BLOOD TRANFUSION THERAPY

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Overview

- Historical time line
- Introduction
- General Transfusion Practices
- Purpose of blood transfusion
- Blood products & their Indications
- Nursing implications
- Complications of blood transfusion
- Conclusion

Historical Time Line

- 1665: 1st documented animal-to-animal (dog) blood transfusion (Oxford by Richard Lower)
- 1667: 1st documented animal-to-human blood transfusion (Jean Denis)
- 1818: The first human-to-human blood transfusion was (James Blundell)
- 1901: Karl Landsteiner's discovery of ABO grouping laid foundation for scientific transfusion practices
- 1907: The first pretransfusion cross-match (Ottenberg)
- 1920's: Development of anti-coagulation solutions to store donated blood
- 1940: The system of Rh typing was invented by Landsteiner and Wiener
- 1950's: Disposable plastic systems for collection & aseptic separation of blood components

Introduction

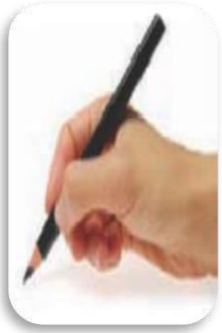
- The goal of blood transfusion therapy (BTT) is to correct an abnormality that will not respond to other modes of treatment
- BTT involves transfusing whole blood (WB) or blood components (specific portion of blood lacking in patient)
- One unit of WB consists of 450 mL of blood collected into 63 mL of preservative or anticoagulant (CPD/CPDA)
- WB stored for >6 hours does not provide therapeutic platelet for transfusion, nor does it contain therapeutic amounts of labile coagulation factors (factors V & VIII)

General Transfusion Practices

- **Compatibility Testing**
- **Storage Temperature:**

CAUTION: Do not store blood in an unmonitored refrigerator

- **Pre –Transfusion:**



- Verify physician's order
- Verify that consent was obtained
- Provide transfusion pamphlet information for patient
- Verify patient & blood unit identification
- Verify special product requirements (eg. Leucodepletion, Irradiation)

General Transfusion Practices

- **Documentation and monitoring**

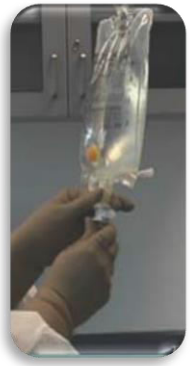
1. Document vital sign intervals within 1 hour prior to administration, minimum of 15 minutes after starting, hourly until transfusion completed & 20-60 minutes following completion of transfusion
2. Document bedside verification process
3. Monitor patient during & after transfusion for signs of an adverse transfusion reaction & document
4. Document volume administered & transfusion reaction
5. Complete patient notification process

General Transfusion Practices

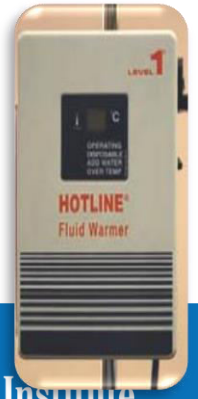
- **Filters:**
- Filter all blood components through a standard (170-260 micron) blood filter
- **Medication:** *CAUTION !!!!*
- Medication must **not be** added to or piggy-backed with any blood/blood component or plasma derivative
- **Pumps:**
- Refer to facility policy & specific blood components / product

General Transfusion Practices

- **Compatible intravenous solutions:**
- *0.9% NaCl* solutions
- **DO NOT** use *Dextrose* solutions (may induce hemolysis) (exception: IVIg infusion)
- **DO NOT** use *Lactated Ringer's* (may induce clot formation in the blood bag and/or administration set).



- **Warming:**
- If warming is needed, a calibrated blood warming device must be used to ensure the blood is not warmed to a temperature at which red cell hemolysis occurs (<42°C)
- Physicians order required.



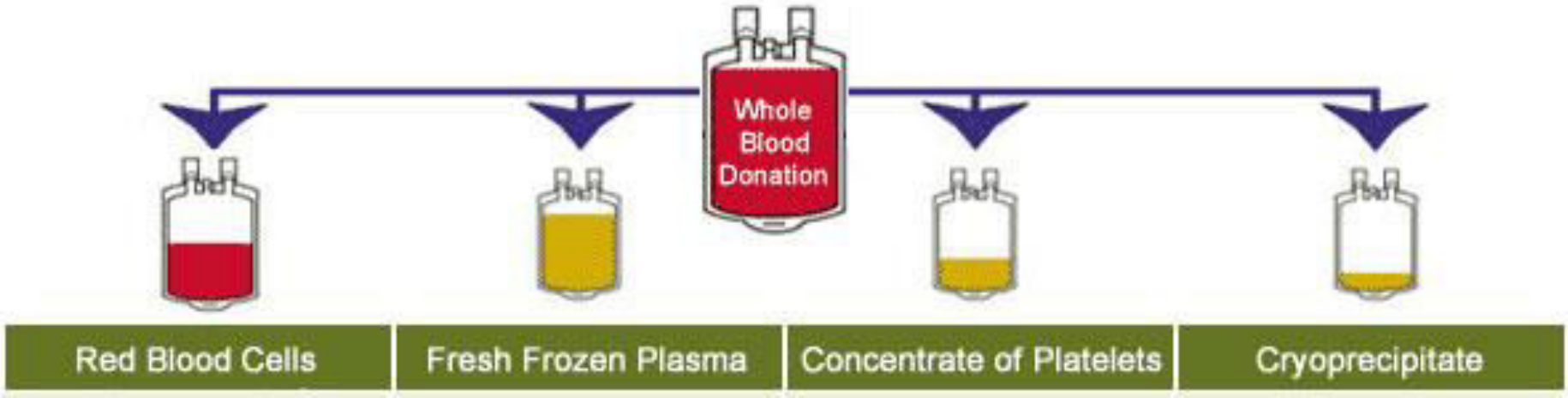
General Transfusion Practices

- **Time of infusion:**
- Blood components/blood products must be infused within ***30 minutes*** of dispensing from BTS
- Before ordering blood components from BTS ensure your patient is ready for transfusion: i.e. consent obtained, IV patent
- If an unexpected delay in starting the transfusion, return unused blood components or blood products immediately ***(within 30 minutes)*** to the BTS to allow them to determine if it can be safely returned to inventory or discarded

Purpose of a Blood Transfusion

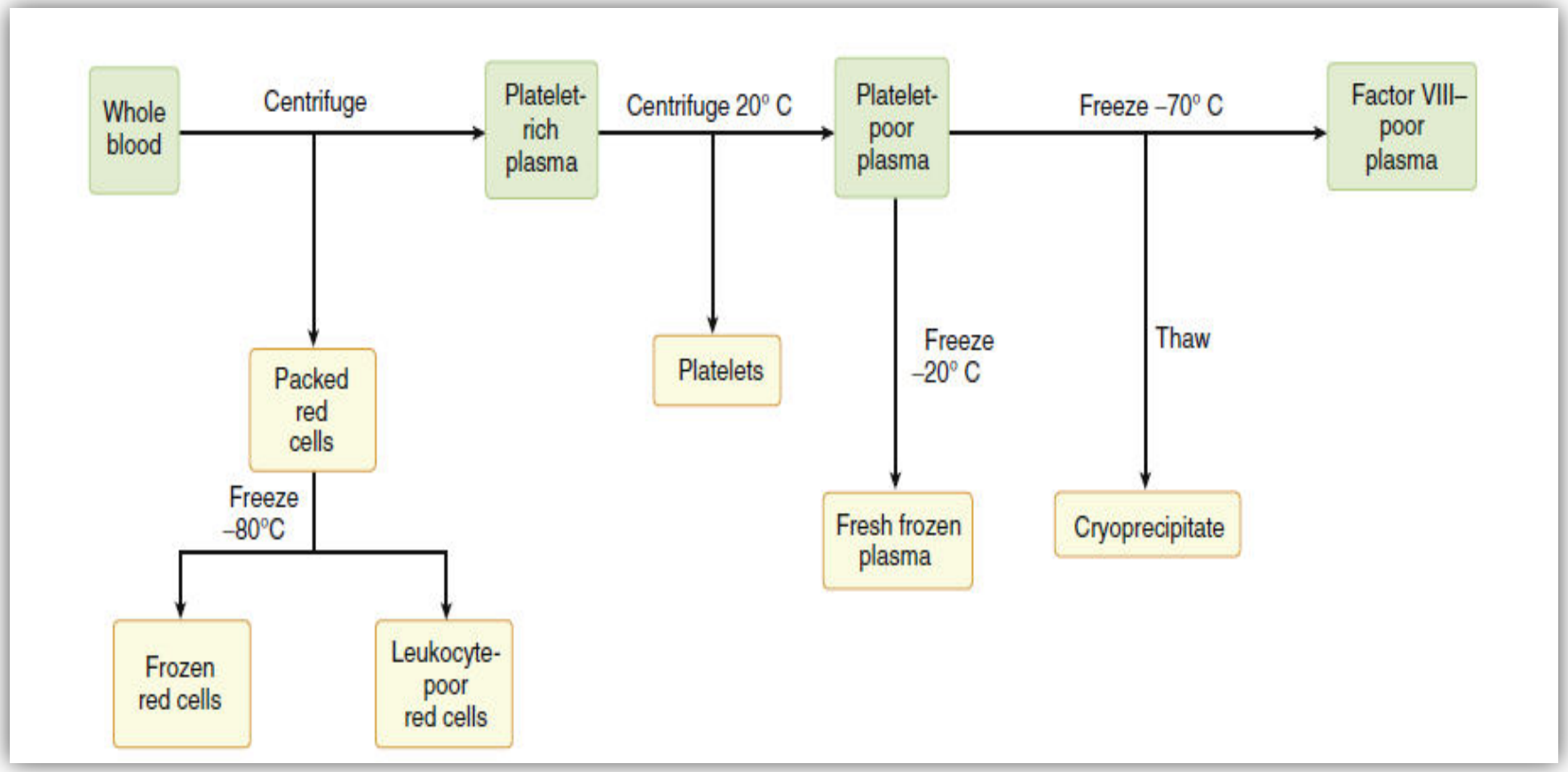
- Replace only the deficient component, if possible
- Restore Hematocrit level
- Replace clotting factors
- Improve oxygen carrying capacity
- Use blood products only when it is essential
- Identify the cause and nature of the deficiency and if possible, treat it
- Prevent complications

Blood Components



Role of Whole Blood ???

Scheme of separation of WB into blood components



Packed Blood red cells (PRBC)

❑ **Characteristics:**

- Volume: 300±50 mL & Hematocrit: 55-65%
- ABO & Rh compatible, antibody screen negative & extended phenotype matched (if possible)
- Free from infectious markers & negative for aerobic/anaerobic culture
- Leukodepleted or Irradiated (special requirements)
- Shelf life: 35 days (CPDA) / 42 days (SAGM)
- Storage temperature: 4±2°C & Transportation temperature: 2-10°C
- Dose: 10 – 15 mL/kg (hemoglobin level increase by 2-3 gm/dL)
- Infusion period: 2-4 hours

Compatibility testing

TABLE 61-3 ABO COMPATIBILITY TESTING

	Red Cells Tested With		Serum Tested With	
Blood Group	Anti-A	Anti-B	A Cells	B Cells
A	+	–	–	+
B	–	+	+	–
AB	+	+	–	–
O	–	–	+	+

TABLE 61-4 DONOR BLOOD GROUPS THAT PATIENTS CAN RECEIVE

Donor	Recipient
O	O, A, B, AB
A	A, AB
B	B, AB
AB	AB

Packed Blood red cells (PRBC)

- **<u>Purpose</u>:**
- Increase RBC mass & oxygen-carrying capacity
- It should ***<u>not</u>*** be used:

✓ For volume expansion

✓ To enhance wound healing

✓ To improve general well being

Packed Blood red cells (PRBC)

❑ **<u>Indications</u>: (*The ASA Task Force 2006*)**

- A close watch on assessment of blood loss during surgery and assessment of tissue perfusion is to be maintained.

1. Rarely indicated – hemoglobin level ***>10 gm/dl***
2. Almost always indicated - hemoglobin level ***<6/7 gm/dl***
3. Hemoglobin concentrations (***6–10 gm/dl)*** - justifying or requiring RBC transfusion should be based on the patient's risk for complications of inadequate oxygenation.

- In any anemic patient, the aim of transfusion therapy should be ***<u>to correct the symptoms of the patient rather than correcting the hemoglobin leve</u>***l.

Modified Red Cell Components

❑ **Leuco-poor red cell components:**

- RBCs may be modified by removal of buffy coat or filtration by leuco-filters to remove contaminating leucocytes (responsible for majority of adverse effects associated with transfusion)
- These leuco-poor products are primarily indicated for patients:

✓ Receive multiple transfusions such as thalassemics, hemodialysis patients, aplastic anemia

✓ Hemato- oncology patients to prevent febrile transfusion reactions to standard products

- Leuco-poor products are also helpful in decreasing the transmission of CMV and alloimmunization to HLA antigens

Modified Red cell Components

❑ Irradiated blood products:

- In order to minimize the risk of transfusion associated graft versus host disease (TA-GVHD) in susceptible individuals, cellular blood products (PRBC, platelets) should be irradiated to a dose of 25 Gy prior to transfusion.
- Patient groups who should receive irradiated blood products are as follows:

✓ Patients undergoing bone marrow or peripheral blood stem cell transplantation

✓ Patients receiving directed donations of cellular product

✓ Patients with Hodgkins lymphoma

✓ Patients with congenital immunodeficiency syndrome

✓ Intra-uterine transfusion

Platelets concentrates (PC)

- Two types:

1. Random donor platelets (RDP) – WB derived
2. Single donor platelets (SDP) – Apheresis derived

- *Current prophylactic platelet transfusion triggers*:

Patient category	Platelet count
All patients	10,000/µL
Stable patient	5000/µL
Patient with fever or recent hemorrhage	10,000/µL
Patient with coagulopathy, on heparin, or with anatomic lesion likely to bleed	20,000/µL
Note: these triggers are most commonly applied to inpatints. Adjustment of the transfusion threshold may be necessitates by unusual clinical situations (source: AABB)	

Platelets concentrates (PC)

- For platelets, ABO specific transfusion is ***preferable but not required***
- In cases where ABO specific platelets (1st Option) are not available, it is recommended that platelets are selected in the order listed in the Platelet ABO Selection Chart (2nd Option)

Platelet ABO Selection Chart

Patient ABO Group	Donor ABO Specific (1st Option)	Donor non -ABO Specific (2nd Option) Selection Order
A	A	AB, B, O
B	B	AB, A, O
AB	AB	A, B, O
O	O	A, B, AB

Random donor platelets (RDP)

- **Characteristics:**
- Volume: 50 - 90 mL
- Platelet yield: ≥5.5 x 10^{10} /unit
- ABO compatible, if possible
- Free from infectious disease markers
- Aerobic/anaerobic culture negative
- Leukodepleted or Irradiated (special requirements)
- Shelf life: 05 days
- Storage temperature: 22±2°C with constant agitation
- *DO NOT REFRIGERATE PLATELETS*
- Transportation temperature: 24°C (Room temperature)
- Dose: 5-10 mL/kg **or** 1 RDP unit/10 kg (pt's ≥ 10kg) [*1 unit of RDP raises the platelet count by 5000 /ul in adult patient*]
- Infusion period: as rapidly as patient can tolerate (20 - 30 min.)
- The clinical response to platelet transfusion should be monitored by measuring the platelet count post transfusion at ***1 hr & 24 hr***

Single donor platelets (SDP)

- **Characteristics:**
- Collected by apheresis/cell separator instrument
- Volume: 250 - 300 mL
- Platelet yield: ≥3.0 x 10^{11} /unit
- ABO compatible, when possible
- Free from infectious disease markers
- Aerobic/anaerobic culture negative
- Leukodepleted or Irradiated (special requirements)
- Shelf life: 05 days
- Storage temperature: 22±2°C with constant agitation
- *DO NOT REFRIGERATE PLATELETS*
- Transportation temperature: 24°C (Room temperature)
- Dose: 5 - 10 mL/kg [*30,000 to 50,000/µL expected rise in platelet count*]
- *1 SDP = 4-6 unit of RDPs*
- Infusion period: as rapidly as patient can tolerate (20 - 30 min.)

SDP Vs RDP

Sr. no.	Parameters	RDP	SDP
1	Platelet yield/unit	≥5.5 x 10^{10}	≥3.0 x 10^{11}
2	Volume	50-90 mL	250-300 mL
3	Platelet count increment/unit	5000 /uL	30,000 to 50,000/µL
4	Leucodepletion	NO (filter required)	Yes (by Apheresis technique)
5	Alloimmunization/ refractoriness risk	More	Less
6	Septic transfusion risk (STR)	More	Less
7	Transfusion transmitted infection (TTI) risk	More	Less
8	Transfusion frequency	More	Less
9	Cost	Less	More

Note: SDP is therapy of choice for patients who are likely to receive long term platelet support such as aplastic anemia or hemato-oncology/BMT recipients as the number of donor exposures is decreased considerably.

Platelets concentrates (PC)

- **Purpose**:
- Helps to stop bleeding (restore clotting ability)
- Essential for coagulation of blood

- **Indications**:

1. Decreased platelet count
   - ≤50000/mm^3 and bleeding
   - ≤50000/mm^3 and invasive procedure
   - <20000/mm^3 and with risk factors
   - <10000/mm^3 without risk factors
2. Hemophilia
3. Thrombocytopenia
4. Platelet dysfunction (End stage renal disease, DIC)

❑ **Contraindications**:

- Thrombotic thrombocytopenic Purpura (TTP)
- Patients with ITP unless there is life threatening bleeding or intracranial hemorrhage

Fresh Frozen Plasma (FFP)

❑ Characteristics:

- Volume: 200 - 220 mL
- Stable factors, Factor VIII: 0.7 units/mL & Fibrinogen: 200-400 mg
- ABO compatible
- Free from infectious disease markers & Aerobic/anaerobic culture negative
- Shelf life: 1 year at -40°C & 5 years at -80°C
- Storage temperature: < - 18°C & Transportation temperature: 2-10°C
- FFP must be thawed at 37°C for ½ hr in a water bath with due precautions
- FFP requires about 30 - 60 minutes to prepare for use
- FFP should be used as soon as it is thawed to avoid the decay of clotting factors
- Infusion period: 20-30 minutes or as rapidly tolerated
- Dose: 10-20 mL/Kg (Factor activity increases by 15% to 20%)
- Laboratory tests such as PT & APTT should be done to monitor the FFP use in patients (*PT/aPTT >1.5 than normal*)

Fresh Frozen Plasma (FFP)

- **Purpose:** To increase blood plasma & replenish clotting factors
- **Indications:**

1. Broad spectrum coagulation factor deficiency (Hereditary & Acquired)
2. Severe liver disease
3. Oral anticoagulant overdose
4. Disseminated intravascular coagulation (DIC)
5. Massive transfusion with coagulation problems
6. Thrombotic thrombocytopenic Purpura
7. Burns
8. Severe Vitamin K deficiency bleeding

- **Most common abuses of FFP:**

- Volume expansion
- As protein supplements
- Prolonged bleeding in the absence of coagulation defects.

Compatible blood groups in case on non-ABO group specific transfusion

Patient Group	Permissible donor groups for red cells	Permissible donor groups for FFP
O	O	O, A, B AB
A	A, O	A, AB
B	B, O	B, AB
AB	AB, A, B O	AB
Rh negative	Rh negative	Not applicable
Rh positive	Rh positive, Rh negative	Not applicable

Cryoprecipitate (Cryo)

❑ Characteristics:

- Cryoprecipitate is the cold insoluble precipitate having Factor VIII, vWF, fibrinogen, fibronectin & factor XIII
- Volume: 10 - 20 mL
- Factor VIII: 80-120 IU & Fibrinogen: 150-250 mg
- *ABO compatibility not required*
- Free from infectious disease markers & Aerobic/anaerobic culture negative
- Shelf life: 1 year at -40°C & 5 years at -80°C
- Storage temperature: < - 18°C & Transportation temperature: 2-10°C
- Cryo must be thawed at 37°C in a water bath with due precautions
- Infusion period: as rapidly tolerated
- Dose: 1 unit / 10 kg (Fibrinogen ↑ to 0.5 g/L)

Cryoprecipitate (Cryo)

- **<u>Indications</u>:**

➢ Factor VIII Deficiency (Hemophilia A): The treatment of choice is virus inactivated factor VIII concentrates

➢ Von Willebrand's Disease

➢ Hypofibrinogenemia (<80 mg/dl)

- Consumptive coagulopathy (DIC)
- Dysfibrinogenemia or Afibrinogenemia

➢ Fibrin Glue for topical hemostasis

Storage and shelf life of components

- Following table summarizes storage requirements and shelf life of various blood components:

Component	Storage Temp	Shelf life	Compatibility
Packed Red Cells	2 to 6 C	42 days	ABO, Rh, Cross-match
Fresh Frozen Plasma	-30 ° C	1 year	ABO
Cryodeficient Plasma	-30 ° C	5 years	ABO
Platelet Concentrate	22 to 24 ° C	5 days	Preferably ABO, but can be given without regard to ABO
Buffy coat	22 ° C	1 day	ABO
Cryoprecipitate	-30 ° C	1 year	Any Group

Nursing Implications

Before transfusion:

- Check physician's orders
- Ensure informed & written consent is provided
- Check laboratory values
- Understand the indications & rationale
- Verification procedure occurs with two nurses
- Compatibility of blood type & Rh factor
- Inspect the blood product for discolouration, clots, leaking, or presence of bubbles
- Check the unit number on the unit of blood & on the form
- Check the expiration date & time on unit of blood
- Ask client to state first & last name
- Check patient's identification number on wristband & record

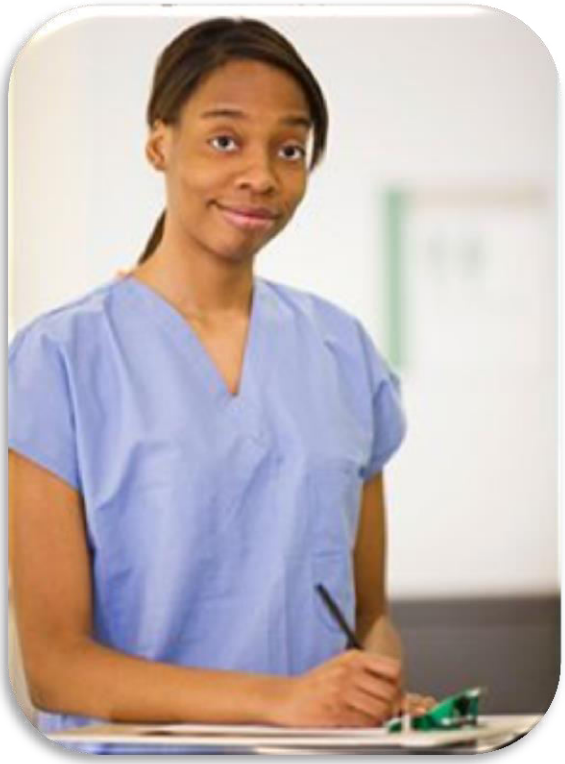
Nursing Implications

- **During the transfusion**:
- Monitor vital signs closely during the blood transfusion
- Inspect condition of IV site
- Observe for signs and symptoms of a reaction

- **After the transfusion**:
- Dispose of materials/equipment
- Observe patient for clinical improvements
- Assess the laboratory values for effectiveness of transfusion

Documentation

- Verification procedure
- Type of blood
- Amount administered
- Vital signs
- Patient’s response to therapy
- Transfusion reaction workup



Transfusion Reactions

Acute (<24 hours)		Delayed (>24 hours)	
Immunological	**Non - Immunological**	**Immunological**	**Non - Immunological**
Hemolytic (AHTR)	Hemolytic (DHTR)	Bacterial contamination	Transfusion induced hemosiderosis
Febrile non hemolytic transfusion reaction (FNHTR) ***[MOST COMMON]***	Transfusion associated graft versus host disease (TAGVHD)	Transfusion associated circulatory overload (TACO)	Transfusion transmitted infections (TTI) • Viral • Bacterial • Protozoans
Allergic / urticaria / anaphylaxis ***[2nd MOST COMMON]***	Post transfusion purpura (PTP)	Physical & chemical hemolysis	
Transfusion related acute lung injury (TRALI)			

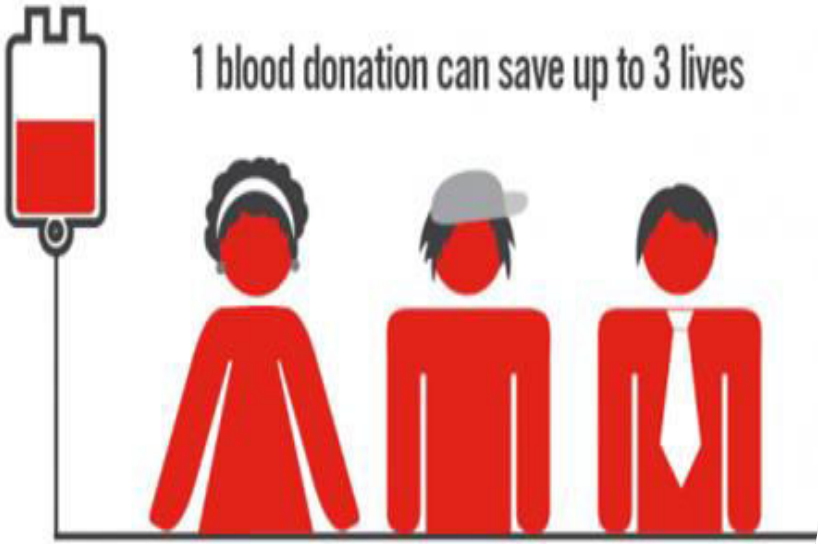
Nursing Implications in a Reaction

- Stop transfusion
- Remove tubing that contains blood product
- Infuse with 0.9% normal saline
- Monitor vital signs
- Notify physician
- Notify blood bank & return blood component
- Administer medication depending on type of reaction
  - Epinephrine, antihistamines, antibiotics, antipyretics, analgesics, diuretics, corticosteroids

Conclusion

- Adherence to proper indications for blood component therapy is essential because of the potential adverse effects & costs of transfusion.
- These risks can be reduced further by other effective measures, i.e e*fforts to minimize exposure to allogeneic blood through use of autologous transfusion & other blood conservation techniques*
- The unnecessary complications of incompatible blood transfusions can be minimized by careful specimen, unit, & patient identification before blood sampling & transfusion & by maintaining a high index of suspicion for transfusion reactions
- Most importantly, transfusion decisions should be based on sound physiologic principles & a comprehensive assessment of the patient's risk factors.

SHARE A LITTLE
CARE A LITTLE
DONATE BLOOD



Thank You

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