New York State Council on Human Blood and Transfusion Services

GUIDELINES FOR TRANSFUSION

OPTIONS AND ALTERNATIVES

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New York State Council on Human Blood and Transfusion Services
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For additional information, this and the Council's other blood services guidelines are available at the website above.

NEW YORK STATE
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TABLE OF CONTENTS

NEW YORK STATE
COUNCIL ON HUMAN BLOOD AND TRANSFUSION SERVICES

GUIDELINES FOR TRANSFUSION OPTIONS AND ALTERNATIVES

I. INTRODUCTION AND OVERVIEW

A mission of the New York State Council on Human Blood and Transfusion Services is to set standards and to develop recommendations for the use of transfusion-related products and services in New York State. This document is intended to assist in discussions with patients regarding decisions about the need for transfusion and the options available to meet such needs. Intrinsic to these discussions is an understanding of the current indications for the transfusion of different blood components; the current safety of the community blood supply; and the various options available in addition to allogeneic transfusion, including strategies to reduce or even avoid the use of blood products.

Blood Management

A structured blood management program may encourage the use of evidence-based transfusion practices and result in reduction of patient exposure to allogeneic blood, while easing availability concerns and reducing costs.

- *Individual departments* with high blood usage may assemble committees to evaluate transfusion practices and determine whether specific strategies may be appropriate in their patient population and how such strategies may be employed effectively.

- A *multidisciplinary team* might include such members as representatives from nursing, pharmacy, the laboratory, point-of-care testing, and hospital administration.

- A hospital-wide *blood management committee*, with members of the individual teams as well as members at large, may promote education in blood conservation and facilitate communications among teams. This may be a function of the transfusion or blood utilization committee or be part of the hospital's overall quality efforts.

- A *transfusion order form* that facilitates pretransfusion as well as posttransfusion peer review may contribute significantly to the effectiveness of such an approach. Physician order entry can facilitate comparison with standardized algorithms that flag orders for additional review.

- *Monitoring practices* over time may assess consistency in practices, their effectiveness, and associated costs (or cost savings).

This guideline is intended to provide information and recommendations that may assist hospitals in managing their use of blood.

II. ALLOGENEIC BLOOD AND COMPONENTS (COMMUNITY)

Donor Qualification

New York State regulations mandate multiple donor screening steps and procedures to minimize the risk of infectious disease transmission. All allogeneic blood donors must complete a questionnaire to ensure that, on the day of donation, they are in good health and have no known medical condition that would pose a risk to blood recipients or to themselves during the donation. In particular, donors are closely questioned about possible risk factors for HIV infection, hepatitis and other infectious diseases believed to be transmissible by blood transfusion. Finally, donors are told how to confidentially inform the blood collection organization of information that may render their donated blood unsuitable, if they fail to declare a risk factor at the time of donation or develop an illness following donation.

Testing for Infectious Disease Markers

Allogeneic blood donors are tested for a variety of infectious disease markers, including hepatitis B surface antigen (HBsAg); HIV-1, hepatitis C virus (HCV), and West Nile virus (WNV) nucleic acid; antibodies to hepatitis B core antigen (anti-HBc), HCV, HIV-1, HIV-2, and human T-cell lymphotropic virus types I and II (HTLV-I/II); and serologic tests for syphilis and Chagas disease. When new tests become available for donor testing, they are implemented as indicated.

Blood Transfusion Risks

Despite all the above precautions and testing, blood components continue to pose a small risk of transmission of pathogens, including viruses, bacteria, and parasites. These risks have been estimated by means of various statistical tools. Table 1 lists known infectious disease risks and provides some estimates of current risks. Currently unrecognized pathogens may also emerge in time. Some studies have suggested that allogeneic blood may have an immunomodulatory effect that may predispose transfused patients to infection and other complications.

Compatibility Testing

Prior to transfusion, the hospital transfusion service ascertains that the component is of the appropriate blood group for compatibility with the patient, and performs any compatibility testing indicated. Testing determines whether the patient possesses any red cell antibodies that might react with the blood component being administered and decrease the effectiveness of the transfusion or cause a transfusion reaction. If such clinically significant antibodies are identified, antigen-negative units are selected.

III. CURRENT RECOMMENDATIONS FOR THE TRANSFUSION OF BLOOD COMPONENTS

Table 2 summarizes the most frequently used blood components and provides information on their indications and precautions. Tables 3, 4, and 5 list indications for administration of red blood cells (RBCs), plasma [fresh frozen plasma (FFP) and 24-hour plasma] and platelets, respectively, and also note some situations when blood components are not or are rarely indicated. Generally accepted indications for transfusion of red cells in various clinical settings have been the subject of several publications. For additional information, see the

Council's various guidelines, available at:
www.wadsworth.org/labcert/blood_tissue/blood_services_guideline.htm.

Transfusion of Red Blood Cells in the Nonsurgical Setting

In the nonsurgical setting, the decision to transfuse red blood cells is based upon the severity of anemia, duration of anemia, availability of alternate therapies, the patient's symptoms, and the presence of co-morbidities or other factors that may increase the risk of significant hypoxia at a given hemoglobin concentration (see Table 3).

The following strategies may be helpful in minimizing exposure to allogeneic blood:

- Patients should be transfused only when medically indicated after careful consideration of their condition and current guidelines.
- Orders by house staff should be supervised closely.
- In asymptomatic, non-acute patients, a red cell transfusion trigger of 7.0 g/dL should be considered.
- The minimum dose needed should be used.
- For red blood cell transfusions in stable patients, one unit should be given and the patient's response evaluated. Additional units should be given only if the patient's condition warrants it.

Transfusion of Red Cells in the Setting of Surgery or Other Acute Blood Loss

In the setting of surgery, trauma, or other instances of acute blood loss, the indications for administration of red blood cells are influenced by:

- The severity of anemia
- Clinical signs and symptoms
- The presence of co-morbidities
- The rate of hemorrhage

Estimated blood volume loss, hemoglobin concentration measurements, and consideration of the patient's clinical status are standard methods for assessing transfusion needs in acutely bleeding patients. It should be noted that these approaches carry limitations because anesthetic agents may mask some signs and symptoms of anemia, making assessment of the amount of blood lost difficult. Hemoglobin measurements are usually artifactually low in patients who have received large volumes of fluids that temporarily expand plasma volume.

Selected patients can be satisfactorily managed by using a variety of blood-sparing strategies instead of transfusion. Some of this information is derived from experience with patients who have religious objections to transfusion. In the event that transfusion of blood

components is likely necessary, the following information is intended to assist clinicians and patients in deciding among the various options available.

IV. ALTERNATIVES TO THE USE OF COMMUNITY BLOOD

Directed Blood Donations

Some patients may wish to meet their transfusion needs with blood donated by relatives or friends. It is important for such patients to recognize that there is no evidence that such donations are any safer than those from volunteer community donors. In fact, some concern has been voiced that they may be statistically less safe. These concerns are summarized as follows:

- Directed donors may feel such pressure to help the patient that they may give inaccurate information about their state of health.

- Most directed donors are first-time donors in whom the risk of disease is higher than traditional repeat donors. Therefore, directed blood donations appear to be no safer than community allogeneic donations in terms of infectious disease and immunomodulatory risks.

- Transfusion of blood from close relatives also may increase the risk of transfusion-associated graft-versus-host disease, which is a rare, but serious and often fatal, complication. To avoid this risk, directed donor cellular blood components must undergo irradiation prior to transfusion.

- In some patients, the use of blood from close relatives may be absolutely contraindicated, including patients who may undergo possible future hematopoietic progenitor cell transplantation.

- Finally, in the case of a woman with child-bearing potential, donations from her husband/partner may be contraindicated because the woman could become immunized to an antigen the father might share with a future fetus. In addition, because antibodies against paternal red cell or HLA antigens may be formed by women during pregnancy, transfusion from a woman to her biologic child or to the father of a biologic child should be avoided.

Directed donation of blood and components is permitted in New York State. While opportunities for directed donation of whole blood are plentiful, donation of platelets or plasma may be difficult to arrange, and must be coordinated with the expected date of transfusion and blood collection center procedures. As an alternative, patients should be encouraged to recruit family or friends as donors to replenish the community blood supply.

Autogeneic Donation and Transfusion

In an attempt to minimize exposure to allogeneic blood, the option of presurgical autogeneic deposit and/or perioperative autogeneic transfusion may be considered. Selection of one or more of these options for an individual patient should consider the health of the patient, the feasibility of collection, and the ability to predict the patient's transfusion needs. Under

limited circumstances, autogeneic platelet, plasma, and cryoprecipitate donations may be arranged with selected blood centers on a case-by-case basis.

Pre-Surgical Autogeneic Blood Deposit

Following discussion with the patient, the physician may request this service by completing and submitting a physician order form that is usually required by blood centers prior to scheduling the first donation appointment. To ensure proper labeling of the autogeneic unit, the order form must include: patient's full legal name (as to be used during the hospitalization); date of birth; date of anticipated transfusion; name and address of the hospital where the surgery will be performed; and the ordering physician's name, address, and telephone number.

Autogeneic Donor Eligibility

Autogeneic patient-donors need not meet the standard eligibility guidelines set for community donors; however, certain criteria must be met.

- At the donation site, the patient-donor must complete a *medical history questionnaire*, and undergo measurement of temperature, blood pressure, pulse, and hemoglobin concentration. Should any of these values fall outside of autogeneic donation criteria, the patient is deemed ineligible for collection at that visit.

- A *hemoglobin concentration* of at least 11 g/dL prior to each donation is required, unless otherwise approved by the medical director of the blood collection facility. To prevent patients from becoming anemic as a result of the procedure, oral iron supplements are generally recommended for patients depositing more than one unit.

- In addition, the patient-donor's physician should communicate any significant patient *medical history* that may affect the safety of the donation process or suitability of the unit for the patient, and must certify that, in the physician's judgment, the patient may safely undergo phlebotomy.

- Particular attention should be accorded to a history of atherosclerotic heart disease (*e.g.*, angina, myocardial infarction, bypass surgery); cardiac valvular disease (*e.g.,* aortic stenosis); cerebrovascular disease (*e.g.,* stroke); seizure disorder, especially if not well-controlled by medication; and any medical condition in which rapid loss of 500 mL of blood, or a prolonged vasovagal reaction, might pose a risk.

- Autogeneic blood deposit is *contraindicated* in patients with active infection/ bacteremia or a condition that predisposes to bacteremia (*e.g.,* having a urinary catheter or any skin-penetrating device).

- Special arrangements with the blood bank may be required for patient-donors under *16 years of age*. A parent or legal guardian must accompany the patient-donor. For autogeneic patient-donors weighing less than 110 pounds (50 kg), it may be possible to collect a volume smaller than a full unit at a given sitting.

Infectious Disease Testing for Autogeneic Donors

- For autogeneic blood collection by blood centers, patient-donors must undergo the same testing as community donors.

- Testing may be performed a maximum of 30 days prior to the date of collection, or may be performed on a specimen collected subsequently.

- The ordering physician and the patient are informed if an autogeneic patient-donor tests positive on any of the standard tests. Authorization for release of such units to the hospital may be needed from the patient's attending physician and from the hospital's transfusion service director.

- Once a patient-donor is found to be positive for any of the *infectious disease tests*, some collection agencies may consider the patient to be ineligible for further autogeneic donation.

- Testing is not required by regulation if collection is performed by a hospital for use in that hospital, but transfusion service policies of individual hospitals may require such testing.

- Patients with *infectious diseases*, such as HIV infection or AIDS, may be ineligible for autogeneic deposit at some blood collection facilities, and some hospitals may not accept such units if collected.

Frequency of Donation/Time Interval to Surgery

The entire process requires about an hour; the donation itself, about ten minutes.

Autogeneic patient-donors may generally give blood as frequently as twice per week during the six-week period preceding the anticipated transfusion date. The last deposit may be made no later than three working days before the anticipated surgery. (Note: If blood needs to be shipped outside New York State, the last donation generally needs to be made no later than ten working days before its anticipated use.)

Storage of Collected Blood

Depending on the preservative solution used, red blood cells can be stored in liquid form from 21 to 42 days. The most commonly used solution allows liquid red cells to be stored for 42 days. If surgery is postponed, frozen storage may be available under certain conditions.

The cost effectiveness of pre-surgical autogeneic blood deposit has been increasingly called into question, given the additional costs involved in preoperative deposit of autogeneic red cell units (in New York, as many as 40 percent of these are eventually discarded rather than used), the risk of rendering the patient anemic and more likely to be transfused as a result of the procedure, combined with the improved safety of allogeneic blood transfusions and the availability of other more convenient and less costly options.

Risks of Autogeneic Transfusion

Predonated autogeneic blood holds the same risk of error as allogeneic blood, carries a risk of bacterial contamination that may exceed that of allogeneic blood, and is subject to the same detrimental effects of refrigerated storage outside of the body, which can reduce the effectiveness of the transfusion. For these reasons, this approach is most effective when there is a high expectation that the blood will be transfused; or in exceptional circumstances, such as patients with multiple red blood cell antibodies or rare blood groups, and patients who do not consent to allogeneic transfusion but accept presurgically deposited autogeneic blood. This procedure is not usually accepted by people with religious objections to transfusion.

V. REDUCING THE NEED FOR TRANSFUSION

Decreasing Iatrogenic Blood Loss

A simple, yet effective, measure to reduce iatrogenic blood loss is to minimize phlebotomy for diagnostic procedures. Both the phlebotomy frequency and volume of blood drawn should be minimized, for example, by using pediatric-sized collection tubes for adults.

Use of Pharmacological Agents to Boost Erythropoiesis

Increasing red blood cell mass preoperatively using iron, folate, and/or vitamin B_{12}, as indicated, has been shown to be an effective strategy in reducing transfusion requirements. These are readily available, of low cost, and safe. *Erythropoietin* has been proposed for patients with significant anticipated surgical blood loss. However, the FDA has issued warnings indicating that erythropoietin can increase the risk of serious cardiovascular and thromboembolic events when administered to a target hemoglobin of greater than 12 g/dL, particularly in patients with renal failure. The FDA has also issued a warning based on several reports that indicate tumor progression and reduced survival in cancer patients taking erythropoietin. Therefore, if erythropoietin is used, indication and dosage instructions should be followed and patients should be carefully monitored.

Preoperative Assessment and Planning

Advance planning is essential to minimizing transfusion requirements in the perioperative period.

- Accurate history taking and physical examination, with special attention to existing anemia and bleeding disorders, are critical.

- A policy for avoiding and controlling blood loss, tailored to the individual patient, with consideration of anticipated and potential procedures, should be formulated.

- Careful evaluation of pre-existing anemia and its treatment prior to surgery are an effective strategy for reducing surgical transfusion requirements.

- The use of anticoagulants and antiplatelet drugs should be carefully re-assessed before and after surgery to minimize their effect on bleeding, while maintaining their

needed function. Whenever possible, agents that could adversely affect coagulation in the perioperative period (*e.g.,* aspirin and medications containing aspirin, antiplatelet agents, and anticoagulants) should be discontinued or replaced for the seven days prior to the surgery, in consultation with prescribing physicians.

Perioperative Autogeneic Transfusion

For many patients, collection of blood in the perioperative period using intraoperative or postoperative blood recovery techniques, or via isovolemic hemodilution, for reinfusion during or immediately after surgery, is an effective transfusion alternative. The feasibility of any of these options may depend on the surgery being performed, hospital policies and procedures, and the availability of necessary staff and equipment.

Indications and Contraindications

- The most likely candidates for intraoperative recovery are patients in whom substantial blood loss is anticipated, such as those undergoing certain cardiac, vascular, orthopedic, neurosurgical, or gynecological procedures.

- Intraoperative blood recovery may be contraindicated if the operative field contains hypotonic fluids, or is grossly contaminated with bacteria, as with spilled intestinal contents, or by malignant cells.

- In cases of malignancy, the use of leukoreduction filters has been proposed to minimize the likelihood of hematogenous dissemination of malignant cells. The theoretical risk of metastatic cell seeding must be weighed against the potential benefit of blood recovery in a particular patient.

Intraoperative Blood Recovery

Blood recovered intraoperatively may be reinfused directly after collection (unwashed) using a disposable system, or may be processed (washed and concentrated) prior to infusion using a semi-automated cell washer, within six hours of the start of collection.

Blood recovered, processed, and stored at room temperature may be reinfused within four hours of the completion of processing. Blood recovered, processed, and refrigerated may be reinfused within 24 hours of the start of collection, provided that refrigerated storage was initiated within four hours of the completion of processing.

A 40-micron filter should be used for reinfusion. In addition, in the case of Cesarean section, consideration should be given to the use of a filter intended to remove fetal squamous cells and other particulates. Because recovered blood is likely to contain fetal red blood cells, consideration should be given to blood group incompatibilities and administration of Rh immune globulin, if indicated.

The oxygen-carrying capacity of recovered red blood cells equals or exceeds that of stored allogeneic red cells; the cell survival is comparable. While reinfusion of unwashed recovered blood is less complex and less costly, such blood has a low hematocrit and may contain procoagulants and contaminants. For this reason, hospital policy may limit the quantity of collected blood that may be reinfused without washing.

Methods that include processing are more complex, requiring specialized equipment and specially trained staff.

Postoperative Blood Recovery

Postoperative blood recovery is performed during the immediate postoperative period. While blood can be collected from surgical drains through a variety of devices, filtered through a 40-micron filter, and then returned to the patient, the safety of reinfusing unwashed orthopedic wound drainage and mediastinal drainage has been questioned. In particular, concerns regarding infusion of fat, fibrin degradation products, activated coagulation factors and complement have been raised. Furthermore, the amount of red cells recovered from orthopedic drainage is so limited that many experts consider the risks to outweigh the benefits. The use of a device designed to concentrate and wash recovered blood is preferred. If blood is recovered postoperatively, the reinfusion of such recovered blood must be completed within six hours from the start of collection.

Isovolemic Hemodilution

Isovolemic hemodilution consists of withdrawal of blood from the patient at the beginning of a surgical procedure and its reinfusion at the end. It is most effective in cases in which the anticipated surgical blood loss equals or exceeds 1,500 mL (generally 30 percent of the patient's estimated blood volume). A minimum of two to three units of blood must be collected for the procedure to be effective and the patient's blood volume is maintained isovolemically with crystalloid or, preferably, colloid solutions. Hemodilution reduces red cell loss by lowering the hematocrit of the blood lost during surgery. In addition, the autogeneic units contain viable platelets and coagulation factors. Careful management of the fluid balance and monitoring of the patient's cardiac status are essential during this procedure. Low preoperative hemoglobin, infection, coagulopathy, and significant cardiac, pulmonary, renal or hepatic disease rank among the concerns and relative contraindications. Blood collected for isovolemic hemodilution and stored at room temperature must be reinfused within eight hours of the start of collection, while blood stored refrigerated may be reinfused within 24 hours of the start of collection, provided that refrigerated storage was initiated within eight hours of the start of collection.

Minimizing Surgical Blood Loss

Meticulous hemostasis can significantly reduce surgical blood loss. Electrocautery, argon-beam coagulation, effective use of sutures and clips, tourniquets, elevation of surgical site/wound, local vasoconstriction with epinephrine or other agents, maintaining normovolemia, and avoiding hypothermia are other effective techniques. Careful monitoring of the patient's temperature and blood pH may help maintain hemostatic function.

Topical application of *tissue adhesives* and other hemostatic agents may enhance local hemostasis.

In selected situations, bleeding may be reduced significantly by deliberate *induction of mild hypotension*, and, in spinal surgery, appropriate positioning of the patient to avoid inferior vena cava compression with resultant engorgement of the epidural plexus.

The patient should be monitored vigilantly to detect bleeding following surgery. If significant post-operative bleeding persists, re-exploration to identify the source of bleeding should be considered.

Hemostasis may be systemically enhanced with pharmacologic agents. *Antifibrinolytics*, such as aprotinin and lysine analogues (ε-aminocaproic acid and tranexamic acid), act by inhibiting fibrinolysis and maintaining clot formation at the sites of bleeding. These agents are therefore effective only if fibrinolysis is contributing to the bleeding. While aprotinin has been found to be more effective in reducing transfusion requirements in cardiac surgery, mounting concerns about the safety of aprotinin (possible risk of renal failure and myocardial infarction) have resulted in the suspension of its marketing until further safety information is available.

Recombinant activated factor VII (rFVIIa) is currently indicated in the management of bleeding episodes in hemophilia patients who have inhibitors. Although an increasing number of reports suggest its effectiveness as a hemostatic agent in other settings, there is a lack of high quality evidence to support such indications. Until results of ongoing and new trials become available, prophylactic or therapeutic use of rFVIIa in bleeding patients, in general, is not recommended.

VI. PATIENTS WITH RELIGIOUS OBJECTIONS TO TRANSFUSION

Some patients do not wish to receive blood transfusions for religious reasons. Among these are Jehovah's Witnesses, who adhere to a religious prohibition on transfusion of blood. However, stances on transfusion may vary from person to person or from procedure to procedure. Most blood components are generally refused by Jehovah's Witnesses, although acceptance of plasma derivatives and of components prepared from other components, such as cryoprecipitate, is considered to be a matter for personal decision. Generally, autogeneic blood deposited prior to surgery, which has been stored, is not allowed, but perioperative blood recovery and acute isovolemic hemodilution are generally accepted. Alternative approaches, including blood-saving surgical and anesthetic techniques and devices, hemostatic agents, and non-blood volume expanders (such as dextran, saline and pentastarch) are appropriate.

It is important to ascertain each patient's wishes on an individual basis. Some persons, including Jehovah's Witnesses, carry an *Advance Medical Directive/Release card*, which specifies their wishes concerning blood transfusion. Many persons may also have executed a *health care proxy form*, which may indicate transfusion preferences, treatment choices, and any end-of-life decisions. Generally, the courts have ruled that patients who are competent adults have the right to make their own health care decisions, but pregnant women and certain older minors present special issues. In the case of minors, hospitals have successfully obtained court orders to appoint a guardian to make health care decisions that may allow transfusion against the parents' wishes.

Practitioners are strongly advised to consult with their legal counsel to establish an institutional policy on these matters. The policies should be made known, well in advance of emergency situations, to both the medical staff and the affected patients. A coordinating team, consisting of a physician, nurse, and administrator, may be helpful in formulating treatment plans for such patients.

The following suggestions may be helpful when treating patients who have religious objections to transfusion:

- If any healthcare professionals object to caring for patients who, while likely to need it, refuse a transfusion, it is advisable for the facility to seek alternative caregivers to ensure optimal care.

- Whenever objections to transfusion are voiced upon admission or subsequently, a process should be in place to disseminate this information to pertinent caregivers without undue delay.

- If the likelihood of needing transfusion therapy is high and the institution is not experienced in treating such patients, offering the option of voluntary transfer to a facility with more experience treating such patients may be considered.

- If there is a likelihood that blood may be needed, the patient's wishes should be determined and documented, including which products, if any, may be acceptable. Appropriate alternatives should be discussed with the patient, along with the risks of not being transfused.

- If a patient is or may be rendered unconscious, there should be a documented determination of the person(s) legally empowered to make health care decisions. Documentation of such patient choices should be available at the patient care site for immediate reference.

- In cases involving a Jehovah's Witness, a member of the local *Hospital Liaison Committee* of the Watchtower Society may be helpful as an intermediary and advisor. The coordinating office for such committees, known as Hospital Information Services, is located at the international headquarters of Jehovah's Witnesses in Brooklyn, New York. Hospital Information Services has established a 24-hour hotline to provide physicians with the contact information for local committee members, arrange for peer-to-peer consultations with physicians experienced in blood conservation, provide information from the medical literature and, in rare situations, facilitate transfer to another facility.

- If the patient is not a competent adult, the hospital may consider pursuing legal action to authorize transfusions. An ethics consultation may be desirable.

- Publicly visible labels indicating the patient's religion should not be used. However, special identification tags on the wristband and/or chart indicating "No Blood Transfusions" are appropriate.

Source of Additional Information:

Watchtower Bible and Tract Society of New York, Inc.
25 Columbia Heights
Brooklyn, New York 11201
(718) 560-4300 (24-hour service)
www.watchtower.org

VII. RECOMMENDATIONS FOR TRANSFUSION SERVICE DIRECTORS TO ENCOURAGE BLOOD CONSERVATION

The Transfusion Service Director has overall responsibility for blood usage. He/she should:

- Educate physicians about appropriate blood usage and options for the use of hematinics, systemic hemostatic agents, and topical hemostatic agents.
- When possible, employ active review of blood orders prior to issuance of blood. Consult with ordering physicians regarding appropriateness of blood orders as necessary.

- Encourage active Transfusion Committee review of blood usage and communicate with ordering physicians expeditiously when indicated.

- Encourage attending physician oversight of orders for blood by housestaff.

- At times of shortage, work with Surgery and Anesthesiology to assure availability of blood for pending surgical cases anticipated to be at risk for large blood loss.

- Facilitate and encourage donations by family and friends of patients, to replenish the community blood supply, at either the facility or a blood center location.

- When Rh-negative blood is in short supply, consider administration of Rh-positive blood to males and to women past child-bearing age.

Table 1. Infectious Disease Risks

Primary Risks
- Bacteria
- Hepatitis B virus
- Hepatitis C virus
- HIV-1

Additional Risks in Immunocompromised Recipients
- Cytomegalovirus
- Parvovirus B19
- Epstein-Barr virus
- Babesiosis (*Babesia microti*)

Very Rare Risks
- Chagas disease (*Trypanosoma cruzi*)
- Malaria (primarily *Plasmodium malariae* and *P. falciparum*)
- West Nile virus
- Hepatitis A
- Syphilis (*Treponema pallidum*)
- Variant Creutzfeldt-Jakob disease
- HIV-2
- Human T-cell lymphotropic viruses
- Leishmaniasis (visceral *Leishmania tropica* and possibly *L. donovani*)
- Human anaplasmosis (formerly human granulocytic anaplasmosis and human granulocytic ehrlichiosis)
- Dengue fever

Theoretical, But Unreported Risks
- Creutzfeldt-Jakob disease
- Human ehrlichiosis (formerly human monocytic ehrlichiosis)
- Lyme disease (*Borrelia burgdorferi*)
- Toxoplasmosis (*Toxoplasma gondii*)

Estimated Residual Risks of Some Transfusion-transmissible Viruses

Virus	**Recent Risk Estimate Ranges**
HIV-1[1]	1/1,467,000 units
HCV[1]	1/1,149,000 units
HBV[2]	1/280,000 – 1/357,000 units
HTLV[3]	1/1,208,000 units

For more information, see *Guidelines for Evaluation of Transfusion-associated Infections*, available at: *www.wadsworth.org/labcert/blood_tissue/infect.htm*.

Table 2. Summary of Blood Components, Their Indications, and Applicable Precautions

Component	Indications	Action	Not Indicated	Precautions	Primary Hazards
Red Blood Cells	Symptomatic anemia	Restores oxygen-carrying capacity	Pharmacologically treatable anemia	Must be ABO compatible	Infectious disease; sepsis; allergic reactions; acute lung injury; circulatory overload; alloimmunization to red cell antigens
Fresh Frozen Plasma and 24-Hour Plasma	Deficit of labile and/or stable coagulation factors; TTP; severe deficit of protein S Note: Coagulation protein content varies by plasma type.	Replaces labile and/or stable factors	Simple volume replacement	Should be ABO compatible	Infectious disease; sepsis; allergic reactions; acute lung injury; circulatory overload
Cryoprecipitate	Hypofibrinogenemia; selected platelet dysfunctions, including renal failure and selected cases of von Willebrand disease; factor XIII deficiency; may be used as part of fibrin glue	Provides fibrinogen, factor XIII, and vWF	Other coagulation abnormalities	For pooled cryoprecipitate, ABO compatibility should be considered	Infectious disease; sepsis; allergic reactions; acute lung injury
Platelets and Platelets by Apheresis	Bleeding due to thrombocytopenia or platelet dysfunction; prophylaxis in patients with < 30 - 50,000/µL prior to an invasive procedure or with < 5 - 10,000/µL	Provides viable platelets with normal function; restores primary hemostasis	Thrombocytopenia due to platelet destruction (ITP, TTP) in the absence of severe bleeding	ABO compatibility should be considered	Infectious disease; sepsis; allergic reactions; acute lung injury; circulatory overload; alloimmunization to HLA and platelet antigens
Granulocytes	Severe neutropenia (< 500 PMN/µL) with sepsis	Provides viable granulocytes	Infections responsive to antibiotics alone	Must be ABO compatible; do not use a leukoreduction filter	Infectious disease; sepsis; acute lung injury; circulatory overload

For more information, see the Council's blood services guidelines, available at: *www.wadsworth.org/labcert/blood_tissue/blood_services_guidelines.htm*.

Table 3. General Guidelines for Transfusion of Red Blood Cells in Acute Blood Loss

Blood loss of: • 15-30 percent of blood volume (800-1500 mL in an adult) – should be treated with crystalloids or colloids. No need for transfusion unless patient has preexisting anemia, limited cardiopulmonary reserve, or ongoing blood loss. • 30-40 percent of blood volume (1500-2000 mL in an adult) – requires rapid volume replacement with crystalloids or colloids. Red blood cell transfusion is probably needed. • > 40 percent of blood volume (> 2000 mL in an adult) – requires rapid volume replacement, including red blood cells.
Hemoglobin (Hb) concentration: • Hb ≥ 10 g/dL – transfusion is rarely indicated. • Hb 6-10 g/dL – indications for transfusion should be based on the patient's risk of inadequate oxygenation from ongoing bleeding and/or high-risk factors, such as age, cardiovascular compromise, or respiratory disease. • Hb ≤ 6 g/dL – transfusion is almost always indicated.

For more information, see *Guidelines for Transfusion of Red Blood Cells – Adults,* available at: *www.wadsworth.org/labcert/blood_tissue/redblood.htm*.

Table 4. Indications for Transfusion of Plasma (Fresh Frozen Plasma and/or 24-Hour Plasma)

- Prophylaxis associated with invasive procedures in nonbleeding patients with hereditary coagulation defects for which specific concentrates are not immediately available. In general, prophylaxis may be indicated if the coagulation factor activity is <30%.
- Coagulation factor activity >30% with a history of recurrent significant bleeding from an inherited defect may indicate a dysfunctional protein; prophylaxis may be indicated for invasive procedures.
- Emergency surgery or invasive procedures in nonbleeding patients on warfarin when time does not permit factor deficiency reversal with vitamin K or warfarin withdrawal. In such instances, the volume of plasma may pose undue hemodynamic risk and prompt reversal may be achieved with factor concentrate(s).
- Bleeding patients with acquired multiple coagulation deficiencies, including those developed prior to or during massive transfusion.
- Thrombotic thrombocytopenic purpura (TTP), for which plasma exchange is standard treatment. In other thrombotic microangiopathies (*e.g.,* hemolytic uremic syndrome and HELLP syndrome), plasma transfusion or exchange may also be useful.
- Rare indications:
  - Factor XIll deficiency, as an alternative to cryoprecipitate when factor XIII concentrate is not available.
  - Prophylactic or therapeutic replacement in deficiencies of other hemostasis proteins (*e.g.,* antithrombin, protein C, protein S, plasminogen, and α_2 plasmin inhibitor) when indicated and specific protein concentrate is not available. Patients with severe protein S deficiency may require fresh frozen plasma (FFP) for replacement.
  - C1 esterase inhibitor deficiency (*e.g.,* life-threatening hereditary angioedema), when C1 inhibitor concentrate is not available.

FFP and other types of plasma are NOT indicated:

- For patients with abnormal coagulation test results due to clotting factor deficiencies for which specific clotting factor concentrates are available, patients with coagulation factor inhibitors, or for heparin reversal
- For volume expansion
- As a nutritional supplement or protein source
- Prophylactically, following cardiopulmonary bypass
- To promote wound healing
- For patients with hypoglobulinemia

For more information, see *Guidelines for the Administration of Plasma,* available at: *www.wadsworth.org/labcert/blood_tissue/plasma.htm*.

Table 5. Indications for Transfusion of Platelets

- Prophylaxis in patients with platelet counts < 30,000 - 50,000/µL prior to an invasive procedure. A platelet count > 100,000/µL is recommended for neurosurgical and ophthalmologic procedures.
- Active microvascular bleeding attributed to platelet dysfunction or thrombocytopenia. In surgical and obstetric patients, usually indicated when the platelet count is < 50,000/µL in the presence of excessive bleeding.
- Intrinsic or acquired platelet dysfunction prior to an invasive procedure
- Prophylaxis in patients with severe thrombocytopenia
  - < 5,000/µL – likely indicated
  - 5,000 - < 20,000/µL – requires clinical judgment based on bleeding risk

Platelet transfusion is rarely indicated:

- In surgical or obstetric patients with normal platelet function and a platelet count >100,000/µL.
- For vaginal deliveries or operative procedures with limited anticipated blood loss.
- Prophylactically, following transfusion of a fixed number of RBC units.
- When thrombocytopenia is due to increased platelet destruction (*e.g.,* heparin-induced thrombocytopenia, immune thrombocytopenic purpura, thrombotic thrombocytopenic purpura).

For more information, see *Guidelines for the Administration of Platelets,* available at: *www.wadsworth.org/labcert/blood_tissue/platelets.htm*.

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