Transfusion Therapy & Safety

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Transfusion Safety Officer
PSONEC Fundamentals – September, 2015
Topics

• Blood Components
• Special Processing/Attributes
  – Irradiation
  – Leukoreduction
  – CMV Negative/CMV Safe
• Patient Safety
  – Type and Crossmatch Verification
  – Unit Verification
  – Monitoring
  – Transfusion Reactions
• Reference Information
Composition of Blood

~55-60% Plasma

~40-45% Formed Elements

- Red Blood Cells (RBC)
- Leukocytes (WBC)
- Platelets
Coagulation

(a) Vasoconstriction
- Platelets
- Endothelial cells
- Vessel injury

(b) Platelet aggregation
- Collagen fibers
- Platelet plug

(c) Clot formation
- Fibrin
Cryoprecipitate = Fibrinogen
Kinds of Blood Components

Donor Whole Blood

- Red Blood Cells
- Plasma
- Platelet-rich Plasma
- Cryoprecipitate
- Platelet
Kinds of Blood Components
Whole Blood Donation

- **RBC**
- **Platelet**
- **Plasma**
- **Cryoprecipitate**

Pooled for adults (5 units pooled in one bag)

Pool for adults (5 units pooled in one bag)
Single Donor/ Apheresis Platelets

Donor Whole Blood

Single donor / Apheresis Platelet
Platelets – Standard Adult Dose

• Pooled Platelet
  • From whole blood donors
  • 5 units in pool

- or -

• Apheresis Platelet
  • From apheresis donor

• Lab will issue one of the above depending on availability
## RBCs - Indications

<table>
<thead>
<tr>
<th>Hemoglobin (g/dl)</th>
<th>Restrictive threshold should be used for the vast majority of hospitalized, stable patients with symptomatic anemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 7-8</td>
<td>Evidence supports this threshold in patients with pre-existing cardiovascular disease</td>
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### Exceptions:

Patients that **may not benefit** from restrictive approach:

- Bleeding, hemodynamically unstable patients
- Hematology / oncology patients
- Anemia in the setting of acute coronary syndrome
Misuse of RBC Transfusions

Both excessive and inappropriate use of blood transfusions exist.

Carries significant risk that may outweigh its benefits in some settings.

Why give 2, when 1 will do?

Transfusion decisions should be based on:

• clinical situation/symptoms
• lab values
Red Blood Cells
Therapeutic Effect

• Average size Adult (per unit)
  – $\uparrow$ Hgb $\sim$ 1 gm/dL = $\uparrow$ Hct $\sim$ 3%

• Dose - depends on clinical situation

ONE and DONE!
Platelets – Indications

• Prevent bleeding r/t bone marrow failure:
  – <10,000/μl

• Active bleeding or surgery:
  – <50,000/μl
    • general med/surg patients
  – <100,000/μl:
    • massive hemorrhage
    • severe vascular injury
    • diffuse alveolar hemorrhage
    • eye surgery
    • neurosurgery
Platelets

Therapeutic Effect

Adult Dose

• Usually one bag

• Increment
  – Platelet count $\uparrow \sim 30,000/\mu l \text{ per bag}$
Plasma Indications

- INR > 1.5 with one of the following:
  - Active bleeding
  - Urgent invasive procedure required
Plasma
Therapeutic Effect

• Adult: One unit:
  – ↑ most coagulation factors ~ 2.5%

• Dose based on clinical condition and underlying disease process
  – Adult dose: 10-15mL/kg
    • Usually 3-6 units
Cryoprecipitate
Indications

• Hypofibrinogenemia
  – Fibrinogen < 100 mg/dL
  – Or < 150 mg/dl – if expected to fall significantly
    • Disseminated Intravascular Coagulation
    • Active bleeding
Cryoprecipitate
Therapeutic Effect

• 1 Pool (5 units/pool):
  – ↑ fibrinogen ~ 37 mg/dL

• Adult Dose:
  – 1 - 2 units per 10kg ( ~ 1 or 2 Pools)
Granulocytes - Indications

• Preparation
  – Collected by apheresis machine
  – Always Irradiated

• Indications - Severe neutropenia with:
  – Life-threatening bacterial or fungal infection
    • not responsive to antimicrobial therapy
  – Neonates with sepsis
Granulocytes

Therapeutic Effect

• May or may not see increase in WBC count

• Dose
  – Pediatrics: max 20mL/kg/day
  – Adults: 1 unit/day
Irradiation Process

• **HOW**
  – Placed in Irradiator

• **EFFECT- Inactivates Lymphocytes**
  – Prevents replication and ability to attack the recipient’s tissue
Irradiation
Applicable Components

RBC

Platelets

WBCs

Note: Granulocytes - ALWAYS IRRADIATED
Irradiation - Purpose

• Prevent
  – Transfusion-Associated Graft versus Host Disease

• Similar to GVHD seen in BM/Stem Cell transplant recipients

• Immunocompromised patients do not destroy the infused lymphocytes in the blood component
  – Lymphocytes engraft / proliferate
  – Attack host tissue
Transfusion-Associated Graft Versus Host Disease

• Lymphocytes launch attack against
  – Skin, Liver, Gut
  – Bone Marrow

• Clinical symptoms present 8-12 days post-transfusion
  – Fever
  – Skin - skin rash
  – Liver - elevated LFTs, hepatitis
  – Gut - diarrhea, anorexia, nausea/vomiting
  – Bone Marrow - bone marrow failure (pancytopenia)
Transfusion-Associated Graft Versus Host Disease - Outcome

• Outcome: ~ 90 % mortality
  – Infectious complications
  – Bleeding complications
  – Death typically occurs 3-4 weeks post-transfusion

• No effective treatment

• Prevention is a must!
Transfusion-Associated Graft Versus Host Disease

• Patients with competent immune systems at risk for TA-GVHD
  – * Components from blood relatives
    • No longer offered by Bloodworks NW
  – * HLA matched platelets

* Above components ALWAYS irradiated for ALL patients
Irradiation Indications

See Handout for Specifics
Leukoreduction Process

• HOW
  – Pass component through Leukoreduction filter at Bloodworks NW
  – Apheresis machine during collection

• Effect
  – Majority of the leukocytes removed
Leukocyte Reduction
Applicable Components

- RBC
- Platelets

Note: Granulocytes are NEVER Leukoreduced

Bloodworks NW
ALL RBCs and Platelets are Leukoreduced
Leukoreduction – Purpose

• Reduce unwanted effects caused by WBCs and their by-products released during storage
  – Prevent Febrile Non-Hemolytic Transfusion Reactions
  – Prevent Alloimmunization
  – Use as substitute for CMV negative components
Leukoreduction

• Prevent recurrent:
  – Febrile Nonhemolytic Transfusion Reaction

• Cause – not completely understood
  – Antibody mediated
    • Patient antibodies react with infused WBCs
  – WBCs breakdown during storage
    • Cytokines released into the component
Leukoreduction

• Help prevent:
  – Alloimmune Platelet Refractoriness

• Alloimmunization
  – Development of patient antibodies against donor HLA antigens

• WBCs contain human leukocyte antigens (HLA)

• 30-50 % of multitransfused patients develop HLA antibodies
Multiple Non-Leukoreduced Transfusions

Donor White Blood Cell

HLA Class I

HLA Class II
HLA Antibody Development – 2 to 4 weeks later

Recipient anti-HLA antibody

HLA Class I

Donor Platelet

Donor White Blood Cell

HLA Class II

HLA Class I

HLA

Donor White Blood Cell

Bloodworks Northwest
Multiple antibodies to different HLA antigens via multiple transfusions with non-LR products

Premature removal by the spleen

No increase in platelet count

Alloimmune Platelet Refractoriness
Alloimmune Platelet Refractoriness

• Poor platelet count increment $\sim < 5,000$
  – At 1 hour post transfusion
  – On at least 2 occasions

• Obtain platelets counts
  – Pre-transfusion
  – 1 hour post (10-60 min)

• Bloodworks NW does workup
  – Patient – HLA antibodies
HLA Matched Platelets

• Donor’s HLA typing
  – Matched to patient’s HLA typing (HLA A, B)
  – As much as possible

• Apheresis - collect from matched donor

• Initial order often requires 48 hours notice

• Resource limited by donor pool
Leukocyte Reduction

• Reduce rate of HLA alloimmunization in organ transplant patients/candidates
  – Renal
  – Heart
  – Lung

• Risk of transplant rejection due to HLA antibodies
Leukoreduction

- Creates CMV “Safe” Component
  - Help prevent CMV transmission
CMV (Cytomegalovirus)

- Herpes virus

- CMV lies dormant in tissues and circulating leukocytes of infected individuals

- ~ 50% of population in WA is CMV positive

- Poses little problems to those with competent immune systems
  - Most no history of illness
CMV Neg/Safe Components

• Purpose
  – Prevent primary CMV infection in immunocompromised CMV-negative patients

• Serious complications
  – CMV-associated pneumonia, myocarditis, retinitis, hepatitis, gastroenteritis
CMV Safe Components

• CMV transmission—reduced by use of either:
  – CMV Negative Components
  – Leukoreduced Components

• With Leukocyte Reduction of ALL RBCs/Platelets
  – Many facilities discontinued CMV Neg ordering option
  – LR substituted for CMV Neg
CMV Safe Indications

See Handout for Specifics
Critical Points in Transfusion Process

1) Collection and labeling of Type/Cross/Screen sample
   • “Wrong Blood In Tube” can be fatal!
   • Two person verification at bedside

2) Pre-Transfusion Verification
   • Transfusing wrong unit can be fatal!
   • Two person verification at bedside
2 Person Verification at Bedside
(Type/Cross, Type/Screen, Hold, 2nd Sample)

1. If able, ask patient to state name/DOB and compare to armband
2. At bedside, check that Name and MRN on all three sources match exactly
3. Both individuals observe filling of blood tube
4. Label immediately after collection

### 1. ARMBAND
- Test, Jane D.
- MRN: 01234567
- BD: 1/1/1950

### 2. PATIENT LABEL
- Test, Jane D.
- MRN: 01234567
- BD: 1/1/1950

### 3. REQUEST FORM
- Must Match
Type and Crossmatch Sample

- **Required** – Red Blood Cells
  - Sample in last 3 days

- **Not required** – platelets, plasma, or cryo
  - If pt’s blood type (ABO/Rh) on file at Bloodworks NW
2\textsuperscript{nd} Confirmatory ABO/Rh Sample

- If pt has no prior hx of blood type (ABO/Rh) at Bloodworks
  - 2\textsuperscript{nd} separately collected sample is required before routine RBCs will be issued

- Purpose – Increased Safety!
  - Double check blood type
  - Prevent Wrong Blood in Tube errors – which can be fatal

- Must be drawn at later (different) time than 1st sample

- Not required: Platelet, Plasma, or Cryo orders

- 1\textsuperscript{st} sample – send immediately

- 2\textsuperscript{nd} sample – send ASAP
  - Emergency RBC units will not be delayed due to lack of 2\textsuperscript{nd} Sample
Transfusion Administration
Pre-Transfusion Preparation

1. Verify Consent

2. Verify IV access: 20 gauge or larger preferred, but not required

3. IV Pump – use for all components (pump must be manufacturer approved for this use)
4. Blood Administration Tubing Set (with 150 – 260 micron filter)
   - Prime with 0.9% NS or blood component
   - Saturate filter, fill drip chamber ~ 1/2 full
   - See manufacturer insert for specific instructions
   - Never use other IV solutions
   - Never add medications
   - Limit per set:
     - Max 4 hours
     - Max 4 units (or per manufacturer instructions)
       - Exception – use new set for Platelets
Component Pick-up from Lab
(follow facility’s policy)

• Take a copy of EMR Pick-Up Slip to Lab

• Downtime
  ► Copy of paper TransfuseOrder

• Emergency when neither available
  ► Patient chart label

• Perform double check with Lab and sign log

All units must be returned in less than 30 minutes of issue from the lab if the unit will not be transfused
Component Handling

• Never place a RBC or Plasma unit in refrigerator on nursing unit
  – Units may be stored in Blood Bank Refrigerator only

• Platelets and Cryoprecipitate must always remain at room temperature
  – Must never be placed in any refrigerator or cooler
2 Person BEDSIDE CHECK

- Informed Consent
- Check component against MD’s order
- Involve patient, ask patient to state name and birth date, verify against ID band
- Compare items shown below, must be identical
- Expiration date/time not passed and will not pass before transfusion completion
- Compare patient’s blood type on trans tag with unit type to ensure they are compatible
- * Compatibility testing expiration on tag (RBCs and Grans only) has not passed
- Visual Inspection
- Check boxes - sign tag

<table>
<thead>
<tr>
<th>Trans Tag</th>
</tr>
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<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>MRN</td>
</tr>
<tr>
<td>Component Type</td>
</tr>
<tr>
<td>Unit #</td>
</tr>
<tr>
<td>Blood Type</td>
</tr>
<tr>
<td>Expiration</td>
</tr>
<tr>
<td>Special Attributes</td>
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</tbody>
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*Compatibility Expiration*
Transfusion Report
(tag attached to blood bag)

Blood Bag Label

A POSITIVE
- Requirement: D Neg
- Component: LEUKOCYTES REDUCED

O POSITIVE
- See COMMENTS
- Component: LEUKOCYTES REDUCED

Comments:
- An acceptable ABO blood group substitution has been made.
- A leukoreduced component has been substituted for a CMV-negative component.

Blood Bag
- Blood Product: RED BLOOD CELLS A5-5
- Code: WH141607 960102
- Expiration Date: 01 FEB 2007
- Collection and Processed By: PUGET SOUND BLOOD CENTER
- DO NOT TRANSFUSE AFTER: 23:56 on 30-01-2007
- Component ABO Type: O
- Component Rh Type: Rh POSITIVE
- Unit Code: WH141607 060102
- Unit Code Prefix: WP
- Expiration Date: 01 FEB 2007
- Volume: 500 mL
- Additive: SALINE (0.9%)
- Irradiated: YES
- Leukoreduced: YES
- CMV Negative: NO
- PLT Positive: NO
- Leukocytes Reduced: YES

Irradiated indicator: YES

Certified:
- BY: EJ
- Date: 10-12-12
- Time: 10:25

Issued:
- Time: 10:25
- Date: 10-12-12
Blood Tags

- Check 3 boxes
- Two signatures with date / time of verification
- Never discard
- Place in patient’s paper chart
Monitoring – All Products

1. Start within 30 minutes of Lab issue
   – If unable, then return to Lab < 30 min

2. Transfusion Assessment
   (T, RR, HR, BP, SaO2, lung & skin assessments)
   – Pre, 15 minutes, End
   – 1 hour post
   – Any time reaction is suspected

3. Stay with patient - first 15 minutes

4. Reaction Assessment q 30 minutes

5. Complete within 4 hours of issue from Lab or before expiration (whichever occurs first)
Transfusion Rates – Routine Non-Emergent (Adults)

- First 15 minutes (non-emergent):
  - Start slowly: **100 ml/hour**

- After 15 minutes:
  - If no reaction, increase to rate on Transfuse Order
  - Rate guidelines (non-emergent transfusions):
    - Red cells: 1.5 - 4 hours
    - Platelets: 1 hour
    - Plasma: 30 - 60 min
    - Cryoprecipitate: 15 - 30 min
    - Grans: 1 – 2 hours
Transfusion Reactions – Signs/Symptoms
Change from Baseline

Anxiety
Hypotension/Shock
Hypertension
Fever (>1 °C or 1.8 °F)
Chills (with or without fever)
Pain - Back, Chest, IV
Dyspnea
Tachycardia
Hemoglobinuria
Oliguria / Anuria

Hives
Itching
Cough
Nausea
Vomiting
Abdominal cramps
Headache
Cyanosis
Diaphoresis
Generalized bleeding
Suspected Transfusion Reactions: Patient Education

“Call me if you feel any differently than you do right now.”
Acute Transfusion Reactions

Stop and do not restart:
• Febrile Nonhemolytic
• Acute Hemolytic
• Transfusion Related Acute Lung Injury
• Anaphylactic
• Bacterial Contamination
• Volume Overload

With Provider order, may restart:
• Urticarial (Mild Allergic) only
  – Stop
  – Antihistamine (Benadryl)
  – If reaction resolve, restart slowly
  – Observe q 15 min
Transfusion Reaction Guide

For Information Only

**Immediate Action**

- Obtain orders for antihistamine
- If reaction resolves, may restart transfusion at slower rate
- Observe every 15 minutes
- Request premed with antihistamine, if history of prior allergic reactions

**Stop transfusion; do not disconnect unit**
- Complete PSBC reaction form
- Not necessary to send samples; check policy

**Febrile reaction**

- Fever ≥38°C, fever with ≥1°C rise or chills
- Fever with ≥2°C rise, or fever + symptoms of dyspnea, hypotension, tachycardia, chest/back pain or tightness, N/V, rigors, or feeling of impending doom

- Stop transfusion. Do not discard unit or infusion set.
- Maintain IV access
- Notify patient’s MD
- Monitor vital signs frequently
- Complete PSBC reaction form
- Perform clerical check (patient ID & blood bag label)
- Send EDTA tubes (per policy) and send STAT to lab with PSBC reaction form
- Obtain urine sample and send red/dark urine to lab
- Send blood bag, infusion set and attached IV fluids with reaction form and samples

**Anaphylactic reaction (urticaria)**

- Hives only
- Stop transfusion; do not disconnect unit
- Complete PSBC reaction form
- Not necessary to send samples; check policy

**Fever ≥38°C, fever with ≥1°C rise or chills**

- Fever ≥2°C rise, or fever + symptoms of dyspnea, hypotension, tachycardia, chest/back pain or tightness, N/V, rigors, or feeling of impending doom

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**Stridor, hypotension, airway compromise, hypoxia**

- Stop transfusion. Do not discard unit or infusion set.
- Maintain IV access
- Notify patient’s MD
- Monitor vital signs frequently
- Complete PSBC reaction form
- Perform clerical check (patient ID & blood bag label)
- Send EDTA tubes (per policy) and send STAT to lab with PSBC reaction form
- Obtain urine sample and send red/dark urine to lab
- Send blood bag, infusion set and attached IV fluids with reaction form and samples

**Dyspnea, fever, hypotension**

- Stop transfusion. Do not discard unit or infusion set.
- Maintain IV access
- Notify patient’s MD
- Monitor vital signs frequently
- Complete PSBC reaction form
- Perform clerical check (patient ID & blood bag label)
- Send EDTA tubes (per policy) and send STAT to lab with PSBC reaction form
- Obtain urine sample and send red/dark urine to lab
- Send blood bag, infusion set and attached IV fluids with reaction form and samples

**Dyspnea, wheezes, angioedema, hypotension**

- Stop transfusion. Do not discard unit or infusion set.
- Maintain IV access
- Notify patient’s MD
- Monitor vital signs frequently
- Complete PSBC reaction form
- Perform clerical check (patient ID & blood bag label)
- Send EDTA tubes (per policy) and send STAT to lab with PSBC reaction form
- Obtain urine sample and send red/dark urine to lab
- Send blood bag, infusion set and attached IV fluids with reaction form and samples

**Stridor, hypotension, airway compromise, hypoxia**

- Stop transfusion. Do not discard unit or infusion set.
- Maintain IV access
- Notify patient’s MD
- Monitor vital signs frequently
- Complete PSBC reaction form
- Perform clerical check (patient ID & blood bag label)
- Send EDTA tubes (per policy) and send STAT to lab with PSBC reaction form
- Obtain urine sample and send red/dark urine to lab
- Send blood bag, infusion set and attached IV fluids with reaction form and samples

**Dyspnea, hypertension, tachycardia, edema**

- Stop transfusion. Do not discard unit or infusion set.
- Maintain IV access
- Notify patient’s MD
- Monitor vital signs frequently
- Complete PSBC reaction form
- Perform clerical check (patient ID & blood bag label)
- Send EDTA tubes (per policy) and send STAT to lab with PSBC reaction form
- Obtain urine sample and send red/dark urine to lab
- Send blood bag, infusion set and attached IV fluids with reaction form and samples

*For severe reactions or further consultation, PSBC has a physician on call 24 hours a day.*

Please call (206) 292-6323 and ask to speak to the POC.
Suspected Reaction - Steps

1) STOP TRANSFUSION
2) Notify Provider (RRT/Code prn)
3) Monitor vital signs/lungs/skin/symptoms
4) Check tag against armband and bag label to verify right unit was given to right patient
5) Hang new IV set with new 0.9% NS bag to keep line open (TKO). Do not flush or use blood set.
6) Treat symptoms per Provider’s orders
7) Order and send reaction workup to hospital lab
8) Document findings / actions in medical record

Call BW Physician On-Call for help, prn (206) 292-6525 (#3)
### Reaction Workup – Submit to Lab

**Instructions:**
- Notify patients MD.
- Maintain IV/meds.
- Monitor vital signs frequently.
- Perform vital signs check:
  1. Name & IRIS/Transfusion Reaction Report agrees with patient's identification band?
  2. The blood bag number and ARN on Transfusion Report agree with the information on the blood bag label?
- No, explain:
- Determine if samples (blood/during needed)
- SRC requires completion of reactions, unless those with pink only.
- Check your hospital policy.
- Blood: Send 1 or 2 EDTA samples as specified by your policy to the hospital lab.
  
  **Next Fresh Urine Sample (if red/dark)**
  - Lavender or Pink tops
  - Bag and attached tubing/IV solution

**Persons Receiving:**
- Last, First (legible)

**Phone Numbers:**
- Physician or Nurse: Last, First (legible)

**Equipment/Supply:**
- Telephone Number (10 digits)

**Signs and Symptoms:**
- 
  **Pink-top Erythrocytes (if needed):**
- 
  **迫切性:**
- 
  **Nausea:**
- 
  **Intubation:**
- 
  **Mechanical Ventilation:**
- 
  **Is the patient now back to baseline for the six symptoms listed above?**

**Person Receiving:**
- Last, First (legible)

**Person上市:**
- Last, First (legible)

**Date & Time Sample Collected:**
- Date & Time (if done)

**Person Obtaining Specimen:**
- Last, First (legible)

**Person Anxious:**
- Last, First (legible)

**Medical Record Number:**

**Hospital/Unit:**

**Social Security Number:**

**Date of Birth (Y/M/D):**

**Call Lab to obtain pink Reaction form**
Reference Information

– Special Attributes Indications Sheet
– Transfusion Reaction Algorithm
– Other guides at BloodworksNW.org
Ways to Help Ensure Safest Transfusion Possible for Your Patient

1. 2 Person Verification at Bedside - Blood Bank Samples
2. 2 Person Verification at Bedside - Pre-Transfusion
3. 0.9% NS only to prime blood tubing set
4. Begin transfusion slowly first 15 minutes = 100 ml/hour
5. Monitor patient before, during, and after transfusion
6. Ensure rate of infusion is appropriate for your patient
7. Finish within 4 hrs of Lab issue (or before expiration, if sooner)
8. Change blood tubing set every 4 units or 4 hrs (whichever first)
   - Always use new set for Platelets
9. Know how to recognize and treat reactions
10. Report reactions to Provider and submit workup to Lab
Resources

• Facility’s Policies

• Bloodworks NW website
  – http://www.BloodworksNW.org

• Transfusion Safety Officer, Mary Grabowski
  Pager 206-969-5222
  marygr@BloodworksNW.org

• Bloodworks NW, Central Seattle Lab
  (206) 292-6525, #3
  Request On-Call Physician as needed