| Akron Children's Hospital | POLICY TITLE<br>**Blood Bank Guidelines and Procedures** | | | |
|---|---|---|---|---|
| **POLICY #** | **VERSION** | **CATEGORY** | **SUB-CATEGORY** | |
| 10037 | 13 | ☒Organizational | Choose a Policy Type. | Medical Staff Only -Choose a Policy Type |
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**THIS POLICY REPLACES:**
Click here to enter text.

**APPLICABILITY:**
☒Akron Children's Hospital & Affiliates

☐Children's Home Care

**Contact Person/Position: Christopher J. Klonk, MD/ Blood Bank Medical Director**

**Pages: 13**

| SPECIAL REVIEW | | ADMINISTRATIVE REVIEW |
|---|---|---|
| ☐Environment of Care/Safety | ☐Medical Staff | ☐Administrative Staff |
| ☐Health Information Management | ☐Nursing Guidelines | ☒Board of Directors |
| ☐Human Resources | ☐Patient Services | ☒Interdisciplinary Care Committee |
| ☐Infection Control | ☐Pharmacy & Therapeutics | ☐Medical Staff Executive Committee |
| ☐Information Services | ☐Radiology | ☐Click here to enter text. |
| ☐Laboratory/Pathology | ☐Click here to enter text. | |

**References and Accreditation Standard:**


1. Stehing L, Luban N, Anderson K et al: Guidelines for blood utilization review. Transfusion 1994;34:438-448.
2. Hess JR, Hippala S: Optimizing the use of blood products in trauma care. Critical Care 2005; 9(Suppl5): S10-14.
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| **APPROVAL** | **APPROVAL** |
|---|---|
| | **Melinda Spoerke** |
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| **Medical Director, Blood Bank** | |

**PURPOSE:**
The Blood Bank of Akron Children's Hospital provides transfusion services and consultation in immunohematology and transfusion medicine for all clinical and surgical areas at Akron Children's Hospital Main Campus.

**POLICY:**

**Specimens**

**There is no place in the laboratory where specimen identification is more important than in the Transfusion Service**. The transfusion of blood is a tissue transplant and subject to many of those limitations and legalities, one can better keep in perspective the possible dangers. Rules for blood banking are established through the Federal Food and Drug Administration (**FDA**), the College of American Pathologists (**CAP**), and other accrediting agencies and will be **rigidly** followed.

Specimens for any tests done by the Transfusion Service will not be drawn unless the patient has an identification wristband in place.

Specimens for any tests done by the Transfusion Service **must** be labeled properly with the following information before any test will be performed and must be accompanied with the Blood Bank Requisition.

Patient's first and last name
Medical record number or date of birth
Date when specimen drawn
Collector's employee #

**Blood Bank Requisition**

ALL Blood Bank specimens must be accompanied by a signed Blood Bank Requisition. **Two** signatures are required: collector's signature with employee number and the witness signature with employee number. The requisition must be signed at the time of collection. The Pertinent Patient History and Transfusion History sections along with the desired testing and Blood Product selection must be filled out by the Ordering Provider, who also must sign the form (electronically in EPIC or manually on a Blood Bank requisition). These requisitions need to be completely filled out in order to be processed.

**Indications for Transfusion of Blood Products**
These are guidelines and are not intended to serve as exclusive or all-inclusive medical indications for transfusion. Transfusions may be indicated in additional clinical situations not falling within these indications listed below.

**Whole Blood**: (Note: it usually takes at least 3 days to obtain whole blood) very few indications for whole blood.

**Packed Red Blood Cells (PRBC):**

Transfusion Guidelines for PRBCs in Infants Less than 4 Months of Age

1. Hemoglobin < 7g/dl with low reticulocyte count and symptomatic anemia (tachycardia, tachypnea, poor feeding).
2. Hemoglobin < 10g/dl and any of the following:
    a. On <35% oxygen hood.
    b. On oxygen by nasal cannula.
    c. On continuous positive airway pressure and/or intermittent mandatory ventilation on mechanical ventilation with mean airway pressure <6 cm of water.
    d. With significant tachycardia or tachypnea (heart rate >180 beats/minute for 24 hours, respiratory rate >80 beats/minute for 24 hours).
    e. With significant tachycardia or bradycardia (>6 episodes in 12 hours or 2 episodes in 24 hours requiring bag and mask ventilation while receiving therapeutic doses of methylxanthines).
    f. With low weight gain (<10 g/day observed over 4 days while receiving ≥100 kcal/kg/day).
3. Hemoglobin < 12 g/dl and either of the following:
    a. On >35% oxygen hood.
    b. On continuous positive airway pressure/intermittent mandatory ventilation with mean airway pressure ≥6-8 cm of water.
4. Hemoglobin <15 g/dl and either of the following:
    a. On extracorporeal membrane oxygenation.
    b. With congenital cyanotic heart disease.

Transfusion Guidelines for RBCs in Patients >4 Months of Age:

1. **Hemoglobin < 7g/dl**
    a. Asymptomatic hemodynamically stable non-trauma patients without ongoing blood loss, medical issues, hemoglobinopathies, coagulopathies, and cardio-respiratory abnormalities who are not about to undergo a homeostatic challenge should be considered for transfusion only if they are less than or equal to a hemoglobin of 7g/dl. However if their hemoglobin is less than 10g/dl it would be prudent to have a valid type and screen or type or type and cross in the event that they do drop lower.
    b. Emergency surgical procedure in patient with significant postoperative anemia.
    c. Preoperative anemia when other corrective therapy is not available.
    d. Intraoperative blood loss >15% total blood volume.

2. **Hemoglobin < 8g/dl and:**
   a. In perioperative period, with signs and symptoms of anemia.
   b. While on chemotherapy/radiotherapy.
   c. Chronic congenital or acquired symptomatic anemia.
3. **Hemoglobin <13g/dl and:**
   a. With severe pulmonary disease.
   b. On extracorporeal membrane oxygenation.
4. **Sickle cell disease and:**
   a. Cerebrovascular accident.
   b. Acute chest syndrome.
   c. Splenic sequestration.
   d. Aplastic crisis.
   e. Recurrent priapism.
   f. Preoperatively when general anesthesia is planned in patients with target hemoglobin of 10 mg/dL and the type of surgery could result in blood loss resulting in levels below 10.
5. **Chronic transfusion programs for disorders of red cell production** (e.g., β-thalassemia major and Diamond-Blackfan syndrome unresponsive to therapy.

**Transfusion Guidelines for PRBC in patients of any age:**

Patients who meet the criteria for the Massive Transfusion Protocol at Akron Children's Hospital and/or Acute
blood loss with hypoperfusion not responsive to other therapy.

**Transfusion Guidelines for Autologous Blood:**

For patients undergoing an elective surgical procedure with a risk of significant blood loss and sufficient time is available for them to donate in the pre-operative period. When autologous blood is obtained it should cover the needed surgery if possible. It is transfused using the same indicators as would be used for allogeneic blood.

**Transfusion Guidelines for Pheno-typed Blood:**

Phenotyped blood is appropriate in patients who will require multiple transfusions over a long period of time such as; patients with hemoglobinopathies, bone marrow failure patients and oncology or burn patients who demonstrate the ability to produce antibodies.

**Transfusion Guidelines for Intraoperative blood salvage:**

Intra-operative blood salvage can be used in selected cases where transfusion is frequently necessary and it can decrease donor exposure by 50%. All of the salvaged blood must be labeled and the transfusion started while in the operating room and transfused within six hours of salvage. See Intra-operative Salvage Policy.

**Transfusion Guidelines for Platelets**

1. Platelet count 5,000 to 10,000/µL with failure of platelet production.
2. Platelet count <30,000/µL in a neonate with failure of platelet production.
3. Platelet count <50,000/µL in stable premature infant:

a. With active bleeding
b. Before an invasive procedure.

4. Platelet count <100,000/µL in sick premature infant:
a. With active bleeding

5. Before an invasive procedure

Platelet count < 100,000/UL in patient of any age
a. Undergoing CNS or Ocular surgery
b. Patient undergoing ECMO
c. Multiple trauma patients actively bleeding
d. Cardiac surgery patients with active bleeding

**Without Thrombocytopenia**

1. Active bleeding in association with a qualitative platelet defect from any cause (ECMO, Cardiopulmonary Bypass, Platelet aggregation disorders that are acquired or inherited, DIC, uremia medications, etc.
2. Patients with an inherited or acquired qualitative platelet defect who are about to undergo a hemostatic challenge should have their platelet count increased by 50,000/UL in routine surgical procedures and by 100,000/UL in CNS or Ocular surgical procedures.

DIC = disseminated intravascular coagulation; ECMO = extracorporeal membrane oxygenation

**Transfusion Guidelines for Plasma Products**

**Fresh Frozen Plasma (FFP)**

1. Support during treatment of disseminated intravascular coagulation.
2. Replacement therapy:
a. When specific factor concentrates are not available, including, but not limited to, antithrombin; protein C or S deficiency; and Factor II, Factor V, Factor X, and Factor XI deficiencies.
b. During therapeutic plasma exchange when FFP is indicated.
3. Reversal of warfarin in an emergency situation, such as before an invasive procedure with active bleeding.
4. According to the Massive Transfusion Protocol at Akron Children's Hospital
5. FFP is not indicated for volume expansion only or enhancement of wound healing.

**Cryoprecipitate**

**Cryoprecipitate AHF**

1. Hypofibrinogenemia or dysfibrinogenemia with active bleeding.
2. Hypofibrinogenemia or dysfibrinogenemia while undergoing an invasive procedure.
3. Factor XIII deficiency with active bleeding or while undergoing an invasive procedure in the absence of Factor XIII concentrate.
4. Limited directed-donor cryoprecipitate for bleeding episodes in small children with hemophilia

A (when recombinant and plasma-derived Factor VIII products are not available).
5. In the preparation of fibrin sealant.
6. Von Willebrand disease with active bleeding, but only when both of the following are true:
a. Deamino-D-arginine vasopressin (DDAVP) is contraindicated, not available, or does not elicit a response.
b. If virus-inactivated plasma-derived Factor VIII concentrates (which contains von Willebrand factor) are not available.
7. According to the Massive Transfusion Protocol at Akron Children's Hospital.

**Transfusion Guidelines for Other Blood Bank Products**

White cell reduced components are used to prevent non-hemolytic febrile transfusion reactions and also to prevent or delay allo-immunization and platelet refractoriness in patients requiring repeated transfusions on a long-term basis. Cellular products at Akron Children's Hospital (PRBC and Platelets) are pre-leukoreduced from the Northeastern Ohio American Red Cross. Leukoreduction does not prevent graft versus host disease**. Leukoreduction makes Cellular products CMV safe.**

**CMV- screened components** are not routinely used because leukoreduction renders products CMV safe. CMV- screened components may be appropriate for organ donor patients.

**Irradiation of blood components** is used to prevent transfusion associated graft versus host disease in patients who are immunosuppressed. It should be ordered for all directed donations, all patients with immune deficiency, patients with malignancies who are immunosuppressed, infants less than 4 months of age, and solid organ/ hematopoietic transplant patients. Other immune deficiency conditions not mentioned here should have irradiated blood ordered. When in doubt order irradiated cellular blood components such as platelets and Packed Red Blood Cells

**Washing of blood components** is used to reduce allergic reactions and remove unwanted elements from units where they should be avoided (e.g., K+, anti-T in T-activated patients).

**Frozen blood** is used for highly allo-immunized patients where a specific donor is utilized or for autologous units collected >42 days prior to surgery.

**HLA or crossmatched platelets** are used for patient's refractory to random donor and single non-matched donor platelets. **Note: It usually takes at least four days to obtain this product.**

**Blood Ordering and Blood Bank Test Ordering Practices:**

No Blood Test Ordering: Many surgical procedures only require blood replacement in rare circumstances and hence no preoperative provision for blood for transfusion or testing is indicated unless the patient has a history of multiple transfusions or previous antibody formation. Such procedures that are commonly done at ACH include but are not limited to:
Herniorrhaphy
Circumcision/hypospadias repair
Cyst/skin lesion removal
Superficial lymph node biopsy
Strabismus surgery
Myringotomy tubes
Adenoidectomy/tonsillectomy-in patient who have not had previous RBC transfusions
Extremity surgery distal to the knee and elbow

**Type and Screen:** In some cases, significant blood loss is a possibility, but blood would not be required in the majority of cases. In this circumstance, a current Type and Screen should be completed prior to starting the procedure or while the below listed condition exists. Rapid availability is then assured. Such procedures or conditions commonly encountered at ACH include but are not limited to:
Cardiac catheterization
Laparotomy

CNS shunt insertion
Cleft lip/palate repair
Pectus repair
Fundoplication
Most bony procedures proximal to the knee and elbow

Patients with multiple long bone fractures, pelvic or spine fractures
Patients admitted for observation following trauma
Patients admitted for observation for possible GI bleed
Any patient with a previous history of transfusion or alloantibody formation
Patients admitted for complications related to Hemoglobinopathy
Spinal fusions, pelvic osteotomies or unstable pelvic fracture repairs where cell saver can be used
Craniosynostosis repair with cell saver
Level 2 and 3 traumas should be typed and screened upon presentation
Tonsillectomy and adenoidectomy in patients with a history of previous rbc transfusions

**Type and Cross (In EPIC this is TYPE and SCREEN and PREPARE):** In some cases, significant blood loss is anticipated or massive blood loss is an immediate, unavoidable risk. In these cases, a **Type and Screen and Prepare red cells is recommended.** This should supply sufficient blood to deal with immediate circumstance and allow time to obtain additional blood as needed. Such procedures or conditions commonly existing at ACH include but are not limited to:
Open heart surgery
Craniosynostosis repair where cell saver is not able to be used
Le Fort osteotomy
Vascular procedures (PDA, coarct)
Spinal fusions, pelvic osteotomies or unstable pelvic fracture repairs where cell saver cannot be used
Large tumor resection such as osteosarcoma/Ewing's sarcoma, laparotomy for large abdominal tumors or thoracotomy for large mediastinal or pulmonary tumors
Craniotomy for evacuation of hematoma, tumor or seizure focus resection
All level 1 traumas should have a type and prepare order upon presentation. All other trauma levels should be typed and screened upon presentation.
If autologous or directed blood has been obtained, it will be prepared for the procedure.

**Products Available on a Routine Basis**

**Packed Red Cells (PRBC)*** Unit = 300-400 mL of RBCs in preservative solution, HCT = 50% to 60% in Adsol products and 65% to 80% in CPD* products

**Platelets*** Single Donor Apheresis Platelet Unit is equivalent to six random donor platelet packs = approximately 150mL to 400 mL with an average of approximately 240 mL, Single donor aphaeresis units contain > 3 x 10e11 platelets.

**Plasma** Units = 220-280 mL

**Cryoprecipitate** Units = 30 mL

Blood is collected and supplied to us in units. Each unit of blood product is equal to one donor

exposure. Best practice dictates that one should strive to give an adequate amount of the products to bring about the desired change; while at the same time, exposing the patient to the least number of units (donors) possible. The table below is an approximation of how the blood product should be ordered in non- hemorrhaging patients where strict volume control is not an issue.** Blood is collected and supplied to us in units. Each unit of blood product is equal to one donor exposure. Best practice dictates that one should strive to give an adequate amount of the products to bring about the desired change; while at the same time, exposing the patient to the least number of units (donors) possible. The table below is an approximation of how the blood product should be ordered in non-hemorrhaging patients where strict volume control is not an issue.**

# Dosing of Blood Products in Neonates and Children:

**Blood Components and Dosing of Small Volumes in Neonatal and Pediatric Patients who are not actively bleeding or actively consuming the blood in products.**

| Component | Dose | Expected Increment |
|---|---|---|
| Packed Red Blood Cells | 10-15 mL/kg | Hemoglobin increase 2-3g/dL* |
| Fresh Frozen Plasma | 10-15 mL/kg | 15%-20% rise in factor levels (assuming 100% recovery) |
| Platelets: Apheresis | 5-10 mL/kg or 1 apheresis per 60-70 kg of lean body weight | 50,000/μL rise in platelet count (assuming 100% recovery)† |
| Cryoprecipitated AHF | 1-2 units/10 kg | 60-100 mg/dL rise in fibrinogen (assuming 100% recovery) |

Blood is collected and supplied to us in units. Each unit of blood product is equal to one donor exposure. Best practice dictates that one should strive to give an adequate amount of the products to bring about the desired change; while at the same time, exposing the patient to the least number of units (donors) possible. The table below is an approximation of how the blood product should be ordered in non- hemorrhaging patients where strict volume control is not an issue.**

| Desired volume | PRBC-<br>1 unit= 300ml to400ml | FFP-<br>1 unit = 220ml to 280ml | CRYO-<br>1 unit = approximately 30 ml | PLT<br>1 Apheresis is approximately 240ml to 400ml |
|---|---|---|---|---|
| 1-50ml | Order in ml | Order in ml | Order in units | Order in ml |
| 51-200ml | Order in ml | Order in ml | Order in units | ½ apheresis |
| 201-300ml | Order in ml | Order in units | Order in units | 1 apheresis |
| >300ml | Order in units | Order in Units | Order in units | 1 apheresis |

PRBC-Packed Red Blood Cells, FFP-Fresh frozen Plasma, Cryo-Cryoprecipitate AHF, Apheresis-Apheresis platelet = 6 RDU with only one donor.

**Administration of Blood Products:**

Unless otherwise specified (i.e., patient with need for strict intake and output regulation) red cells or plasma will be dripped into all patients > 10 kg using biutrol for approximating rate. You must specify if precise rate control if a pump is needed. For neonates, red cells or plasma is issued in syringes and administered by a pump. Platelet packs and cryoprecipitate are generally dripped into patients >20 kg and given as slow I.V. push to others, although in small patients (i.e., <10 kg) a pump may be used.

All blood products are administered through an appropriate filter.

**AT NO TIME IS THE ADMINISTRATION OF DRUGS OR FLUIDS OTHER THAN 0.9% SODIUM CHLORIDE (NACL) ALLOWED TO BE ADDED TO THE TRANSFUSION OF BLOOD OR BLOOD COMPONENTS OR TO BE RUN IN THE SAME LINE WITH BLOOD OR BLOOD COMPONENTS. ALWAYS FLUSH IV TUBING OR LOCKS WITH NORMAL SALINE BEFORE TRANSFSION OF BLOOD PRODUCTS AND AFTER TRANSFUSING BLOOD PRODUCTS PRIOR TO INSTILLING OTHER MEDICATIONS OR FLUIDS.**

*Dependent on anticoagulant-preservative solution: with 3 g/dL increment for CPD and CPDA-1 and 2 g/dL for AS-1, AS-3, and AS-5
†Assumes ≥5.5 x 10e10 platelets in 50 mL of plasma (whole-blood-derived) and ≥3.0 x 10e11 platelets in 250-300 mL plasma (apheresis).
CPD = citrate-phosphate-dextrose; CPDA-1 = citrate-phosphate-dextrose-adenine-1; AS = additive solution.
*Preservative solution can be removed from the red cells to concentrate them to a volume of 210-260mL with Hct = 65% to 80% and plasma can be removed from platelets to concentrate them to a volume of 25 or 50 mL for use in patients where minimizing volume is crucial. Both can also be washed. RBCs washed have a volume of 180-200 mL/unit, washed platelets 50 mL/unit. Note: washing platelets is rarely indicated and results in significant reduction in function and survivability.
*Red cells for neonates are obtained in special packs which contain either 200-240 mL packed red cells, Hct = 65% to 80% or 450-410 mL whole blood
** In ordering for non- hemorrhaging patients less than 5 kg; PRBC, platelets and plasma should be ordered in ml and cryoprecipitate by unit. For non-hemorrhaging patients between 5 kg to 20 kg, PRBC and plasma can be ordered in ml and platelets and cryoprecipitate should be ordered in units or ½ units. This way you will get maximum benefit and minimum blood product exposure. For all patients greater than 20 kg in whom exact volume is not critical, you should attempt to order blood products in units where possible taking into account the approximate volumes of the units of the various blood products. For example, you have a 39 kg patient who is anemic and not actively bleeding or hemolyzing and you desire to raise the hemoglobin by 1g/dl. Your usual transfusion would be 10 mL/kg which would require 390 ml. If, instead of ordering 390ml, you order one unit, the patient will receive 320-375 mL, almost the same amount. You can then check the Hgb and see if another unit seems reasonable and justifiable. This way the patient is only exposed to one donor. For

a platelet example; you have a 15 kg child who is not extremely volume sensitive and not actively consuming platelets and you wish to raise the platelet count by 50,000/microliter. You calculation calls for 150ml of platelets. You order ½ apheresis platelet which would be approximately 75-200ml. Following the transfusion you re-check the count and if you did not reach the desired effect you can give the second ½ of the same unit with only one donor exposure.

**Transfusion Reaction:**

Transfusion of blood and blood components is ordinarily safe, but adverse effects may occur. These adverse effects are called Transfusion Reactions. Transfusion reactions may be acute where the onset of symptoms occurs immediately or within a short time of the commencement of the transfusion; or, they may be delayed where they occur days or weeks afterwards.

**The blood bank is to be notified as soon as feasible for all suspected transfusion reactions. All remaining untransfused blood product, are to be returned to the blood bank as soon as possible. The exceptions are volume overload and citrate toxicity as defined below. In the case of a purely allergic or urticarial reaction, where no sign of anaphylaxis is present, the blood bank must be notified and a sample sent, but the remaining untransfused product does not have to be returned as described below.**

**Acute Transfusion Reactions:**

1. **Acute Hemolytic Transfusion Reactions (AHTR).**

An AHTR is triggered by an antigen-antibody reaction that activates the complement and coagulation systems and prompts inflammatory and endocrine responses. Shock, disseminated intravascular coagulation, acute renal failure and death may occur. Life-threatening AHTRs are usually due to ABO incompatibility. Incompatibility of other blood groups may result in an AHTR but usually they result in less severe reactions. Reactions may occur after as little as 10-15 ml of incompatible blood has been infused. Symptoms that may occur include fever, chills, flank pain, chest pain, hypotension, nausea, hemoglobinuria, shock, generalized bleeding, back pain, and pain at infusion site. Whenever any transfusion reaction including an AHTR is suspected, the transfusion must be stopped immediately, the IV kept patent with a saline lock or saline drip and the physician or APP are immediately notified. If the symptoms are severe and include mental status changes or changes in vital signs that include hypoxia or shock, a code blue should be called.

2. **Febrile Nonhemolytic Transfusion Reactions (FNTR)**

A FNTR reaction involves a 1 degree or more Celsius temperature rise associated with the transfusion, and may begin any time during the transfusion, or within four hours following its completion. Some FNTR reactions are caused by a recipients antibodies reacting to transfused white blood cells or to pyrogens in the serum of the donor which the recipient reacts to. These are usually benign reactions and can be minimized by giving antipyretics prior to the transfusion and by using leukocyte-reduced blood components (all blood components at ACH are pre-leukoreduced except for whole blood and autologus blood). Since a temperature rise of 1 degree Celsius may also be the initial sign of several other types of transfusion reactions it is important to rule out, more serious transfusion reactions. Therefore, a rise in temperature of one degree Celsius is treated in a fashion similar to a suspected acute hemolytic transfusion reaction.

3. **Bacterial Contamination of the Transfused Product**

Bacterial contamination is rare, but such reactions may be fatal. Severe reactions are characterized by high fever, shock, hemoglobinuria, DIC, and renal failure. While platelets are the most common

product to be contaminated with bacteria, this phenomenon can occur with any blood product.

4. **Anaphylactic Reactions and Anaphylactoid Reactions (for the purposes of this document both will be considered the same)**

Anaphylactic Reactions can present similar to “urticarial reactions” (described below) and or acute hemolytic transfusion reactions (AHTR). They usually can be distinguished from AHTR by the absence of fever. They can usually be distinguished from urticarial reactions by occurring very early in the transfusion (many times after only a few ml of product is transfused) and by being much more sever. Initially hives, pruritus, and
flushing can be seen similar to urticarial reactions; however, anaphylactic reactions frequently progress to include stridor (laryngeal edema), wheezing (bronchospasm), and circulatory collapse (hypotension and tachycardia). Other general signs and symptoms may be present such as abdominal pain and nausea and vomiting. Causes may include anti-IgA antibodies in IgA-deficient patients and antibodies to soluble plasma antigens or to drugs contained in transfused blood products.

5. **Urticarial Reaction (purely allergic reaction)**

Urticarial reactions are characterized by flushing, hives, and itching (pruritus) with no temperature rise of more than 1 degree Celsius and no other signs of a transfusion reaction. This must be differentiated from an early anaphylactic reaction by lack of progression to any of the other symptoms described above in the anaphylactic transfusion reaction section and any of the other signs of transfusion reaction. In all transfusion reactions, the treating physician or APP must evaluate the patient according to the transfusion reaction protocol described at the end of this section. If it is determined by the physician or APP that the reaction that is occurring is purely urticarial, then this is one instance where the unit that is causing the reaction may be re-started cautiously under the direction of the physician or APP. In order to accomplish this re-start, the physician or APP is to evaluate the patient to determine that significant clinical improvement has occurred following treatment (the treatment is prescribed by the physician or APP and usually includes anti-histamines). Then the physician or APP (or designee) must call the blood bank to determine if the clerical check matches, that the post transfusion DAT is negative and that there is no evidence of hemolysis in the post transfusion sample. In such cases, if the four hour expiration from the time of issuance has not occurred, then the transfusion may be re-started under the direction of the physician or APP and with close monitoring. In such cases the Blood Bank ultimately may not receive the untransfused portion of the unit in question.

6. **Circulatory Overload**

Rapid increases in blood volume are poorly tolerated by patients with compromised cardiac or pulmonary status or chronic anemia with expanded plasma volume. Even transfusion of small amounts of blood may cause circulatory overload in infants. These are recognized by showing signs and symptoms of congestive heart failure with associated chest x-ray findings of pulmonary edema. Clinical findings may include pulmonary rales, edema and increased central venous pressure. Laboratory findings may include an elevated serum Brain Natriuretic Peptide (BNP). The workup of this reaction is determined by the physician or APP and the Blood Bank should be notified for record keeping. It is important for the physician or APP to differentiate this reaction from TRALI (see next section) because in circulatory overload the untransfused portion of the blood product does not necessarily need to be returned to NORC for testing and the blood bank does not need to perform

additional workup.

7. **Transfusion Related Acute Lung Injury (TRALI)**

These reactions involve clinically apparent pulmonary edema which occurs within 6 hours of a transfusion without concurrent elevation in central venous pressure and elevated BNP levels. The clinical picture is similar to that of Adult Respiratory Distress Syndrome (ARDS) occurring during or within 6 hours of the transfusion when other causes of ARDS have been excluded.

8. **Citrate Toxicity and Hypothermia**

Citrate toxicity and hypothermia both occur when large volumes of blood have been given in a short period of time. Citrate toxicity is caused by the Citrate anticoagulant found in the blood products binding calcium and causing hypocalcemia. Treatment is usually accomplished by the treating physician or APP administering calcium orally or intra-venously. In these cases when no other signs or symptoms of transfusion reaction are present, the Blood Bank does not need to be involved. Citrate toxicity can be recognized early on as peri-oral or extremity tingling and numbness. Untreated it can progress to tetany and muscle spasm.

Hypothermia is also related to rapid infusion or large volumes of blood product, especially in small patients. Treatment and prevention include using an approved blood warmer and warming the patient. This is usually performed under the direction of the treating physician or APP. Hypothermia is recognized by a decrease in body temperature during or with four hours of a transfusion and the absence of other signs or symptoms of a transfusion reaction. The Blood Bank is usually not involved in hypothermic transfusion reactions.

**Delayed Transfusion Reactions**

1. Delayed hemolytic transfusion reactions are transfusion reactions that occur days to weeks following a transfusion. These reactions usually result from exposure to red cells that have antigens that the patient lacks allowing formation of an alloantibody that was not present at the time of the transfusion or that was not in high enough titers to be picked up by routine antibody screen (anamnestic response). Most delayed hemolytic transfusion reactions are not as severe as acute hemolytic transfusion reactions (AHTR); although in certain circumstances they can be severe and life threatening. Usually the hemolysis associated is extra-vascular (AHTR is intra-vascular) and occurs at slower rate. The clinical presentation is usually associated with fever and decreased hemoglobin. Jaundice and hemoglobinuria may or may not be present. DIC and renal failure rarely ensue.

   **Transfusion Reaction Protocol:**

   The tranfusionist (physician, APP, Nurse, Anesthetist, Anesthesiologist, Physician Assistant and Nurse Practitioner) must be aware of the signs and symptoms of a transfusion reaction and must monitor the patient in a way to be able to identify and treat a transfusion reaction in a timely fashion. The patient or his/her parent or guardian should be made aware of signs and symptoms of transfusion reactions and instructed to report any of these to the treating physician or APP or tranfusionist.

   When a transfusion reaction is suspected:

   1. Immediately stop the transfusion and keep the vein open with a saline drip or a saline lock

2. Stay close to the patient and monitor him while calling the treating physician or APP. A Code Blue should be called if the symptoms/signs are severe enough to warrant. Severe symptoms/signs may include but are not limited to: change in mental status, significant change in vital signs such as hypotension, hypoxia or decrease in oxygen saturation, and severe respiratory difficulty such as stridor or severe bronchospasm.
3. Once the patient is stabilized and the physician or APP has initiated treatment, notify the Blood Bank via phone call. Obtain a transfusion reaction workup order from the physician or APP in EPIC or in non-EPIC locations on the chart order sheet and send the untransfused portion of the unit to the Blood Bank along with the necessary blood and urine sample. The transfusion with the same unit may not be restarted except in the case of an Urticarial reaction (see #4)

In the case where the physician or APP has determined that the reaction is urticarial (purely allergic) and the patients symptoms have resolved with treatment, the unit may be cautiously re-started with close monitoring if the physician or APP (or his designee) has called the Blood Bank and determined that the post transfusion DAT is negative, the clerical check is appropriate and there are no signs of hemolysis in the post transfusion blood sample that was sent. The unit may only be re-started under close monitoring and if the four hour expiration from the time of issuance has not occurred.