

Blood Components

Constituents of Blood

Manufacturing – How do we collect prepare and store blood and blood components?

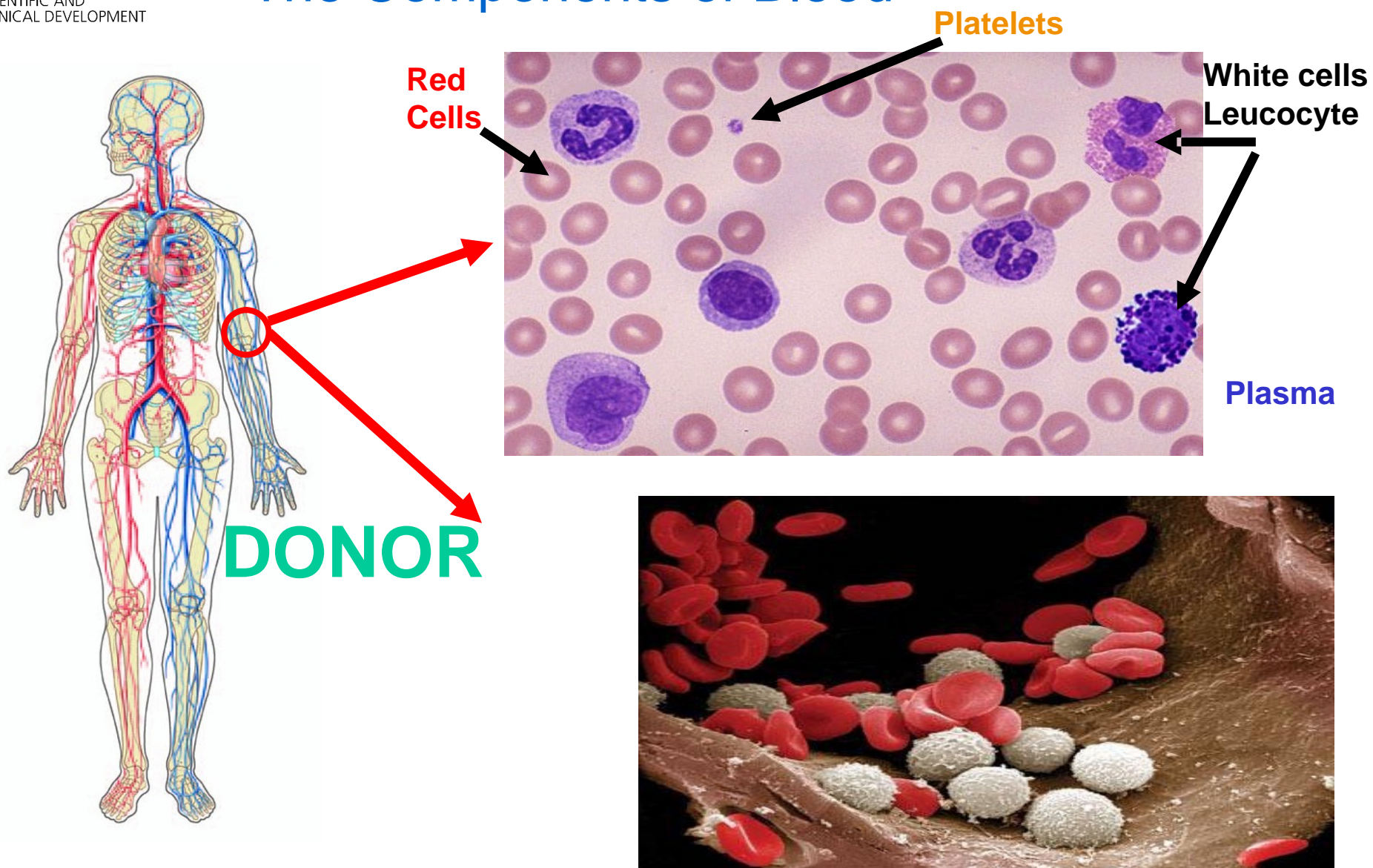
Lianne Rounding – Training Co-ordinator

Transfusion Medicine for Nurses and Midwives

Learning Objectives

- List the components manufactured from whole blood
- Identify the specification requirements of blood components
- Differentiate between routine and specialised transfusion components
- Look at the future of blood components!

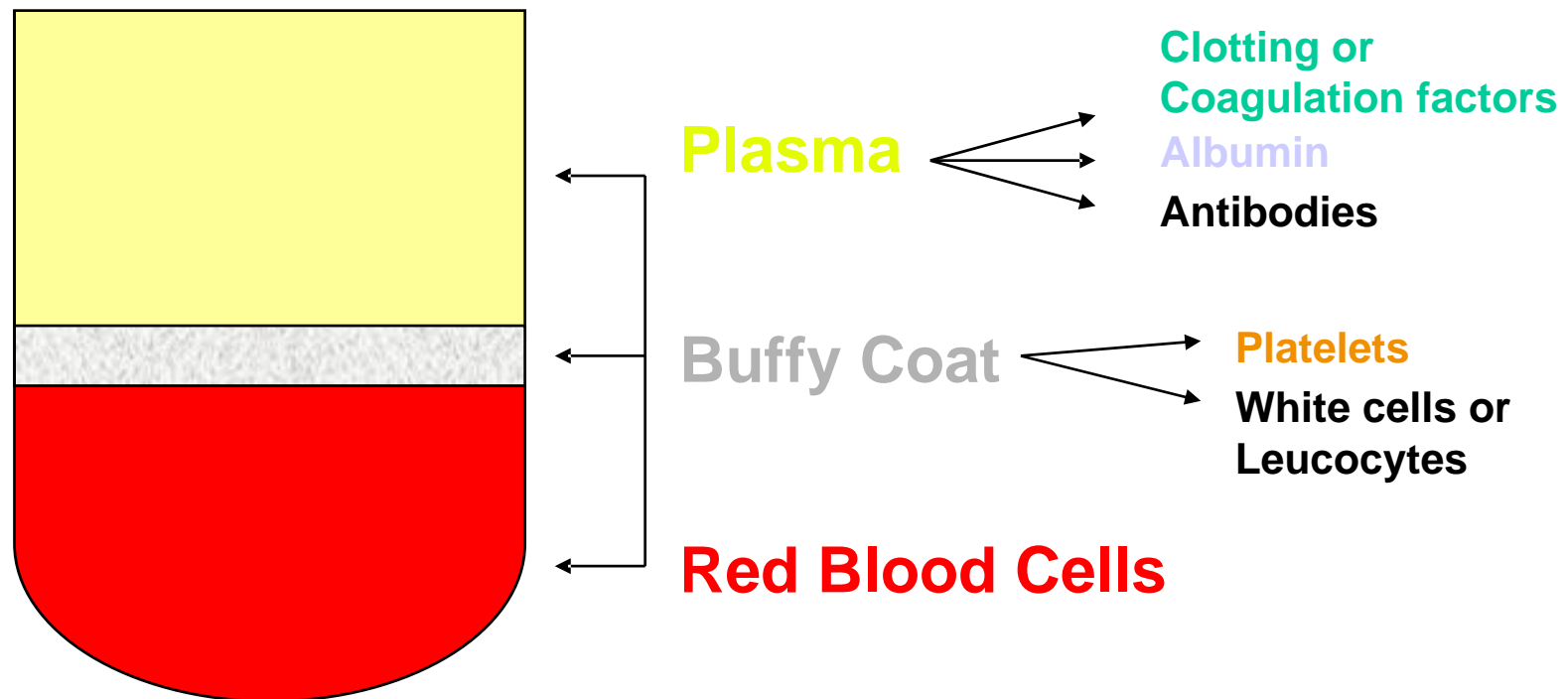
The Components of Blood



Activity

What Transfusion medicines can be prepared from Blood Donations?

Blood Components and Products



Bio Products Laboratory

- Take Donated Plasma and process it into usable **products**;
 - Clotting or Coagulation factors
 - Albumin
 - Antibodies (Immunoglobulin)

Routine Components manufactured in NHSBT Centres

1. Red cells

- Packed/ Concentrated in additive solution (SAG-M)
 - Saline Adenine Glucose - Manitol
- (Whole blood available by special request only)

2. Platelets

- Pooled; 4 donors to make 1 'adult therapeutic dose'
- 'Automated component donation': single donor

3. Plasma

- Male only where possible (~90%)

4. Cryoprecipitate

Component Donation Collection (Apheresis)

- Donor blood passes through a centrifuge which separates different components
- Mainly used for platelets
- Can also be used for 'double-dose' red cells & granulocytes
- Collect 2-3 adult doses / 12 'baby' doses from a single donor
- The red cells are returned back to the donor
- The donor can donate more frequently
 - minimum 2 weeks
- Takes about 90 minutes

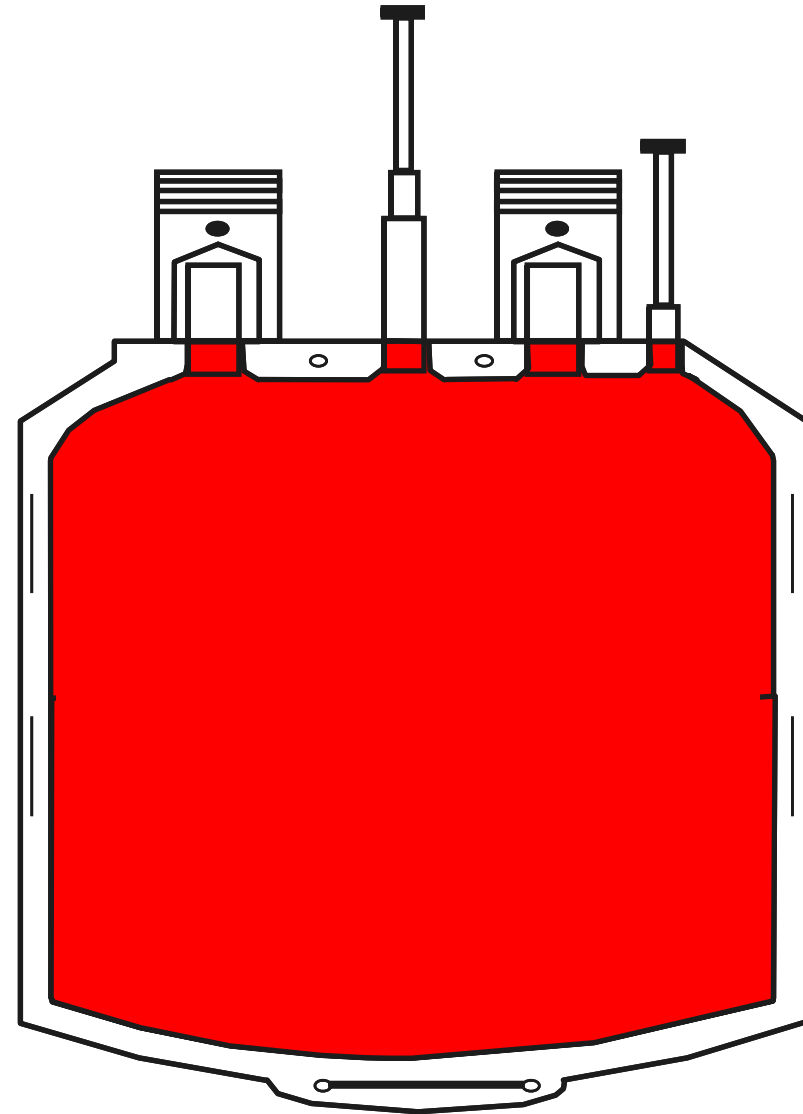
Whole Blood – ready to be processed



Activity: discussion points

- Why don't we give them whole blood?
- How do we separate the different cells in blood?
- Do we want all the different cells and constituents we separate?
- Is there an advantage to separate the different parts of blood

Manufacturing (Processing) of Blood Donations

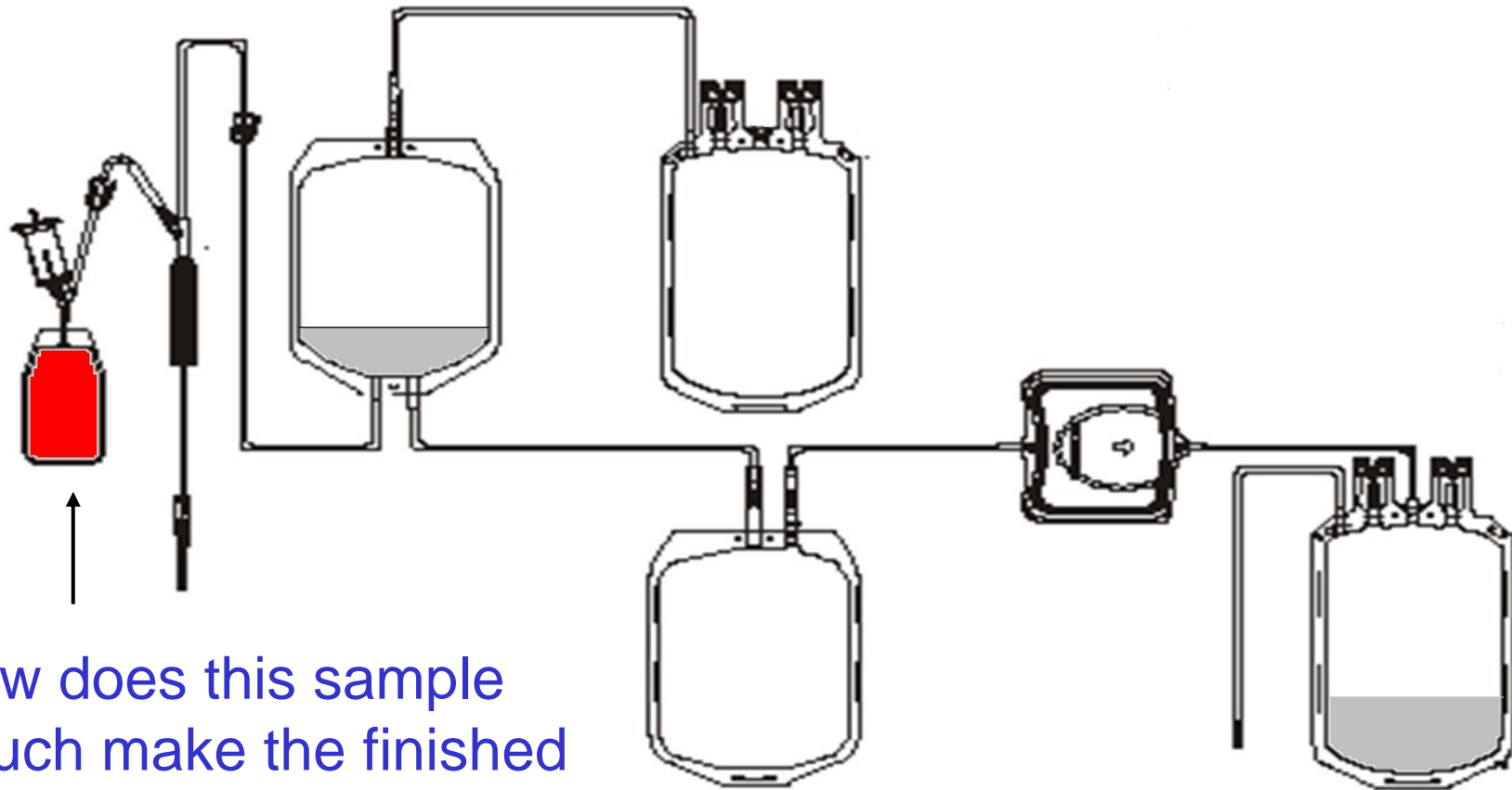


What Manufacturing is required?

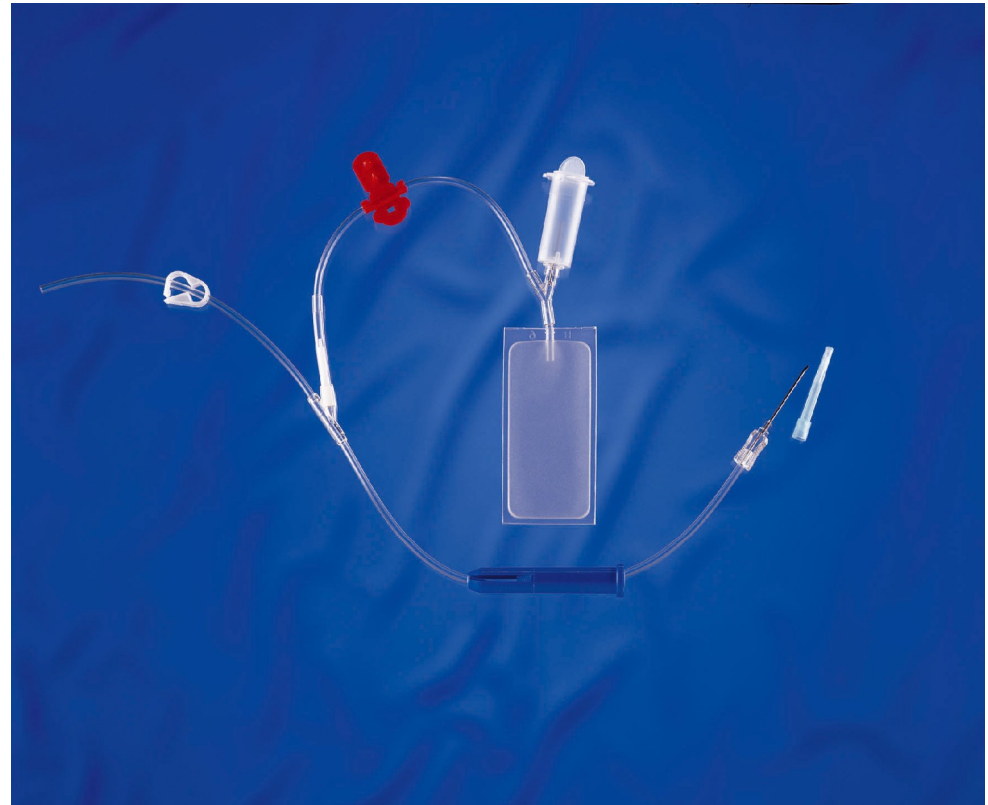
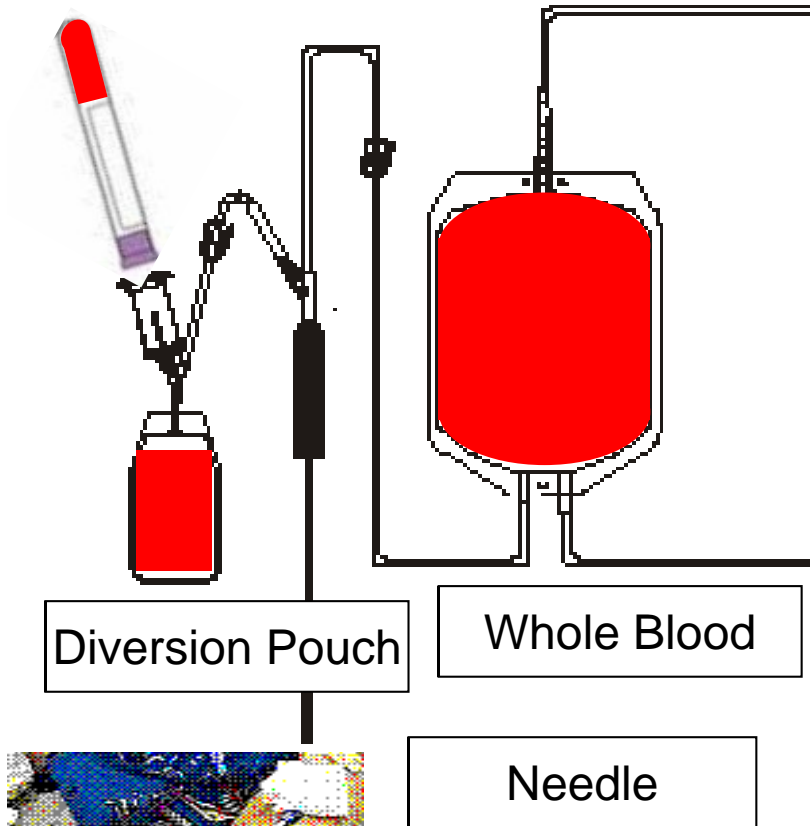
- All products are leucodepleted (except for granulocytes)
- Collection pack varies depending on what products are required
 - Pooled platelets (BAT pack: Bottom and Top)
 - Cryoprecipitate (TAT pack: Top and Top)
- Decided on current stock levels and donor availability



Bottom and Top (BAT) Packs



How does this sample pouch make the finished components safer?



Centrifugation

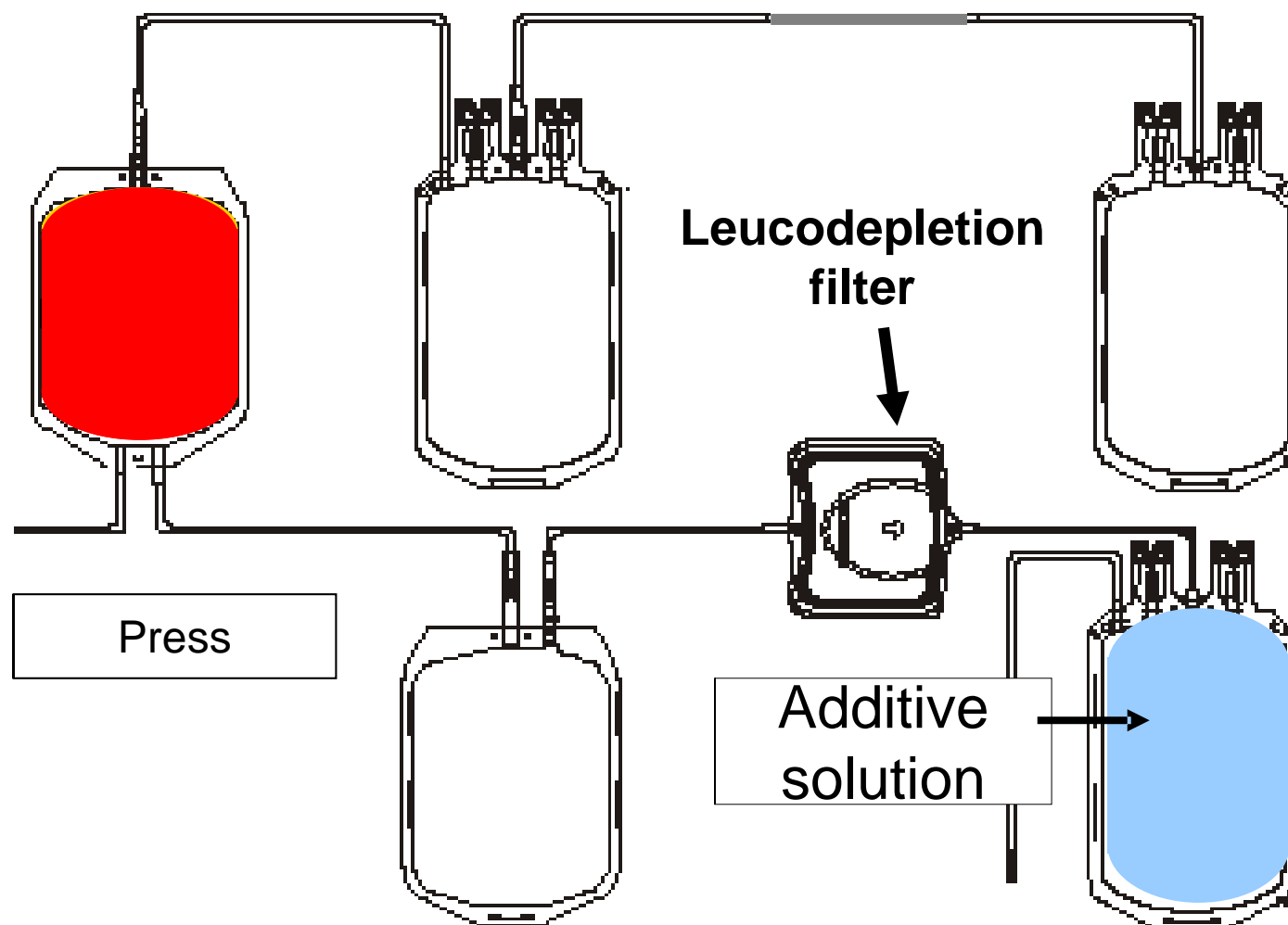


Fairground ride spun at 10 times a minute

Blood centrifuge spins at between 3600 and 4200 times a minute!



This way up ↑

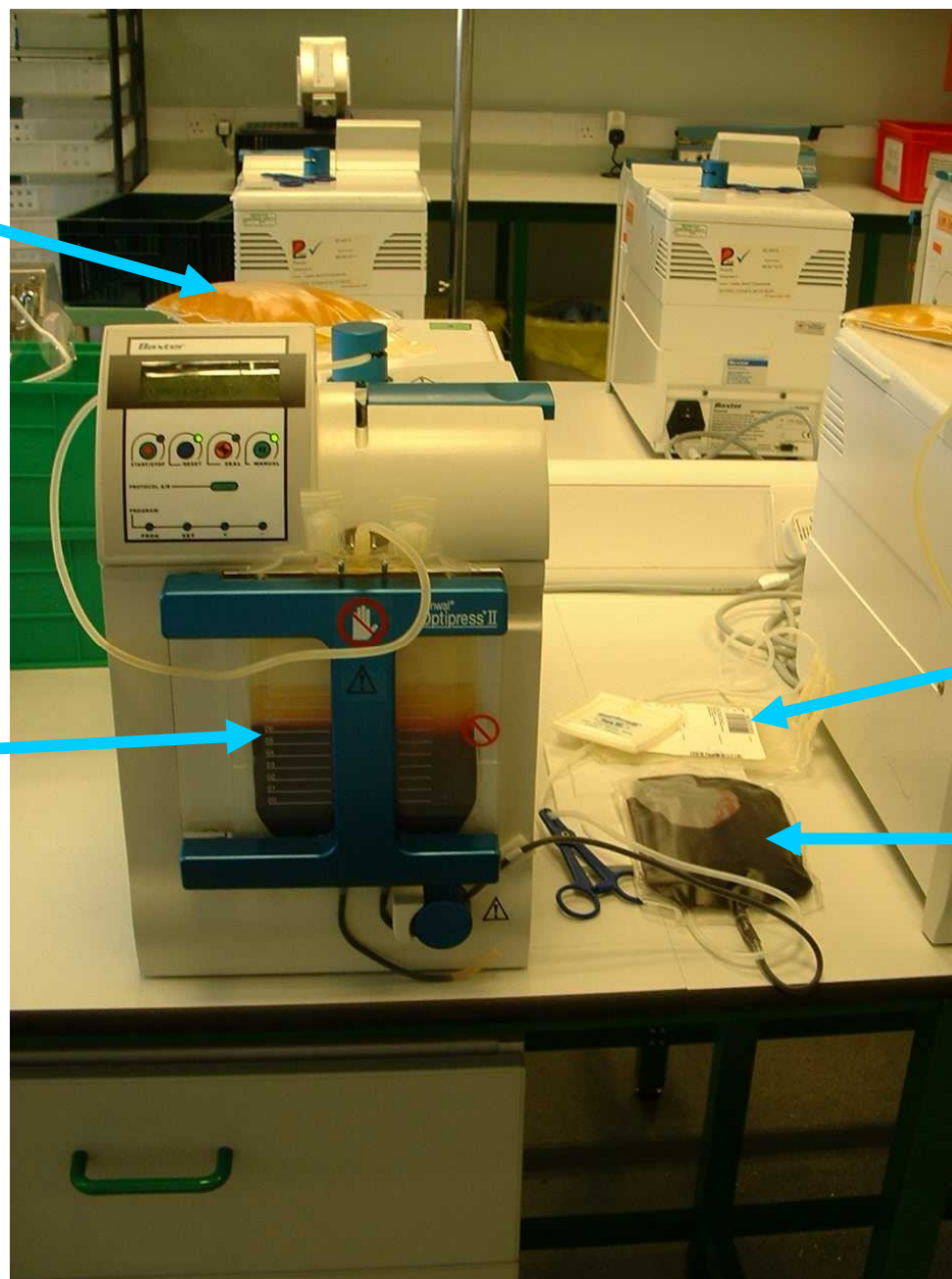


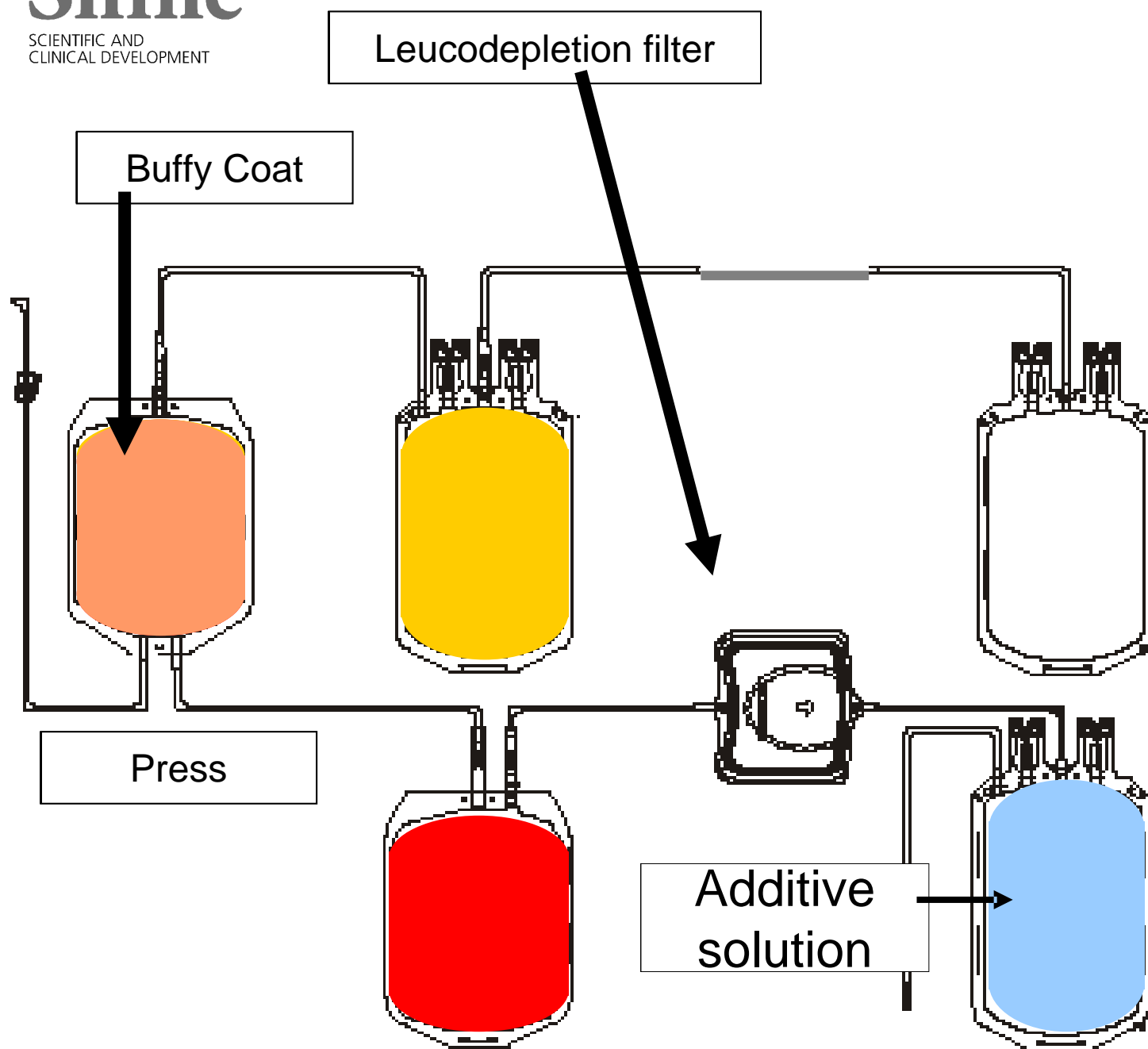
Plasma

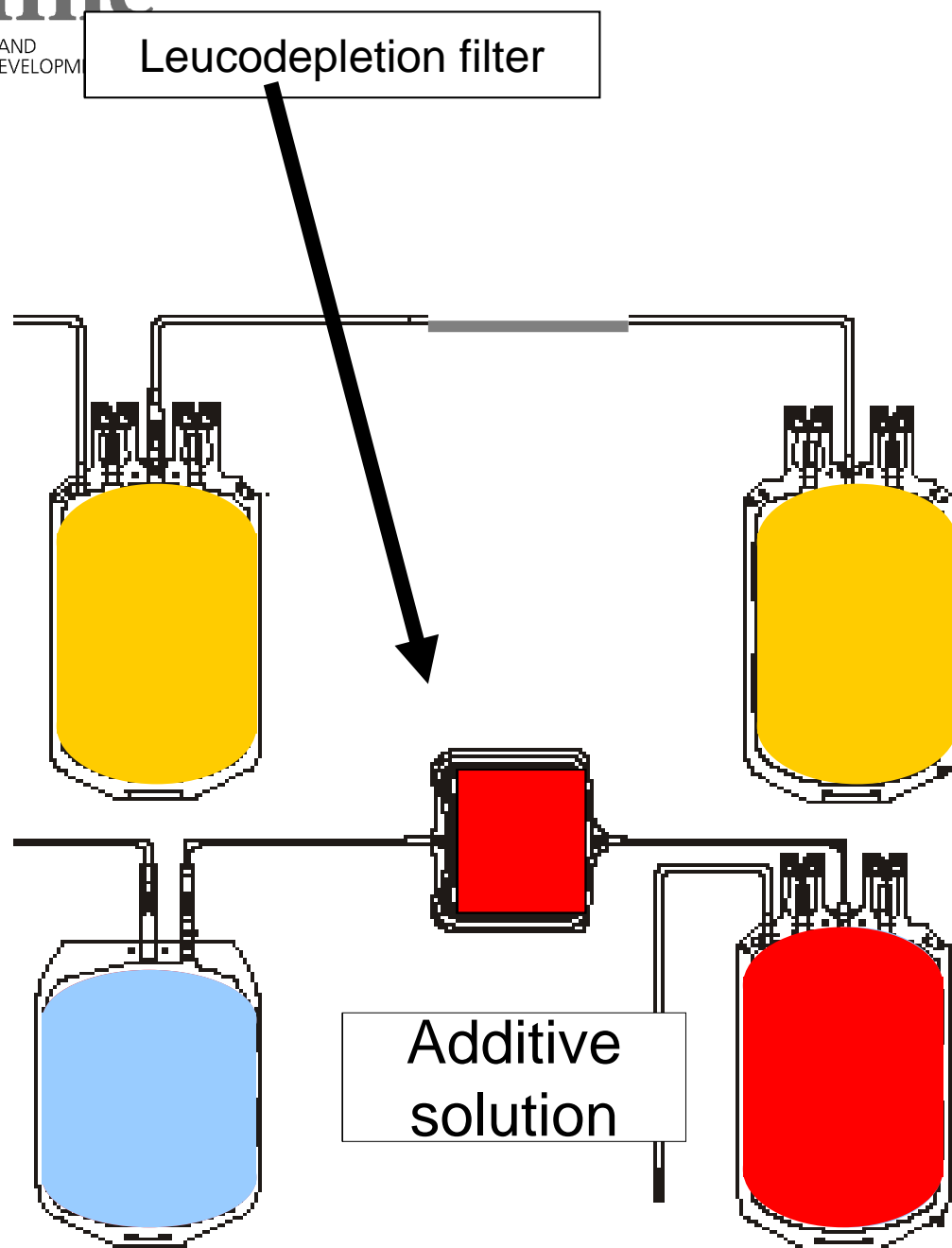
Buffy Coat
left behind

Additive Solution
for

Red cells





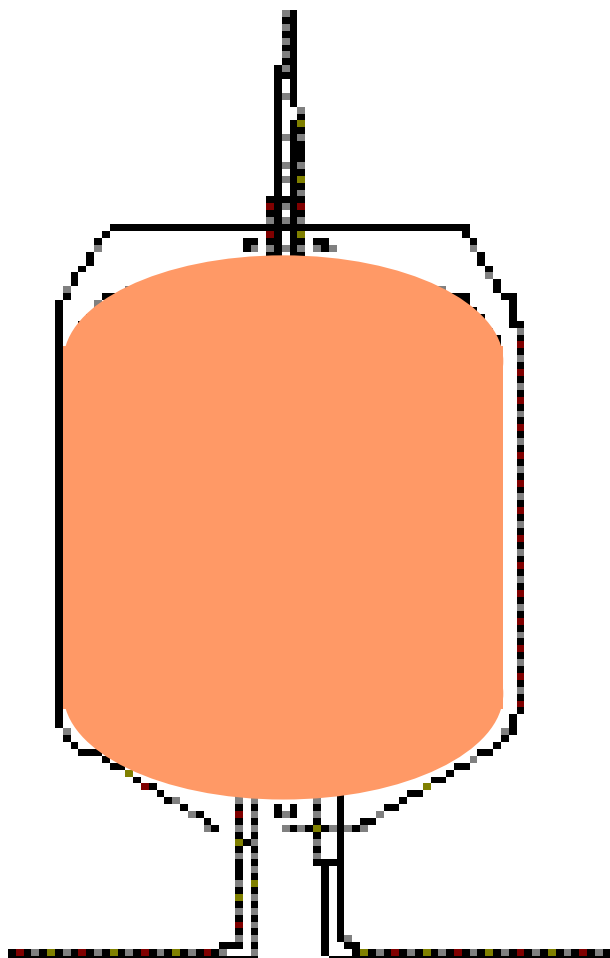


FFP



Red
cells in
SAGM

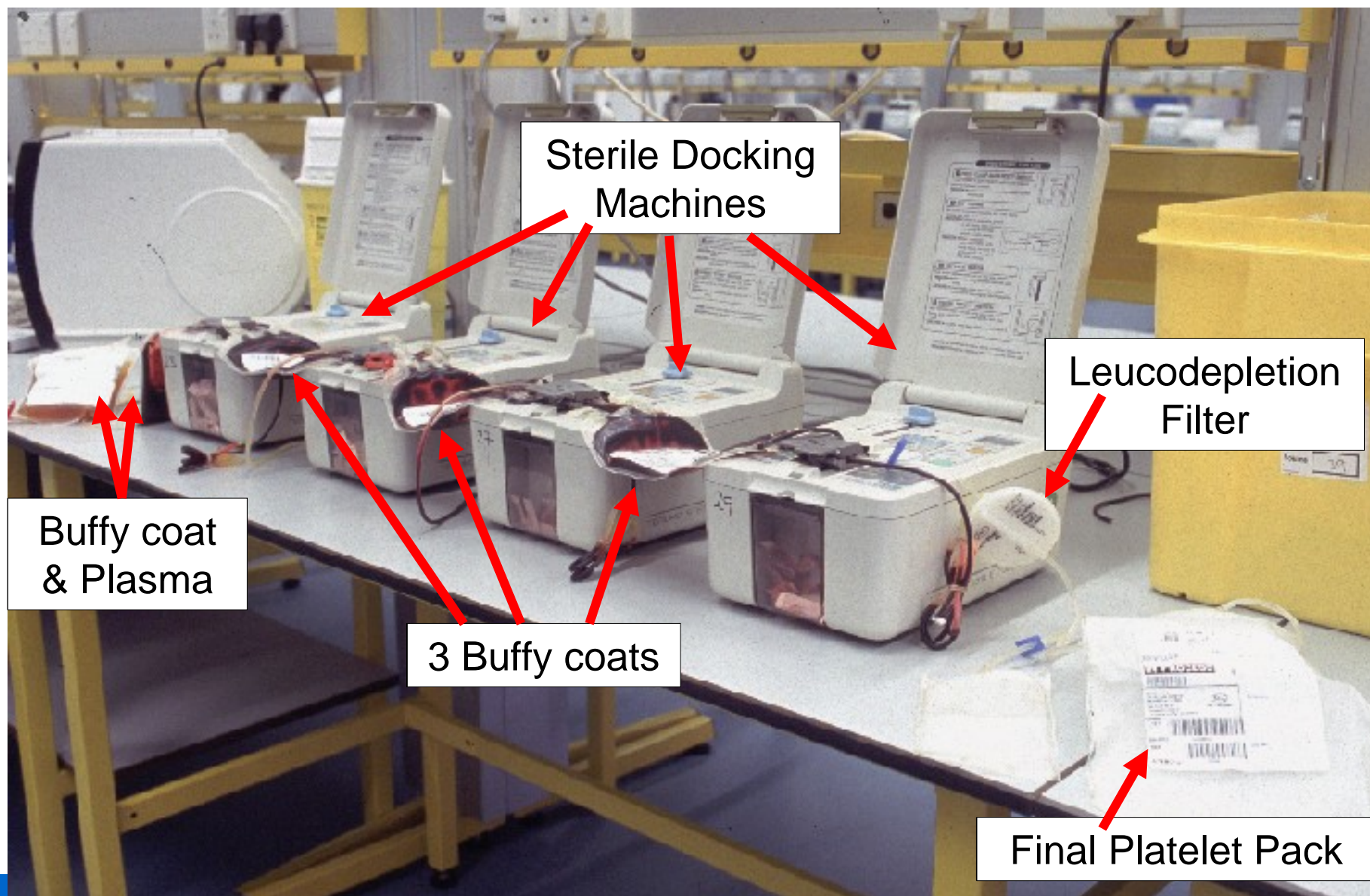
Buffy Coat contains the platelets



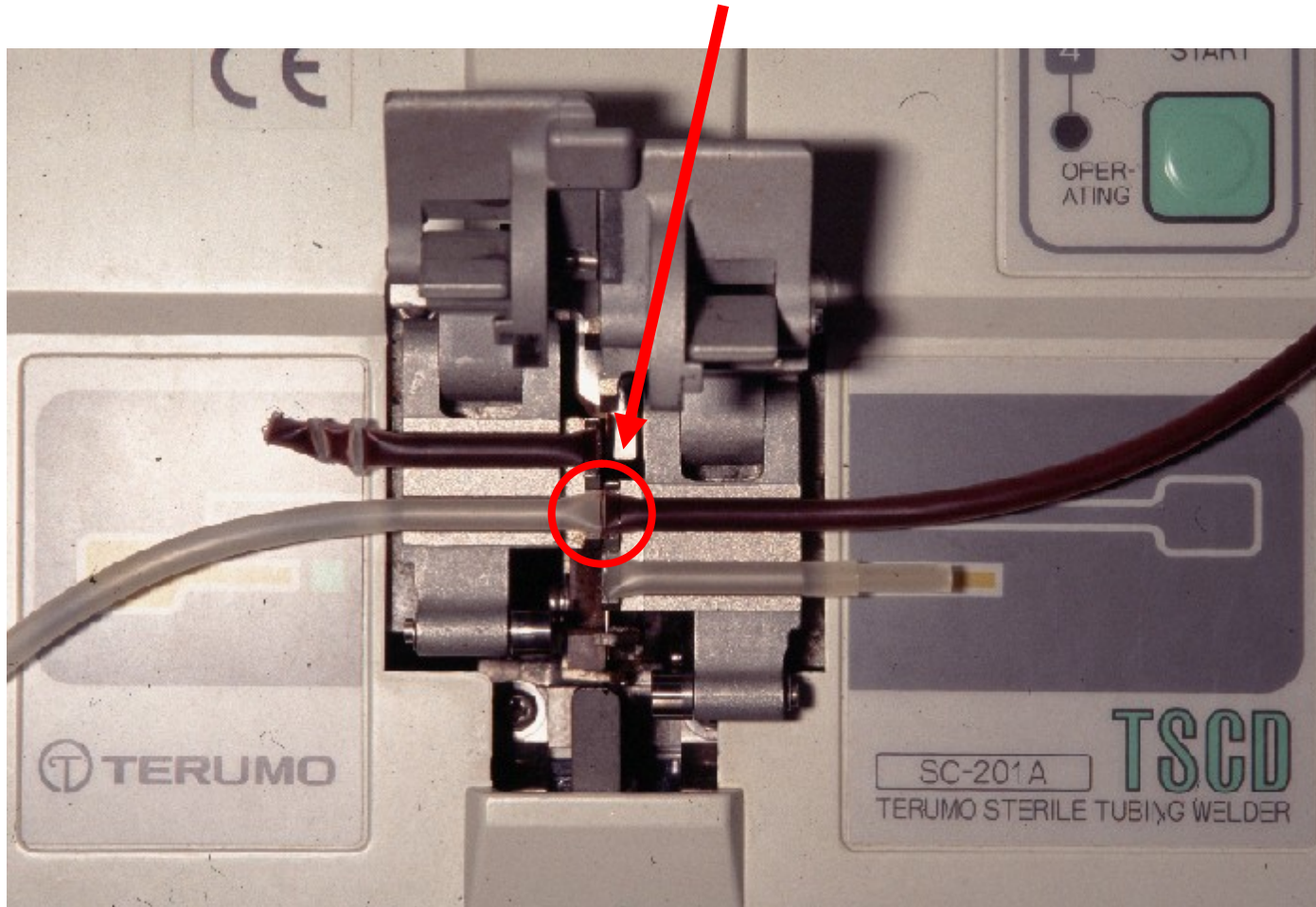
You need at least 4 buffy coats to make one adult dose – this requires further processing to **pool** them together



Sterile Docking Process



Joined together & sealed



4 buffy coats, 1 plasma,
LD filter & final platelet
pack

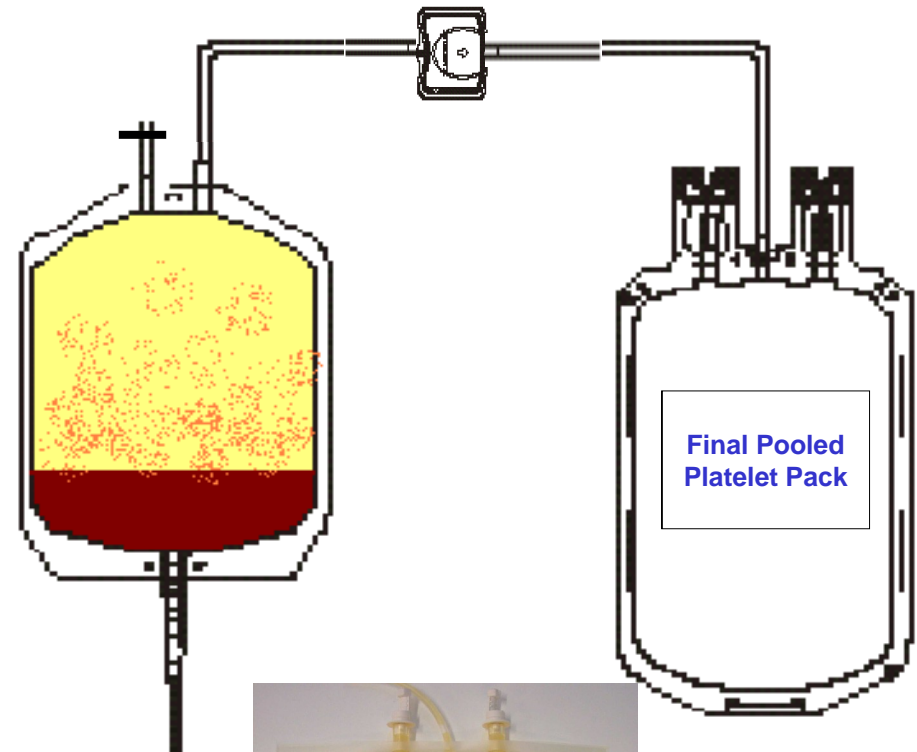


Gravity
does the
work



Final stage

- The pool of 4 buffy coats plus 1 plasma is now centrifuged to
 - Concentrate the platelets
 - Remove any last remaining red cells
- The top layer will contain platelet rich plasma
- This is 'pressed-off' & leucodepleted into the final bag ready for labelling & issues
- The new unit number for this pooled platelet contains the information on the original 4 separate donors – allows traceability



Blood Components Produced by NHSBT

SPECIFICATION SPN223/5.4

NHSBT Portfolio of Blood Components and Guidance for their Clinical Use

This Specification replaces SPN223/5.3	Copy Number
	Effective: 25/10/12
Summary of Significant Changes Removal of the shading on the Pooled Granulocyte barcode and update on granulocyte availability. Changes to FFP storage temperature and thawing requirements. Addition to availability of exchange units.	

Purpose

To provide details of the therapeutic blood components currently supplied to Hospitals

Definitions

NHSBT – NHS Blood and Transplant

Portfolio – NHSBT Portfolio of Components and guidance for their Clinical use

Component donation – Collection of blood components by apheresis

HT – High titre anti-A,B antibodies

Applicable Documents

[ESD1](http://www.transfusionguidelines.org.uk/) Guidelines for the Blood Transfusion Services in the United Kingdom. Current edition. TSO (The Stationery Office) Norwich, 2005.

<http://www.transfusionguidelines.org.uk/>

http://hospital.blood.co.uk/library/pdf/components/SPN223_5_4.pdf

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SPECIFICATION SPN223/5.4

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Donation of Red cells

Standard red cells: £123.31



Adults

1 unit of red cells raises the adult Hb by 0.7-1.0 g/dl

Children

Volume required in ml is calculated depending on the required increase in Hb

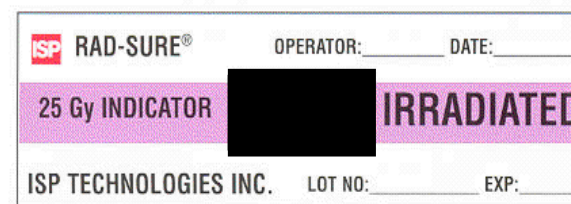
Storage and handling

Store at 4°C +/- 2°C

Should be infused within 4 hours of leaving the fridge

Red Cell Components

- Standard red cells
- Neonatal red cells
- Frozen Red cells, thawed and washed
- Red cells for exchange transfusion
- Red cells for intrauterine transfusion
- Large volume neonates and infants
- Red cells, Added value services
 - CMV negative
 - Irradiated
 - washed



Donation of Platelets

One Adult Therapeutic Dose: £209.30

Shelf-life of 7 days
Constantly agitated

Bacterial screening

Stored at 22°C - risk of
bacterial contamination

Platelet transfusions are
much less common than
red cell transfusions but
their use is increasing



Platelets – Bacterial Screening

- Sample each platelet unit for bacterial growth
- SHOT reported 28 cases in 12 years (8 fatal)
- Bacterial screening of platelet components implemented in January 2011 and 100% by March 2011
- Increases shelf-life to 7 days
- Expiry date of 5 days without bacterial screening

Platelet Components

- Platelets (one adult therapeutic dose)
 - Neonatal platelets
 - Platelets for intrauterine transfusion (IUT)
 - Buffy Coats
-
- Platelet, Added value services
 - CMV negative
 - Irradiated
 - Washed then in additive solution
 - HLA selected platelets
 - HPA selected platelets



Automated component donation platelets: split for pediatric patients



One adult dose is 'split'
into four smaller packs

Plasma Components

Fresh Frozen Plasma £27.60

Cryoprecipitate £31.70

- Clinical FFP (250/300mls)
- Paediatric Neonatal methylene blue treated FFP (MBFFP) (non UK source)
- Cryo-depleted plasma
- Cryoprecipitate
- Methylene blue Cryoprecipitate – neonatal (non-UK source)



Fresh Frozen Plasma (FFP)

- **Single unit:**
 - Processed and frozen to -25°C within 8 hrs
 - Shelf life : 2 years at -25°C or colder
 - ABO group specific FFP transfused
 - Methylene blue treated for anyone born after 1st January 1996



Methylene Blue (MB) Treatment

- Blue dye which inactivates viruses by binding to the virus DNA
- MB added to single unit plasma then exposed to white light for 30-60 mins.
- Cannot be used for red cell components as light energy is absorbed by red cells
- MB removed by filtration
- Fibrinogen and Factor VIII recovery is lower
- Cost
 - £48.20 per neonatal pack of 65mls.
 - £171.54 per paediatric pack of 275mls

Cryoprecipitate



- Preparation : a precipitate that forms by controlled thawing of Fresh Frozen Plasma at 4°C
- Processed and frozen immediately to -25°C
- Shelf life : 2 years at min. -25°C
- It contains coagulation factors e.g Factor VIII, von Willibrand factor, fibrinogen, Factor XIII and fibronectin
- Pools of 5 units Cost – approx £190.00
- MB-treated cryoprecipitate also available for neonates

Pooled buffy coat derived: £1041.10

- Supportive therapy for patients who have or are at risk of developing life threatening bacterial or fungal infection which has resulted from bone marrow failure or white cell dysfunction
- Irradiated
- Store at 22°C / **not agitated**
- Use: within 24 hours of collection
- Their use is not without risk of significant adverse events
- See INF 276

For more information

http://hospital.blood.co.uk/library/pdf/INF276_3.pdf

Routine Blood Component – Quality & Storage

Component	Quality parameters	Temp	Shelf-life
Red cells in SAG-M	Volume 280ml \pm 60ml Hb >40g /unit	4°C \pm 2°C	35 days
Platelets (pooled or CD)	Volume ~220ml pooled/ ~310ml CD Platelets $\geq 240 \times 10^9$/unit	22°C \pm 2°C with cont. agitation	7 days with bacterial screening
FFP	Volume ~270ml FVIII ≥ 0.7 IU/ml	< -25°C	24 months
Cryo (single)	Volume ~40ml FVIII ≥ 70 IU/unit Fibrinogen ≥ 140 mg/unit	< -25°C	24 months
Cryo (pooled)	Volume 100-250 ml FVIII ≥ 350 IU/unit Fibrinogen ≥ 700 mg/unit	< -25°C	24 months

Specialist Red Blood Cell Components

- Exchange red blood cells
 - Process of patient blood removal and transfusion replacement
 - used to treat babies with excessive toxicity due to red blood cell debris
- Intrauterine Transfusion (IUT)
 - Transfusion replacement *in utero (i.e. in the womb)*
 - used to treat babies with excessive anaemia
- Blood compatible – Phenotyped

Specialist Platelet Components

- **Matched platelets**
 - Component donation platelets
 - used to treat patients with specific immune antibodies that have previously caused an incompatibility
- **Hyper concentrated platelets (IUT)**
 - Used for babies whose platelets are affected by an antibody mum has produced

More Specialist Components by special arrangement only

- **Washed cells**
 - Red cells or platelets have all plasma removed using saline solution or platelet additive.
 - Used for patients who might have allergic reaction
- **Granulocytes (white cells)**
 - Collected by component donation or from buffy coats.
 - Used for patients with low white cell count and unable to fight off infections (such as post chemotherapy)

Future Developments

Required for patient safety!

Changes required for recipient safety

- SaBTO – Safety of Blood, Tissues & Organs
 - Independent advisory committee
 - Make recommendations to government
- Department of Health
 - Acts on recommendations
 - Instructs Blood Services to implement changes
- vCJD screening
 - No test licensed yet
 - Still in development & trial phases
 - Safety measures in place include:
 - Deferral of anyone transfused since 1st January 1980
 - Leucodepletion: removes 50% of prion activity
 - Non UK plasma for anyone born after 1st January 1996

Current & Future Developments

- All products – vCJD screening test
- Red cells
 - Prion filtration – currently under assessment in UK. Patient safety trials. (will lead to 6g of Hb lost)
 - Importation – to remove CJD risk
 - Double red cells – reduces patient exposure
- Platelets
 - Bacterial screening (since January 2011)
 - Pathogen inactivation – costly / may damage product
 - >80% from component donation: met - recommendation changing
- Plasma/ Cryo
 - Import all: initially considered by SABTO but recommended against in March 2012
 - Fibrinogen concentrate (to replace Cryo) Not licensed yet

Learning Objectives – have we met them today?

Can you

- List the components manufactured from whole blood?
- Identify the specification requirements of blood components?
- Differentiate between routine and specialised transfusion components?
- See the future of blood components?

Over to you – any
questions or
comments?