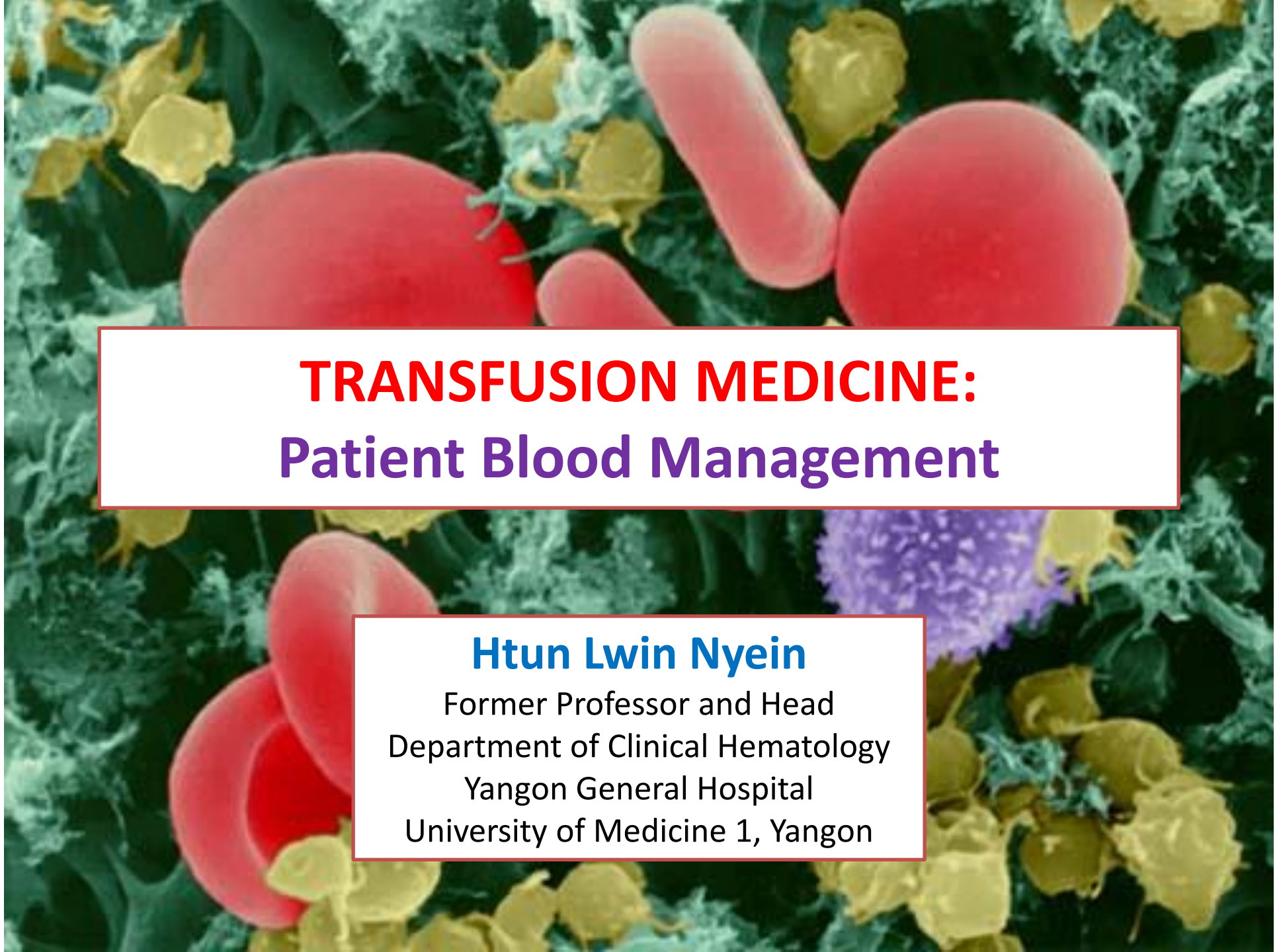

TRANSFUSION MEDICINE:
Patient Blood Management

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Transfusion Medicine

- One of the **medical specialty**
  - **Blood transfusion services (BTS)**
  - **Immuno-hematology**
  - **Microbiology**
  - **Transplantation science and medicine**
  - **Public health**

Clinical Services

- **Clinical consultation**
- **Hemovigilance program**
- **Therapeutic apheresis service**
- **Autologous blood program**

Clinical Services

- **Clinical consultation**
  - **to clinical colleagues on management of patients requiring blood/component therapy, including management of complications**
  - **professional advice to hospitals and overseas blood banks on matters related to transfusion medicine and blood safety issues**
- **Work with the hematologists, hospital blood banks and the Hospital Transfusion Committees**
- **Strengthen the clinical transfusion interface**
- **Training of medical officers, hematology trainees and nurses**
- **Evidence based medicine**

Blood Transfusion Services (BTS)

- Donor recruitment and retention
- Blood collection and donor care
- Blood testing
- Component processing
- Blood component supply (Distribution)
- Information exchange with medical facilities
- Research and development on transfusion medicine
- Support for HSCT (BM donor registry; cord blood bank)
- International cooperation

BLOOD TRANSFUSION

- **Blood Transfusion**

  (**from an unrelated donor to a recipient**)

  is a form of **allogeneic transplant**

  is complex process " **From Vein To Vein**"

  is a form of **cellular therapy**

- **Blood products as a pharmaceutical**

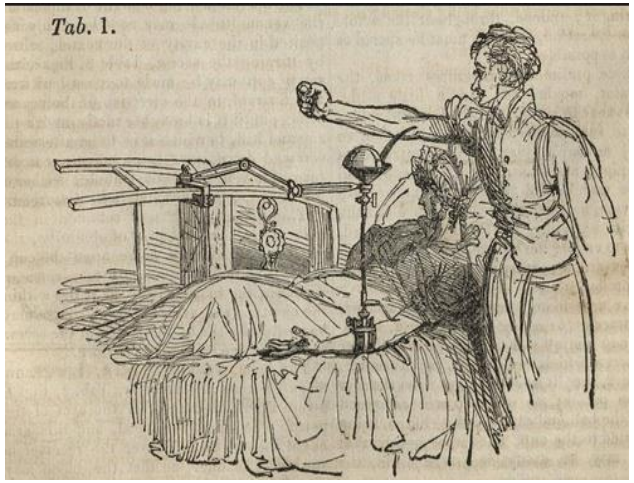
  ID registration

  collection date and expiry date;

  indications; used with caution

  contraindication

  inevitably carries adverse reactions.



Blood
is
the most dangerous
medication
that
clinician ever order !

What is Patient Blood Management (**PBM**)?

- **A multidisciplinary approach to improve patient outcomes** using evidence-based strategies **in patients who may need blood transfusion.**

- **The goals are:**
  - **to improve outcomes by transfusing blood appropriately**, and
  - **to introduce strategies to prevent patients from needing at transfusion in the first place.**

INTEREST FOR PATIENT BLOOD MANAGEMENT

- **Many patients receive blood transfusions that are not indicated** based on evolving clinical evidence;

  offer **no benefit** and can only **create an increased risk** of adverse transfusion reactions.

- **Costs** of volunteer blood components **continue to rise** due to increasing regulatory requirements, infectious disease testing and hospital administration costs.

Ness PM and Frank SM. Enhancing patient blood management: a long-term FOCUS. Lancet2015;3852(9974):1157-1159

International Consensus on Transfusion Outcomes, Arizona 2009

Why Patient Blood Management (PBM) requires?

- **Blood transfusion saves lives but patients should only receive blood when they really need.**
- PBM helps in **maintaining the sustainability of blood supply.**

- **Blood is precious resource; not synthesized.**
- Red cell transfusion is a common practice.
- **Cost of one unit of red blood cell:**

  International : USD 150 – 200 (K 3.0 – 4.0 Lakh)

  Local : Private hospital – K 50,000 – > 100,000

  Public hospital – Free of charge

Development of one blood unit

- **Donor qualification**
- **Blood bag:** single, **double, triple**
- **TTI screen**: **Rapid tests**, **immunoassay**, ELISA, **NAT**
- **Donor: Type and screen**: blood group/Ab screen (Tube/**Auto**)
- **Blood component preparation**: **Refrigerated centrifuge**
- **Storage**: Red cell (2 – 6˚C **blood bank refrigerator**),
  Platelet (20 – 24˚C **incubator** with gentle agitation)
  FFP (- 18˚C or -30˚C Deep Freezer)
- **Patient** : **Type and screen**
- **Compatibility testing** (cross matching)
- **Issue of blood**
- **Transport** – **blood container**/carry box (optimal temperature)


Gammacell
IRRADIATOR SAFETY MANUAL
GAMMACELL OPERATORS MANUAL


GIVE
BLOOD
BLOOD DONOR
Optia


Thermo

Donor qualification

- **Age**: 18 - 55 years (up to 60 years for repeated donor)
- **Weight**: minimum limit > 110 Ib for male; 100 Ib for female
- **BP**: SBP 90 – 180/DBP 50 – 100 mmHg
- Pulse: 50 -100 bpm
- No fever
- **Hb**: minimum limit ≥ 12 g/dL for male; ≥ 11.5 g/dL for female

- Donation interval: 16 weeks after whole blood donation
- Whole blood collected: maximum 10.5 mL/kg donor BW

➢ **Don’t use blood from relatives !**

- **Risk of Transfusion associated Graft-vs-Host disease (TAGVHD)**

Blood Components implicating TA-GVHD

- **Red cells,**
- **Platelet concentrates, Fresh plasma and granulocyte**

Patients at risk:

- All newborn and premature babies
- Immunodeficient (BMT, Acute leukemia, all immunocompromised patients)
- Immunocompetent patients transfused with blood from individuals with whom they have a compatible tissue type (HLA), usually **relatives.**

Pathogenesis of TA-GVHD

- is the result of engraftment and proliferation of allo-reactive **donor lymphocytes** (viable donor lymphocytes escape host immune surveillance)

1) **Sharing of HLA haplotype** between donor and recipient
2) **Defective recipient cell mediated immunity**

Transfusion associated Graft-vs-Host disease (TAGVHD)

- Onset: 10-12 days after transfusion
- Diagnosis: HLA typing, skin biopsy
- **Clinical: fever, skin rash/ erythroderma/desquamation, diarrhoea, hepatitis and pancytopenia**
- **Treatment: supportive.**
- **Mortality > 90-99%.**

Preventing TAGvHD

- ONLY way to prevent TAGVHD is by blood component irradiation by impairing the proliferative capacity of lymphocytes in the blood component.
- Blood components MUST be irradiated BEFORE transfusion
- Gamma ray dosage : 2500 cGy
- At risk patients

Screening of Blood Donor

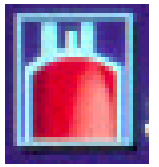
- **Blood Type**: ABO, Rh, **and Screen**: irregular Abs
- **Serological tests**: **Transfusion transmitted infections (TTIs)**

  Syphilis, HIV Ab, HCV Ab, HTLV-1 Ab

  HBV (Hbs Ag, Hbc Ab, Hbs Ab)

  Parvo B 19 Ag, HEV Ab, HGC, Zika, CMV,

  T. cruzi, CJD
- **Individual NAT**: HBV, HCV, HIV
- **Biochemistry**: ALT (ineligible > 101 IU/L)



Safe blood

- **No one is safe from TTIs** because of:

  the window periods of each infectious disease, or

  occult blood infections and

  not to mention the new emerging infections.

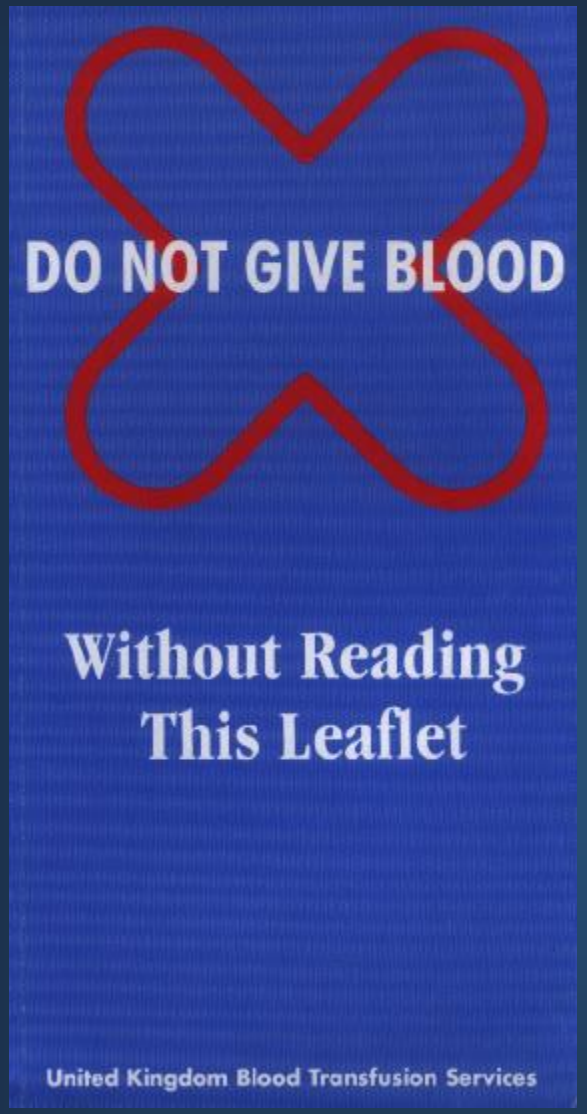
PROBLEMS IN LABORATORY TESTING

- **Window period**
- **Donor with unusual or incomplete immune response "immunosilent infections"**
- **Laboratory error:** Pipetting error, Poor quality test reagents, Mal-functioning equipment
- **No test available**

Therefore testing alone is not sufficient

Need for voluntary non-remunerated regular donors – Safe Donors

Need to exclude donors with risk of TTIs – DONAR DEFERAL



သွေးလှူဒါန်းသူမှဖြည့်သွင်းရန်

သင်၏သန့်စင်သောသွေးဖြင့်လူနာများ၏အသက်ကိုကယ်တင်နိုင်ရန်အတွက် အောက်ပါမေးခွန်းများကိုကျေးဇူးပြု၍ မှန်ကန်စွာဖြေဆိုပေးစေလိုပါသည်။

	(✓)	(×)
၁။ သင်ယခင်ကသွေးလှူဒါန်းဘူးပါသလား။	☐	☐
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၅။ လွန်ခဲ့သော (၇) ရက်အတွင်း ဓမ်းမှက်၊ ဓမ်းလျှောရောဂါ ဖြစ်ခဲ့ပါသလား။	☐	☐
၆။ လွန်ခဲ့သော (၃)လ အတွင်းကိုယ်အလေးချိန် သိသိသာသာ လျော့ကျခဲ့ခြင်း ရှိပါသလား။	☐	☐
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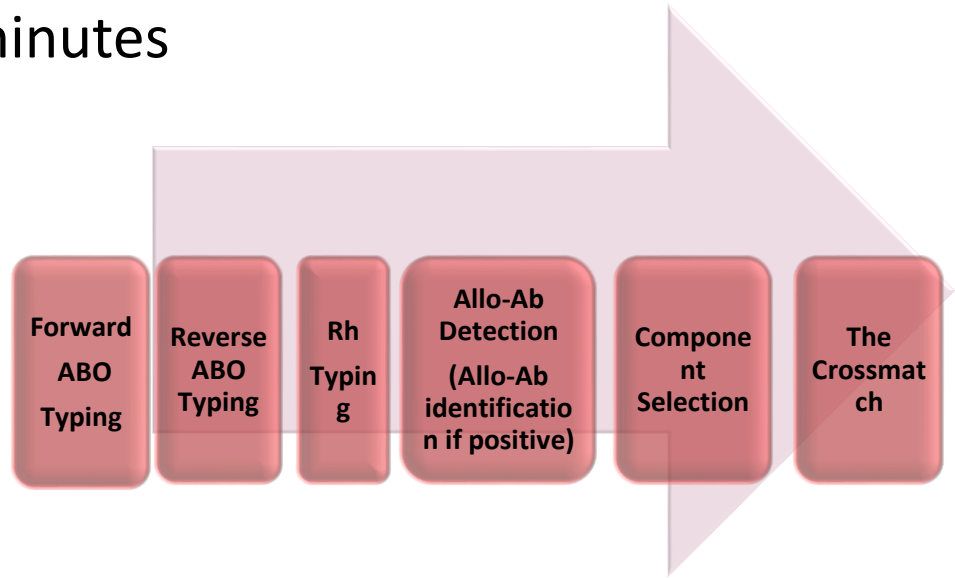
“Donor education and donor self deferral system”

Time to get one blood unit

- **Patient**: Type and Screen (immuno-hemato-analyzer): 30 minutes
- **Donor qualification**:
  - form and self-deferral questionaries, medical check-up
  - taking blood sample:
    - Hb estimation
    - Type and Screen: 30 minutes
    - Compatibility testing (Cross Matching): 30 minutes - 1 hour
    - TTI screen (immunoassay: 30 - 60 minutes)
- **Blood collection (donation):** 15 minutes
- **Estimated total time: 2 - 4 hours**

- **FFP thawing:** 40 minutes



ABO blood group

- The most significant blood group used for transfusion medicine
- **Cell (forward) grouping and Serum (reverse) grouping**

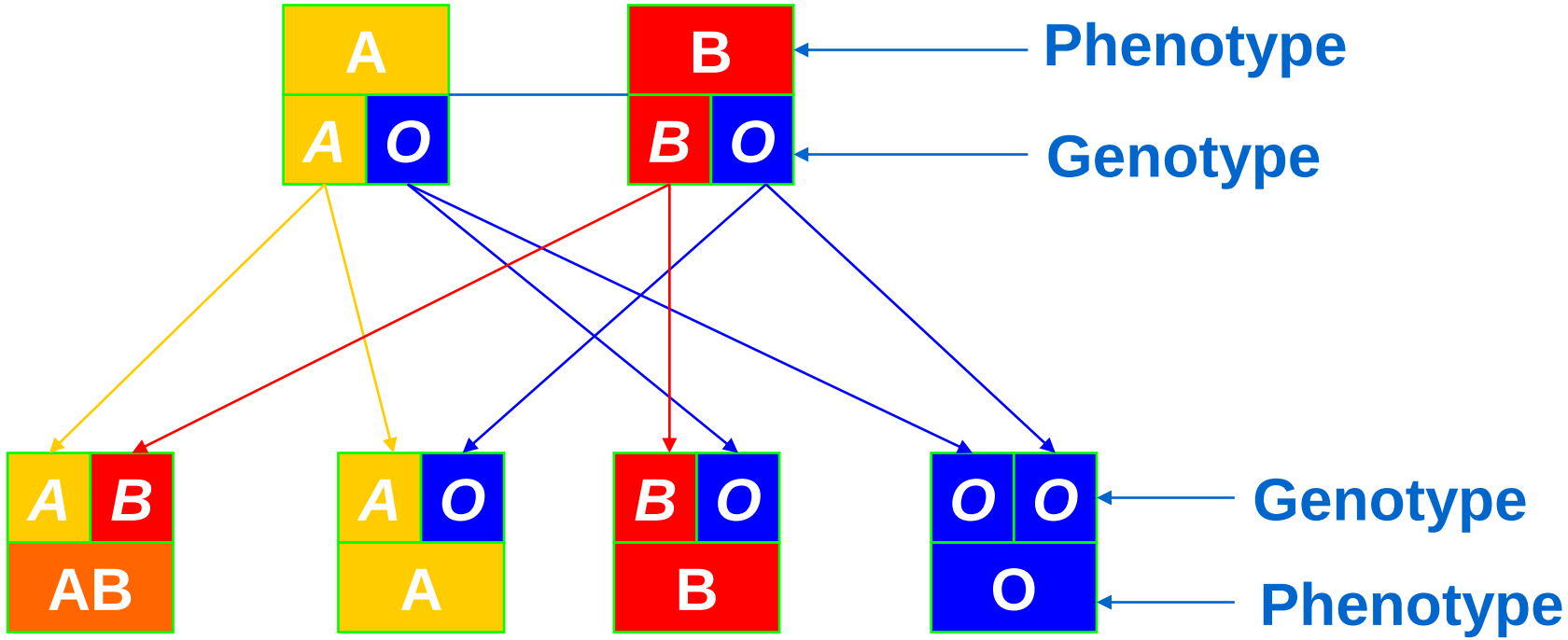
Red Cells	Adult Plasma
• A_1	• Anti-B
• A_2	• Anti-B ± Anti-A_1
• B	• Anti-A
• O	• Anti-A,B
• A_1B	• None
• A_2B	• None ± Anti-A_1

ABO blood group

- **four main phenotypes - A, B, AB, and O** (lack of both A and B Ag)

Genotypes	Phenotype
A^1A^1	A_1
A^1A^2	
A^1O	
A^2A^2	A_2
A^2O	
BB	B
BO	
A^1B	A_1B
A^2B	A_2B
OO	O

ABO blood group



Rh (D) Blood Group System

- The second most important blood group system
- **Five main Rh antigens: C,c,D,E,e**
  - **Rh D positive; Rh D negative; Rh weak D**

- ***DCe***
- ***DcE***
- ***Dce***
- ***DCE***
- ***dCe***
- ***dcE***
- ***dce***
- ***dCE***

- R_1
- R_2
- R_o
- R_z
- ***r'***
- ***r''***
- ***r***
- r_y

Fresh blood

- **What is "fresh blood"?** ***(within 24 hours of collection)***

- **Requires time to process the donor and donated blood:** cell grouping, serum grouping, antibody screening, cross- matching, proper TTI testing.
- Unit kept at 2 - 6^{o}C for at least 4 hours is **no longer "fresh"**

- **Increased risk of disease transmission from fresh blood transfusion:**

- **intracellular pathogens** (e.g. CMV, HTLV) survive in leukocyte
- **syphilis** transmission (*Treponema* can not survive > 96 hours in stored blood)
- **malaria** transmission (malarial parasite can not survive > 72 hrs in stored blood)

WHOLE BLOOD

- It contains all the cellular and plasma constituents of blood.
- Stored blood in refrigerator (2 - 6C):

contains *no functioning platelet and is defective in hemostatic properties (activity of Factor V, VIII, and IX falls significantly).*

➢ **Indication**

➢ There are very few, if any, indications for whole blood.

1. Actively bleeding with loss > 25% of the blood volume (massive blood transfusion)
2. Exchange transfusion in neonate(Blood < 5 days old)

➢ **Should not be used** to raise Hb **in chronic anemia.**

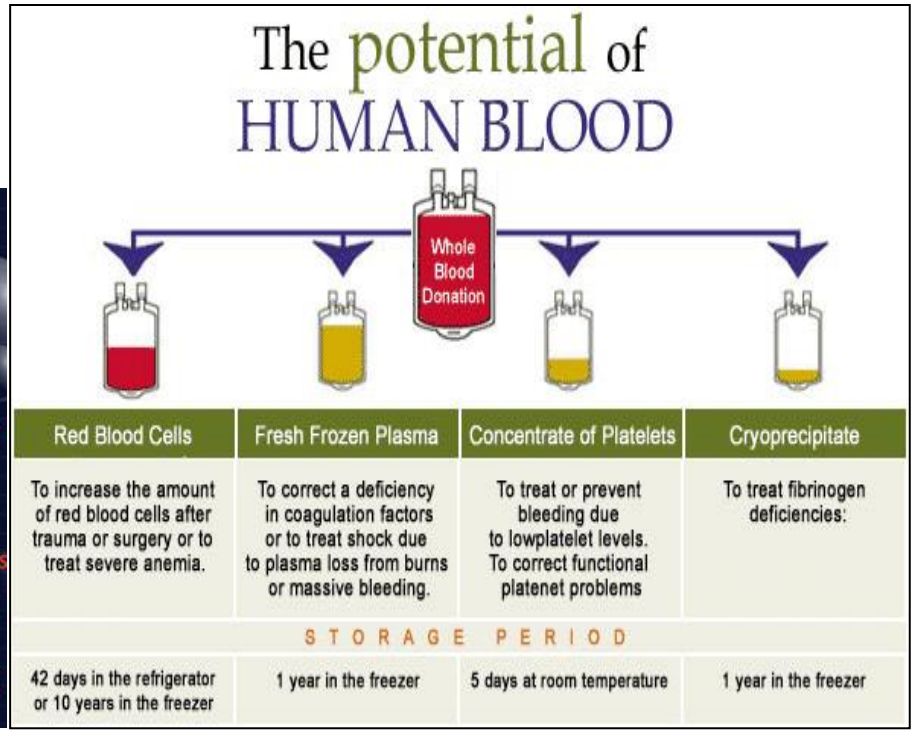
➢ **It is rarely used in modern transfusion practice.**

What is blood components therapy?

- **Blood components**

→ are prepared **from a single donation of whole blood.**

- **Red blood cell (packed red cell)**
- **Platelet Rich Plasma (PRP)/Platelet concentrate**
- **Fresh frozen plasma (FFP)**
- **Cryoprecipitate**



Blood Components/Products

Whole Blood

Packed Red cells

Granulocyte

PRP/PLT concentrate

Fresh Frozen Plasma

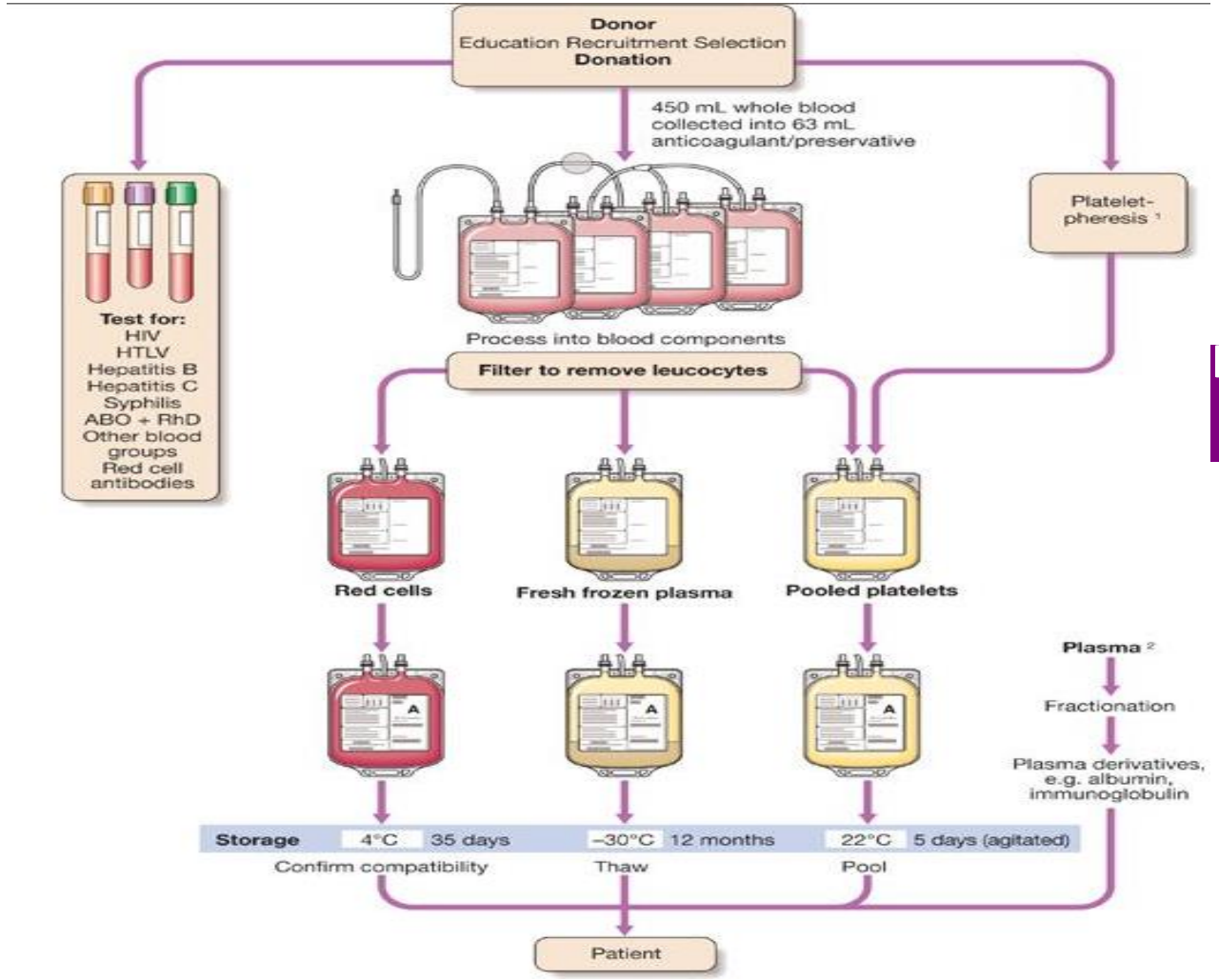
Cryoprecipitate

Plasma derivatives

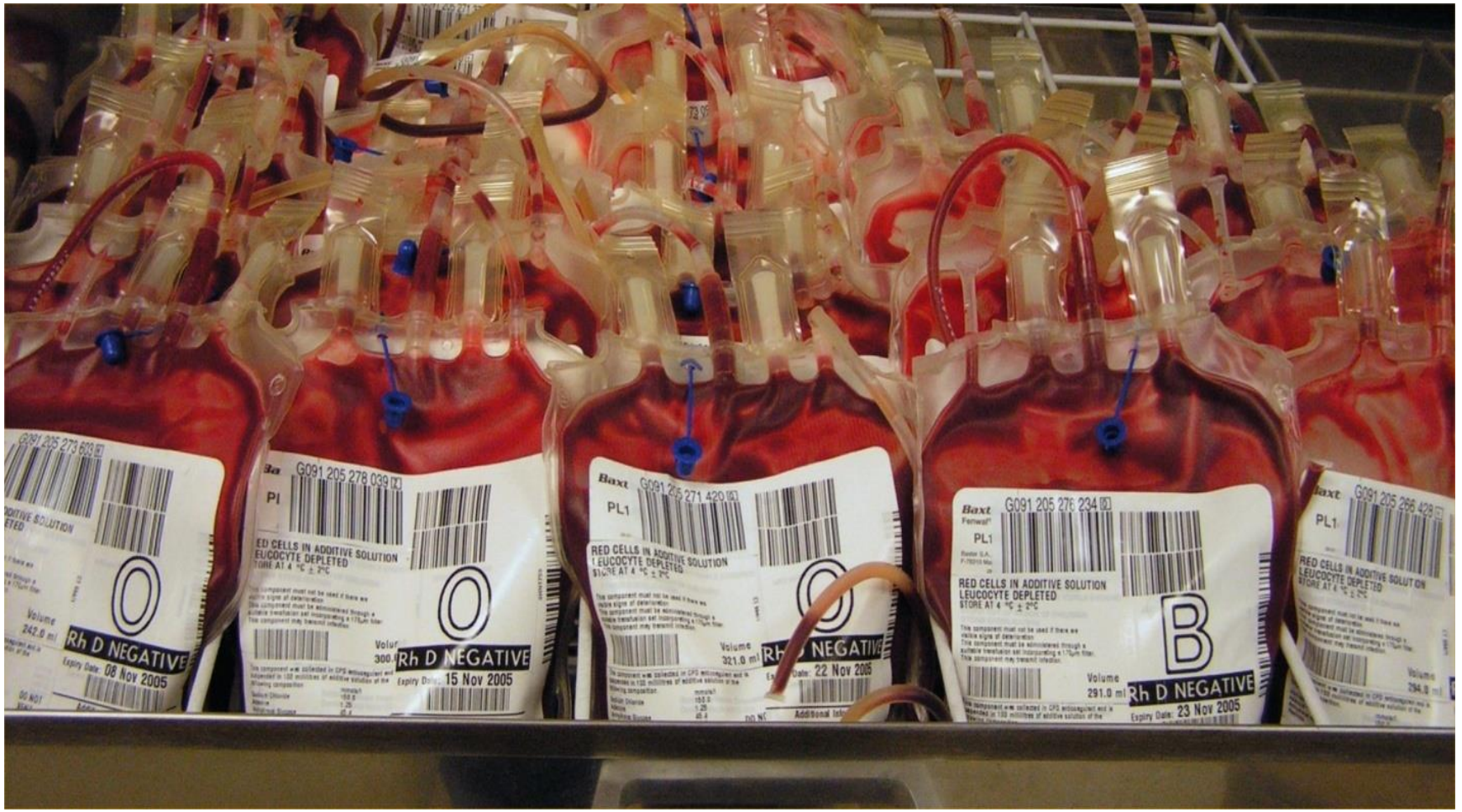
Factor VIII & Factor IX Concentrates

Human Albumin Solution

Immunoglobulin



Packed Red Cell Transfusion (PRBC)



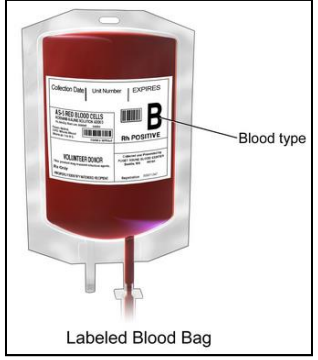
PRBC

- **Source**: Voluntary Non Remunerated Blood Donors
- **Storage: 2^{o} - 6^{o} C in blood bank refrigerator**
    - **Usually 35 days**
- **Compatibility**
  - **must be ABO compatible**
  - unless life saving condition – **major cross match** between recipient's serum and donor's red cell must be performed
  - **antibody screening** is desirable
- **Dose**: mean volume 280 mL (220-340mL)
- In non-bleeding patient, one unit in 70 kg adult may raise hemoglobin about 1 g/dL (HCT 3%)
- **Administration**
  - **through a blood giving set**
  - rate should be determined according to clinical condition
  - should be completed **within 2 - 4 hours**.

General considerations for Red Blood Cells Transfusion

- **Transfusion of red cells should be avoided if possible.**
- **Transfusion may not be required** in well-compensated patients or where other specific therapy is available.
- **Hematinic deficiency** should be **treated with replacement therapy** rather then with transfusion.
- An **initial 1-2 units** transfusion should suffice.
- **Single unit transfusion** followed by clinical reassessment to determine the need for further transfusion is current best practice in adults.
- **Post –transfusion Full Blood Count (Not Hb only)** must be obtained before ordering additional units.
- **There is no universal transfusion trigger.**

Indications for Red Cell Transfusion



- Red cell transfusion
  - increases oxygen-carrying capacity by increasing the Hb concentration and circulating red cells mass.

➢ **Red Cell Transfusion is indicated in -**

(1) Bleeding (Acute blood loss – Trauma or GI Bleeding)

(2) Peri-operative Setting

(3) Symptomatic Anemia

(4) Exchange transfusion

Indications for Red Cell Transfusion in Bleeding

A blood volume loss	Indications for Red Cell Transfusion in Bleeding
15% (750 ml in adults)	• Transfusion is **not required.**
15–30% (800–1500 ml)	• RC transfusion is **usually not necessary** unless the patient has pre-existing anemia, reduced cardiorespiratory reserve or if blood loss continues. (Transfuse crystalloids or colloids first)
30–40% (1500–2000 ml)	• RC transfusion is **probably necessary.**(requires rapid volume replacement with crystalloids or colloids)
40% (> 2000 ml)	• Rapid volume replacement including **red cells is indicated.**

Red Cell Transfusion In Anemia

- **The cause of anemia** should be established.
- Red cell transfusions **should not be given where effective alternatives exist** unless the anemia is life threatening.

Decision to transfuse red cell should be based:

- **not only on Hb concentration,**
- **but also on other factors like**: e.g.
  - Underlying cause,
  - Amount and rate of blood loss,
  - Presence of coagulopathies,
  - the risk of further bleeding,
  - severity and chronicity of the anemia,
  - the patient's clinical condition and ability to compensate
  - body temperature, and
  - other risk factors or co-morbidities, etc.

Recommendations for Red Cell Transfusion in Anemia

Clinical Conditions	Hb level at which RC transfusion is recommended
Stable non- bleeding patients	Hb < 7 g/dL
Critical Care	Hb < 7 g/dL - at least as effective and possibly superior to transfusion at Hb < 10g/dL
Patients with cardiovascular disease	Hb < 8 g/dL or for symptoms
Patients with severe sepsis, traumatic brain injury and/or acute cerebral ischemia	Hb < 9 g/dL
Patients with co-morbidities and risk factors (e.g. age>65 y, cardio/respiratory diseases)	Hb 7-10 g/dL Depend on clinical assessment
Radiotherapy	Hb < 10 g/dL

Platelets Transfusion
(Platelet Rich Plasma (PRP)/ Platelet Concentrate)

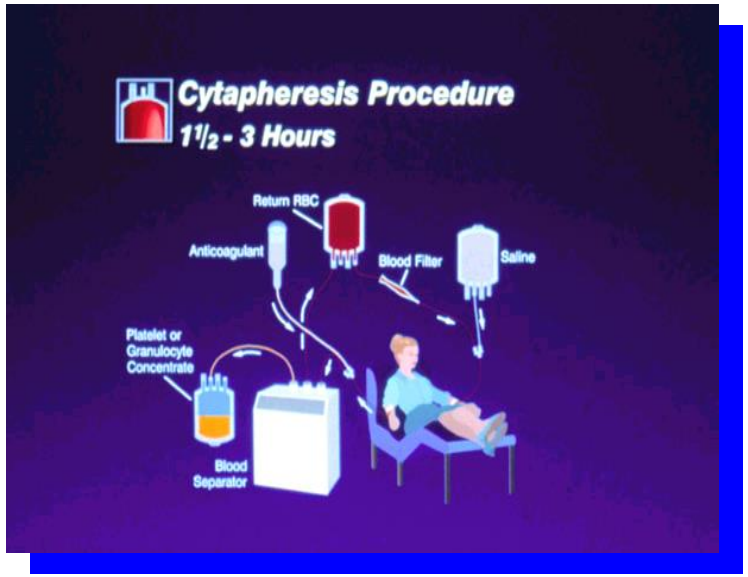
Platelet Transfusion

Random donor platelet

- **Source:** prepared from individual unit of fresh whole blood by centrifugation
- **Pool Platelet: 4 donor units per pack** (one adult dose)

Single donor platelets

- **Source – by apheresis**



	Platelet Concentrate (Random Donor)	Platelet (Single Donor/Apheresis)
Contains	≥ 55 x 10^9/L	> 300 x 10^9/L
Volume	50 mL	300 mL
Expected Increments	5 - 10 x 10^9/L	30 - 40 x 10^9/L
Usual Adult Dose	4 Units	1 unit
Shelf Life	Up to 5 Days at 20 - 24 C	same

Platelet Transfusion

- Platelets **- do not survive in stored blood for 48 h at 4°C**
- **Storage: at 20 – 24°C incubator with constant gentle agitation**
- **Platelets shelf-life – 5 days**
- **Compatibility**
  - **ABO compatibility is preferred but not essential**
  - **Cross matching is not required**
  - **Do not give Group O platelets to Group A,B & AB patients.**

- **Dose: 1 adult therapeutic dose (4 units)** of platelet transfusion should **raise – 20 - 40 x 10^9/L** in 70kg adult.
  - for paediatric patients: 1 unit/10 kg body weight
- **Administration:**
  - transfuse **as soon as possible (Do not refrigerate)**
  - **transfusion must be completed within 30 min**
  - administer by a **blood transfusion set BUT not an IV infusion set.**

General Considerations for Platelet transfusion

- **Cause of thrombocytopenia should always be established.**
- Patients with **severe thrombocytopenia are at increased risk of bleeding but bleeding occurs at any platelet range.**
- **Bleeding time (BT) is not a good indicator for risk of bleeding.**
- be given **as close to the procedure as possible or during procedure** for the best hemostatic effect.
- **Thrombocytopenia does not always correlate with abnormal bleeding.** Hence **the decision for platelet transfusion –**
  - **should not be used based on platelet count alone**
  - but take into consideration of **clinical situation of the patient** and **other risk factors for bleeding**:

  e.g. fever or sepsis, presence of other coagulopathies, coexistent medical conditions including liver disease and renal failure and the rapidity of fall of the platelet count.

Therapeutic Platelet Transfusion

- Usually **inappropriate** in **PLT > 100 x 10^9/L**
- Usually **unnecessary** in **PLT > 50 x 10^9/L**

  and **consider comorbidities** e.g.:

  anticoagulant and antiplatelet agents,

  significant renal, liver, cardiac or hematology disease,

  fever and/or infection,

  previous response to platelet transfusion.

Platelet Transfusion in Patients With Chronic, Stable, Severe Thrombocytopenia Who Are Not Receiving Active Treatment

- **Individuals with myelodysplasia or aplastic anemia, who are not receiving active treatment** may be observed without prophylactic transfusion, **reserving platelet transfusions for episodes of hemorrhage or during times of active treatment**

Therapeutic Platelet Transfusion to control bleeding

➢ **No specific platelet counts, which require platelet transfusions.**

- **Thrombocytopenia** with **significant bleeding: Target PLT > 30** (e.g. prolonged epistaxis, extensive skin bleeding)
- Thrombocytopenia with **severe bleeding: Target PLT > 50** (e.g. bleeding that requires a RBC transfusion)
- Thrombocytopenia with **bleeding at critical sites: Targe PLT > 100** (e.g. CNS, spine, eyes)
- **Acute DIC with bleeding**: **Target PLT > 50**
- Fetal and Neonatal alloimmune thrombocytopenia (**FNAIT**) **with bleeding** (calculate paediatric dose): **Target PLT > 50**
- **Functional platelet defects with bleeding: Target > 30**

Prophylactic Platelet Transfusion to reduce risk of spontaneous bleeding

- **Transfuse one adult dose if:**
  - **< 10 x 10^9/L, chemotherapy without risk factors**

    (bleeding, fever, antibiotics)
  - **< 20 x 10^9/L, chemotherapy with risk factors, CVP line, post cardiac surgery,** preterm and low birth weight infants
  - **≤ 50 x 10^9/L, undergoing Surgery,** major cardiac surgeries**,** **Invasive procedure, childbirth, massive transfusion,**

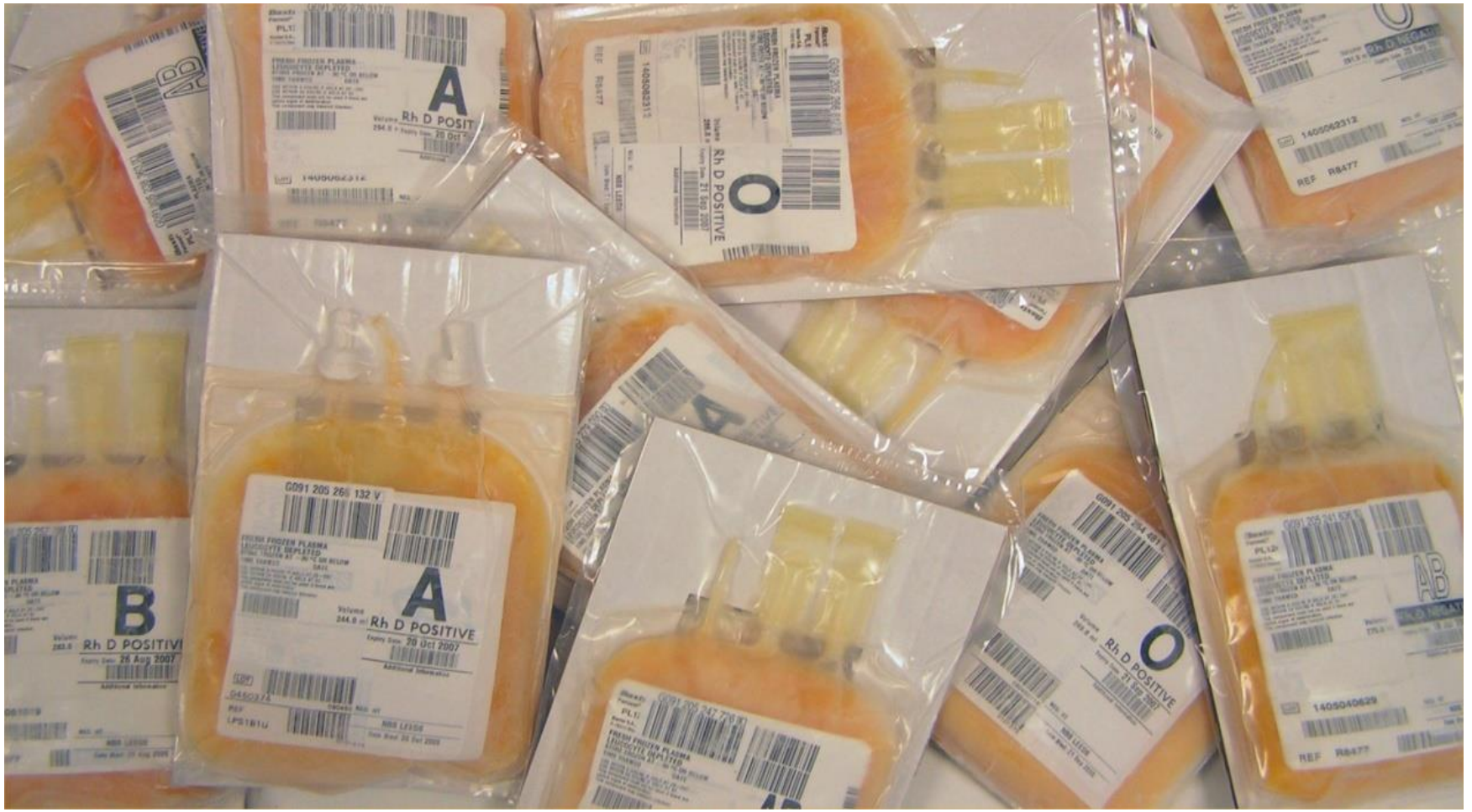
    preterm neonate with FNAIT.
  - **≤ 80 - 100 x 10^9/L, undergoing neurosurgery / eye surgery**

+ Platelet transfusion may be administered at higher counts based on clinician judgment

Platelet Transfusion

- **No benefit from platelet transfusion in followings conditions UNLESS there is LIFE THREATENING BLEEDING.**
- **May even be harmful:**
  - Immune thrombocytopenia (**ITP)**
  - Thrombotic thrombocytopenic purpura (**TTP/HUS**)
  - Heparin induced thrombocytopenia (**HIT**)
  - **Post-cardiac bypass surgery without bleeding**
  - **Drug induced thrombocytopenia without bleeding**
  - Post transfusion purpura (**PTP**)

Fresh Frozen Plasma (FFP)



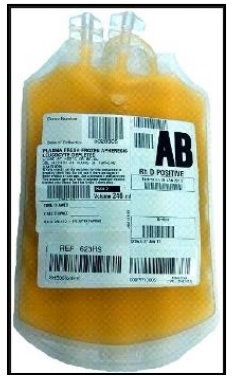
Fresh Frozen Plasma (FFP)

- Frozen within 8 Hrs of collection
  Stored at – 18^{0} to - 30°C for up to 12 - 24 months

- **Thawed** rapidly **at 37°C**. **Account for time to thaw (40 minutes)**
- **Once thawed,**
  - **can be stored at 4°C for a maximum of 24 hours;**
  - **must not be refrozen.**

(The time of thawing must be written on the bag label, documented, labelled for the patient and issued)

Fresh Frozen Plasma



- **Compatibility**
  - Must be ABO compatible to recipient's red cells
  - Cross match is not required
  - **Group O FFP should only be given to Group O patient**
  - In children, should also be Rh compatible.
- **Volume** : 175 -250 ml/ unit
- **1 IU activity of coagulation factor in one mL of FFP**

  (70 -80 units/dL of F VIII, F IX, VWF and other clotting factors)
- **Dose**: 12 - 15 mL/kg = 4 units FFP in 70 Kg adult

  For child < 30 kg: 10 - 15 mL/kg
- **Rate of transfusion**: 2 - 3 mL/kg/ hr

Consider lower dose in patients at risk of fluid overload
e.g. neonates or CCF; rate of transfusion – 1 mL/kg/ hr

General considerations for FFP Transfusion

- Timely **tests for coagulopathy** such as **PT/INR, APTT, fibrinogen** and **CBC** (Hb, HCT, **Platelet count**) should be obtained to guide decision.

- **Abnormal PT/ INR or APTT result -**
  - **should not be the sole reason** for transfusion the FFP
  - they **do not correlate well with bleeding risk**

- These results **should be integrated with** a thorough assessment of patient's **clinical condition** and the presence of **risk of bleeding**.

- All attempts must be made to –

- **identify** the **underlying cause of a coagulopathy** and

- **manage this appropriately together** with efforts to correct such abnormality with FFP transfusion if necessary

General considerations for FFP Transfusion

- A comprehensive **personal and family history of bleeding** is the best preoperative **screen for bleeding in surgical patients.**
- In the event that **preoperative PT and APTT** tests are performed **(NOT BT/CT)** and found to be abnormal, its significance should be carefully considered and if necessary, further **discussed with a hematologist.**

➢ Hemostasis can be achieved when coagulation activity is at least 25 - 30% of normal in the absence of inhibitor such as heparin or when fibrinogen 75 – 100 mg/dL.

➢ Mildly prolonged INR (< 1.7) is not a risk for bleeding and does not need FFP infusion for minor procedures.

Clinical Indications for transfusion of FFP

- **Active bleeding** in the setting of **multiple coagulation factors deficiencies (e.g. acute DIC)**
- **Emergency reversal of warfarin effect with major bleeding (if 4 factor PCC unavailable)**
- For use as replacement fluid when **performing plasma exchange (e.g. in treatment of TTP)**
- **Isolated coagulation deficiencies (if specific factor concentrates unavailable)**
- **Clinical coagulopathy (laboratory evidence) associated with massive blood transfusion or advanced liver disease with bleeding.**

No justification

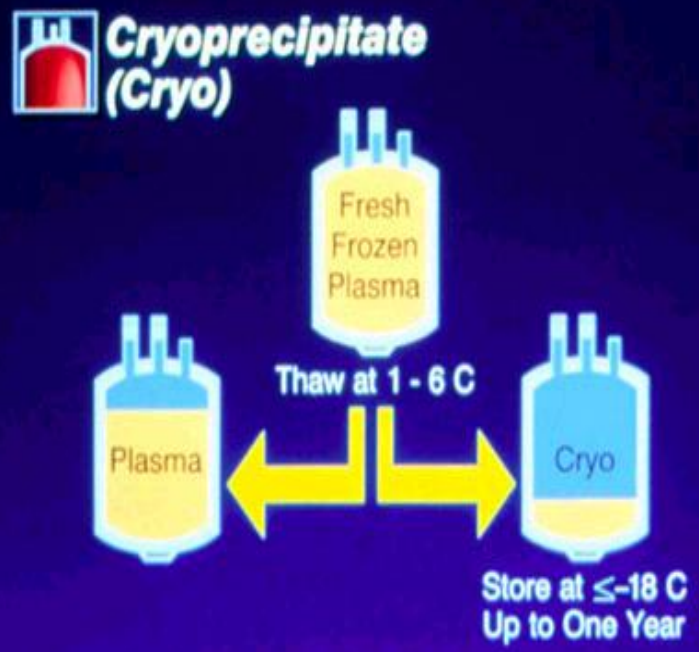
- **Volume expander**
- **Nutritional support**
- **Treatment of immunodeficient states.**

Cryoprecipitate

Factor VIII-	80-120 units/Bag
Fibrinogen-	>140 mg/Bag
v WF-	40-70% of original FFP
Factor XIII-	20-30% of original FFP

Thawing FFP at 1-6°C, stored at <-30°C X 1 year

***20 ml* and supplied in packs of five**



- It must be thawed in a 37^0C water-bath.
- The pack must be contained in an intact outer heat sealed bag.
- The plasma must reach a uniform 37^0C to ensure the cryoprecipitate is in solution.

Indications for cryoprecipitate transfusion

- **Acute DIC with bleeding** and **fibrinogen < 1 g/L.**
- Hypo/dysfibrinogenemia in **advanced liver disease** or **liver transplant**
- Bleeding associated with **thrombolytic therapy** causing hypofibrinogenemia
- **Massive blood transfusion** with hypofibrinogenemia
- **Hemophilia A and VWD** (Factor concentrates not available)
- **Renal or liver failure** associated with abnormal bleeding where DDAVP is not available or ineffective
- Congenital dys/hypofibrinogenemia

Choice of ABO Blood Component

Patient's ABO group	Red cells	Platelets	FFP
O First choice Second choice Third choice	O	O A	O A or B AB
A First choice Second choice Third choice	A O	A O	A AB B
B First choice Second choice Third choice	B O	B O	B AB A
AB First choice Second choice Third choice	AB A or B O	AB O	AB A B

Response to blood transfusion

- **1 unit of red cell transfusion increases Hb 1 g/dL (70 kg)**

- **Post-transfusion Complete Blood Count (CBC) (NOT test Hb only) must be obtained before ordering additional unit.**

➢ **Effect of transfusion: temporary**

➢ **Outcome of transfusion depends on:**

Donor characteristics,

Blood component preparation and storage,

Patient characteristics

➢ **Poor response: Hemolysis, Refractory anemia**

Response to Platelets Transfusion

- **Check post-transfusion CBC (Not platelet count only) after 1 hour**
- **Corrected platelet count increment (one unit) is about 10 x 10^9/L**

  Corrected count increment **(CCI) P** = (Post-transfusion count – pre-transfusion count**)** x **S**urface area/ **U**nits of platelet given

➢ **Clinical status of each patient varies.**

➢ **Effects of the platelet transfusion therapy:**

Temporary (PLT life-span is short)

Sometime Poor responses (less increment due to multifactorial causes e.g. splenomegaly, ITP, DIC, infection, receiving chemo or improper storage or preparation conditions)

Even decrease after platelet transfusion (alloantibodies)

Platelet refractoriness (an unacceptable response - a CCI of < 7.5 × 10^9/L or, an absolute increment of < 13 × 10^9/L after transfusion of six units of platelets to a 70-kg adult)

Response to FFP Transfusion

- **1 U/mL activity of each coagulation factor in FFP**
- **Re-Check PT and APTT 5 – 10 minutes after FFP infusion.**
- **Evaluate clinical outcomes e.g. cessation of bleeding.**
- **PT/INR changes: not correlate well with clinical effect of FFP transfusion.**
- **The effect** of FFP transfusion on INR is **transient.**
- The effect of FFP transfusion on INR reduction **diminishes as more FFP is transfused.**

Safe blood transfusion

- The safety and effectiveness of transfusion depend on **two key factors:**
  1. A supply of blood and blood products are safe, accessible at reasonable cost and adequate to meet national need.
  2. the appropriate clinical use of blood and blood products.

- **Three key principles** must be strictly followed at every stage of blood administration process include:
  1) Patient identification
  2) Documentation
  3) Communication

Blood Administration Procedure

- **POSITIVE patient identification at all stages of blood transfusion is essential.**
- **Patient Information and consent** obtained**.**
- Prescription and **blood request for transfusion.**
- Pretransfusion blood sample collection (**MUST be clearly labeled at bed side** (**NOT Pre-label**)
- Collection and delivery of blood components to the clinical area.
- **Two personnel check before transfusion.**
- **Take vital signs**. **Start transfusion.**
- **Always MONITOR** carefully especially **first 15 minutes of transfusion and Check on patient periodically**.
- **Completion of transfusion episode within the scheduled time.**
- **RECORD keeping** : **Date and Time of Starting and End** of transfusion, **Vital signs**, **Any transfusion reaction** and **Signed**.

DO For Blood Transfusion

Final step

- **Check and Double Check by TWO persons before blood transfusion.**

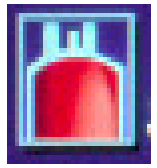
  identity the patient POSITIVELY at the patient's bedside

  Identification the product and the documentation: Blood issue form, patient medical note; **Patient blood group**, type of **blood component**, date of donation, date and time of issue, date of expiry

  Blood unit for any evidence of damage:

The blood unit should not be transfused

- If the unit has been (or may have been) out of refrigerator for **longer than 30 minutes**
- If there is any sign that there is a **leak** or the bag has been **opened**
- If there is **blood clots**
- if the **plasma is pink or red (hemolysis)**
- If the **red cells look unusual color e.g. purple or black** (contamination)



Don’ts for Blood transfusion

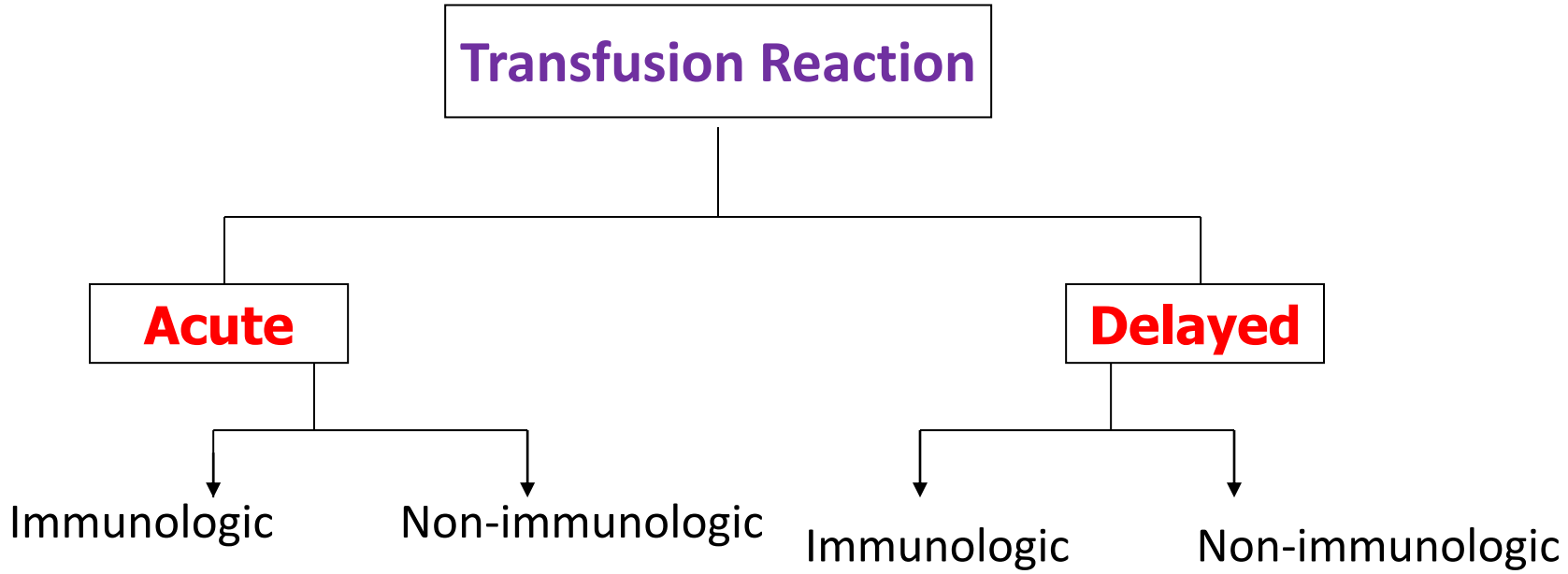
- Don’t transfuse whole blood or packed cell > 4 hours
- Don’t warm blood unit in a bowl of hot water or under the tap water
- Don’t leave the transfused patient unmonitored
- Don’t add any medication to the blood bag
- Don’t forget to return unused blood to blood bank for safe disposal
- Don’t use the IV infusion drip set for any blood component transfusion
- Don’t store platelets in a refrigerator
- Don’t use blood from immediate relatives unless irradiated
- Don’t give Injection Calcium unless massive blood transfusion is given

Duration of Blood Component Transfusion

Blood Component	Stored at	Start	Complete
Whole Blood	• 2° - 6° C (Never Freeze)	Within 30 minutes	Within 4 hours
Packed Red Cell	• 2° – 6° C (Never Freeze)	Within 30 minutes	Within 2 hours
Platelet (PRP/PC)	• 20 - 22°C in incubator with shaking; - Never refrigerate	As soon as possible	Within 30-45 mins
FFP	• - 18 to - 30°C; • After thawing, 2°– 6°C (used within 24 hours)	As soon as possible	Within 30 minutes
Cyroprecipitate	• - 30°C; - Never refrigerate again	As soon as possible	Push

Each blood unit can cause Adverse Transfusion Reactions

"A response or an effect in a patient temporally associated with the administration of blood or blood components"



Adverse Transfusion Reactions

Acute (< 24 hour) Immunologic:

- Acute Hemolytic Transfusion Reaction **(AHTR)**
- Fever Non-hemolytic Transfusion Reaction **(FNHTR)**
- Allergic Reaction and Anaphylactic Reaction
- Transfusion Related Acute Lung Injury **(TRALI)**

Acute (< 24 hour) Non-Immunologic:

- Transfusion Associated Circulatory Overload **(TACO)**
- Bacterial Contamination: acute sepsis/ endotoxic shock
- **Transfusion Associated Dyspnea (TAD)**
- **Hypotensive Transfusion Reaction**
- Hypothermia , Hypocalcemia
- Air Embolus

Adverse Transfusion Reactions

Delayed (> 24 hour) Immunologic:

- Delayed Hemolytic Transfusion Reaction **(DHTR)**
- **Delayed Serologic Transfusion Reaction (DSTR)**
- Transfusion Associated Graft-Versus-Host Disease **(TAGVHD)**
- Post Transfusion Purpura **(PTP)**
- Immuno-modulation

Delayed (> 24 hour) Non-Immunologic:

- Transfusion Hemosiderosis (Iron overload)
- Transfusion Transmitted Infection **(TTI)**

Biovigilance Component – Hemovigilance Module

The 12 Defined Adverse Reactions

- Transfusion-associated circulatory overload **(TACO)**
- Transfusion-related acute lung injury **(TRALI)**
- **Transfusion-associated dyspnea (TAD)**
- **Hypotensive transfusion reaction**
- Acute hemolytic transfusion reaction **(AHTR)**
- Delayed hemolytic transfusion reaction **(DHTR)**
- Febrile non-hemolytic transfusion reaction **(FNHTR)**
- **Delayed serologic transfusion reaction (DSTR)**
- Allergic reaction
- Transfusion-associated graft versus host disease **(TA-GVHD)**
- Post transfusion purpura **(PTP)**
- Transfusion-transmitted infection **(TTI)**

cdc.gov -National Center for Emerging and Zoonotic Infectious Diseases
-Division of HealthCare Quality Promotion

Near-Miss Events

- ❑ Sample error
- ❑ Request error
- ❑ Laboratory component selection, handling and storage errors
- ❑ Laboratory sample handling and testing error
- ❑ Component issue, transportation, collection and administration errors
- ❑ Other blood bank error

Human error as a risk factor?

What to Watch for During Transfusion

- Fever
- Chills
- Abdominal, chest, flank or back pain
- Hyper- or hypotension
- Nausea/vomiting
- Skin manifestations: urticaria, rash, flushing, pruritus and localized edema.
- Respiratory distress: wheezing, coughing and dyspnea
- Jaundice or hemoglobinuria
- Abnormal bleeding or generalized bleeding (DIC)
- Oliguria or anuria
- Pain or burning at infusion site.
- Shock

Acute Transfusion Reactions: ACTION
Recognise; React; Report (Three "R")

- **STOP transfusion**
- **Check vital signs** (temperature, pulse, blood pressure, respiratory rate, oxygen saturation).
- **Maintain IV access. open with infusion of normal saline.**
- **Repeat all clerical and identity rechecks of the patient and blood product.**
- **Call for medical assistance. Notify** patient's physician **immediately**
- **Commence specific clinical management immediately.**
- **Contact the transfusion laboratory service immediately /Collect blood and urine samples**
- **Document reaction in patient's chart and complete incident report as per institution policy.**

Mild Acute Transfusion Reaction

- **Within 4 hours** of starting transfusion
- Pruritus and skin rash only (mild allergy) and/or
- **Isolated $T^o \geq 38^oC$** and **rise of 1^oC from baseline**
- Of course, fever is the one of transfusion reaction. **Fever before transfusion is not contraindication or delay the transfusion**. **Evaluate the cause of fever by clinical and laboratory assessment.**
- May have chills or rigors but **NO other symptoms.**

Action :

- Stop transfusion
- Give IV chlorpheniramine slowly and oral paracetamol
- **Restart transfusion at a slower rate if reaction subsides** and patient is stable after 15 -30 minutes
- **Observe more frequently**
- **If no improvement or worsening, do not restart and treat as severe reaction.**

LEUKOCYTE REDUCTION

What is leukodepletion?

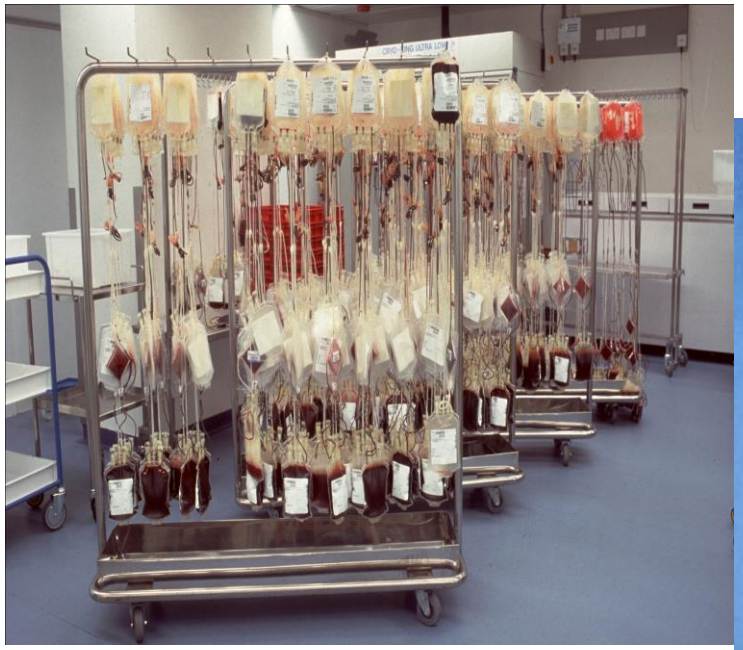
- **Reduction of leukocytes (99.99%) within the blood component**

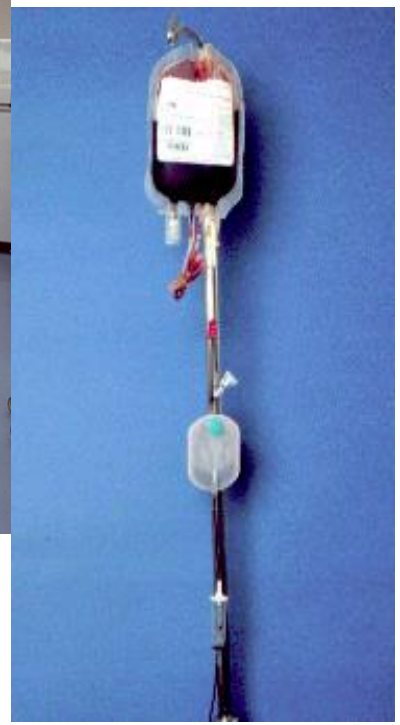
How to reduce ?

Filtering

pre-storage

pre-transfusion





Pre-transfusion

Red cell Leukocyte Filter
one set for each packed RBC

Advantages:

Reduction of

HLA alloimmunization

CMV transmission

Nonhemolytic febrile reaction

Prion disease

Severe Life-Threatening Transfusion Reaction

- **Within 15 minutes of starting transfusion**
  but may be later (1-2 hours)
- **Pain** (Chest, Back, Head, **transfusion site**)
- **Fever ≥ 39^{o}C and rise of ≥ 1^{o}c from baseline**
- **Acute onset of Dyspnea, Decreased oxygen saturation**
- **Tachycardia,**
- **Hypotension,**
- **Restlessness,**
- **Vomiting**

Severe Life-Threatening Transfusion Reaction

Action : STOP Transfusion

- Maintain airway and commence **oxygen therapy**
- **Replace with Normal Saline by NEW infusion set**
- Give IV Chlorpheniramine/ Hydrocortisone
- Commence IV broad spectrum antibiotics if suspected bacterial infection (take blood for C and S)
- Give Bronchodilator nebulizer if bronchospasm
- Give IV fluid / Inotropic agent if hypotension
- Monitor Vital Signs, Intake/output Balance
- **Notify senior medical staff and transfusion laboratory**
- **Notify hospital transfusion committee.**

Investigations of Serious Reactions

➢ **Send the followings to blood bank**

Return discontinued bag of blood with the giving transfusion set **without the IV needle**, and all the related forms and labels.

New blood samples of the patient from vein opposite to transfused site

(5 mL of clotted blood and 2 mL of anticoagulated blood)

- ABO group and antibody screen
- CBC and DAT
- Coagulation screen and D dimer
- Blood culture and sensitivity
- Biochemistry (Liver and Renal Function Tests)
- Urine analysis including 24 hour Urine collection

PATIENT BLOOD MANAGEMENT (PBM)

- More successful when everyone works together:

  (Multidisciplinary team approach)

  Administrators

  Clinicians

  Pathologists/Transfusion specialists

  Laboratory technicians

  Nurses and

  Patients

- **Focus on Your Patient, NOT the Transfusion**
- **What is really dangerous: Anemia or Transfusion?**
- **One size does not fit all**

PBM in Medical Practice

- **Biggest medical users** of blood are hematology, oncology, GI medicine (including hepatology) and renal medicine.
- Blood transfusion should not be given where there are appropriate alternatives such as **hematinic replacement (in IDA) or EPO (in CKD).**
- **There is no universal transfusion trigger. Transfusion decision based on clinical assessment, laboratory results and guidelines.**
- Transfusion dependent anemia (e.g. MDS) should **aim to minimize anemic symptoms rather than achieve an arbitrary Hb value.**
- Transfusion in hemoglobinopathies is complex and changing, directed by hematologists.
- Prophylactic platelet transfusion is not required for bone marrow examination and level of 50 x 10^9/L is safe for other invasive procedures.

General Guideline for Multiple Transfusion

- **Packed red cell transfusion is preferable** to whole blood.
- **Leucocyte poor red cell** should be used in patient with non-hemolytic reaction (or **use of WBC filter**).
- **Compatibility testing should be done by anti-human globulin technique.**
- **Antibody screening** should be performed prior to every transfusion episode especially if previous one was more than 72 hours ago to detect the presence of any new antibodies.
- **Patients should receive at a minimum matched for Rh (C,c,D,E,e) and Kell antigens** (most common antigens implicated in alloimmunizations.)
- Blood less than 10 days old should be used for transfusion.
- **Iron chelating agents** should be given to prevent ill effects of iron overload.

PBM in Paediatric Practice

- Children transfused in fetal or neonatal life have the longest potential life span in which to develop late adverse effects of transfusion.
- **Extra-safety measures** for transfusion: enhanced donor selection and screening for clinically significant blood group antibodies('PAbTs').
- **Transfusion volumes and rates for children** carefully calculated and **prescribed as mL**, not component units, to minimize dosing errors and reduce risk of circulatory overload.
- **Restrictive Hb transfusion** threshold are safe in clinically stable neonate requiring small volume 'top-up' transfusion.
- Low platelet count are common in sick neonates, but appropriate trigger for platelet prophylactic transfusion remain uncertain.
- Tranexamic acid IV is recommended for children with major traumatic hemorrhage

PBM in Obstetric Practice

- **Inappropriate transfusion during pregnancy and post-partum expose mother to risk of HDFN in subsequent pregnancies.**
- Prevention and treatment of **anemia in pregnancy** (mostly IDA) avoids unnecessary blood transfusion.
- Oral iron therapy is appropriate for most IDA , but IV iron (after first trimester) provide more rapid response.
- **Full blood count checked at AN booking visit and at 28 weeks.**
- **Transfusion is rarely required in hemodynamically stable woman with Hb > 7 or 8 g/dL unless active (or high risk of) bleeding.**
- Women may be alloimmunized by feto-maternal hemorrhage during pregnancy or at delivery or by blood transfusion.
- Successful management of **major obstetric hemorrhage** depends on multidisciplinary team work and excellent communication with hematologist and transfusion laboratory. Tranexamic acid IV used.

PBM in Surgical Practice

- **PBM in surgery focus on:**
  - **Preoperative optimization of erythropoiesis**
  - **Minimizing blood loss and control bleeding at surgery**
  - **Avoiding unnecessary transfusion after surgery**
- Assess CBC, iron status and coagulation (**PT, APTT**; **NOT BT/CT**) at least 2-4 weeks before elective surgery; Investigations and correction of anemia and bleeding disorders.
- **Decision to transfuse based on clinical assessment and lab results.**
- **Restrictive red cell transfusion strategies** are safe in wide variety of surgeries (and in critically ill patients).
- In hemodynamically stable, non-bleeding patient, transfusion considered if **Hb ≤ 8 g/dL. A single red cell unit** may be transfused and reassess.
- Most invasive surgical procedures carried out **safely with platelet count ≥ 50 x 10^9/L or INR < 2.0.**
- **Massive transfusion protocol** depends on multidisciplinary team work and excellent communication with surgical team, hematologist and transfusion laboratory. **Tranexamic acid IV used**.

Getting started with PBM

- Applies to all clinical setting
- **Define standard based on guidelines**
- **Hospital transfusion committee**
- **Hospital CME**
- Leadership needed
- Multidisciplinary team approach
- **Need Champions to lead the change.**

Good Clinical Transfusion Practice

- The **transfusion of safe blood components** to treat a condition leading to significant morbidity or mortality that cannot be prevented or managed effectively by other means.
- **The clinician should prescribe blood transfusion only when**:
  i. **Clinical and Lab. indications** that transfusion is needed
  ii. **No suitable alternative** treatments are available
  iii. **Benefits to the patients** are likely to outweigh the risks.

➢ **Optimal Use of Blood**

- **The safe** : No adverse reactions or infections
- **Clinically effective** : Benefits the patients
- **Efficient** : No unnecessary transfusions
- **Use of donated human blood**

Patient identification is a crucial factor of safe transfusion.

Ethics in Transfusion Medicine

- Ethics are important as blood comes from human beings, is **a precious resource with a limited shelf life**.
- It involves **a moral responsibility** towards both donors and patients.
- **Wastage should be avoided** to safeguard the interests of all potential donors and recipients.

Decisions must be based on 4 principles:

- **Respect** for individuals and their worth,
- **Protection** of individual's rights and well being,
- **Avoidance of exploitation**, and
- The Hippocratic principle of primum non nocere or **"first do no harm".**

Rationale use of blood transfusion

" the transfusion of safe blood products only to treat a condition leading to significant morbidity or mortality that cannot be prevented or managed effectively by other means."

Before prescribing blood or blood products for a patient, ask yourself the following questions:

- **What improvement am I aiming to achieve?**
- **Any other options?**
- **Do the benefits of transfusion outweigh the risk?**
- **If in doubt, consult with hematology and blood transfusion colleagues.**
- **Ask if this was myself, would I agree to the transfusion?**

"primum non nocere"

the first thing is not to do harm

(Hippocrates)

SAFE BLOOD IS THE ONE
THAT YOU HAVE NOT TRANSFUSED.

TREAT THE PATIENT,
NOT TREAT THE PAPER.

Take Home Message

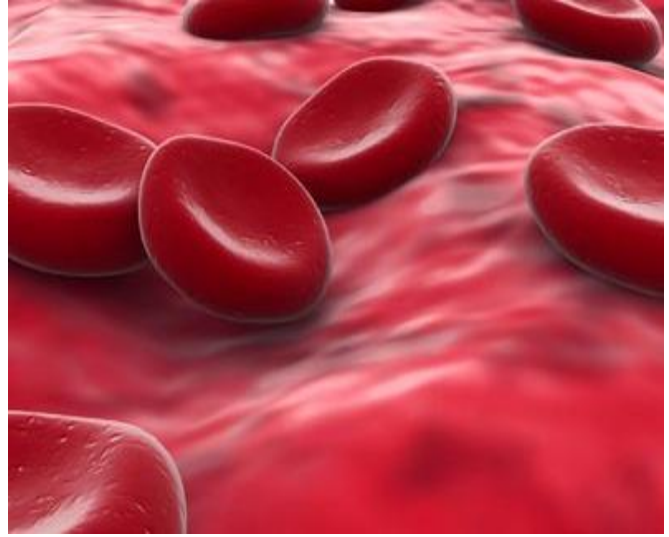
1. **Transfusion only be used when benefits outweigh risks** and **no appropriate alternatives.**
2. **Laboratory results are not sole deciding factor for transfusion.**
3. Transfusion decisions **based on clinical assessment and guidelines.**
4. **Not all anemic patients need transfusion.**
5. Discuss with patient and **obtain consent.**
6. **Reason for transfusion documented** in medical record.
7. **Good communication between clinicians and blood bank is essential**.
8. **Confirm identity at every stage of transfusion process.**
9. Patient must be **monitored during transfusion.**
10. **Education and training underpin safe transfusion practice.**

1900 Karl Landsteiner;

“ Blood transfusion should never be ordered or given unless it is worth the risk”

“Safe Blood Starts with Me”

Thank You!



Questions?