physician immediately. Standard 7.4.2.4 applies.*

7.4.2.4 *When a transfusion fatality or other serious, unexpected adverse event occurs that is suspected to be related to an attribute of a donor or a unit, the collecting facility shall be notified immediately and subsequently in writing.*

 **7.4.3 Delayed Transfusion Reactions (Antigen-Antibody Reactions)**
If a delayed transfusion reaction is suspected or detected, tests shall be performed to determine the cause. The results of the evaluation shall be reported to the patient's physician and recorded in the patient's medical record. Standard 7.4.2.4 applies.

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Time Limits and Volume Ranges for Transfusion

Transfusion of Red Cell Components

- Transfusion should be completed in 4 hours or less.
- The blood bank should be notified when it is anticipated that

transfusion cannot be completed in 4 hours, as in patients with:

- Compromised cardiovascular systems.
 - Inadequate venous access.
- The medical director may decide whether or not to continue the transfusion, weighing the factors of donor exposure and possible bacteremia.

Unit Splitting

- Can be done for pediatric patients who will require smaller volume transfusions over a period of several days.
- Reduces the number of allogeneic donors to which a child is exposed.
- Is appropriate for other patients, such as the elderly, who may not be able to tolerate the fluid volume of an entire unit at one time.
- Individual portions of a donor unit can be released for transfusion while the remainder is safely stored.
- If a donor unit is opened to be split, the separate packs become outdated in 24 hours when kept at 1 to 6 C.
- If a donor unit is split within its closed system of attached bags, separate packs have the same expiration as the original unit.
- Tubing should be checked frequently to ensure early detection of a clogged filter. Tubing should not remain connected to the patient for prolonged periods.

AABB Standard

5.7 Preparation/Processing of Components

Methods that ensure the quality and safety of components, including aliquots and pooled components, shall be employed.

5.7.1 Seal

If the seal is broken during processing, components shall be considered to have been prepared in an open system and expiration times specified for such components in Reference Standard 5.1.8A, Requirements for Storage, Transportation, and Expiration, apply.

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Reference Standard 5.1.8A—Requirements for Storage, Transportation, and Expiration

Item No.	Component	Storage	Transport	Expiration ¹	Additional Criteria
Whole Blood Components					
1	Whole Blood	1-6 C. If intended for room temperature components, then store at 1-6 C within 8 hours after collection	Cooling toward 1-10 C. If intended for room temperature components, cooling toward 20-24 C	ACD/CPD/CP2D: 21 days CPDA-1: 35 days	
2	Whole Blood Irradiated	1-6 C	1-10 C	Original expiration or 28 days from date of irradiation, whichever is sooner	
Red Blood Cell Components					
3	Red Blood Cells (RBCs)	1-6 C	1-10 C	ACD/CPD/CP2D: 21 days CPDA-1: 35 days Additive solution: 42 days Open system: 24 hours	
4	Deglycerolized RBCs	1-6 C	1-10 C	Open system: 24 hours or as FDA approved Closed system: 14 days or as FDA approved	
5	Frozen RBCs 40% Glycerol	≤-65 C if 40% glycerol or as FDA approved	Maintain frozen state	10 years (A policy shall be developed if rare frozen units)	Frozen within 6 days of collection unless rejuvenated

				are to be retained beyond this time)	Frozen before Red Blood Cell expiration if rare unit
6	RBCs Irradiated	1-6 C	1-10 C	Original expiration or 28 days from date of irradiation, whichever is sooner	
7	RBCs Leukocytes Reduced	1-6 C	1-10 C	ACD/CPD/CP2D: 21 days CPDA-1: 35 days Additive solution: 42 days Open system: 24 hours	
8	Rejuvenated RBCs	1-6 C	1-10 C	CPD, CPDA-1: 24 hours	AS-1: freeze after rejuvenation
9	Deglycerolized Rejuvenated RBCs	1-6 C	1-10 C	24 hours or as approved by FDA	
10	Frozen Rejuvenated RBCs	≤-65 C	Maintain frozen state	CPD, CPDA-1: 10 years AS-1: 3 years (A policy shall be developed if rare frozen units are to be retained beyond this time)	
11	Washed RBCs	1-6 C	1-10 C	24 hours	
12	Apheresis RBCs	1-6 C	1-10 C	CPDA-1: 35 days Additive solution: 42 days Open system: 24	

				hours	
13	Apheresis RBCs Leukocytes Reduced	1-6 C	1-10 C	CPDA-1: 35 days Additive solution: 42 days Open system: 24 hours	
Platelet Components					
14	Platelets	20-24 C with continuous gentle agitation	20-24 C	24 hours to 5 days, depending on collection system	Maximum time without agitation: 24 hours
15	Platelets— Irradiated	20-24 C with continuous gentle agitation	20-24 C	No change from original expiration date	Maximum time without agitation: 24 hours
16	Platelets— Leukocytes Reduced	20-24 C with continuous gentle agitation	20-24 C	Open system: 4 hours Closed system: No change in expiration	Maximum time without agitation: 24 hours
17	Pooled Platelets Leukocytes Reduced	20-24 C with continuous gentle agitation	20-24 C	4 hours after pooling or 5 days following collection of the oldest unit in the pool ²	Maximum time without agitation: 24 hours
18	Pooled Platelets (or open system)	20-24 C with continuous gentle agitation	20-24 C	Open system: 4 hours	
19	Apheresis Platelets	20-24 C with continuous gentle agitation	20-24 C	24 hours or 5 days, depending on collection system	Maximum time without agitation: 24 hours
20	Apheresis Platelets Irradiated	20-24 C with continuous gentle agitation	20-24 C	No change from original expiration date	Maximum time without agitation: 24 hours
21	Apheresis Platelets Leukocytes	20-24 C with continuous gentle	20-24 C	Open system: within 4 hours of opening the	Maximum time without agitation:

	Reduced	agitation		system Closed system: 5 days	24 hours
Granulocyte Components					
22	Apheresis Granulocytes	20-24 C	20-24 C	24 hours	Transfuse as soon as possible; Standard 5.26.10 applies
23	Apheresis Granulocytes Irradiated	20-24 C	20-24 C	No change from original expiration date	Transfuse as soon as possible; Standard 5.26.10 applies
Plasma Components					
24	Cryoprecipitated AHF	≤-18 C	Maintain frozen state	12 months from original collection	Thaw the FFP at 1-6 C Place cryoprecipitate in the freezer within 1 hour after separation
25	Cryoprecipitated AHF (after thawing)	20-24 C	20-24 C	Single unit: 6 hours	Thaw at 30-37 C
26	Pooled Cryoprecipitated AHF (before freezing)	≤-18C	Maintain frozen state	12 months from earliest date of collection of product in pool	
27	Pooled Cryoprecipitated AHF (after thawing)	20-24 C	20-24 C	Pooled in an open system: 4 hours If pooled using a sterile connection device: 6 hours	Thaw at 30-37 C
28	Fresh Frozen Plasma (FFP)	≤-18 C or ≤-65 C	Maintain frozen state	≤-18 C: 12 months from collection ≤-65 C: 7 years	Placed in freezer within 8 hours of collection in CPD, CP2D, or CPDA-1, or within 6 hours of

				from collection	collection in ACD or as FDA-cleared Storage at ≤ -65 requires FDA approval if product is stored for longer than 12 months
29	FFP (after thawing)	1-6 C	1-10 C	If issued as FFP: 24 hours	Thaw at 30-37 C or using an FDA-cleared device
30	Plasma Frozen Within 24 Hours After Phlebotomy (PF24)	≤ -18 C	Maintain frozen state	12 months from collection	Placed in freezer within 24 hours of collection
31	Plasma Frozen Within 24 Hours After Phlebotomy (after thawing)	1-6 C	1-10 C	If issued as PF24: 24 hours	Thaw at 30-37 C or using an FDA-cleared device
32	Thawed Plasma	1-6 C	1-10 C	5 days from date original product was thawed	Shall have been collected and processed in a closed system
33	Plasma Cryoprecipitate Reduced	≤ -18 C	Maintain frozen state	12 months from collection	
34	Plasma Cryoprecipitate Reduced (after thawing)	1-6 C	1-10 C	24 hours	Thaw at 30-37 C
35	Thawed Plasma Cryoprecipitate Reduced	1-6 C	1-10 C	5 days from date of thaw	Shall have been collected and processed in a closed system

36	Liquid Plasma	1-6 C	1-10 C	5 days after expiration of Whole Blood	21 CFR 610.53(c) applies
37	Recovered Plasma, liquid or frozen	Refer to short supply agreement	Refer to short supply agreement	Refer to short supply agreement	Requires a short supply agreement ³
Tissue and Derivatives					
38	Tissue	Conform to source facility's written instructions	Conform to source facility's written instructions	Conform to source facility's written instructions	
39	Derivatives	Conform to manufacturer's written instructions	Conform to manufacturer's written instructions	Conform to manufacturer's written instructions	

¹If the seal is broken during processing, components stored at 1 to 6 C shall have an expiration time of 24 hours, and components stored at 20 to 24 C shall have an expiration time of 4 hours, unless otherwise indicated.

²Storage beyond 4 hours requires an FDA-cleared system.

5.7.2 Weld

If a sterile connection device is used to produce sterile welds between two pieces of compatible tubing, the following requirements shall apply:



5.7.2.1 *The weld shall be inspected for completeness.*

5.7.2.1.1 *If the integrity of the weld is complete, the component shall retain original expiration dates or have storage times approved by the FDA.*

5.7.2.1.2 *If the integrity of the weld is incomplete, the container shall be considered an open system and may be sealed and used with a component expiration as indicated in Reference Standard 5.1.8A, Requirements for Storage, Transportation, and Expiration.*

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Slow Infusion

If a blood component is infusing too slowly, the transfusionist should investigate probable causes.

- Intravenous access is the first area that should be checked.
 - The site should be assessed for signs of infiltration.
 - If the line is no longer patent, then a new venous access should be started as soon as possible.
 - When a component is infusing by gravity, raising the height of the blood container should increase the rate of flow.
 - Resuspending red cells and granulocytes by gently rocking the unit bag horizontally 2-3 times may help.
 - The filter in the administration set may become clogged with debris; in this case, change the filter and tubing.
-

Transfusion Reactions**Transfusion Reactions**

- Defined as any unfavorable events that occur in a patient during or following transfusion of blood or blood components and that can be related to that transfusion.

→ NOTE:

Any adverse change in a patient's condition should be considered a possible symptom of a transfusion reaction and evaluated (see Table 5-1).

- Because the possibility of a transfusion reaction is always present, the responsibility for recognition and initial intervention rests with the transfusionist.

Institutional policy will dictate the exact sequence of events that must take place when a transfusion reaction is suspected.

However, the essential elements for any procedural policy regarding transfusion reactions are universal:

1. The transfusion should be discontinued immediately.
 2. The intravenous access should be kept open for treatment, if necessary.
 3. The responsible physician must be notified to evaluate the patient.
 4. The blood bank must be notified to evaluate the component.
-

TABLE 5-1. Care of the Patient Receiving Blood Transfusions

Immediate Reactions		
Complication	Signs/Symptoms	Precautions/Nursing Responsibilities
Hemolytic reactions (most severe types are rare); caused by incompatible blood.	<ul style="list-style-type: none"> • Chills. • Shaking. • Fever. • Pain at needle site and along venous tract. • Nausea/vomiting. • Sensation of tightness in chest. • Red or black urine. • Headache. • Flank pain. • If progressive, signs of shock and/or renal failure. 	<ul style="list-style-type: none"> • Positively identify donor and recipient blood types and groups before transfusion is begun. • Verify the patient/blood component unit identification with one other nurse, physician, or other health-care professional, as required by state, local, or hospital regulations. • Save donor blood to re-crossmatch with patient's blood. • Transfuse blood slowly for the first 15 minutes, and remain with patient during this time. • In event of signs or symptoms: <ul style="list-style-type: none"> - Stop transfusion immediately. - Maintain patent intravenous line. - Notify provider and transfusion service. • Monitor blood pressure for signs of shock. • Insert urinary catheter and monitor hourly outputs. • Send sample of patient's blood and urine to laboratory to check for presence of hemoglobin (indicates intravascular hemolysis). • Observe for signs of hemorrhage, resulting from disseminated intravascular coagulation (DIC). • Support medical therapies to reverse shock.
Bacterial sepsis (most common with platelet products that are not stored cold).	<ul style="list-style-type: none"> • Rigors. • Chills. • Fever. • Shock. 	<ul style="list-style-type: none"> • Support blood pressure. <ul style="list-style-type: none"> - In the event of signs or symptoms: <ul style="list-style-type: none"> - Stop transfusion immediately. - Report to provider for evaluation. - Notify blood bank immediately. - Treat fever. • Send samples from both patient and blood component for culture and sensitivity testing. • Give antibiotics as indicated. These reactions may occur hours or even days posttransfusion.

Immediate Reactions		
Complication	Signs/Symptoms	Precautions/Nursing Responsibilities
<p>Febrile reactions: Causes:</p> <ul style="list-style-type: none"> • Leukocyte or platelet antibodies. • Plasma protein antibodies. • Cytokines from donor leukocytes. 	<ul style="list-style-type: none"> • Fever. • Chills. 	<ul style="list-style-type: none"> • May give acetaminophen or antihistamines for prophylaxis. • If leukocyte antibodies are suspected, acetaminophen or antihistamines may be given for prophylaxis. • Use of leukocyte-reduced RBCs is less likely to cause a reaction. • In the event of signs or symptoms: <ul style="list-style-type: none"> - Stop transfusion immediately. - Report to physician for evaluation. - Notify blood bank immediately.
<p>Transfusion-related acute lung injury (TRALI) (usually involving a plasma-containing product).</p>	<ul style="list-style-type: none"> • Dyspnea. • Pulmonary edema. • Normal pulmonary capillary wedge pressure. 	<ul style="list-style-type: none"> • Support blood pressure and respiration (may require intubation).
<p>Allergic reactions (recipient reaction to allergens in donor's plasma).</p>	<ul style="list-style-type: none"> • Urticaria. • Flushing. • Asthmatic wheezing. • Laryngeal edema. 	<ul style="list-style-type: none"> • Give antihistamines for prophylaxis to individuals with a tendency toward allergic reactions. • In the event of signs or symptoms if only mild itching, slightly decreasing the transfusion rate may alleviate symptoms. • In the event of signs or symptoms more severe than mild itching <ul style="list-style-type: none"> - Stop transfusion immediately. - Report to provider and blood bank. • Epinephrine may be used for wheezing or anaphylactic reactions. • <i>NOTE: With this type of reaction, it may be possible to restart transfusion if no other cause or symptoms are found.</i> <ul style="list-style-type: none"> - Transfusion is often restarted after administration of antihistamine and relief from itching. - Transfusion should not be restarted if there is a fever, any pulmonary or airway symptoms, or anaphylaxis.

Immediate Reactions		
Complication	Signs/Symptoms	Precautions/Nursing Responsibilities
<p>Circulatory overload [transfusion-associated circulatory overload (TACO)]: Causes:</p> <ul style="list-style-type: none"> • Patient is transfused too rapidly (even if small quantity). • Excessive quantity of blood is transfused (even if slowly). 	<ul style="list-style-type: none"> • Precordial pain. • Dyspnea. • Rales. • Cyanosis. • Dry cough. • Distended neck veins. 	<ul style="list-style-type: none"> • Transfuse blood component slowly. • Prevent overload by using volume-reduced platelets. • Use infusion pump to regulate and maintain flow rate. • Place patient in semi-Fowler or upright or sitting position, to increase venous resistance. • In the event of signs or symptoms: <ul style="list-style-type: none"> - Stop transfusion immediately. - Notify provider and blood bank.
<p>Air emboli (may occur when blood is transfused under pressure).</p>	<ul style="list-style-type: none"> • Sudden difficulty in breathing. • Sharp pain in chest. • Apprehension. 	<ul style="list-style-type: none"> • Can occur when infusing blood under pressure, before container is empty. • If air is observed in tubing: <ul style="list-style-type: none"> - Clamp tubing immediately below air bubble. - Clear tubing of air by aspirating air with syringe or by disconnecting tubing and allowing blood to flow until air has escaped. • In the event of signs or symptoms: <ul style="list-style-type: none"> - Stop transfusion immediately. - Notify provider and blood bank.
<p>Hypothermia.</p>	<ul style="list-style-type: none"> • Chills • Low temperature • Irregular heart rate • Possible cardiac arrest 	<ul style="list-style-type: none"> • Allow blood to warm at room temperature (less than 1 hour). • Use a blood warmer to rapidly warm blood. • Take temperature if patient complains of chills. • If temperature is subnormal, stop transfusion and notify provider and blood bank.
<p>Hyperkalemia (an electrolyte disturbance occurring only in massive transfusions or in patients with renal problems).</p>	<ul style="list-style-type: none"> • Nausea, diarrhea. • Muscular weakness. • Flaccid paralysis. • Paresthesia of extremities. • Bradycardia. • Apprehension. • Cardiac arrest. 	<ul style="list-style-type: none"> • Use washed RBCs or fresh blood if patient is at risk. • In the event of signs or symptoms: <ul style="list-style-type: none"> - Stop the transfusion immediately. - Notify provider and blood bank.

Immediate Reactions		
Complication	Signs/Symptoms	Precautions/Nursing Responsibilities
<p>“Citrate” intoxication (hypocalcemia).</p> <p><i>Note: This is very rare.</i></p>	<ul style="list-style-type: none"> • Tingling in fingers. • Circumoral tingling or “buzzing.” • Tetany. • Muscular cramps. • Carpopedal spasm. • Hyperactive reflexes. • Convulsions. • Laryngeal spasm. • Respiratory arrest. 	<ul style="list-style-type: none"> • Infuse blood slowly (citrate reaction less likely to occur). • If signs of tetany occur: <ul style="list-style-type: none"> - Clamp tubing immediately. - Maintain patent intravenous line. - Notify provider and blood bank. - Oral calcium (eg, Tums may be ordered to alleviate early signs/symptoms. - IV calcium may be ordered to treat advanced symptoms.
Delayed Reactions		
Complication	Signs/Symptoms	Precautions/Nursing Responsibilities
Delayed hemolytic reactions.	Destruction of red cells and fever, 5 to 10 days after transfusion.	<ul style="list-style-type: none"> • Observe for posttransfusion anemia and decreasing benefit from successive transfusions. • In the event of signs or symptoms, notify physician and blood bank.
Alloimmunization (antibody formation).	Increased risk of hemolytic, febrile, and allergic reactions.	<ul style="list-style-type: none"> • Patients receiving multiple transfusions are at risk. • Use donors with red cell phenotypes similar to that of the patient, if possible. • Use a limited number of donors. • Observe patient carefully for signs of reactions, and notify provider and blood bank if they occur.

**Transfusion
Reactions:
Nursing
Management**

Basic Transfusion Reaction Protocols

- 1. Stop the transfusion immediately.**
 - Disconnect the administration set with attached blood and fluids from the needle or catheter. (Cover hub with sterile cap.)
 - Do not allow the remaining blood in the filter and tubing to be infused.
 - Do not discard administration set.
 - Establish a keep-open IV line of 0.9% NaCl (normal saline) with a new administration set.
- 2. Notify the physician and do not leave the patient.**
- 3. Perform a clerical check at the bedside to verify that the patient is receiving the correct unit of blood.**
 - Check identifying information on the container label, attached tag, and patient wristband.
 - If the patient is receiving the wrong unit, notify the blood bank immediately so that further mismatching may be prevented.
- 4. Treat the symptoms as ordered by the provider.**
- 5. Notify the blood bank immediately.** Provide a description of the clinical findings responsible for initiating the transfusion reaction report.
- 6. Return the blood bag, attached fluids, and administration tubing set to the laboratory, with all related forms and labels.**
- 7. Monitor vital signs.** Record baseline, transfusion, and posttransfusion vital signs, as well as other assessment data.
- 8. Monitor urinary output.**
- 9. Collect venous blood samples from a different vein.**
- 10. Complete a “Transfusion Reaction” form.**
- 11. Document these actions in the patient chart.**

AABB Standard**7.3 Adverse Events Related to Donation**

Adverse events related to the blood donation process shall be assessed, investigated, and monitored.

Also, see page 18 for AABB Standard 7.4

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**Transfusion Reactions:
Terminating the Transfusion**

The transfusion can be terminated when the prescribed volume of the blood component has been infused.

- The patient's maintenance solution, if ordered, should be restarted with new intravenous administration tubing set.
 - If the intravenous line was established solely for purposes of the transfusion, it can be discontinued.
 - The patient must be thoroughly assessed.
 - Temperature, pulse, respiration, and blood pressure should be monitored and recorded.
 - Vital signs should be documented in the patient's medical record.
 - Some reactions may occur after the completion of the transfusion. The patient should be reminded to report any signs or symptoms.
-

Documentation**Record the following in the patient's clinical record:**

- Date and time the transfusion was started.
- Type of blood component transfused.
- Unit identification number.
- Recipient's condition at the start of the transfusion.
- Clinical observations and vital signs.
- Completion of transfusion:
 - Time.
 - Volume infused.
 - Patient's condition.
 - Identity of the person who stopped the transfusion and observed the patient.

→ NOTE:

Return a copy of the completed transfusion form to the laboratory, if required.

Record outcome goals reached.

- Implement posttransfusion monitoring as indicated for the particular component transfused.
Examples:
 - Hematocrit.
 - Platelet count.
 - Coagulation factor level.
 - Follow up to report any evidence of posttransfusion reaction or symptoms of disease transmissible by blood.
-

**Discharge
Instructions****Instructions to Patient/Family**

Patients and their family members should be instructed:

- About signs and symptoms of a transfusion reaction.
 - To be alert to the possibility of delayed transfusion reactions.
-

**Transfusion
Reactions:
Management****Investigation of Immediate Reactions**

- Nursing Responsibilities:
 - Clerical check.
 - Notification of physician and blood bank.
 - Management of patient.
- Laboratory Responsibilities
 - Clerical check.
 - Testing of samples for hemolysis.
 - Repeat testing for ABO/Rh, antibody screen, direct antiglobulin test, crossmatch, etc.
 - Any additional testing needed (eg, antibody detection and identification, eluates, etc).
 - Clinical evaluation of suspected cases.
 - Determining the presence of any other causes of the transfusion reaction.

Detection and Investigation of Delayed Reactions

- Hemolytic reactions.
- Infectious complications.

→ NOTE:

1. Hospital staff should be made aware of infections that can be transmitted by blood components.

2. Suspected transfusion-associated diseases *must* be reported to the blood bank.

Records and Reporting of Reactions

- Records *must* be kept on all reports of transfusion complications.
- Transfusion-associated diseases *must* be reported to the facility that collected the donor unit by the transfusion service.
- Fatalities *must* be reported to the FDA. The FDA requires that initial reports of fatalities *be made within 24 hours, or the next FDA working day*, by the facility that performed the compatibility testing.

Prevention of Reactions

- Transfusion reactions may be prevented when procedures are followed by:
 - Phlebotomists.
 - Medical technologists.
 - Transfusionists.
- Methods should be developed to ensure patients who have reactions receive intervention on subsequent transfusions.
- Premedication may be ordered for patients experiencing recurrent febrile or allergic reactions, but this is not always effective in preventing reactions.

Outpatient Transfusions

Changes in the health-care system are prompting increasing use of outpatient services.

- Many acute care institutions and home health agencies have added outpatient transfusion therapy to the services they provide.

→ NOTE:

The procedures and requirements for safe, effective transfusion therapy do not change if the patient is an outpatient.

- The major difference is that the patient will not have prolonged contact with a health-care professional after the transfusion is completed.
- Provision of written information is recommended, including:
 - Signs and symptoms of transfusion reactions.

- The name of a contact person and a phone number at the health-care facility.
-

Biohazard Control Practices

Blood Container and Administration Set

Dispose of these according to the institution's policy.

Blood Components

Handle all components as if they have the potential for disease transmission.

Used Equipment

Used equipment must be carefully handled and packaged to protect other members of the health-care team.

Basic Precautions

The following basic precautions must be observed in whatever system is chosen to meet the needs of the institution:

1. Identify hazardous waste consistently.
 - Red or orange seamless plastic bags are recommended.
 - Always use the biohazard symbol.
2. Double-bag or place hazardous waste in protective containers to preserve its integrity when storing or transporting.
3. Discard sharps only in rigid, puncture-proof, leakproof containers.
4. Put liquid only in leakproof, unbreakable containers.
5. Do not compact.
6. Use appropriate materials.

Out-of-Hospital Biohazardous Waste

Biohazardous equipment in the home must be disposed of properly as required by federal, state, and local law. Refer to each agency's policies and procedures.
