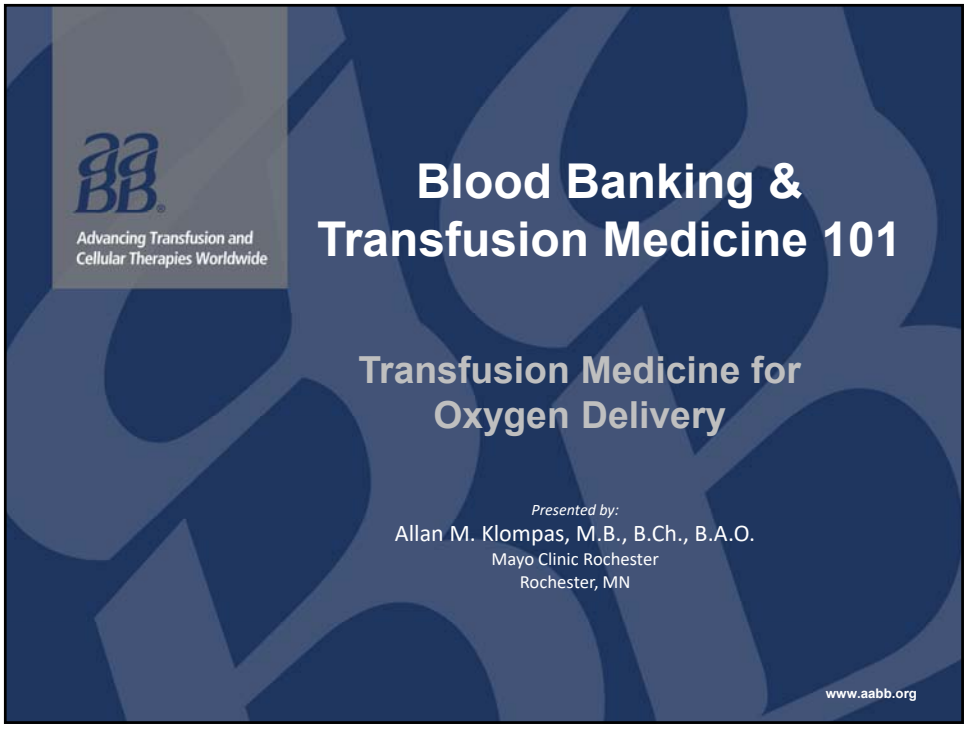

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Learning Objectives

After participating in this program you should be able to….

- Explain the use of blood components in immunohematology.
- Discuss the use of transfusion medicine as a therapy for various conditions that involve oxygen delivery.
- Recognize the multiple factors that contribute to the decision to transfuse.
- Define and discuss blood types and their place in the practice of transfusion.

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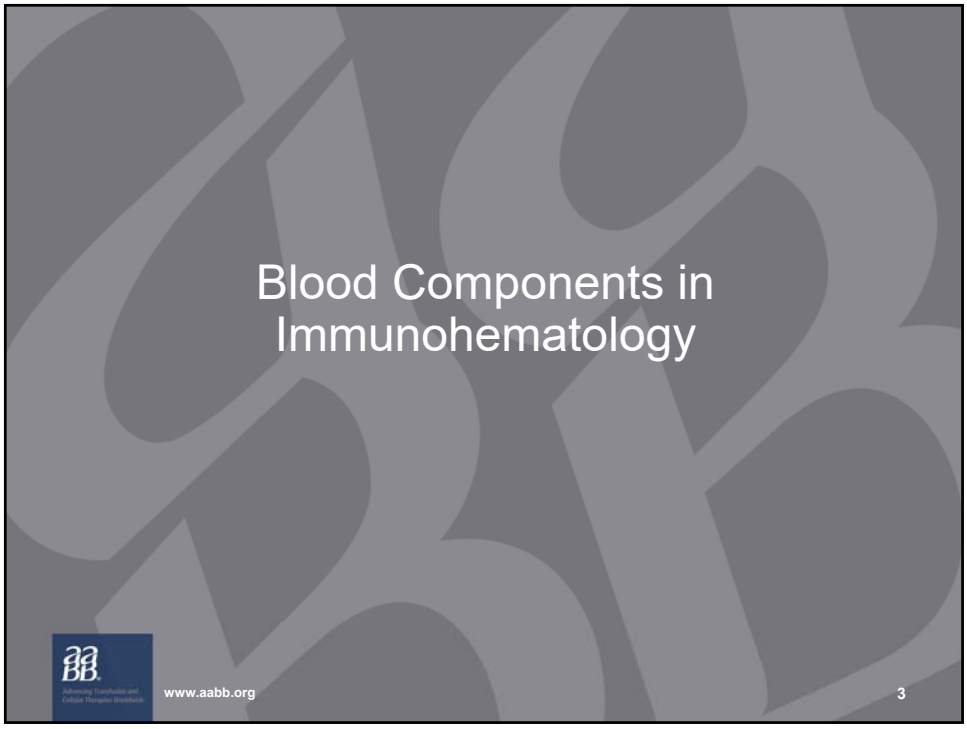

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Immunohematology

- Definition: the field of study of the reactions that take place on blood cells and antibodies in the plasma

  ISBT

- In short, this is the scientific study of how the body interacts with and reacts to various blood products
- This topic is HUGE!

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Common blood components used clinically

RBC	Used to deliver oxygen to tissues (among other things)
FFP	Used to replace coagulation factors and functional proteins
Platelets	Used to initiate hemostasis and help form blood clots (among other things)
Cryo	A concentrate derived from plasma, used to promote blood clotting

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So why is there a whole field for this?

- Each product has its own collection, manufacturing, storage, testing and dispensing characteristics
- In general:
  - Plasma based products contain ANTIBODIES that can cause harm to cells
  - Red cells have ANTIGENS that can be targeted by these antibodies
- As we learned more, a new scientific discipline was created = immunohematology

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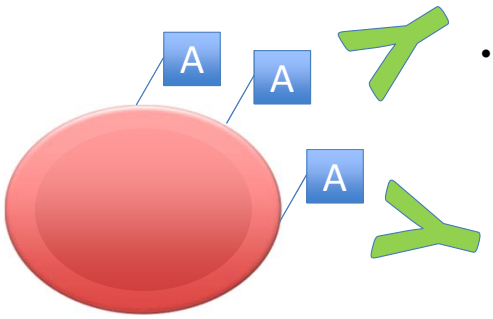
Antigens & Antibodies



- These interactions can cause:
  - Cell removal
  - Loss of function
  - Cell destruction
  - Tissue damage
  - Death

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Antigens & Antibodies

- Antigens
  - Any cell 'marker' capable of provoking an immune response
  - These can be proteins, sugars, fats, drugs etc.
  - Over 600 are known, each with their own specific characteristics
  - Many require special testing conditions and techniques
- Antibodies
  - A protein made by the immune system to 'combat' the foreign antigen
  - Can result in a host of reactions from mild injury to patient death

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Antigens & Antibodies

- So for patient safety we test:
  - Plasma products for **ANTIBODIES**
  - Cellular products for **ANTIGENS**
  - **COMPATIBILITY** with our donor and recipient
- We always aim to give the most compatible products and avoid incompatible products
- We can't always do this (for many complex reasons)
  - This is where the science and art of transfusion medicine meet

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Transfusion as a Therapy for Improving Oxygen Delivery

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Physiology of Blood Flow

- Blood is a complex tissue which must:
  - Contain nutrients
  - Pick up oxygen in the lungs
  - Deliver these to body tissues
  - Remove waste products
- In addition, blood delivers other cells (white blood cells etc.) to help fight infection and allow healing, as well as clot and repair damaged vessels

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Body Oxygen Needs

- All cells need oxygen to make energy
- Each body tissue has a certain ability to respond to a lack of oxygen before irreversible damage occurs
  - For example, compare brain to leg muscles
- Our cardio-vascular-heme system must then all be working to maintain this or tissue injury occurs

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Oxygen Delivery

- DO_2 = Cardiac output x CaO_2
- DO_2 = (HR x SV) x ((1.39 x **Hb** x SpO_2) + 0.003 x PaO_2)

- At rest, we need around 250 mLs of O_2 per minute to meet basic demands
- The average person delivers about 1000 mLs of O2 per minute
- We have a 'buffer' built in

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Indications for RBC Transfusion

- RBCs might be helpful when the delivery of oxygen falls in relation to usage
  - Either oxygen usage goes up (illness, exercise etc.)
  - Delivery goes down (heart/lung dysfunction, anemia etc.)
- RBCs might also be needed if you are losing blood faster than you are making blood (ex. Bleeding)
- RBCs might be helpful if the red blood cells you make are abnormal or don't work well (ex. SCD)

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Indications for Transfusion

- Note that all of these say RBCs 'might' be helpful because not all patients have the same needs
- Many studies have tried to determine exactly what numbers to target but there are no hard cutoffs
- How do you decide who needs blood then?

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Factors Contributing to Decision to Transfuse

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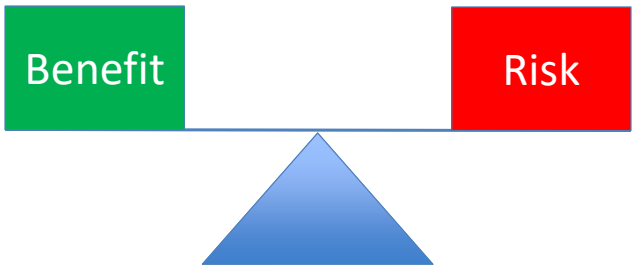
Risk vs. Benefit



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Benefits

- Increase oxygen delivery to someone who is not able to keep up with their demands
  - Low cardiac output – bad heart
  - Poor oxygenation – bad lungs
  - Low storage - anemia

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Risks

- All red blood cells currently in use are from human donors
  - Infectious risks
  - Allergic reactions
  - Immunologic reactions (Fevers etc.)
  - Lung injuries
  - Volume overload
  - Increase risk for future transfusions (Ab formation etc.)

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Factors Affecting Decision to Transfuse

- Clinical urgency
- Rate of blood loss
- Patient comorbidities (other illnesses)
- Patient compensation
- Laboratory assessments
- Availability of blood
- Complications of transfusion or previous reactions
- Likelihood of needing future transfusions
- Clinical transfusion culture

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Clinical Urgency

- If a patient is doing well but seems to have a need for blood, you may have time to further assess
  - Reasons why they might need blood
  - How to optimize their ability to make blood etc.
- If a patient is doing poorly, you may have to act by transfusing while you are assessing

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Rate of Blood Loss

- In a bleeding patient, the rate of bleed is paramount
  - If a slow trickle bleed from the GI tract, I can likely wait
  - If a major bleed from trauma, I probably have to act
- Assessments of bleeding patients takes skill and experience
  - You are essentially trying to predict where you will be if the bleeding continues and act before harm is done
  - Different providers will approach this differently

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Patient Comorbidities

- Sick patients will not tolerate low oxygen delivery as long
  - If underlying organ damage exists, those organs cannot buffer against low oxygen delivery for long
  - Patients with heart disease cannot increase their cardiac output and therefore cannot increase oxygen delivery
- Compare a young healthy athlete to an elderly diabetic patient

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Laboratory/Imaging Assessments

- Interpreting labs may inform decision to transfuse
  - Following trends in Hb
  - Trending acidosis and lactate
    - When oxygen delivery is less than demand, the tissues release acid
    - This can be a marker of need to transfuse in some contexts
  - Imaging (Xrays, CT scans, MRIs)
    - Demonstrating 'internal bleeding' not easily seen may inform decision to transfuse

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Availability of blood

- Some exceptionally rare blood types may be hard to come by and need special coordination
- Some blood may even need to be shipped in from elsewhere

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Complications of Transfusion

- Patients with a history of severe transfusion reactions may require more evidence before getting blood
- Patients with bad heart and lung disease may be more prone to volume overload with transfusions

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Likelihood of Future Transfusions

- Some diseases (ex. Sickle cell disease, thalassemia etc.) may require lifelong transfusions
- Each transfusion given may make it harder to transfuse in the future
  - Exposure to someone else's blood can cause Ab formation
  - This can create a situation of needing 'special' or 'rare' blood in the future

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Culture of Transfusion

- The decision to transfuse is often shared
  - As an example:
    - Anesthesiologist, Surgeon, Perfusionist all have a voice in the OR
  - Certain practices have picked transfusion goals or markers because it works best for them
    - Transfusion cutoffs
    - Blood testing before transfusing

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So how do you actually decide?

- Ultimately, no one factor determines if a patient needs blood or not
- There are numerous influences

- Decision comes down to the provider's knowledge, experience, and judgement as to what is best for the patient

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Blood Types and how they Affect Transfusion

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Blood types

- As mentioned earlier, red cells have ‘markers’ on their surface that have functions and tell the body this is ‘my’ cell
- Many of these markers have genetic features and run in families or ethnicities
- There are hundreds of markers known
- When exposed to a marker different than your own, your immune system makes an antibody to ‘fight’ it
- Some antibodies just happen (ABO) and some need exposure through transfusion, transplant or pregnancy

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Blood types

- Red cells are collected from donors in the community
  - Their markers will mirror what is common in the population
- If your patient has very different markers from the donors, they might make antibodies to them when exposed

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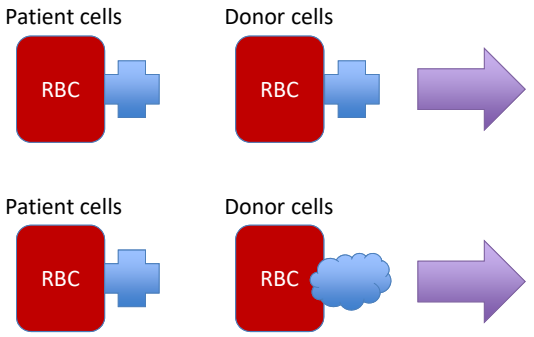
Blood types



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Blood types & need

- Fortunately, blood types in communities are often reflected in the donor populations
- Sometimes, incompatibilities exist
  - Need for special testing
  - Testing takes more time/expertise/cost
  - Need for special products
- These issues can make it difficult to get blood in a timely fashion when patients need it

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Transfusion Experts

- Numerous blood bank strategies exist to help with this and get patients treated with the safest possible product
- Transfusion services often have processes in place to help manage these situations
  - Special inventory
  - Backup supply
  - Reference lab testing
  - Transfusion physicians to consult
  - Alternative product recommendations

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Summary

- Red blood cells are vitally important to deliver oxygen to the body
- When patients cannot meet this demand, a transfusion might be warranted
- Lots of factors influence the decision to transfuse
- Provider knowledge, experience and judgement ultimately inform the decision

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Summary

- Unique patient blood types mandate routine testing to ensure safe transfusions
- This testing takes time and resources to perform
- Special blood types often need specialist transfusion medicine consultation

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Questions?

Contact

AABB eLearning Team

eLearning@aabb.org

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