Association for the Advancement of Blood & Biotherapies

CRYO PRECI PITATE

(CRYO)

BLOOD COMPONENT CARD

Description	Cryoprecipitate (cryo) is enriched for 5 cold-insoluble proteins: fibrinogen; von Willebrand factor; factors VIII; and XIII; and fibronectin.
Storage and handling	Cryoprecipitate is stored at -18 C or colder for up to 1 year and is thawed at 30-37 C. Once thawed, cryo should be stored at room temperature and expires within 4 hours if pooled with other units in an open system or within 6 hours if pooled prior to storage, pooled in a closed system, or not pooled.
Clinical use and indications	Cryoprecipitate is primarily used for fibrinogen replacement. The following thresholds can be used as guidance for transfusing cryoprecipitate: • Life-threatening hemorrhage: 200 mg/dL • Active bleeding: 150 mg/dL • Prophylaxis for an invasive procedure: 100 mg/dL • ABO requirements: None. ABO incompatible cryoprecipitate is not associated with clinically significant hemolysis.
Dosage, expected increment, and infusion rate	For fibrinogen, one single unit of cryoprecipitate contains approximately 325 mg of fibrinogen. These numbers vary considerably depending on fibrinogen concentration in the donor plasma. • In a 70 kg patient the expected fibrinogen increase from a 5-unit pool is 35 mg/dL. • A typical adult dose of cryoprecipitate is two 5-unit pools. Infuse as tolerated
Risks	Adverse Events (AE) due to cryo are rare. AEs of all types have been reported.
Alternatives	• Pathogen reduced fibrinogen complex: Cryo with reduced levels of factor VIII. May be stored for 5 days post-thaw at room temperature. • Fibrinogen concentrate: Fibrinogen concentrates have been shown to be noninferior to cryoprecipitate for fibrinogen repletion in cardiovascular surgery.
Suggested reading	1. Janson PA, Jubelirer SJ, Weinstein MJ, Deykin D. "Treatment of the bleeding tendency in uremia with cryoprecipitate." *N Engl J Med.* 1980;303(23):1318-1322. ***https://www.nejm.org/doi/full/10.1056/NEJM198012043032302*** 2. Callum J, Farkouh ME, Scales DC, et al. "Effect of fibrinogen concentrate vs cryoprecipitate on blood component transfusion after cardiac surgery: the FIBRES randomized clinical trial." *JAMA*. 2019;322(20):1966-1976. ***https://jamanetwork.com/journals/jama/fullarticle/2753529*** 3. Hadjesfandiari N, Levin E, Serrano K, Yi Q-L, Devine DV. "Risk analysis of transfusion of cryoprecipitate without consideration of ABO group." *Transfusion*. 2021;61:29. ***https://onlinelibrary.wiley.com/doi/10.1111/trf.16125*** 4. Cohn CS, Delaney M, Johnson ST, Katz LM. *Technical Manual*. AABB, 2020. ***https://www.aabb.org/aabb-store/product/technical-manual-20th-edition---print-14885311*** 5. *Blood Component Therapy: Cryoprecipitate (CRYO). Bloodworks* Northwest. ***https://www.bloodworksnw.org/medical-services/transfusion-medicine/cryoprecipitate*** 6. Nascimento B, Levy JH, Tien H, Da Luz LT. "Cyroprecipitate transfusion in bleeding patients." *CIEM-JCMU*. 2020;22(2):S4-11. ***https://www.cambridge.org/core/journals/canadian-journal-of-emergency-medicine/article/cryoprecipitate-transfusion-in-bleeding-patients/BC93DE93E6389E24D88E88A2F06FCE9B***

Association for the Advancement of Blood & Biotherapies

PLASMA

BLOOD COMPONENT CARD

Description	Plasma can be obtained from whole blood or apheresis collections (single donor unit)

Storage and handling	**Storage:** Most plasma units are stored frozen at -18 C or colder for one year as required by FDA.
	
	Plasma Units: Different types of plasma units are available in the US and are essentially interchangeable. However, factors V, VIII, and proteins C and S are present at higher levels in FFP than in other plasma components.
	• **Fresh Frozen Plasma (FFP)** units are frozen within 8 hours of collection
	• **Plasma Frozen (PF) or PF24 units are** frozen from 8-24 hours after collection
	• **Thawed Plasma:** Thawed FFP or PF24 may be stored at 1-6 C for up to 24 hours. Thawed FFP or PF24 held longer than 24 hours must be relabeled as **'Thawed Plasma'** and may be stored an additional 4 days at 1-6 C.
	• **Liquid Plasma:** The plasma is separated from whole blood and may be stored up to 26 days (If WB is stored in ACD/CPD or CP2D) or 40 days (if WB is stored in CPDA-1) at 1-6 C.
	• **Pathogen reduced plasma:**
	  • **Octaplas is pooled solvent-detergent treated plasma (SD Plasma):** 630-1520 of ABO-identical FFP units are pooled and treated with solvent/detergent to inactivate enveloped viruses. The pooled plasma is aliquoted into 200 ml units and stored frozen. Thawed units may be stored for 24 hours at 1-6 C.
	  • **INTERCEPT** plasma is treated with amotosalen and UVA light to irreversibly block the replication of nucleic acids, reducing the risk of proliferation of susceptible pathogens.
	
	Thawing: Frozen units should be thawed in a 30-37 C water bath or an FDA-cleared dry thawing device.

Indications	Plasma is generally transfused to replenish coagulation factors to stop bleeding as part of a balanced resuscitation effort. There is a lack of high-quality evidence establishing an INR threshold for prophylactic transfusions, but plasma should not be used to lower minimally elevated INR (1.5 – 2.0). Prothrombin complex concentrate (PCC) decreases INR faster than plasma in emergency situations and are the first choice of treatment, but plasma can be used if PCC is not available or if it is contraindicated.
Dosage and infusion rate	A suggested dose of plasma is 15 ml/kg in adults, which will increase coagulation factors by approximately 30%. This large volume of fluid should be infused at 2-3 ml/kg/hour for healthy adults, which should be reduced to 1 ml/kg/hour for patients at risk of volume overload.
Risks	Plasma has been associated with transfusion reactions including allergic, febrile, transfusion associated volume overload (TACO), transfusion related acute lung injury (TRALI), hemolytic, and septic reactions. The use of plasma collected from male donors or female donors testing negative for the presence of HLA antibodies has been associated with a decreased risk of TRALI. Liquid plasma (never frozen) may contain lymphocytes and carries a risk of TA-GVHD that can be prevented with irradiation.
Suggested reading	1. Dzik W, Rao A. "Why do physicians request fresh frozen plasma?" *Transfusion*. 2004;44:1393. *https://onlinelibrary.wiley.com/doi/10.1111/j.0041-1132.2004.00422.x* 2. Roback JD, Caldwell S, Carson J, et al. "Evidence-based practice guidelines for plasma transfusion." *Transfusion*. 2010;50:1227. *https://onlinelibrary.wiley.com/doi/10.1111/j.1537-2995.2010.02632.x* 3. McGonigle AM, Patel EU, Waters KM, et al. "Solvent detergent treated pooled plasma and reduction of allergic transfusion reactions." *Transfusion*. 2020;60:54. *https://onlinelibrary.wiley.com/doi/10.1111/trf.15600* 4. Abdel-Wahab OI, Healy B, Dzik WH. "Effect of fresh-frozen plasma transfusion on prothrombin time and bleeding in patients with mild coagulation abnormalities." *Transfusion*. 2006;46:1279. *https://onlinelibrary.wiley.com/doi/10.1111/j.1537-2995.2006.00891.x* 5. Triulzi DJ. "The art of plasma transfusion therapy." *Transfusion*. 2006;46:1268. *https://onlinelibrary.wiley.com/doi/10.1111/j.1537-2995.2006.00923.x* 6. Holland LL, Foster TM, Marlar RA, Brooks JP. "Fresh frozen plasma is ineffective for correcting minimally elevated international normalized ratios." *Transfusion*. 2005;45:1234. *https://onlinelibrary.wiley.com/doi/10.1111/j.1537-2995.2005.00184.x* 7. Segal JB, Dzik WH. "Transfusion Medicine/Hemostasis Clinical Trials Network. Paucity of studies to support that abnormal coagulation test results predict bleeding in the setting of invasive procedures: an evidence-based review." *Transfusion*. 2005;45:1413. *https://onlinelibrary.wiley.com/doi/10.1111/j.1537-2995.2005.00546.x* 8. Stanworth SJ, Brunskill SJ, Hyde CJ, et al. "Is fresh frozen plasma clinically effective? A systematic review of randomized controlled trials." *Br J Haematol*. 2004;126:139. *https://onlinelibrary.wiley.com/doi/10.1111/j.1365-2141.2004.04973.x* 9. Chowdary P, Saayman AG, Paulus U, et al. "Efficacy of standard dose and 30 ml/kg fresh frozen plasma in correcting laboratory parameters of haemostasis in critically ill patients." *Br J Haematol*. 2004;125(1):69-73. *https://onlinelibrary.wiley.com/doi/10.1111/j.1365-2141.2004.04868.x* 10. Carson JL, Ness PM, Pagano MB, et al. "Plasma trial: Pilot randomized clinical trial to determine safety and efficacy of plasma transfusions." *Transfusion*. 2021;61:2025. *https://onlinelibrary.wiley.com/doi/10.1111/trf.16508*

Association for the Advancement of Blood & Biotherapies

PLATELETS

BLOOD COMPONENT CARD

Description	Platelets can be obtained through apheresis collection (single donor unit) or by pooling platelets obtained from whole blood units.
Storage and handling	Platelets are most commonly stored at room temperature (20-24 C) with gentle agitation but can also be stored at cold temperatures (1-6 C) without agitation. The shelf-life can be 3, 5 or 7 days depending on the bacterial testing strategy, including culture at 24 h, large volume delayed sampling at 36 h (LVDS-36) and pathogen reduction (PR), or LVDS at 48 h (LVDS-48), respectively. Platelets can be stored in plasma or platelet additive solution (PAS)
Indications	Platelet transfusions are intended to stop or prevent bleeding in thrombocytopenic patients or those with platelet dysfunction. Transfusion decision should be made after considering overall clinical context and alternative therapies. The AABB recommends the following: **Recommendation 1:** Platelets should be transfused prophylactically to reduce the risk for spontaneous bleeding in hospitalized adult patients with therapy-induced hypoproliferative thrombocytopenia. Transfuse hospitalized adult patients with a platelet count of 10×10^9 cells/L or less to reduce the risk for spontaneous bleeding. **Recommendation 2:** Transfuse patients having elective central venous catheter placement with a platelet count less than 20×10^9 cells/L. **Recommendation 3:** Transfuse patients having elective diagnostic lumbar puncture with a platelet count less than 50×10^9 cells/L. **Recommendation 4:** Transfuse patients having major elective nonneuraxial surgery with a platelet count less than 50×10^9 cells/L. **Recommendation 5:** The AABB recommends against routine prophylactic platelet transfusion for patients who are nonthrombocytopenic and have cardiac surgery with cardiopulmonary bypass. The AABB suggests platelet transfusion for patients having bypass who exhibit perioperative bleeding with thrombocytopenia and/or evidence of platelet dysfunction.
Dosage, expected increment, and infusion rate	Platelet units contain at least 3×10^{11} platelets with an approximate volume of 300 mL. The average increase in post-transfusion count is 30,000-60,000 platelets/ul. Patients with consistently suboptimal responses to platelet transfusions may have immune-based refractoriness and should be fully evaluated for compatible platelets. Platelets should be infused as tolerated.
Risks	Due to the high plasma content, platelets have been associated with transfusion reactions including allergic, febrile, transfusion associated volume overload (TACO), transfusion related acute lung injury (TRALI), hemolytic, and septic reactions. Mitigation strategies to decrease the incidence of transfusion reactions include the use of PAS, leukodepletion, volume reduction, collections from male donors or female donors testing negative for the presence of HLA antibodies, pathogen reduction, bacterial testing, irradiation, and the use of diversion pouch at the time of the unit collection.
Suggested reading	1. "Bacterial Risk Control Strategies for Blood Collection Establishments and Transfusion Services to Enhance the Safety and Availability of Platelets for Transfusion." FDA. 2020. *https://www.fda.gov/regulatory-information/search-fda-guidance-documents/bacterial-risk-control-strategies-blood-collection-establishments-and-transfusion-services-enhance* 2. Kaufman RM, Djulbegovic B, Gernsheimer T, et al. "Platelet Transfusion: A Clinical Practice Guideline From the AABB." *Ann. Intern. Med.* 2015;162(3):205-213. *https://www.acpjournals.org/doi/full/10.7326/M14-1589?rfr_dat=cr_pub++0pubmed&url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org* 3. Brogi E, Corbella D, Coccolini F, et al. "The Role of Platelet Transfusions After Intracranial Hemorrhage in Patients on Antiplatelet Agents: A Systematic Review and Meta-Analysis" *World Neurosurg.* 2020;141:455-466. *https://pubmed.ncbi.nlm.nih.gov/32289507/* 4. Cohn CS. "Platelet transfusion refractoriness: how do I diagnose and manage?" *Hematol Educ Program.* 2020;2020(1):527-532. *https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7727584/* 5. Harvey AR, Basavaraju SV, Chung KW, et al. "Transfusion-related adverse reactions reported to the National Healthcare Safety Network Hemovigilance Module, United States, 2010 to 2012." *Transfusion*. 2015;55(4):709-718. *https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7879051/* 6. Pagano MB, Katchatag BL, Khoobyari S, et al. "Evaluating safety and cost-effectiveness of platelets stored in additive solution (PAS-F) as a hemolysis risk mitigation strategy." *Transfusion*. 2018;59(4):1246-1251. *https://onlinelibrary.wiley.com/doi/10.1111/trf.15138* 7. Lee CK, Wong HK, Ho PL, et al. "Significant bacterial contamination risk reduction with the use of diversion pouch." *Transfus Med.* 2012;22(6);404-8. *https://pubmed.ncbi.nlm.nih.gov/23036088/*

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RED BLOOD CELLS

BLOOD COMPONENT CARD

Description

Red blood cell units can be obtained through apheresis collection or centrifugation and plasma removal from whole blood units.

Storage and handling

RBCs should be stored refrigerated at 1-6 C. Shelf-life depends on the anticoagulant and/or additive solution:

Anticoagulant-Preservative	Unit HCT	Shelf Life
Anticoagulant Citrate-Dextrose A (ACD-A), Citrate-Phosphate-Dextrose (CPD), Citrate-Phosphate-Dextrose-Dextrose (CP2D)	65-80%	21 days
Citrate-Phosphate-Dextrose-Adenine (CPDA-1)	65-80%	35 days
Additive Solution (AS-1, AS-3, AS-5, AS-7)	55-65%	42 days
Saline Adenine Glucose Mannitol (SAGM)	65%	35-42 days* *shelf life varies by country

Rare RBC units may be frozen with glycerol for long term storage (10 years) and deglycerolized after thawing. There is currently no FDA approved technology for pathogen reduction of RBC units. All solutions except SAGM are FDA approved.

Indications

RBC transfusions are intended to increase oxygen carrying capacity and indicated to treat symptomatic anemia. Transfusion decision should be made after considering overall clinical context and alternative therapies. The AABB recommends the following:

Recommendation 1: The AABB recommends adhering to a restrictive transfusion strategy (7 to 8 g/dL) in hospitalized, stable patients.

Recommendation 2: The AABB suggests adhering to a restrictive strategy in hospitalized patients with preexisting cardiovascular disease and considering transfusion for patients with symptoms or a hemoglobin level of 8 g/dL or less.

Recommendation 3: The AABB cannot recommend for or against a liberal or restrictive transfusion threshold for hospitalized, hemodynamically stable patients with the acute coronary syndrome.

Recommendation 4: The AABB suggests that transfusion decisions be influenced by symptoms as well as hemoglobin concentration.

The decision to transfuse RBCs in the setting of massive transfusion and patients with hemoglobinopathy is not based on the patient's hemoglobin level.

Dosage/ expected increment and infusion rate

For non-bleeding adult patients, typical dose is 1 unit with recheck of hemoglobin and patient symptoms before transfusing a second unit. One RBC unit is expected to increase hemoglobin level ~ 1 g/dL (HCT 3%) in an average sized (70 kg) adult.

Transfusion should be started slowly for first 15 minutes (1-2mL/min; not faster than 120 mL/hr) and then rate can be increased to as fast as tolerated and routine transfusion should not exceed 300mL/hr. Slower rates recommended for patients at risk for circulatory overload. Transfusion with blood warmer is recommend for patients receiving rapid infusions or with cold agglutinins.

Non-additive solution units which have higher hematocrits are not amenable to rapid transfusion.

Risks

Fatal transfusion reactions with RBC transfusion are rare but can occur due to acute hemolytic transfusion (usually from inadvertent ABO-incompatible RBC transfusion), hyperhemolysis (with or without antibody identification to minor RBC antigens), transfusion associated circulatory overload (TACO), transfusion-related acute lung injury, or anaphylaxis. The most common reactions reported with transfusion are mild allergic and febrile non-hemolytic transfusion reactions.

Suggested reading

1. Carson JL, Guyatt G, Heddle NM, et al. "Clinical Practice Guidelines From the AABB: Red Blood Cell Transfusion Thresholds and Storage." *JAMA*. 2016;316(19):2025–2035. *https://jamanetwork.com/journals/jama/article-abstract/2569055*
2. Lacroix J, Hebert PC, Fergusson DA, et al. "Age of Transfused Blood in Critically Ill Adults." *NEJM*. 2015;372:1410-1418. *https://www.nejm.org/doi/10.1056/NEJMoa1500704*
3. "Transfusion/Donation Fatalities." FDA. 2021. *https://www.fda.gov/vaccines-blood-biologics/report-problem-center-biologics-evaluation-research/transfusiondonation-fatalities*
4. "National Healthcare Safety Network Biovigilance Component Hemovigilance Module Surveillance Protocol." CDC. 2021. *https://www.cdc.gov/nhsn/pdfs/biovigilance/bv-hv-protocol-current.pdf*
5. Cohn CS, Delaney M, Johnson ST, Katz LM. *Technical Manual*. AABB. 2020. *https://www.aabb.org/aabb-store/product/technical-manual-20th-edition---print-14885311*
6. Benjamin FS, Almeida JP, Landoni G et al. "Liberal versus Restrictive transfusion strategy in critically ill oncologic patients: The Transfusion Requirements in Critically Ill Oncologic Patients Randomized Controlled Trial." *Crit Care Med*. 2017;45:766-773. *https://pubmed.ncbi.nlm.nih.gov/28240687/*
7. Mazer CD, Whitlock RP, Fergusson DA., et al. "Restrictive or Liberal Red-Cell Transfusion for Cardiac Surgery." *NEJM*. 2017;377:2133-44. *https://www.nejm.org/doi/full/10.1056/nejmoa1711818*
8. Simon GI, Craswell A, Thom O, et al. "Outcomes of restrictive versus liberal transfusion strategies in older adults from nine randomised controlled trials: a systematic review and meta-analysis." *Lancet Haematol*. 2017;4(10):e465-e474. *https://pubmed.ncbi.nlm.nih.gov/28919087/*
9. Lenet T, Baker L, Park L, et al. "A Systematic Review and Meta-analysis of Randomized Controlled Trials Comparing Intraoperative Red Blood Cell Transfusion Strategies." *Ann Surg*. 2022;275(3):456-466. *https://journals.lww.com/annalsofsurgery/Fulltext/2022/03000/A_Systematic_Review_and_Meta_analysis_of.9.aspx*
10. Tay J, Allan DS, Chatelain E, et al. "Liberal Versus Restrictive Red Blood Cell Transfusion Thresholds in Hematopoietic Cell Transplantation: A Randomized, Open Label, Phase III, Noninferiority Trial." *J Clin Oncol*. 2020;38(13):1463-1473. *https://ascopubs.org/doi/full/10.1200/JCO.19.01836*