

## Blood Bank and Transfusion Services

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## Blood Banking and Transfusion Services

### • Introduction

- People have always been fascinated by blood:
  - Ancient Egyptians bathed in it, aristocrats drank it, authors and playwrights used it as themes, and modern humanity transfuses it.
- The road to an efficient, safe, and uncomplicated transfusion technique has been rather difficult
  - But great progress has been made.

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## Historical Perspective

- In 1492, blood was taken from three young men and given to the stricken Pope Innocent VII in the hope of curing him;
  - Unfortunately, all four died.
  - Although the outcome of this event was unsatisfactory, it is the first time a blood transfusion was recorded in history.
- The path to successful transfusions that is so familiar today is marred by many reported failures,

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## Historical Perspective

- But our physical, spiritual, and emotional fascination with blood is ancient.
- Why did success elude experimenters for so long?
  - Clotting was the principal obstacle to overcome.
  - Attempts to find a nontoxic anticoagulant began in 1869, when Braxton Hicks recommended sodium phosphate.
  - This was perhaps the first example of blood preservation research.
- Karl Landsteiner in 1901 discovered the ABO blood groups
- He explained the serious reactions that occur in humans as a result of incompatible transfusions.
- His work early in the 20th century won a Nobel Prize.

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## Historical Perspective

- Next came devices designed for performing the transfusions.
- Edward E. Lindemann was the first to succeed.
  - He carried out vein-to-vein transfusion of blood by using multiple syringes and a special cannula for puncturing the vein through the skin.
  - However, this time-consuming, complicated procedure required many skilled assistants.
    - To overcome, Unger designed his syringe-valve apparatus
    - This made transfusions from donor to patient by an unassisted physician became practical.

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## Historical Perspective

- In 1914, Hustin reported the use of sodium citrate as an anticoagulant solution for transfusions.
- Later, in 1915, Lewisohn determined the minimum amount of citrate needed for anticoagulation
  - He demonstrated its nontoxicity in small amounts.
  - Transfusions became more practical and safer for the patient.

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## Historical Perspective

- The development of preservative solutions to enhance the metabolism of the RBC followed.
- World War II stimulated blood preservation research
  - This was because the demand for blood and plasma increased.
  - Dr. Charles Drew during World War II developed techniques in blood transfusion and blood preservation
- This development led to the establishment of a widespread system of blood banks.

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## Historical Perspective

- The daily occurrence of transfusions led to the discovery of numerous blood group systems.
- Sophisticated techniques were developed for Antibody identification
- Frequent transfusions and the massive use of blood soon resulted in new problems, such as circulatory overload.
- Component therapy has solved these problems.
  - Before, a single unit of whole blood could serve only one patient.
  - With component therapy, one unit may be used for multiple transfusions.

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## Historical Perspective

- Now, a specific component for patient's particular needs can be used
  - This will prevent the inherent hazards of whole blood transfusions.
  - Physicians can transfuse only the required fraction in the concentrated form, without overloading the circulation.
- Appropriate blood component therapy now provides more effective treatment and more complete use of blood products

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## Historical Perspective

- Fantus was the first to coin the phrase "blood bank" for the operation
  - Because blood could be stored and saved for future use.
- Many developments in blood transfusion technology took place during World War II
- Another advance in transfusion was development of the first cell separator in 1951 by Edwin Cohn;
  - The cell separator allowed blood to be separated into red cells, white cells, platelets, and plasma.
  - In principle it was possible to harvest any particular component of the blood,
    - In practice, satisfactory yields of only red cells or plasma could be obtained.

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## Blood Banking in India

- History of voluntary blood donation in India started in 1942 during the second world war
  - Blood was required to treat wounded soldiers
- First blood bank was started in Kolkata, West Bengal at the All India Institute of Hygiene and Public Health in 1942
  - The donors were mostly from Govt. employee
- This bill

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FIRST BLOOD BANK IN INDIA

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## Modern Era

- Transfusion medicine continues to evolve in the modern era.
- New, problematic infectious agents emerge, such as West Nile virus,
  - This is usually transmitted to humans by mosquitoes.
  - West Nile virus was first reported to be transmitted by transfusion and organ transplantation in 2002.

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## Modern Era

- Detection and prevention of transfusion-transmitted viral infections has improved
  - But bacterial contamination has evolved into one of the most significant causes of transfusion-transmitted infectious disease.
- Bacterial detection systems are being used on platelet components with some success.
- New methodologies designed to inactivate bacteria have been developed
  - This is under evaluation.

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## National Blood Policy

### Mission Statement

- To ensure adequate safe and quality blood / blood products
- Collection only from non-remunerative blood donors
- Collection only at well equipped places
- To be free from transfusion transmitted infections

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## National Blood Policy

- Transfusion under supervision of trained personnel
- Storage and transportation under optimum condition
- Blood to be made available to all who need it irrespective of social and economic status
- Efficient and total quality management aspects to be ensured

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## Objectives of the policy

- ▶ To reiterate firmly the Govt. commitment to provide safe and adequate quantity of blood, blood components and blood products
- ▶ To make available adequate resources to develop and reorganize the blood transfusion services in the country
- ▶ To make latest technology available for operating the blood transfusion services and ensure its functioning in an updated manner

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## Objectives of the policy

- To launch extensive awareness programmes for
  - donor information,
  - education,
  - motivation,
  - recruitment and retention in order to ensure adequate availability of safe blood
- To encourage appropriate clinical use of blood and blood products

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## Objectives of the policy

- To strengthen the manpower through human resource development
- To ensure Research & Development in the field of transfusion medicine and related technology
- To make adequate regulatory and legislative steps
  - This is required for monitoring and evaluation of blood transfusion services, and
  - To take steps to eliminate profiteering in blood banks

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## Strategy

- ▶ Blood transfusion services to be non-profit oriented
- ▶ National Blood Transfusion Council (NBTC) will be policy formulating body
- ▶ NACO to allocate budget to NBTC
- ▶ Implementation by state/UT Blood Transfusion Councils (SBTC)
- ▶ Enforcement of standards by Drugs Controller General of India under Drugs and Cosmetics Act
- ▶ Trading in blood is prohibited

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## Strategy

- ▶ Practice of replacement donors to be phased out
- ▶ Cent percent voluntary non-remunerative blood donation in a time-bound programme
- ▶ National guidelines on Clinical Use of Blood to be made
- ▶ Hospital Transfusion Committee to be established to monitor clinical use of blood
- ▶ For new licenses including blood bank plan, all applications by a committee to be scrutinized as per guidelines provided by Drugs Controller General of India

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## Strategy

- ▶ Fresh license to stand alone banks in private sector shall not be granted.
  - Renewal will be subject to thorough scrutiny
- ▶ Separate blood bank cell under a senior officer to be created at the HQ
- ▶ Similar committee also in state Drugs Control Department for proper inspection and enforcement
- ▶ Nursing homes to be registered for affiliation with a licensed blood bank for procurement of blood for their patients

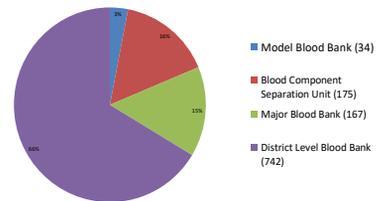
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## Blood Bank

- ▶ Many clinical conditions need blood transfusion
- ▶ In hospitals where need of blood is high, has to set up a blood bank.
- ▶ The basic functions of the bank include:
  - Collection from donors
  - Processing
  - Storage under optimal condition and
  - Issue to the recipient

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Blood Banks in India 2012-13



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## Blood Transfusion

- ▶ Meticulous attention required
- ▶ Errors of identification to be avoided
- ▶ Collection tubes to be labeled only after blood has been put into it.
  - ▶ No prior labeling
- ▶ 50% fatalities due to "clerical" errors

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## Steps for selection of Blood Donors

- ▶ ABO and Rh group of patient are determined
- ▶ Patient's serum screened for atypical antibodies
- ▶ Donor blood of same ABO and RH group is selected
- ▶ Patient's serum is crossed matched against donors red cells

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## Donor Selection

- ▶ Donor's age between 18 and 60 years
- ▶ Weight above 45 kg
- ▶ Haemoglobin above 12.5 grammes %
- ▶ Have not suffered recently from certain communicable diseases
- ▶ Should not be on certain drugs
- ▶ Five mandatory tests should be negative:
  - HBV, HCV, HIV, Syphilis, Malaria
- ▶ Can donate not more than once in three months

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## Blood and Blood Components

- ▶ Whole blood
- ▶ Red-cell concentrate
- ▶ RBC in optimal additive solution
- ▶ Leucocyte poor red-cell concentrate
- ▶ Washed red-cell concentrate
- ▶ Platelet concentrate
- ▶ Fresh Frozen Plasma
- ▶ Cryoprecipitate
- ▶ Factor VIII & IX conc.
- ▶ Albumin
  - Plasma Protein Fraction
  - Salt-poor albumin
- ▶ Normal immunoglobulins
- ▶ Specific immunoglobulins

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## Factors Influencing Planning

- ▶ Level of blood donation
- ▶ Average need of blood per bed
  - Based on size of the hospital
    - Highest level : 6 Litres per bed
    - Large General Hospital : 5 Litres per bed
    - Smaller Hospitals : 4 Litres per bed

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## Blood Donation

- Blood donation is critical to all of transfusion therapy
  - It provides the starting product
  - Donated whole blood is made into transfusable components
  - These include:
    - Packed red blood cells, platelet and frozen plasma or cryoprecipitate
  - Other lesser utilised blood components are granulocytes and cryoprecipitate-depleted plasma
  - Individual plasma protein, such as factor VIII have been manufactured using recombinant methods

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## Blood Donation

- Blood donation can be divided into five processes:
  - Recruitment
  - Screening
  - Physical examination
  - Collection, and
  - Post-donation care

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## Blood Donation

- Recruitment of blood donors is a specialised task
- In advanced countries such as USA, it is often performed by telerecruiters
  - The message delivered must be convincing
- In India, message is sent through social, political and educational organisations
- Once a donor has been recruited, the screening process is carried out

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## Blood Donation

- **Screening is done to ensure**
  - That the donation process should be safe for the donor, and
  - The collected blood will be safe for the recipient
- **Donor recruitment**
  - Maintaining an adequate blood supply is an ongoing challenge
  - It is often difficult for blood banks to keep pace with the increasing demand for blood
  - It is unacceptable to provide volunteer blood donors with monetary compensation

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## Blood Donation

- **Sources of Donor Motivation**
  - The most successful approach to recruitment of volunteer blood donors has been an appeal to community responsibility.
  - Individuals often first learn about the need for donation during blood shortages
    - via public service announcements and
    - appeals for blood from newspapers, radio, and television.
  - Other donors become aware of the importance of blood donation when transfusions are needed for family and friends (or themselves).

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## Blood Donation

- Appeals after disasters tend to bring out community spirit due to the motivation of the entire community to contribute to their fellow being
- Donating blood for a friend or relative (directed donation) has proven to be an excellent motivator and
  - This has brought many first-time blood donors into the system.
- Donating for one's own use (autologous donation) has also been an effective motivator.

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## Blood Donation

- **Factors of Success**
  - Donor's internal motivation will only provide a finite amount of impetus for continued participation in the blood donation process
  - The entire blood collection team should make the donation process as pleasant as possible
    - If they are successful, a hesitant first-time donor may be converted into a regular repeat blood donor
  - Regular repeat blood donors are more reliable and have less risk of infectious disease

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## Blood Donation

- **Paid Donors**
  - It is totally banned in India
  - In USA, allowed in licensed centres producing plasma products
    - Otherwise, No monetary compensation is permissible
    - Pooled plasma during the manufacturing process gets "sterilized"
  - These donors are often motivated by a lack of funds to maintain drug or alcohol habits
    - They have a higher incidence of transfusion transmissible diseases, particularly, hepatitis
  - In some states in USA, due to shortage of single donor platelet by apheresis, it was permitted for some period of time
    - These centres maintain a very strict screening procedure

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## Blood Donation – Examples of Donor Incentives (USA)

Items considered "Paid" incentives	Items that may qualify as "Non-payment"
Cash payment or cash equivalent	Token or prizes of nominal value (e.g. coffee cups, pins, Employee paid time-off)
Tickets to concerts or sporting events where market for resale exists	Raffle tickets, regardless of value of prize which should not be convertible to cash
Music media not associated with product promotions where market for resale exists	Membership in blood assurance programme
Transferable product discounts or coupons convertible to cash	Medical tests performed at the time of donation
Vouchers for free medical tests	Scholarship transferred directly to academic institution
Scholarships paid directly to students	Gift cards and gift certificates that are non-transferable, and not redeemable for cash, and bears the donor's name

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## Blood Donation – Donor Consent

- **Donor Consent and Additional Information**
  - It is necessary to obtain informed consent prior to donation.
- To help ensure that the prospective donor is properly informed,
  - educational material about the donation process is distributed,
  - This should include information about screening, phlebotomy, and potential donation-related complications.

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## Blood Donation – Donor Consent

- The goal of this material is for the donor to understand the reasons for self-deferral, and
  - the importance of self-deferral when appropriate.
- The notification process for positive serologic tests may be explained as well as donor confidentiality issues.
- This reading material should be in language simple enough that every donor can comprehend it.

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## Blood Donation – Collection

### • **Pre-venipuncture Procedures**

- The collection process begins with accurate identification of the blood donor.
- This is especially important in large centers where screening and phlebotomy are done in separate areas and by different staff.
- A unique identification number is placed on the collection bags, paperwork, and
- The pilot tubes collected for serologic testing.

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## Blood Donation – Collection

- The maximum liquid storage time for any RBC unit is currently 42 days.
- The number of bags in the collection set depends on intentions for further manufacture:
  - whole blood, packed cells and plasma, or
  - packed cells, plasma, and platelets.
- Multiple small bags can be attached if the blood is designated for pediatric transfusion.

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## Blood Donation – Collection

- It is possible, through a sterile docking device, to add additional bags to a set.
- It is also possible to manually adjust the amount of anticoagulant in a collection bag for an underweight donor,
  - This requires significant time and expertise and is not done in most centers.
- The collection bag is often placed on a trip-scale, which impedes further blood flow once the desired amount has been drawn.

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## Blood Donation – Collection

### • **Apheresis Platelet Collections**

- Plateletpheresis is a sophisticated technology
- By this process blood is processed by an apheresis machine that uses centrifugation to remove a selected component of the blood
  - Rest is returned to the donor.
- The most common use of this technology is for collection
  - of apheresis platelets.
- Platelet donors are usually recruited from the ranks of whole blood donors.
- The minimum platelet count required to donate apheresis platelets is 150,000/ $\mu$ L.

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### Blood Donation – Adverse Donor Reaction and Injuries

- The vasovagal reaction is the most common systemic donor reaction,
  - This occurs in 2% to 3% of donors.
- These reactions often present as loss of consciousness due to a drop in blood pressure without a normal compensatory increase in heart rate.
- Vasovagal reactions are 5 to 10 times more frequent in younger donors (8% to 11%)

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### Blood Donation – Adverse Donor Reaction and Injuries

- This makes careful observation especially important at high school and college blood drives.
- Other predisposing factors include:
  - first-time donor status,
  - low weight, and
  - a history of a previous donation reaction.
- An anxiety-related psychosomatic component appears to be present because vasovagal reactions have occurred before donation and epidemic fainting is known to occur.

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### Blood Donation – Adverse Donor Reaction and Injuries

- The sudden drop in blood pressure caused by a vasovagal reaction may evoke an ischemic event in donors
  - This can happen with occlusive atherosclerotic vascular disease
- These reactions tend to be rare, likely due to successful donor screening techniques.
- The risk, of course, is higher for individuals with pre-existing disease

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### Blood Donation – Adverse Donor Reaction and Injuries

- Minor local tissue injury at the venipuncture site is a well-known complication of any venipuncture.
- Postphlebotomy bruising is the most common adverse donor event.
  - Hematomas occur less commonly
  - These hematomas generally resolve within 2 weeks.
- A common adverse effect of apheresis donation is hypocalcemia,
  - This is due to the calcium-binding citrate anticoagulant used to keep blood from clotting in the apheresis machine tubing.

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