PRINCIPLES OF BLOOD TRANSFUSION

HISTORY

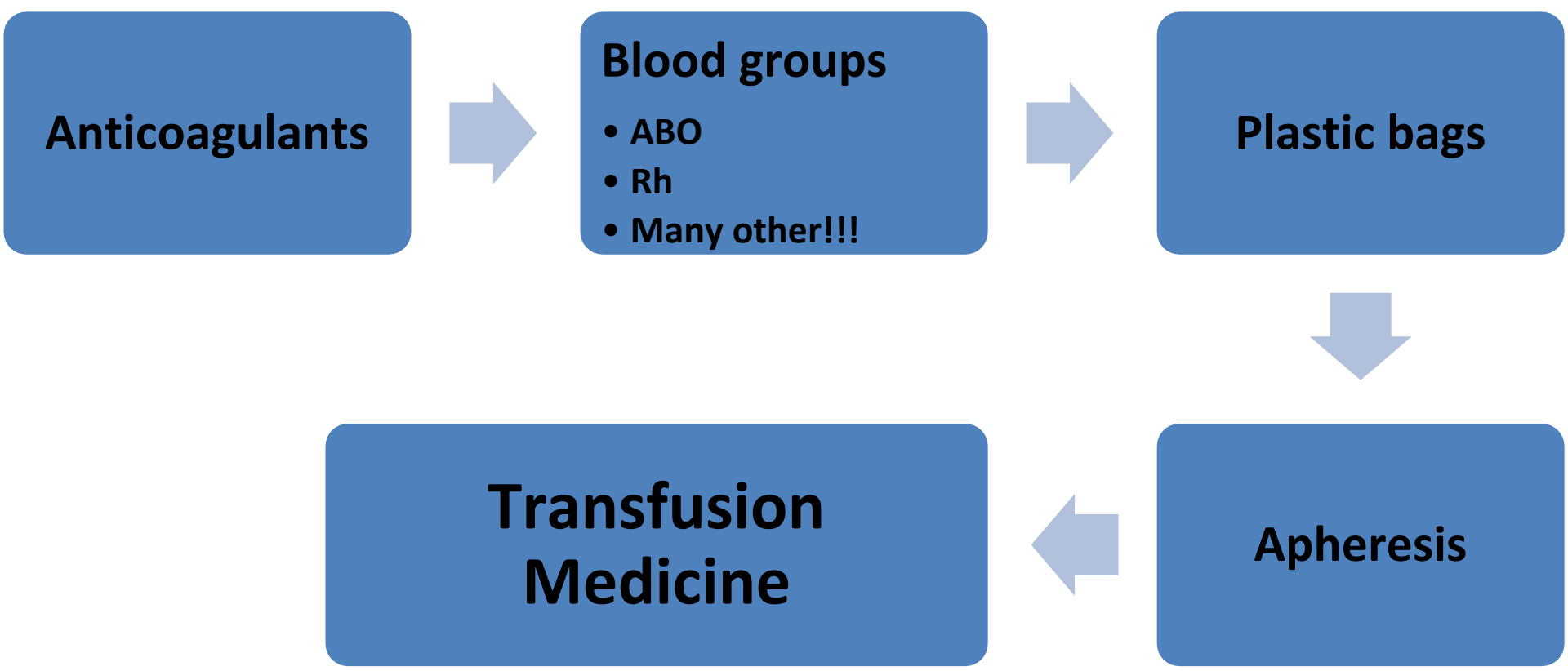
1900- Landsteiner -Blood Groups A, B, and O

1902- Sturli and DeCastello - AB

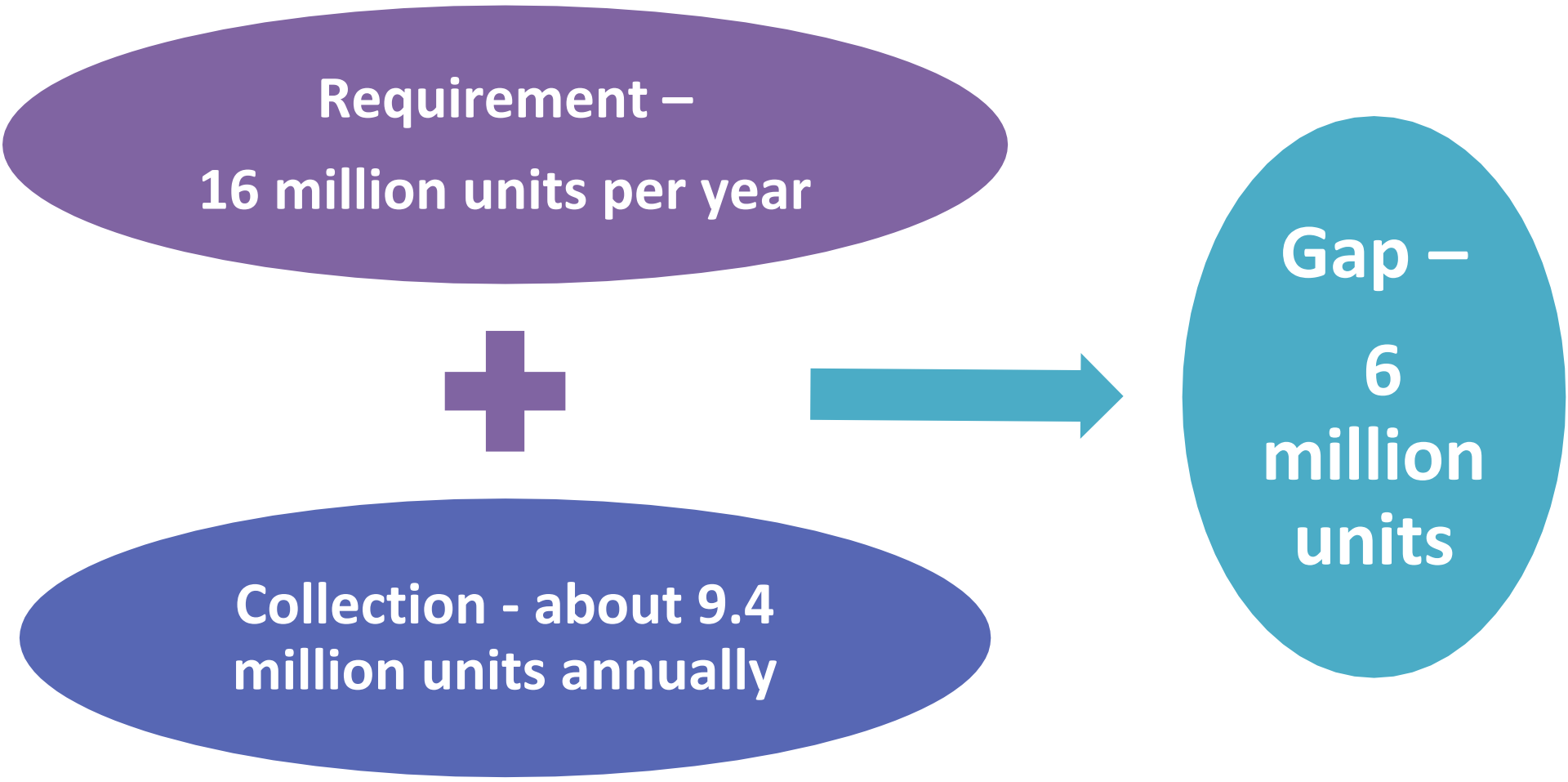
1940- Landsteiner and Wiener- Rh typing

Over 250 different antigens categorized
More than 25 major discrete systems are now known

Progression



World Health Organization data for Southeast Asia



Aggarwal S, Sharma V. Attitudes and problems related to voluntary blood donation in India: A short communication. Ann Trop Med Public Health 2012;5:50-2

Every three seconds someone needs blood!

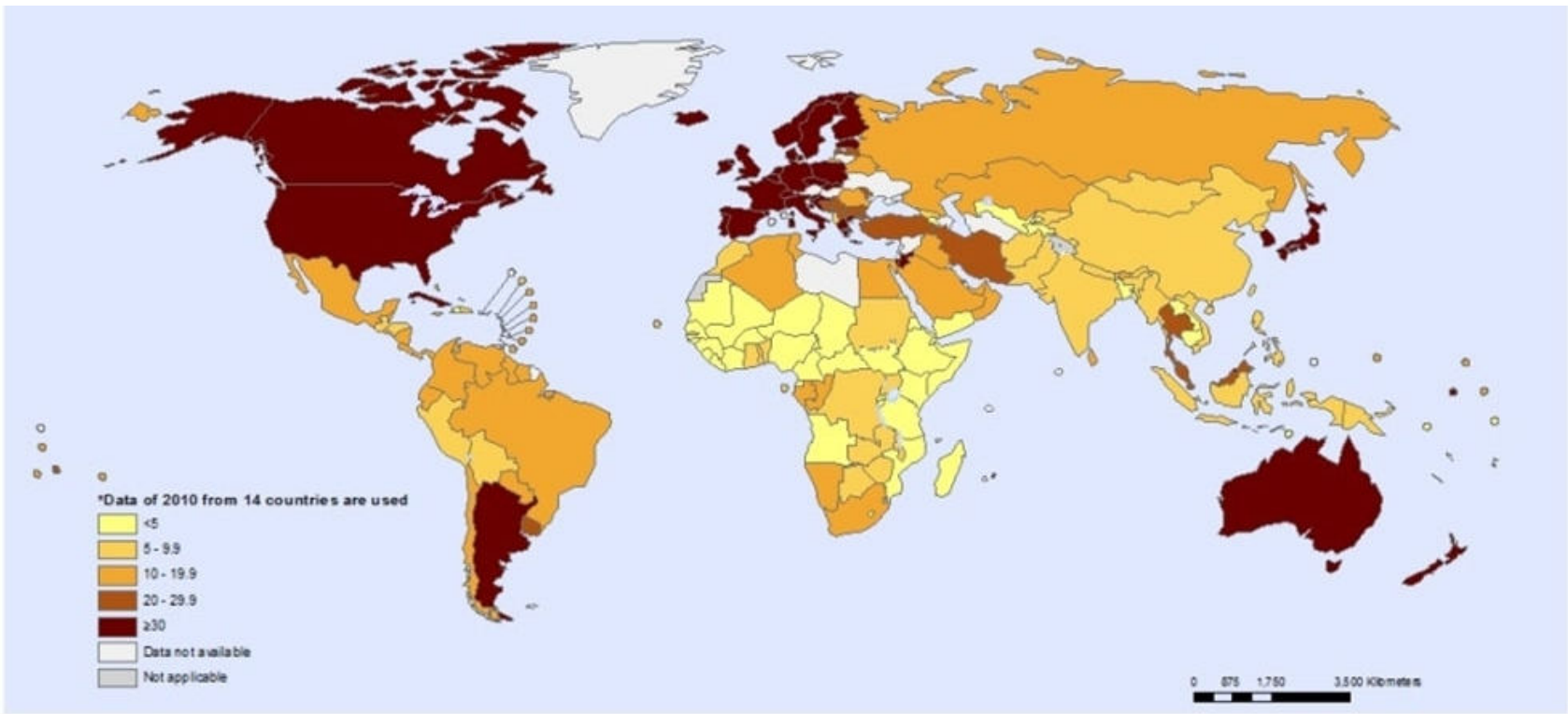
One out of every 10 people entering a hospital needs blood !

A country needs- 20–25 donors per 1000 inhabitants.

In developed countries
50 per 1,000 people
donate blood

In India eight per 1,000
do so

- About 112.5 million blood donations are collected yearly worldwide.
- More than half of these are collected in high-income countries, home to 19% of the world's population.



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Blood Transfusion Safety (BTS)
World Health Organization

World Health Organization

Blood donation rate (per 1000 people)

- High-income countries- 33.1
- Middle-income countries- 11.7
- Low-income countries-4.6

- Data reported to WHO shows significant increases of voluntary unpaid blood donations in low- and middle-income countries

Blood cannot be manufactured

It can only come from generous donors.

Facts about donors

- Common reasons cited by people who don't give blood

"I don't like needles."

"Never thought about it"

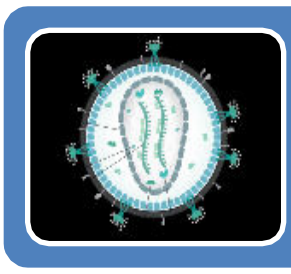
What is the solution??

- Retention donors
- Donor satisfaction

Donating blood is a safe process

Sterile disposable blood bags are used.

The entire process, from the time you arrive to the time you leave, takes about an hour.



Donated blood is tested for HIV, hepatitis B and C, syphilis and malaria.

Blood cannot be manufactured in factories, and someone has to donate.

Action needed

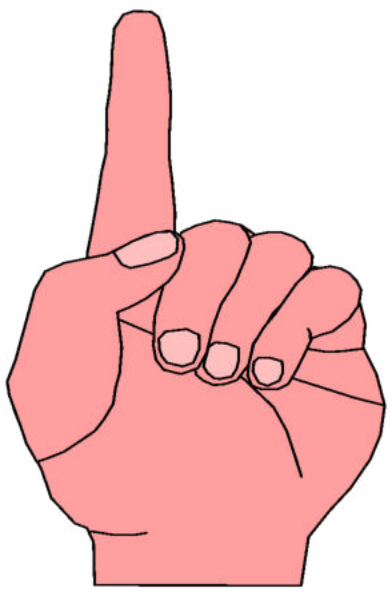
- Conduct more blood donation camps.
- Enlist dedicated donors.
- Conduct donor education / awareness programs.

Social media plays a role too!!

They donate regularly too !!

Right blood
to the right patient
at the right time!

Rational Use of Blood



- **Right product**
- **Right dose**
- **Right time**
- **Right reasons**

Criteria for donor selection

Conditions for donation of Blood

(1)*General* –

once in three months

good health

(2)Age group

18 to 65 years

(3)Weight > 45 kg

(4)Normal

Temperature

Pulse

Blood pressure

e) Hemoglobin more than 12.5 g/dl

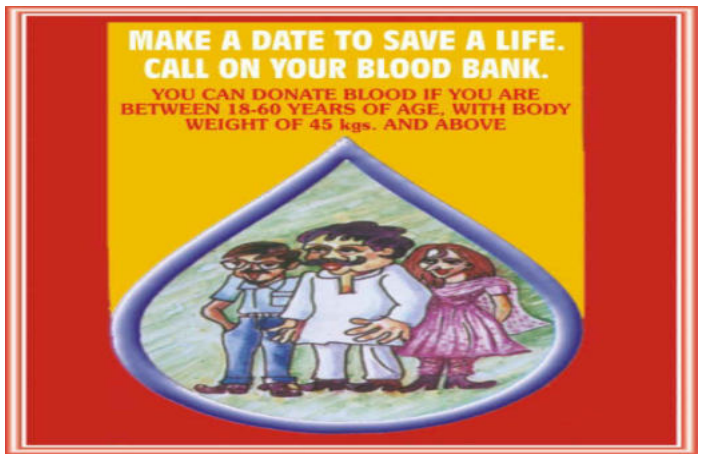
f) The donor should be free from
acute respiratory diseases
skin diseases at the site of phlebotomy
disease transmissible by blood transfusion

i) The arms and forearms of the donor should be free from skin punctures or scars indicative of professional blood donors or addiction of self injected narcotics.

Additional criteria- (Deferral)

Conditions	Period of Deferment
1) Abortion	6 Months
2) Accident – major	6 Months
3) Accident – minor	4 Weeks
4) Acupuncture	6 Months
5) Alcoholism	24 hours after intake
6) Allergy	Till symptom free
7) Anemia	Till treated
8) Aspirin	3 days
9) Asthma	Till acute attack subsides
10) Blood Donation (previous)	3 months
11) Blood Transfusion	6 months

Conditions	Period of Deferment
l2) Common Cold	Till symptom free
13) Contraceptive	No deferral
14) Child Birth	6 months
15) Ear Piercing	6 months
16) Fracture	6 months
17) Hepatitis	12 months
18) Immunization	15 days
19) Immunoglobulin	12 months
20) Infectious Mononucleosis	24 months
21) Hepatitis Vaccination	6 months after the last dose



Conditions	Period of Deferment
21)Lactation	12 months after delivery
22)Malaria	3 months after treatment
23)Menstruation	Temporary
24)Pregnancy	12 months
25)Rabies vaccination	1 year after vaccination
26)Surgery – major	12 months
27)Surgery – minor	3 months
28)Tattooing	6 months
29)Toxoplasmosis	12 months
30)Tuberculosis	Till completely treated
31)Typhoid	12 months after recovery
32)Vaccination – Killed Vaccine	48 hours
33)Vaccination – Live Vaccine	3 weeks

No person shall donate blood suffering from any of the disease mentioned below,

a) Cancer
b) Heart disease
c) Abnormal bleeding tendencies
d) Unexplained weight loss
e) Diabetes – controlled on Insulin
f) Hepatitis infection
g) Chronic nephritis
h) Signs and symptoms, suggestive of AIDS
i) Liver disease
j) Tuberculosis
k) Polycythemia vera
l) Asthma
m) Epilepsy
n) Leprosy
o) Schizophrenia
p) Endocrine disorders

QUESTIONNAIRE FOR MEDICAL HISTOR

- (Ask following question from the donor in privacy)
- HAVE YOU HAD ANY OF THE FOLLOWING ILLNESS?
- Hepatitis
- Malaria
- Asthma
- Allergic to Medication/Chemicals ?
- Significant infections or diseases of the skin ?
- Do you bruise easily ?
- Do you perspire excessively ?
- Do you faint easily ?
- Have you ever been knocked unconscious ?
- Do you have light headedness/dizziness ?
- Have you been jaundiced (Yellow eyes and skin) ?
- Have you lost weight ?
- Do your gums bleed frequently ?
- Do you get up every night to urinate ?
- Have you had sugar in the urine ?
- Have you had /suspected you had a venereal disease ?
- Did you ever have painful, swollen joints/rheumatism ?
- Have you ever been told you have anemia ?
- Subjects to diziness, fainting, twitching, spells/fits ?
- Do you have neuralgia or neuritis ?
- Do you have numbness/tingling in your fingers/toes ?
- Does cold/hot weather bother you excessively ?
- Do you have a chronic cough ?
- Have you ever coughed up blood ?

Types of blood bags & anticoagulants used in Blood Bank

Blood Storage

- **Acid Citrate Dextrose (ACD)**
- **Citrate Phosphate Dextrose (CPD)**
- **Citrate-phosphate-double dextrose (CP2D)**
- **Citrate-phosphate-dextrose-adenine (CPDA1)**

SINGLE BAG-WHOLE BLOOD

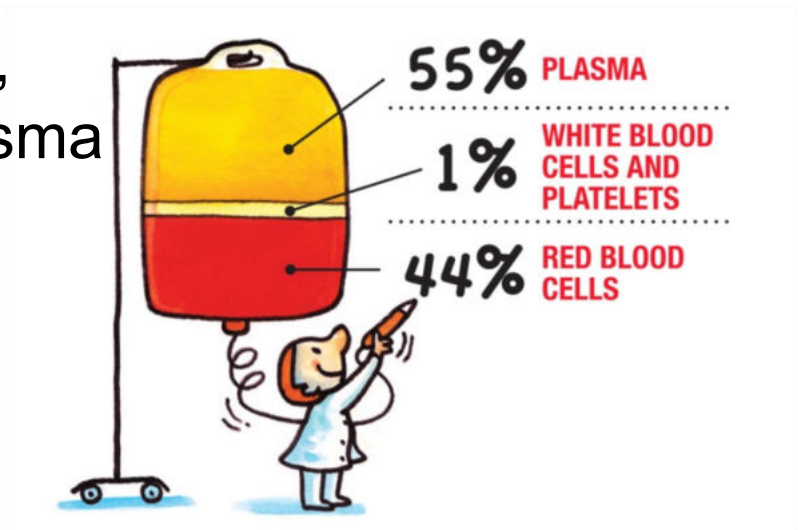
DOUBLE BAG-PRBC & PLASMA

TRIPLE BAG-PRBC & FFP & PLATELETS

Quadruple bag- +Cryoprecipitate

What are Components?

1. Cellular components: RBCs, platelets, granulocytes
2. Non cellular components: FFP, Cryoprecipitate, Cryo poor plasma



Why Components?

- Better shelf life
  - Whole blood has shelf life of 35days

- Shelf life of components: PRBC 42days
  FFP 1year
  RDP 5days

Why Components?(Contd..)

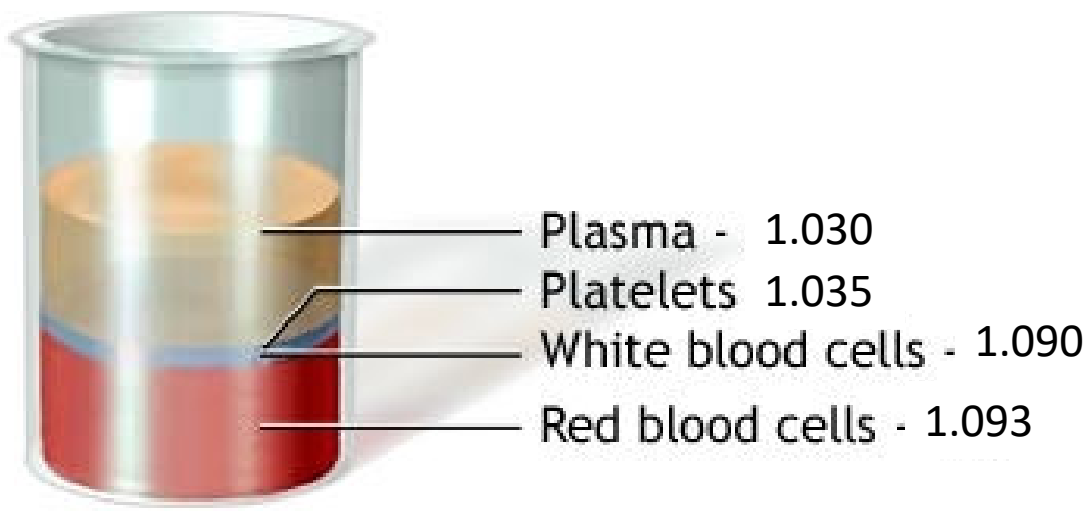
- Whole blood can be used only for one patient.

- Components:
  - PRBC can be used for anemia and thalassemia.
  - FFP for coagulopathy
  - Platelet concentrate for thrombocytopenia.

Principle of component preparation:

- **Principle**: different components of whole blood have different specific gravities and require different centrifugal force to separate from one another.

Specific gravities of Components:



Different components that can be prepared:

1. Packed RBC(PRBC)
2. RBC with Additive solution(ADSOL)
3. Leucoreduced RBC
4. Platelet concentrates: random donor platelets(RDP)
5. Granulocyte concentrates
6. Fresh frozen plasma(FFP)
7. Cryoprecipitate
8. Single donor plasma(SDP)
9. Cryo poor plasma(CPP)

Preparation of Packed RBC:

Whole blood bags are kept at room temperature after donation

↓

Bags are put in centrifuge cups and balanced by soft weights

↓

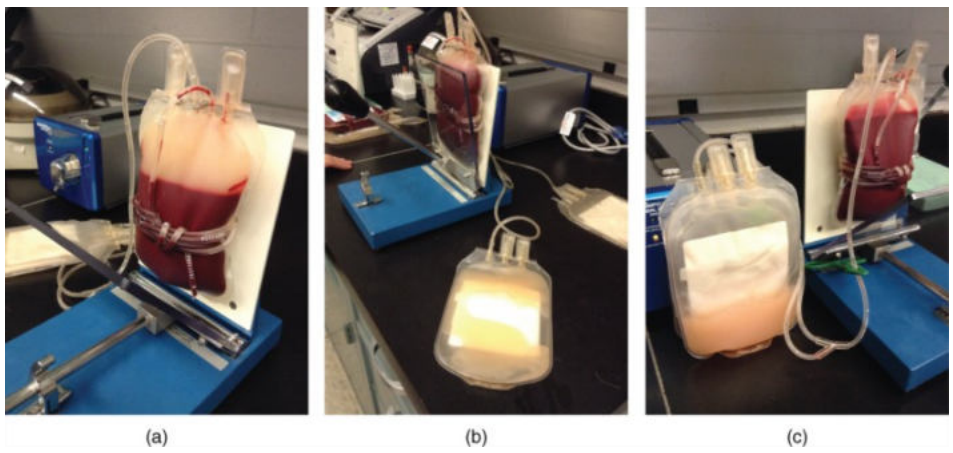
Balanced centrifuge cups are to placed diagonally in refrigerated centrifuge

↓

Centrifuge should be run at speed of 1800rpm with 9 acceleration and 6 deceleration for 10mins

↓

Using plasma expresser, platelet rich plasma(4/5th Plasma) is separated into another satellite bag to retain RBC in mother bag.



(a) (b) (c)

RBC Components:

1. PRBC: RBCs are separated from plasma by plasma expresser and kept at 2-4^{0}C. Shelf life is 35days.
2. RBC with Additive: SAGM

- Requires quadruple or penta bags.
- Shelf life is 42days when stored at 2-4^{0}C.
- It contains Saline, Adenine, Glucose and Mannitol

Clinical indications of PRBC transfusion: BCSH

- Surgery/Critical care: <7g/dl
- Cardiovascular disease: <8g/dl
- Chronic anemia: Hb maintained >8g/dl to prevent symptoms

Clinical response of PRBC transfusion:

- Each unit of PRBC,

i. In a 70kg adult will cause increase of 1g/dl of Hb and 3% HCT
ii. In a child, 3g/dl of Hb and 6% HCT

Long term storage

- **<u>Cryopreservation</u>** of red blood cells is done to store rare units for up to 10 years.
  - The cells are incubated in a **glycerol** solution which acts as a cryoprotectant

Platelet Concentrate:

- Random donor platelets(RDP) are prepared from whole blood unit by centrifugation.
- Ideally from 450ml unit of whole blood kept at room temperature and within 6 to 8 hours of collection.

Storage of Platelet Concentrate:

Temperature:20-24 degrees
Agitation

- Exchange of gases
- Maintenance of pH
- Decreased formation of aggregates

Clinical response of Platelet concentrate:

- 1 unit of RDP causes an increment of 5000 to 10000/mm^3 in a 70kg adult.

Fresh frozen plasma:

- Prepared from a single unit of whole blood and frozen rapidly within 6-8hrs
- Contain all coagulation factors
- Rapidly frozen within 1 hour of separation
- Used as FFP until 1year if stored below -30^{0}C.

FFP Transfusion:

- Dosage of FFP: 15ml/kg body weight
- Compatibility testing is not necessary before transfusion.
- Donor plasma should not contain ABO antibodies that interact with recipient’s red cells.

Cryoprecipitate:

- Precipitated proteins of plasma rich in Factor VIII, Fibrinogen and Fibronectin.
- Stored at -30^{0}C for 1year.

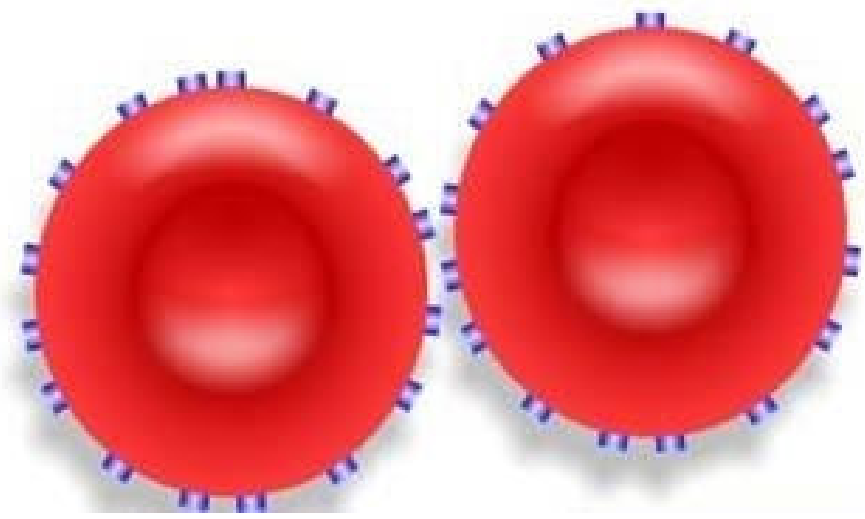
Component	Storage	Expiration
Whole Blood	2-6 ^{0} C	35-42 days
PRBC	2-6 ^{0} C	35-42 days
Platelets	20-24 ^{0} C	5 days
FFP	<-18 ^{0} C	12 months

PRETRANFUSION TESTING

- BLOOD GROUPING
- CROSS- MATCHING

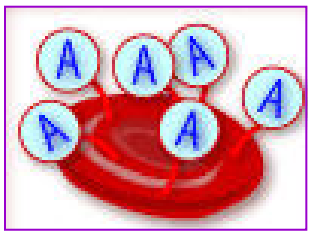
Q. What determines a blood group?

A. The antigens on the red cell surface.



What are the antigens?

Group A



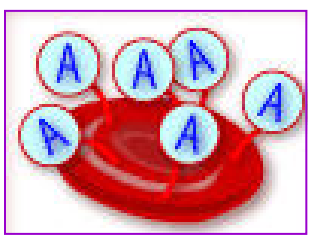
Group B

Group AB

Group O

We have antibodies to the antigens we don't have!

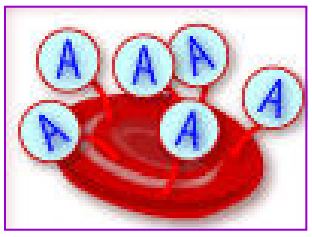
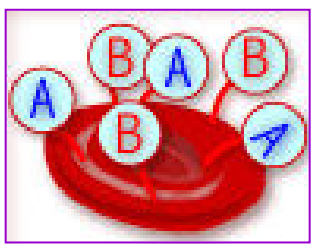
Group A



Group B

Group AB

Group O

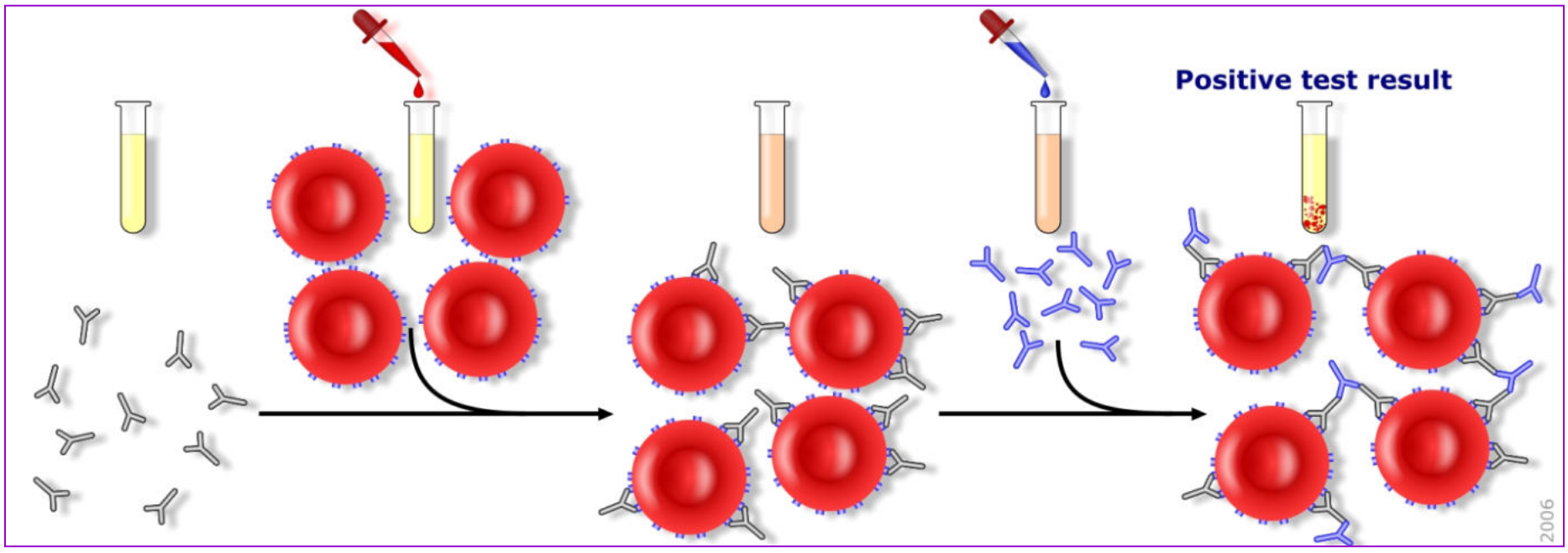
	Cell grouping	Serum grouping
Group A		
Group B		
Group AB		
Group O		

<u>This is very important during blood transfusion</u>

Anti-A antibodies lyse type A red cells

Anti-B antibodies lyse type B red cells

CROSSMATCH



patient serum

donor red cells

AHG

Cross-matching

- Major Cross-match: Recipient serum is tested against donor packed cells
- Minor Cross-match: Recipient red cells are tested against donor serum