These guidelines have been prepared to assist physicians in the use of the various available blood components. They illustrate conditions under which transfusion would be considered reasonable, and to serve as a basis for establishing criteria for auditing blood component administration as required by various accrediting agencies. Such guidelines cannot substitute for clinical judgment and they are not to be interpreted as mandatory practice or standard of care. A medical staff member of the Transfusion Work Group will review transfusions not meeting the indications outlined in these guidelines.

In addition to appropriate documentation of informed consent, all transfusions should be documented as to indications and outcomes with specific notations when exceptions to these criteria exist. Documentation in the Anesthesia or Perfusion record will suffice for intra-operative transfusions. Pre- and post-transfusion laboratory tests and/or notations in the physician's notes are appropriate in other situations.

BLOOD PRODUCTS AVAILABLE FROM THE HOSPITAL BLOOD CENTER

1. **Packed Red Blood Cells:** All red blood cells processed at the CHOMP Blood Center, or obtained from alternative sources, are pre-storage leukoreduced. The use of this product is designed to reduce the occurrence of chills/fever reactions, sensitization to HLA antigens, occurrence of immune modulation, and transmission of cytomegalovirus disease.

2. **Whole Blood and Non-leukoreduced Packed RBC's:** These products are not routinely available.

3. **Washed Red Blood Cells:** RBC's are washed with sterile normal saline to remove plasma proteins, electrolytes, and antibody. Useful in patients with history of severe allergic transfusion reactions; patients at risk from transfused antibody; hyperkalemia; paroxysmal nocturnal hemoglobinuria.

4. **Frozen-Deglycerolized Red Blood Cells:** CHOMP has full capability of freezing and storing RBC's up to 10 years. This process is used to preserve rare blood for patients with complex antibody problems; to extend the storage of autologous units when necessary; to treat anemia with low risk of febrile and allergic transfusion reactions. Freezing-deglycerolizing procedures are costly, time consuming, and result in some red-cell loss. Once thawed, the unit expires in 24 hours.

5. **Irradiated Red Blood Cells:** Red blood cells are irradiated when the transfusion is to be given to a first degree relative of the donor or if the patient has serious immune compromise due to disease or chemotherapy to prevent graft versus host disease.

6. **Autologous Blood:** By law in California, patients must be given the option, where possible, to donate blood for themselves. This must be incorporated into the informed consent and so documented in the record. The CHOMP Blood Center supports a full autologous program. The risks of donating and using autologous blood needs to be balanced with the small potential medical benefit on a case by case basis.

7. **Designated Blood Donations:** This product is available through the Blood Center upon physician's order. The donor's blood type must be compatible with the recipient. The recipient must have agreed to receive the donor's blood. If the donor is a first degree relative, the blood must be irradiated prior to transfusion.
8. **Platelets, Pheresis, Leukoreduced:** All platelet aphereses performed at CHOMP Blood Center are prestorage leukoreduced. This is true also for those imported from the Red Cross. Presently CHOMP uses apheresis exclusively to produce platelets.
9. **Frozen Plasma:** This product contains plasma proteins including all soluble coagulation factors. Must be ABO compatible with the recipient's red cells. It carries a risk of disease transmission.
10. **Cryoprecipitate:** This product provides Factor VIII, fibrinogen, vWF, and factor XIII. Its use is mainly to control bleeding associated with fibrinogen deficiency. It is indicated as second-line therapy for von Willebrand's disease and hemophilia A (Factor VIII:C deficiency). It should only be used if recombinant VIII or virus-inactivated Factor VIII concentrates are not available for management of patients with hemophilia A or von Willebrand's disease.

PRODUCTS AVAILABLE FROM THE HOSPITAL PHARMACY

Recombinant Factors

1. VIII – as indicated for hemophilia A
2. Factor IX – as indicated for hemophilia B
3. Factor VIIa (Novo Seven)

Albumin-Volume Expansion

Prothrombin Complex Concentrate

Calcium

GUIDELINES FOR THE TRANSFUSION OF RED BLOOD CELLS IN ADULTS

Rationale

The major indications for red blood cell transfusion are symptomatic deficit of oxygen carrying capacity. Red blood cell transfusion restores the oxygen carrying capacity of blood and thus alleviates the symptoms of tissue hypoxia. Since a clinically significant hypoxemia does not usually begin to develop until the hemoglobin concentration of the blood is under 8 g/dL, transfusion above this concentration must be justified by the presence of either symptoms and/or co-morbid risk factors which might place the patient in jeopardy of tissue hypoxia and its clinical consequences. Co-morbid risk factors include congestive heart failure, symptomatic coronary artery disease, severe pulmonary disease, and cerebrovascular insufficiency.

In the decision of whether or not to transfuse red blood cells to the patient who is actively bleeding, the clinical assessment of the degree of blood loss and the development of signs and symptoms of hypovolemia are more important than the hemoglobin level or hematocrit, which may not reflect the degree of blood loss for many hours, or until the patient is again normovolemic.

Indications for Red Blood Cell Transfusion in Adults

1. Hemoglobin of 7 gm/dL or less/hematocrit of 21% or less, unless significant pulmonary or cardiac disease is present.
2. Symptomatic anemia resulting in tachycardia (greater than100 beats/minute), mental status changes, EKG signs of cardiac ischemia, angina or shortness of breath with mild exertion.
3. Transfusion for a regular predetermined therapeutic program such as aplastic anemia and hemoglobinopathies, radiation/chemotherapy, etc., where a nadir less than 7 gm/dL is anticipated.
4. Acute blood loss of 10 to 15% of estimated blood volume with evidence of inadequate oxygen delivery following volume resuscitation.
5. Preoperative hemoglobin of less than 9gm/dL, hematocrit less than 27%.
6. Hemoglobin of less than 10gm/dL or hematocrit less than 30% when autologous units are available.

GUIDELINES FOR THE TRANSFUSION OF PLATELETS

Rationale for Platelet Transfusion

The major indication for platelet transfusion is the treatment or prevention of bleeding in profoundly thrombocytopenic patients with bone marrow failure due to malignancy and/or myelosuppressive therapy. Even within these clinical circumstances, however, consideration must be given to the overall clinical picture, including the severity of the complications, rather than just the platelet count, when considering the necessity for a platelet transfusion. Although platelet transfusion therapy has become a mainstay in the support of cancer patients receiving aggressive chemotherapy, the appropriate clinical circumstances for either prophylactic or therapeutic platelet therapy requires exercise of considerable clinical judgment.

Patients with severe preoperative thrombocytopenia are generally assumed to benefit from prophylactic platelet transfusion, but this has not been demonstrated in experimental studies. In the utilization criteria of most hospitals, the threshold for such prophylaxis is typically set at platelet counts between 50,000 and 100,000/uL. Published guidelines suggest a platelet transfusion trigger of 50,000/uL for most surgery, with counts of 100,000/uL possibly required for patients undergoing neurosurgery or ophthalmic procedures.

Other indications are rare, but platelet transfusions may be useful in the thrombocytopenic, massively bleeding patient with disseminated intravascular dissemination, or in life threatening bleeding in patients with an immune type of thrombocytopenia. In patients with either congenital or acquired thrombocytopathies, other therapies are usually more appropriate, although platelet transfusions may be indicated for serious bleeding.

In the decision as to whether to transfuse platelets to any individual patient, the following outline of indications for platelet transfusion should be useful as an ancillary guide. It is emphasized that not all patients meeting these criteria are in need of platelet transfusion, and conversely, platelets may be beneficial for some patients not meeting these criteria, depending on the clinical circumstances.

1. Platelet count less than 10,000/uL due to bone marrow infiltration or suppression, for prophylaxis or bleeding.

Patients with platelet counts above 5,000/uL who are not bleeding and who are otherwise stable may not require transfusion. Between 10,000/uL and 20,000/uL, clinical judgment must be exercised with consideration to the risk of serious bleeding and to the presence of infection, coagulopathy, splenomegaly or other clinical circumstances, which increase that risk by compromising platelet function or survival.

Note: Aplastic patients are not usually transfused in the absence of serious bleeding.

Platelet transfusions should be avoided in immune thrombocytopenia (ITP, PTP), and in thrombotic microangiopathies such as TTP, HUS and HELLP syndrome, even when the thrombocytopenia is very severe. Other therapeutic strategies, such as steroids, intravenous gamma globulin, or plasma exchange, are usually more appropriate, depending on the clinical diagnosis. In cases of life threatening hemorrhage, platelet transfusions in the immune thrombocytopenias may on rare occasions be necessary when other therapies have either failed or not had time to become effective. Platelet transfusion therapy in such patients with increased platelet destruction may require more intensive therapy than in patients with marrow failure.

Note: Platelet transfusions are contraindicated in heparin-induced thrombocytopenia, as this may precipitate extensive intravascular coagulation.

2. Platelet count less than 50,000/uL with microvascular bleeding, or pre-operatively.

If surgery cannot be postponed or there is traumatic bleeding, patients with a platelet count of less than 50,000/uL may require a platelet transfusion. For elective surgery, it is preferable to wait for the platelet count to rise spontaneously, or with appropriate treatment. In the case of drug-induced thrombocytopenia, the platelet count usually returns spontaneously within 1-2 weeks after the offending agent has been withdrawn.

Occasionally, massive transfusion may result in dilutional thrombocytopenia to less than 50,000/uL associated with abnormal microvascular bleeding and require platelet replacement therapy. Prophylactic platelet administration after the transfusion of a fixed number of red cell units is not indicated. No absolute platelet threshold exists for transfusion of platelets in massive hemorrhage. Platelet count does not fall below 100,000/uL until hemorrhage exceeds one and a half to two blood volumes, and platelet transfusion is indicated if bleeding exceeds this level. However, the concomitant presence of a consumption coagulopathy may well mandate platelet transfusion earlier in the course of a massive hemorrhage, with therapy gauged on the platelet count and evidence of microvascular bleeding.

Note: For neurosurgical procedures, a platelet count of 100,000/uL is recommended.

3. Intrinsic or acquired platelet dysfunction with bleeding, or pre-operatively.

Congenital disorders of platelet function can be categorized according to disorders within the platelet affecting interactions with other platelets, vessel walls, platelet agonists, or coagulation factors. Clinical manifestations range from minimal to severe bleeding. The bleeding time is usually prolonged because of platelet dysfunction but the platelet count is generally normal. Treatment of these disorders requires supportive care and, if possible, the use of pharmacologic

agents such as DDAVP to improve hemostasis. Disorders involving extrinsic platelet defects, such as von Willebrand disease, can be treated with plasma products or DDAVP, but platelet transfusions generally have little benefit as platelet function depends on extrinsic humoral factors. Intrinsic congenital platelet defects, such as in Bernard-Soulier syndrome, Glanzmann's thrombasthenia, or storage pool disease, to name a few, may benefit from platelet transfusions, but should be limited to significant hemorrhagic events or surgical procedures.

Acquired reversible platelet dysfunction occurs most commonly in patients with renal insufficiency. In such patients, therapy with dialysis (in the case of frank uremia), DDAVP, estrogen, or cryoprecipitate should be employed as the primary therapeutic strategies. For abnormal uremic bleeding, platelet transfusion is seldom indicated. Rarely, platelet transfusions may be required in patients unresponsive to other therapies who have serious bleeding, in which case larger doses may be necessary in patients with marrow failure.

In patients with other reversible causes of platelet dysfunction, usually due to medication, these drugs should be discontinued prior to elective surgery for as many days as is necessary to clear the drug's effect on the platelets. Patients with drug-induced platelet dysfunction may require DDAVP and/or platelet transfusions in acute surgical situations or when the patient is bleeding despite other therapies.

GUIDELINES FOR THE ADMINISTRATION OF PLASMA

Rationale for Administration of Frozen Plasma (FP)

Frozen plasma contains adequate levels of all soluble coagulation factors except those provided by platelets. It is used for the treatment or prophylaxis of multiple or specific coagulation factor deficiencies (PT and/or PTT greater than 1.5x the upper limits of normal and/or documented specific coagulation factor deficiency). Frozen plasma is also indicated in those patients with a suspected coagulation deficiency (PT/PPT pending) who are bleeding or at risk of bleeding from an invasive procedure. When possible, the patient's coagulation parameters, such as PT/PTT, or specific coagulation factor analyses, should be determined prior to transfusion and within 24 hours after transfusion. Where specific factor concentrates are available, they should be used instead of frozen plasma to avoid transfusion transmitted infectious disease or circulatory overload problems.

Indications for Frozen Plasma

1. Management of preoperative or bleeding patients who require replacement of multiple plasma coagulation factors.
2. Patients with massive transfusion who have clinically significant coagulation abnormalities.
3. Patients on Coumadin who are bleeding, or need to undergo an invasive procedure with insufficient time for Vitamin K to reverse the anticoagulant effect. Prothrombin Complex Concentrate is available for selected patients if reversal is time critical, see pharmacy's guidelines.
4. Patients with thrombotic thrombocytopenic purpura (plasma exchange).
5. Management of patients with selected coagulation factor deficiencies for which no concentrates are available.
6. Management of patients with rare specific plasma protein deficiencies, such as C-I-esterase, alpha-I-antitrypsin, and antithrombin if concentrates are unavailable.

Coagulation factors for which virus-safe specific concentrates are available: Factors VIII, IX, VII, VIIa, XI, and vWF factor.

Contraindications

1. Empiric use during massive transfusion where patient does not exhibit clinical coagulopathy.
2. Intravascular volume expansion.
3. Nutritional supplement or protein source.
4. To promote wound healing.

Plasma Dosing Calculations to Correct Patient INR

See Appendix A or refer to the on line *CHOMP Laboratory Services Guide* via the intranet page for physicians ► Lab Services Guide ► search for plasma dosing.
http://online.lexi.com/crlsql/servlet/crlonline

GUIDELINES FOR THE TRANSFUSION OF CRYOPRECIPITATE

Rationale for the Use of Cryoprecipitate

Cryoprecipitate is the only fibrinogen concentrate available for intravenous use. Each unit contains approximately 150-250 mg. of fibrinogen in approximately 15 ml. of plasma. It also contains 80-100 units of factor VIII plus some factor XIII and von Willebrand factor.

Indications for Use of Cryoprecipitate

1. Fibrinogen replacement in patients with fibrinogen levels less than 100 mg/dL who are bleeding, or immediately prior to an invasive procedure.
2. Hypofibrinogenemia associated with disseminated intravascular coagulation (DIC) or abruptio placentae.
3. Dysfibrinogenemia with bleeding where the fibrinogen levels are normal but functionally defective as measured by the thrombin time, eg, severe liver disease.
4. Factor XIII deficiency.
5. Factor VIII or von Willebrand factor deficiency when specific concentrates are unavailable.
6. See below for massive GI bleed

GUIDELINES FOR MANAGEMENT OF PATIENTS WITH MASSIVE BLEEDING

Definition

Massive bleeding is considered expected or unexpected blood loss which is measured or estimated as 2,000 ml of blood or 40% of calculated blood volume in a 24-hour period.

Assessment and Monitoring

Prior to a clinical episode if the blood loss is expected, or as early as possible during an unexpected episode, recommended objective lab assessment includes:

1. CBC (for Hemoglobin, hematocrit and platelet count), PT/INR, PTT and Fibrinogen levels.
2. Assessment of Calcium and albumin may be considered in pediatric patients and adults with hepatic dysfunction.
3. Assessment of markers of DIC may be considered if clinically indicated, including D-dimer and fibrinogen degradation products (FDP) levels.

Blood Product Replacement

Current published recommendations regarding massive bleeding episodes suggests using clinical judgment and, when possible, objective laboratory data, as opposed to a standard formula, for considering use of platelets, cryoprecipitate, plasma or calcium. Pathologists are available for consultation regarding the ordering and interpretation of laboratory tests and ordering of blood products. Replacement blood products include:

1. **Red Blood Cells**
   Red blood cells are covered previously in these guidelines.

2. **Platelets**
   Platelets are covered previously in these guidelines. In cases of microvascular (platelet-type) bleeding, consideration should be given for a hereditary or acquired functional platelet disorder. If a functional platelet disorder is considered likely, platelet transfusion may be indicated, even if the platelet count is normal or elevated. Assessing the efficacy of platelet transfusion is recommended either by clinical observation of effect or, more objectively and preferentially in cases with low counts, by platelet count.

3. **Fibrinogen from cryoprecipitate**
   Cryoprecipitate is covered previously in these guidelines. In cases of dysfibrinogenemia, such as from liver dysfunction, transfusion of cryoprecipitate as a source of functional fibrinogen may be indicated, even if the fibrinogen level is normal. Assessing the efficacy of cryoprecipitate either by clinical observation of effect or, more objectively and preferentially, by fibrinogen level, is recommended. Elevated fibrinogen levels can result in hyperviscosity. Physicians should use published data (when available) and appropriate medical judgment when considering a numeric threshold level for transfusing cryoprecipitate as a source of fibrinogen in patients with massive blood loss, such as gastrointestinal (GI) bleeding.

4. **Frozen Plasma**
   Frozen plasma is covered previously in these guidelines. Periodically assessing the efficacy of frozen plasma transfusion by PT/INR and PTT quantitation is recommended.

Other Therapeutic Considerations

1. **Calcium**
   Never add calcium directly to blood products. Calcium supplementation (to counteract the effect of citrate infusion with blood products), for red cell units given at a rate of up to one unit every five or ten minutes, is usually not indicated in most adults with adequate hepatic function. Pediatric patients and patients with hepatic dysfunction may be slower metabolizers of citrate. Calcium supplementation, in the form of intravenous Calcium Chloride, may be indicated in pediatric patients, patients with hepatic dysfunction or in adults receiving numerous red cell units at a rate faster than one per five minutes. Assessment of serum calcium, in conjunction with serum albumin levels, can assist with clinical judgment regarding indications for calcium supplementation.

2. **Recombinant Activated Factor VII (rFVIIa)**
   This product is a recombinant activated Factor VII and has been used in limited trials to assist with controlling life threatening bleeding, such as intracranial bleeds or patients with Factor VIII or Factor IX deficiency and an inhibitor. The attending physician could consider rFVIIa for the treatment of life-threatening bleeding episodes which are not expected to be responsive to conventional therapy and when the potential benefits outweigh the potential risks. See the pharmacy guidelines for indications.

3. For rapid infusion of blood products, the *Rapid Infuser* can be used.

4. Warming blood products prior to infusion can limit effects of potential hypothermia.

GUIDELINES FOR MANAGEMENT OF PATIENTS WITH SEVERE ANEMIA AND WITHOUT AVAILABLE COMPATIBLE OR ACCEPTABLE RED CELLS

Rationale

Rare patients have severe anemia but do not have routinely acceptable or crossmatch-compatible red cells. These patients include, but are not limited to, Jehovah's Witnesses and patients with autoimmune hemolytic anemia. Consultation with a pathologist and the transfusion service is recommended for patients with complicated transfusion issues.

Options for these patients include:

1. Maximizing oxygen delivery.
2. Limiting the number and volume of blood draws.
3. Considering options for increasing oxygen-carrying capacity:
   a. Erythropoietic growth factors, possibly intravenous.
   b. Synthetic red cell/hemoglobin substitutes are under investigation and are not currently available for clinical practice.
4. Maximizing blood volume, consider hydroxyethyl starch solutions.

Submitted by:	C. Hansen MD / Transfusion Work Group
Next review date:	2014
Effective date:	09/2011
Application:	All CHOMP facilities
Approved by:	Transfusion Work Group
Reviewed by:	Interdisciplinary Quality Committee 09/11; MEC 09/11
Replaces	12/2009 Policy for Transfusion Guidelines
References:	American Association Blood Banks; Lab Services Guide; Pharmacy Guidelines
Key Words	Transfusion, policy, guidelines, blood, blood products
Distribution:	Medical Staff Policy / Medical Staff Services
Additional Information:	Available on intranet in Policies and Procedures
Related policies:	Pediatric Transfusion Guidelines

Appendix A
Frozen Plasma (FP) Dosing Calculation to Correct Patient INR
CHOMP Laboratory Services Guide

Plasma dosing calculation for adults / children: the on-call pathologist is available for any questions. Please use laboratory values (INR) and clinical assessment/judgement to guide frozen plasma therapy. Ideally the INR should be checked prior to and after the calculated FP dose is given.

Summary of calculation for adults <u>and children greater than 10 kg</u> with example:
Mass (Kg) x 70 mL/kg x (1 - Hct) x fractional increase in factors needed x 1 unit FP/200 ml = # FP units to transfuse

70 kg x 70 mL/kg x (1 – 0.45) x 0.3 x 1/200 mL = 4 units FP to transfuse (to correct INR from 3 to 1.3 or lower)

Details and instructions <u>(note: for children less than 10 kg use 100 mL/kg):</u>

1. Determine the patient's blood volume, then their plasma volume:

   Mass (kg) x 70 mL plasma/kg x (1 – Hct) = mL plasma volume

   Example: 70 Kg x 70 mL/kg x (1 – 0.45) = 4900 mL x 0.55 = 2695 mL plasma volume

2. Determine the coagulation factor deficit (volume of plasma to transfuse):

   INR is gross assessment of coagulation, not a direct measure of individual factors. In general, an INR of 3 could represent a need to replace 30% of plasma volume to correct to 1.3 or lower. An INR of over 8 could represent a need to replace 40% of plasma volume to correct the INR to 1.3 or lower.

   Sample calculation: INR 3, to correct to 1.3 or lower: 2695 mL x 0.3 = 808 ml

3. Determine the number of units needed:

   Example: 808 mL x 1 unit FP/200 mL = 4 units FP to transfuse