

Division of Blood Transfusion Services

Ministry of Health and Family Welfare



Storage and Transportation of Blood and its components

Teaching Aims

- You will learn about the different methods for storage of blood and the transportation of blood and its products.
- You will learn about the different types of refrigeration and the maintenance of the temperature inside the blood bank .

Introduction

- The collection of blood from donors may take place within the blood transfusion centre or hospital blood bank.
- It is also often collected from donors during mobile blood collection sessions.
- The blood is then taken to a laboratory for testing and processing into components and for storage and distribution as the need arises.
- Blood is collected at body temperature, i.e. $+37^{\circ}\text{C}$. But in order to maintain its vital properties, it must be cooled to below $+10^{\circ}\text{C}$ to be transported, and stored at refrigeration temperatures of around $+4^{\circ}\text{C}$ until use.

What is blood cold chain

- The term, blood cold chain, which begins the moment the blood is collected and continues until it is transfused.
- The blood cold chain is a series of interconnected activities involving equipment, personnel and processes that are critical for the safe storage and transportation of blood from collection to transfusion.

Harmful effects of Improper Storage.

- If blood is stored or transported outside of these temperatures for long, it loses its ability to transport oxygen or carbon dioxide to and from tissues respectively upon transfusion.
- Other factors of serious concern are the risk of bacterial contamination if blood is exposed to warm temperatures.
- Conversely, blood exposed to temperatures below freezing may get hemolysed and can lead to a fatal transfusion reaction.

Safe storage of blood

A. Whole blood :

- Whole blood and red cells must always be stored at a temperature between +2 °C and +6 °C.
- If blood is not stored at between +2 °C and +6 °C, its oxygen-carrying ability is greatly reduced.
- The anticoagulant/preservative solution in the blood bag contains nutrients for the blood during storage and stops the blood from clotting.
- The red cells can carry and deliver oxygen only if they remain viable.

Storage and Transport of Whole Blood and Red Cells

Condition	Temperature range	Storage Time
Transport of pre-processed blood	+20 °C to +24 °C	Less than 6 hours
Storage of pre-processed or processed blood	+2 °C to +6 °C	Approx. 35 days
Transport of processed blood	+2 °C to +10 °C	Less than 24 hours

B. Fresh frozen plasma

- Fresh frozen plasma (FFP) is plasma which is separated from a unit of whole blood within 6 hours of collection, and has been rapidly frozen and maintained at all times at a temperature of minus -30°C or lower.
- FFP, once thawed has a shelf life of 24 hours at 1°C to 6°C .
- Plasma contains water, electrolytes, clotting factors and other proteins (mostly albumin), most of which are stable at refrigerator temperature, i.e. $+2^{\circ}\text{C}$ to $+6^{\circ}\text{C}$.

Permitted Storage Time According To Temperature Used To Store FFP and Cryoprecipitate

Product	Storage temperature	Maximum storage time
FFP	–30 °C or below	1 year
Cryoprecipitate	–30 °C or below	1 year

C. Platelet concentrates

- Platelet-rich plasma (PRP)/ Platelet concentrate (PC) must be separated from whole blood by centrifugation within 6 hours of collection.
- whole blood should be kept at between +20 °C and +24 °C until it is processed into platelet concentrates and other blood components.
- Platelet concentrates should be stored at a temperature of between +20 °C and +24 °C i.e 22 ± 2 °C with continuous gentle agitation. This is essential to prevent platelet aggregation which results in loss of viability.

Length of Time Permitted For The Storage And Transportation of Platelet Concentrates Within The Temperature Range +20 °C To +24 °C

Process	Maximum Storage Time
Storage	Upto 5 days
After issue, before transfusion	30 minutes
Open system and/or pooled platelet prepared in open system.	4 hours
Pooled platelets prepared in closed system.	5 days.

D. Plasma derivatives

- Unlike blood components, plasma derivatives such as albumin or immunoglobulin are concentrated, sterile specific proteins, obtained from large pools of donor plasma through a complex pharmaceutical process called plasma fractionation
- It is essential to store all plasma derivatives according to the manufacturer's instructions

Cold chain samples and reagents

- The storage and transportation of reagents or blood samples is as critical as that for blood.
- Manufacturers of laboratory reagents recommend methods for their safe storage and transportation.
- The recommendations in the package inserts must be followed to avoid deterioration of the reagents and subsequent poor performance in use.

Cold chain samples and reagents (contd...)

- Testing of the blood samples should be carried out rapidly after collection. The longer that testing is delayed, the poorer the results.
- The method of collection, storage and transportation of blood samples will depend on the type of laboratory test to be carried out.

Packing and transportation of blood and blood components

- All blood and blood components must be transported maintaining the correct temperature ranges.
- Red blood cell components must be kept at a temperature of +2 °C to +10 °C during transportation.

Packing and transportation of blood and blood components (contd...)

- All components routinely stored at +20 °C to +24 °C should be kept at these temperatures during shipment.
- All frozen components should be transported as per the Standard Operating Procedures.(SOPs)
- The transit time for blood and blood components should not normally exceed 24 hours.

Transportation Of Whole Blood From The Collection Site To The Laboratory

- Blood and blood components collected at donor sessions should be transported to the blood centre in appropriate conditions of temperature, security and hygiene in accordance with standard operating procedures. Validated Blood Transport boxes should be used for transportation.
- After collection, blood should be cooled to between +2 °C and +10 °C (except when PC/PRP is to be prepared).
- Blood units should be transported from the collection site to the component preparation laboratory as soon as possible, but elapsed time between their collection and centrifugation for component preparation should not exceed 6 hours.

Transportation Of Whole Blood From The Collection Site To The Laboratory (contd...)

- Depending on the distance special gel pouches are can be used to store the blood units intended for the preparation of platelet concentrates at between $+20^{\circ}\text{C}$ and $+24^{\circ}\text{C}$ during transportation.
- If special gel pouches are not available, the blood packs should be transported as quickly as possible at a temperature of $+2^{\circ}\text{C}$ to $+10^{\circ}\text{C}$, but cannot then be used for the preparation of platelet concentrates.

Transportation Of Blood Components From One Blood Bank To Another

A. Whole blood and packed red cells :

- The temperature of whole blood and red cell components must be kept at $+2^{\circ}\text{C}$ to $+10^{\circ}\text{C}$ during transport.
- Specially designed blood transport boxes should be used.
- If these are not available, sturdy, well-insulated containers may be used after evaluated and validated to ensure that they can reliably maintain temperatures at $+2^{\circ}\text{C}$ to $+10^{\circ}\text{C}$ for the planned journey, using appropriate coolants or ice packs.

Transportation of Blood

Blood Transport Box



Gel Ice Packs



B. Frozen plasma and cryoprecipitate

- During transport, frozen components must be maintained at or below the required storage temperature.
- This can be achieved with a suitable quantity of wet ice or dry ice (dry ice temperature = minus 78.5⁰ Celcius) in well-insulated containers or standard shipping cartons lined with insulating material such as plastic air bubble packaging or dry packaging fragments.

C. Platelet concentrates

- Every effort must be made to ensure that platelets are maintained at temperatures between +20 °C and +24 °C during shipment.
- A well insulated container without added ice is often sufficient.

Issuing Blood Components To Clinical Areas

- When blood is issued from the blood bank, the time of issue must always be recorded.
- Blood should be issued in a cold box or insulated carrier which will keep the temperature under +10 °C.
- Only one unit of red cells should be removed from the blood bank refrigerator at a time unless the rapid transfusion of large quantities of blood is required.

Issuing Blood Components To Clinical Areas (contd...)

- Platelet concentrates should be issued from the blood bank in a carrier that will keep the temperature at between +20 °C and +24 °C.
- Platelets should be transfused as soon as possible. If unused, they should never be placed in a refrigerator, but returned immediately to the blood bank.
- FFP and cryoprecipitate are thawed at between +30 °C and +37 °C in the blood bank before issue and transported to the ward at ambient temperature. They must be used immediately and should never be refrozen.

The hospital ward refrigerator

- The blood bank personnel are responsible for the issue of blood to the respective hospital ward on the understanding that the blood will be transfused within 30 minutes.
- The refrigerator must maintain a temperature of between $+2^{\circ}\text{C}$ and $+6^{\circ}\text{C}$ and be fitted with an appropriate temperature alarm.
- Blood bank staff should have access to the refrigerator for the purposes of monitoring the temperature and retrieving unused blood.

The hospital ward refrigerator – (contd...)

- Ward staff must be trained in the procedures for use of the hospital ward blood refrigerator or freezer.
- A general notice like, the refrigerator should only be used for the storage of blood components, and no other consumables of the ward, even for brief periods.

THE BLOOD UNIT MUST BE DISCARDED IF:

- It has been out of the refrigerator for longer than 30 minutes,
- OR — if the seal is broken,
- OR — there is any sign that the pack has been opened,
- OR — there is any sign of haemolysis,

Summary

- Whole blood and packed red cells must always be stored at +2 °C to +6 °C and transported between +2 °C and +10 °C.
- Blood components and plasma derivatives should never be stored in unmonitored equipment.
- Red cells, platelets or whole blood must never be allowed to freeze.
- The optimal storage temperature for conditions for fresh frozen plasma and cryoprecipitate is –30 °C, and they must always be frozen solid.

Summary

- Platelets must be stored at +20 °C to +24 °C with constant agitation and transported at temperatures within this range.
- During transportation, frozen components must be maintained at a temperature that ensures they will remain frozen.
- It is important to use a temperature monitor during transportation in order to check temperature ranges on receipt of the shipment.
- To assist the maintenance of temperatures for blood components, it is often useful for hospital wards to possess a refrigerator for short-term storage of issued blood from the blood bank.

Learning Outcome

- You learned about the different methods for storage of blood and the transportation of blood and its products.
- Enabled knowledge on different types of refrigeration and the maintenance of the temperature inside the blood bank .