Oh “G,” What Role Does the Blood Bank and Transfusion Service Play in Perinatal Care?

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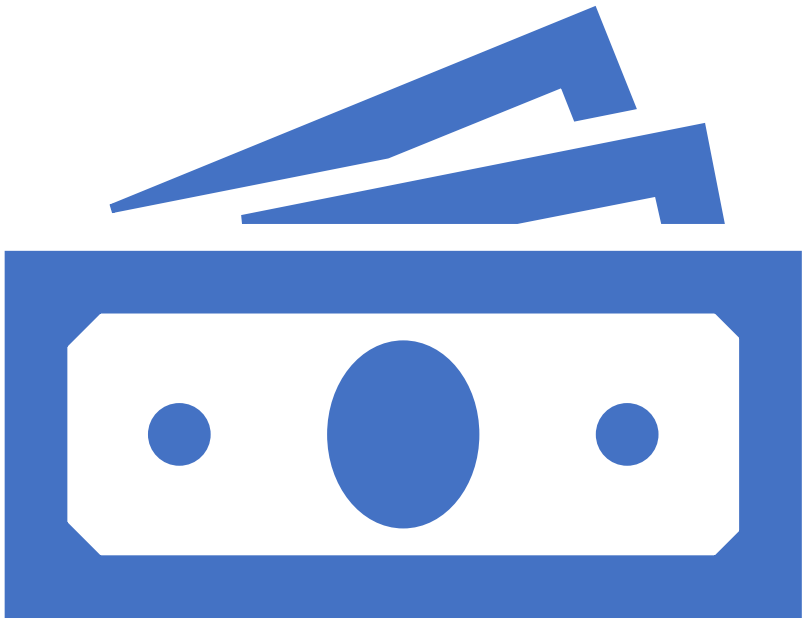
Background

Blood Bank System Coordinator at Billings Clinic

Adjunct Instructor of Immunohematology at Montana State University Bozeman

Board Certified as a Medical Laboratory Scientist and Specialist in Blood Banking



Conflicts of Interest and Financial Disclosures

None

Objectives

1

Recognize the importance of prenatal testing and consistent monitoring of antibodies.

2

Describe the clinical use of available blood products and compare their storage and transport requirements.

3

Describe the importance of Kleihauer-Betke/Fetal Hgb Flow testing and how to appropriately calculate RhIG dosing.

Hemolytic Disease of the Fetus and Newborn (HDFN)

- Occurs when fetal cells enter maternal circulation
- Fetal red blood cell antigens that the mother lacks stimulate her to produce antibodies
- Maternal IgG antibodies cross the placenta and bind to fetal antigens, causing red blood cell destruction

Types of HDFN

ABO	Rh	Alloantibodies other than anti-D
• Most Common • Occurs in 1:125 births • Mild HDFN	• Affects Rh(D) Negative Women • Moderate to Severe HDFN	• Mild to Severe: E, c, C, k, Kp^a, Kp^b, Js^a, Js^b, Jk^a, Jk^b, Fy^a, Fy^b, S, s, and U • Severe: K, Jr^a, Ge

Recommended Prenatal Testing to Identify/Predict HDFN

Initial Prenatal Visit

- ABO/Rh
- Antibody Screen
  - If positive, Antibody Identification and Titration of IgG antibodies

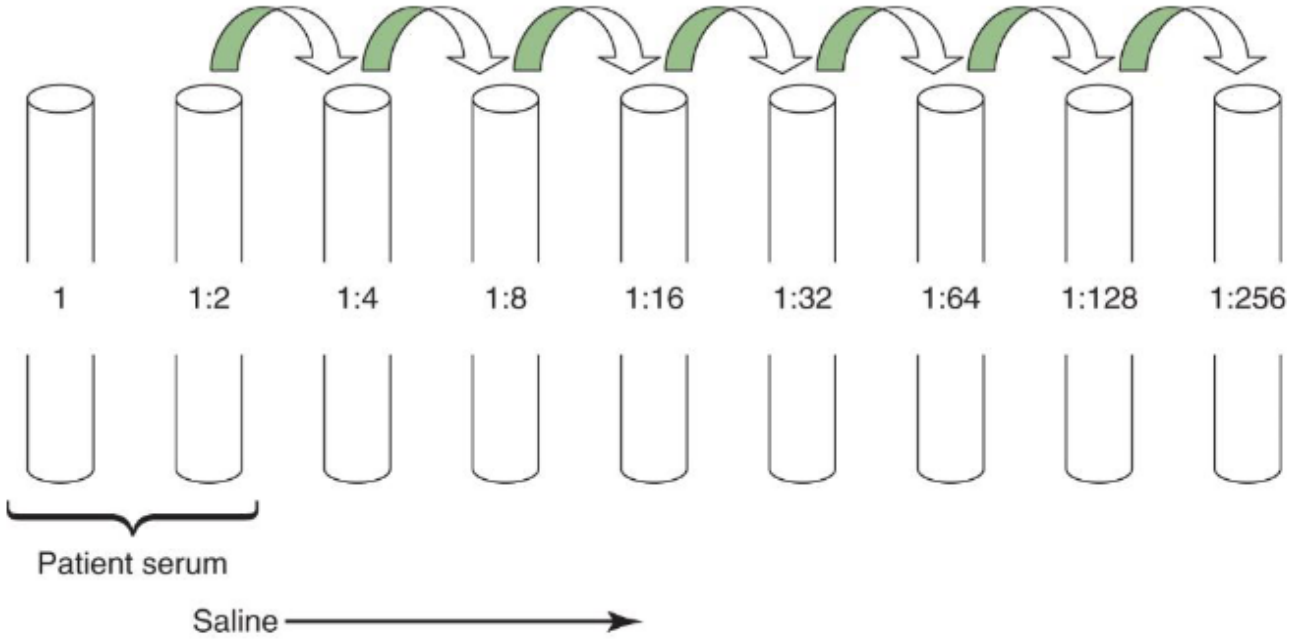
Follow-up Visits (If IgG antibody is identified)

- Antibody Screen with Identification
- Antibody Titration—performed in parallel with initial sample at 4-6-week intervals

26-28 Weeks Gestation

- ABO/Rh to confirm D typing
- Antibody Screen (Rh negative patients)

Antibody Titration



Additional Methods to Monitor HDFN

Middle Cerebral Artery Doppler

Typically done every 2 weeks to track the degree of fetal anemia

>1.5 multiples of the mean (MoM) predicts significant fetal anemia

Cordocentesis

Can be done to collect a sample of fetal blood to determine hematocrit

Opportunities for Fetomateral Hemorrhage

Events of Pregnancy	• Delivery • Antepartum hemorrhage • Spontaneous or therapeutic abortion • Abdominal trauma
Complications of Pregnancy	• Ectopic pregnancy • Stillbirth • Fetal Demise • Placental Abruption
Medical Procedures	• Amniocentesis • Chorionic villus sampling • Cordocentesis • External cephalic version • Manual removal of placenta

Antenatal Care for suspected FMH in Rh(D) Negative Patients

Gestational Age	Fetal Hgb Flow	RhIG dosing
<20 weeks	Not indicated	1 vial
20-28 weeks	Yes	Calculated from Hgb Flow results
28 week (Prophylaxis)	NA	1 Vial
28-40 weeks	Yes	Calculated from Hgb Flow results

*Type and Screen should be performed prior to any RhIG administrations

Upon Admission for Delivery

Hold for Blood Bank

-Low risk for HDFN
-No previous uterine incision
-Singleton pregnancy
-≤ 4 previous vaginal births
-No known bleeding disorder
-No history of PPH

Type and Screen

-Prior cesarean birth or uterine surgery
-Multiple gestation
-> 4 previous vaginal births
-Chorioamnionitis
-History of previous PPH
-Large uterine fibroids

Crossmatch

-Positive Antibody Screen (previous or current)
-Placenta previa, low lying placenta
-Suspected Placenta accreta or percreta
-Hematocrit <30 AND other risk factors
-Platelets <100,000
-Active bleeding on admit
-Known coagulopathy

Available Blood Products

Product	Information	Storage Temp	Transport Temp
 **Red Blood Cells**	**Packed Red Blood Cells:** • Increase recipient's oxygen carrying capacity by increasing the mass of circulating red cells. • Used in treatment of symptomatic or critical deficit of oxygen-carrying capacity. **Whole Blood** • Contains RBC's, plasma, and platelets. • Increases recipient oxygen carrying capacity by increasing the mass of circulating red blood cells. • Used in life-threatening hemorrhage where oxygen carrying capacity, coagulation factors, platelets and volume expansion is needed.	1-6°C	1-10°C
 **FFP/Plasma**	• Serves as a source of plasma proteins (coagulation factors) for patients who are deficient in or have defective plasma proteins. • Used in management of preoperative or bleeding patients who require replacement of multiple coagulation factors (e.g. liver disease, DIC), MTP's, and exchanges in patients with TTP. **EXPIRATION: FFP: 24-Hours from thaw date/time** **PLASMA: 5 days from thaw date/time** **Liquid Plasma: 26 days**	Frozen: ≤-18°C Thawed: 1-6°C	Frozen: ≤-18°C Thawed: 1-10°C

Available Blood Products (cont'd)

Product	Information	Storage Temp	Transport Temp
 **Platelets**	• Goal of platelet transfusion is to provide adequate numbers of normally functioning platelets for the prevention or cessation of bleeding. **Platelets can be off the rocker for a maximum of 24-hours during transport**	20-24°C (Room Temp)	20-24°C (Room Temp)
 **Cryoprecipitate**	• Serves as a source of fibrinogen, vWF, Factor VIII, and Factor XIII. • Used to control bleeding associated with fibrinogen deficiency, and when recombinant and/or virally inactivated preparations of fibrinogen, Factor VIII, Factor XIII, and vWF are not readily available **EXPIRATION: 6-Hours from thaw date/time**	Frozen: ≤-18°C Thawed: 20-24°C (Room Temp)	Frozen: ≤-18°C Thawed: 20-24°C (Room Temp)

Neonate Blood Bank Testing

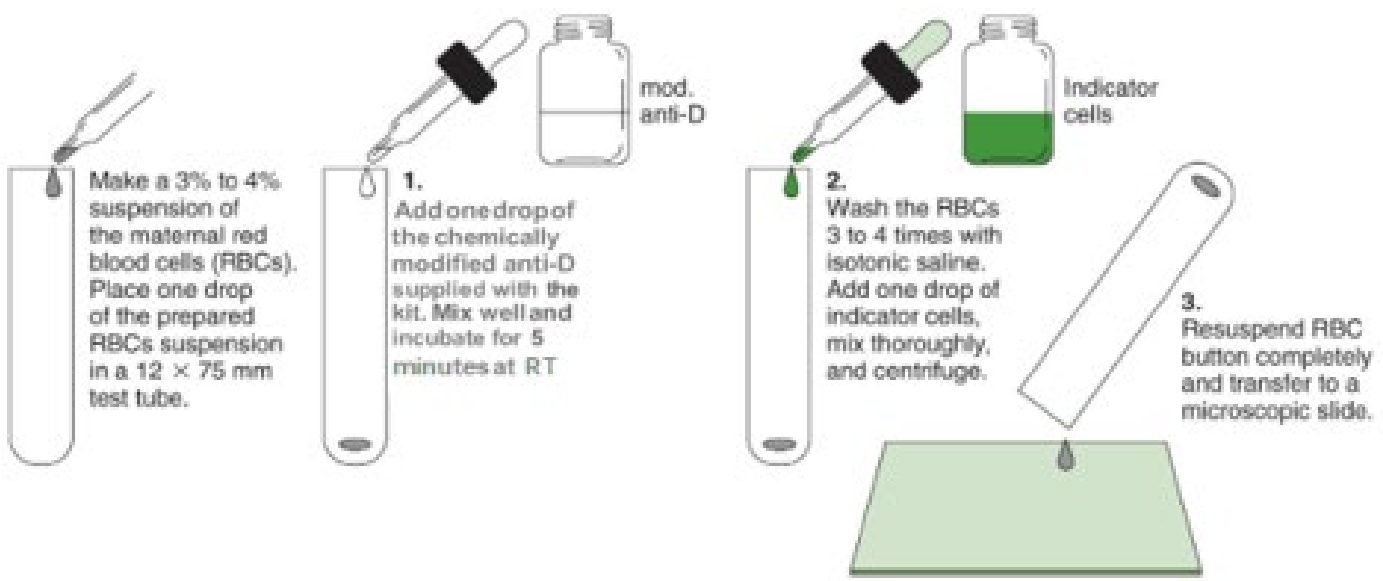
Cord Blood Screen

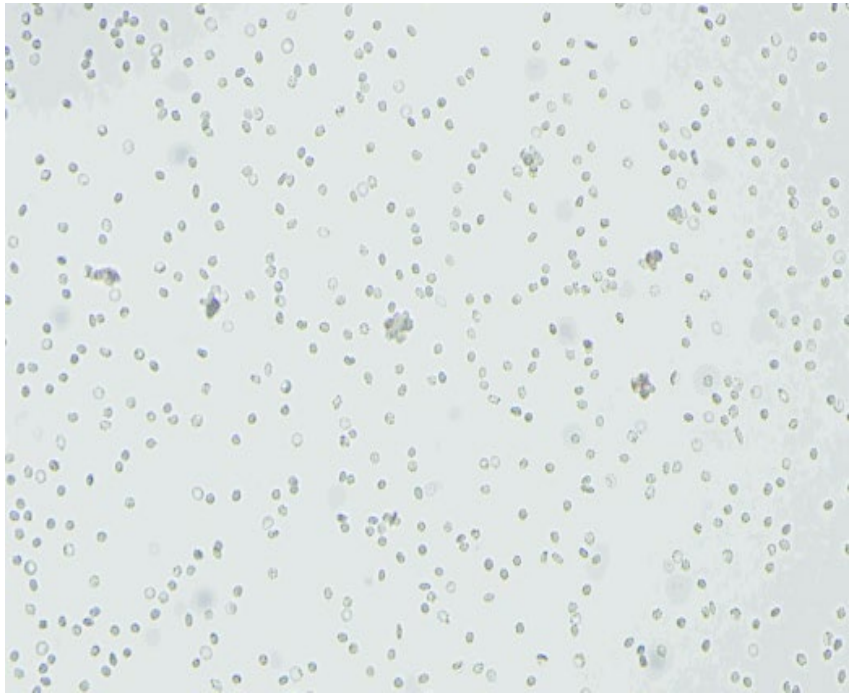
- Includes
  - Neonatal ABO/Rh
  - DAT (IgG Only)
  - Cord Blood Interpretation
  - Maternal Rhogam Interpretation

- REQUIRED on all babies born to Rh(D) Negative mothers
  - Rh of baby is used to determine mother's eligibility for post partum RhIG
- Recommended on all babies born to type O mothers
  - ABO and DAT are used to determine if ABO HDFN is present

Additional Testing: Rh(D) Negative Mothers Who Give Birth to Rh(D) Positive Babies

Fetomaternal Hemorrhage Screen (FMH Screen)

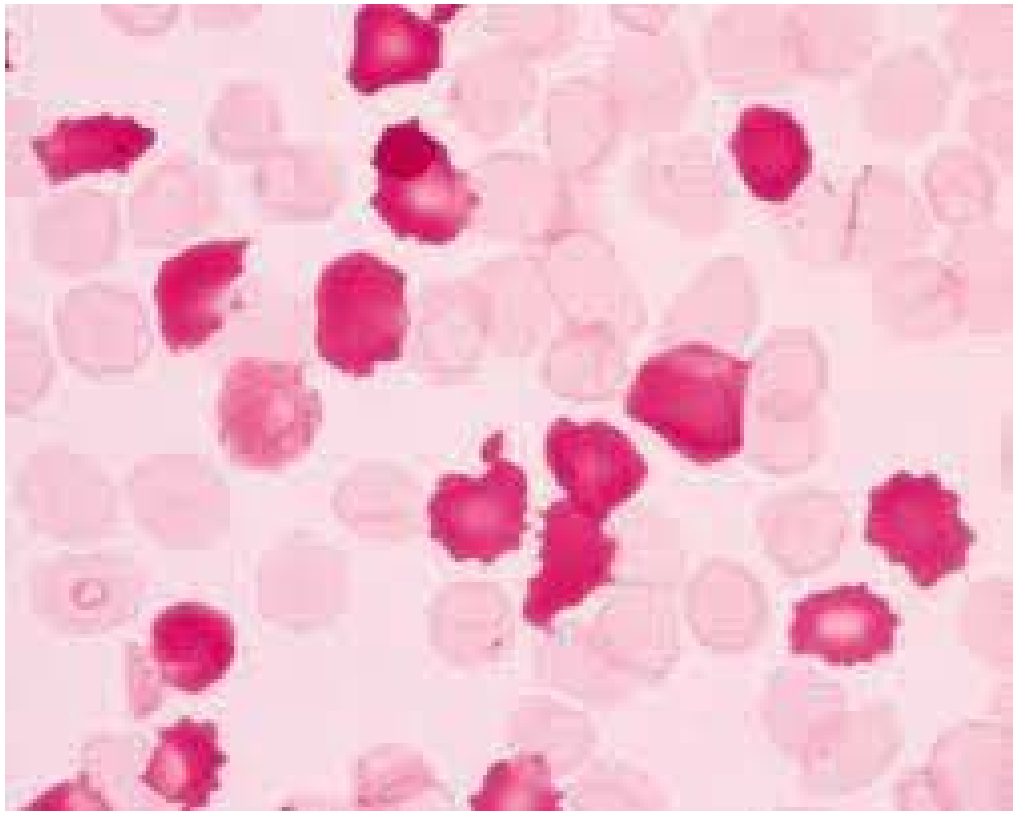




Additional Testing: Rh(D) Negative Mothers Who Give Birth to Rh(D) Positive Babies

Kleihauer-Betke

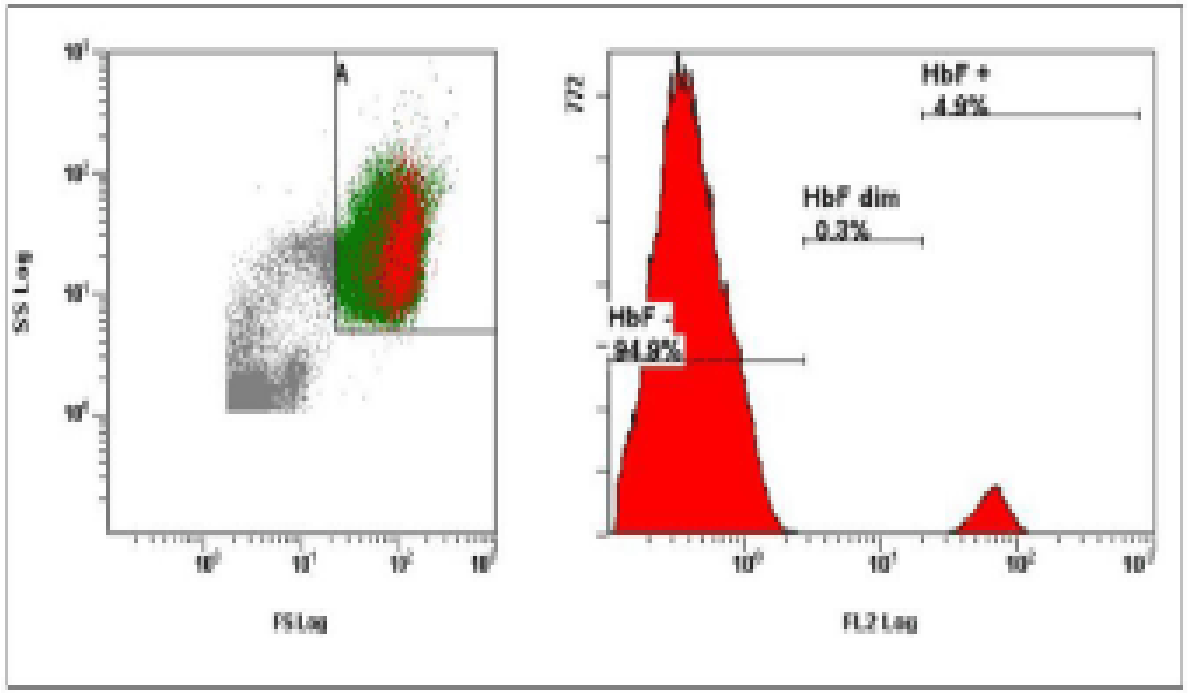
1. Prepare thin blood smears by diluting blood with equal volume saline.
2. Fix and stain smears using erythrosine B followed by Harris hematoxylin.
3. Examine dry smears under 40x magnification, count a total of 2,000 cells and record the number of fetal cells observed.
   - Fetal cells stain dark pink
4. Calculate the percentage of fetal red cells in the total counted.



Additional Testing: Rh(D) Negative Mothers Who Give Birth to Rh(D) Positive Babies

Fetal Hgb Flow

1. Fluorescent tags are added to well mixed maternal sample collected after delivery and incubated, then washed
   - Fetal cells-antibody to HbF
   - Maternal cells-antibody to Carbonic Anhydrase (CA)
2. Sample is placed into flow cytometer and at least 50,000 events are read.
3. # of HbF and CA are counted and percent of HbF is determined.



Calculating RhIG Doses

Current Height and Weight Provided

First, calculate Body Surface Area (BSA):

$$\text{BSA } (m^2) = \sqrt{\frac{(h \times w)}{3600}}$$

h=height in centimeters *w*=weight in kilograms

*round to 3 decimal places

Next, calculate Total Blood Volume (TBV):

$$\text{TBV (mL)} = \text{BSA } (m^2) \times 2370 \text{ (mL/m}^2\text{)}$$

$$Whole\ Blood\ FMH\ (mL) = \left(\frac{\%\ fetal\ cells}{100}\right) x\ TBV$$

$$\#\ Vials\ of\ RhIg = \frac{Whole\ Blood\ FMH\ (mL)}{30\ \left(\frac{mL\ Whole\ Blood}{vial}\right)}$$

If # after decimal point is…	Then…	And…
<5	Round down	Add 1 vial
≥5	Round up	Add 1 vial

RhIG Calculation Example

Current Height and Weight Provided

First, calculate Body Surface Area (BSA):

$$\text{BSA } (m^2) = \sqrt{\frac{(h \times w)}{3600}}$$

h=height in centimeters *w*=weight in kilograms

*round to 3 decimal places

Next, calculate Total Blood Volume (TBV):

TBV (mL)= BSA (m^2) x 2370 (mL/m^2)

Patient weighs 84 kg and is 172 cm

1.5% fetal cells were detected

- BSA=2.003m^2
- TBV=4747 mL

RhIG Calculation Example (cont'd)

$$Whole\ Blood\ FMH\ (mL) = \left(\frac{\%\ fetal\ cells}{100}\right) x\ TBV$$

$$\#\ Vials\ of\ RhIg = \frac{Whole\ Blood\ FMH\ (mL)}{30\ \left(\frac{mL\ Whole\ Blood}{vial}\right)}$$

If # after decimal point is...	Then...	And...
<5	Round down	Add 1 vial
≥5	Round up	Add 1 vial

- Whole Blood FMH (mL)= 71.2 mL
- # Vials=2.4
- # after the decimal is <5, so we round down and add 1
- Total # of vials given= 3

Questions?

Case Study

29-year-old G2P1 patient presented at an outside facility at 10 weeks and 4 days with planned pregnancy. At this visit, the prenatal panel was ordered, which included an ABO/Rh and Antibody Screen.

O Negative	Positive Antibody Screen

At this time, it was also noted that with her first pregnancy, she was induced and had an operative vaginal delivery (vacuum extraction). She had a positive antibody screen (passive anti-D), which led to post partum dose of RhIG getting missed even though baby was Rh(D) positive.

Case Study (cont'd)

Patient was referred to MFM at our facility, where an ABO/Rh and Antibody Screen were repeated.

- O Negative
- Positive Antibody Screen—Anti-D and anti-C were identified

Questions

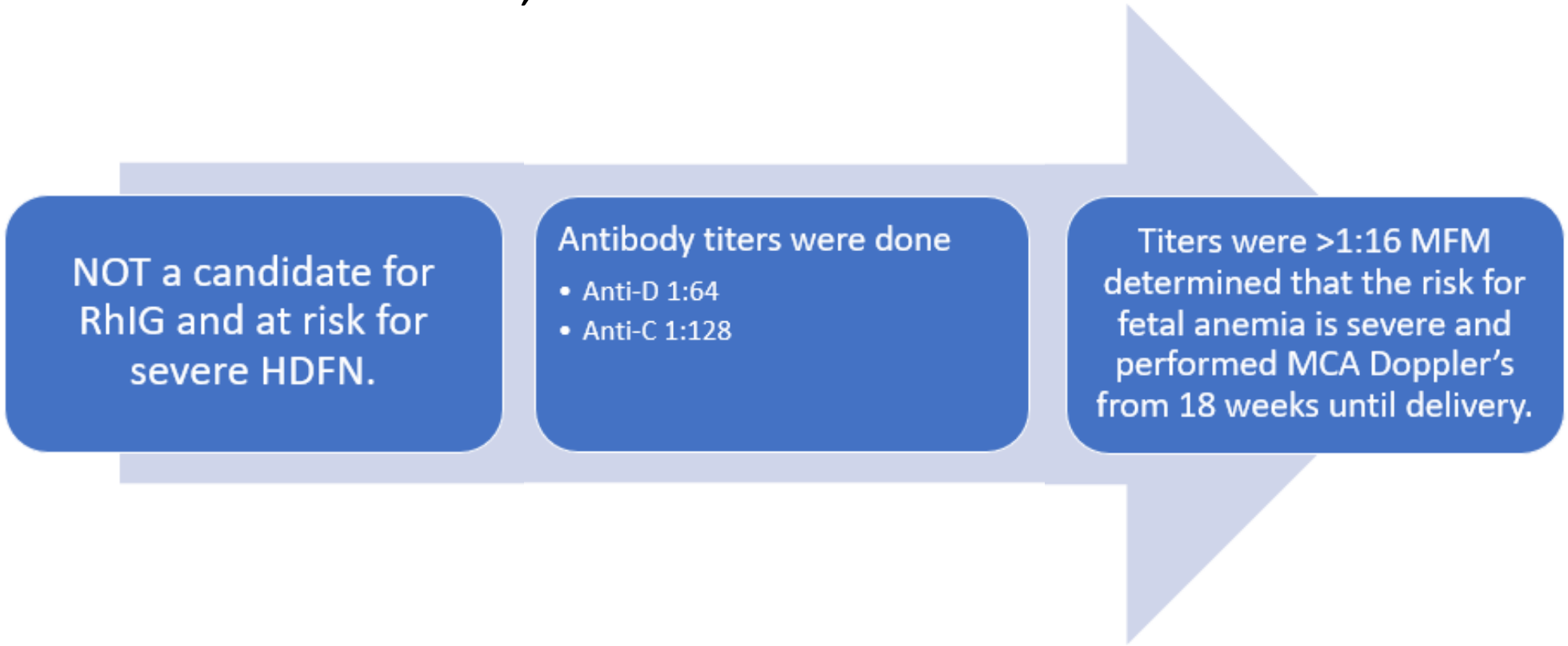
- Does this combination of antibodies warrant any concern?
- What should we do next?

Anti-G

- G antigen is found on red blood cells that possess the C or D antigens
- Antibodies to G appear as an anti-D and anti-C that cannot be separated
- Identification is done by using adsorption and elution techniques
- Only clinically significant in OB cases to determine if RhIG is necessary
  - Anti-G WITHOUT anti-D—Can receive RhIG
  - Anti-G WITH anti-D—Not a candidate for RhIG

Case Study (cont'd)

Through Adsorption and Elution procedures, it was found that the patient did have an anti-D, anti-C and anti-G



Case Study (cont'd)

Blood Bank was actively involved in this patients care with the MFM.

This patient has a very rare Rh phenotype D-C-c+E+e- (0.1%)

Recommended patient undergo autologous red blood cell donation

At 29 weeks, MCA Doppler was >1.5 and patient was referred out for intrauterine transfusions

Case Study (cont'd)

- Received 2 intrauterine transfusions (IUT) at an Academic Medical Center and returned for delivery.
  - D-, C-, c+, E-, e+ red cells were administered during IUT
  - In addition to previously identified anti-D, anti-C, and anti-G, mom developed anti-e
  - Due to the rarity of D-C-e- red blood cells, patient had to deliver at the Academic Medical Center where she received IUT
  - 2 weeks following delivery, baby presented to EMR requiring transfusions due to severe anemia due to HDFN

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