1.1 In order to monitor and address transfusion practices for all categories of blood and
blood components, a peer-review program is designed to monitor appropriateness of
use using the following LBH Transfusion Criteria.

2.1 Indications for Appropriate Transfusion of Red Cells / Leukoreduced Red Cells:

- **Acute or anticipated blood loss.** Clinical assessment is required to establish if a patient
  with blood loss requires red cell transfusion. Transfusion should be avoided in patients
  that can be safely managed with crystalloid infusions. Blood loss of greater than 30-40%
  of a patient’s blood volume will generally require red blood cell transfusion.

- **Symptomatic Anemia** unresponsive to medical management. Documentation of
  clinical reason for transfusion in the medical record is required. Examples of
  symptomatic anemia include: Angina, congestive heart failure, unexplained tachycardia
  or hypotension unresponsive to fluid replacement, other signs of hypoxia and extreme
  fatigue.

- **Inadequate circulating red cell mass/Hgb.** Generally patients with a Hgb < 6g/dl
  require transfusion while patients with a Hgb >10g/dl do not require transfusion under
  most circumstances. LBH uses a restrictive transfusion criteria restricting against
  transfusion in hemodynamically stable asymptomatic patients with a Hgb > 7-8 g/dl.

  - Hgb < 7g/dL (Hct 21%) in an asymptomatic hemodynamically stable patient
  - Hgb < 8g/dL (Hct 24%) in an asymptomatic hemodynamically stable patient with
    established cardiovascular disease or risk factors.
  - Hgb <8g/dL (Hct 24%) in an asymptomatic hemodynamically stable post-operative
    patient.

LBH recommends transfusion of stable patients with a single RBC unit at a time and
reassessing before transfusing a second unit. Hemodynamically stable patients transfused
multiple units for the purpose of correcting a low Hgb will be flagged for potential
Submission to third party peer review in cases where there is a post transfusion hgb >9.5 g/dl.

**Preoperative and intraoperative transfusions.** Hgb 7-10g/dL (Hct 21-30%) in an operative or pre-operative patient with potential/actual blood loss, organ ischemia, risk of inadequate oxygenation (e.g. low cardiopulmonary reserve, high oxygen consumption). Documentation of clinical reasons for transfusion is in medical record.

**Acute Coronary Syndrome.** According to the American Red Cross “In general RBC transfusion may be beneficial in patients with acute coronary syndromes who have a Hgb level <8g/dL on hospital admission, and a transfusion should be considered in critically ill patients with stable cardiac disease and a Hgb level <7g/dL.” Due to the lack of randomized controlled trials, the AABB does not make recommendations for either liberal or restrictive transfusion criteria in the setting of acute coronary syndrome. Observational studies have shown a benefit of transfusion at Hct <24 in patients with NON-ST segment acute coronary syndrome and have seen a relative increase in mortality seen in patients transfused with Hct >27% (Am Heart J 2008;155:1047-53).

**Acute cerebrovascular accident.**

**Sickle Cell Disease**

**- Hypoplastic bone marrow**

**Anemia in patients receiving or awaiting to receive chemo/radiation therapy.**

**Anemia in pediatric patients.** The stated restrictive transfusion criteria are for transfusion of RBCs in adults and are not necessarily applicable to the pediatric and neonatal population. The following are guidelines are used at Lifebridge health.

**Neonatal (<24 hrs.):**
- Hgb < 13g/dL
- Persistent hypotension unresponsive to 20-30ml/Kg Plasmanate and pressor support

**Neonatal (<4 mos.):**
- Hgb < 13g/dL and heart or lung disease
- Blood loss >10% of blood volume (including phlebotomy)
- Hgb <8g/dL with clinical signs of anemia

**Pediatrics (>4 mos.)**
- Acute blood loss >15% of blood volume
- Hgb <8g/dL with clinical signs of anemia
- Hgb <13g/dL with cardiac or pulmonary disease
- Chronic anemia with Hgb <8g/dL and poor response to treatments
- Chronic anemia with Hgb <10g/dL and clinical signs or anemia
- Chronic anemia with hypertransfusion therapy (Sickle diseases, thalassemias)

These criteria are currently under review and are subject to change.
2.2 Indications for Transfusion of Apheresis Platelets:

- **Prophylactic platelet transfusion.**
  < 10K/ul in stable non-bleeding patients
  < 20K/ul in unstable non-bleeding patients
  < 50K/ul in patients that are actively bleeding or undergoing major surgery.
  < 100K/ul in patients undergoing neurosurgical or ophthalmologic procedures or at risk of intraventricular hemorrhage.

- Note: Procedures with insignificant blood loss or vaginal deliveries can be performed with a PLT count <50K/ul. In the absence of coagulopathy or thrombocytopenia, the following invasive procedures only require a plt count of 40-50K/ul: paracentesis/thoracentesis, respiratory/GI biopsies, closed liver biopsies, sinus aspiration and dental extraction. A threshold of 50,000/µL is typically recommended for high-risk lumbar puncture and a threshold of 20,000/ µL is recommended for placement of a central venous catheter. A threshold of 80K/ul has been proposed for spinal and epidural anesthesia. Bone marrow biopsies can be performed with a PLT count of 10-20K/ul.

- **Patients that are actively bleeding due to functional platelet defect.** Examples include patients with congenital defects, on drugs causing platelet dysfunction, and on ECHMO. Patients with congenital or acquired defects in platelet function may be transfused for critical bleeding or before major surgery regardless of the platelet count. Transfusion is generally not indicated when platelet dysfunction is extrinsic to the platelet (for example, uremia, certain subtypes of von Willebrand disease, hyperglobulinemia) since transfused platelets function no better than the patient’s own platelets. Other alternatives (for example, desmopressin in uremia or plasma exchange with hyperglobulinemia) are more often efficacious. When platelet surface glycoproteins are missing (for example, with Glanzmann thrombasthenia, Bernard-Soulier syndrome), transfusion should be undertaken only when more conservative efforts to manage bleeding have failed since alloimmunization may cause future life-threatening refractoriness.

- **Bleeding related to cardiothoracic surgery.** When coagulation parameters are not significantly abnormal with counts <100,000/µL or evidence of platelet dysfunction, accompanied by significant unexpected microvascular bleeding are appropriately treated with platelet transfusion. Routine prophylactic transfusions do not alter bleeding or postoperative transfusion requirements and are not recommended, even in patients on aspirin and P2Y12 receptor inhibitors (for example, clopidogrel, prasugrel and ticagrelor), who are known to be at higher risk for bleeding and reoperation.

- **Platelet transfusion in pediatrics.**
  - Platelet count <20K/uL in a stable, nonbleeding patient
  - Platelet count <50K/uL in a bleeding patient
  - Platelet count <50/uL in a preoperative patient or a patient at risk for IVH
  - Platelet count <300K/uL in DIC or unknown reason for bleeding
  - Platelet dysfunction by history (e.g., ASA), aggregation or bleeding time studies
• Less than 10,000 platelets per cubic millimeter

These criteria are currently under review and are subject to change.

- **Antiplatelet Agents** P2Y<sub>12</sub> receptor inhibitors and direct glycoprotein IIb/IIIa inhibitors impair platelet function. Platelets should not be transfused prophylactically without thrombocytopenia, but high-dose therapeutic transfusion may be required for life-threatening hemorrhage in patients on these drugs. The efficacy of platelet transfusion in cerebral hemorrhage in patients on antiplatelet agents has, however, been questioned.

-Massive transfusion. In the setting of a massive transfusion it is recommended to maintain platelets at 50K/ul and up to 100K/ul in patients with multiple trauma, CNS injury or in the presence of microvascular bleeding. The platelet count may fall below 50,000/µL when >1.5–2 blood volumes have been replaced with red cells. In the presence of microvascular bleeding, transfusion may be appropriate when counts are known or suspected to be <100,000/µL. Transfusion of pRBCs, plasma and apheresis platelets at a ratio of 6:6:1 can be considered to effectively reconstitute whole blood in the setting of a massive transfusion.

- **Acute Leukemia and Following High-Dose Chemotherapy** A prophylactic transfusion trigger of ≤10,000/µL may be used for stable patients, except as noted below. Patient-specific clinical data may increase the threshold at which prophylactic transfusion is desirable (for example, coagulopathy, drug-induced platelet dysfunction, fever/ sepsis, hyperleukocytosis, planned procedures, use of antithymocyte globulin, serious mucositis or cystitis, acute graft-versus-host disease, hepatic veno-occlusive disease, or rapid decline in counts). Prophylactic platelets may also be given at higher counts when availability of compatible platelet products is reduced. Higher-than-usual doses of platelets result in longer intervals between transfusions, which may be of value in the outpatient setting. Therapeutic transfusion for major bleeding should maintain counts ≥50,000/µL.

- **Chemotherapy for Solid Tumors** The usual prophylactic transfusion trigger is ≤10,000/µL. The greater risk of bleeding from bladder neoplasms/necrotic tumors and the serious impact of even minor bleeding in patients with limited physiologic reserves may warrant a transfusion trigger of ≤20,000/µL.

- **Transfusion Refractoriness** Posttransfusion platelet counts at 10–60 minutes after infusion should be obtained whenever transfusion refractoriness is suspected (successful transfusion defined as a corrected count increment [CCI] ≥7,500/µL per m<sup>2</sup> per 10<sup>11</sup> platelets infused). The 10–60 minute post-infusion count measures transfusion recovery, which is sensitive to immune platelet destruction, splenomegaly, major hemorrhage, or multiple severe non-immune conditions such as sepsis, coagulopathy, graft-versus-host disease, and hepatic veno-occlusive disease. Post-infusion counts at 24 hours assess platelet survival, which is sensitive to non-immune, as well as immune conditions.

Alloimmune refractoriness is more likely in the setting of at least two consecutive poor platelet increments at 10–60 minutes after transfusion. Alloimmunization should be
confirmed by demonstration of antibodies to antigens on platelets (that is, human leukocyte antigens [HLA] or human platelet antigens [HPA]). Single donor products identified either by HLA-A and -B locus/HPA matching and/or antibody compatibility, or by crossmatching should be transfused. When these are unavailable, fresh ABO-compatible units are preferred.

The incidence of HLA alloimmunization has been shown to be reduced by the use of leukoreduced cellular blood products in any patient expected to receive multiple platelet transfusions during the course of therapy.

Broadly alloimmunized patients without available matched products do not benefit from unmatched prophylactic platelet transfusions. For active bleeding, these patients may respond to high-dose or continuous platelet transfusion.

- **Idiopathic Thrombocytopenic Purpura (ITP)** Patients who experience major, life-threatening bleeding or intraoperative hemorrhage should receive high-dose platelet transfusions as well as steroids, intravenous immunoglobulin (IVIG) ± other second-line therapies.

Prophylactic transfusions are usually inappropriate since transfused platelets do not survive any longer than patients’ native platelets. Transfusion with IVIG may be considered before minor surgery with platelet counts \(\leq 50,000/\mu L\) or major surgery with counts \(\leq 80,000/\mu L\).

- **Thrombotic Thrombocytopenic Purpura/Hemolytic Uremic Syndrome (TTP/HUS) and Heparin-Induced Thrombocytopenia with Thrombosis (HITT)** Due to the significant risk of fatal thrombosis, platelets should be transfused only for life-threatening hemorrhage or, possibly, before invasive procedures in patients without thrombotic manifestations.

- **Posttransfusion Purpura (PTP)** Platelets may be used therapeutically for severe bleeding. Transfusion of randomly selected platelets is usually ineffective. Though efficacy is not well documented, HPA-1a (Pl[A])-negative platelets are frequently given empirically while specific alloantibody testing is in progress. High-dose IVIG is the treatment of choice for PTP.

- **Neonatal Alloimmune Thrombocytopenia (NAIT)** While awaiting response to IVIG, platelet transfusions are indicated for severe thrombocytopenia and/or bleeding. Platelets should lack the HPA recognized by circulating maternal antibodies, although platelets from random donors may be effective when matched platelets are unavailable.

If maternal platelets are used, they should be washed or volume-reduced and irradiated. HPA-1a-negative platelets are often used empirically as more than 75% of infants are affected by HPA-1a antibodies.

- **Aplastic Anemia** Transfuse stable patients prophylactically at counts \(\leq 5,000/\mu L\) and patients with fever or minor hemorrhage at counts 6,000–10,000/\(\mu L\).
2.3 Indications for Transfusion of Plasma:

- **Active bleeding or risk of bleeding due to deficiency of multiple coagulation factors.** When used to correct multiple coagulation factor deficiencies, plasma transfusion should be guided by coagulation testing. A prothrombin time (PT) greater than 1.5 times the mid-range of normal, an activated partial thromboplastin time (aPTT) greater than 1.5 times the top of the normal range or an INR of greater than 1.7. When such testing is not readily available, clinical evidence of bleeding may be used to direct transfusion decisions. Plasma should not be used for the a coagulopathy that can be corrected with administration of Vitamin K or normalizing abnormal coagulation screen results in the absence of bleeding.

- **Liver Disease** Plasma may be used to replace multiple coagulation factor deficiency from liver disease in patients who are actively bleeding or prior to an invasive procedure that would create a risk of bleeding. However, the response may be unpredictable and complete normalization of the hemostatic defect may not occur, therefore posttransfusion coagulation testing may be necessary to evaluate efficacy. Patients with liver disease may safely undergo operative or invasive procedures when the PT is ≤1.5 times the mid-range of normal.

- **Warfarin** Patients on warfarin who experience serious bleeding are treated with Vitamin K (at a dose determined by the INR) and plasma or prothrombin complex concentrates as clinically warranted. Recent guidelines suggest the use of 4-factor prothrombin complex concentrates are preferable to plasma transfusion for situations requiring urgent reversal of warfarin. Three-factor prothrombin complex concentrates with plasma have been proposed as an alternative without supporting randomized controlled trial data. All these suggestions, however, are based on limited evidence from the literature. When prothrombin complex concentrates are not immediately available, plasma transfusion may be necessary. As with liver disease, patients on warfarin may safely undergo operative or invasive procedures when the PT is ≤1.5 times the mid-range of normal.

- **Massive transfusion.** Transfusion of plasma can be indicated to correct coagulopathic bleeding. Transfusion of plasma and pRBC at a ratio of 1:1 can be considered to effectively reconstitute whole blood in the setting of a massive transfusion.

- **Thrombotic thrombocytopenic purpura (TTP).** Plasma exchange with plasma or cryoreduced Plasma is indicated for TTP. If plasma exchange is not immediately available, simple transfusion of plasma can be a useful alternative until exchange can be started. With equivalent levels of ADAMTS13, plasma and Plasma Cryoprecipitate Reduced are equally efficacious in the treatment of TTP and newly diagnosed TTP. If ADAMTS13 is used to diagnose and/ or monitor the response, a level should be obtained prior to initiation of treatment.

- **Intraoperative microvascular bleeding.** Plasma may be used to treat excessive microvascular bleeding, as determined on joint visual assessment of the operative field by
the anesthesiologist and surgeon when the coagulation screening test results are abnormal or are not available in a timely fashion. However, microvascular bleeding may be a result of hypofibrinogenemia or residual heparin effect.

- **Specific Plasma Protein/Factor Deficiencies**
  Deficiencies of other isolated plasma proteins and factors in a setting where concentrates are not readily available are also treated with plasma:

  - Prophylactic correction of a known factor deficiency for which specific concentrates are unavailable is guided by recommended perioperative hemostatic levels for each type of procedure.

  - Treatment or prophylaxis of thromboembolism in anti-thrombin, protein C, and protein S deficiencies.

  - Therapy of acute angioedema or preoperative prophylaxis in hereditary C1-inhibitor deficiency.

  - Factor V deficiency (no plasma concentrate available).

  - Factor XI deficiency (factor concentrate not available in the U.S.).

**Pediatrics** The indications for transfusion of plasma in children are essentially the same as for adults. In infants less than 6 months of age, the levels of vitamin K-dependent coagulants, anticoagulants, and fibrinolytic proteins are decreased, resulting in prolongation of coagulation assays as compared to older children and adults. Despite these differences, hemostatic balance is maintained in the healthy newborn, and spontaneous bleeding or thrombosis are rarely observed. The reserve capacity to respond to pathologic insults in a sick premature infant during the first week of life, however, may be limited.

2.4 **Indications for Transfusion of Cryoprecipitate:**

Cryoprecipitate is indicated for bleeding associated with fibrinogen deficiencies. Alternative uses in congenital fibrinogen deficiency, dysfibrinogenemia, Factor XIII deficiency, hemophilia A, or von Willebrand disease are not recommended and should be considered only when the specific factor concentrate is not available. Use of this component may be considered for uremic bleeding after other modalities have failed.

- **Acquired Fibrinogen Deficiency and Bleeding** Cardiac surgery is the most common surgical circumstance for cryoprecipitate transfusion. Excessive bleeding associated with worsened morbidity and mortality may result from coagulopathy due to exposure of the blood to artificial surfaces, hemodilution, hypothermia, and/or acidosis. Established general guidelines have recommended maintaining fibrinogen levels above 100 mg/dL in bleeding patients, although this number was not based on clinical trials and more recent studies in obstetric, trauma, and cardiac surgery patients indicate higher levels (150–200 mg/dL) improve *in vitro* parameters and may improve clinical outcomes. Further clinical validation, including use of cryoprepitate as the fibrinogen source, is required.
- **Massive Transfusion**  Transfusion for bleeding is often required after one or more blood volumes have been replaced when fibrinogen levels may decrease to <100 mg/dL. Algorithms employing early fibrinogen infusion have not been validated for efficacy or for safety with cryoprecipitate, but higher levels (150–200 mg/dL) may be beneficial in treating trauma, obstetric, and cardiac surgery patients.

- **Uremic Bleeding**  Other modalities such as 1-deamino-8-D-arginine vasopressin (DDAVP) are preferred. Cryoprecipitate is used in the failure or absence of other treatments, though effectiveness has not been uniformly observed.

- **Disseminated Intravascular Coagulation (DIC)**  Although transfusion in DIC is not based on lab values, severe hypofibrinogenemia (<100–150 mg/dL) that persists despite FFP replacement may be treated with cryoprecipitate.

- **Congenital Factor Deficiencies**

  **Congenital Fibrinogen Deficiency**  In 2009, a human-derived, virus-inactivated fibrinogen concentrate was FDA approved and is now considered first-line treatment for congenital fibrinogen deficiency. For spontaneous bleeding, prior to surgery, or to prevent fetal loss throughout pregnancy, recommendations are to keep fibrinogen levels above 100 mg/dL. After surgical or spontaneous bleeding is stopped, levels above 50 mg/dL should be maintained until wound healing is complete.

  **Hemophilia A and von Willebrand Disease (vWD)**  Cryoprecipitate is not recommended unless recombinant or virus-inactivated Factor VIII:C or Factor VIII:vWF concentrates are not available. DDAVP is the treatment of choice for type 1 vWD.

  **Factor XIII Deficiency**  Deficiency of Factor XIII presents risk for severe bleeding, spontaneous abortion, and spontaneous intracranial hemorrhage (25–40%). Cryoprecipitate is not recommended and only used if virus-inactivated Factor XIII concentrates are not available. Due to the high incidence of intracranial hemorrhage, newborns and some adults receive prophylactic dosing

2.5 **Indications for Modified Units:**

2.5.1  **Leukocyte reduced packed red blood cells.** All red cell units used at LBH are leukocyte reduced.

2.5.2  **Washed cellular units**

- History of anaphylactic or recurrent significant allergic transfusion reactions unresponsive to premedication.
- Patient with IgA deficiency when IgA deficient donor product is unavailable.
- Exchange transfusion of newborn or adult.
- Patient with history of severe and recurrent non-hemolytic febrile transfusion reactions that do not respond to pretreatment.
- Transfusion of washed maternal platelets in Neonatal alloimmune thrombocytopenia.
- Units in which donor has antibody (documented) to recipient antigen.
2.5.3 Irradiated cellular units
- Irradiation requirements for a specific patient need must be requested by the physician. This will permanently update the patient’s transfusion requirements to allow for continuous preparation of irradiated products.
- Infants and children with or suspected to have immune deficiency.
- Intrauterine transfusion or infants who have received prior intrauterine transfusion
- Directed donations from blood relatives (any degree relation), regardless of patient’s immune status
- Blood products selected from an HLA selected or HLA crossmatched donor, regardless of immune status
- Status post stem cell or bone marrow transplantation (allogeneic or autologous)
- Patient at risk for Graft vs Host disease
- Patients with congenital cellular immunodeficiency including (SCID, Wiskott-Aldrich, DiGeorge Syndrome)
- Patients receiving T-cell suppression therapy: purine nucleoside analogs (for example fludaribine, cladaribine, bendamustine, azathioprine) and alemtuzab (Campath)
- Patients with a history of Hodgkin disease
- All patients receiving Granulocyte transfusions
- All pediatric aliquots for neonates / patients < 1 year old, infants (< 4 mos or < 1500G).

**At physician request** for patients whom have received chemo or irradiation therapy for cancer:

- Acute lymphoblastic leukemia
- Acute myeloblastic leukemia
- Hodgkins disease
- Non-Hodgkins disease
- Neuroblastoma
- Glioblastoma

2.6 Indications for Appropriate Administration:
- In the absence of acute hemorrhage, RBC transfusion should be ordered as single units. Criteria for red cell transfusion are the same for both allogenic and autologous units.
- Laboratory results upon which a transfusion is based (Hct, PT, PTT, platelet count) should be drawn no more than 24 hours prior to transfusion.
- If alloimmune refractoriness to platelet transfusion is suspected documentation with 10-60 min post transfusion platelet count. Alloimmune refractoriness is most likely in the presence of two consecutive poor platelet increments measured at 10-60 min and is a candidate for HLA matched or cross match compatible platelets.
- It is acceptable to premedicate a patient with a history of urticarial reactions with antihistamines prior to transfusion. Simple urticarial reactions do not require stopping a transfusion.
- See the Nursing Departments’ “Blood and/or Blood Component Transfusion” procedure.
References

4. LifeBridge Health Transfusion Service BQA.1002 Peer Review Program