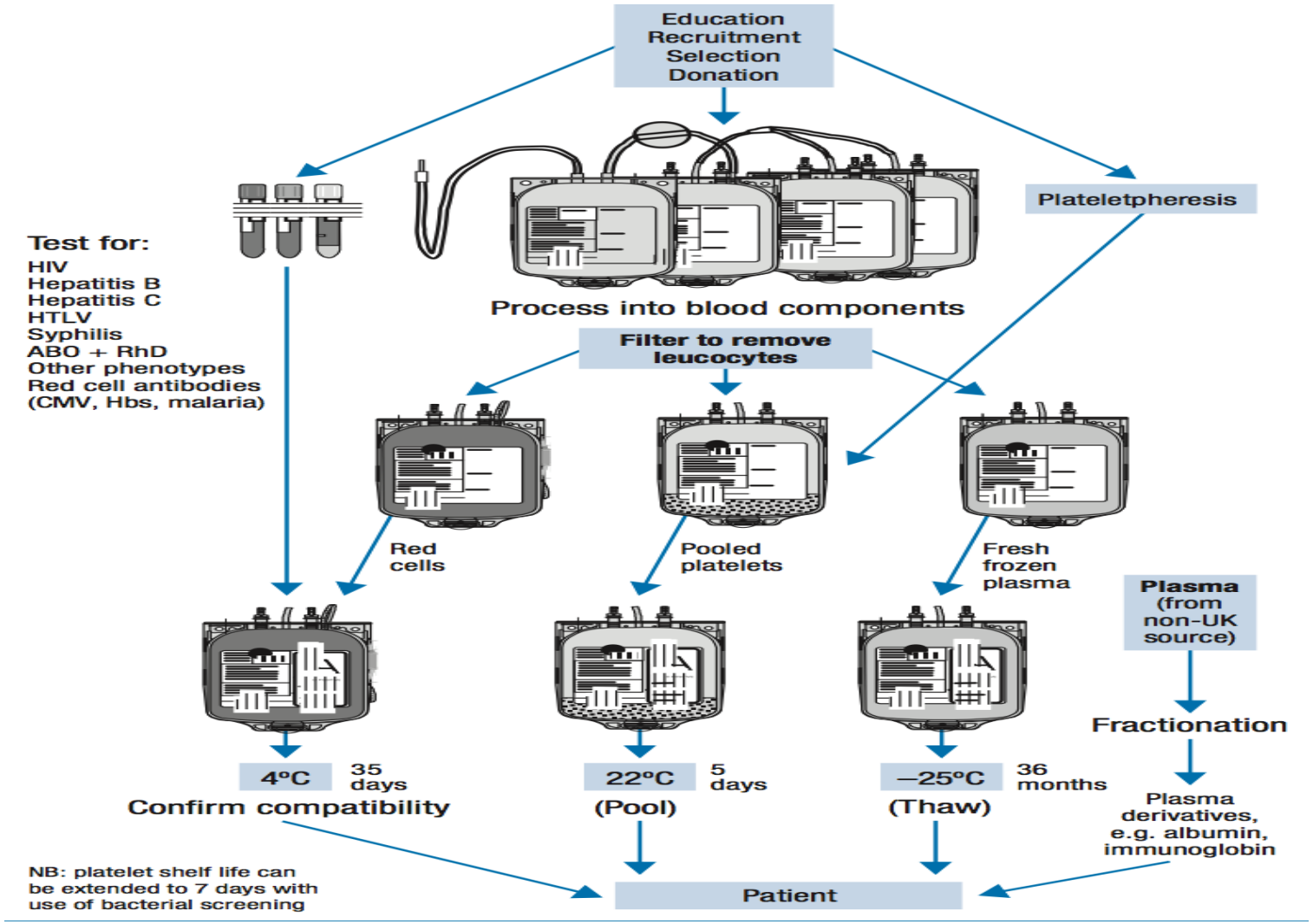
RATIONAL USE OF BLOOD COMPONENTS




Introduction



Fresh whole blood

Light spin, 22°C

(within 8 hrs)

Platelet Rich Plasma

Packed red cells

Heavy spin,22°C

Platelet Concentrate

Fresh Plasma

Fresh whole blood

Heavy spin,4°C

(within 8 hrs)

Fresh Plasma

Packed red cells

STORAGE AND SHELF LIFE OF BLOOD COMPONENTS

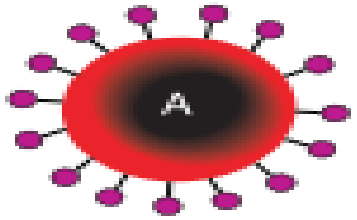
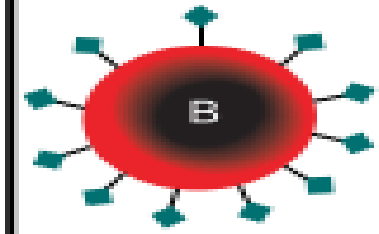
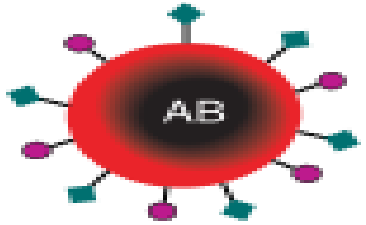
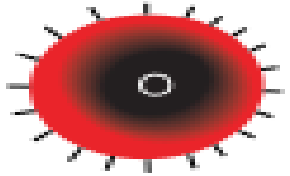
COMPONENT	STORAGE TEMPERATURE	SHELF LIFE
Whole blood	1-6° C	35 days
RBCs	1-6° C	35-42 days
Platelets	20-24° C	5 days
FFP	< –18° C	1 year
Cryoprecipitate	< –18° C	1 year

Pre-transfusion testings

- ABO and RhD typing
- Antibody screen
  - Look for alloantibodies
  - Risk: previous transfusion, multiparity
- Compatibility testing (crossmatch)
  - Donor bag
  - Recipient serum

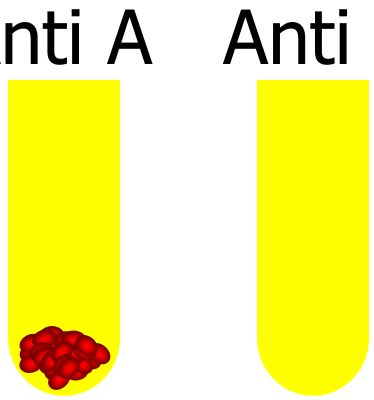
ABO and RhD typing

- Forward typing
  - Test for RBC antigens
- Reverse typing
  - Test for antibody in plasma
  - Only for ABO type
- Need compatible results

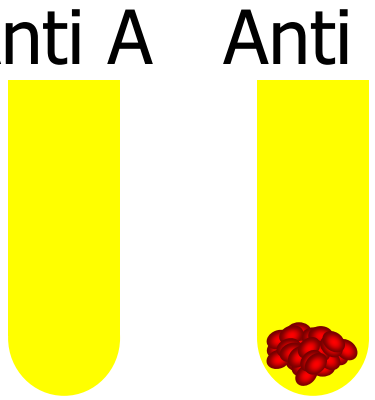
	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies present	 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens present	 A antigen	 B antigen	 A and B antigens	No antigens

ABO blood group antigens present on red blood cells and IgM antibodies present in the serum

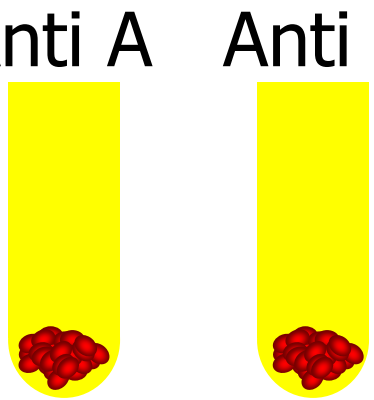
A



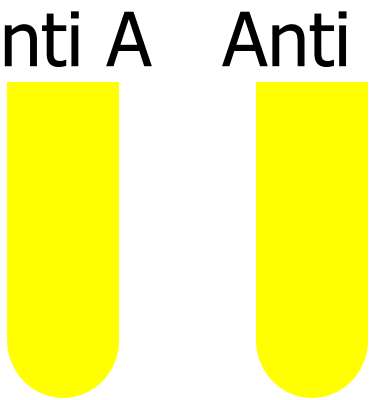
B



AB



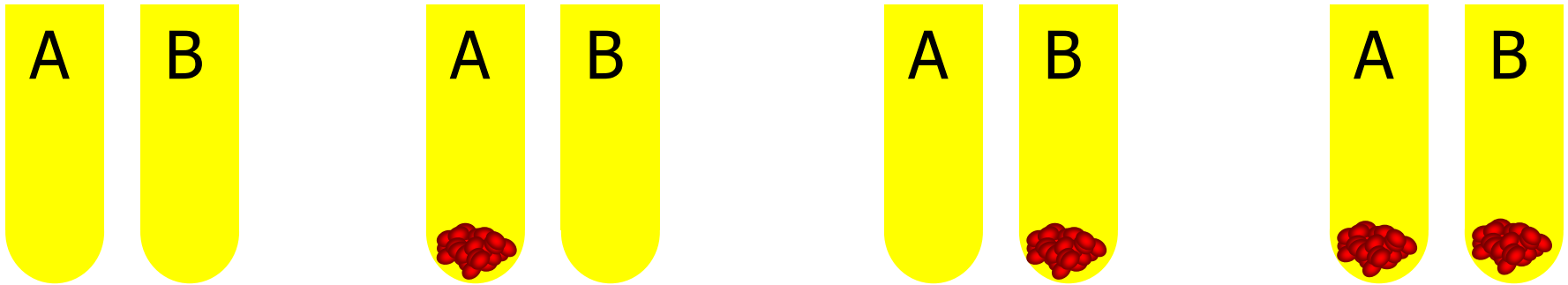
O



ABO TYPING

Back or reverse type with A and B cells

- Commercially available A and B cells are added to two tubes of plasma
- AB B A O



ANTIBODY SCREENING

- Detection of unexpected clinically significant antibodies against the minor blood group system antigens

- Also called the indirect Coombs test or the indirect antiglobulin test

Packed red cells

- Shelf-life 21-42 days

  – ACD/CPD/CP2D 21 days
  – CPDA-1 35 days
  – Additive solution 42 days
  – Open system 24 hours

- Volume 250-350 mL

- Red cells 65-80%

- Plasma 20-35%

Blood products for special patients

- Washed red cells: repeated severe allergic transfusion reactions
- Frozen(or cryopreserved) red cells: used to maintain a supply of rare donor units
- Red cells obtained by donor apheresis

Two unit red cells

Leukocyte Depleted Red Blood Cell

- Advantages
  - Decreased febrile non-hemolytic transfusion reaction
  - Decreased HLA-alloimmunization
  - Decreased CMV transmission (less than $1x10^6$ WBC per unit)

Method of Leukoreduction

Centrifugation:
buffy coat removal

- easiest and least cost
- least efficient
- reduce WBC only **70 - 80%**
- reduce RBC volume ~ 20%

WBC < 5 x 10^8

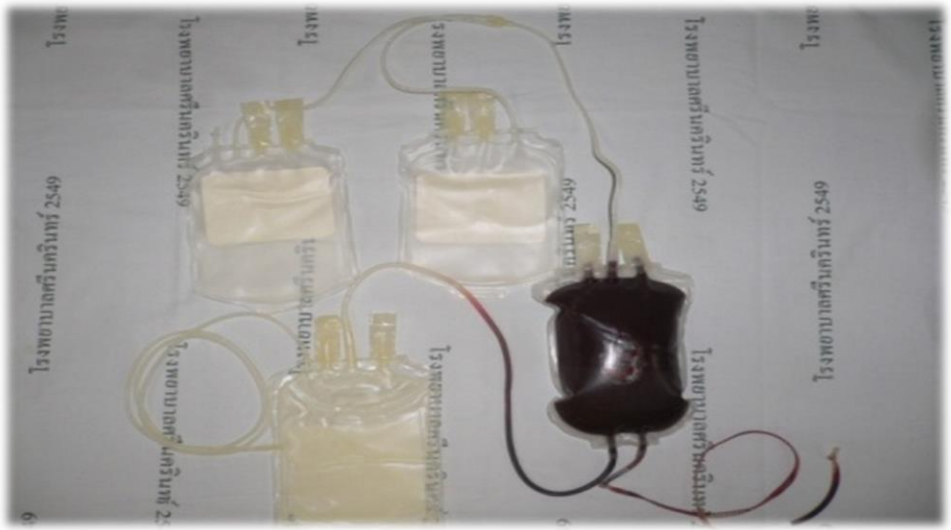
Filtration method:
special leukocyte filter

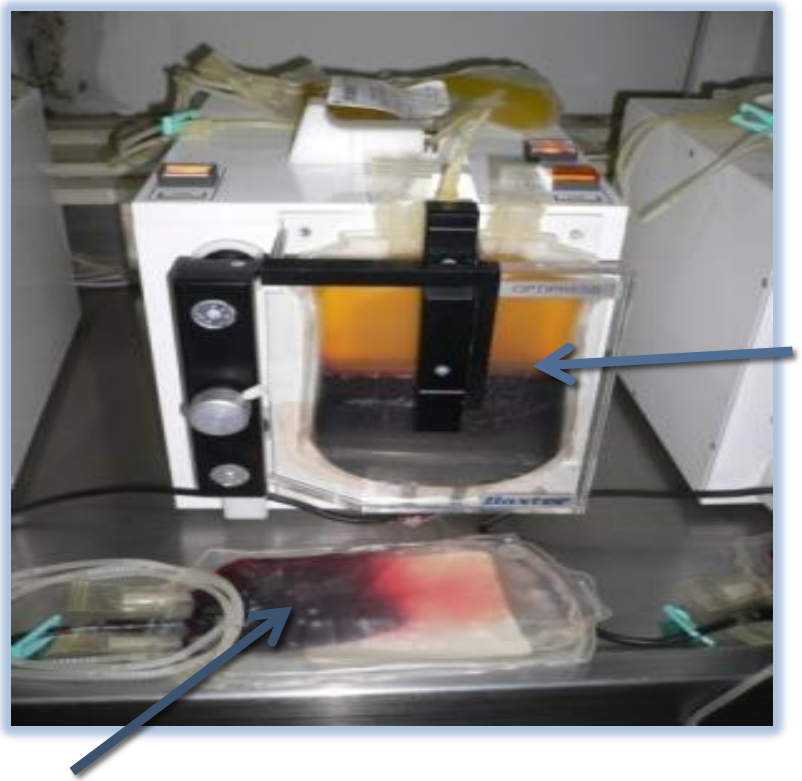
- easy, quick
- high efficient
- remove WBC more than 99.9%
- little loss of RBC volume
- use PRC age < 24 hrs

WBC < 5 x 10^6

Centrifugation method

- Preparation of LPRC by buffy coat removal





Buffy coat

Leukocyte Poor Red Blood Cell

Filtration method

- wbc removal by special leukocyte filter
  - Pre-storage
  - Post-storage

↓

Leukocyte Depleted Red Blood Cell

Pre storage-Leukocyte Depleted Red Cell

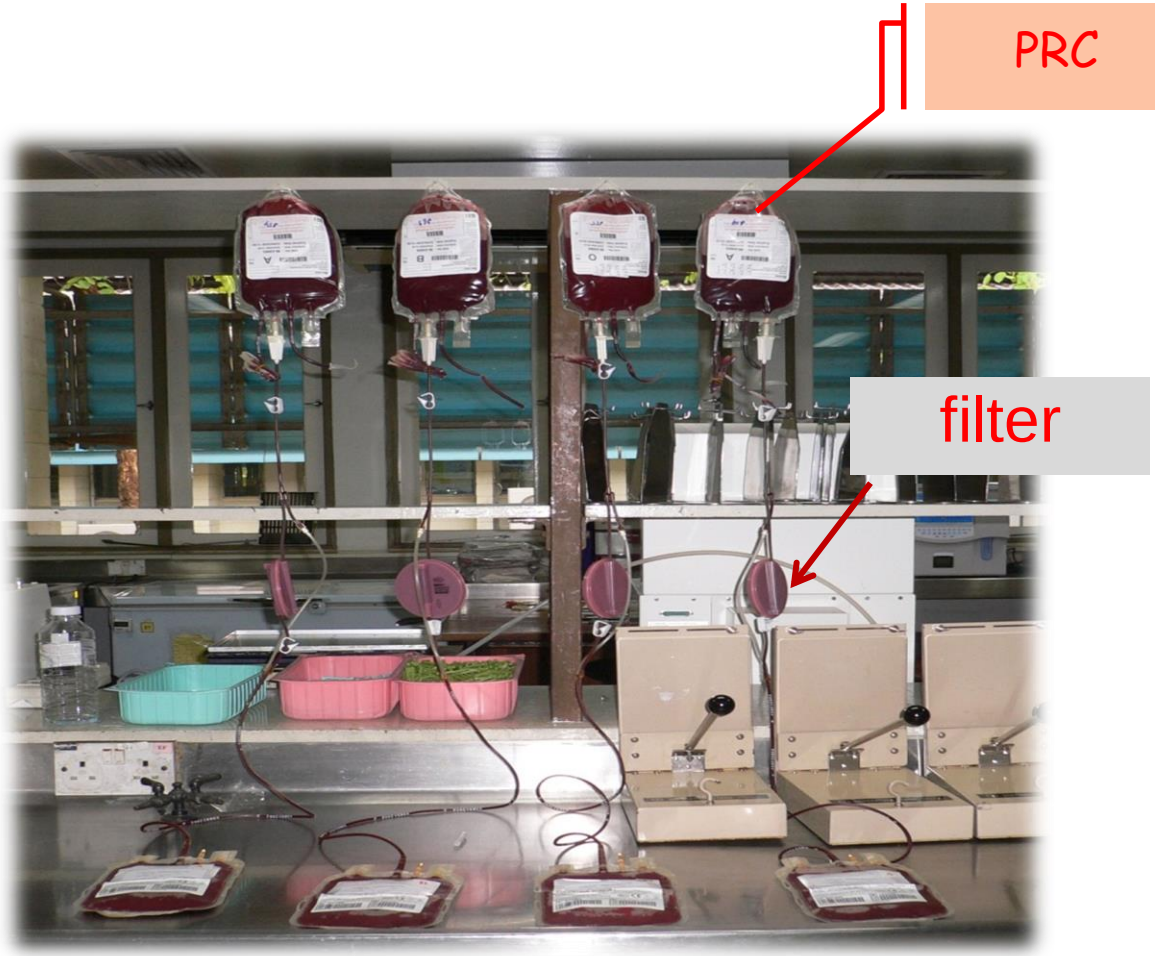
Quadruple with inline filter

filter

- intact leukocyte removal is better than poststorage
- Set of bags with inline leukocyte reduction filter
  → *high cost*

WBC < 5×10^6

Post storage-Leukocyte Depleted Red Cell



- บิดาของทารกต้องการใช้เลือดของตนเอง หรือญาติพี่น้องในครอบครัวมาให้แก่ทารก จะปลอดภัยกว่าการใช้เลือดจากธนาคารเลือดหรือไม่ ?

Transfusion associated graft-versus-host disease: TA-GVHD

- Donor T-lymphoctyes causing inflammatory reaction in recipient
- Risk:
  - Congenital T-cell immunodefiency
    - Severe Combined Immunodeficiency Disease; SCID
  - Fetus
  - High dose chemotherapy, stem cell transplantation, fludarabine

- Increased risk if receiving blood from
  - first degree relatives (partly or fully HLA-matched)
  - HLA-matched products

Transfusion guidelines for neonates and older children. Br J Haematol 2004;124:433-53.

Gamma irradiation is currently the only recommended method for transfusion-associated GvHD prevention. Leucodepletion by current filtration technology is inadequate for this purpose.

Transfusion guidelines for neonates and older children. Br J Haematol 2004;124:433-53.

Indications for irradiation

- Cellular components (PRC, platelet)
- Indications
  - Intrauterine transfusion (IUT)
  - Exchange transfusion after IUT
  - Top-up transfusion after IUT
  - When donation is from a first- or second-degree relative or an HLA-selected donor
  - When the child has proven or suspected immunodeficiency
- Hodgkin's disease or receiving purine analogue drugs
- Stem cell or bone marrow transplant recipient
- Aplastic anaemia on immunosuppression

Transfusion guidelines for neonates and older children. Br J Haematol 2004;124:433-53.

Fresh Frozen Plasma

Fresh frozen plasma

- FFP ต้องทำ cross match หรือไม่
- ข้อควรระวังของการให้ FFP ?

Fresh frozen plasma

- FFP ไม่ต้องทำ cross match เลือกให้ตรง กับ group เลือดของผู้ป่วย หรือใช้ group AB ก็ได้

- Shelf-life 1 year (frozen) and 24 hours after thawed
- Volume 200-250 mL

- Coagulation factor 200-250 units and fibrinogen 400-500 mg
- Raises most coagulation factors levels ~ 20%
- Albumin / globulin

Indications

- Rapid reversal of warfarin overdose
- Bleeding and multiple coagulation defects as evidenced by ↑PT/INR/aPTT > 1.5 control (liver disease, DIC)
- Correction of coagulation defects for which no specific factor is available
- Tx > 1 blood volume with evidence of active bleeding and ↑PT/INR/aPTT
- TTP, antithrombin deficiency, hereditary angioedema

Not indicated in

- Burns
- Wound healing
- Volume expansion (hypotension)
- Source of nutrients
- Infection
- Immunodeficiency

WHO. The clinical use of blood. 2001

Semin Perinatol 2009;33:66-74

Cryoprecipitate

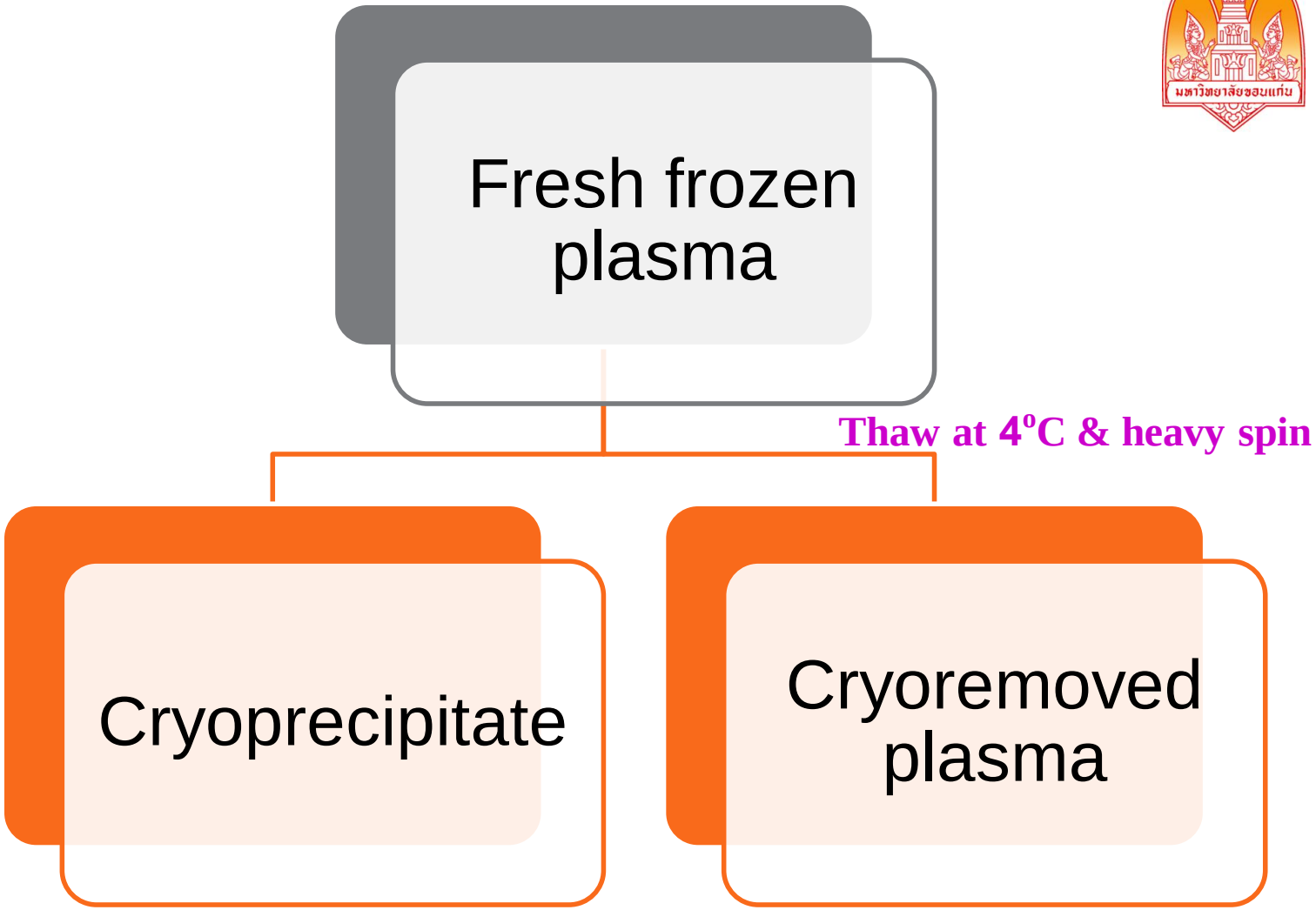
Cryoprecipitate

- ข้อบ่งใช้และข้อควรระวังในการใช้ ?

Cryoprecipitate

- ทำจาก FFP
- Shelf-life 1 year frozen

- Factor VIII 80-100 units,
- fibrinogen 225 mg
- vWF variable amounts
- FXIII



Cryoprecipitate

- Indications
  - Alternative to factor concentrates in vWD, Haemophilia A, factor XIII deficiency
  - As a source of fibrinogen in acquired coagulopathies: DIC

WHO. The clinical use of blood. 2001

Type of platelet

- Random donor (from whole blood)
- Single donor (collected by apheresis)
- HLA-matched single donor (for patients with HLA-alloimmunization and refractory to random donor platelet)

Random donor Platelets

Whole blood 1 unit

↓

Platelet Concentrate 1 unit

↓

≥ 5.5 x 10^{10} platelets in 50 - 70 ml of plasma

Single-Donor Platelets

platelets must contain at least 3 x 10^{11} platelets

↓

a volume of 200 mL
contains few red cells
red cell crossmatching is not necessary

stored for up to 5 days at 20°C to 24°C

single-donor apheresis platelets

- minimize the number of donors
- Theoretically minimize the likelihood of disease transmission
- Histocompatible platelets are required for patients refractory to random donor transfusions

Indications for Platelet transfusion

Bleeding

- Hereditary platelet dysfunction
- Acquired platelet dysfunction

Prophylaxis

- Acute Leukemia <10,000/mL
- patients with solid tumors during chemotherapy-induced thrombocytopenia <10,000/mL
- major invasive procedures with safety; keep 40,000/mL to 50,000/mL

Follow-up

- Obtain post-transfusion platelet counts (10-60min) after all transfusions to ensure adequate replacement and recognition of platelet refractoriness

- A pool of 5 units of random donor platelets should raise the platelet count of an average sized adult by at least $15x10^9/L$

Refractoriness to Platelet Transfusion

- definition of refractoriness, or poor response to platelet transfusions is when two consecutive platelet transfusions lead to 10-minute to one-hour posttransfusion CCI values of less than 5000/microL.

Diagnosis of Refractoriness to Platelet Transfusion

- posttransfusion platelet counts should be obtained
- a diagnosis of refractoriness to platelet transfusion should only be made when at least two ABO-compatible transfusions, stored less than 72 hours, result in poor increments

Expected and observed increase in platelet counts and use of the CCI

- the expected response is an immediate increase in the platelet count that is maximal at about 10 minutes to one hour post-transfusion
  - the response to platelet transfusion is adequate is by calculating an index known as the corrected count increment (CCI)

  - The CCI can be determined by using the following formula:

$$= \frac{[\text{platelet count increment}] \times [\text{BSA } (m^2)]}{[\text{number of platelets transfused}(10^{11})]}$$

Refractoriness to Platelet Transfusion

- The theoretically expected value of the CCI is approximately 20,000/microL.

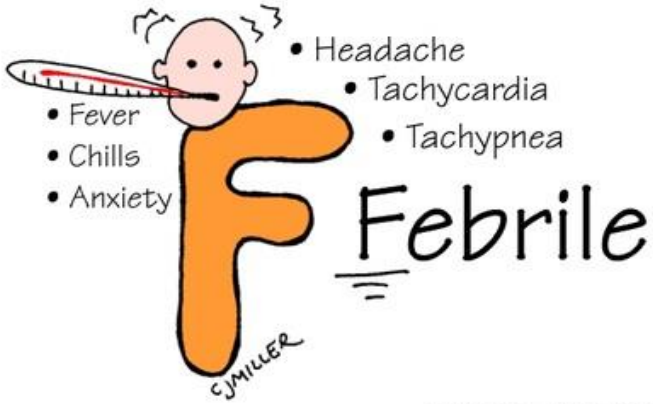
- If CCI > 7,500 = normal
- If CCI < 5,000 at least 2 times = platelet refractoriness

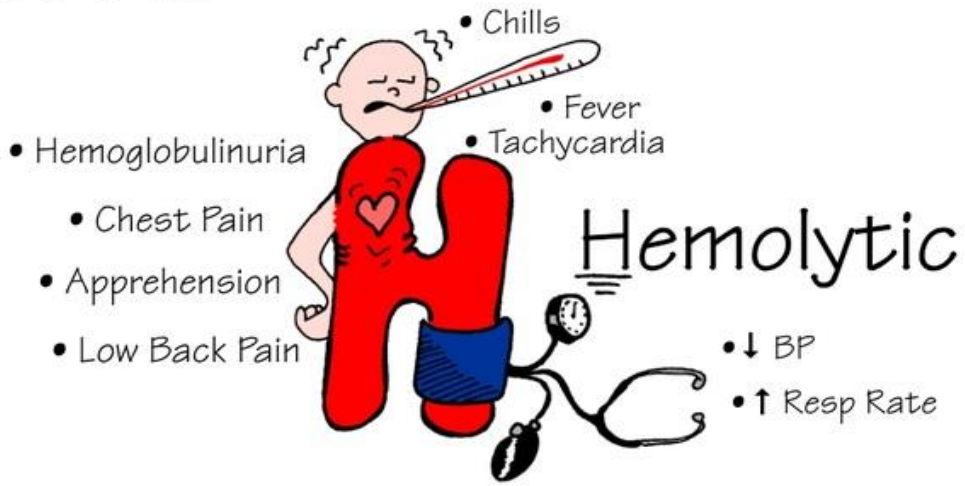
Management of Refractoriness to Platelet Transfusion

- platelet transfusions from donors who are HLA-A and HLA-B antigen selected

TRANSFUSION REACTIONS:

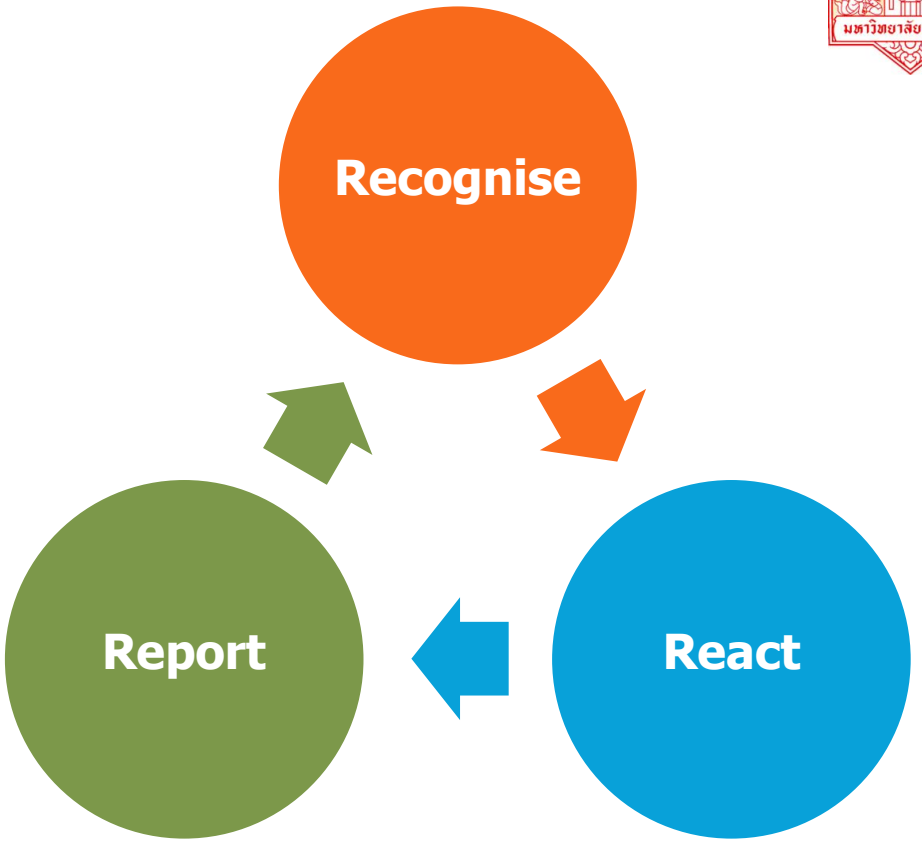
(Occurs In The First 10-15 Min
Or First 50cc of Blood)





Safe Transfusion Practice

- Assessing for the types of reactions
- Understanding causes of those reactions
- Observing for signs and symptoms
- Initiating appropriate action required



Transfusion Reactions

- **Recognise**

- **React**:

✓ React immediately,
✓ STOP the transfusion (keep IV patent)
✓ assess the patient
✓ manage immediate life-threatening symptoms
✓ Review documentation (check that it's the right patient & right blood)

- **Report**: treating medical officer, issuing transfusion service

Classification

Acute:

– Symptoms appear within minutes or up to 24 hours post transfusion

Delayed:

– Reactions occurring more that 24 hours following transfusion (up to months following)

Types of Transfusion Reactions

- Acute hemolytic reactions (ABO incompatibility)
- Febrile reactions
- Allergic reactions (reaction to plasma proteins)
- Circulatory overload
- Transfusion Related Acute Lung Injury (TRALI)
- Sepsis

Acute

Delayed

Most Common-ABO incompatibility

- Mislabeling and administering to wrong person
- Burning at the intravenous (IV) line site
- Fever, chills, dyspnea
- Shock, DIC
- Cardiovascular collapse
- Hemoglobinuria, hemoglobinemia
- Renal Failure

Management

- Stop Transfusion as soon as reaction is suspected
- Check the name, type and crossmatch
- Keep the line open with the 0.9% NS
- Notify MD and the blood bank
- Monitor VS q 5minutes
- Prepare to administer emergency meds
- Collect urine specimen
- Return blood, bag, tubing, labels, transfusion record to the blood bank

Febrile Non-Hemolytic Transfusion reactions

- Defined as 1^0 rise in temperature associated with transfusion and without explanation

- Primarily caused by the presence of cytokines, leukocytes and/or plasma antibodies in the recipient plasma or in donor blood

Circulatory or Volume Overload (TACO)

- Symptoms include signs of congestive
- heart failure; shortness of breath, wheezing, hypertension

- Treatment:
  - Diuretics before, during or after transfusion
  - Monitor flow rates carefully

Transfusion Related Acute Lung Injury (TRALI)

- Non cardiogenic pulmonary edema (ARDS) like reaction associated with recent transfusion episode

- Occurs within 1-6 hours and usually within 1-2 hours

✓Acute respiratory distress
✓Severe bilateral pulmonary edema
✓Severe hypoxemia
✓Tachycardia, fever (1-20 increase), hypotension and cyanosis

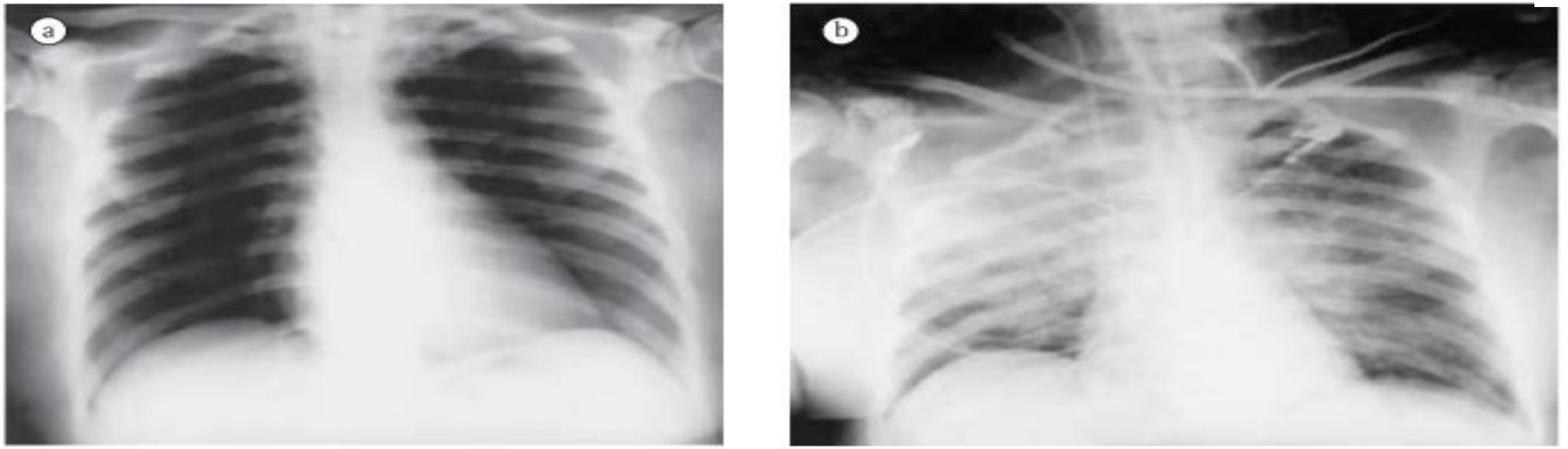
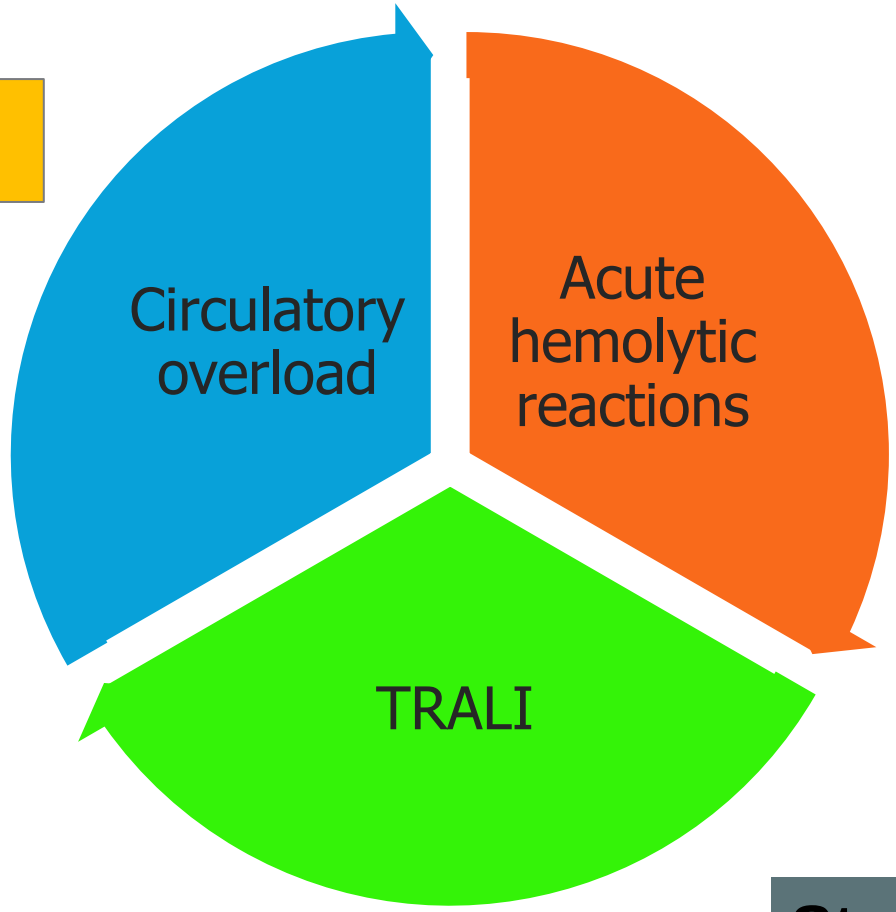


Figure 1 – Pre-and post-transfusion X-rays of a patient with TRALI. Bilateral lung infiltrate with pulmonary edema is an essential criterion for the clinical diagnosis of TRALI. Radiographic discrepancies can be seen in the first hours after transfusion, with progression of the alveolar and interstitial infiltrate throughout the lung. Radiographic findings tend to be more specific than the results of physical examinations. TRALI: transfusion-related acute lung injury.

Dyspnea

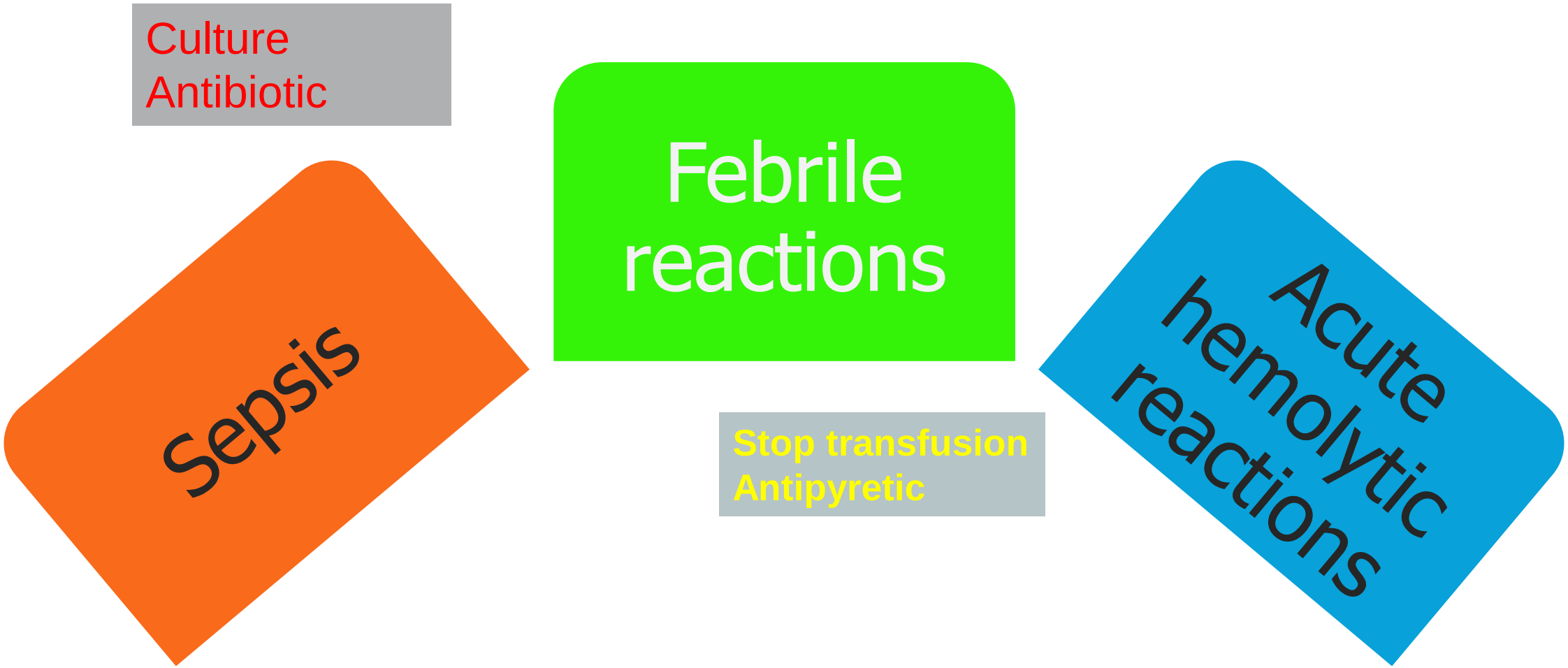
Diuretic



Stop Transfusion

Steroid
Respiratory support

Fever


Culture
Antibiotic
Sepsis
Febrile reactions
Stop transfusion
Antipyretic
Acute hemolytic reactions

Allergic Reactions

- Urticaria that can be localized or extensive
- Characterized by intense itchy welts (hives)

Treatment

- usually stopping the transfusion for a short period of time
- treating the symptoms, usually with an antihistamine with appropriate monitoring a transfusion


THANK YOU
FOR
YOUR
ATTENTION!
ANY QUESTIONS?