Neonatal transfusion practices

Cases on TML testing and Blood administration

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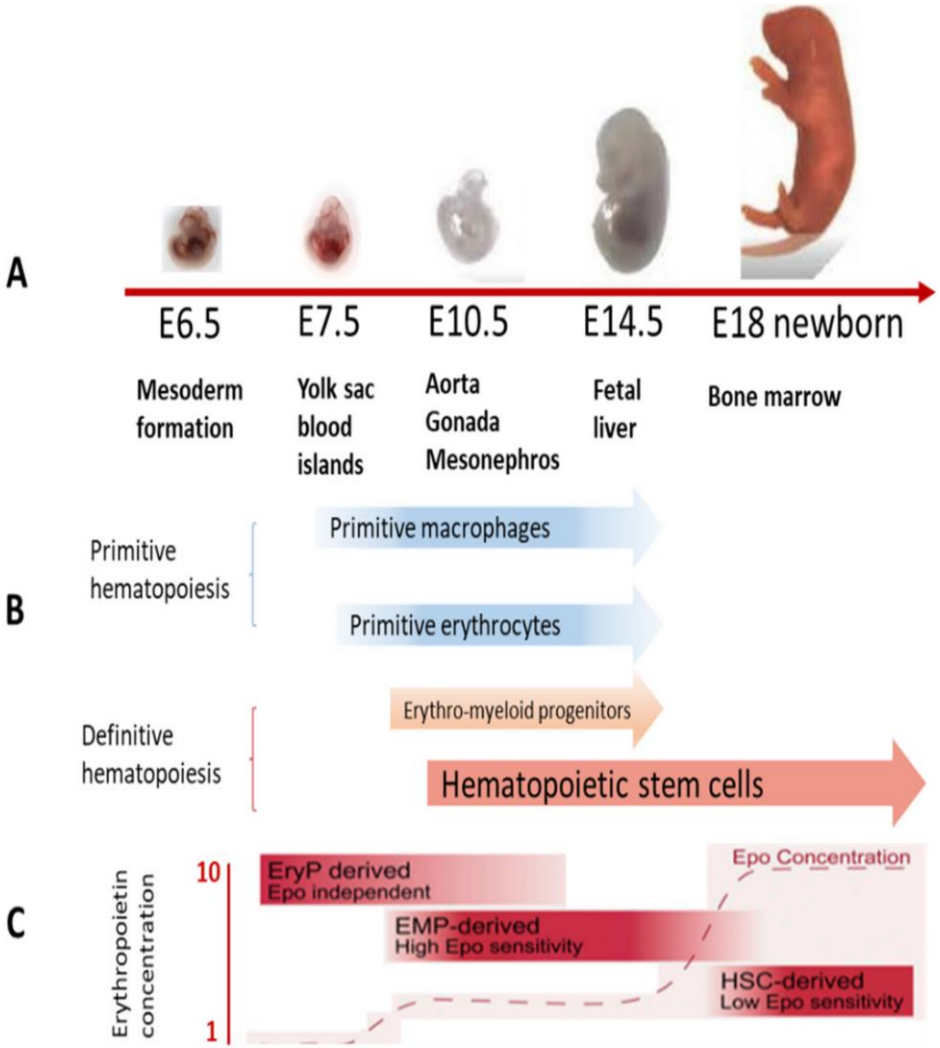
Objectives

- Understand the developmental differences in hemoglobin and coagulation parameter values between neonates, children and adults
- Recognize the transfusion thresholds for red cells and platelets in neonates
- Understand the differences in pre-transfusion testing for neonates
- Recognize the specifics of blood product administration and modification for neonates

Developmental Hematology 101

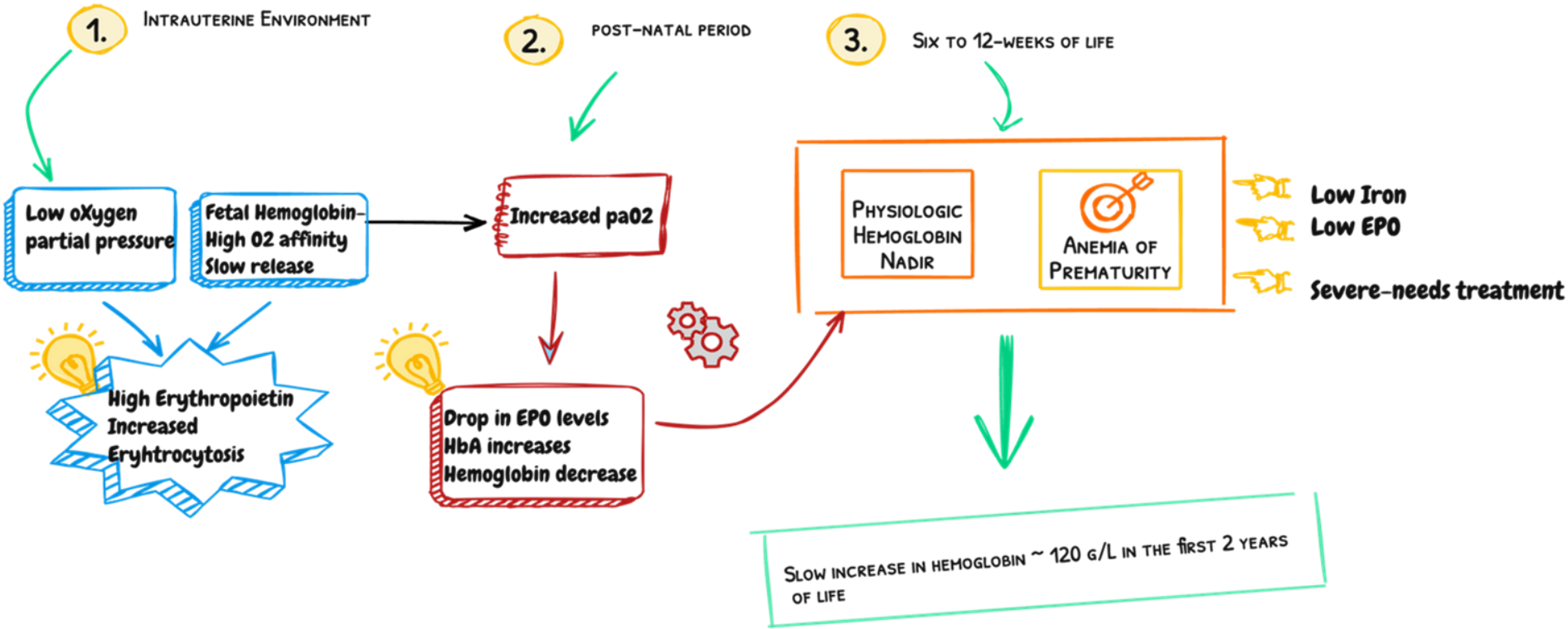


Case 1:

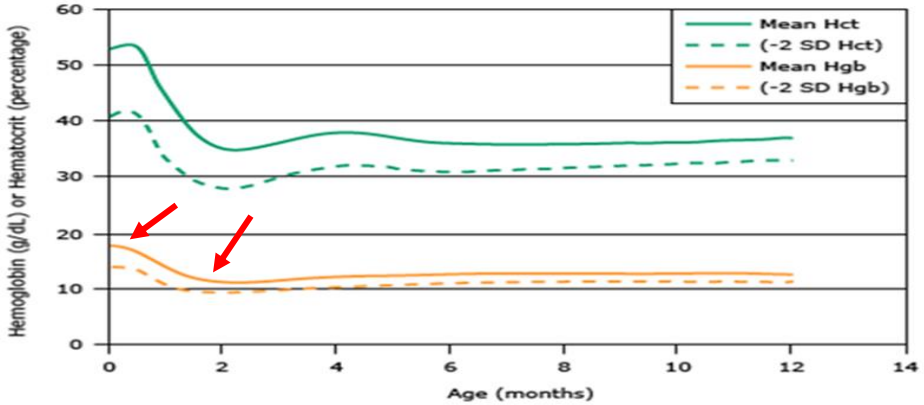
A 2-month old male born at 30-weeks gestation has a hemoglobin of 85 g/L today whereas it was 170 g/L at birth.

What is the most likely reason for the change in his hemoglobin level?

Developmental changes in Hemoglobin



Normal values for hematocrit and hemoglobin during the first year of life in healthy term infants



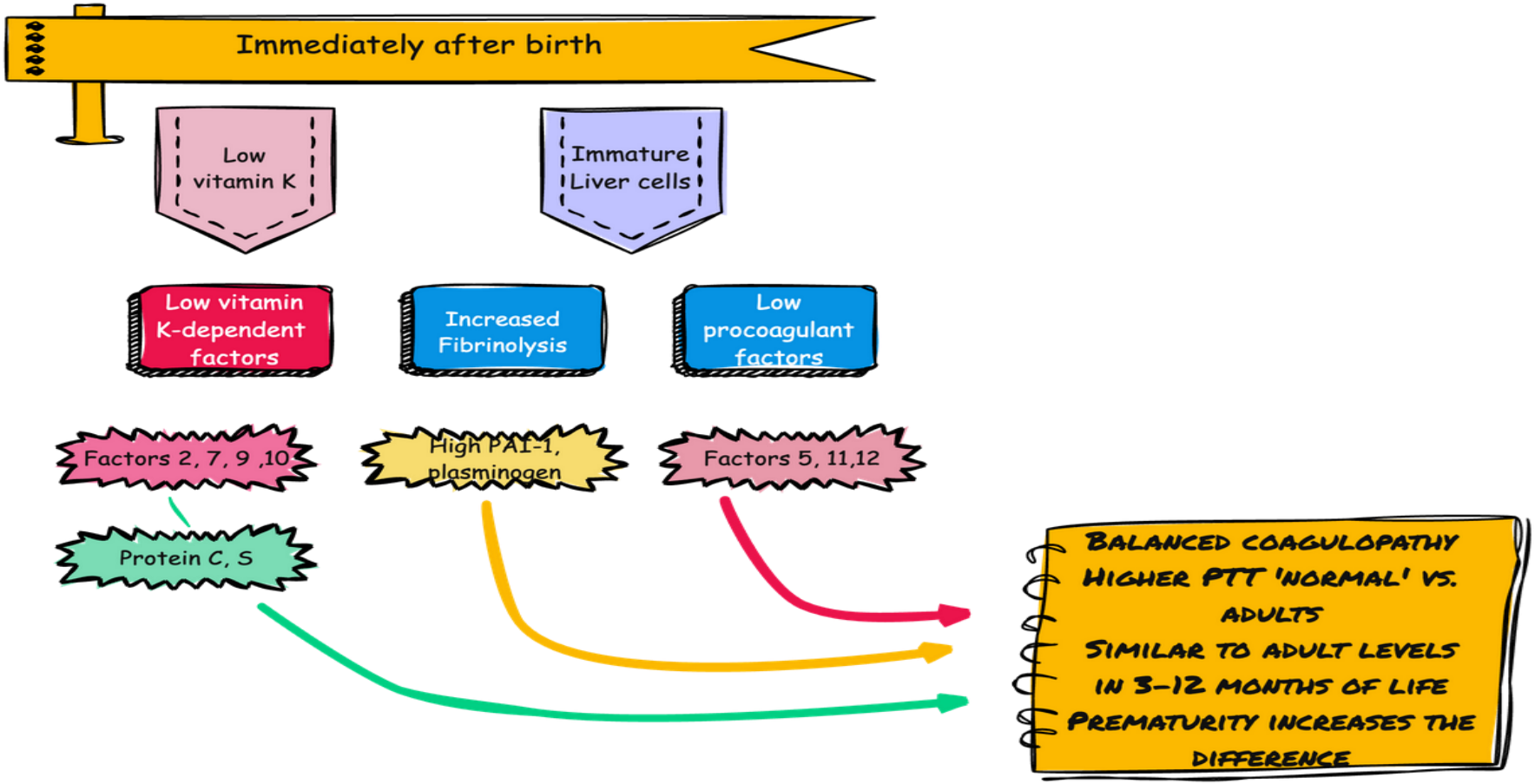
Hct: hematocrit; SD: standard deviation; Hgb: hemoglobin.

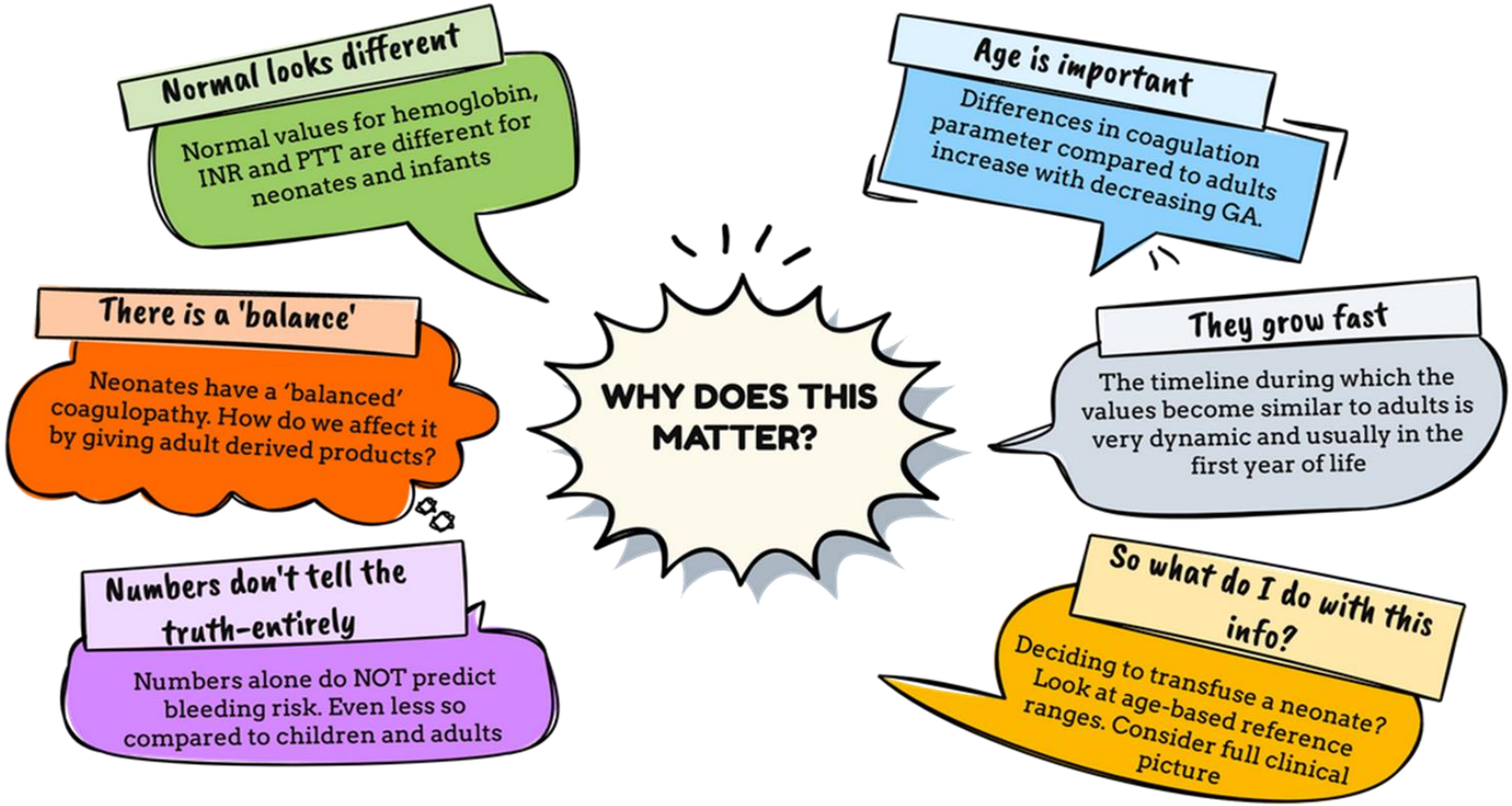
Data from:

1. Jopling J, Henry E, Wiedmeier SE, et al. Reference ranges for hematocrit and blood hemoglobin concentration during the neonatal period: data from a multihospital health care system. Pediatrics 2009; 123:e333.

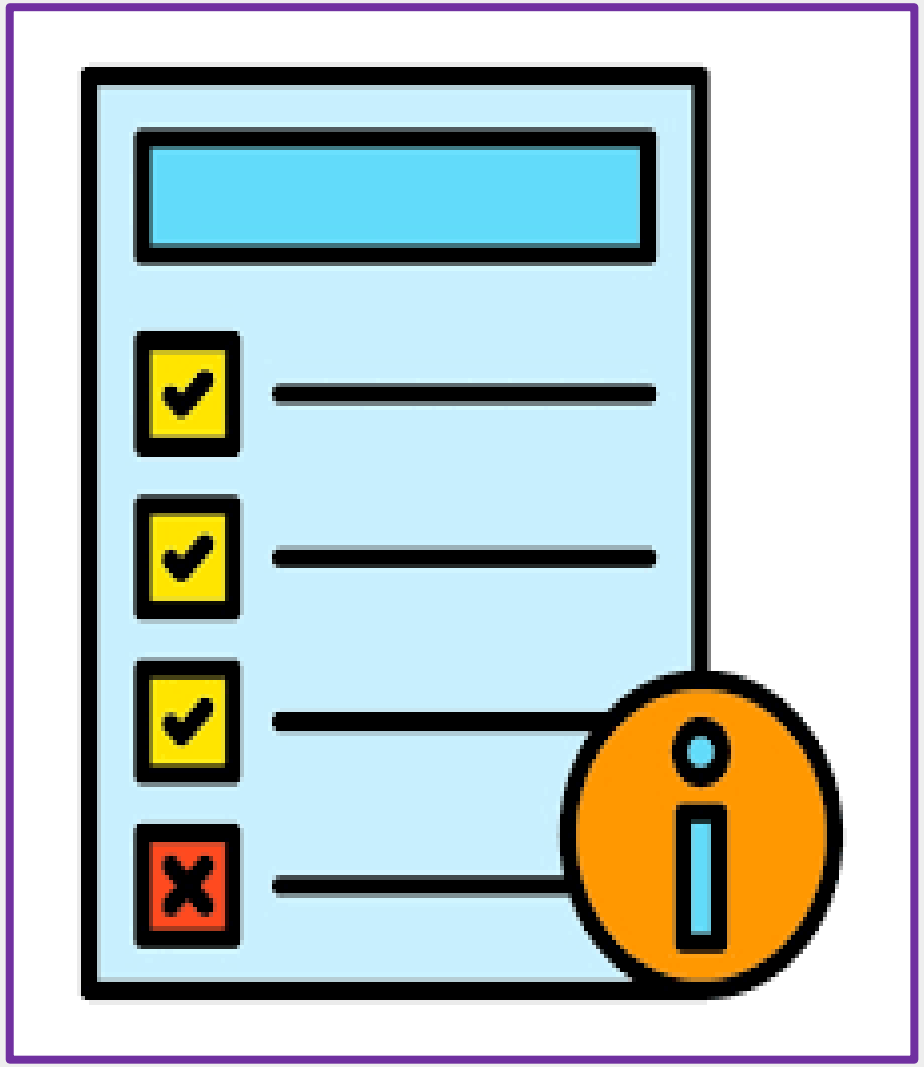
2. Oski FA, Naiman JL. Hematologic problems in the newborn, 2nd ed, WB Saunders, Philadelphia 1972; p.13.

3. Saarinen UM, Siimes MA. Developmental changes in red blood cell counts and indices of infants after exclusion of iron deficiency by laboratory criteria and continuous iron supplementation. J Pediatr 1978; 92:412.


Immediately after birth
Low vitamin K
Immature Liver cells
Low vitamin K-dependent factors
Increased Fibrinolysis
Low procoagulant factors
Factors 2, 7, 9 ,10
Protein C, S
High PAI-1, plasminogen
Factors 5, 11,12
BALANCED COAGULOPATHY
HIGHER PTT 'NORMAL' VS. ADULTS
SIMILAR TO ADULT LEVELS IN 3–12 MONTHS OF LIFE
PREMATURITY INCREASES THE DIFFERENCE


Normal looks different
Normal values for hemoglobin, INR and PTT are different for neonates and infants
Age is important
Differences in coagulation parameter compared to adults increase with decreasing GA.
There is a 'balance'
Neonates have a 'balanced' coagulopathy. How do we affect it by giving adult derived products?
WHY DOES THIS MATTER?
They grow fast
The timeline during which the values become similar to adults is very dynamic and usually in the first year of life
Numbers don't tell the truth-entirely
Numbers alone do NOT predict bleeding risk. Even less so compared to children and adults
So what do I do with this info?
Deciding to transfuse a neonate? Look at age-based reference ranges. Consider full clinical picture

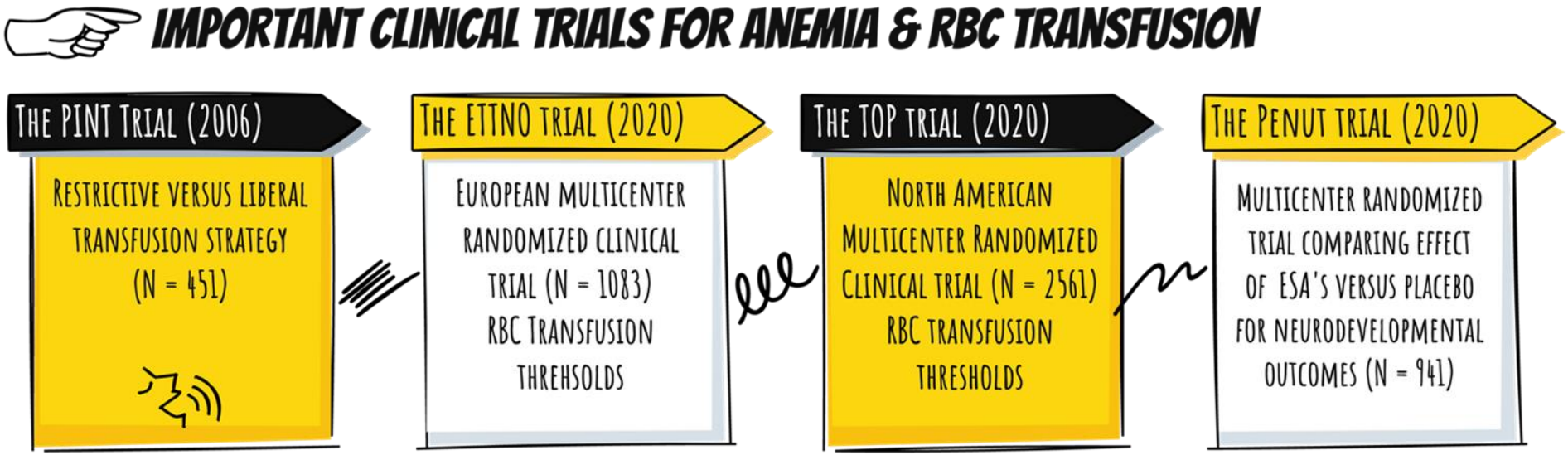
Transfusion Thresholds



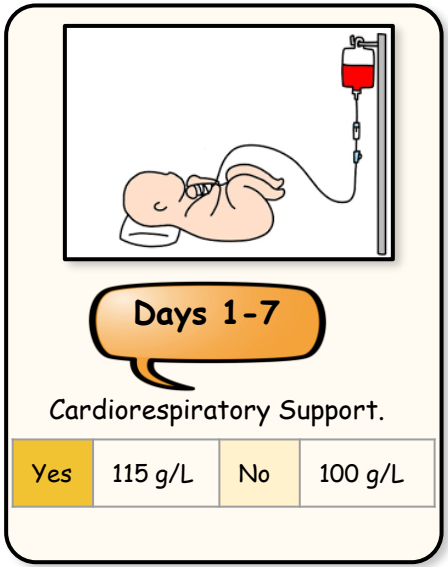
Case 2:
You receive request for RBC transfusion in a 2-day old male in NICU. He was born at 28 weeks gestation. His hemoglobin was 140 at delivery and is 100 today. He is not bleeding.

Is this request appropriate?
How is that determined?

What does that mean for RBC transfusion in neonates



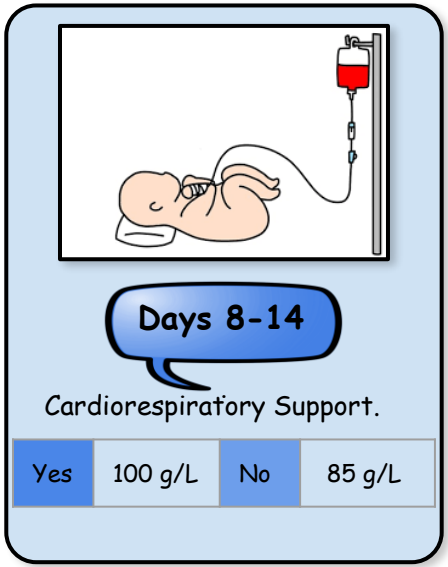
Red cell transfusion thresholds for non-bleeding neonates



Days 1-7

Cardiorespiratory Support.

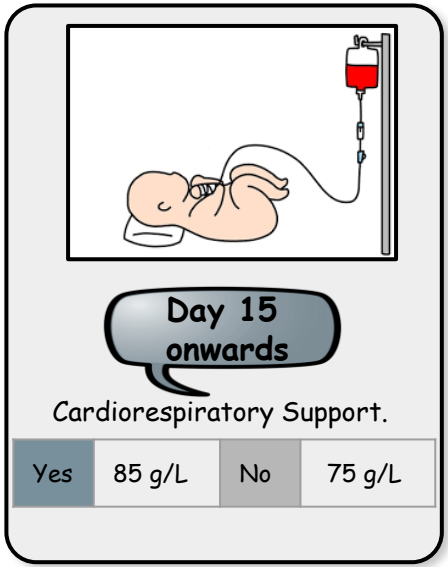
Yes	115 g/L	No	100 g/L



Days 8-14

Cardiorespiratory Support.

Yes	100 g/L	No	85 g/L



Day 15 onwards

Cardiorespiratory Support.

Yes	85 g/L	No	75 g/L

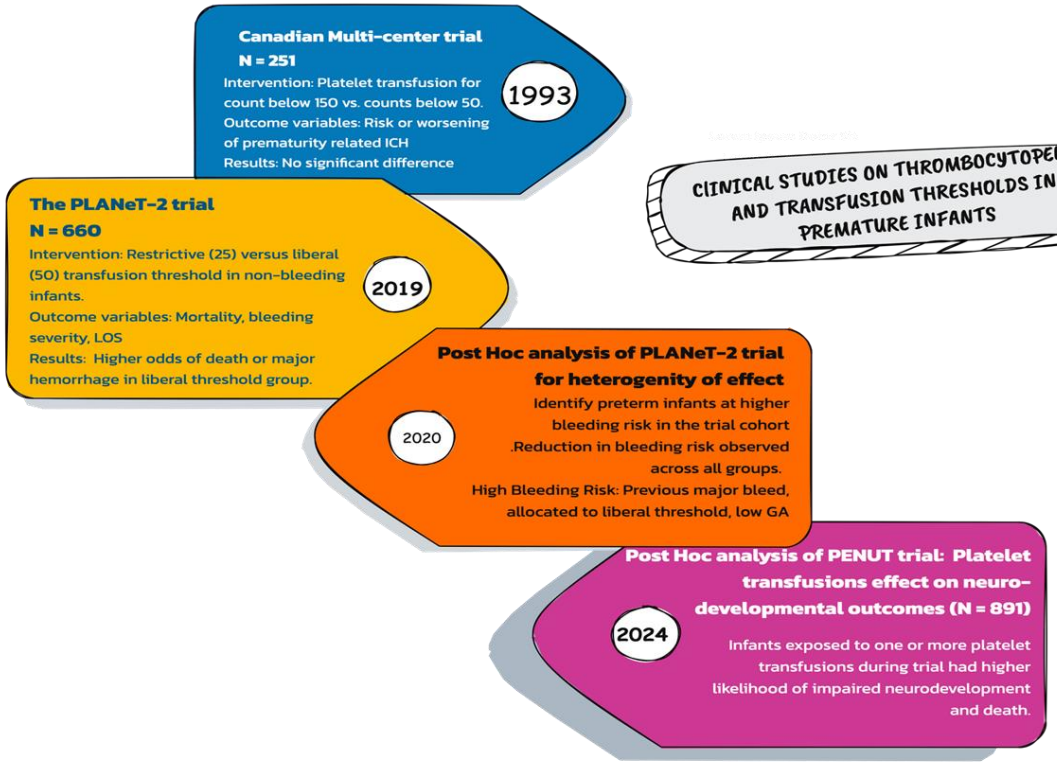
Case 3:
A 5-day-old infant born at 30-weeks gestation had a head US done today. It showed a grade 1 hemorrhage in CNS ventricles which is stable compared to last imaging. His CBC is shown below.

Is platelet transfusion an appropriate next step for him?

WBC count	10 x 10^9/L
Hemoglobin	120 g/L
Platelets	68 x 10^11/L

Research favors a restrictive transfusion threshold for platelets at 25 in non-bleeding neonates and infants

Low grade prematurity related CNS bleeds alone should not prompt platelet transfusion unless count is < 25-50



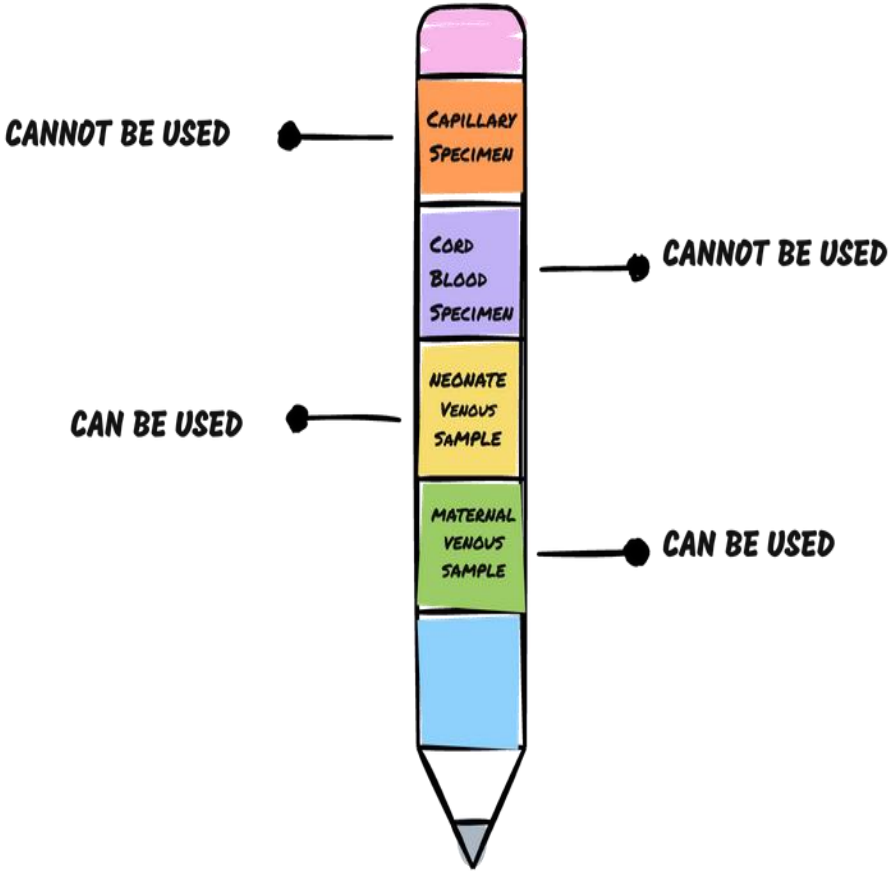
Pre-transfusion testing conundrums

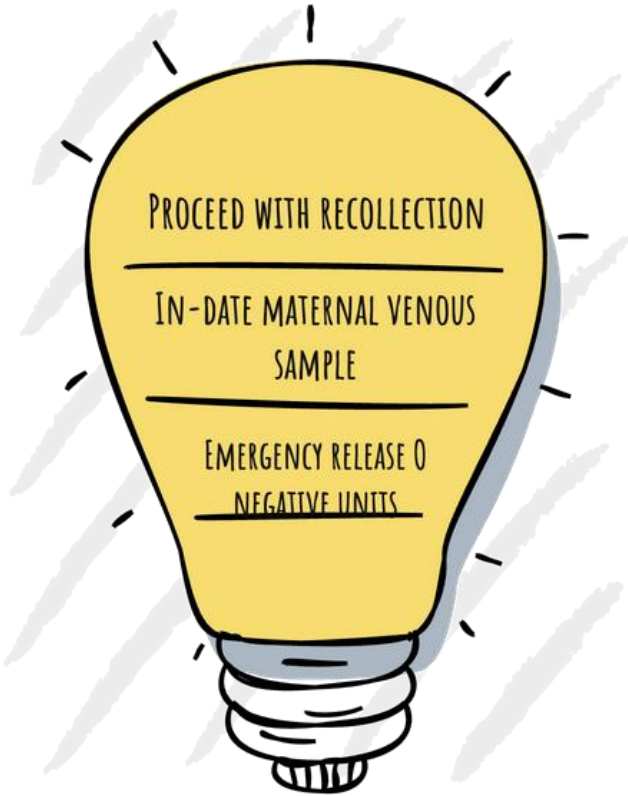
Case 4:

A red cell transfusion is ordered for an NICU infant at 5-days of life. His requisition for pre-transfusion type and screen is not signed by any clinical care providers. When you request a recollection, the nurse says ‘well, he is an extremely hard draw and really needs blood, can I just come down and sign the requisition?’

How do you approach this scenario

WHAT CAN I USE FOR NEONATAL GROUP, SCREEN AND CROSSMATCH





POTENTIAL SOLUTIONS

Case 5:

A new technologist gets an order for blood group typing in a neonate. Following are the results

Anti-A	Anti-B	Anti-A,B	A1 cells	B cells
0	0	0	0	0

What is the blood type for the neonate?

ANTI-A AND ANTI-B ANTIBODIES IN NEONATES

1

Naturally Occurring Isoheamagglutinins

Require exposure to A and B antigens in food and gut flora

2

Antibodies in Neonatal plasma are of maternal origin

IgG anti-A/B, antibodies against minor RBC antigens or anti-D via recent maternal RhIg

3

Infants de novo isoheamagglutnins

Develop by 3-6 months of life

4

Pre-transfusion testing in first 4 months

May only reveal forward type and no reverse type

Blood group O RhD compatible

Current common practice in most North American Institutions

ABO specific RhD compatible

CAN be given to neonates.

Caveat with ABO specific RBCs

ABO compatibility with mother. As maternal IgG anti-A/B antibodies can be detected in neonatal plasma

Blood Administration specifics

Case 6:

A nurse is preparing to infuse 22 ml of red cells to a 1500 gram neonate in NICU.

Physician order recommends to give over 4 hours.

The TML sends a 300 ml unit of red cells up to NICU

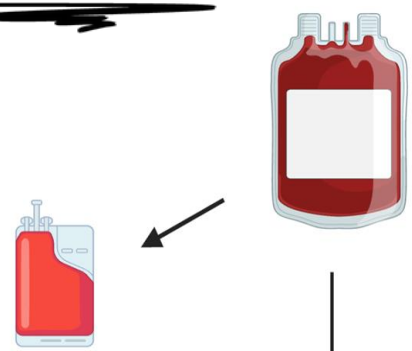
How to approach this scenario?

Small volume blood transfusions in infants

01 Small volume blood transfusion practices different across different facilities

02 Depending on TML aliquoting ability, discard of remaining unit may occur

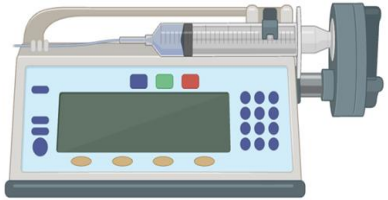
03 Familiarize your self with the local NICU practice and and blood bank aliquoting ability



Desired amount into transfer pack

Blood bank aliquots the units

Into syringe for infusion



The prescribed amount directly from the unit

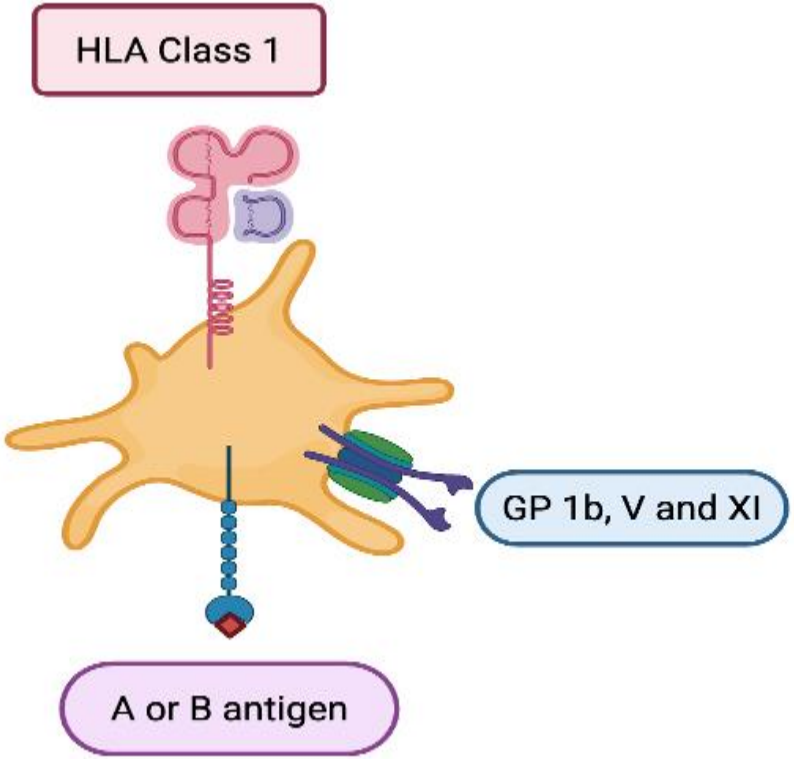
Blood Product Modification

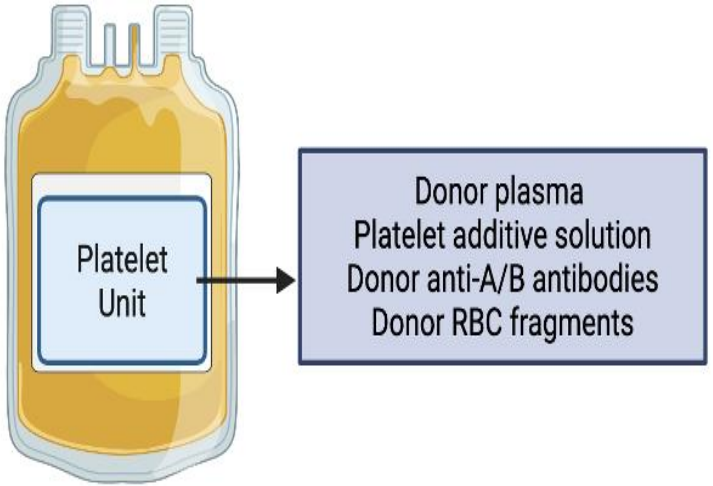
Case 7:

You receive a request for platelet transfusion for a neonate who is A positive. The blood bank only has O positive platelets at time.

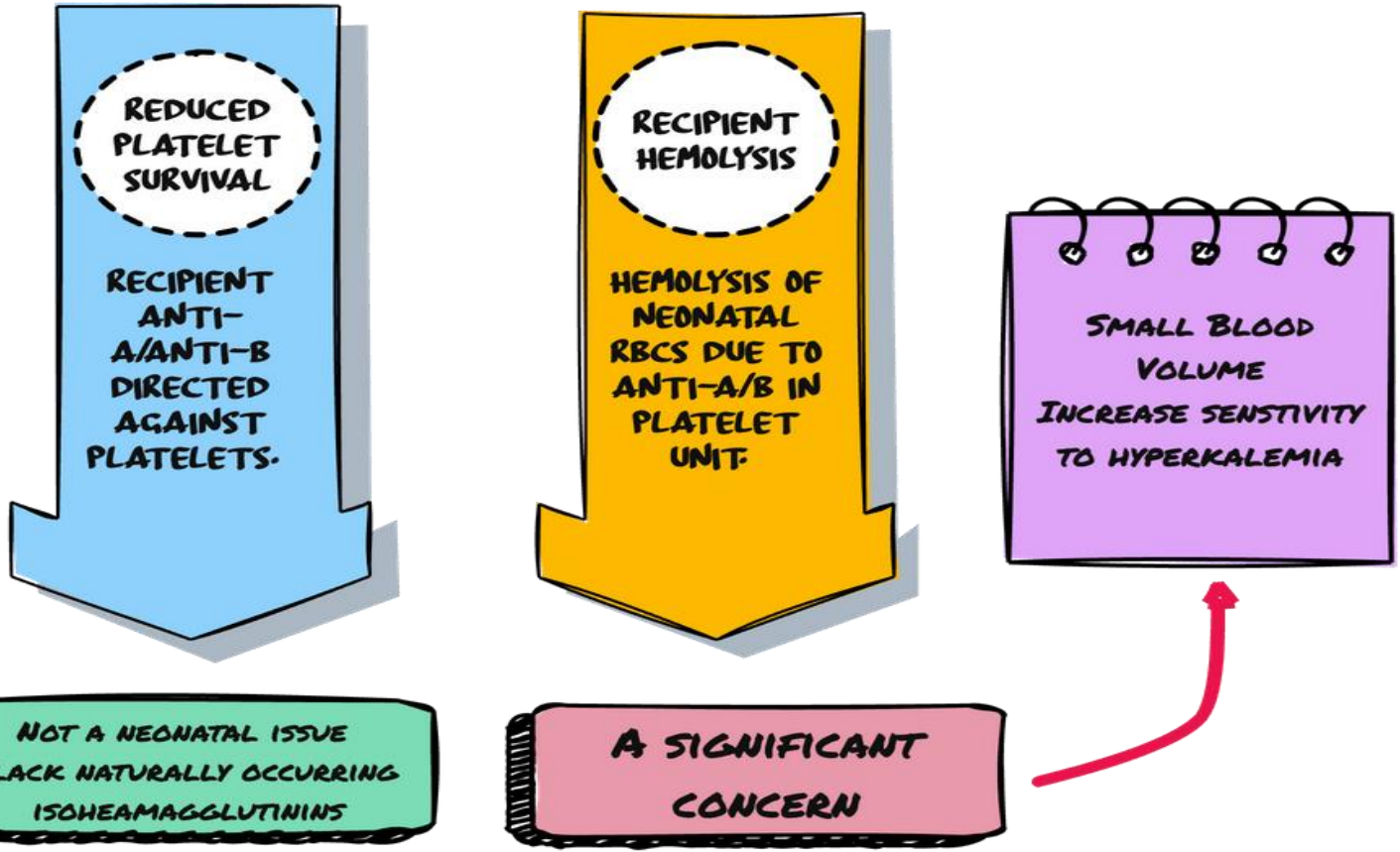
Does this matter?

How do you approach this situation?

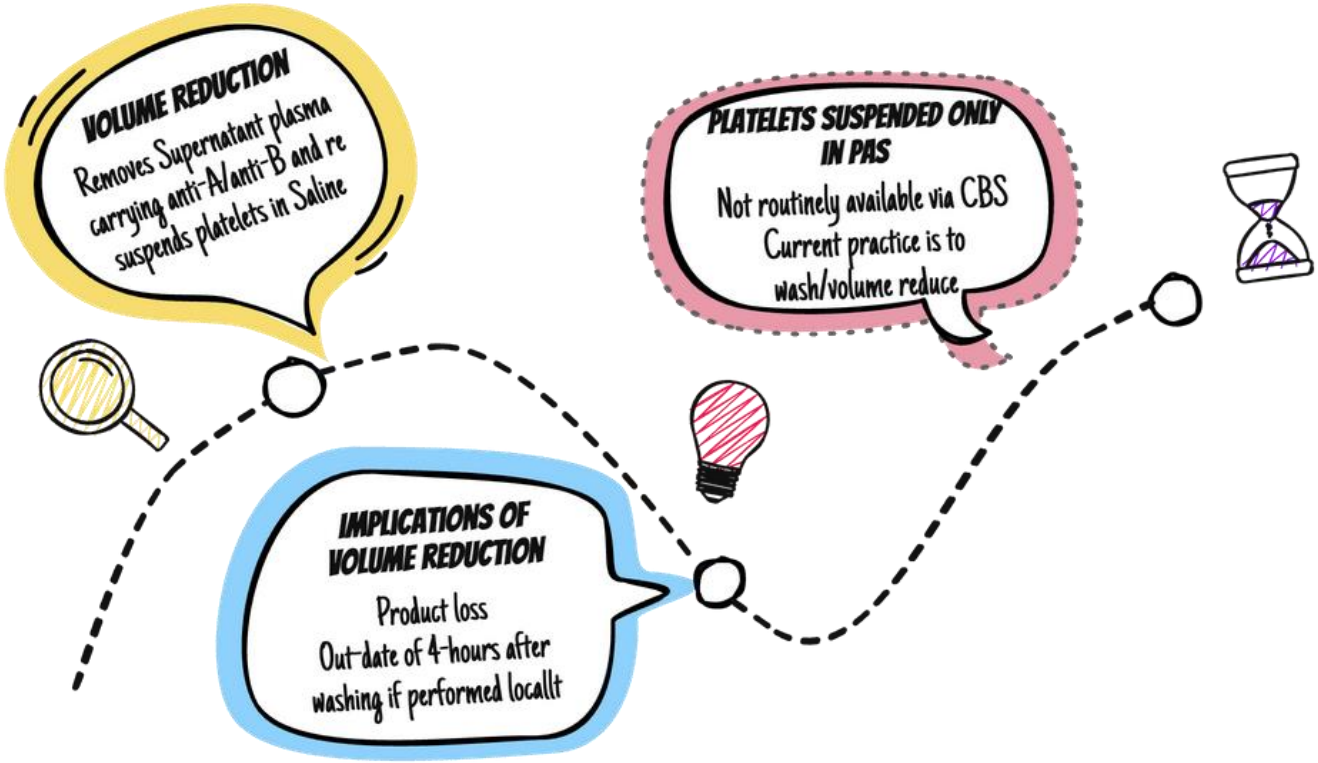

HLA Class 1
GP 1b, V and XI
A or B antigen


Platelet
Unit
Donor plasma
Platelet additive solution
Donor anti-A/B antibodies
Donor RBC fragments

Implications of ABO incompatible platelets for neonates



HOW TO ISSUE ABO INCOMPATIBLE PLATELETS TO NEONATES



Case 8:

You receive a call from RRPL in Saskatoon that Baby Yoda's newborn screen is positive for Severe Combined Immunodeficiency as she has low TRECS.

Why is this information important for the blood bank?

What are they?

Circular DNA fragments in plasma produced during T-cell maturation

Why does it matter in TML?

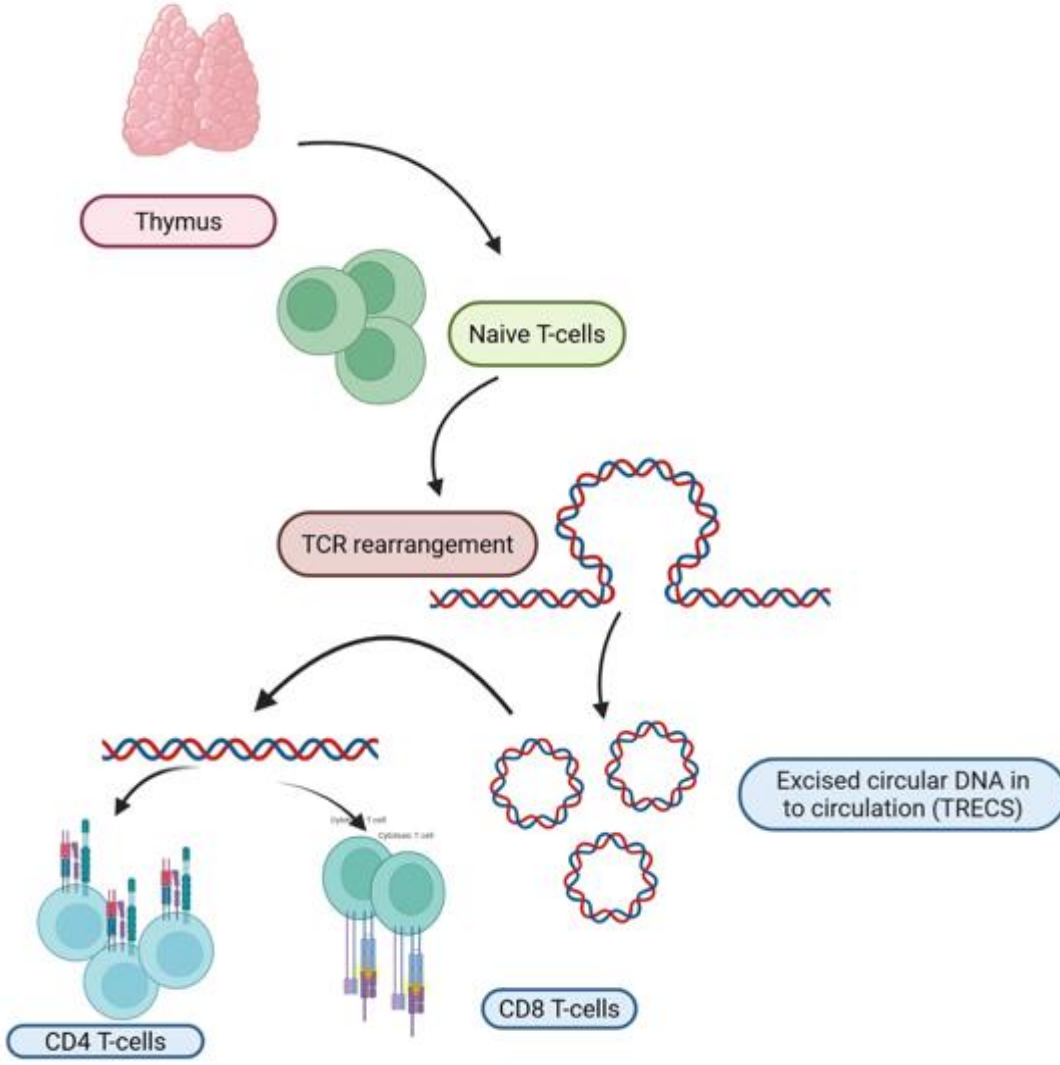
Neonates with SCID are at high risk of developing transfusion associated graft versus host disease

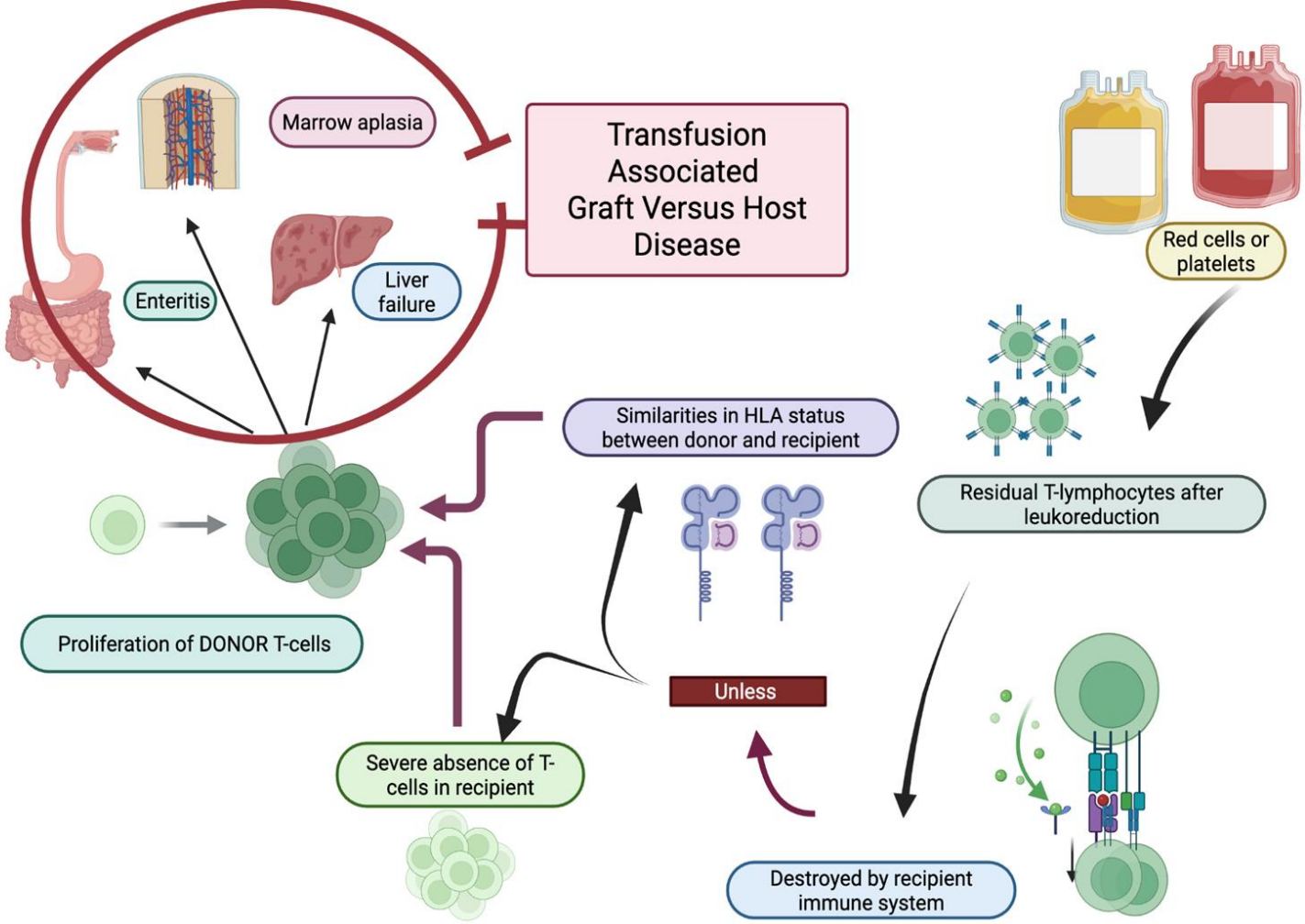
Why do they matter?

Highly sensitive screening tool for severe combined immunodeficiency in neoantes

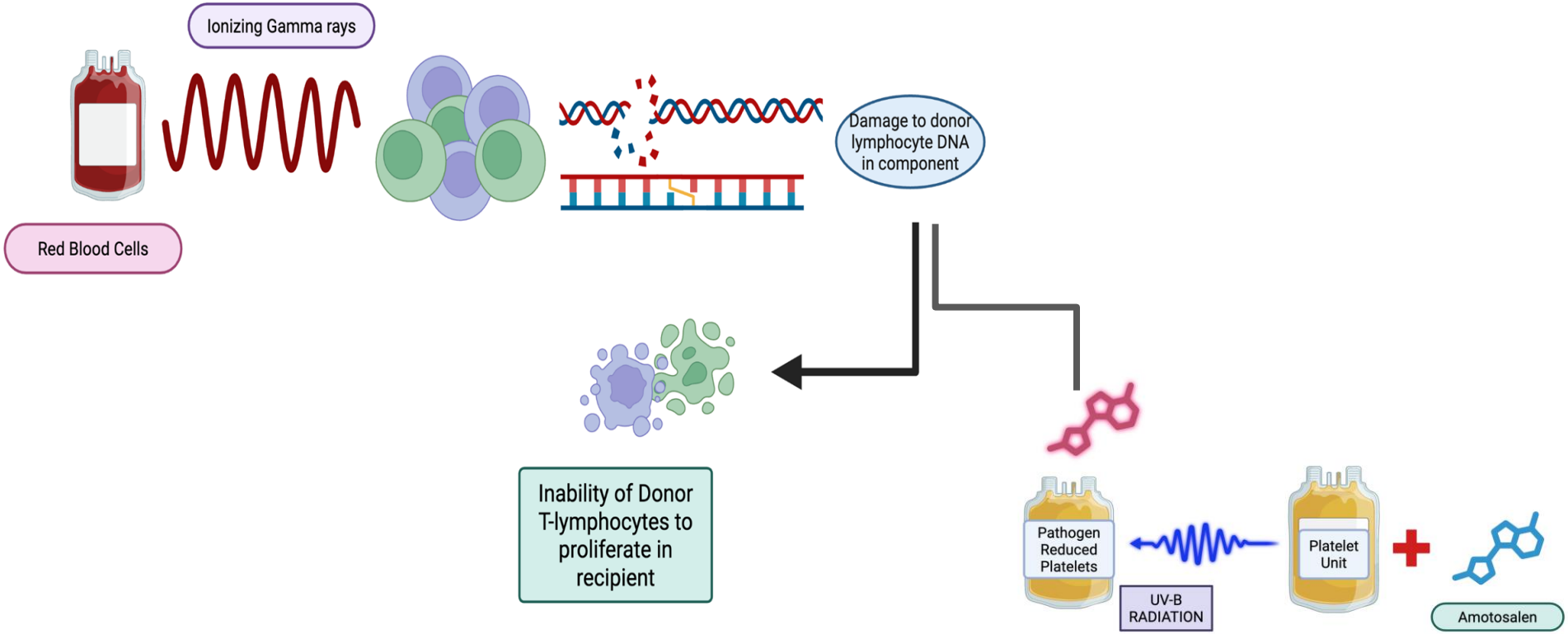
What is the prevention?

Irradiation of blood products

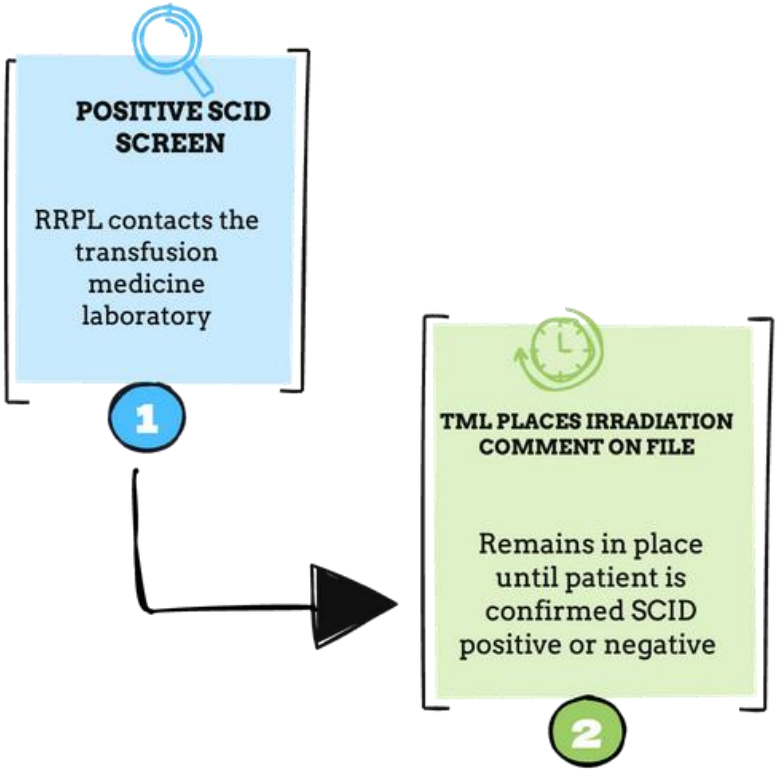



Marrow aplasia
Enteritis
Liver failure
Transfusion Associated Graft Versus Host Disease
Red cells or platelets
Residual T-lymphocytes after leukoreduction
Similarities in HLA status between donor and recipient
Proliferation of DONOR T-cells
Unless
Severe absence of T-cells in recipient
Destroyed by recipient immune system

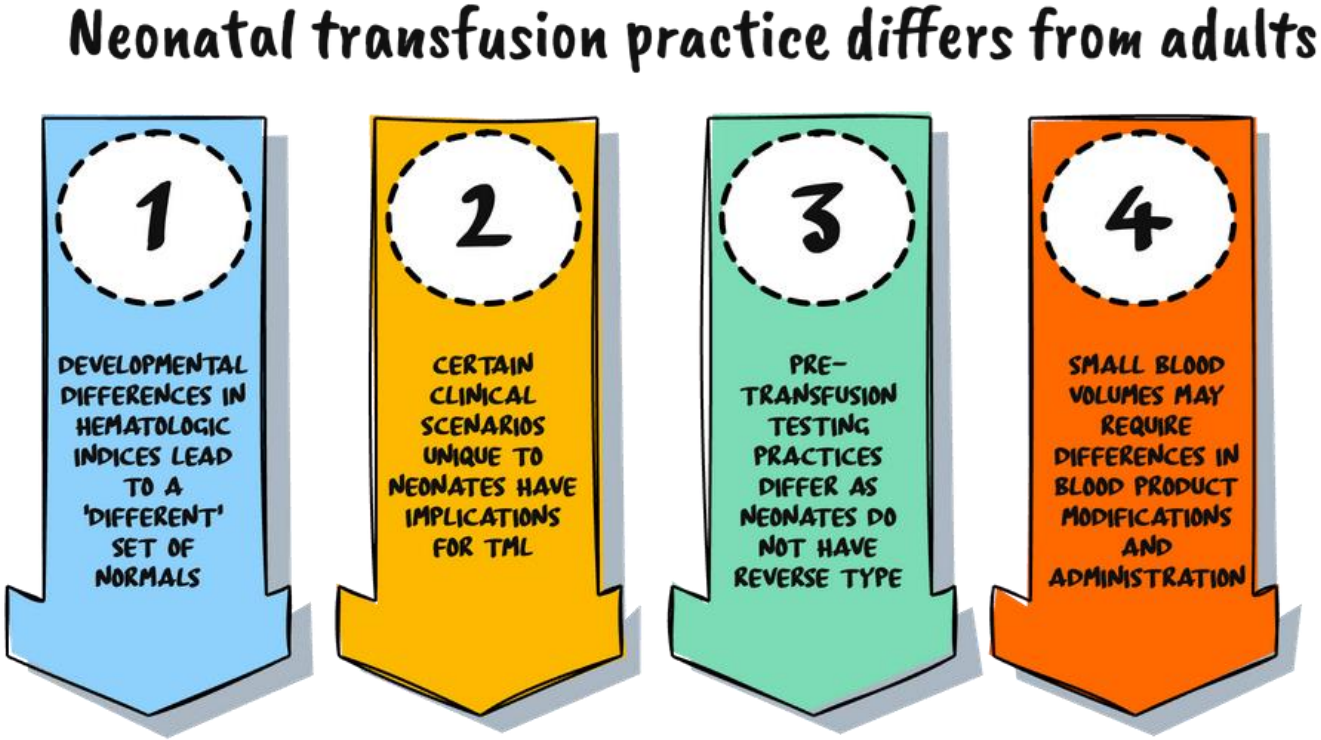
TA-GVHD Prevention strategies



Current Process for neonates screened positive for SCID in SK



Summary


Neonatal transfusion practice differs from adults
1
DEVELOPMENTAL DIFFERENCES IN HEMATOLOGIC INDICES LEAD TO A 'DIFFERENT' SET OF NORMALS
2
CERTAIN CLINICAL SCENARIOS UNIQUE TO NEONATES HAVE IMPLICATIONS FOR TML
3
PRE-TRANSFUSION TESTING PRACTICES DIFFER AS NEONATES DO NOT HAVE REVERSE TYPE
4
SMALL BLOOD VOLUMES MAY REQUIRE DIFFERENCES IN BLOOD PRODUCT MODIFICATIONS AND ADMINISTRATION