

Pediatric massive transfusion protocol

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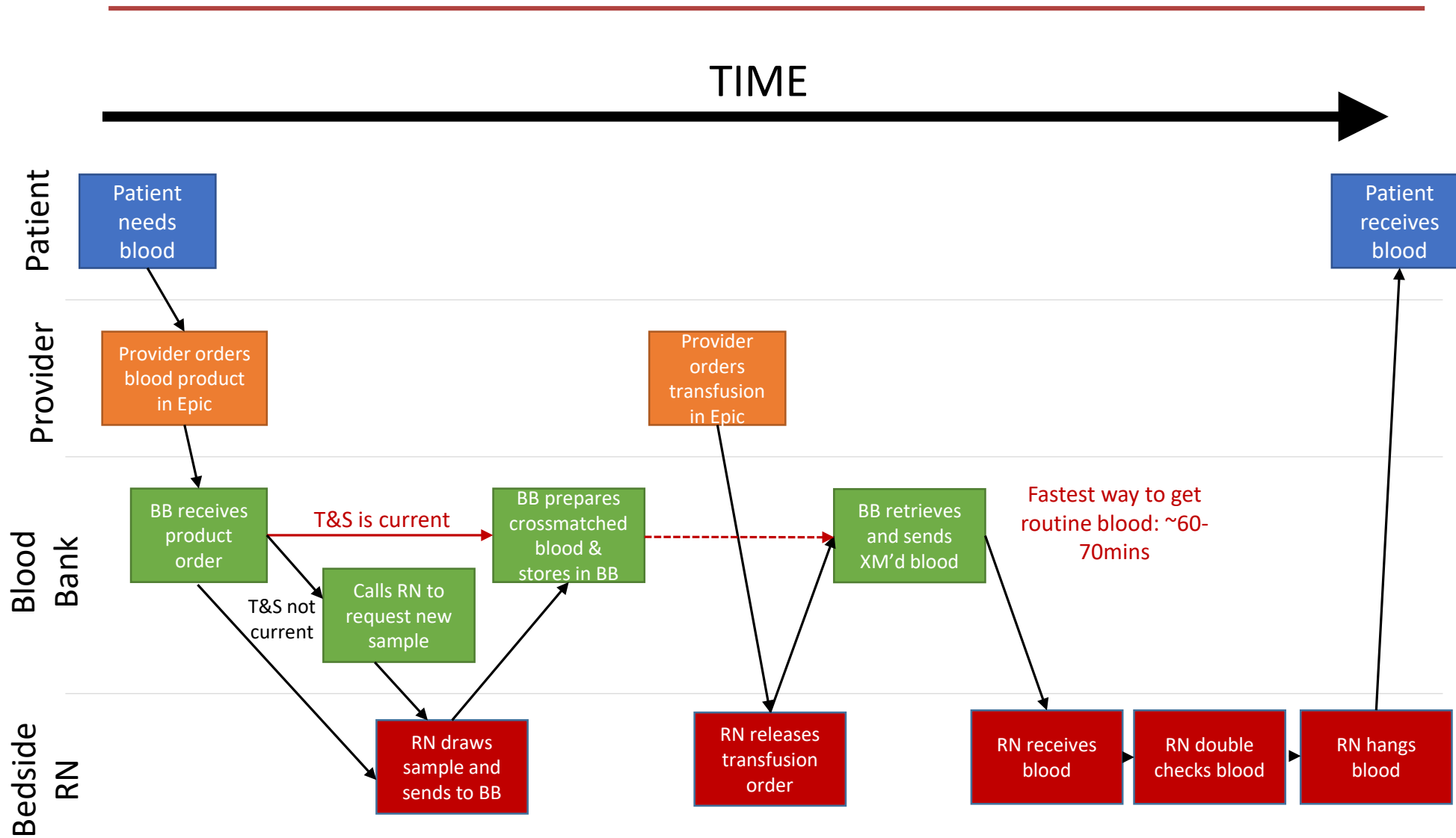
Objectives

1. Understand the different types of emergency-issue blood products available to children and when to use them
2. Compare/contrast pediatric and adult MTP
3. Learn strategies to make MTPs less crazy

Outline

- Compare routine- vs. emergency-issue blood pathways
- Contrast adult vs. pediatric MTP
- Pertinent immunohematologic aspects in peds MTP
- Pertinent hemostasis and metabolic aspects
- Pediatric MTP logistics
- Q&A

Routine blood orders



Repeat for every
product you need...

Routine blood orders

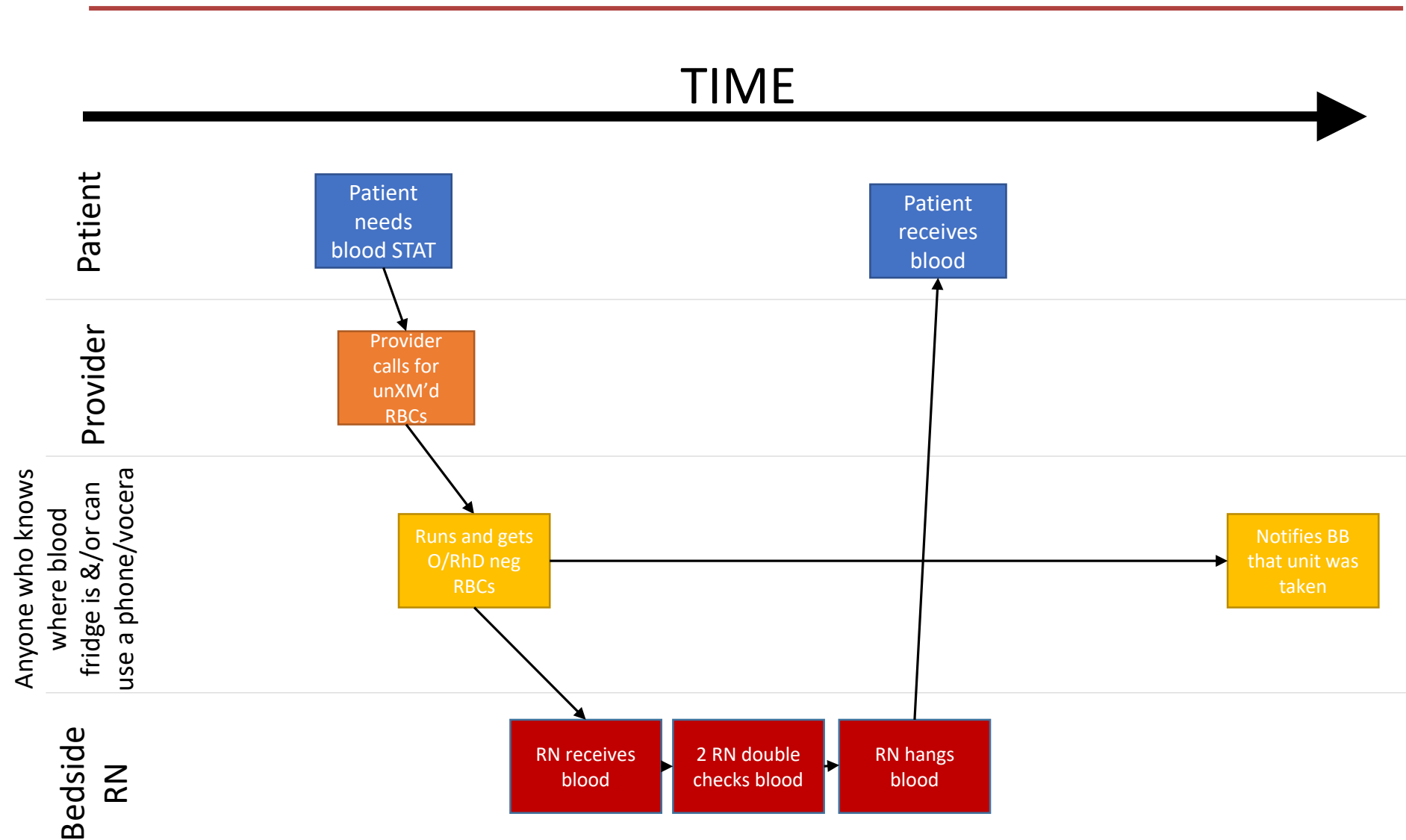
Pros

- We're looking for new alloantibodies every 3 days
- We've proven that the blood is compatible
- Conserves inventory of Group O/RhD neg blood
- Efficient use of skilled staff
- Computer validation and barcode scanning increase safeguards

Cons

- 90% of the time, takes <70 mins
- Requires current T&S sample
- May still alloimmunize recipient to donor antigens

DOR blood fridge: RBCs only



Using Blood from DOR Fridge

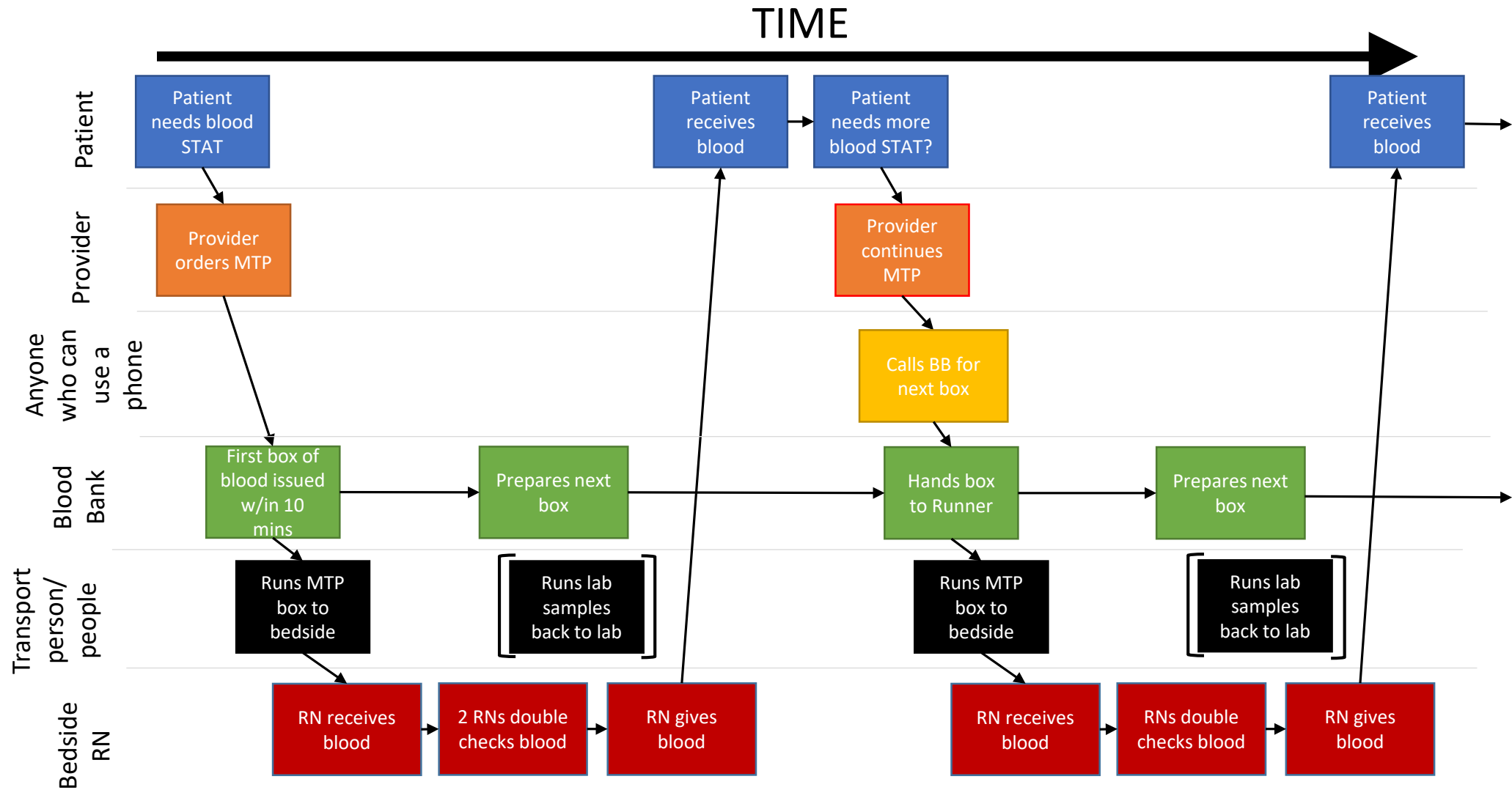
Pros

- 2 units fresh (<7 days from collection) O-neg blood
- Quick
- Efficient use of skilled staff

Cons

- May be incompatible
 - Ie: Recipient has current antibody against donor antigen
- May still alloimmunize recipient to donor antigens
- Uses precious Group O/RhD neg RBCs
- No irradiated units for hem/onc pts
- Two unit of RBCs only
- No electronic safeguards

Massive Transfusion Protocol



Massive transfusion protocol

Pros

- Balanced resuscitation
- Ongoing
- Quick

Cons

- May be incompatible
 - Ie: Recipient has current antibody against donor antigen
- May still alloimmunize recipient to donor antigens
- Uses precious Group O/RhD neg RBCs
- No irradiated units for hem/onc pts
- Labor intensive
- No electronic safeguards

Adults vs. Pediatric MTPs

Adults

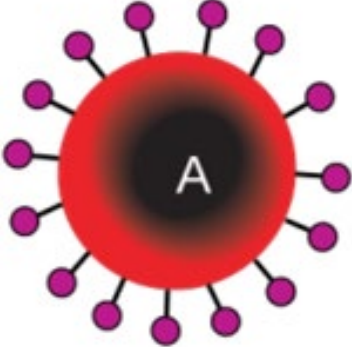

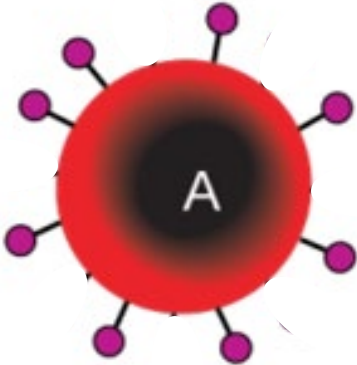
- RCTs to guide practice
- Consistent total blood volume
- Coag levels stable
- RBC antigens/Abs stable
- Some females are of childbearing potential (FCPs)

Kids

- No RCTs for age <15 yo
- Total blood volumes vary by age
- Coag levels vary by age
- Neonatal RBC antigens/Abs immature
- All females are of childbearing potential (FCPs)

Immuno-hematologic considerations

Neonatal RBC antigens and antibodies differ

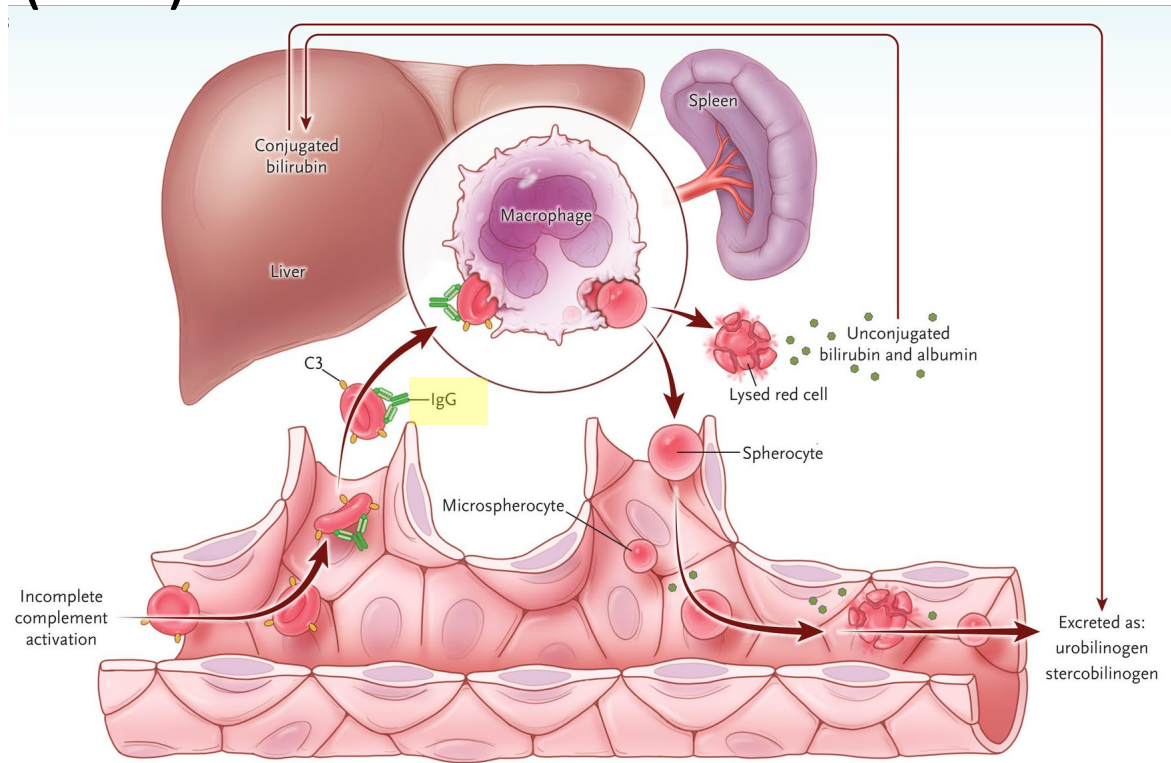
| Group A | RBC antigens | RBC antibodies |
|----------|---|--|
| Adults |  A red blood cell with a red gradient and a black center containing the letter 'A'. It has 15 purple dots on its surface, each with a short black line extending outwards, representing A antigens. |  Anti-B A Y-shaped antibody molecule with two antigen-binding sites, colored in a light teal color. |
| Neonates |  A red blood cell with a red gradient and a black center containing the letter 'A'. It has 10 purple dots on its surface, each with a short black line extending outwards, representing A antigens. | Anti-B doesn't form until ~6mo in healthy term baby |

Low-titer group O whole blood & Group A universal plasma

- “Low titer” in LTOWB varies by manufacturer by 5-fold
- Group A universal plasma not titered
- Due to antigen and antibody differences, can adult studies be extrapolated to kids safely?
 - But what if these measures are withheld from children?
- To date, no adult or pediatric study of LTOWB has detected increased hemolysis in at-risk recipients
- OHSU gives group A universal plasma to any trauma patient >2yo

What if Oneg FCP gets Opos RBCs?

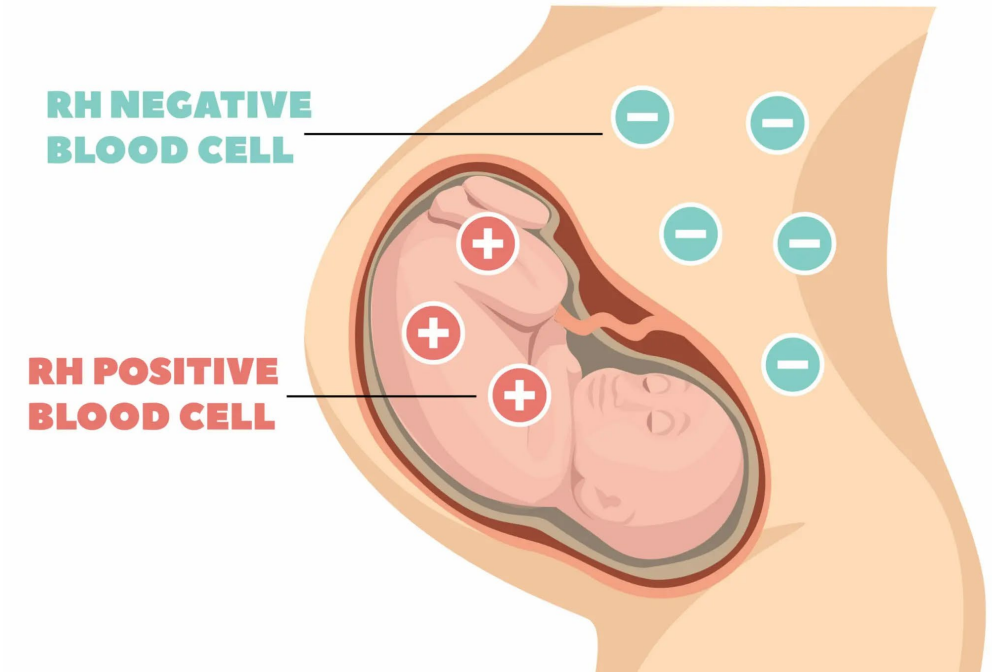
1. Hemolytic transfusion reaction (HTR)



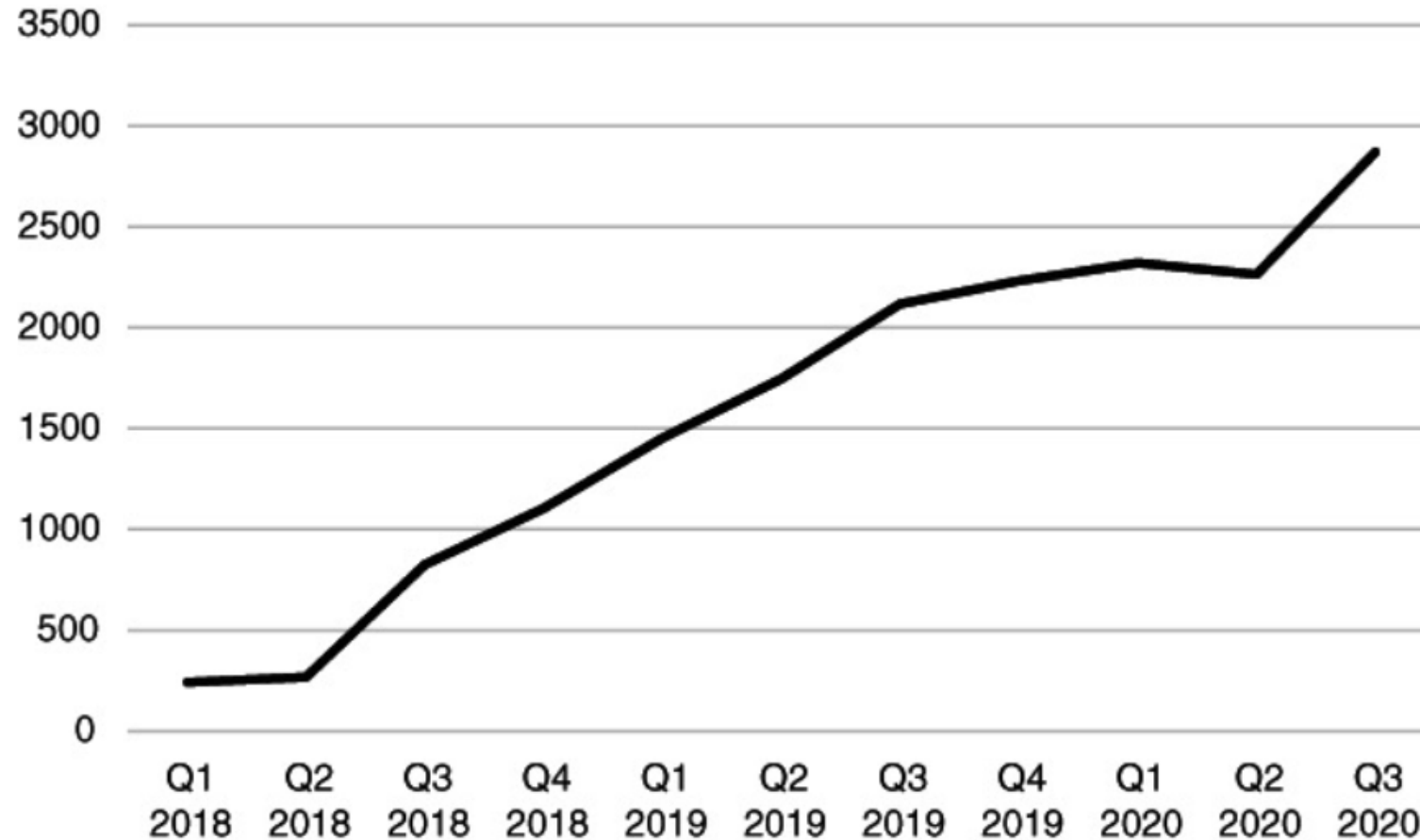
1a. Now

1b. In future

2. Hemolytic disease of the fetus and newborn (HDFN)



Red Cross' group O use over time



- Group O donors are not increasing, maybe even dropping
- LTOWB spreading fewer donors thinner

What if no Onegs to give to Oneg FCPs?

- Death due to exsanguination is bad
- If Oneg FCP exposed to Opos RBCs, one HTR or HDFN event per every ~520 Opos RBC exposure
- Therefore, net benefit if can save 2 lives of FCP out of every 520 exposures by giving early Opos RBCs/LTOWB
- And therefore, exposure to Opos RBCs may not be as bad as it seems and may need to be way of future

Coming soon: LTOWB RCT in pediatrics



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Metabolic and Hemostasis considerations

Potassium concerns in neonates & infants

- Case reports of cardiac arrest in neonates getting massive transfusion
- RBC transfusion >25ml/kg rapidly infused at >0.5 mL/kg/min should be <5-7 days from collection
 - Therefore, “RC7” for MTPs <2 years old at OHSU

“Developmental hemostasis”

Table 3. Reference Values for Coagulation Tests in Healthy Full-Term Infants During the First Six Months of Life

| Coagulation Tests | Day 1 | | Day 5 | | Day 30 | | Day 90 | | Day 180 | | Adult | |
|--------------------------|-------|--------------|-------|--------------|--------|--------------|--------|--------------|---------|--------------|-------|-------------|
| | M | B | M | B | M | B | M | B | M | B | M | B |
| PT (s) | 13.0 | (10.1-15.9)* | 12.4 | (10.0-15.3)* | 11.8 | (10.0-14.3)* | 11.9 | (10.0-14.2)* | 12.3 | (10.7-13.9)* | 12.4 | (10.8-13.9) |
| INR | 1.00 | (0.53-1.62) | 0.89 | (0.53-1.48) | 0.79 | (0.53-1.26) | 0.81 | (0.53-1.26) | 0.88 | (0.61-1.17) | 0.89 | (0.64-1.17) |
| APTT (s) | 42.9 | (31.3-54.5) | 42.6 | (25.4-59.8) | 40.4 | (32.0-55.2) | 37.1 | (29.0-50.1)* | 35.5 | (28.1-42.9)* | 33.5 | (26.6-40.3) |
| TCT (s) | 23.5 | (19.0-28.3)* | 23.1 | (18.0-29.2) | 24.3 | (19.4-29.2) | 25.1 | (20.5-29.7)* | 25.5 | (19.8-31.2)* | 25.0 | (19.7-30.3) |
| Fibrinogen (g/L) | 2.83 | (1.67-3.99)* | 3.12 | (1.62-4.62)* | 2.70 | (1.62-3.78)* | 2.43 | (1.50-3.79)* | 2.51 | (1.50-3.87)* | 2.78 | (1.56-4.00) |
| II (U/mL) | 0.48 | (0.26-0.70) | 0.63 | (0.33-0.93) | 0.68 | (0.34-1.02) | 0.75 | (0.45-1.05) | 0.88 | (0.60-1.16) | 1.08 | (0.70-1.46) |
| V (U/mL) | 0.72 | (0.34-1.08) | 0.95 | (0.45-1.45) | 0.98 | (0.62-1.34) | 0.90 | (0.45-1.32) | 0.91 | (0.55-1.27) | 1.06 | (0.62-1.50) |
| VII (U/mL) | 0.66 | (0.28-1.04) | 0.89 | (0.35-1.43) | 0.90 | (0.42-1.38) | 0.91 | (0.39-1.43) | 0.87 | (0.47-1.27) | 1.05 | (0.67-1.43) |
| VIII (U/mL) | 1.00 | (0.50-1.78)* | 0.88 | (0.50-1.54)* | 0.91 | (0.50-1.57) | 0.79 | (0.50-1.25)* | 0.73 | (0.50-1.09) | 0.99 | (0.50-1.49) |
| vWF (U/mL) | 1.53 | (0.50-2.87) | 1.40 | (0.50-2.54) | 1.28 | (0.50-2.46) | 1.18 | (0.50-2.06) | 1.07 | (0.50-1.97) | 0.92 | (0.50-1.58) |
| IX (U/mL) | 0.53 | (0.15-0.91) | 0.53 | (0.15-0.91) | 0.51 | (0.21-0.81) | 0.67 | (0.21-1.13) | 0.86 | (0.36-1.36) | 1.09 | (0.55-1.63) |
| X (U/mL) | 0.40 | (0.12-0.68) | 0.49 | (0.19-0.79) | 0.59 | (0.31-0.87) | 0.71 | (0.35-1.07) | 0.78 | (0.38-1.18) | 1.06 | (0.70-1.52) |
| XI (U/mL) | 0.38 | (0.10-0.66) | 0.55 | (0.23-0.87) | 0.53 | (0.27-0.79) | 0.69 | (0.41-0.97) | 0.86 | (0.49-1.34) | 0.97 | (0.67-1.27) |
| XII (U/mL) | 0.53 | (0.13-0.93) | 0.47 | (0.11-0.83) | 0.49 | (0.17-0.81) | 0.67 | (0.25-1.09) | 0.77 | (0.39-1.15) | 1.08 | (0.52-1.64) |
| PK (U/mL) | 0.37 | (0.18-0.69) | 0.48 | (0.20-0.76) | 0.57 | (0.23-0.91) | 0.73 | (0.41-1.05) | 0.86 | (0.56-1.16) | 1.12 | (0.62-1.62) |
| HK (U/mL) | 0.54 | (0.06-1.02) | 0.74 | (0.16-1.32) | 0.77 | (0.33-1.21) | 0.82 | (0.30-1.46)* | 0.82 | (0.36-1.28)* | 0.92 | (0.50-1.36) |
| XIII _a (U/mL) | 0.79 | (0.27-1.31) | 0.94 | (0.44-1.44)* | 0.93 | (0.39-1.47)* | 1.04 | (0.36-1.72)* | 1.04 | (0.46-1.62)* | 1.05 | (0.55-1.55) |
| XIII _b (U/mL) | 0.76 | (0.30-1.22) | 1.06 | (0.32-1.80) | 1.11 | (0.39-1.73)* | 1.16 | (0.48-1.84)* | 1.10 | (0.50-1.70) | 0.97 | (0.57-1.37) |

MTP logistics

Total blood volumes by age

| | |
|------------|-----------|
| Preterm | 100 ml/kg |
| Term | 90 ml/kg |
| Infant | 80 ml/kg |
| School Age | 75 ml/kg |
| Adult | 70 ml/kg |

Contributes to:

- Varying transfuse “dose”
- Risk of fluid overload

MTP details that vary within and amongst hospitals

1. How the MTP order is activated (by computer order, telephone call, etc.)
2. Who can activate it (attending level, trainee, nurse delegate, etc.)
3. Whether and where remote emergency-issue blood is located for immediate transfusion
4. Mode of transportation of units issued from the BB
5. What types and how many of each component is included in each delivery
6. Whether the deliveries happen automatically or if each delivery needs to be requested
7. How and who receives notification when the patient changes location
8. How, when and what laboratory results are ordered
9. Who can double check blood products against the patient identification
10. How and where the double check, unit numbers, transfusion time, etc. is documented
11. How the MTP is discontinued
12. Who are the main clinical and laboratory points of contact

OHSU's MTP

| Approximate age group | Each MTP delivery contains: | |
|-----------------------|--|------------------------|
| | If component-based MTP | If LTOWB-based MTP |
| <2yo | <ul style="list-style-type: none">• 2 units of group O RC7 RBCs• 2 Group AB plasma• ½ - 1 unit apheresis platelets | Not eligible for LTOWB |
| 2-14.9yo | <ul style="list-style-type: none">• 4 units RBCs• 4 units group A or AB plasma• ½ - 1 unit apheresis platelets | 2-4 units LTOWB |
| >15yo | <ul style="list-style-type: none">• 6 units RBCs• 6 units group A plasma• 1 unit apheresis platelets | 5 units LTOWB |

Advice from a blood banker

- Assign roles:
 - One person to direct MTP
 - One person to record
 - One person to communicate with BB. Must call for next delivery
 - Two people to check in blood
- Start with balanced resuscitation
 - Switch to goal-directed resuscitation once bleed slows (CBC, coags, TEG, etc.)
- Have same person running blood to patient and running empty blood boxes and labs back to lab
 - Do not send labs via tube
 - Get empty boxes out of room
- Ask for Blood Bank MD/DO on call PRN

Spread the word!



Upcoming events

OHSU Blood Drive

Tue., 1/4/2022, 8am – 2pm

BICC Gallery

3280 SW Sam Jackson Park Road
Portland, OR 97239

Managing Leaves for Managers

Tue., 1/4/2022, 9 – 11am

Webex

3245 SW Pavilion Loop



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Wednesday, October 19, 2022

Biomedical Information Communications Center

SEE TIMES

3280 SW Sam Jackson Road
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mi | 08:00 AM - 02:00 PM

20 Appointments Remaining

[+ More Details](#)

Thursday, October 20, 2022

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SEE TIMES

3280 SW Sam Jackson Road
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Thursday, October 27, 2022

OHSU Rood Family Pavilion

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3410 S Bond Avenue
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Thank you!



Questions?