

Modification of Blood Components

LEUKOCYTE-REDUCED BLOOD PRODUCTS (Red Blood Cells, Platelets)

All red blood cell and platelet products supplied by Versiti are leukocyte-reduced including autologous whole blood/red cells.

Indications:

1. Prevention of febrile non-hemolytic transfusion reactions
2. Prevention of alloimmunization to HLA antigens
3. Prevention of cytomegalovirus infections in patients at risk for CMV transfusion-transmitted (TT) infection. Leukocyte-reduced cellular products are considered ‘CMV-Safe’ and can be routinely used for those patients at risk for CMV TT infection. See [Cytomegalovirus Reduced-Risk Cellular Products](#) section below and [TxMD™ News - In the Era of Leukoreduction, are CMV-Seronegative Tested Blood Products Beneficial? \)](#)

Comments:

- Guidelines from AABB require that a leukocyte-reduced blood product contain fewer than 5×10^6 leukocytes to prevent non-hemolytic febrile transfusion reactions, and for other indications.¹ At Versiti, both leukocyte-reduced red cells and leukocyte-reduced platelets generally contain $< 1 \times 10^6$ leukocytes.
- There is insufficient evidence of the role of leukocyte reduction in the prevention of transfusion-related immune modulation.

PHENOTYPE – MATCHED (Red Blood Cells)

Phenotypically matched red cell units are “matched” for the patient’s Rh (D, C, E, c, e) and K antigens, regardless if the patient has the corresponding red cell antibodies or not. In patients who require chronic transfusions, providing phenotype-matched blood has shown to decrease the rate of red cell alloimmunization from as high as 43% to only 2.2%.^{2,3}

Indications:

1. Patients undergoing chronic transfusion therapy (i.e. sickle cell disease or thalassemia).⁴

Comments:

- Red cell genotyping of both donors and transfusion recipients is increasing. With more readily available RBC units having extended antigen typing, other patient populations may benefit from antigen matching beyond ABO/RhD.
- Use of phenotype-matched red cell products may help to reduce the risk of alloimmunization for those patients with strong warm autoantibodies or undergoing treatment with interfering monoclonal antibody drug therapy (e.g. anti-CD38) and avoid extended work-ups allowing for timely provision of blood.⁵

CYTOMEGALOVIRUS REDUCED-RISK CELLULAR PRODUCTS (Red Blood Cells, Platelets)

The risk of CMV transmission from transfusion of cellular products can be reduced by transfusing leukocyte-reduced, CMV seronegative, or pathogen-reduced blood products.

‘CMV Negative’ products are **both** leukocyte-reduced **and** serologically negative for CMV IgG. Current studies indicate that leukocyte-reduced blood *alone* safely reduces the risk of CMV transmission to levels not significantly different to transfusion with CMV-seronegative blood.⁶⁻¹¹ In addition, no improved safety has been demonstrated with the use of leukocyte-reduction **plus** CMV-seronegative for prevention of transfusion-transmitted (TT) CMV.^{7,8,11}

Pre-storage, leukocyte-reduced blood need not be CMV seronegative to prevent recipient CMV seroconversion. For at-risk individuals (see below) the use of leukocyte-reduced blood components (RBC or platelets) or use of pathogen-reduction (currently available for platelets) is appropriate.

Patients at high risk for TT-CMV infection:

1. Neonates weighing <1500 grams
2. Intrauterine transfusion
3. Allogeneic peripheral stem cell or bone marrow transplant patients or candidates who are CMV seronegative or of unknown CMV serostatus
4. CMV seronegative bone marrow transplant donors who require allogeneic products
5. Heart and lung transplant patients who are CMV seronegative
6. CMV seronegative autologous stem cell transplant patients
7. Known or suspected congenital immunodeficiency due to T-cell defects (DiGeorge syndrome, etc.) or other severe immune deficiencies who are CMV seronegative

Comments:

- Versiti physicians support the use of leukocyte-reduced blood as an acceptable means of prevention of TT-CMV disease.⁶⁻¹¹ Though, it is advisable for institutions to establish site-specific policies.
- Pathogen reduction technology involving psoralen plus UVA light treatment inactivates a broad range of viral, bacterial, and protozoan pathogens, including CMV, and is effective in prevention of TT-CMV infection.¹²
- Based on the clinical significance and burden of CMV infection acquired in utero, along with the difficulty of monitoring fetal infection, leukocyte-reduced plus CMV seronegative blood may be considered for intrauterine transfusions.¹³
- Granulocytes, which are never leukocyte-reduced, should be CMV seronegative whenever possible for transfusion to CMV seronegative patients.

IRRADIATED BLOOD PRODUCTS (Red Blood Cells, Platelets, Granulocytes)

Irradiated blood products are indicated for the prevention of transfusion-associated graft vs. host disease (TA-GVHD). Irradiated blood products are prepared by exposure of the blood component to gamma or X-ray irradiation.

Indications:

1. Intrauterine transfusions (IUT) or neonatal exchange transfusions
2. Neonates weighing <1500 grams (up to 6 months of age or longer based on clinical condition e.g. past IUT, need for complex cardiac surgery, congenital immune deficiency suspected)
3. Donation from blood relatives
4. HLA-matched platelets
5. Granulocyte transfusions
6. Recipients of allogeneic or autologous bone marrow/hematopoietic progenitor cell transplants
7. Patients with hematologic malignancies
8. Patients with Hodgkin's lymphoma
9. Patients with known or suspected congenital immunodeficiency due to T-cell defects (e.g. DiGeorge syndrome, SCID)
10. Patients who have received purine analogue drugs [such as fludarabine, cladribine, pentostatin (2'-deoxycoformicin), bendamustine] or other related chemotherapeutic drugs
11. Patients who are receiving alemtuzumab (anti-CD52 monoclonal antibody, CAMPATH-1H) for treatment of CLL, aplastic anemia or other hematological malignancies
12. Aplastic anemia patients who are receiving anti-thymocyte globulin (rabbit derived) ATG medications
13. Patients with neoplastic disease considered to be at high risk for TA-GVHD by their physician

Comments:

- Irradiation of the product should be done as close as possible to the time of planned transfusion, particularly when the patient is at risk for hyperkalemia (e.g. intrauterine transfusion, exchange transfusion or other large volume transfusion for neonates).¹⁴
- Pathogen reduction is as equally effective as irradiation in preventing proliferation of donor T-lymphocytes for prevention of TA-GVHD. Pathogen reduction technology involving amotosalen plus UVA light treatment inactivates DNA replication in cells, including the DNA in any donor T-lymphocytes.^{15,16}
- There is no indication for irradiation of red blood cells or platelets for patients who are HIV positive or have AIDS.^{14,17}
- Use of irradiated blood components is not routinely required for solid organ transplant patients.

- For emergency transfusions in patients for whom irradiated cellular blood components are indicated, do not delay issuing of blood components when irradiated products are not available. One may consider preferentially issuing older red cells (>14 days) since in the majority of published cases of TA-GVHD the implicated red cells were “fresh” or ≤10 days old.^{14,18}
- Irradiation is not required for previously frozen products (FFP/FP24, Cryoprecipitated AHF).
- Liquid Plasma distributed from Versiti (special order only) is irradiated since the component is never frozen and may contain viable white blood cells. This precaution is to inactivate any donor lymphocytes and prevent potential TA-GVHD.

PATHOGEN REDUCTION (Platelets)

Pathogen reduction is a post-collection manufacturing process to reduce the risk of transfusion-transmitted infection (TTI). Pathogen reduction technology available at Versiti involves the combination of amotosalen (psoralen derivative) and UV-A light treatment which results in damage of nucleic acids in bacteria, viruses, protozoa and donor lymphocytes.¹⁹ Currently, pathogen-reduced platelets are the only pathogen-reduced component available at Versiti. (See Versiti brochure [Pathogen Reduced Platelets](#)).

Indications:

1. Meets the FDA Guidance “Bacterial Risk Control Strategies for Blood Collection Establishments and Transfusion Services to Enhance the Safety and Availability of Platelets for Transfusion” for reducing the risk of transfusion-transmitted infection by inactivating pathogens in apheresis platelets.
2. Prevention of TA-GVHD (See [Irradiated Blood Products](#))
3. Prevention of transmission of CMV

VOLUME REDUCED (Platelets)

Volume reduction involves the aseptic removal of a portion of the supernatant containing plasma and storage medium. Removal of excess plasma can result in reduction of unwanted plasma proteins, allergens and/or ABO antibodies.

Indications:

1. Recurrent mild to moderate allergic reactions despite appropriate premedication
2. Patients in whom fluid status is being aggressively managed (e.g. severe congestive heart failure, renal failure) or patients at risk for transfusion-associated circulatory overload (TACO)
3. Prevent reactions related to infusion of large amounts of ABO incompatible platelet products

Comments:

- The shelf-life of volume-reduced components is no more than 24 hours if stored at 1-6°C or 4 hours if stored at 20-24°C.

WASHED (Red Blood Cells, Platelets)**Indications:**

1. History of anaphylactic reaction to blood components
2. IgA deficiency with documented antibody to IgA
3. Recurrent severe allergic reactions not prevented with appropriate premedication
4. Severe hyperkalemia (e.g. neonates) – Red blood cells only

Comments:

- The red cell or platelet unit is washed using 0.9% sodium chloride, which removes plasma proteins, antibodies, potassium and free hemoglobin. There is loss of some red cells during the washing process. When preparing washed platelets, 20-30% of the platelets can be lost as well as loss of platelet function due to platelet activation.
- Expiration date of a washed red cell unit is 24 hours from the time the washing process commences.
- Expiration date of a washed platelet is 4 hours from the time the washing process commences.

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Additional Resources:

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