

## COMPLICATIONS OF BLOOD TRANSFUSION: DISCUSSION AND INVESTIGATION

It is assumed the reader has a working knowledge of immunohematology. Requirements for COLA's Laboratory Accreditation and Community Hospital Laboratory Accreditation programs are underlined for your information.

Every medical procedure bears potential benefits to the patient as well as potential risks. These must be evaluated whenever transfusion of blood or blood components is considered.

This COLA Fast Facts discusses various adverse effects of blood transfusion, and suggest a protocol to be followed when a transfusion reaction occurs. However, each immunohematology laboratory should have its own policies and procedures to investigate a transfusion reaction.

The information in this publication is from generally recognized authorities, but does not constitute a comprehensive practice of immunohematology and transfusion services.

### Immune-Mediated Transfusion Reactions

#### Acute Hemolytic

The most severe reactions occur when transfused red blood cells (RBCs) combine with recipient antibodies and lead to increased RBC destruction. Most of these cases result from transfusion of ABO-incompatible red cells, and can be life-threatening. Other RBC antibodies commonly identified as causing acute hemolytic transfusion reactions are anti-Kell, anti-Kidd (anti-Jka), and anti-Duffy (anti-Fy<sup>a</sup>). Symptoms of acute hemolytic transfusion reaction may begin mildly, after infusion of as little as 10-15 mL of incompatible blood.

The following reactions may occur in an acute hemolytic immune-mediated transfusion reaction:

- When incompatible RBCs bind with patient antibody, the immune complex on the cell surface can activate

### Definitions

**Anamnestic:** An increased antibody response following a secondary exposure to the antigen.

**Transfusion Reaction:** A transfusion reaction may be defined as any unfavorable transfusion-related event occurring in a patient during or after transfusion of blood components.

**Acute Transfusion Reaction:** This unfavorable event may occur within minutes or hours of beginning the transfusion.

**Delayed Transfusion Reaction:** When a transfusion reaction manifests itself a few days after the transfusion.

**Immune-Mediated Transfusion Reaction:** Occurs when the reaction is the result of a recipient's immune response to the transfused components.

**Non-Immune-Mediated Transfusion Reaction:** When the reaction is the result of mechanisms other than an immune response at work in the recipient.

**Platelet Refractoriness:** When the platelet count fails to increase after a transfusion of an appropriate dose of platelets.

complement which leads to cell lysis and the release of anaphylatoxins  $C3_a$  and  $C3_b$ .

- Hemolysis that occurs intravascularly releases hemoglobin, RBC stroma, and intracellular enzymes into the plasma which result in the manifestation of symptoms.
- Renal failure can result from the presence of cell fragments and microthrombi in the renal vasculature. Complement activation may lead to disseminated intravascular coagulopathy (DIC) characterized by the formation of microthrombi within the vasculature, depletion of fibrinogen, production of fibrin degradation products, and a general outcome of uncontrollable bleeding.

Table 1 provides a broad categorization of immune-mediated transfusion reactions.

<b>Table 1</b>	
<b>Immune-Mediated Transfusion Reactions</b>	
<b>Acute</b>	<b>Delayed</b>
Hemolytic	Alloimmune
Febrile, Nonhemolytic	Hemolytic
Transfusion-related	Graft-vs-Host
lung injury (TRALI)	Disease
Urticarial	Platelet-refractory
Anaphylactic	

### Febrile Non-Hemolytic Transfusion Reactions

Febrile non-hemolytic transfusion reactions occur in about 1% of transfusions. Along with allergic reactions, febrile reactions are the most commonly encountered type of transfusion reaction. The commonly accepted definition of a febrile transfusion reaction is an increase in temperature of  $1^{\circ}\text{C}$  or  $2^{\circ}\text{F}$  or more associated with transfusion and without any other medical explanation. These reactions may be caused by antileukocyte antibodies present in the recipient's plasma directed against antigens present on transfused monocytes, granulocytes, and lymphocytes.

A patient may be sensitized during pregnancy, previous transfusion, or tissue transplantation. Some reactions are thought to be due to the infusion of cytokines produced by leukocytes during component storage. Since a febrile condition may be a symptom of a more serious hemolytic transfusion reaction, febrile situations should always be promptly evaluated. Bedside filters that remove leukocytes, as well as leukocyte-poor blood components, washed RBCs, or deglycerolized RBCs, may be used to prevent a febrile transfusion reaction.

### Transfusion-Related Acute Lung Injury (TRALI)

Whenever a transfusion recipient experiences acute respiratory difficulties or x-ray findings demonstrate pulmonary edema without evidence of cardiac involvement, transfusion-related acute lung injury should be considered. The severity of respiratory distress is usually proportional to the volume of blood product transfused. It is thought that transfused antileukocyte antibodies react with recipient granulocytes to initiate a sequence of events that result in pulmonary capillary damage, and eventually an accumulation of fluid in alveolar spaces. Decreased efficiency in the exchange of gases leads to hypoxia and respiratory symptoms. Patients should receive appropriate respiratory support, and generally regain adequate pulmonary function in a day or two.

### Allergic (Urticarial) Transfusion Reactions

Allergic reactions to blood transfusion complicate about 1% of transfusions. The majority of symptoms are mild and include local redness, itching and hives. Fever and other symptoms usually are not present. It is thought this reaction is the result of either foreign allergens in the donor plasma with which recipient antibodies react, or transfused donor antibodies which combine with recipient allergens.

Some physicians will interrupt the transfusion when allergic symptoms begin, treat the patient with antihistamine therapy, then, when symptoms have subsided, resume the transfusion with the remainder of the component unit. Allergic reactions to transfusion can not be completely prevented, but patients with a history of this type of reaction may be premedicated with antihistamines before the transfusion is initiated.

Since some allergic reactions are severe, the transfusionist and the laboratory should follow the established protocols for transfusion reactions and continue to observe the patient for severe reaction symptoms.

### Anaphylactic Transfusion Reactions

Anaphylactic transfusion reactions are the result of an immediate hypersensitivity type of immune response. Symptoms may begin after infusion of only a few milliliters of blood. Anaphylaxis may begin rather mildly with skin flushing, hives, and itching, but can progress to loss of consciousness, shock, and death. Any organ system can be involved, and symptoms may include coughing, dyspnea, abdominal cramps, nausea, vomiting, diarrhea, chest pain, hypotension, and syncope.

Patients with this type of reaction are usually determined to have a congenital deficiency in IgA and have produced anti-IgA which then reacts with donor IgA in transfused plasma. IgA deficiency is the most common congenital immune deficiency, but anaphylactic transfusion reactions remain quite rare.

Patients known to have this condition may be transfused with products in which all plasma has been removed (washed cells), or they may be transfused with blood from donors who are also IgA deficient. Autologous donation may be an option when the need for blood transfusion can be planned.

### Alloimmune

Alloimmune transfusion reactions occur when patients develop antibodies as the result of receiving blood or blood products. Symptoms may be mild to severe, depending on the hemolytic affect of antibody attachment to the surface of the RBCs. Alloimmunization may lead to future difficulty in finding compatible RBC units or component products. Compatibility testing and bedside leukocyte filters help minimize the occurrence of alloimmunization.

### Delayed Hemolytic

Hemolytic transfusion reactions are usually due to non-ABO incompatibilities. The mechanism of RBC destruction for most delayed hemolytic transfusion reactions occurs when the sensitized RBCs are removed from the circulation by the reticuloendothelial system (RES). The patient experiences less severe symptoms, including mild fever, chills, and moderate jaundice, than in the acute hemolytic reaction.

Recipients may be sensitized to RBC antigens during pregnancy or previous transfusion (alloimmunization). The corresponding antibodies may be undetectable in pre-transfusion laboratory testing, but when transfused, an anamnestic response leads to antibody production and clinical symptoms in about three to seven days post-transfusion.

Unexpected or unexplained decreases in hemoglobin or hematocrit values following a transfusion should be investigated as a possible delayed hemolytic transfusion reaction.

### Graft-Versus-Host Disease

Graft-vs.-host disease (GVHD), a rare complication of transfusion, is a concern of a particular population of recipients and has a significant rate of mortality. Immunosuppressed patients, fetuses receiving intrauterine transfusion, neonates receiving exchange transfusion, and those receiving blood from immediate relatives are at risk.

The disease is caused when T-cell lymphocytes from the donor proliferate in response to histocompatibility antigens in the recipient. The recipient immune system is unable to reject the foreign lymphocytes and the transfused cells launch an immune response against the recipient. Symptoms appear in 3 to 30 days with pancy-

topenia, fever, elevated liver enzymes, enterocolitis with 3-4 liters of watery diarrhea per day, dermatitis and erythroderma, and a depression in bone marrow elements.

Preventive measures are the only way to avoid transfusion-associated GVHD. Gamma irradiation of donor products prove the most effective mechanism to inactivate donor lymphocytes and reduce the risk of GVHD.

### Platelet-Refractoriness

Platelet refractoriness may be caused by immune and non-immune mechanisms, but for the purpose of this discussion, only the immune pathway will be addressed. This condition is characterized by post-transfusion purpura and thrombocytopenia, 1-2 weeks after transfusion.

This occurs most often in women that have given birth to more than one child or in individuals who have received repeated transfusions of ABO-mismatched platelet products. It is believed that an anamnestic production of anti-platelet antibodies is responsible for the platelet destruction. Alloantibody attaches to the platelet cell surface permitting extravascular removal by the RES. Hematuria, black tarry stools, and vaginal bleeding have been reported symptoms. Transfusion of additional platelets is usually not effective.

Platelet antibody studies may be used to help diagnose the etiology of this condition, and HLA-matched platelets may be an appropriate choice if further platelet therapy is warranted. When a recipient's condition is such that multiple platelet transfusions are anticipated over a period of time, it is preferable to use single-donor apheresed platelet products to reduce the number of donor exposures and alloimmunization.

Table 2 provides a broad categorization of non-immune-mediated transfusion reactions.

<b>Acute</b>	<b>Delayed</b>
Hemolytic	Metabolic
Embolic	iron overload
Metabolic	Infectious
<ul style="list-style-type: none"> <li>• citrate toxicity</li> <li>• coagulopathy</li> <li>• hypothermia</li> <li>• hyperkalemia</li> <li>• hypocalcemia</li> </ul>	<ul style="list-style-type: none"> <li>• bacterial</li> <li>• viral</li> <li>• parasitic</li> </ul>
Circulatory Overload	

### **Non-Immune Mediated Transfusion Reactions**

Many of the clinical symptoms of these transfusion reactions are nonspecific, but include facial numbness, chills, numbness, muscle twitching, cardiac arrhythmias, nausea, vomiting, altered respirations, and anxiety. Laboratory tests for investigation and diagnosis of these conditions include electrolyte levels, calcium, pH, glucose, urinalysis, hemoglobin, hematocrit, platelet count, prothrombin time, and activated partial thromboplastin time.

### **Hemolytic**

Red blood cells can undergo in-vitro hemolysis due to physical or chemical factors not associated with the immune response. Units of blood that are exposed to improper temperatures during shipping or storage or units that are mishandled at the time of administration are candidates for a mechanically induced transfusion reaction.

Additionally, RBCs can undergo temperature-related damage from the use of microwave ovens or hot water-baths to warm the units, malfunctioning blood warmers, or from damage caused by freezing in the absence of a cryopreservative. The use of pressure infusion pumps, pressure cuffs, roller pumps and needles with an improper bore may also cause physical damage. Hypertonic or hypotonic solutions may damage cell membranes.

### **Embolic**

Air embolism is a concern if blood is infused in an open system, or if air enters the system when containers or tubings are changed. Proper use of pumps, apheresis equipment, and tubing connectors is essential. Patient symptoms may include cough, dyspnea, chest pain, and shock.

### **Metabolic**

During massive transfusions, depletion of platelets and coagulation factors may occur if the patient is not supported with transfusion of these components. Hypothermia may occur when large volumes of cold fluids are infused.

Citrate toxicity may result from apheresis procedures and when large volumes of fresh frozen plasma (FFP), whole blood, or platelets are transfused. The citrate will bind the recipient's free calcium ions and produce hypocalcemia. This is also a concern when exchange transfusion is performed on infants who are already ill. RBCs lose intracellular potassium during storage and may be the cause of transfusion-induced hypokalemia when washed RBCs are administered.

### **Circulatory Overload**

Whereas TRALI is associated with transfusions of blood volumes that do not produce hypervolemia, circulatory overload may be caused when blood volume is rapidly increased.

Transfusion that proceeds at too fast a rate may lead to congestive heart failure and pulmonary edema. The administration of 25% albumin may also be implicated as it causes a shift of large amounts of interstitial fluid into vascular spaces. The transfusion should be stopped, or at least slowed when completion of the transfusion is critical.

Patient support generally includes administration of oxygen, diuretics, and in severe cases, therapeutic phlebotomy to reduce blood volume.

For patients at risk of developing circulatory overload, blood units may be split into aliquots to allow for transfusion over longer time periods, and the use of washed RBCs may help diminish the plasma load administered to the recipient.

### **Metabolic Iron Overload**

A complication of long-term RBC transfusion is an accumulation of iron that may affect heart, liver, and endocrine gland function. Also called hemosiderosis, symptoms of iron overload include muscle weakness, fatigue, weight loss, jaundice, anemia, and cardiac arrhythmias. Laboratory investigation will include iron and ferritin levels and possibly tissue stains for iron.

### **Bacterial Contamination Reactions**

No matter how carefully blood is collected and processed, bacteria can never be completely eliminated. Bacterial contamination is responsible for one-eighth of reported transfusion-associated fatalities.

It is believed that bacteria in blood products originate with the donor, either from the venipuncture or from inapparent donor bacteremia. Bacterial multiplication in stored blood may occur with the production of endotoxins that give rise to symptoms including fever and chills, hypotension, hemoglobinuria, muscle pain, shock, renal failure, and disseminated intravascular coagulopathy (DIC).

Gram negative organisms capable of growing at cold temperatures include *Pseudomonas species*, *Citrobacter freundii*, *Escherichia coli*, and *Yersinia enterocolitica*. Gram positive organisms are more likely to be found in products stored at room temperature. Before release to the transfusionist, examine each unit of blood for visual evidence of contamination. Color change to dark purple or black, clots in the bag, and hemolysis may suggest

contamination, but more often the unit appearance remains unremarkable.

Whenever a septic reaction occurs, the transfusion should be immediately stopped, and the remaining blood product, transfusion tubing, and intravenous fluids returned to the laboratory for Gram stain and culture workup.

Preventive measures are the most effective in reducing the occurrence of bacterial contamination of blood products. Strict adherence to sterile techniques must be ensured during the collection and processing of components. In the laboratory, frozen products (such as Fresh Frozen Plasma) must be handled with care to prevent damage to packaging during storage in the freezer. When thawed, protect frozen units from contamination with waterbath liquid by overwrapping, and examine the unit ports for trapped fluid.

Frequently empty, clean, and decontaminate the waterbaths used in the laboratory. Employ great care and good technique when pooling platelets to prevent bacterial contamination.

### **Viral or Parasitic Contamination Reactions**

Other delayed effects of blood transfusion may include the transmission of parasites such as malaria, babesia, and trypanosomes, and viral agents such as cytomegalovirus (CMV), hepatitis B (HBV), hepatitis C (HCV), human immunodeficiency virus (HIV), and human T cell lymphotropic viruses (HTLV I & II). Good donor screening is the key to preventing transmission of these agents, in conjunction with laboratory testing of donor products.

### **Symptoms of a Transfusion Reaction**

Transfusionists must be alert to the symptoms of a transfusion reaction so that the transfusion can be halted and appropriate immediate patient care be given. Retain blood specimens of each donor and patient for at least seven days after transfusion to facilitate follow-up of all suspected transfusion reactions. When a transfusion reaction is suspected, promptly investigate the event to provide an accurate diagnosis and guide appropriate patient therapy. Signs and symptoms that may indicate a transfusion reaction include:

- Fever, defined as at least 1°C or 2°F increase from baseline temperature, with or without chills.
- Shaking chills, with or without fever.
- Pain, at infusion site, in chest, abdomen, back, or flank.

- Changes in blood pressure, usually acute, either hypertension or hypotension.
- Respiratory difficulties such as dyspnea, tachypnea, or hypoxemia.
- Skin changes, including facial flushing, urticaria (hives), and localized or generalized edema.
- Nausea and/or vomiting.
- Hemoglobinemia.
- Hemoglobinuria.
- Generalized bleeding or oozing.
- Anemia.
- Oliguria or anuria.
- Acute onset of sepsis.
- Anaphylaxis.
- Disseminated intravascular coagulopathy (DIC).

Observe the recipient of a transfusion frequently during the infusion for the development of the symptoms noted above. In anesthetized patients who cannot report symptoms, diffuse bleeding, changes in blood pressure, or hemoglobinuria may be the only warning signs of a transfusion reaction.

## **Transfusion Reaction Investigation**

### **Immediate Investigation**

Every transfusion service must have a procedure manual detailing the procedures to follow when a transfusion reaction is observed. Promptly investigate all adverse transfusion reactions. Investigations are important for diagnosis and the determination of appropriate patient care and prevention of future transfusion reactions.

Transfusionists are generally the first to suspect a transfusion reaction and the first to take action. The transfusion should be immediately stopped, when symptoms are recognized, to limit the volume of blood component infused. Maintain the intravenous line with normal saline or other FDA-approved solution compatible for use with blood administration for possible use in patient therapy and support. Recheck all labels, forms, and patient identification for clerical errors at the bedside to determine if the component transfused was administered to the correct patient. If it is found that the wrong unit has been administered, undertake an immediate search to locate the correct component and avert putting another patient

at risk. Immediately notify the recipient's physician and the transfusion service when a transfusion reaction is suspected.

The medical staff attending to the transfusion recipient should complete a transfusion reaction form. Documentation on this form should include:

- The patient's vital signs before and after transfusion.
- The type of reaction and symptoms.
- Time of occurrence.
- Volume of transfused blood.
- Type of component transfused.
- The rate of infusion.
- Length of time the unit was infused.
- Whether components were warmed.
- Whether pressure was applied to accelerate infusion.
- The needle size used.
- The type of filter used.
- Any solutions or drugs given just prior to or at the time of infusion.

To perform a laboratory investigation, carefully collect (avoiding hemolysis) a post-transfusion blood specimen in a plain barrier-free collection tube, an EDTA-anticoagulated specimen, and a first-voided post-transfusion reaction urine specimen. Return the blood unit to the laboratory, even if empty, along with the administration set (minus the needle), and solutions infused with the blood.

Other post-reaction specimens may be useful in the laboratory investigation as determined by the initial laboratory findings and the guidance of the medical director of the transfusion service. If the reaction symptoms are clearly limited to urticaria (hives), or symptoms of circulatory overload, the post-transfusion blood specimens do not need to be evaluated for other possible types of reactions.

## Laboratory Investigation

### Immediate Procedures

- Clerical checks.
- Visual inspection of pre-transfusion and post-transfusion sera and plasma for hemolysis or icterus.
- Direct antiglobulin test on post-transfusion EDTA specimen, and pre-transfusion specimen.

In the laboratory, immediately perform clerical checks of all paperwork, forms, and specimens to detect discrepancies. Perform a visual check of the recipient's serum for hemolysis, comparing the pre-transfusion specimen to the post-transfusion specimen.

If only the post-transfusion specimen displays evidence of hemolysis, rule out the possibility of a traumatic venipuncture as a cause. A second post-transfusion specimen may be warranted. If the post-transfusion sample collection is delayed, hemoglobin may be converted to bilirubin in the bloodstream causing the serum to appear bright yellow or brown (icterus). Laboratories must collect a post-transfusion urine specimen to evaluate the presence of free hemoglobin in suspected hemolytic transfusion reactions.

Perform a direct antiglobulin test (DAT) on the post-reaction blood specimen, preferably using an EDTA anticoagulated specimen to diminish the effects of complement that may be coating the RBCs. A mixed-field appearance is frequently observed if transfused cells have been coated with antibody but not immediately destroyed. If transfused cells are rapidly destroyed, the DAT may be negative. When a non-immune mechanism, such as thermal damage, is the cause of hemolysis, the DAT will be negative. If the post-reaction specimen demonstrates a positive test, perform a DAT on the pre-transfusion specimen for comparison.

If any of the immediate procedures give a positive or suspicious result, consider immune hemolysis and conduct additional laboratory procedures at the direction of the physician or laboratory director. Protocols for extended investigation of transfusion reactions must be included in the procedure manual.

### Additional Procedures (as appropriate)

- Repeat ABO and Rh testing on pre-transfusion and post-transfusion specimens, and on blood from the transfused unit or an attached segment.
- Perform antibody screening on pre- and post-transfusion specimens, and on donor blood.
- Identify alloantibodies detected.
- Repeat crossmatch procedures with pre- and post-transfusion specimens and donor blood.
- Test first-voided urine after transfusion reaction for free hemoglobin.
- Test post-transfusion blood specimen for bilirubin (5-7 hours post reaction).
- Periodically check patient's hemoglobin and hematocrit for therapeutic rise or unexpected decline.

- Examine the returned unit and administration set for hemolysis, contamination, or physical damage or malfunction.
- Gram stain and culture blood from the unit, if indicated.
- Perform serum haptoglobin levels on pre- and post-transfusion specimens.
- If anaphylactic reaction is suspected, test patient serum for presence of IgA.

Confirm ABO and Rh reactions on pre-transfusion and post-transfusion patient specimens and on blood from the donor unit or attached segment. If ABO and Rh results do not agree between the pre- and post-reaction specimens, an error has been made in patient or specimen identification, or in testing.

If specimen mix-ups in labeling or testing have occurred, other patients may be at risk and a thorough check of all specimens received and tested in the same time period should be conducted. If the blood in the unit is of a different type than what is on the label of the unit, an error has been made in unit labeling.

Perform antibody detection tests on pre- and post-transfusion specimens to determine if the reaction is due to alloantibody. Identify all detected antibodies. In addition, if a positive DAT is observed, an antibody elution should be attempted and the antibody coating the RBCs identified. When the antibody specificity is determined, test the donor unit and the patient for the presence of the corresponding antigen.

If antibody is detected in the post-reaction specimen but not in the pre-reaction specimen, an anamnestic response should be considered or, less likely, passive transfer of antibody from the donor plasma. Antibody detection procedures performed on donor blood may be helpful in this instance. It is important, as well, to obtain a thorough patient history including previous transfusions, tissue transplantation, and pregnancies that may have given opportunity for alloimmunization.

Perform compatibility testing with pre- and post-reaction specimens and donor blood cells. These procedures should be completed through the antiglobulin phase, even if your routine protocol outlines an immediate-spin or computer crossmatch. Incompatibility with the pre-transfusion specimen indicates a technical or clerical error in the original testing. Incompatibility with the post-reaction specimen only may indicate an anamnestic response to a donor antigen, or the possibility of specimen identification errors.

The first-voided, post-transfusion reaction urine specimen must be collected and tested for the presence of

free hemoglobin. A positive test for hemoglobinuria indicates hemolysis, whereas the presence of intact RBCs indicates bleeding. A urine sediment microscopic examination will be helpful to identify intact RBCs in conjunction with the use of standard urinalysis reagent strips.

Hemoglobin degradation products in the bloodstream, especially bilirubin, will cause a color change in the plasma from the normal straw color to a bright yellow or brown (icterus). This may be detected as early as one hour after the transfusion reaction has occurred, with a peak in five to seven hours. With normal liver function, plasma returns to normal in about 24 hours. Comparison of pre- and post-reaction sera for the presence of icterus as well as serum bilirubin determinations may indicate on-going hemolysis.

Under normal circumstances, administration of one unit of packed RBCs should have a therapeutic effect of elevating a recipient's hemoglobin level by 1 g/dL for each unit received. When this hemoglobin increase is not observed, or if a decrease in hemoglobin and hematocrit are noted in the absence of active bleeding, suspect hemolytic processes.

Examination of the returned donor unit and transfusion set may reveal evidence of hemolysis, especially when a non-immune mechanism is suspected. Hemolysis may be present only in the administration tubing, or in both the tubing and the unit, depending upon how the damage occurred. Malfunctioning blood warmers or infusion devices, hypotonic solutions added to the unit, and other such devices may be at fault.

Examination of the returned materials may also indicate bacterial contamination when the unit has an abnormal appearance including clots, or discolorations described as brown and muddy, opaque, or purplish. Perform Gram stain and culture studies when these changes are observed, or when the patient symptoms indicate sepsis.

Comparison of pre-transfusion and post-transfusion haptoglobin levels may be helpful in diagnosing a hemolytic process. A decrease in haptoglobin is observed when haptoglobin molecules combine with free hemoglobin and are removed from circulation by the RES.

When a patient presents with anaphylactic symptoms, testing for the presence of IgA in the pre-transfusion specimen is useful. If an IgA deficiency is detected, it may be worthwhile to test for the presence of anti-IgA in the recipient.

An example of a laboratory transfusion reaction worksheet and record is included at the end of this COLA Fast Facts.

## Transfusion Reaction Records and Reporting

Adverse reactions represent a serious and potentially fatal complication to transfusion therapy. Interpretation of the transfusion reaction investigation and any recommendation for future transfusion therapy must be included in the patient's clinical record.

Every transfusion service must maintain records of patients who experience transfusion complications. These records and the records of patients with known alloimmunization are to be maintained indefinitely. These should be consulted prior to transfusion to prevent patients from being exposed to offending agents in subsequent transfusion events.

When a blood transfusion is suspected of disease transmission, the institution responsible for donor collection must be notified. Every transfusion service must have policies and procedures to enable the service to trace all units from source to disposition. These policies and procedures facilitate the investigation of adverse transfusion reactions and blood product recalls if necessary.

Transfusion-related fatalities must be reported to COLA. Additionally, notify the FDA via Center for Biologics Evaluation and Research, FDA, 8800 Rockville Pike, HFB-120, Bethesda, MD 20892; (301) 295-8191. Both organizations must be contacted by telephone within 24 hours, followed by a written report within 7 days.

## Quality Improvement

Transfusion services and other departments must establish quality assurance policies and procedures that provide for optimal transfusion practice and patient safety. The leading causes of preventable errors in the laboratory are:

- Improper specimen identification.
- Improper patient identification.
- Errors in antibody identification.
- Errors in compatibility testing.

For nursing, anesthesia, and medical staff, improper patient identification is by far the most commonly reported error in transfusion-related fatalities. Strict adherence to established transfusion standards and protocols is essential in preventing transfusion-related deaths.

It is appropriate, then, to implement a continuous plan of quality improvement and monitoring. Each transfusion service should routinely evaluate the effectiveness and efficiency of its practices and procedures.

Thoroughly train and observe new staff to be knowledgeable and competent in all required tasks before working autonomously. Assess on-going competency by direct observation, successful completion of proficiency tests or other "unknowns", and by means of a number of other methods.

Perform audits of laboratory records and worksheets to detect errors or incomplete documentation. The blood bank's technical supervisor should conduct regular reviews of documentation such as quality control, corrective action records, and temperature logs.

Perform a quality review of the procedures for releasing blood components and administration by nursing staff by following individuals to the patient bedside for observation of adherence to proper protocols in patient identification, and performance of clerical checks.

Whenever an error or an inefficiency is identified, apply the principles of quality improvement. Evaluate the policy or procedure for weaknesses that contributed to the error or problem. Determine a corrective measure or modification to the procedure to correct the weakness and implement it. Review the policy or procedure at a later time to evaluate the effectiveness of the corrective action that was taken. Maintain records of your quality assurance activities.

Despite all efforts to the contrary, transfusion reactions may still occur. However, it is the duty of the laboratory staff and medical director to ensure that all efforts have been made to reduce the chance that a reaction may occur. Rigorous adherence to procedure and protocol, as well as complete and thorough record keeping, will enhance a laboratory's efforts to avoid transfusion reactions.

For a more in-depth study of the adverse effects of blood transfusion and its investigation, please refer to published reference texts, such as the AABB Technical Manual.

## References

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4. Harmening, D.M. ed. *Modern Blood Banking and Transfusion Practices*, 3rd ed. Philadelphia, PA. F.A.Davis Company. 1994.
5. Henry, J.B. *Clinical Diagnosis & Management By Laboratory Methods*, 18th ed. Philadelphia, PA. W.B. Saunders Company. 1991.

## Transfusion Reaction Laboratory Investigation

(Transfusion Service Name, Address, and Phone Number)

**ALL TESTING SHOULD BE PERFORMED ON ALL UNITS TRANSFUSED TO THE PATIENT WITHIN 24 HOURS OF TRANSFUSION REACTION.**

### Section 1: General Patient Identification

Date: \_\_\_\_\_

Patient Name: \_\_\_\_\_

Identification Number: \_\_\_\_\_

Patient's Physician: \_\_\_\_\_

Date and Time of Notification of Transfusion Service Director: \_\_\_\_\_

### Section 2: Clerical Checks to be Performed

Clerical Check of ALL blood components transfused within the last 24 hours

Transfused Products Returned	Donor ID	Date	Time	Volume Remaining (mLs)

Initial the following when check is completed: \_\_\_\_\_ Worksheets \_\_\_\_\_ Logs \_\_\_\_\_ Product Labels

Conclusion: No clerical error detected: \_\_\_\_\_ Clerical error detected: \_\_\_\_\_

### Section 3: Observation of Returned Blood Products/Administration Tubing

Place a checkmark in the appropriate box.

	Yes	No
Clots Present?		
Discoloration?		
Hemolysis?		

Staff Initials: \_\_\_\_\_

### Section 4: Observation for the Presence of Hemolysis and Icterus

Observe for the presence of visible hemolysis and icterus in both pre- and post-transfusion patient specimens. Place a checkmark and initial in the appropriate box. If hemolysis is present in the post-transfusion specimen, test for presence of free hemoglobin in the post-transfusion urine specimen.

Specimen Type	Visible Hemolysis	No Visible Hemolysis	Icterus Present	No Icterus Present
Pre-Transfusion				
Post-Transfusion				

Free Hb in urine? \_\_\_\_\_ Yes \_\_\_\_\_ No

Staff Initials: \_\_\_\_\_

**Section 5: Direct Antiglobulin Test**

Specimen Type	Negative	Positive/Description
Pre-Transfusion		
Post-Transfusion		

If all findings are negative, STOP, work-up is complete. Report findings to Director of Transfusion Services. Otherwise, continue with Section 6: ABO and Rh Confirmation.

Staff Initials: \_\_\_\_\_

**Section 6: ABO and Rh Confirmation**

Specimen	Cell Reaction With					Serum Reaction With		Interpretation	
	Anti-A	Anti-B	Anti-A,B	Anti-D	Rh Control	A1 Cells	B Cells	ABO Group	Rh Type
Pre-transfusion									
Post-Transfusion									
Donor #									
Donor #									
Donor #									

Staff performing the testing must initial the following:

Conclusion: No discrepancies: \_\_\_\_\_ Discrepancies Identified: \_\_\_\_\_

**Section 7: Antibody Detection**

Saline/Albumin

	Cell	Room Temp.	37°C	Anti-Human Globulin	Check Cells
Pre-Transfusion	I				
	II				
	Auto				
Post-Transfusion	I				
	II				
	Auto				

Staff performing the antibody screen must initial the following:

Antibody Detection Results: Pre-Transfusion Specimen: Positive \_\_\_\_\_ Negative \_\_\_\_\_  
 Post-Transfusion Specimen: Positive \_\_\_\_\_ Negative \_\_\_\_\_

If positive, follow with antibody identification panel.

**Section 8: Compatibility Testing**

Pre-Transfusion Specimen With	Room Temp.	37°C	AHG	CC	Post-Transfusion Specimen With	Room Temp.	37°C	AHG	CC
Donor #					Donor #				
Donor #					Donor #				
Donor #					Donor #				

Any units crossmatched on pre-transfusion specimen but not yet transfused must be re-crossmatched with a post-transfusion specimen.

**Section 9: Bacteriological Testing**

Performed on \_\_\_\_\_ Not Performed: \_\_\_\_\_ Staff Initials \_\_\_\_\_

Signature of Laboratory Staff: \_\_\_\_\_ Date: \_\_\_\_\_

Interpretation by Director of Transfusion Services: \_\_\_\_\_

Signature of Director of Transfusion Services: \_\_\_\_\_ Date: \_\_\_\_\_