RED BLOOD CELL TRANSFUSION GUIDELINES

GENERAL GUIDELINES for RBC transfusions:

- Rarely indicated when the hemoglobin is **greater than/equal to 10 mg/dL.**
- Almost always indicated when the hemoglobin is **less than/equal to 6 gm/dL.**
- Transfusion in patients whose hemoglobin is 6 to 10 mg/dL should be based on the patient's risk of complications due to inadequate oxygenation.
- 1 unit RBCs = Increase hemoglobin level approximately 1 gm/dL and the hematocrit by 3% (normal sized adult)
- Transfused RBCs have a half-life of 30 days.
- All RBC blood products at BAH are AS-1 (Adsol) leukoreduced red cells.
- In a non-bleeding, non-hemolyzing adult transfused with compatible RBCs, the hemoglobin level should equilibrate within 15 minutes of transfusion
- In the absence of acute hemorrhage, RBCs should be given as single units followed by appropriate evaluation to justify additional units, with transfusion of an RBC unit ideally completed within 4 hours.

ADULT RBC TRANSFUSION TRIGGER GUIDELINES:

DIAGNOSIS	TRIGGER	ADDITIONAL INFORMATION
Symptomatic Chronic Anemia	Transfusion is usually suggested when **Hgb is less than 7.0-8.0 gm/dL**	In asymptomatic patients, preference is to treat with pharmacologic agents as first-line therapy
General Critical Care	Transfusion is usually suggested when **Hgb is less than 7.0-8.0 gm/dL**	Applies to hemodynamically stable, hospitalized, adult patients
Cardiovascular Disease	Transfusion is usually suggested when **Hgb is less than 8.0 gm/dL**	Applies to patients with pre-existing cardiac disease or cardiovascular risk factors
Cardiac Surgery (Intraoperative)	Transfusion is usually suggested when **Hgb is less than 7.5 gm/dL**	
Preoperative/Periprocedural Anemia	Transfusion is usually suggested when **Hgb is less than 8.0 gm/dL**	Warranted in patients undergoing cardiac and orthopedic surgery
Acute blood loss/Trauma	Transfusion usually not necessary until there is **loss of 30% blood volume** (calculate 70 mg/kg)	Initial treatment should always include resuscitation with crystalloid which can be sufficient treatment in young healthy patients with blood loss of up to 40% blood volume (2 liters).
Sickle Cell Anemia	Transfusion is usually suggested when **Hgb is less than 10 gm/dL** - Preoperative (routine) prophylaxis Transfusion is usually suggested when **Hgb is less than 8.5 gm/dL** - On long-term hydroxyurea or facing high-risk surgery	- Post-transfusion hematocrits should be maintained below 35% to avoid hyperviscosity. - Should match RBCs for Rh (C, E or C/c, E/e) and Kell antigens - **Other indications for transfusion in SCD patients include:** Symptomatic anemia, severe symptomatic acute chest syndrome, acute splenic sequestration with severe anemia, acute stroke, hepatic sequestration, intrahepatic cholestasis, multisystemt organ failure, aplastic crisis, previous clinically overt stroke
Severe Thalassemia	Maintain Hgb **9.5 to 11 gm/dL**	Suppress endogenous erythropoiesis; obtain RBC phenotype
DIAGNOSIS	**TRIGGER**	**ADDITIONAL INFORMATION**

PEDIATRIC AND NEONATE RED BLOOD CELL TRANSFUSION GUIDELINES***

GENERAL GUIDELINES for RBC transfusions:

- 1 unit RBCs = Increase hemoglobin level approximately 3 gm/dL
- Dosing or RBC: 10 to 15 mL/kg
- Transfused RBCs have a half-life of 30 days.
- All RBC blood products at BAH are AS-1 (Adsol) leukoreduced.

SPECIFIC PEDIATRIC RBC TRANSFUSION TRIGGER GUIDELINES:

DIAGNOSIS	TRIGGER	ADDITIONAL INFORMATION
Stable Anemia (Infants)	Transfusion is usually suggested when **Hct less than 20-30%**	
Major surgery (Infants)	Transfusion is usually suggested when **Hct less than 30-35%**	
Cardiopulmonary Disease (Infants)	Transfusion is usually suggested when **Hct less than 40-45%** if "severe"**; Hct less than 30-35%** if "moderate"	
Hemodynamically stable children not in hemorrhagic shock	Transfusion is usually suggested when **Hgb less than 5 g/dL, though if between 5-7 g/dL, clinical judgement should guide decision to transfuse**	**- Post-transfusion target should be a Hgb between 7-9.5 g/dL** - In hemodynamically stable children with Hgb exceeding 7 g/dL, pRBCs are generally unnecessary, but may be beneficial in the following settings: Acute brain injury, ARDS, hemolytic anemia, Cancer or hematopoietic SCT, Cardiac disease, ECMO, Ventricular assist device
Acute Blood Loss / Trauma	a. ***Newborns with respiratory distress*** - Hct **less than 40%** - Hypovolemia symptoms* - **greater than 20%** blood volume loss in **less than** 48 HRS and Hgb **less than** 15 gm/dL b. ***Newborns without respiratory distress*** - Pulse **greater than** 160 / minute - Hct **less than** 35% first week of life, **less than** 30% second to fourth week, and **less than** 25% first year c. ***Pediatric (1 to 18 years)*** - Same guidelines as adults. Usually no need to transfuse until blood loss **greater than** 20%	*Hypovolemic symptoms judged by pallor, tachycardia, and hypotension.
Neonatal Transfusion	- Acute blood loss **greater than** 10% blood volume - Hgb **less than** 8 mg/dL, in stable NB with apnea, bradycardia, tachycardia, tachypnea, decreased vigor, or no weight gain - Respiratory distress syndrome or severe congenital heart disease with Hgb **less than** 12 gm/dL	NEVER transfuse above a hemoglobin of 15 gm/dL
Stable Anemia (Infants)	Transfusion is usually suggested when **Hct less than 20-30%**	

******FOR ANY PEDIATRIC/NEWBORN SPECIFIC FFP AND PLATELET TRANSFUSION REQUIREMENTS, SEE THE FP AND PLATELET PHERESIS TRANSFUSION GUIDELINES**

FROZEN PLASMA (FP) TRANSFUSION GUIDELINES

GENERAL GUIDELINES for FP transfusions:

- Plasma for transfusion is prepared by either centrifugation of whole blood or by apheresis.
- Multiple forms of plasma components are available based on differences in how the plasma is processed and stored following collection.
- Despite differences in plasma protein (coagulation factor) levels, FFP, Plasma Frozen within 24 hours after Phlebotomy (PF24), Plama Frozen within 24 hours after Phlebotomy Held at Room Temperature up to 24 Hours after Phlebotomy (PF24RT24), and Thawed Plasma are generally used for the samie indications.
- The plasma component name, volume, anticoagulant, and expiration date are indicated on the label.
- The volume range of each unit of plamsa product is between 200 to 250 mL (derived from whole blood) and 400 to 600 mL (apheresis-derived unit).
- The Portland American Red Cross blood center supplies BAH with predominantly male plasma which reduces the risk of TRALI (transfusion related acute lung injury).
- Stored frozen in the laboratory and requires thawing at 30 to 37° which takes approximately 30 minutes. Thawed FP should be transfused within 24 hours. It cannot be refrozen.
- Generally 5 to 20 mL/kg are necessary to bring coagulation factor levels up to sufficient concentration to achieve hemostasis.
- Plamsa is transfused to provide clotting factors and not volume or "protein". For volume expansion, saline, albumin, or synthetic colloids are safer, cheaper, and more effective.
- Treatment with vitamin K can avoid the need for plasma transfusion in patients with vitamin K deficiency or on Coumadin.

SPECIFIC PLASMA TRANSFUSION TRIGGER GUIDELINES:

DIAGNOSIS	TRIGGER	ADDITIONAL INFORMATION
Massive Blood Loss/Trauma	Blood loss leading to a deficiency of multiple coagulation factors	Coagulation testing, including fibrinogen levels are helpful in guiding therapy
Warfarin Therapy (If significant bleeding or when require urgent invasive procedure)	Transfusion is usually suggested when **INR is greater than 1.5 times the mid-range of normal**	Appropriate therapy with Vitamin K usually reverses warfarin defect in 12 hours. 4-factor prothrombin complex concentrates are preferable to plasma transfusion for situations requiring urgent reverasal of warfarin.
Congenital or Acquired Coagulation Factor Deficiency (including liver disease) with active bleeding or prior to an invasive procedure	Transfusion is usually suggested when : **- PT is greater than 1.5 times mid-range of normal** **- aPTT is greater than 1.5 times the upper level of the normal** **- INR is greater than 1.7**.	Only use FP if no specific factor concentrate is available (emergency situation); Should bring laboratory values to within the hemostatic range, but this may be transient.
Specific Protein Deficiencies	Use for specific disorders with no available concentrate	Includes: - Prophylaxiso of Treatment of clot in antithrombin, protein C, and protein S deficiency - Acute angioedema or Preoperative prophylaxis in hereditary C1-inhibitor deficiency - Factor V deficiency - Factor XI deficiency
Thrombotic Thrombocytopenic Purpura and related syndromes	Support with Plasma, cryoprecipitate, and platelets only as needed if plasma exchange is not immediately available	Initially requires the exchange of 1-1.5 plasma volumes daily; Obtain ADAMTS13 level prior to treatment.
Massive Blood Loss/Trauma	Blood loss leading to a deficiency of multiple coagulation factors	Coagulation testing, including fibrinogen levels are helpful in guiding therapy
Warfarin Therapy (If significant bleeding or when require urgent invasive procedure)	Transfusion is usually suggested when **INR is greater than 1.5 times the mid-range of normal**	Appropriate therapy with Vitamin K usually reverses warfarin defect in 12 hours. 4-factor prothrombin complex concentrates are preferable to plasma transfusion for situations requiring urgent reverasal of warfarin.
Congenital or Acquired Coagulation Factor Deficiency (including liver disease) with active bleeding or prior to an invasive procedure	Transfusion is usually suggested when : **- PT is greater than 1.5 times mid-range of normal** **- aPTT is greater than 1.5 times the upper level of the normal** **- INR is greater than 1.7**.	Only use FP if no specific factor concentrate is available (emergency situation); Should bring laboratory values to within the hemostatic range, but this may be transient.

PLATELET PHERESIS TRANSFUSION GUIDELINES

GENERAL GUIDELINES for Platelet Pheresis transfusions:

- At BAH, only preleukoreduced platelet pheresis products are available (Single Donor Platelets, or SDPs; Random Donor Platelets, or RDPs). Platelet pheresis products contain a dose of platelets equivalent to four to six random donor platelets.
- A psoralen and ultraviolet light-based pathogen reduction process for leukocyte reducded Aphereseis Platelets is now available with a shelf-life of 5 days.
- Rh Negative patients should receive as the first choice, Rh Negative products. If this is not possible, Rh immune globulin prophylaxis should be considered for females of child-bearing potential.
- The bleeding patient can receive non-ABO-compatible platelets with negligible deleterious effects to the recipient or transfused platelet function. The patient on extended platelet therapy should receive ABO-specific products, if possible.
- Expect an increase of 20,000 to 60,000 platelets/µL for each RDP product and 10,000 to 60,000 platelets/µL for each SDP product given in an adult, usually measured 10-60 minutes after transfusion (a “one hour” post transfusion platelet count). In neonates and infants, a dose of 5-10 mL/kg of platelets should result in a 50,000 to 100,000 platelet/µL increment increase.
- Pharmacologic agents such as aprotinin may reduce major surgical bleeding and therefore avoid dilutional thrombocytopenia.
- Time consuming collection and processing procedures of specially selected donors(s) are required EACH AND EVERY TIME HLA-matched products are ordered. Careful planning and follow-through are necessary to complete the transfusion of this product as soon as possible after the collection.

SPECIFIC PLATELET PHERESIS TRANSFUSION TRIGGER GUIDELINES:

DIAGNOSIS	TRIGGER	ADDITIONAL INFORMATION
Stable, non-bleeding patient	Transfusion is usually suggested when **Platelet count is less than 10,000/µL**.	If possible, try to determine the reason before transfusion.
Unstable, non-bleeding patient	Transfusion is usually suggested when **Platelet count is less than 20,000/µL**	
Active bleed	Transfusion is usually suggested when **Platelet count is less than 50,000/µL**	
Antiplatelet Agents (P2Y12 receptor inhibitors and direct GIIb/IIIa inhibitors)	Platelets should not be transfused prophylactically in the absence of thrombocytopenia	Consider high-dose transfusion for life-threatening hemorrhage
Massive Transfusion / Trauma	- Transfusion is usually suggested when **Platelet count is less than 50,000/µL** for *acutely bleeding patients.* - Transfusion may be appropriate when **Platelet count is less than 100,000/µL** *for patients with multiple trauma, CNS injury, or with microvascular bleeding.*	Always obtain a platelet count and coagulation studies before transfusion.
Preoperative Prophylactic Platelet transfusion thresholds (Adults)	Transfusion is usually suggested when Platelet count is: **Less than 10,000 - 20,000/µL** - Bone marrow bioopsy **Less than 20,000/µL** - Venous catheter placement **Less than 20,000 - 50,000/µL** - Flexible bronchoscopy or GI endoscopy; Lumbar puncture **Less than 50,000/µL** - Major invasive surgical procedures (non-neuraxial). **Less than 80,000/µL** - Spinal and epidural anesthesia **Less than 100,000/µL** - Neurologic or ophthalmologic procedures	For any patient receiving preoperative platelet transfusion, a post transfusion platelet count should ALWAYS be performed.
Intraoperative Use	When coagulation parameters are not significantly abnormal, counts **less than 100,000/µL** accompanied by major unexpected bleeding from a microvascular source may require platelet transfusion.	Always obtain platelet counts to guide transfusion.
Oncology/Chemotherapy	Transfusion is usually suggested when **Platelet count is less than 10,000/µL**	Pt specific clinical data may increase this threshold.
Platelet Dysfunction (Glanzmann thrombasthenia or Bernard-Soulier Syndrome)	Transfuse if there is an active bleed or perioperative bleed, regardless of count.	In these patients, transfusion should be undertaken only when more conservative efforts to manage bleeding have failed, given risk of alloimmunization.

Accelerated Platelet Destruction with bleeding (i.e. DIC)	Transfusion is usually suggested when **Platelet count is less than 50,000/µL** – in children and adults who have active bleeding, require an invasive procedure, or are otherwise at high risk for bleeding complications	There is no role for prophylactic transfusion in these patients
Idiopathic Thrombocytopenia Purpura	Platelets should only be given for major bleeding.	Prophylactic transfusions are inappropriate; Consider IVIG prior to **minor surgery** with platelet count **<50,000/uL**; or with **<80,000/uL** prior to **major surgery**.
Aplastic Anemia	Transfusion is usually suggested when **Platelet count is less than 5,000/µL;** and with fever or minor bleed at **less than 6-10,000/µL**	
TTP/HUS and HITT	Due to risk of fatal thrombosis, only transfuse in the setting of life-threatening hemorrhage	
Post Transfusion Purpura (PTP)	Platelets may be given for severe bleeding but usually ineffective.	- High dose IVIG with steroids is the treatment of choice - Human platelet antigen (HPA)-1a negative platelets are frequently given empirically while testing is in process

CRYOPRECIPITATE TRANSFUSION GUIDELINES

GENERAL GUIDELINES for Cryoprecipitate transfusions:

- At BAH only pooled cryoprecipitate units (pool of 5 donors) are available.
- Cryoprecipitate is stored at -18°C and must be thawed at a temperature of 30 to 37°C for 15 minutes. Thawed product must be maintained at 20 to 24°C. Pooled units must be used within four (4) hours of thawing.
- Single donor unit of cryoprecipitate contains fibrinogen, factor VIII:C, factor VIII:vWF, factor XIII, and fibronectin. Each unit contains at least 80 IU factor VIII and 150 mg of fibrinogen in 15-20 mL of plasma.
- 1 unit cryoprecipitate = An increase in intravascular fibrinogen content between 200-250 mg/unit.

DIAGNOSIS	TRIGGER	ADDITIONAL INFORMATION
Acquired Fibrinogen Deficiency with associated bleeding	Transfusion is suggested when **Fibrinogen level is less than 150-200 gm/dL**	
Massive Transfusion/Trauma	Transfusion is suggested when **Fibrinogen level is less than 150-200 gm/dL**	Consider Cryo in adult if **greater than 8 units RBC** and pediatric **greater than 30 mL/kg** RBC transfused (After one or more blood voumes have been replaced)
Fibrin sealant	Safer options available	Although allogeneic cryoprecipitate has been used in the past a a hemostatic surgical adhesive, several virus-inactivated and autologous fibrin sealant systems are preferable to Cryoprecipitate
DIC	Transfusion is suggested when **Fibrinogen level is less than 100-150 gm/dL**	If severe hypofibrinogenemia after Plasma replacement
Uremic Bleed	Efficacy not clearly demonstrated.	DDAVP therapy preferred
Hemophilia A or von Willebrand's Disease	Only use if appropriate concentrates or DDAVP is not available and the need is URGENT.	

IRRADIATED BLOOD COMPONENT TRANSFUSION CRITERIA

General guidelines: A severe and almost uniformly fatal consequence of transfused allogeneic leukocytes is transfusion-associated graft-versus-host disease (TA-GVHD), a reaction that occurs in a recipient incapable of mounting an immune response against foregin donor-derived white blood cells. Viable donor WBCs are capable of recognizing foreign HLA antigens on tissues and organs and mounting a cellular immune response that damages recipient skin, liver, the gastrointestinal tract, and other tissues. Inactivation of donor lymphocytes by gamma- or X-irradiation can prevent the proliferation of transfused lymphocytes and the development of TA-GVHD. The only products that may require irradiation are cellular products such as RBCs and platelets (non-pathogen-reduced). Not needed for FP or cryoprecipitate.

Patient populations with well-defined and relative* irradiated products indications:

1. Intrauterine transfusion (IUT) and infants who have received IUTs.
2. Pediatric patients: infants and children with or suspected to have immune deficiency.
3. Congenital cellular immunodeficiency, for example, severe combined immunodeficiency (SCID), DiGeorge syndrome
4. Hodgkin disease
5. Granulocyte transfusions
6. Blood product from a related donor (any degree relation), regardless of the patient's immune status
7. Blood product from an HLA-selected or crossmatched donor, regardless of patient's immune status
8. Allogeneic or autologous hematopoietic progenitor cell (HPC) transplant. (However, HPC products MUST NOT be irradiated).
9. Patients receiving T-cell suppression therapy including purine nuycleoside analogs and antagonists (e.g., fludarabine, bendamustine, azathioprine, alemtuzumab, antithymocyte globulin).

CYTOMEGALOVIRUS (CMV) REDUCED-RISK COMPONENTS

General guidelines: These products are used to prevent transfusion transmitted cytomegalovirus infection in patients seronegative for CMV or whose CMV serologic status in unknown. The only CMV reduced-risk products are cellular products such as RBCs and platelets. Not needed for FP or cryoprecipitate. Blood products that are considered to have reduced risk including CMV seronegative cellular blood components from individuals who test negative by an FDA-approved screening test for CMV antibodies, as well as leukoreduced cellular blood components, though redsidual risk may remain due to the presence of cell-free virus and/or residual infected WBCs in the product.

Patient populations with well-defined indications:

1. Intrauterine transfusions
2. Exchange transfusions
3. Neonates born to CMV seronegative mothers or CMV serologic status unknown mothers
4. Premature infants who weigh less than 1500 grams at birth
5. CMV seronegative pregnant women
6. CMV seronegative patients infected with HIV-1 or HIV-2
7. Solid organ and bone marrow transplant patients where both the donor and recipient are CMV seronegative
8. CMV seronegative patient candidates for solid organ or bone marrow transplantation

AT BAH, PRESTORAGE LEUKOREDUCED CMV-REDUCED RISK ("CMV SAFE") BLOOD PRODUCTS WILL BE AUTOMATICALLY SUBSTITUTED FOR ANY "CMV NEGATIVE" PRODUCT ORDER RECEIVED BY THE CLINICIAN.

Reference:

A Compendium of Transfusion Practice Guidelines. American Red Cross publication. Edition 4.0. September 2021

Original authors: Debra Groom, M.D. and Terrence Bach, M.D. Review of proposed blood utilization criteria by BAH medical departments first quarter 2007. Originally approved by BAH medical executive committee April 25, 2007.

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