



POLICY TITLE

Blood Bank Guidelines and Procedures Mahoning Valley

| POLICY # | VERSION | CATEGORY | SUB-CATEGORY | |
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| KEY WORDS Blood Bank | | <input type="checkbox"/> Divisional | Professional Services | Choose a Policy Type |
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APPLICABILITY:

- Akron Children's Hospital & Affiliates
- Children's Home Care

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SPECIAL REVIEW

ADMINISTRATIVE REVIEW

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| <input type="checkbox"/> Environment of Care/Safety | <input type="checkbox"/> Medical Staff | <input type="checkbox"/> Administrative Staff |
| <input type="checkbox"/> Health Information Management | <input type="checkbox"/> Nursing Guidelines | <input checked="" type="checkbox"/> Board of Directors |
| <input type="checkbox"/> Human Resources | <input type="checkbox"/> Patient Services | <input type="checkbox"/> Interdisciplinary Care Committee |
| <input type="checkbox"/> Infection Control | <input type="checkbox"/> Pharmacy & Therapeutics | <input type="checkbox"/> Medical Staff Executive Committee |
| <input type="checkbox"/> Information Services | <input type="checkbox"/> Radiology | <input type="checkbox"/> Click here to enter text. |
| <input type="checkbox"/> Laboratory/Pathology | <input type="checkbox"/> Click here to enter text. | |

REFERENCES AND ACCREDITATION STANDARDS:

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APPROVAL

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PURPOSE:

The Blood Bank of Akron Children's Hospital provides transfusion services and consultation in immunohematology and transfusion medicine to the Main campus at Akron Children's Hospital. Transfusion services at the Mahoning Valley Beeghly campus are provided by St. Elizabeth's Health Center Blood Bank.

POLICY:

Specimens

No place in the laboratory is specimen identification more critical than in the Transfusion Service. If one recalls that 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, the College of American Pathologists, 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:

- patient's first and last name
- Date of birth
- Date and time specimen drawn
- Collector's employee #
- Verifier's employee #
- Transfusion identification number label

Indications for Blood Transfusion

These indications are guidelines and are not intended to serve as exclusive medical indications for transfusion. Transfusions may be indicated in clinical situations not falling in these indications.

Red Blood Cells

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

1. Hemoglobin <7 mg/dl with low reticulocyte count and symptomatic anemia (tachycardia, tachypnea, poor feeding).
2. Hemoglobin <10mg/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.
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 <12mg/dl and either of the following:
 - a. On >35% oxygen hood.
On continuous positive airway pressure/intermittent mandatory ventilation with mean airway pressure ≥6-8 cm of water.
4. Hemoglobin <15mg/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: asymptomatic hemodynamically stable non-trauma patients without ongoing blood loss, medical issues, hemoglobinopathies, coagulopathies, and cardiorespiratory abnormalities who are not about to undergo a hemostatic challenge should be considered for transfusion only if they are less than or equal to a hemoglobin of 7 g/dl. However if their hemoglobin is less than 10g/dl it would be prudent to have a valid type and screen or type and cross in the vent that they do drop lower.

1. Emergency surgical procedure in patient with significant postoperative anemia.
2. Preoperative anemia when other corrective therapy is not available.
3. Intraoperative blood loss >15% total blood volume.
4. Hemoglobin <8 mg/dl and:
 - a. In perioperative period, with signs and symptoms of anemia.
 - b. While on chemotherapy/radiotherapy.
 - c. Chronic congenital or acquired symptomatic anemia.
5. Acute blood loss with hypovolemia not responsive to other therapy.
6. Hemoglobin < 13mg/dl and:
 - a. With severe pulmonary disease.
 - b. On extracorporeal membrane oxygenation.
7. 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 (target hemoglobin 10 mg/dL).
8. Chronic transfusion programs for disorders of red cell production (eg, β -thalassemia major and Diamond-Blackfan syndrome unresponsive to therapy).

Platelets

Transfusion Guidelines for Platelets in Neonates and Older Children With Thrombocytopenia

1. Platelet count 5,000 to 10,000/ μ L with failure of platelet production.
2. Platelet count <30,000/ μ L in neonate with failure of platelet production.
3. Platelet count <50,000/ μ L in stable premature infant:
 - a. With active bleeding, or
 - b. Before an invasive procedure, with failure of platelet production.
4. Platelet count <100,000/ μ L in sick premature infant:
 - a. With active bleeding, or
 - b. Before an invasive procedure or hemostatic challenge in patient with DIC.

Without Thrombocytopenia

1. Active bleeding in association with qualitative platelet defect.
2. Unexplained excessive bleeding in a patient undergoing cardiopulmonary bypass.
3. Patient undergoing ECMO with:
 - a. A platelet count of <100,000/ μ L, or
 - b. Higher platelet counts and bleeding.

DIC = disseminated intravascular coagulation; ECMO = extracorporeal membrane oxygenation.

Plasma

Transfusion Guidelines for Plasma Products in Neonates and Older Children

Fresh Frozen Plasma (FFP)

1. Support during treatment of disseminated intravascular dissemination.
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 (cryopoor plasma, plasma from which the cryoprecipitate has been removed).
3. Reversal of warfarin in an emergency situation, such as before an invasive procedure with active bleeding.

Note: FFP is not indicated for volume expansion or enhancement of wound healing.

Cryoprecipitate

Cryoprecipitated 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 response.
 - b. Virus-inactivated plasma-derived Factor VIII concentrate (which contains von Willebrand factor) is not available.

Autologous blood is appropriate for patients when they are undergoing a surgical procedure where risk of significant blood loss exceeds 50%. When autologous blood is obtained it should cover the needed surgery. It is transfused using the same indicators as would be used for allogeneic blood.

Phenotyped blood is appropriate in immunocompromised patients undergoing repeat transfusion (e.g. Hb S patients undergoing hemopheresis) to reduce the risk of allo-immunization.

White cell reduced components are used to prevent non-hemolytic febrile transfusion reactions, to prevent or delay allo-immunization and platelet refractoriness in patients requiring repeated transfusions on a long-term basis, and are used at ACH on a routine basis.

CMV- screened components are not routinely used as components are leukoreduced. CMV- screened components may be appropriate for organ donor patients.

Irradiation of blood components is used for all directed donations from family members, all patients with congenital immune deficiency, patients with malignancies who are immunosuppressed, and premature infants.

Washing of blood components is used to avoid anaphylactic reactions and remove unwanted elements from units where they should be avoided (e.g., 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 patients refractory to random donor and single non-matched donor platelets.

Surgical Blood Ordering

Many surgical procedures only require blood replacement in rare circumstances and hence no preoperative provision for blood for transfusion is indicated. Such procedures commonly done at ACH include but are not limited to:

- herniorrhaphy
- circumcision/hypospadias repair
- cyst/skin lesion removal
- lymph node biopsy
- strabismus surgery
- myringotomy tubes
- adenoidectomy/tonsillectomy in patients with no prior history of transfusion
- most minor Orthopedic procedures distal to the knee and elbow

In some cases, significant blood loss is a possibility but blood would not be required in the majority of cases. In this circumstance, a type and screen is recommended because rapid availability is assured. Such procedures commonly performed at ACH, Akron campus include but are not limited to:

- cardiac catheterization
- osteotomy
- laparotomy
- CNS shunt insertion
- cleft lip/palate repair
- pectus repair
- fundoplication
- adenoidectomy and tonsillectomy in patients with a prior history of transfusion
- inpatients who have a history of previous alloantibody formation

In some cases, significant blood loss is anticipated or massive blood loss is an immediate, unavoidable risk. In these cases, typing and crossmatching for 2 units is recommended as it should supply sufficient blood to deal with immediate circumstance and allow time to obtain additional blood as needed. Such procedures commonly performed at ACH, Akron campus include but are not limited to:

- open heart surgery
- craniostenosis repair
- Le Fort osteotomy
- vascular procedures (PDA, coarc)
- spinal fusion
- large tumor resection
- Grade 3 or more severe trauma
- Multiple long bone fractures or unstable pelvic fractures
- Patients admitted for observation for possible GI bleed
- Any patient with a previous history of transfusion or alloantibody formation who is about to undergo a hemostatic challenge

If autologous or directed blood has been obtained, it will be crossmatched for the procedure.

Ordering of Blood Products
Products Available on a Routine Basis

| | |
|----------------------|---|
| Red cells* | Unit = 320-375 mL of RBCs in preservative solution, Hct = 50% to 60% in Adsol products and 65% to 80% in CPD products. |
| Platelets* | Random Donor Platelet Unit = 40-60 mL of platelets in plasma, contains > 5.5 X 10 ¹⁰ platelets. Single Donor Apheresis Platelet Unit is equivalent to six random donor platelet packs. It is approximately 200 to 400 ml and 90% of the units contain 3 x 10E11 platelets |
| Plasma | Units = 220-280 mL |
| Cryoprecipitate | Units = 10-15 mL |
| Red cells and plasma | Order by amount required. An order of more than 350 mL of red cells and 250 ml of plasma required more than one unit to be ordered. |

*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.

*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.

Ordering Pattern

One wants to give enough products to bring about a significant change while exposing the patient to the least number of units possible.

Approximate dosages for blood products in a non-bleeding patient

Blood Components and Dosing of Small Volumes in Neonatal and Pediatric Patients

| 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 : Random Donor Platelet Pack | 5-10 mL/kg or 1 pack/10 kg | 50,000/ μ L rise in platelet count (assuming 100% recovery) [†] |
| Cryoprecipitated AHF | 1-2 units/10 kg | 60-100 mg/dL rise in fibrinogen (assuming 100% recovery) |

*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 $\geq 5.5 \times 10^{10}$ platelets in 50 mL of plasma (whole-blood-derived) and $\geq 3.0 \times 10^{11}$ platelets in 250-300 mL plasma (apheresis).

CPD = citrate-phosphate-dextrose; CPDA-1 = citrate-phosphate-dextrose-adenine-1; AS = additive solution.

In ordering for patients less than 5 kg, PRBC platelets and plasma should be ordered in ml, cryo by unit. For 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 partial units when possible with units being able to be split into 1/2 units for Random Donor Platelet Packs and 1/2 units for Single Donor Apheresis Platelet Units where applicable. In patients greater than 20 kg, when exact volume is not as critical, round off dosage of all products to the nearest unit. This way you will get maximum benefit and minimum blood product exposure. For example, you have a 39 kg patient who is anemic. Your usual transfusion would be 10 mL/kg which would require 390 mL, but if you order one unit the patient will receive 320-375 mL, almost the same amount. You can then check Hgb and see if another unit seems reasonable and justifiable. Conversely, if you are ordering blood for a 27 kg patient, it would be

reasonable to order one unit (if the patient could tolerate the added volume) because 320 mL is not significantly more than 270 mL and the patient has already been exposed to that unit of blood which would yield maximum benefit from that exposure.

Administration

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 by 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 TRANSFUSION OF BLOOD PRODUCTS AND AFTER TRANSFUSING BLOOD PRODUCTS PRIOR TO INSTILLING OTHER MEDICATIONS OR FLUIDS.

Transfusion Reactions

Principle:

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

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 in 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 recipient's 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). Since a temperature rise of 1 degree Celsius may be the initial sign of several types of transfusion reactions it is important to rule out other, 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 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 severe. 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, 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 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 this reaction 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 without concurrent elevation in central venous pressure and elevated BNP levels which occurs within 6 hours of a transfusion. 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 a 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 transfusionist (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 transfusionist.

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 patient's 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.