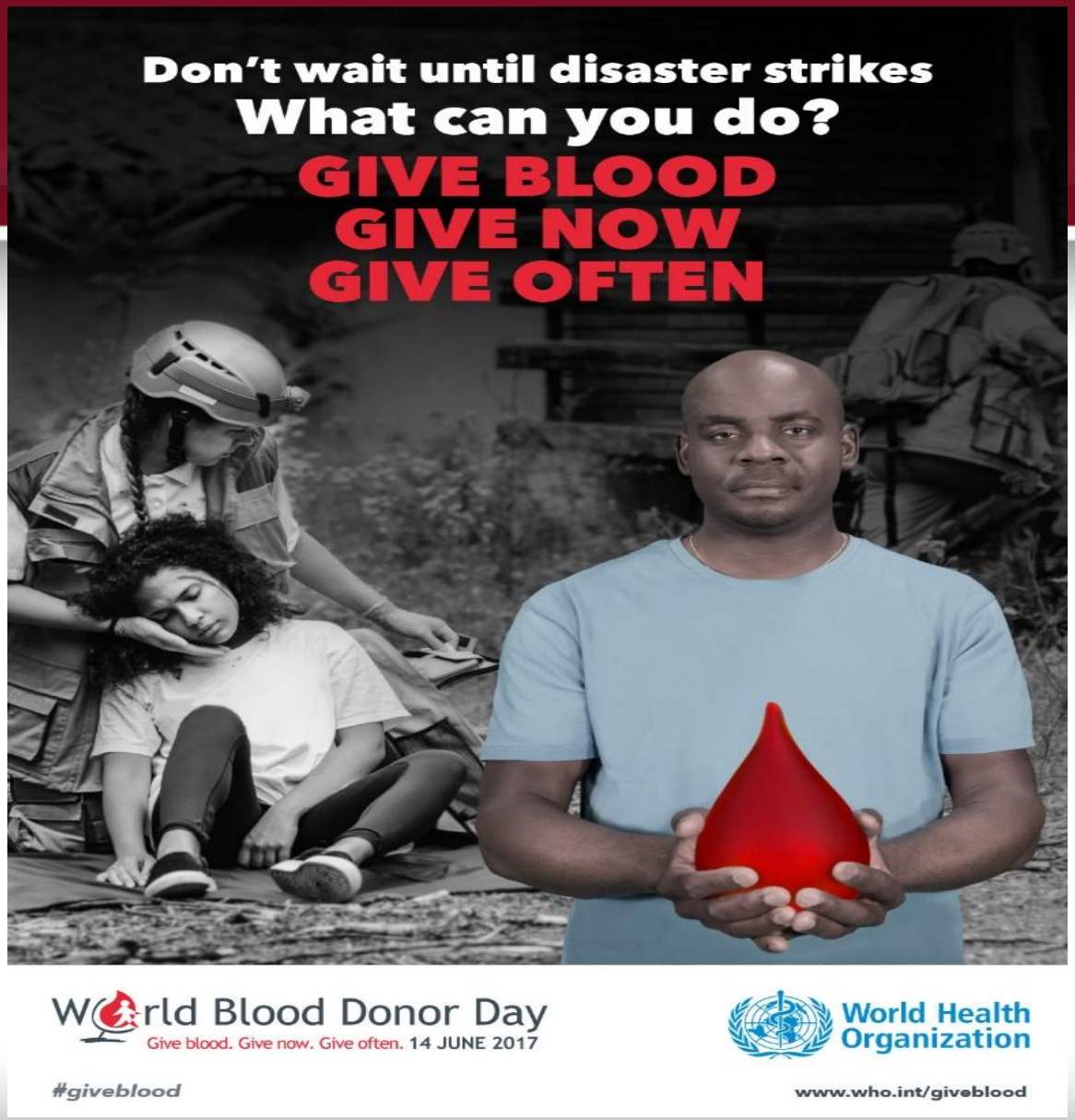
Rational Use of Blood
&
Blood Products

Prof. Md. Golam Kibria Khan
Ex-Professor of Medicine
Dhaka Medical College
Dhaka


Don't wait until disaster strikes
What can you do?
GIVE BLOOD
GIVE NOW
GIVE OFTEN
World Blood Donor Day
Give blood. Give now. Give often. 14 JUNE 2017
World Health Organization
#giveblood
www.who.int/giveblood

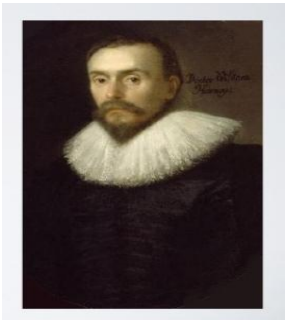
Outline

- Historical summary
- Global & Local prevalence
- Blood supply
- Blood screening & processing
- Blood Product
- Guidelines for rational use of blood
- The appropriate use of blood and blood products

Historical Summary of Blood Transfusion Concept

In 1492 ‘ the harrowing story was told that , at the suggestion of Jewish physician , the blood of three boys infused into the dying pontiffs mouth . They were ten years old and had been promised a ducat each. All three died.

In 1628 William Harvey published De Motu Cardis (On the Motion of the Heart and Blood) revealed the action of the heart pumping blood around the body in a circuit.



In 1667 Jean – Baptiste Denys, French physician performed transfusion with sheep’s and calf’s blood

In 1818 James Bundle , successfully performed transfusion for postpartum hemorrhage, using patient’s husband blood.

In 1905 George Washington Crile, co- founder of Cleveland clinic, was the first surgeon who used direct blood transfusion in surgery.

In 1901 , Karl Landsteiner discover human blood groups . Blood transfusion had become a lot safer since then.

Development of Blood Banking

- Anticoagulant was discover in 1910, making the way to blood banking.
- First stored blood was successfully transfused in 1916 by Oswald Hope Robertson during World War- I
- In 1925 first academic transfusion institution was found by Alexender Bogdanov in Moscow.

The First Blood bank in Moskow

Global & Local Prevalence

- Of the 112.5 million blood donations collected globally
- Approximately half of these are collected in high-income countries, home to 19% of the world's population.
- In low-income countries, up to 65% of blood transfusions are given to children under 5 years of age; whereas in high-income countries, the most frequently transfused patient group is over 65 years of age, accounting for up to 76% of all transfusions.

WHO , Fact Sheet -2017

- An increase of 10.7 million blood donations from voluntary unpaid donors has been reported from 2008 to 2013
- Only 51 of 180 reporting countries produce plasma-derived medicinal products (PDMP) through the fractionation of plasma collected in the reporting country.
- A total of 96 countries reported that all PDMP are imported, 17 countries reported that no PDMP were used during the reporting period, and 16 countries did not respond to the question.

Global….

- In 2013, 68% of reporting countries, or 122 out of 179, had a national blood policy. Overall, 58% of reporting countries, or 105 out of 181, have specific legislation covering the safety and quality of blood transfusion, including:
- 79% of high-income countries
- 64% of middle-income countries
- 41 % of low-income countries.

Global….

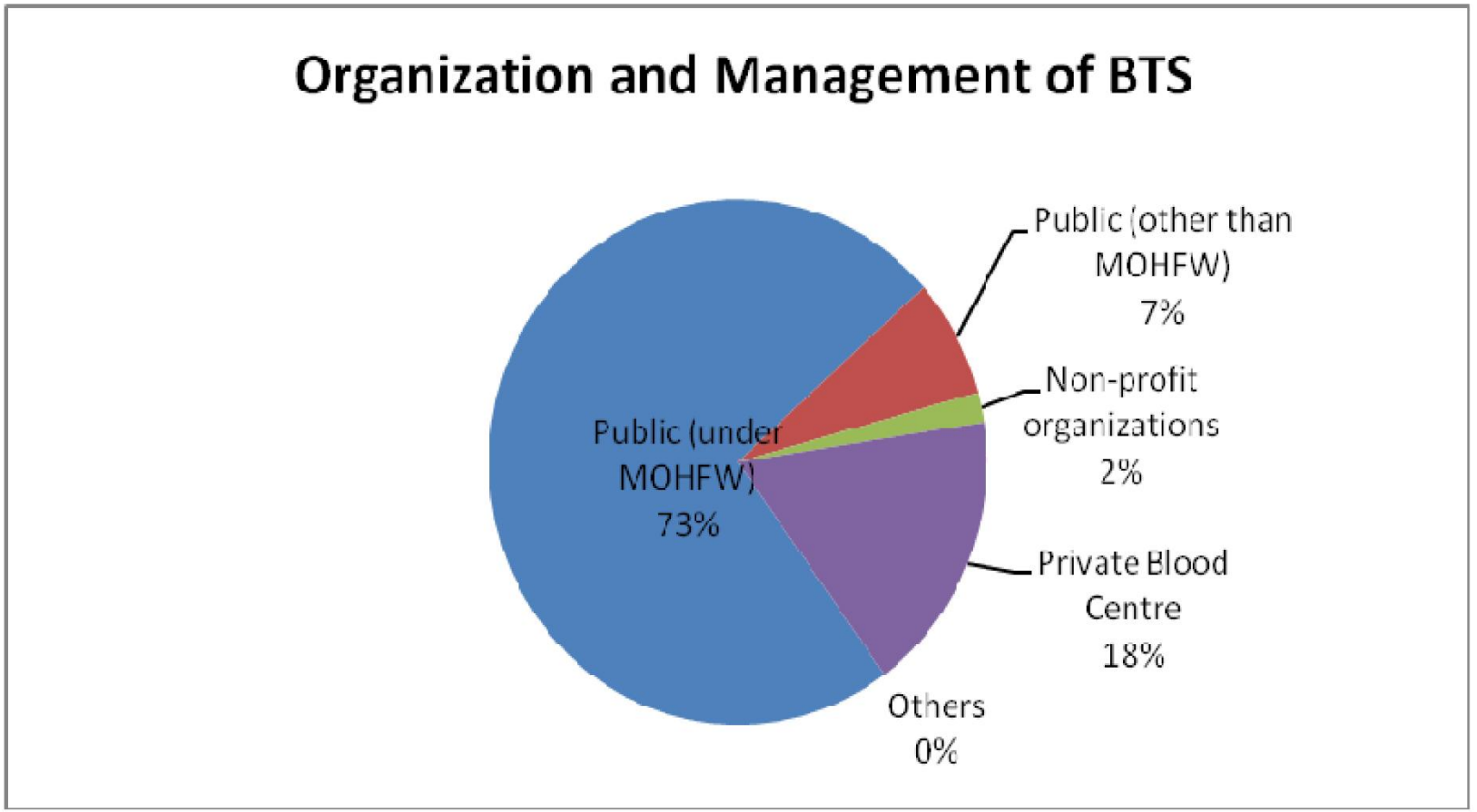
- The capacity to provide patients with the different blood components they require is still limited in low-income countries: 50% of the blood collected in low-income countries is separated into components, 59% in lower-middle-income countries, 92% in upper-middle-income countries, and 97% in high-income countries.

Bangladesh….

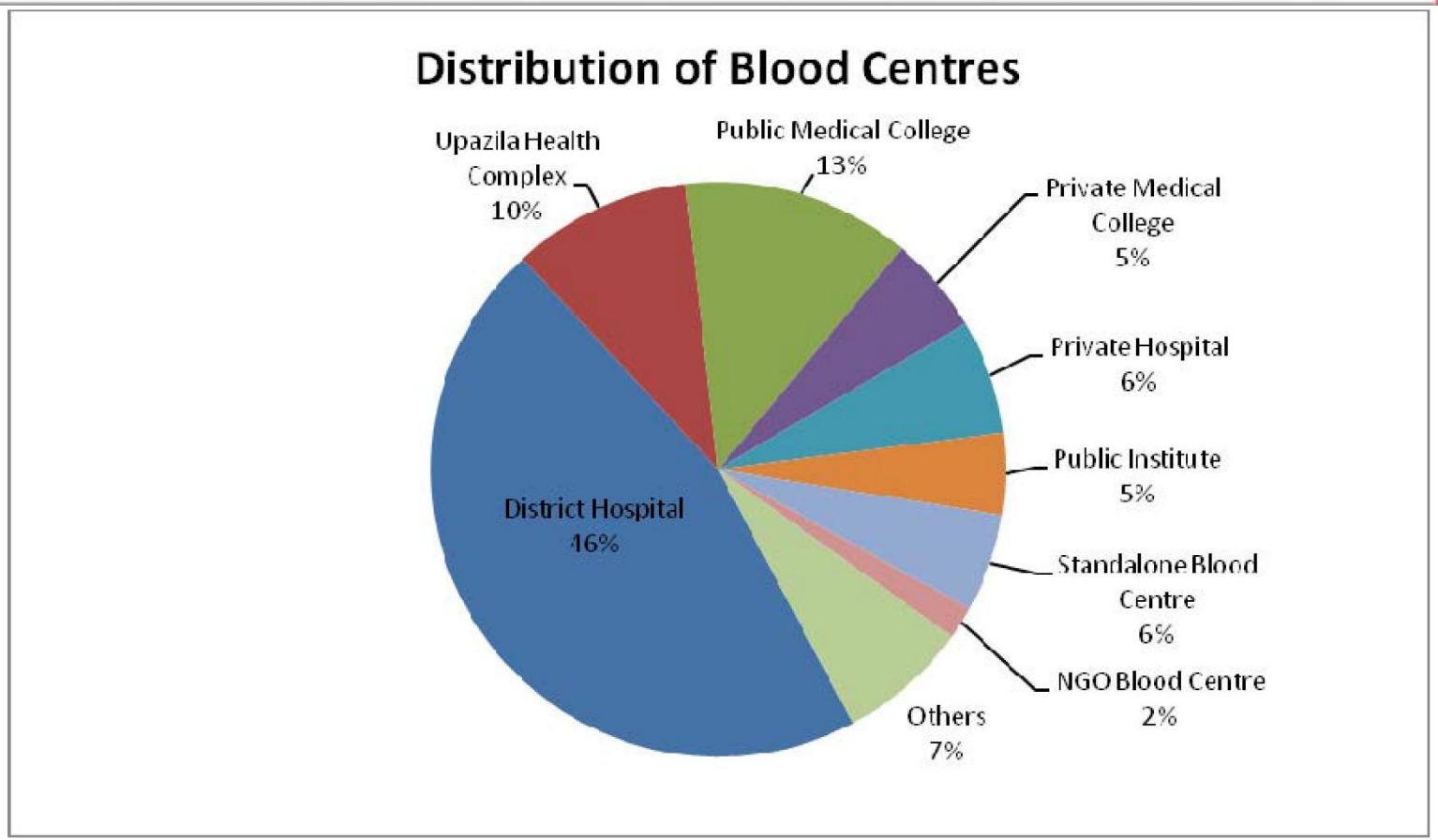
- If we take the general principle of blood donation by 1% population, yearly blood collection should have been about 15,00,000. However, total collection is about 4,00,000 per year.
- 60% donation comes from family relative donors, 31% comes from voluntary donors and 9% donation from paid donors.
- more than 131 blood banks under government sector which caters to more than 50% demand.

Blood Collection

Cont..


Organization and Management of BTS
Public (other than MOHFW) 7%
Non-profit organizations 2%
Private Blood Centre 18%
Others 0%
Public (under MOHFW) 73%

Cont…


Distribution of Blood Centres
Upazila Health Complex 10%
Public Medical College 13%
Private Medical College 5%
Private Hospital 6%
Public Institute 5%
Standalone Blood Centre 6%
NGO Blood Centre 2%
Others 7%
District Hospital 46%

Cont….

- Only 2% of district hospitals reported to produce blood components,
- 43% of public medical colleges, and 20% of public institutes, 50% of private medical colleges,
- 57% of private centres and 100% of NGO blood centres reported to produce blood components.
- This figures show that 10% of collected whole blood is converted into blood components by
- 17 centres in both public and private centres which represent 7% of the total (253 centres) throughout the country.

Blood Screening & Processing

- From 2008 to 2010 104 new centers were developed in Upazila health complexes and in other hospitals.
- Today, there are officially a total of 203 blood screening centers.
- Over a total of 2,440,096 units of blood screened for TTI between 2000 and 2010, 129 HIV, 21,715 HBV, 3,182 HCV, 2,800, syphilis and 1,149 malaria reactive cases were detected, maintaining TTI prevalence almost below 1%.

Cont…

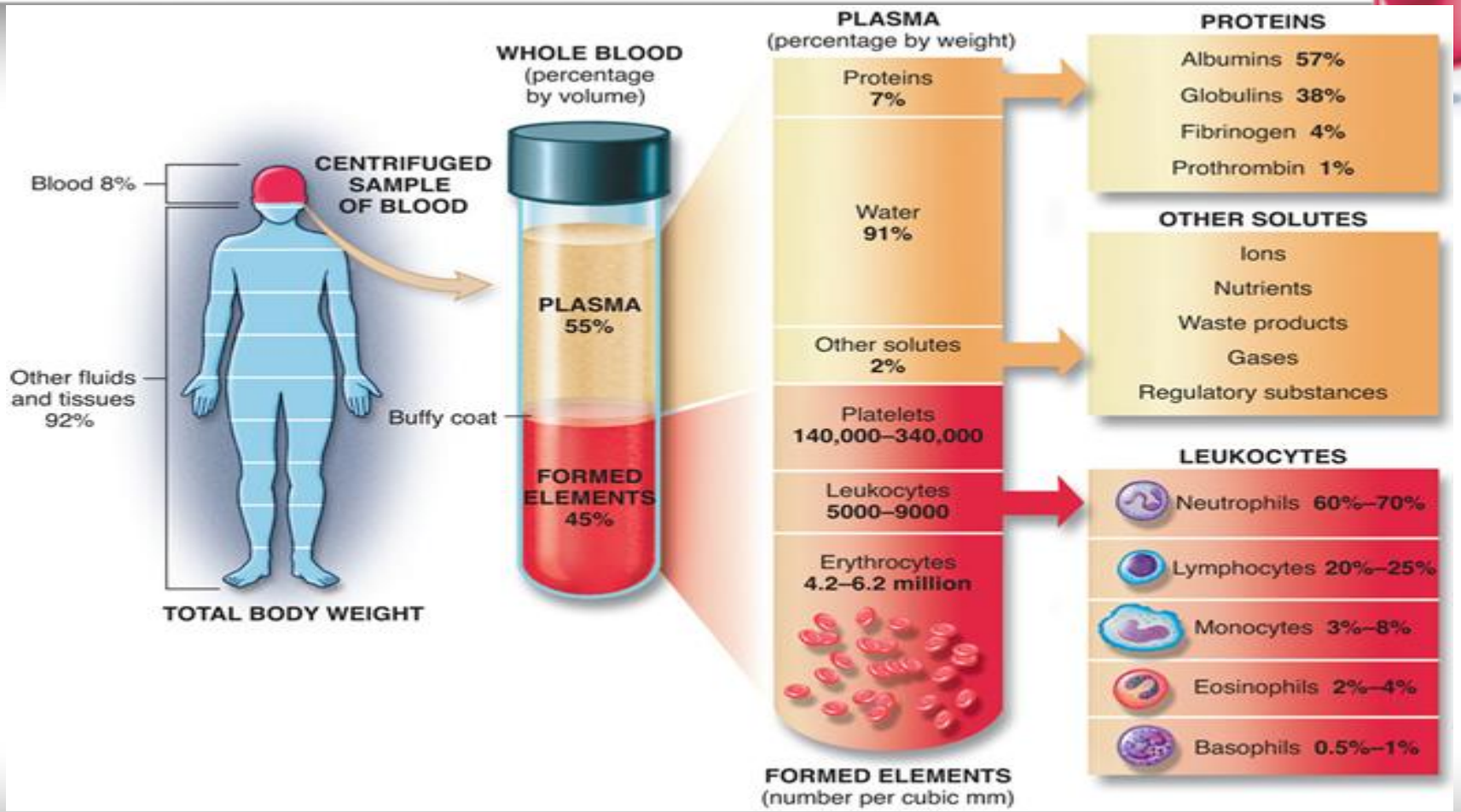
- Most of TTI screening is done on rapid tests. Only in some centers of the private sector is blood screening is performed by ELISA.

- TTI= Transfusion transmitted infection
- ELISA= An Enzyme-Linked Immunosorbent Assay

Blood Product

- DEFINITIONS
- Blood product Any therapeutic substance prepared from human blood
- Whole blood Unseparated blood collected into an approved container containing an anticoagulant-preservative solution
  - Blood component 1 A constituent of blood, separated from whole blood, such as:
  - ■ Red cell concentrate
  - ■ Red cell suspension
  - ■ Plasma
  - ■ Platelet concentrates

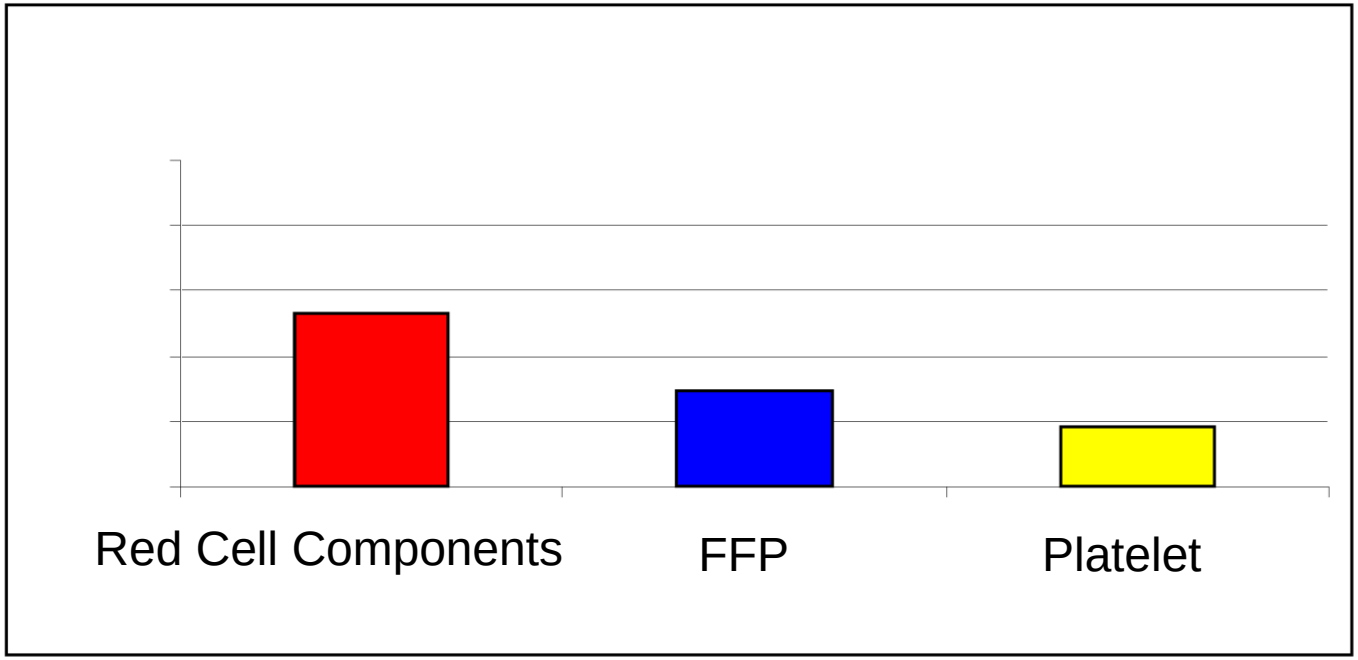
Whole Blood Composition



Red Blood Cells

Fresh Frozen Plasma

Blood Product



- 55% of Red Cell Components 26% of Fresh Frozen Plasma and 20% of Platelet are produced and distributed.
- None of the centers has a QC program for blood components

The Clinical Use Of Blood

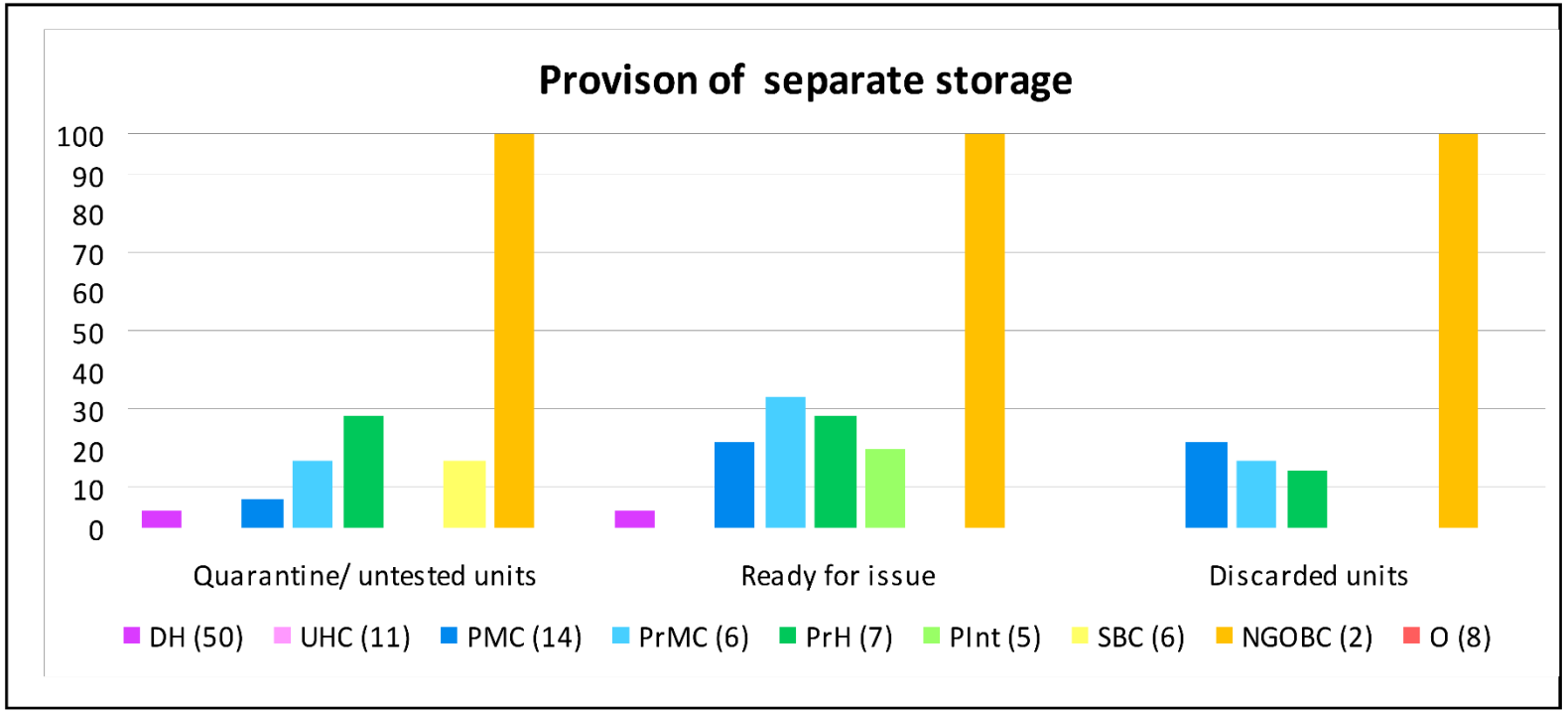
Composition	Whole blood	Red cell concentrate/ packed red cells	Red cell suspension in additive solution
Blood	400–500 ml	220–340 ml	280–420 ml
Anticoagulant-preservative solution	63 ml	Minimal	0
Additive solution		Small amount of plasma is left to improve viscosity plus some benefit of additive solution	100 ml
Haemoglobin	Minimum 45 g	Minimum 45 g	Minimum 45 g
Haematocrit: %	45–55%	55–75%	50–70%
Packed red cells: ml	120–250 ml	120–250 ml	120–250 ml
Plasma	200–300 ml	50–70 ml	10–20 ml (or less)
Maximum storage time at +2°C to +6°C	21 days: ACD, CPD 35 days: CPDA	21 days: CPD 35 days: CPDA	42 days: CPDA + red cell additive solution (e.g. SAG-M, ADSOL)

ACD = Acid Citrate Dextrose
CPD = Citrate Phosphate Dextrose
CPDA = Citrate Phosphate Dextrose Adenine

Fig: Volume of red cell components from a whole blood donation of 450 ml

Storage of Blood

Storage Condition in Bangladesh

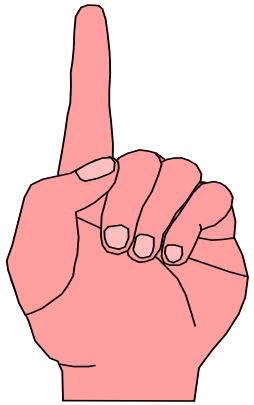


Provision of separate storage- In response to facilities for separate storage like quarantine, ready for use and discarded units, 4% of district hospitals, 7% of public medical colleges, 100% of NGO blood centres have separate facilities.

Rational Use of Blood

Rational Use of Blood

RATIONAL



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

Logic
(Rationale behind Rational use of blood)

- Economy -Scarcity of resource
  1 in 4 get blood component
- Safety - Inherent risks involved in transfusion therapy
  1 in 2 million gets HIV
- Scientifically appropriate
  Haematinic in nutritional anemia

Guidelines For Promoting Component Therapy

- Definite indication - *A blood transfusion should never be ordered unless it is worth the risk*

- Single unit transfusion – has no significant *therapeutic benefit*
- Use of fresh blood - *should be avoided because of increased risk of infections (TTI)*

1. Give only what is needed

Red cells	O_2 carrying capacity (Anemia)
Platelets	Thrombocytopenia
FFP	Multiple clotting factor deficiency
CRYO	Hemophilia A

2. Different Storage Conditions

Comp.	Temp.	Shelf life
Red cells	4-6^0 C	35 days
FFP/CPP	- 40 ^{0} C	1 year
Platelets	22-24^0 C on platelet agitator	5days
CRYO	- 40^0 C	1 Year

3. Conservation of Scarce Resource

- Separation of whole blood in 3-4 components

- Benefits more than one patient at a time.

Centrifugation

Principle

Sediment of blood cells depend on their size as well as the difference of their density from that of the surrounding fluid, viscosity of medium, flexibility of the cells which are temperature dependent.

Whole blood vs Packed red cells

Parameter	Whole blood	Packed red cells
Volume	350 – 450 ml	200 – 240 ml
Increment in Hb	1 -1.5 gm/dl	1 -1.5 gm/dl
Red cell mass /ml	Same as PRBC	Same as WB
Viable platelets	No	No
Labile factors	No	No
Plasma citrate	++++	+
Allergic reactions	++++	+
FNHTR	++++	+
Risk of TTI	++++	+
Waste of components	Yes	No

Why whole blood not rational

- **Maximize blood resource**

Whole blood → one patient
Component therapy → four patients

packed red cells → thalassemia
plasma → liver disease / burns
platelets → thrombocytopenia
cryoprecipitate → hemophilia

Cont…

Specific storage requirements of components

Whole blood	+ 4^0C
Components	
platelets	+ 20 – 24 ^{o}C
cryoprecipitate & FFP	- 30^{o}C
red cells	+ 2 – 8^0C

Why whole blood not rational

- **Better patient management**
  - concentrated dose of required component
  - avoid circulatory overload
  - minimize reactions

Requirement of platelets to raise count from 20 to 50,000/ul

fresh whole blood	5 units	1750 ml
random platelets	5 units	250 ml
apheresis platelets	1 unit	200 ml

- **Decreased cost of management**

  except for the cost of bag, other expenses remain same

"Fresh blood" – a misconception

- **Immunological complication due to WBCs in fresh blood**
  - TA-GvHD – 90% fatality
  - TA-immunomodulation
  - alloimmunization
- **Logistics**
  - no time for component preparation
  - less time for infection screening
  - increased chances of error

Compatibility

The clinician should;

1. complete all required details on the blood request form
2. accurately label blood sample tubes
3. check the identity of the patient, the product and the documentation at the patient's bedside before transfusion.

Warming Blood

- No evidence that warming blood is beneficial to the patient when infusion is slow

ESTIMATED RESIDUAL RISKS OF SOME TRANSFUSION-TRANSMISSIBLE VIRUSES

Virus	Recent Risk Estimate Ranges
• HIV-	1/1,467,000 units
• HCV-	1/1,149,000 units
• HBV -	1/280,000 – 1/357,000 units
• HTLV-	1/1,208,000 units

TRANSFUSION PRACTICE

- Correct blood component processing
- Correct sample taking and labeling
- Correct crossmatch technique
- Correct blood component label
- Correct patient identification

Cont.…

- Check if bags are in good condition •
  - No leakage
  - No fibrin clot
- Record vital sign at before, start, 15 min after, 1 hr after, and 4 hr after transfusion

Key Points for rational Use of Blood

1. No place for Whole Blood in clinical medicine
2. Discourage single unit / fresh blood
3. Component preparation and use is the demand of time
4. Promotion of judicious use of blood / components
5. Promote autologous use of blood

Appropriate Use of Blood Component

Responsibility where services are outsourced

- **Many health service organizations receive blood from an outsourced pathology**
- **It remains the health service organization's responsibility to demonstrate compliance with the Standard**

You use blood provided by a contracted pathology provider

Have a contract that includes standards and reporting

Review reports and seek implementation of strategies to rectify problems

Red Blood Cells

- Whole blood is collected in bags containing citrate-phosphate-dextrose-adenine (CPDA) solution. The citrate chelates the calcium present in blood and prevents coagulation. The PRBCs are then prepared by centiugation of the whole blood.
- CPDA blood has a Hct of 70-75% and contains 50-70 mL of residual plasma for a total volume of 250-275 mL and a shelf live of 35 days.

Additive Solution

- With the additive solution preparation the original preservative and most of the plasma is removed and replaced with 100 mL of Additive Solution.
- Lower Hct, 60%
- Less citrate per unit
- 75-80% fewer microaggregates
- Longer shelf life, 42 days
- Blood is able to regenerate 2,3-DPG more rapidly.

RBC Preparations

- Saline-washed RBCs may be used for patients that experience reactions to foreign proteins.
- White cells can be removed by washing, irradiation, or leukofiltration.
  - Irradiation is the only way to prevent GVHD post transplant
  - Leukoreduction makes PRBCs CMV safe
- One unit of RBCs will increase the Hb and Hct of a 70-kg adult by approximately 1g/dL and 3% respectively.

American Society of Anes- thesiologists (ASA) Task Force Guidelines

- RBCs should usually be administered when the hemoglobin concentration is low (for example less than 6 g/dL in a young otherwise healthy patient) and the blood loss is acute, and transfusion is usually unnecessary when the hemoglobin is greater than 10 g/dL
- The determination of whether intermediate levels of hemoglobin (between 6-10) justify or require RBCs should be based on any ongoing indication of organ ischemia, potential or ongoing bleeding, patient's intravascular volume status and the patient's risk factor for complications of inadequate oxygenation

Fresh Frozen Plasma

- Plasma is separated from the RBC component of whole blood by centrifugation.
- One unit has a volume of 200-250 mL and contains all the plasma proteins, particularly factors V and VIII. It also contains the preservative added at the time of collection.
- FFP is frozen promptly to preserve two labile clotting factors (V and VIII) and thawed only immediately prior to administration.
- FFP must be ABO compatible but Rh+ plasma can be given to Rh- recipients, but should be avoided in young females because of the possibility of alloimmunization to the Rh antigen.

Cont.....

- For correction of microvascular bleeding secondary to coagulation factor deficiency in patients transfused with more than one blood volume and when PT and aPTT cannot be obtained in a timely fashion.
- FFP should be given in doses calculated to achieve a minimum of 30% of plasma factor concentration. (usually achieved with 10-15mL/kg of FFP)
- FFP is contraindicated for augmentation of plasma volume or albumin concentration
- For cases of antithrombin III deficiency
- Treatment of immunodeficiencies
- Treatment of thrombotic thrombocytopenia purpura

ASA Task Force Recommendations

- Prophylactic platelet transfusion is ineffective and rarely indicated when thrombocytopenia is due to increased platelet destruction (e.g. ITP)
- Prophylactic platelet transfusion is rarely indicated in surgical patients with thrombocytopenia due to decreased platelet production when the platelet count is >100,000 and is usually indicated if the count is <50,000.

ASA= American Sociological Association

ASA Task Force Recommendations

- Vaginal deliveries or operative procedures ordinarily associated with insignificant blood loss may be undertaken in patients with platelet counts less than 50,000.
- Platelet transfusion may be indicated despite an apparently adequate platelet count if there is known platelet dysfunction and microvascular bleeding.

Cryoprecipitate

- Cryoprecipitate is the precipitate that remains when the FFP is thawed slowly at 4° C. It is a concentrated source of factor VIII, factor XIII, vWF, and fibrinogen.
- One unit of cryoprecipitate (which is the yield from one unit of FFP) contains sufficient fibrinogen to increase fibrinogen level 5 to 7 mg/dL. It usually comes in containers with 10 to 20 units.

Cryoprecipitate

- ABO compatibility is not essential because of the limited antibody content of the associated plasma vehicle (10 to 20 mL)
- Viruses can be transmitted with cryoprecipitate.
- It is stored at -20°C and thawed immediately prior to use.
- Cryoprecipitate is used in the treatment of factor VIII deficiency, hemophilia A and fibrinogen deficiencies.

Management of blood and blood products

- Blood must be stored and handled appropriately to prevent risk to patients.
- Systems should be implemented to reduce risks associated with receipt, storage, collection, and transport
- Wastage of blood should be minimized

CONCLUSION

- The use of blood and blood products should form part of the many available medical or surgical interventions for the patient
- The scarcity of these make their usage a matter of serious consideration, bearing the side effects in mind
- It is imperative that the appropriate product is used for the appropriate indication.

THANK YOU