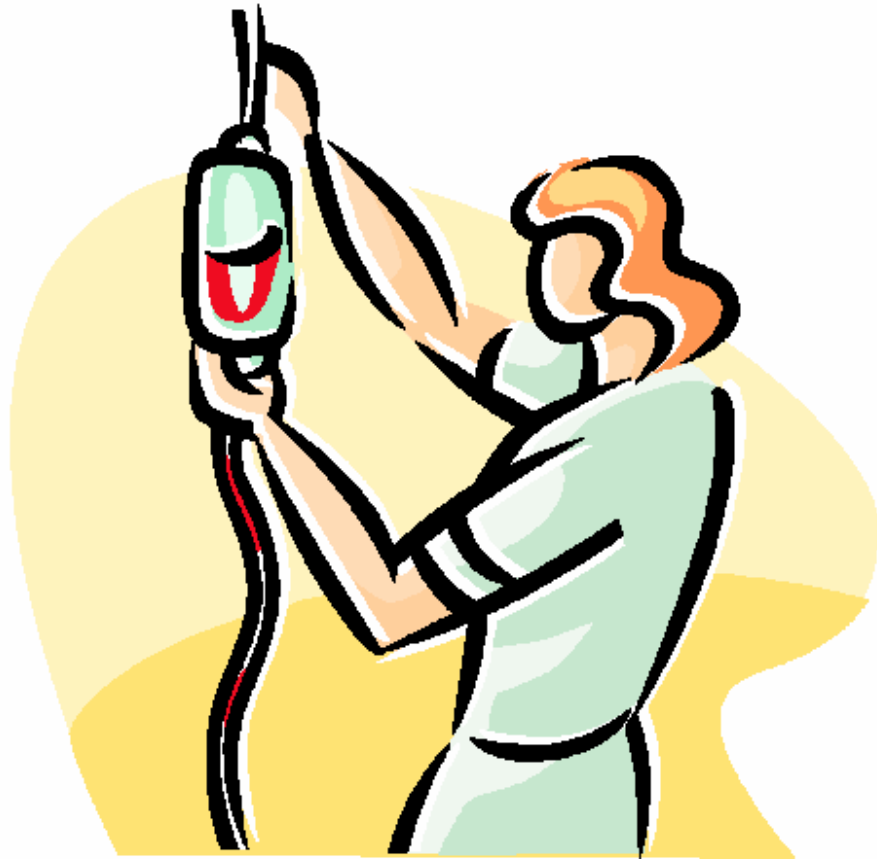




Rochester and Elmore District Health Service



Blood Transfusion Self Learning Pack

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13/11/2006

Pathway to Safe Transfusion Practice

1 Aim

- To ensure Registered Nurses Division 1 have an appropriate understanding and knowledge of safe transfusion practice.
- That all RN's transfusing blood, do so in accordance with REDHS Policy and Procedure

2 Learning Objectives

On completion of the package, the RN will be able to: -

- Safely transfuse Red Blood Cells and have an understanding of transfusion of FFP, platelets and cryoprecipitate.
- Provide basic patient education regarding blood transfusion
- Describe appropriate storage conditions for RBCs.
- Understand compatibilities for RBCs.
- Demonstrate correct paperwork required for ordering and receiving of blood for transfusion.
- Understand the correct paperwork for administration of a Red Blood Cell transfusion.
- Describe all checks for collection of blood for transfusion and for administration of RBCs.
- Be alert for acute and delayed transfusion reactions which may occur and describe the appropriate management.
- Describe the return process for used blood bags.

3 Introduction

Donated blood is a valuable commodity which must be managed correctly prior to transfusion to ensure safety for the recipient.



The Australian national regulating bodies are :-

- 1 The Australian Red Cross Blood Service (ARCBS)
- 2 National Health and Medical Research Council (NHMRC)

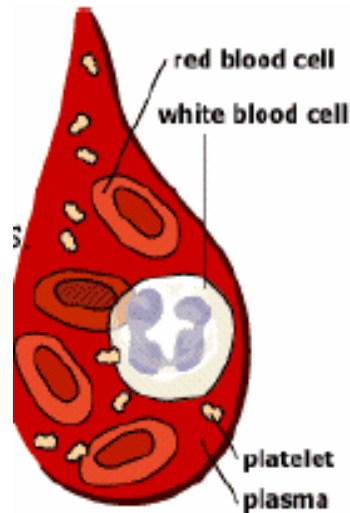
The State body is Better Safer Transfusion Practice (BeST)

Careful donor selection and available laboratory tests do NOT eliminate all potential hazards of blood transfusion. The risk of transmitting infectious agents is present, including bacteria, parasites, viruses, and the agent of variant Creutzfeldt-Jacob disease.

In addition, blood components may contain immunizing antigens. For example, a unit of platelets also contains some red blood cells and white blood cells, both of which carry antigens on their surface.

Transfusion reactions from incompatible blood components are rare but are life threatening.

4 Blood Components



Whole blood is rarely transfused; rather the 470ml or so of blood collected from each donor is usually spun down into the specific blood components, each having specific clinical indications, known benefits and potential adverse reactions.

4.1 Red Cells

The red cell component obtained by removing most of the plasma after centrifuging whole blood.

Storage:

42 days at 2-6°C only in approved Blood refrigerators. **Never in the ward refrigerators**

Indications for Use

For treatment of clinically significant anemia with symptomatic deficit of oxygen carrying capacity, and for replacement of traumatic or surgical blood loss.

In deciding whether to transfuse red blood cells, patient factors, signs and symptoms of hypoxia, ongoing blood loss, the risk to the patient of anaemia and the risk of transfusion should be considered.

The risk/benefit profile of not transfusing any product should also be considered.

Modifications

Buffy Coat Poor, Leuco-depleted, Irradiated, CMV antibody negative, Phenotyped, Washed Autologous.

Irradiated red cells

Units of red cell do contain some viable lymphocytes. Irradiation destroys T-Lymphocytes, which are responsible for TA-GVHD.

Red cells can be irradiated up to 14 days after collection and must then be used within the next 14 days.

Caution with the rate of the transfusion and the volume given are required as irradiated cells alter the movement of potassium across cell membranes

4.2 Platelets - Pooled

An adult dose of platelets obtained from a pool of buffy coats from ABO - identical donors and resuspended in a nutrient additive solution. A pool generally consists of 4 individual platelet units derived from whole blood donations.

Storage

5 days at 20- 24° C. Platelets must be agitated gently and continuously on a platelet shaker during storage in a single layer.

Indications for Use

Surgery/Invasive procedures

- To maintain platelet count $>50 \times 10^9/L$
- Ocular/Neuro surgery- where high risk of bleeding, to maintain platelet count $>100 \times 10^9/L$

Platelet Function Disorders:

- Inherited /acquired disorders
- Platelet count is not a reliable indicator.

4.3 Fresh Frozen Plasma

Fresh Frozen Plasma (FFP) is separated and frozen within eighteen hours after collection of whole blood. A unit of FFP contains all coagulation factors including approximately 200 units of factor VIII plus the other labile plasma coagulation factors & Factor V.

Indications for Use

Indicated for patients with a **coagulopathy** who are bleeding or at risk of bleeding where specific therapy eg. Vitamin K or factor concentrate is not appropriate or available

In **massive transfusion, cardiac surgery, liver disease** or **acute DIC** to replace labile coagulation factors

Warfarin overdose

TTP

Disseminated intravascular coagulation: is where there is ongoing micro-thrombosis in vessels and ongoing consumption of coagulation factors which paradoxically leads to bleeding.

Storage

12 months at -25°C or below

4.4 Cryoprecipitate

Cryoprecipitate is prepared by controlled thawing of Fresh Frozen Plasma (FFP) between 1°C and 6°C and recovering the precipitate.

The cold-insoluble precipitate is refrozen, within the hour. The component contains most of the factor VIII, factor XIII, VWF and fibronectin from the FFP.

Indications for Use

Fibrinogen deficiency (based on laboratory results and clinical condition)

Dysfibrinogenaemia when there is clinical bleeding

Invasive procedures

Trauma or disseminated intravascular coagulation (**DIC**)

Storage

12 months at -25°C or below

5 Collection of blood for cross matching



NB: Patients statement/Patients wristband information/Patients request form and medical records. All information must be in agreement.

- Ask patient to state:-
Surname, first (Christian) name and date of birth.
(Do not ask Yes, no questions such as "Is your Name....?")
- If patient is unable to do so because of conscious state, illness or age, ask relative to do so.
- Check that this information matches the details on the pathology request form and the patient's identification band. (If ID band not present ask patient to spell his name and rectify the situation immediately)
- DO NOT PRE-LABEL BLOOD TUBES. AFTER collecting the sample, hand label the blood tube at the bedside (not a label) and sign the tube and the pathology form. Also complete the date and time of collection. Only sign the Collecting Officers Declaration on the pathology form if YOU collected the sample. (Do not sign on behalf of another person)

SAFETY ESSENTIALS -

**RIGHT PATIENT
RIGHT PRODUCT,
RIGHT SPECIMEN,**

These Safety Essentials are one of the most important areas of this whole Learning Package, Of all the messages in this document, this is the key take home message.

The first step in ensuring the right product gets to the right patient is accurately identifying the patient at the time of sample collection and accurately labeling the sample.

For a red cell blood product to be prepared for a specific patient the patient's ABO blood group needs to be identified their Rh status identified and their blood screened for antibodies and then cross-matched to a donor unit.

The cross-match is an important step for detecting antibodies. For the cross match, the donor's red cells are mixed with the patient's serum, and the result examined.

BLOOD SAMPLE

The sample tubes must be accurately labeled at the patients bedside at the time the blood sample is taken. Information required on the sample tube includes patient's surname, patient's forename, patient's date of birth, patient's hospital number, time sample taken, date sample taken, name of person taking sample and signature of person taking sample.

6 Blood Groups / Antigens / Antibodies

6.1 ABO System

There are many antigens on the surface of RBC.s, but there are two major systems that are significant in terms of potential immunologic reactions: the ABO system and Rh system.

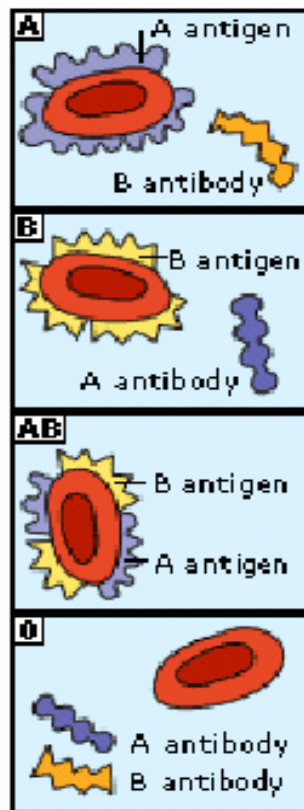
Within the ABO system there are four major blood groups that exist in

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humans: A, B, AB, and O. Each blood group implies a specific antigen presence on the RBC.

ABO Antigens

- Group A Antigen A is present on the red cell
- Group B Antigen B is present on the red cell
- Group AB Both antigens A and B are present on the red cell
- Group O Neither antigen A nor B is present on the red cell



ABO Antibodies

Within the plasma, individuals possess naturally occurring antibodies to the RBC surface antigens that are not present on their own erythrocytes. These antibodies are called isohemagglutinins.

- Group A Anti B antibody is present in the plasma
- Group B Anti A antibody is present in the plasma

Group AB No antibodies present in the plasma.

Group O Anti A and B antibodies are present in the plasma.

These antibodies are capable of cross-reacting with A or B antigens on the surface of the foreign or donor red cells. Therefore mismatched blood cells from a red cell transfusion or a transfusion with some red cells in it [e.g. a contaminated platelet product] will be immediately coated by the isohemagglutinins, causing the agglutination of the introduced cells and the rapid lysis of the cell. The products released by the lysed cells are then dumped into the blood- stream.

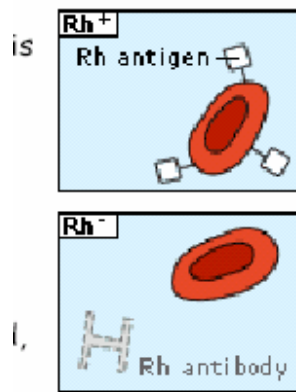
Mismatched non-red cell products such as platelets and plasma may still stimulate an antibody response in the patient. This is far less serious than the antigenic stimulus that one would get with mismatched red cells.

Therefore all fresh blood products should be ABO compatible with the recipient, but in an emergency situation, non-ABO specific products can be used.

6.2 Rh System

The Rh system encompasses at least 40 antigens. The D antigen is the most clinically significant, since it is more immunogenic than any other Rh antigen. When the term Rh positive is used, the presence of antigen Rh D is implied: Rh negative indicates the absence of antigen D. Approximately 85% of the population has Rh positive blood.

When the Rh negative person is first exposed to Rh positive blood, Rh antibodies are formed. On subsequent exposures to Rh positive blood, the Rh antibody binds to its corresponding antigen. The Rh antibodies do not usually fix complement; therefore there is no immediate haemolysis as occurs in the ABO system. Instead, the Rh positive RBCs are rapidly broken down by macrophages in the spleen, with increased conversion of haemoglobin to bilirubin resulting in jaundice.



Rh compatibility is as follows:

Blood Product	Rh considerations
Red Blood Cells	<ul style="list-style-type: none">• All transfusions should be Rh compatible• Rh negative red cells can be given to Rh positive patients• In certain emergencies, especially bleeding emergencies, Rh positive red cells can be given to Rh negative patients.
Platelets	<ul style="list-style-type: none">• Rh negative platelets can be given to Rh positive patients
FFP	May be transfused without regard to Rh type
Cryoprecipitate	May be transfused without regard to Rh type
Plasma Derivatives	May be transfused without regard to Rh type

6.3 Other antigens – the HLA System

The HLA – Human Leukocyte Antigen system, is an identification code, which is unique for every person. The antigens are present on the surfaces of all nucleated human cells and are therefore on blood cells as well. These antigens specify a person's tissue type and form the basis of recognition and self-tolerance. A person's tissue type, is similar in concept to blood type but much more extensive and is determined genetically by the inheritance from his or her parents. As leukocytes move throughout the body they compare the HLAs of any structure they encounter to determine whether the encountered cell belongs in the body's internal environment. If the encountered cell's HLA perfectly matches the body's HLAs, the encountered cell is considered to be self and is not acted on by the leukocyte. If the encountered cell's surface proteins do not match the body's HLAs perfectly, the encountered cell is considered non-self and actions are taken to neutralize, destroy, or eliminate the non-self cells. These antigens then are proteins that play a critical role in protecting the body against invading organisms such as bacteria, viruses and other foreign matter.



7 ADMINISTRATION OF BLOOD PRODUCTS

Two qualified staff members should check all blood products at the bedside. All details on the product, the patient's identification band and the paperwork accompanying the product should match exactly. Any inconsistencies should be checked and rectified before the product is commenced.

All patients receiving fresh blood components must have an identification band attached prior to the product commencing.

Attention to the specific indications for blood components is needed to avoid inappropriate transfusion.

Correctly identifying the patient, both during collection of the pre-transfusion sample and before starting the transfusion, is vital in avoiding wrong blood episodes.

ABO incompatible transfusions are usually due to identification errors.

The **SHOT study** in 2003 indicate the chance of the wrong blood going to the wrong patient to be as high as 67% of recorded adverse incidents of blood transfusion.

SHOT- **Serious Hazards of Transfusions**- a study from the UK that collects and interprets data on blood transfusions.

Pretty sobering thought. So do your bit and ensure all information relating to the transfusion episode match, if you are at all unsure about anything check and recheck. If you cannot resolve the discrepancy return the blood unit to pathology.

Remember **all blood components must commence transfusion within 30 mins of leaving the Blood refrigerator.**

Visit the **SHOT site** to see the latest statistics from the UK

<http://www.shotuk.org/home.htm>

8 Transfusions Reactions

Now this is a really important part of your responsibilities. Once you are sure the right blood is going to the right patient we need to ensure it does no harm or minimal harm. If we have overlooked something the patient is more at risk of a reaction to the Foreign Product.

- Ensure you monitor the patient closely for the first 15 minutes and leave them with a call bell so they can summon you if necessary.
- The patient should be clearly visible in the ward area.
- Explain what signs and symptoms they may experience and that they must call you immediately.
- Ensure baseline observations have been attended and record vital signs at 15 mins and half hourly thereafter for the duration of a red cell transfusion.
- All blood product transfusions must be completed within 4 hours.

All fresh blood products have the potential to cause the following reactions and therefore patients should be monitored closely throughout the infusion by both vital signs observation and visual observation.

The three "R"s of transfusion reactions: -

Recognise, React, Report.

Acute reactions include FNHTR, Anaphylactic reaction, Acute haemolytic reaction, bacterial contamination, Allergic reaction, volume overload, and TRAIL.

Delayed reactions include contamination with infectious agents eg. Hepatitis, HIV, CMV, EBV, Syphilis, malaria, parovirus; Delayed Haemolytic reaction, Iron overload, Transfusion associated graft versus host disease (TA-GVHD), alloimmunization HLA agents.

8.1 Febrile Non-Haemolytic Transfusion Reaction [FNHTR]

FNHTR is the most common transfusion reaction occurring in 1% of all transfusions. It can be caused by patient's antibodies to donor white cells

or by the presence of bio-reactive substances such as interleukins or complement fragments that accumulate during storage of blood

components.

Patients most at risk of FNHTR are those who have had multiple units of blood components.

A FNHTR is defined as a rise in temperature greater than 38°C or 1.0°C from baseline if febrile. Chills and rigor can accompany the fever.

Secondary symptoms also include headache, facial flushing, nausea and vomiting. These reactions are often dose related and tend to occur toward the end of the transfusion or even up to one hour after the procedure has been completed.

Symptomatic treatment or pre-medication with antipyretics, steroids or antihistamines may be of benefit. Leuko-depletion (ie filtering out white cells) can also significantly reduce the incidence of FNHTRs.

NB: an elevated temperature can also be indicative of more serious transfusion reactions such as haemolysis or bacterial contamination

Platelet units are all leuco-depleted and irradiated at the Australian Red Cross Blood Service in Victoria, at the time of processing and therefore should contain minimal bio-reactive substances

If the patient experiences the above symptoms during a platelet transfusion, consider bacterial contamination.

However in times of shortage, platelets may be sourced from interstate - so always check the product labels.

8.2 Acute Haemolytic Transfusion Reaction [HTR]



The usual cause of this type of reaction is ABO mismatch. This manifests as intravascular haemolysis caused by the donor red cell antigens interacting with the patient's plasma antibodies. As little as 5 to 10 mL of

incompatible red cells can stimulate a HTR. The patient's antibodies agglutinate the donor red cells carrying the antigen, forming clumps, blocking the blood vessels and kidneys. The complement system is activated and the patient may be tumbled into Disseminated Intravascular Coagulation (DIC).

Undetected serologic incompatibilities can cause these reactions, but most reactions occur when clerical or identification errors lead the wrong product to be given to the wrong patient.

Signs and symptoms include shock, sense of impending doom, dyspnoea,

tachycardia, hypotension, chest pains, facial flushing, back pain, headache, abnormal bleeding, pain radiating along transfusion site and arm. If the patient is anaesthetized then DIC and hypotension may be the first signs.

Stop the transfusion immediately, change the giving set, commence Normal Saline and administer oxygen.

Seek URGENT MEDICAL ATTENTION

Symptomatic management is then usually employed. This usually involves antihistamines, antipyretics, corticosteroids, bronchodilators and maybe even adrenaline and inotropes.

8.3 Delayed Haemolytic Transfusion Reaction



The cause of this reaction is patient's blood carrying antibodies to donor antigens other than ABO e.g. Kidd, Kell or Duffy antigens.

It manifests as an unexplained fall in haemoglobin, 4 to 14 days following the transfusion. The patient may appear jaundiced, have a fever or continued anaemia.

Following the transfusion of red cells bearing the relevant antigen, a rapid secondary immune response raises the antibody level so that after a few days, transfused red cells bearing that antigen are destroyed. Most of the red cell haemolysis is intravascular, the symptoms less dramatic than AHTR and generally it doesn't activate the complement system. There is no immediate treatment but the patient should be screened in order to define the specific antibodies so that antigen negative blood can be given in the future.

8.4 Septic/Bacterial Contamination



Caused by bacteria or endotoxins (Waste product from cell breakdown) from gram-negative bacteria. It is more likely if high fever occurs early in the transfusion, is associated with other symptoms such as hypotension, and occurs during platelet transfusions.

Bacterial sepsis is the leading microbial cause of transfusion mortality. **Visual inspection for abnormal appearance prior** to administration should be carried out and products should never be transfused beyond their expiry date.

Septic and toxic reactions may be life threatening, and management must be aggressive. Treatment should include broad-spectrum antimicrobials, vasopressors to maintain blood pressure and urinary flow, and intravenous therapy to maintain fluid and electrolyte balance.

8.5 Anaphylactic Reaction



The cause of this reaction is a re-exposure to an offending antigen in the donor blood. Patients that are IgA deficient may have developed an antibody response to a previous donation and on receiving a subsequent transfusion of IgA positive blood, will have an anaphylactic reaction. Rarely a lack of other plasma proteins and presence of the corresponding antibody have been implicated.

Cases of anaphylaxis have been described where the patient reacts to a drug (e.g. aspirin) or food (e.g. peanuts or seafood) consumed by the donor.

Symptoms include shock, hypotension, chest tightness, dyspnoea, bronchospasm, hoarseness, and abdominal cramps.

Anaphylactic transfusion reactions usually begin within 1 to 45 minutes after the start of the transfusion, while less severe anaphylactoid reactions can be delayed up to 2 to 3 hours after the commencement of transfusion. In general, the shorter the time between commencement of transfusion and onset of symptoms, the more severe the reaction is likely to be.

8.6 Allergic Reaction



An allergic reaction can occur in 5% of all recipients. Patients react to plasma proteins in the blood product by producing histamine. Therefore this is more likely to happen with the products that have significant amounts of plasma such as FFP. With reduced plasma in red cells and platelets this should be less of a risk, but is still possible.

The majority of allergic reactions can be discovered early with symptoms of pruritus, urticaria, erythema and cutaneous flushing.

When allowed to progress, the upper airway can become involved because of laryngeal oedema, and there may be hoarseness, stridor and a feeling of a lump in the throat. Lower airway involvement due to bronchoconstriction manifests with wheezing, chest tightness, substernal pain, dyspnoea, anxiety or cyanosis.

For future transfusions washed red cells may be required or antihistamines administered prophylactically prior to plasma or platelet transfusions.

8.7 Fluid Overload



Circulatory overload, manifested by pulmonary oedema, may occur when excessive volume is administered. The risk increases in the elderly, in patients with small stature and in patients with cardiac or renal co-morbidities.

For elderly patients with cardiac failure or poor renal function, monitor them carefully, give diuretics as required and use an Imed pump to regulate flow - maximum time limit is 4 hours for any blood components.

Patients present with dyspnoea, productive cough, pink frothy sputum, hypertension/hypotension and headache.

8.8 TRALI [Transfusion Associated Acute Lung Injury]



This manifests as a non-cardiogenic pulmonary oedema but with similar symptoms to fluid overload. It has a distinctly unique x-ray presentation. Over several hours the CXR shows 'white-out' with diffuse alveolar and

interstitial infiltrates with no cardiomegaly.

Do not give diuretics to these patients. Diuretics exacerbate the condition. Support with oxygen therapy and wait.

The cause of this is unclear. It is potentially a granulocyte-mediated reaction whereby leuco-agglutination in the pulmonary circulation occurs resulting in pulmonary damage.

Symptoms usually arise within 1-6 hours of commencement of transfusion of a plasma-containing product and include respiratory distress (dyspnoea, cyanosis), tachycardia, fever, and hypotension.

Approximately 80% of patients with TRALI improve rapidly (clinically and radiologically) over 48 hours provided there is prompt and vigorous respiratory support. Many patients will require intubation and respiratory support. It usually resolves completely within 96 hours.

9 Principles of Blood Transfusion Administration

Red Cells, Platelets, Fresh Frozen Plasma and Cryoprecipitate

1. Assess the Product

- Does it look the right colour, Red Cells, dark red not black, Platelets- straw coloured opaque, and FFP clear, straw coloured.
- Is it the right temperature. Red Cells cold to the touch, FFP and platelets room temperature
- Are there any lumps or clots.
- Is the bag intact, any tears or leaks
- Invert it and mix thoroughly and look again.

With any concern over quality of product - return to Pathology

2. Correctly identify the Patient & Product

- DO all checks at the bedside by 2 RNs.
- ASK patient to say his name and date of birth
- CHECK the name and UR on the ID band, the Blood Product and the Crossmatch Issue Form. All must be identical, no mismatch acceptable.
- CHECK the donation number on the blood product and Crossmatch Issue form
- CHECK the blood group on the blood product and Crossmatch Issue form.
- CHECK the expiry date on the blood product.

All must match exactly - any mismatch seek clarification.

3. Commence Slowly and Stay with Patient.

- Observe patient as product enters the vein for reactions- dyspnoea, flushing, wheeze, hypotension.
- Observe patient frequently throughout transfusion - ask patient to report feeling unwell. Record vital

signs at 15mins and half hourly throughout the transfusion.

- Stay with patient for the first 5 minutes
- **ABSOLUTELY NO MEDICATIONS OR SOLUTIONS ADMINISTERED THROUGH SAME LINE EXCEPT FOR NORMAL SALINE**

4 hour limit - no product can run longer.

10 References:

ARCBS public website <http://www.giveblood.redcross.org.au>

ARCBS clinician's website <http://www.transfusion.com.au>

NHMRC website <http://www.nhmrc.publications@nhmrc.gov.au>

ANZSBT website <http://www.anzsbt.org.au>

CSL website <http://www.csl.com.au>

Vic Govt. website www.health.vic.gov.au/best/index.htm

Blood Matters webpage

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