#### Evolution of Blood Component Preparation in the IBTS

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#### **Dublin Blood Transfusion Service**

- Sir John Lumsden (St. John's Ambulance Brigade) places newspaper ads inviting people to register as blood donors (1935).
  - Prior to this, blood transfusion direct donor/patient
  - Brigade supplies Dublin blood transfusions through 1940s
- Irish Government advised to establish blood collection/storage centre for emergencies (WWII)





#### WWII BRITAIN

> 1939-1945 growth from primitive organisation to functioning blood Tx system storing blood & distributing where needed

Produced WB, freeze dried plasma, albumin

- Individual field hosps & med units collected WB from army personnel
- Limited resources reusable transfusion bottles

Preservation of RBCs up to 21 days with ACD developed

#### Dublin Blood Transfusion Service (The Emergency)

- St. Bricin's Military Hospital uses blood from military/allied service personnel for processing into plasma.
  - Released to civilian hospitals due to 'great and urgent demand'
- St. Bricin's Authorities open Grafton St. Donation centre for general public donations with assistance from civilian staff
- > 1935-1945 transfusions in Dublin increased "well over tenfold" with further increase expected



St Bricin's Military Hospital, Dublin 7





#### **KOREA 1950**

> 3 wk shelf life (ACD)

Iong supply lines <50%used</p>

> Wastage – research



Introduction of plastic bags & longer RBC storage

## Blood Components in Ireland (1960s)

- > 1966: Introduction of PVC blood bags ("singles")
- > Whole Blood in ACD (420ml in 80ml)
- Shelf life of 21 days
- Recovered plasma from expired units returned from the Hospital blood banks
- "QA": temperature charts from fridges assured maintenance of cold chain
- Plasma sent for fractionation

# Blood Components in Ireland (1970s)

- > 1977: Introduction of Frozen Red Cell bank
- Packed red cells in glycerol "plunge" frozen in liquid nitrogen (-196°C)
- Stored in vapour phase -150°C
- Thawed on demand and transfused after washing out the glycerol
- Early research with rejuvenation cocktails
   PIGPA /PIPA

## Blood Components in Ireland (1970s)

> 1978: Introduction of Double blood bags

Packed red cells in ACD (Hct. 0.75L/L)

Fresh plasma in pools of 3 units A:B:O

> 400ml lyophilised in bottles

- Issued to hospitals as kit containing sterile water for reconstitution
- Stored on wards at room temperature up to 5 years

## Blood Components in Ireland (1970s)

- > 1978 cont.: Pooled Fresh Plasma into 2 litre plastic containers and frozen in alcohol baths containing dry ice.
- Specification: Platelet "poor" with low risk of bacterial contamination (Gram stain?)
- Suitable for fractionation into Albumin solutions for use in Irish patients

### Blood Components in Ireland (1970s & 1980s)

- > 1979: First single donor platelet concentrates prepared on demand
- > Use immediately: 6 hour shelf life
- > 1980s: Introduction of triple bags and PRP method. (Packed red cells Hct. 0.85L/L)
- Increase in demand with requirement to store @4°C up to 3 days
- Units were issued on demand for immediate use after temperature had equilibrated to ambient.

## Blood Components in Ireland (1980s)

- > 1980s cont.: Cryoprecipitate for in-patient care of Haemophilia A
- Import of Factor VIIIc concentrates directly by hospitals for out-patient treatment
- > AIDS
- Introduction of Plasmapheresis programme to drive self sufficiency in F VIIIc concentrates
   Introduction of Fresh Frozen Plasma for
  - clinical use

### Blood Components in Ireland (1980s & 1990s)

- > 1989: Introduction of semi-automated whole blood separators
- Blood donations stored overnight @22°C and separated next morning
- Triple bags to prepare Packed red cells in CPD/28 day shelf life (Buffy Coat Removed)
- Platelet concentrates from "buffy coats" stored @22°C for 5 days on agitators

## Blood Components in Ireland (1990s)

- > 1990s:Introduction of "designer" blood for Neonates and paediatric patients
- Whole Blood in CPD A1 (5 way splits with 35 day shelf life)
- Plasma Reduced Red Cells (5 way splits)
- Red Cells for IUT (high haematocrit)
- Introduction of Red Cells in additive solution using quadruple bag systems

## Blood Components in Ireland (1990s)

- > 1998:Introduction of next generation blood separators; "Top and Bottom" quadruple bag systems
- Introduction of Leucocyte reduced pooled platelets from 4 buffy coats and 1plasma
- > 1999: Introduction of universal leucocyte reduction of all components

## Blood Components in Ireland (2000s)

- > 2000's: Policy driven largely by vCJD risk.
- Expansion of Apheresis Platelet programme to reduce donor exposure risk to recipients
- Introduction of additive solution into pooled platelet concentrates (2007)
- Introduction of Octoplas to replace plasma from Irish donors

#### What's in the bag now?

#### **RED CELLS**

SAGM 35 days
 Irradiated up to 14 days; max 28 days
 125,374 prepared 2019

Quality Parameter	Expected Value
Volume	231ml- 355ml
Haematocrit	0.50-0.70 L/L
Haemoglobin content	≥40g/unit
Residual Leucocyte content	<1.0 x10 <sup>6</sup> /unit



### RED CELLS, Washed

Washed and resuspended in SAGM 24 hours Patients with reactions to plasma Not for IgA deficiency per se > 9 in 2019

Quality Parameter	Expected Value
Volume	≥226ml
Haematocrit	0.50-0.70 L/L
Haemoglobin content	≥40g/unit
Protein Content	<0.5g/unit

#### **Components Suitable for Neonatal Use**

7. Components suitable for use in intrauterine transfusion, neonates and infants under one year

#### General requirements are

- 7.1 Components are prepared from donors who fulfil the following criteria:
  - have given at least one donation in the previous two years and have tested negative in microbiology tests that were designated as mandatory at that time
  - CMV antibody negative
  - C and E antigen negative if Rh D negative
  - K antigen negative (red cell components only)
  - free from clinically significant irregular blood group antibodies
  - free from high titre Anti A and Anti B (components suspended in plasma only)
  - Sickle Cell trait negative (red cell components only)
  - have not received a blood transfusion or organ transplant
  - have not taken aspirin in the last five days

#### **Red Cells for Neonatal Use - Specifications**

General Specification:	IBTS/PMF/SPEC/	/0232	IB	STS/PMF/SPEC/0209	
Parameter	Quality Requirements 231 – 355 ml	Frequency of Control	Parameter Volume	Quality Requirements 45 – 71 ml x 5 split units	Frequency of Control
Haematocrit	0.50 - 0.70 L/L	1%	Haematocrit	0.50 - 0.70 L/L	1%
Leucocyte Contem		1%	Leucocyte Coment	$\geq 8 \text{ g / split unit}$	Counted in units of red cells
life	< 0.8% of red cell mass	4 per month (RED CELLS, 04333/E7429V00)	Haemolysis at end of s life	shelf < 0.8% of red cell mass	1 per month
ABO Agglutinins	No HighTitre Anti-A or Anti-B	100%	ABO Agglutinins	No High Titre Anti-A or Anti-B	100%
CMV	CMV ab negative	100%		CMV ab negative	100%

Red Cells, Suitable for Neonatal Use for 5 Days after Date Drawn (including Irradiated) are used for augmenting the oxygen carrying capacity of the blood where this is critically reduced in infants requiring large volume transfusion, particularly in the surgical setting, within 5 days from date drawn. Red Cells Suitable for Neonatal Use, Split 1/2/3/4/5 are used for augmenting the oxygen carrying capacity of the blood where this is critically reduced in infants requiring repeated small volume transfusions within a four to five week period. It is recommended that the first split unit should be transfused within 5 days from date bled and subsequent split units from the same donation may be transfused up to the end of shelf life.

This is the O Negative NNU standby product held in stock in the IBTS and in 23 hospitals nationwide. 714 splits prepd in 2019.

#### **Plasma Reduced Whole Blood for Neonatal Use - Specifications**

IBTS/PMF/SPEC/0208

Parameter	Quality Requirement	Frequency of Control	Whole Blood, Suitable for Neonatal Use for 5 days after date drawn / Whole
Volume	260 – 380 ml	100%	Blood, Suitable for Neonatal Use, Irradiated (with Hct. ranges of 0.50-0.60 L/L or 0.50-0.55 L/L,) are used to augment the oxygen delivery capacity of
Haematocrit	0.50 - 0.60 L/L 0.50 - 0.55 L/L	100 %	<ul> <li>the blood where this is critically impaired. Typically indicated for:</li> <li>Exchange transfusion of neonates.</li> </ul>
Haemoglobin	≥ 40 g/unit	≥1%	<ul> <li>Massive transfusion in neonates and small infants.</li> <li>adult transfusion.</li> </ul>
Leucocyte Content	< 1 x 10 <sup>6</sup> /unit	≥1%	For exchange or massive transfusion of neonates it should be used within
Haemolysis at end of shelf life	< 0.8% of red cell mass	4 per annum (including irradiated)	days after date drawn and up to 24 hrs after irradiation. For adult use it can be
ABO Agglutinins	No HighTitre Anti-A or Anti-B	100%	stored up to 28 days.
CMV	CMV ab negative	100%	

This is the NNU standby product held in stock in the IBTS and in 2 hospitals. All Are group O Negative. In 2019, 393 units were prepared, 226 were issued.

#### **Red Cells for IUT- Specifications**

IBTS/PMF/SPEC/0210
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Parameter	Quality Requirement	Frequent of Control
Volume	190-310 mL	100 %
Haematocrit	0.7 – 0.85	100 %
Haemoglobin	≥ 40 g / unit	100 %
Leucocyte Content	<1 x 10 <sup>6</sup> / unit	Parent Component tested
ABO Agglutinins	No High Titre Anti-A or Anti-B	100%
CMV	CMV ab negative	100%

Red Cells, Suitable for Intrauterine Transfusion, Irradiated are prepared, on request, for use in intra-uterine transfusion. Haematocrit may be adjusted to the required value prior to issue.

> Red Cells, Suitable for Intrauterine Transfusion, Irradiated must be irradiated before transfusion. Post irradiation the storage is unchanged.

### PLATELETS (Irradiated)

Collected in 100% plasma by apheresis

 > 18,489 prepd in 2019. 7,864 extended 7 days.
 > 2,256 (12.2%) outdated

Quality Parameter	Expected Value
Volume	Average: 235ml
Platelet Content	≥200 x10 <sup>9</sup> /unit or split
Leucocyte content	<1.0 x10 <sup>6</sup> /unit or split
Swirling	Present
Aggregates	Visually absent
pH at expiry	>6.4

### PLATELETS, Adult Dose with Plasma/PAS, (Irradiated)

 Prepared by pooling 4 whole blood buffy coats.
 Ratio of Plasma to

SSP+: 35%:65%.> 2019: 6,908.

> 720 (10.4%) outdated

Quality Parameter	Expected Value
Volume	251ml-343ml
Platelet Content	≥200 x10 <sup>9</sup> /unit or split
Leucocyte content	<1.0 x10 <sup>6</sup> /unit or split
Swirling	Present
Aggregates	Visually absent
pH at expiry	>6.4

### PLATELETS, Adult Dose, Washed, (Irradiated)

Prepared by washing a unit or split Apheresis platelet in platelet additive solution (SSP) > Use within 6 hours > 2019:12 washed

Quality Parameter	Expected Value
Volume	180ml- 220ml
Platelet Content	≥160 x10 <sup>9</sup> /unit
Protein content	<0.5g/unit
Swirling	Present
Aggregates	Visually absent
pH at expiry	>6.4

#### Fresh Frozen PLASMA

Prepared from whole blood by rapid freezing (1 hour) to -60°C (240 in 2019) Shelf life 12 months @-25°C > 6 hours post thaw > Use: coagulation disorders

Quality Parameter	Expected Value
Volume	≥220ml
Platelet conc.	<30 x10 <sup>9</sup> /litre
Leucocyte content	<1.0 x10 <sup>6</sup> /unit
Red Cell content	Visually absent
Total Protein concentration	≥50g/litre
Factor VIIIc concentration	>0.7iu/ml

### CRYOPRECIPITATE, suitable for neonatal use

- Prepared from FFP by slow thaw/centrifugation/v olume reduction. (167 in 2019)
- Shelf life 12 months @-25°C
- > 6 hours post thaw
- Used to replenish fibrinogen in NNU/Paeds

Quality Parameter	Expected Value
Volume	30ml-40ml
Factor VIIIc content	>70 iu/unit
Fibrinogen content	>140mg/unit
Von Willebrand factor content	>100 iu/unit

#### LEUCOCYTES, pooled, Irradiated, (Source of Granulocytes)

- Prepared by pooling 5 buffy coats on Day 1 (24 hour shelf life) (45 in 2019)
- Indication: Severe neutropenia with sepsis and antibiotics
- Recommended dose: 20 x10<sup>9</sup> (2 pools)

Quality Parameter	Expected Value
Volume Range	49ml-67ml per BC unit pooled
Leucocyte content	1.6 x10 <sup>9</sup> /BC unit pooled
Volume Range (5 BC pool)	245ml-335ml per pool
Leucocyte content	8.0 x10 <sup>9</sup> /BC unit pooled

### LEUCOCYTES, pooled, red cell reduced, Irradiated, (Source of Granulocytes)

> Prepared by pooling/centrifuging/ volume reducing 5 buffy coats on Day 1 (24 hour shelf life) (19 in 2019)Use for patients ongoing therapy to reduce risk of iron overload

Quality Parameter	Expected Value
Volume Range	44ml-62ml per BC unit pooled
Leucocyte content	1.6 x10 <sup>9</sup> /BC unit pooled
Volume Range (5 BC pool)	220ml-315ml per pool
Leucocyte content	8.0 x10 <sup>9</sup> /BC unit pooled

#### What will be in the bag?

Back to the future! > Low titre, Gp O. WB (trialled in trauma) > Lyophilised plasma > 4°C stored platelets (active bleeding) > Thawed liquid plasma (5 day shelf life) Thank you