

Stewardship of O-Negative Red Blood Cells

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BLOOD CENTER

YOUR BLOOD. YOUR HOSPITAL. YOUR NEIGHBORS.

Goals

- Understand the importance of ensuring that there are always enough O-negative red blood cells available, and what you can do to help
- **After this presentation, you should be able to...**
 1. Explain why O-negative red blood cells are rare
 2. Discuss why it is important to maintain an adequate supply of O-negative red blood cells
 3. Institute practices at your institution that ensures there are enough O-negative red blood cells for all transfusing facilities



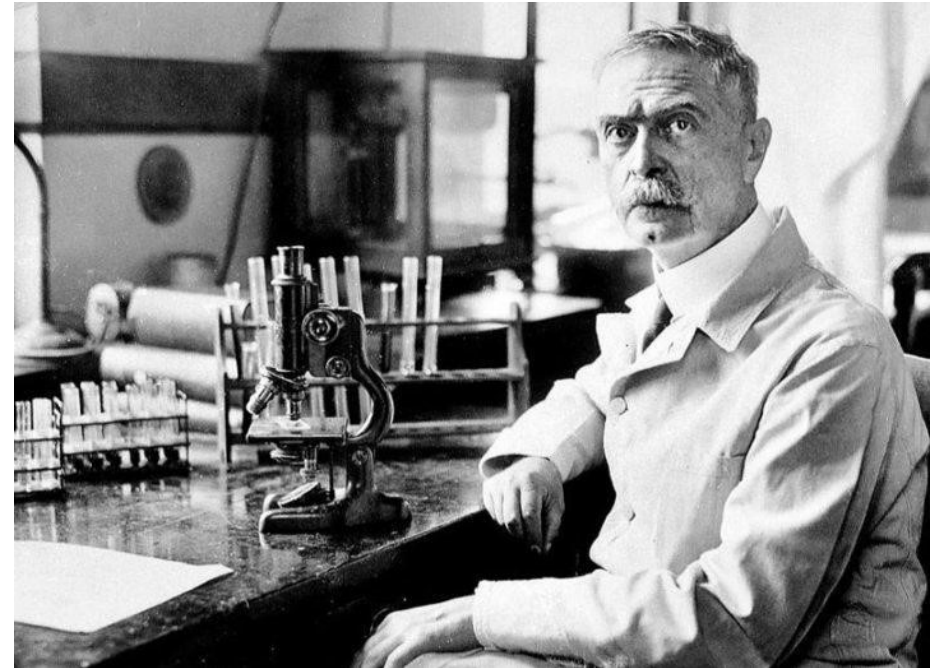
GOAL 1

**Explain why O-negative red
blood cells are rare**



The ABO System

- Discovered by Austrian physician Karl Landsteiner in 1900
 - Noted that RBCs agglutinated when mixed with serum from different people
- The following year he observed that sometimes agglutination did not occur between every individual
 - Based on this, he classified human blood into three groups: A, B, and C
 - Group A blood agglutinates with group B, but never with its own type
 - Group B blood agglutinates with group A, but never with its own type
 - Group C blood agglutinates with both A and B

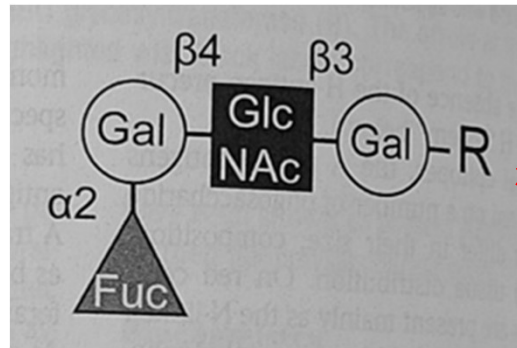


The ABO System

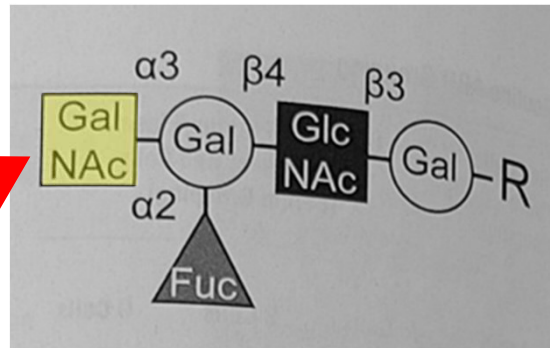
- For this work, he was awarded the Nobel Prize in Physiology or Medicine in 1930
- In 1902, two of his colleagues, Alfred von Decastello and Adriano Sturli, discovered the AB group
 - In 1910, Ludwik Hirszfeld and Emil Freiherr von Dungern introduced the term O (null) for the group
 - Landsteiner designated as C



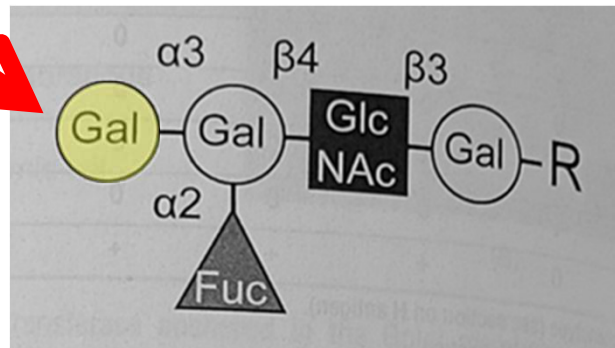
The ABO System



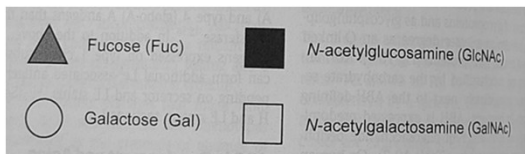
H-antigen



A-antigen



B-antigen

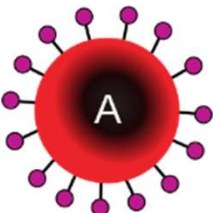
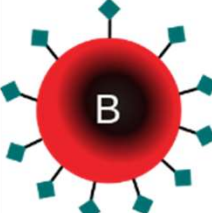
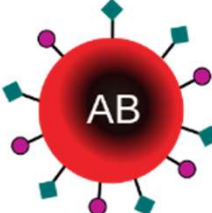






		Parent 1												
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%	#			#	%
33%	48	A	AA	16	11%
			AO	32	22%
33%	48	B	BB	16	11%
			BO	32	22%
			AB	32	22%
			OO	16	11%



The ABO System

	Group A	Group B	Group AB	Group O
Red blood cell type	 A	 B	 AB	 O
Antibodies in plasma	 Anti-B	 Anti-A	None	 Anti-A and Anti-B

The ABO System

- Development and Aging
 - Detected on RBCs at 5 to 6 weeks gestation
 - Adult levels by 2 to 4 years old
 - Endogenous synthesis of anti-A and anti-B develops at 4 to 6 months old
 - Almost all children have anti-A and anti-B by 1 year old
 - Titers reach adult level by 5 to 10 years



The ABO System

- Subgroups
 - Most common are A₁ and A₂
 - A₁ represents the majority of group A (80%)
 - Remaining are almost all A₂
 - A₁ individuals have five times more A antigen epitopes per red cell than versus A₂
 - Multiple weak B subgroups have been described



IF YOU HAVE ...

YOU CAN RECEIVE ...

	O-	O+	B-	B+	A-	A+	AB-	AB+
AB+								
AB-								
A+								
A-								
B+								
B-								
O+								
O-								



Americans				
	White	Black	Hispanic	Asian
O+	37%	47%	53%	39%
O-	8%	4%	4%	1%
A+	33%	24%	29%	27%
A-	7%	2%	2%	0.5%
B+	9%	18%	9%	25%
B-	2%	1%	1%	0.4%
AB+	3%	4%	2%	7%
AB-	1%	0.3%	0.2%	0.1%



GOAL 2

Discuss why it is important to maintain an adequate supply of O-negative RBCs



Population

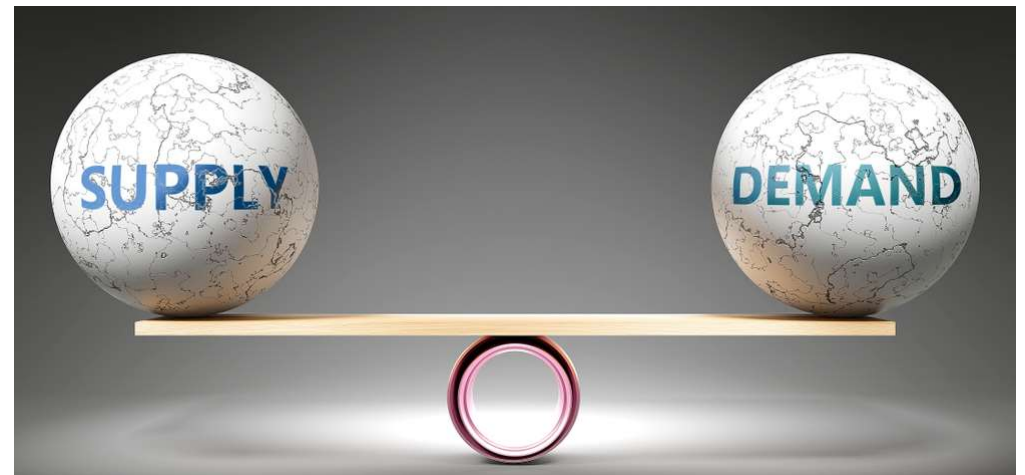
- Overall, about 7% of donors are O-negative
 - But, about 11% of RBC transfusions are O-negative
 - Unsustainable

	Americans			
	White	Black	Hispanic	Asian
O+	37%	47%	53%	39%
O-	8%	4%	4%	1%
A+	33%	24%	29%	27%
A-	7%	2%	2%	0.5%
B+	9%	18%	9%	25%
B-	2%	1%	1%	0.4%
AB+	3%	4%	2%	7%
AB-	1%	0.3%	0.2%	0.1%



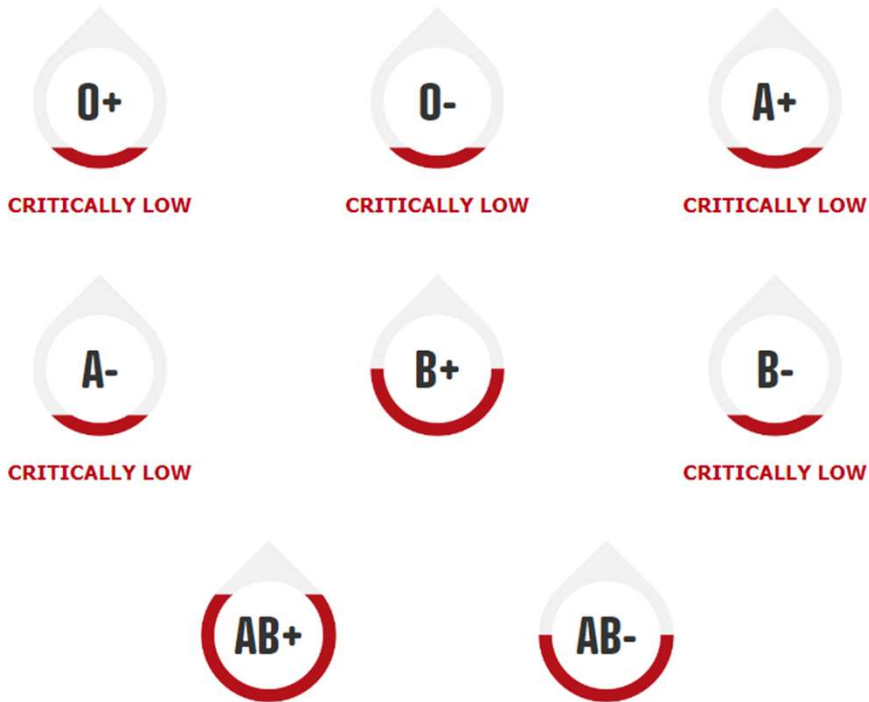
Blood Supply

- A low blood supply makes it more difficult to meet needs during a surge, e.g. MTP
 - The surge further reduces the blood supply, which affects ability to provide blood for non-urgent transfusions
 - This applies especially to O-negative RBCs since they are the choice for emergency transfusions when the patient's blood type is unknown



Blood Supply

- Temporary blood shortages are not uncommon, but...
 - There is nationwide downward trend in blood collections
 - Anticipated chronic blood shortages will require additional mitigation strategies



[Schedule a Donation](#)



Blood Supply

- Because of the preceding, hospitals must be good stewards of the blood supply
 - To ensure blood products are available to patients everywhere
- LifeServe Blood Center has been able to boost collection of O-negative RBCs to about 13% of our supply
 - Recruitment efforts
 - Focusing on double RBC donations
- If the O-negative usage exceeds 13%, it threatens the stability of the blood supply
 - “Your facility is exceeding this with greater than 13% transfusions utilizing O-negative blood”



GOAL 3

Institute practices at your institution that ensures there are enough O-negative RBCs for all transfusing facilities



Background on O-RBCs Usage



- Rural/smaller hospitals
 - Often stock only A- and O-negative RBCs
 - Simplify inventory
 - Decrease wastage
 - May also stock even more O-negative RBCs for emergencies
 - Results in more O-RBCs transfused to non-O patients



Background on O-RBCs Usage

- Large hospitals
 - Urban/suburban areas
 - Inventories are often larger because their population is more complex
 - Neonates
 - Stem cell transplant recipients
 - Sickle cell disease
 - Alloimmunized
 - Traumas
 - More overall
 - Higher level
 - Accept and use O-RBCs close to expiration → less wastage



THE JOURNAL OF AABB

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O– product transfusion, inventory management, and utilization during shortage: the OPTIMUS study

Nancy M. Dunbar  Mark H. Yazer,

the OPTIMUS Study Investigators on behalf of the Biomedical Excellence for Safer Transfusion (BEST) Collaborative

- “If age and gender were considered, 45% of O-negative RBC transfusion could have been replace with O-positive RBCs”





*Advancing Transfusion and
Cellular Therapies Worldwide*

Association Bulletin #19-02

Date: June 26, 2019

To: AABB Members

From: Michael Murphy, MD, FRCP, FRCPath, FFPATH - President
Debra BenAvram - Chief Executive Officer

Re: Recommendations on the Use of Group O Red Blood Cells





Advancing Transfusion and
Cellular Therapies Worldwide

Association Bulletin #19-02

Date: June 26, 2019

To: AABB Members

From: Michael Murphy, MD, FRCP, FRCPath, FFPATH - President
Debra BenAvram - Chief Executive Officer

Re: Recommendations on the Use of Group O Red Blood Cells

1. Reserve O-negative RBCs for three cohorts of females of childbearing potential
2. Closely monitor O-negative inventory, particularly during bleeding emergencies and O-negative shortages
3. Have protocols to expedite sample collection to quickly switch patients to type-specific blood



Reserve O-negative RBCs for three cohorts of females of childbearing potential

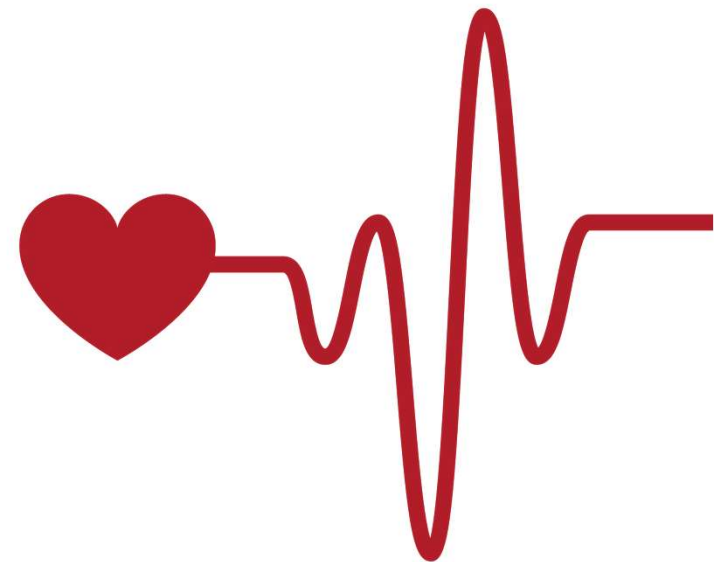
1. O-negative
2. When Rh-negative and type-specific blood is not available
3. Blood type unknown and require RBCs before completion of pretransfusion testing

Why? → to avoid alloimmunization and subsequent hemolytic disease of the fetus/newborn during future pregnancies



Reserve O-negative RBCs for three cohorts of females of childbearing potential

- Emergent
 - Male or postmenopausal females → O-positive RBCs
 - Switch to type-specific once blood type is known
 - If O-negative RBCs are not available or in short supply and there is significant bleeding → give O-positive RBCs to O-negative patients
- Non-emergent
 - O-negative males and females of no childbearing potential can receive O-positive RBCs when you inventory conditions dictate
 - Exception: already have an anti-D



Reserve O-negative RBCs for three cohorts of females of childbearing potential

- About 25% of hospitalized Rh-negative patients who are hemorrhaging will form an anti-D after receiving a Rh-positive unit
 - < 10% for immunosuppressed marrow/solid-organ transplant patients
 - About 5% of ER patients whose blood type is not known may form an anti-D after they receive a Rh-positive RBC unit
- In emergency settings, the risk of an acute hemolytic transfusion reaction after receipt of an Rh-incompatible RBC unit is < 1%
 - The reaction is usually mild
 - An anti-D will not be an issue for most patients who have only one transfusion in their lifetime



Reserve O-negative RBCs for three cohorts of females of childbearing potential

- Switching to Rh-positive is discouraged for some Rh-negative patient populations, as they are more heavily transfused
 - Patients who require chronic transfusion support
 - Pediatric patients undergoing multiple surgical procedures
 - Patients destined for a stem cell transplant procedure



Closely monitor O-negative inventory, particularly during bleeding emergencies and O-negative shortages

- Develop policies that state when a patient should be switched to Rh-positive units
 - Unfortunately, there is not much data to guide usage for individual institutions
 - Conduct regular audits of O RBC usage
 - Understand utilization patterns
 - Develop usage policies



Have protocols to expedite sample collection to quickly switch patients to type-specific blood

- Switch to type-specific RBCs as soon as pretransfusion testing is completed and compatible blood is available
- Verification of the patient's ABO type requires either a second specimen drawn at the current visit or, if available, comparison of the current testing result with blood bank records
 - *Alternatively, some institutions use electronic patient verification to eliminate the need to test a second separately drawn specimen to confirm the recipient blood type*



Have protocols to expedite sample collection to quickly switch patients to type-specific blood

- The importance of early sample collection must be clearly communicated to those responsible for patient care
 - Transfusion services should work with their hospital transfusion committees and clinical champions to make sure this message is relayed to care teams
- Transfusion service staff should be fully engaged in minimizing O-negative usage



Specific Patient Populations

- Trauma and Mass Casualties
 - Administering uncrossmatched RBCs in this setting is serologically safe
 - Hemolysis is unlikely to occur even in recipients with RBC antibodies
 - During an emergency, give O-positive RBCs to males and females without childbearing potential
 - Once pretransfusion testing is complete, switch to type-specific RBCs
 - Ensure you have strong safety measures in place
 - ER with multiple simultaneous traumas



Specific Patient Populations

- Trauma and Mass Casualties
 - Giving uncrossmatched blood in air/ground ambulances is increasingly common
 - The use of O-positive RBCs should be considered for these settings
 - Most patients are either male or females of no childbearing potential



Specific Patient Populations

- Trauma and Mass Casualties
 - The AABB Interorganizational Task Force on Domestic Disasters and Acts of Terrorism recommends 3 units of O RBCs per admission
 - When faced with many patients simultaneously, transfusion services should prioritize uncrossmatched O-negative RBCs for females presumed to be of childbearing potential
 - Identification of such patients in the format of the hospital emergency medical record numbering system has been suggested
 - Event demographics may accentuate this concern
 - In the 2017 Manchester concert bombing, 69% of the admissions were female and 39% were < 21 years old
 - As in other settings, rapid typing of mass casualty patients is very helpful



Specific Patient Populations

- Neonatal and Pediatric Patients
 - Anti-A and anti-B present neonates are passively acquired from the maternal circulation
 - Usually disappear by two months of age
 - Only ABO forward typing is required
 - Further, these patients are thought to be at low risk of forming red cell alloantibodies
 - Therefore, type-specific RBCs may be issued but only after it is clearly shown that potential maternal antibodies will not be incompatible



Specific Patient Populations

- Neonatal and Pediatric Patients
 - Per AABB Standards...
 - The mother's blood type must be compatible with the donor RBCs, or
 - The neonate must be tested for anti-A and anti-B
 - Because both tests present logistical challenges, it is often easier to issue O-RBCs to neonates
 - As a result, routinely switching neonates to type-specific RBCs is unlikely to occur, and the small quantities used are unlikely to have a material impact on O-negative RBC inventory



Specific Patient Populations

- Stem Cell Transplantation
 - Due to the potential effect of antibodies on engraftment and hemolysis, transfusion strategies focus on minimizing the use of RBCs that are incompatible with donor, recipient, and passively transfused antibodies
 - As a result, group O RBC usage is considerable



General Recommendations from the Bulletin

- Patients should receive ABO type-specific blood for routine transfusion:
 - Switch patients receiving group O RBCs urgently to type-specific units as soon as possible, following completion of type and screen testing and verification of ABO group.
 - Implement an electronic patient verification system to eliminate the need for a second verification of the patient's blood type prior to providing type-specific blood (see Standard 5.16.2.2).17
- Group O Rh(D)-negative RBCs should be reserved for transfusion of group O Rh(D)-negative females of childbearing potential and in bleeding emergencies for females of childbearing potential with unknown blood group.
- A transfusion should never be withheld from a bleeding patient. If group O Rh(D)-negative units are not available for a female of childbearing potential then the benefit of an emergent Rh(D)-positive blood transfusion must be balanced against the risk of alloimmunization.
- Clinical conditions may dictate the need for a temporary switch to group O Rh(D)-negative RBCs for some patients. This remains within a medical director's purview.



General Recommendations from the Bulletin

- Hospital transfusion services should have policies describing when patients should be switched to Rh(D)-positive RBCs to avoid depletion of the group O Rh(D)-negative supply.
 - Group O Rh(D)-positive RBCs may be given to group O Rh(D)-negative patients for significant surgical or medical bleeding.
 - Group O Rh(D)-negative critical care patients over age 50 can be switched to group O Rh(D)-positive RBCs for routine transfusions.
 - Hospitals should have protocols in place to expedite sample collection during bleeding emergencies so that patients can promptly be switched to type-specific blood upon completion of pretransfusion testing.
- Hospitals should closely monitor utilization of group O Rh(D)-negative inventory during bleeding emergencies and perform periodic audits of group O blood use to better understand utilization patterns.
- Hospitals should develop reasonable goals for group O Rh(D)-negative usage and work together with blood collection facilities to design feasible plans that meet specific hospital needs.
- Provision of group O Rh(D)-positive RBCs should be considered for air and/or ground ambulance and/or emergency department transfusions because most patients in this setting are either males or females of no childbearing potential.





Blood Bulletin



America's Blood Centers
It's About Life

Transfusing O-Negative Blood: Good Stewardship of a Precious Resource

By: Chris Gresens, MD, Senior Chief Medical Officer, Mountain & West Divisions at Vitalant; Nanci Fredrich, RN, BSN, MM, Transfusion Safety & Blood Management Officer for Versiti; Richard Gammon, MD, Medical Director at OneBlood; & Nancy Van Buren, MD, Medical Director at Innovative Blood Resources, a division of New York Blood Center; The authors disclose no conflicts

Key Points

- It is critically important to transfuse O-negative red blood cells (RBCs) wisely to protect availability of this limited resource.
- Hospital transfusion services should monitor O-negative blood usage and develop policies to optimize its use, including promotion of a culture of patient blood management to mitigate blood shortages which are an important public health issue.
- O-negative blood should be reserved for:
 - Females of childbearing potential before their blood type is known;
 - Individuals who are group O-negative, especially females of child-bearing potential;
 - Females who are Rh-negative requiring transfusion when type-specific blood is unavailable; and
 - O-negative individuals with anti-D antibodies.





Transfusing O-Negative Blood: Good Stewardship of a Precious Resource

- Transfusion service strategies to optimize use of O-negative RBCs
 1. **Number of units**
 - Currently in inventory
 - Transfused daily/weekly, including emergency releases
 2. **Determine where O-negative units are stored**
 - Inside and outside the transfusion service
 3. **Evaluate true need**
 - Consider reducing the number of units stored outside the transfusion service
 4. **Other factors include...**
 - The services provided by your hospital (e.g. cardiovascular surgery, obstetrics, trauma, hematology/oncology, etc.)
 - Distance from your blood supplier
 - Frequency of blood product deliveries





- Emergency-release of O-positive RBCs for males and/or females of non-childbearing potential
 - Collaborate with ER and trauma staff
 - Evaluate the number of emergency release RBCs in a trauma pack, the number of packs prepared, and frequency of use
 - Determine if it is possible to reduce the number of O RBCs in each pack
 - Prepare trauma packs with RBCs with various expiration dates.
 - Allows rotation of these units with the general inventory
 - Increases the ability of the blood bank to issue these units to group O patients
 - Reduces transfusion to non-group O patients
 - Reduces outdate wastage





Transfusing O-Negative Blood: Good Stewardship of a Precious Resource

- Other strategies include use of 2nd ABO confirmatory sample collected separately from the first and electronic crossmatch
 - Use of an ABO confirmatory sample can boost issue of type-specific RBCs
 - By having historical patient results, electronic crossmatch can rapidly compare ABO and Rh types of product and patient for compatibility
 - When searching for compatible RBC units for patients with antibodies, start with type-specific units rather than O-negative units
 - Request a type-specific, antigen negative unit from your blood supplier



Outreach



- Physician available 24/7
 - Practitioners with transfusion-related questions/issues
 - Blood bank-related questions/issues
 - (515) 309-4840
- Educate the medical community to keep them up to date on transfusion-related topics
 - Presentations to medical personnel
 - Contact me:
alex.smith@lifesevrbloodcenter.org
- Quarterly webinars
 - *<https://www.lifesevrbloodcenter.org/for-hospitals/resource-guide/education>*
 - To request to be on the notification list please contact Rachael Muhs:
rachael.muhs@lifesevrbloodcenter.org



Question?



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Thank you!



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