

# ABO, Rh, HLA Antibodies...

## *Issues with Whole Blood*

---

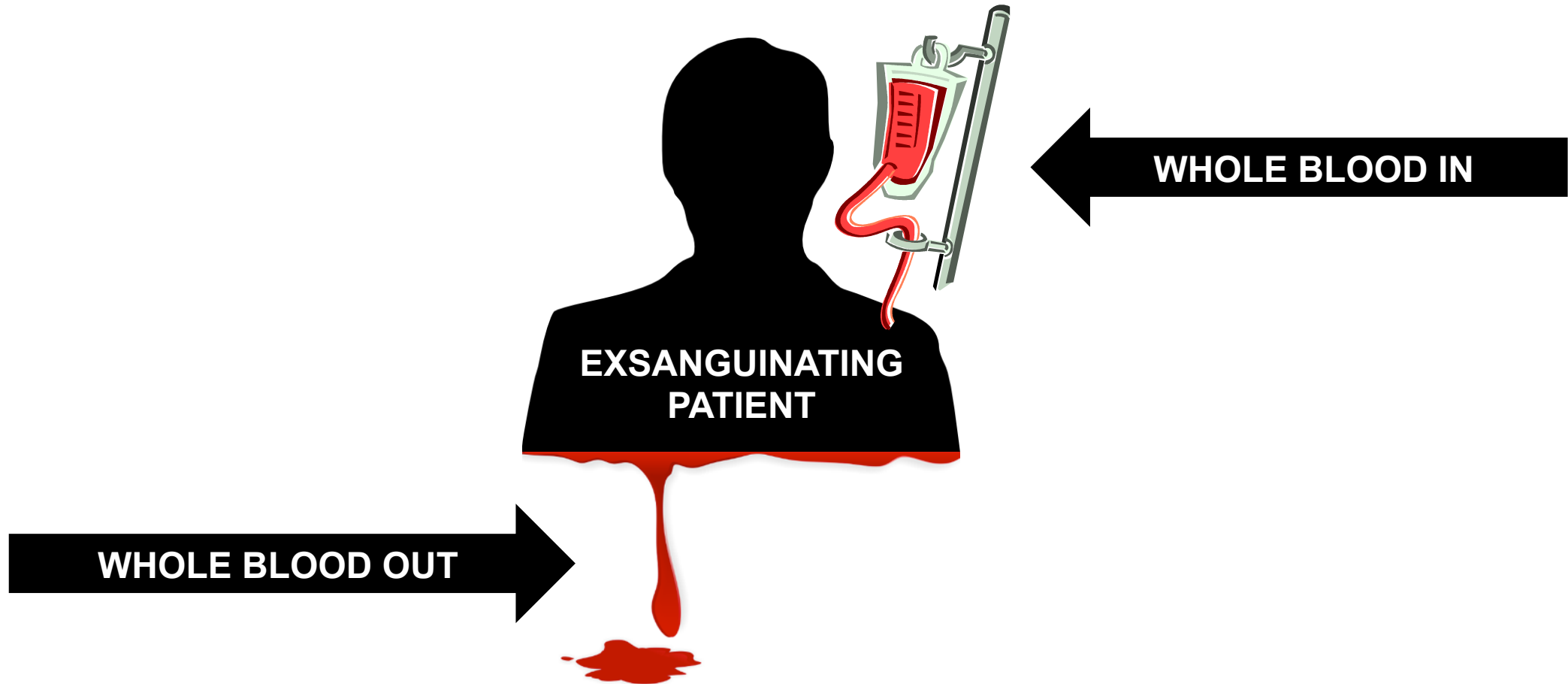
NANCY M. DUNBAR, MD

MEDICAL DIRECTOR, BLOOD BANK

DARTMOUTH-HITCHCOCK MEDICAL CENTER, LEBANON, NH, USA

# The Appeal of Whole Blood

---





# Baby Steps ... ABOut ABO

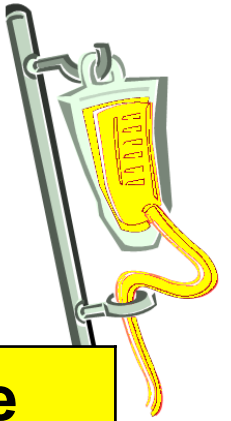
# Red Cell Compatibility



- ✓ Group O is “Universal Donor” for red blood cells because the RBCs LACK A and B antigens.
- ✓ Group O people can ONLY receive group O red cells
- ✓ Group AB people can receive ANY type.

ABO Group	Compatible Red Cells
Group O	O
Group A	A, O
Group B	B, O
Group AB	AB, A, B, O

# Plasma Compatibility



- ✓ Group AB is “Universal Donor” for plasma because it LACKS anti-A and anti-B antibodies.
- ✓ Group O people can receive ANY type of plasma
- ✓ Group AB can receive ONLY AB

ABO Group	Compatible Plasma
Group O	<b>AB, A, B, O</b>
Group A	<b>AB, A</b>
Group B	<b>AB, B</b>
Group AB	<b>AB</b>

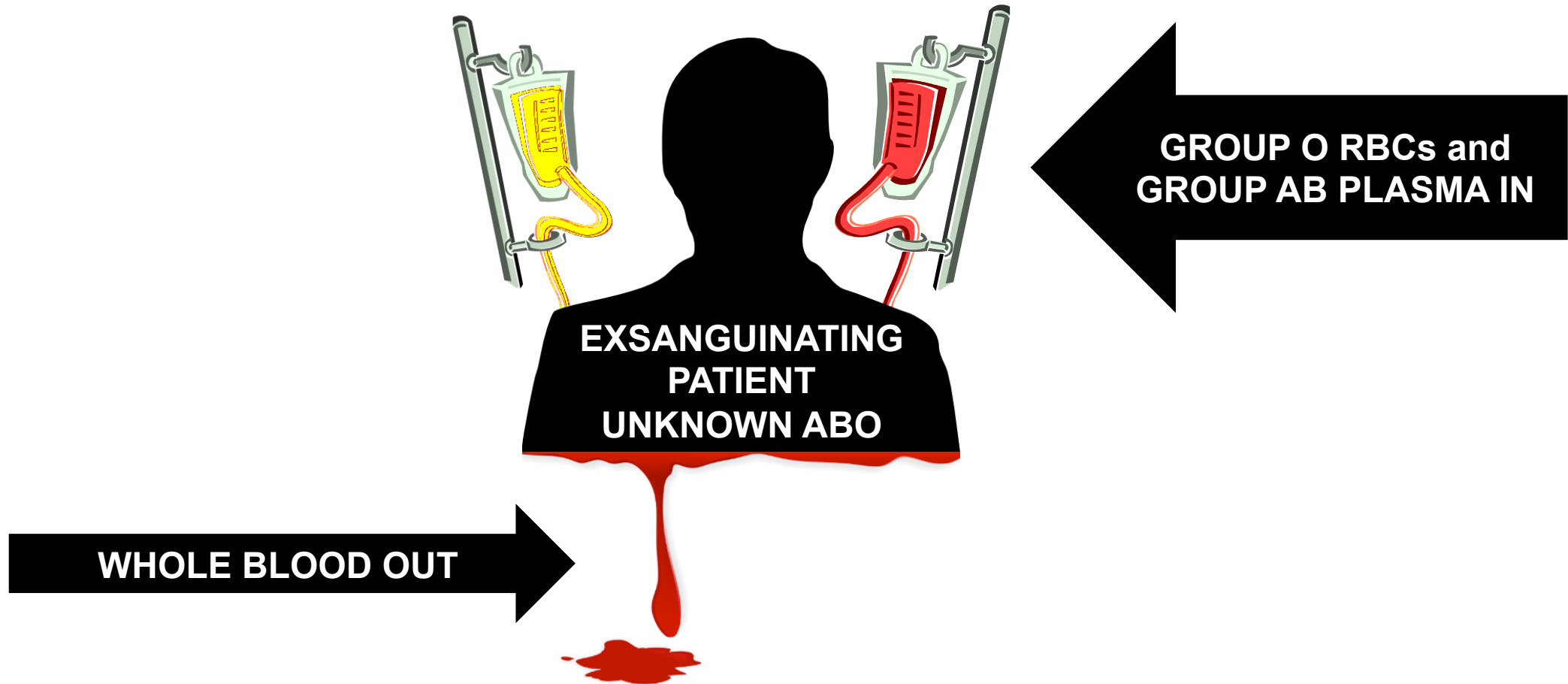
# Practical Teaching

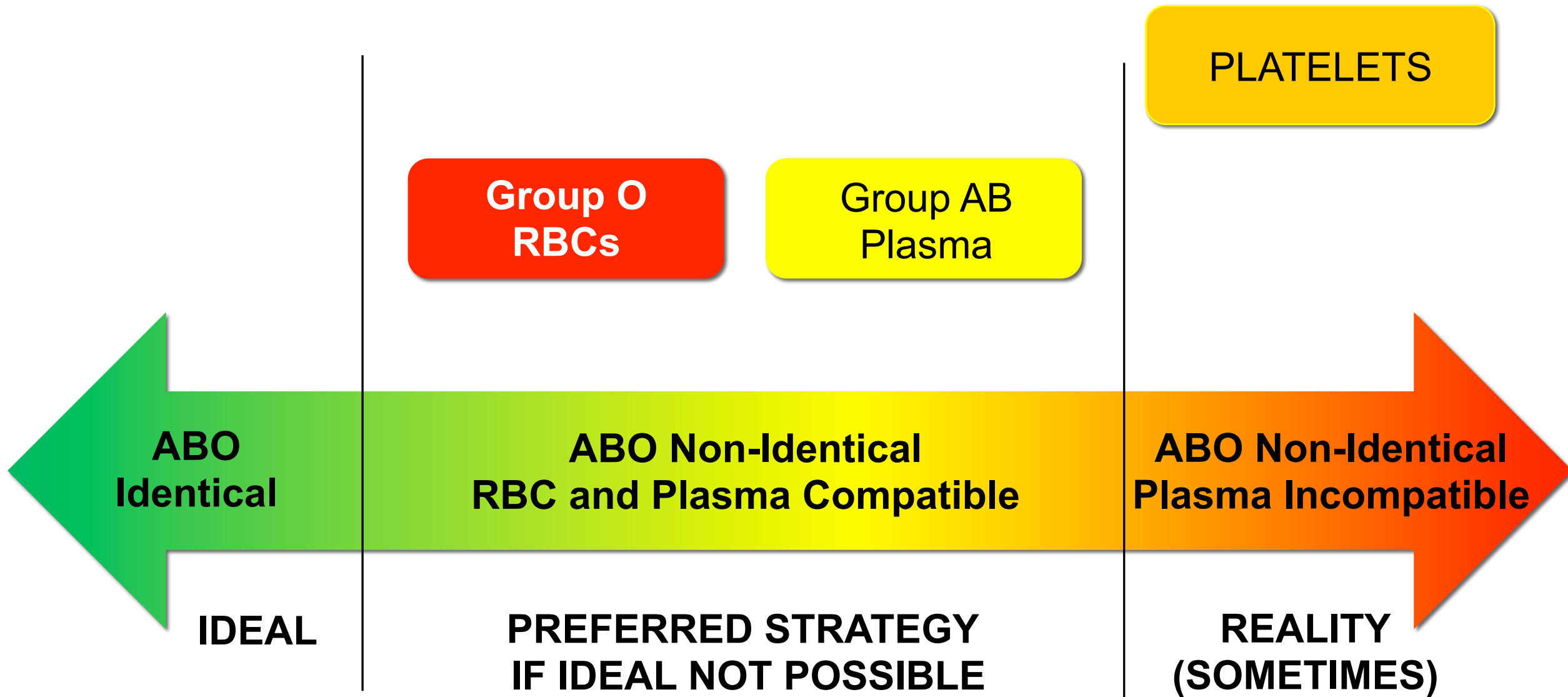
---

<b>Patient ABO Group</b>	<b>COMPATIBLE RED CELLS</b>	<b>COMPATIBLE PLASMA</b>	<b>COMPATIBLE WHOLE BLOOD</b>
<b>O</b>	<b>O</b>	<b>AB, A, B, O</b>	<b>O</b>
<b>A</b>	<b>A, O</b>	<b>AB, A</b>	<b>A</b>
<b>B</b>	<b>B, O</b>	<b>AB, B</b>	<b>B</b>
<b>AB</b>	<b>AB, A, B, O</b>	<b>AB</b>	<b>AB</b>

# Modern Component Therapy

---







## ORIGINAL ARTICLE

---

### **Risks of hemolysis due to anti-A and anti-B caused by the transfusion of blood or blood components containing ABO-incompatible plasma**

*Olle Berséus, Kjell Boman, Shawn C. Nessen, and Lars A. Westerberg*

*Transfusion* 2013;53:114S-123S

- 25 published case reports describing 30 patients with severe hemolytic transfusion reactions following platelet transfusion
- Vast majority of cases are group O platelet units transfused to group A or group AB patients

# Risk Reduction Strategies for Platelet Transfusions

---

- 1. Limit volume of incompatible plasma**
2. Use whole blood derived platelets
- 3. Screen for high titer anti-A and/or anti-B**
4. Volume reduce or wash incompatible platelets
5. Use platelet storage media

## TRANSFUSION PRACTICE

---

### **A practical strategy to reduce the risk of passive hemolysis by screening plateletpheresis donors for high-titer ABO antibodies**

*Karen Quillen, Sherry L. Sheldon, Jennifer A. Daniel-Johnson, A. Hallie Lee-Stroka,  
and Willy A. Flegel*

**TRANSFUSION** 2011;51:92-96.

- 10,000 apheresis platelet units screened by titer with a saline dilution of 1:250
- 25% of group O and 5% of group A donors were classified as high titer

## BLOOD COMPONENTS

---

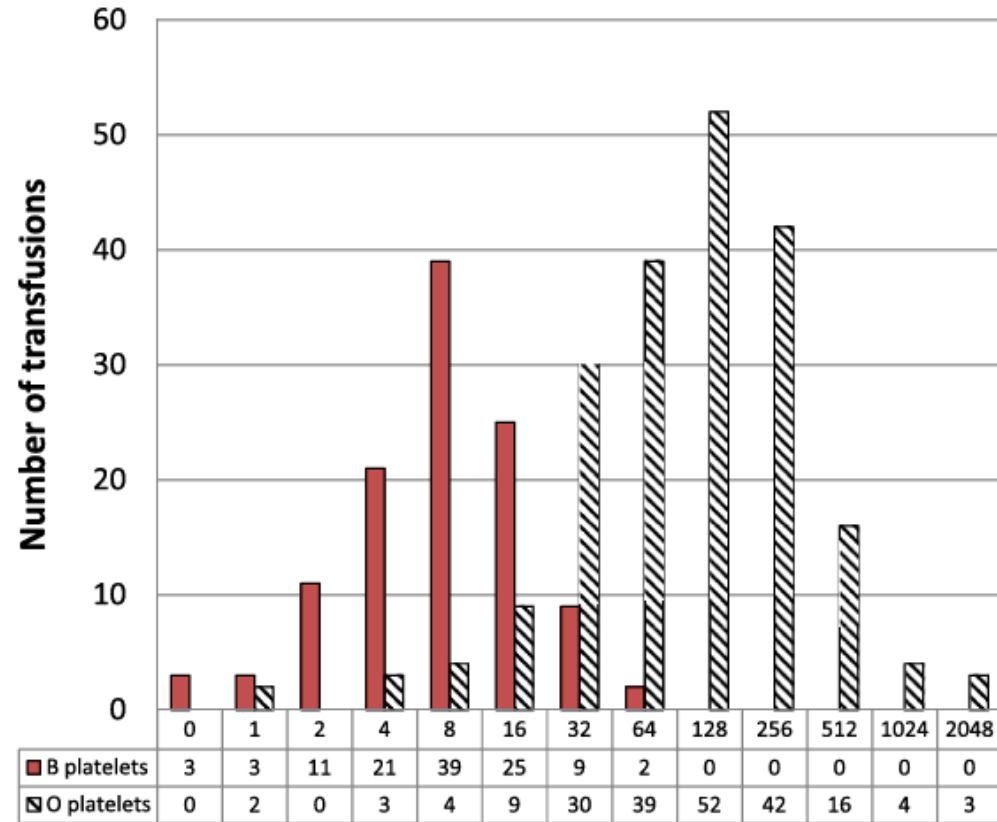
### **ABO antibody titers are not predictive of hemolytic reactions due to plasma-incompatible platelet transfusions**

*Matthew S. Karafin, Lorraine Blagg, Aaron A.R. Tobian, Karen E. King, Paul M. Ness,  
and William J. Savage*

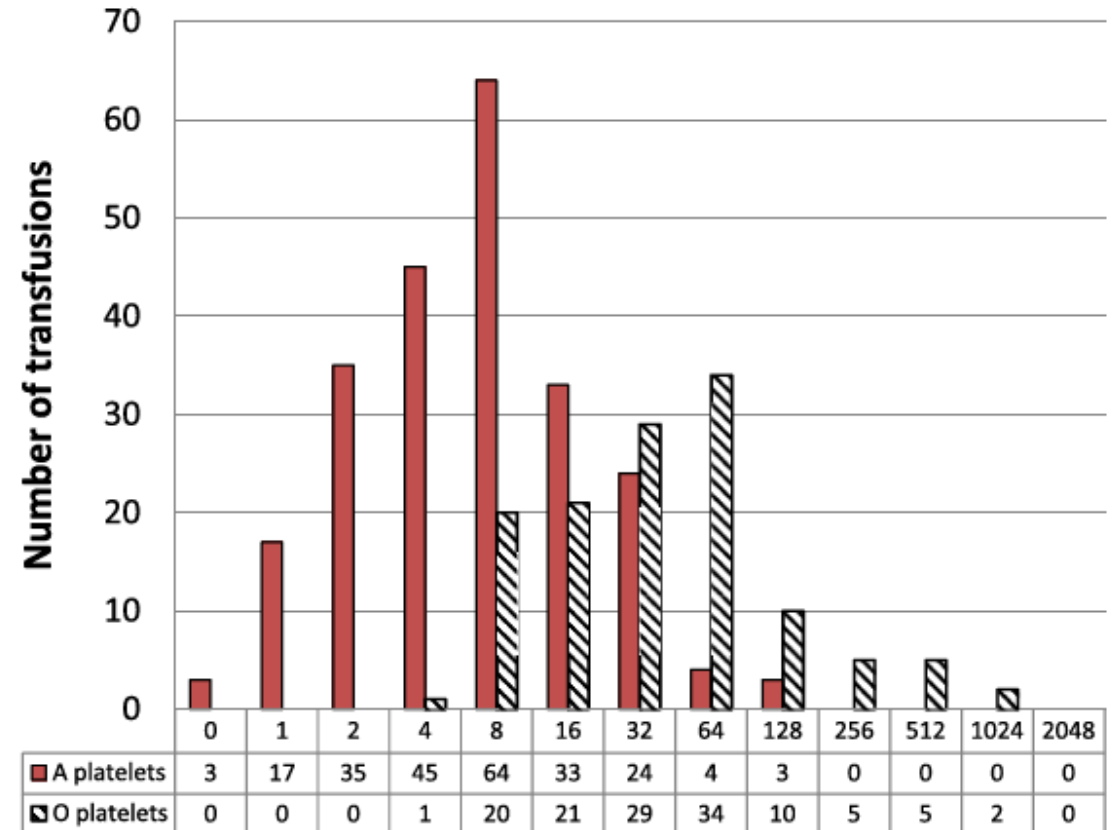
**TRANSFUSION** 2012;52:2087-2093.

- 647 of 4288 apheresis platelet transfusions (15%) were plasma incompatible
- Group O apheresis platelets had significantly higher anti-A and anti-B titers than group A or B ( $p < 0.0001$ )
- For group O APs, 73 had titers of 256 or greater (26.3%), and 27 had titers of 512 or greater (9.7%).
- No HTRs were reported to any plasma-incompatible AP transfusion during the study period.

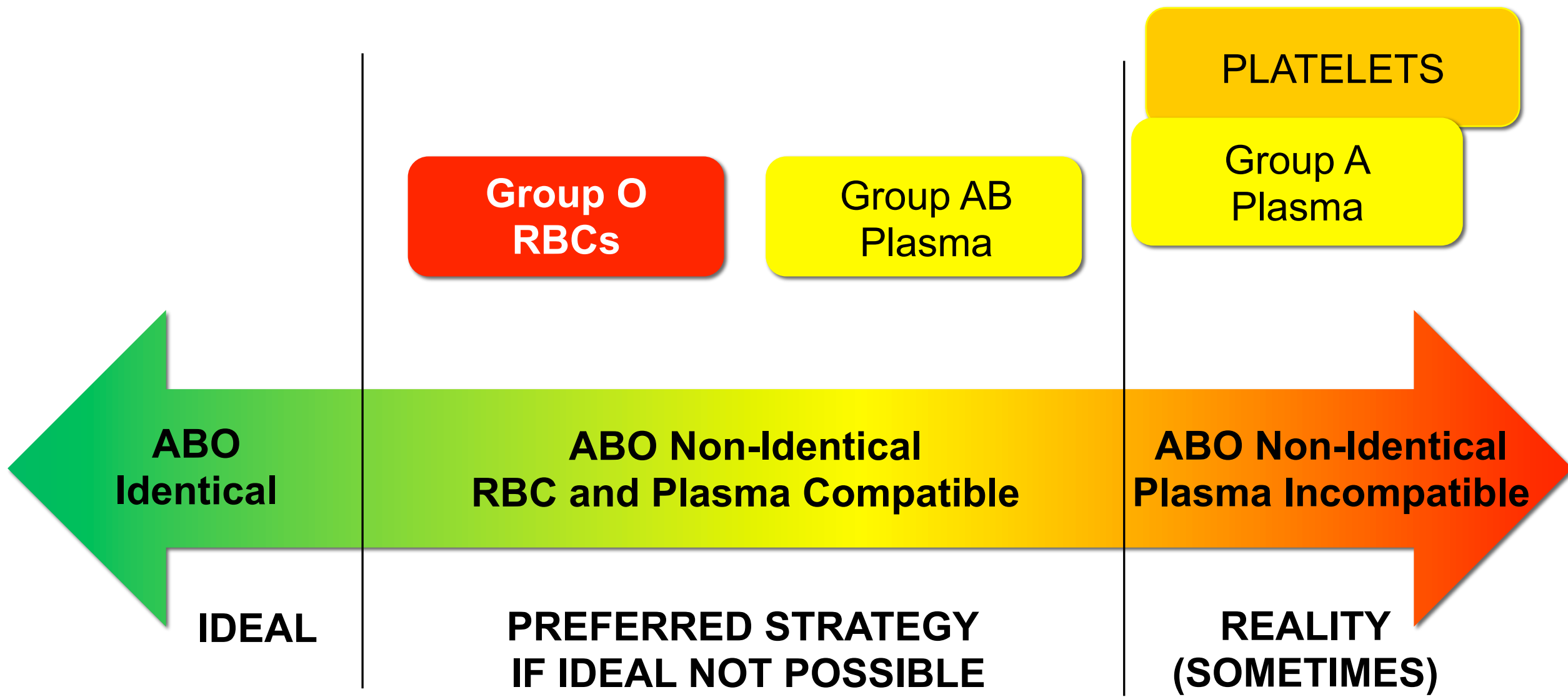
## Anti-A Titers



## Anti-B Titers



- Group O apheresis platelets had significantly higher anti-A and anti-B titers than group A or B ( $p < 0.0001$ )



PLATELETS

Group O RBCs

Group AB Plasma

Group A Plasma

ABO Identical

ABO Non-Identical RBC and Plasma Compatible

ABO Non-Identical Plasma Incompatible

IDEAL

PREFERRED STRATEGY IF IDEAL NOT POSSIBLE

REALITY (SOMETIMES)

ORIGINAL ARTICLE

---

Balancing risk and benefit: Maintenance of a thawed  
Group A plasma inventory for trauma patients  
requiring massive transfusion

Chelsea R. Mehr, BA, Rajan Gupta, MD, Friedrich M. von Recklinghausen, PhD,  
Zbigniew M. Szczepiorkowski, MD, PhD, and Nancy M. Dunbar, MD, *Lebanon, New Hampshire*

---

*Trauma Acute Care Surg* 2013;74:1425-31

- 84 trauma MTP activations reviewed prior to availability of thawed plasma inventory
- 38 patients received  $\geq 6$  RBC (range 6-68)
- Average time from time MTP called to shipping of first plasma dose: **26 min**
- Average number RBCs sent before first plasma dose: **8 (range 0-24)**

## BRIEF REPORT

---

### **A possible new paradigm? A survey-based assessment of the use of thawed group A plasma for trauma resuscitation in the United States**

*Nancy M. Dunbar,<sup>1,2</sup> and Mark H. Yazer,<sup>3,4</sup>*

*on behalf of the Biomedical Excellence for Safer Transfusion (BEST) Collaborative<sup>5</sup>*

*Transfusion* 2016;56:125-9

- The majority of Level 1 trauma centers maintain thawed plasma inventories and use group A plasma for trauma recipients of unknown ABO group
- Most centers do not limit the amount of group A plasma used in this situation or titer the anti-B



# TRANSFUSION PRACTICE

---

## **Safety of the use of group A plasma in trauma: the STAT study**

*Nancy M. Dunbar<sup>1</sup> and Mark H. Yazer,<sup>2</sup> on behalf of the Biomedical Excellence for Safer Transfusion (BEST) Collaborative and the STAT Study Investigators<sup>†</sup>*


*Transfusion* 2017;57:1879-1884

- 354 B/AB and 809 A trauma patients receiving at least one unit of group A plasma
- Use of group A plasma was not associated with increased in-hospital mortality, early mortality, or hospital LOS for group B and AB patients compared to group A patients

## ORIGINAL RESEARCH

---

### **Soluble antigens in plasma allow mismatched transfusion without hemolysis**

*James Sikora <sup>1</sup>, Jason Gregory,<sup>2</sup> Alan George,<sup>2</sup> Simon Clayton,<sup>3</sup> Baiming Zou,<sup>4</sup>  
Matthew Robinson,<sup>4</sup> Faisal Mukhtar,<sup>1</sup> and Joseph P. Pelletier<sup>1</sup>*

**TRANSFUSION 2018;00;00–00**

- 80% of the population are known to be “secretors”
- Soluble ABH antigens in the secretor patient plasma binds to, and neutralizes, the soluble antibodies present in the transfused plasma

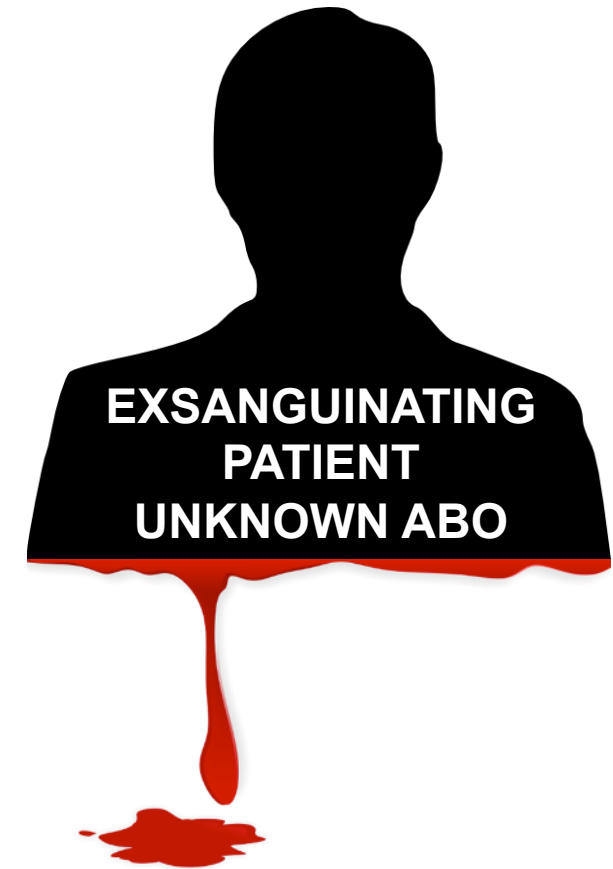
# ABO Incompatibility Risk Mitigation

---

AABB Standards 31<sup>st</sup> Ed

5.15.1

*Recipients shall receive ABO group-compatible Red Blood Cell components, **ABO group-specific WB, or low titer group O WB (for non-group O or for recipients whose ABO group is unknown)***





Get  
Outside  
the Box  
...Rh!



# What about RhD?

---

- This antibody is NOT “naturally occurring”
- 85% of Caucasians are RhD positive
- 20-25% of RhD negative patients who receive an RhD positive RBC unit will form anti-D antibodies
- 20% of pregnancies where maternal anti-D is detectable will have severe hemolytic disease of the newborn

# RhD Compatibility Chart

Rh Type	RBCs	PLASMA	PLATELETS	CRYO
POS	ANY Rh TYPE			
NEG	<b>NEG</b> <i>Unless you run out, then POS</i>	ANY	<b>NEG</b> <i>POS → give Rhogam</i>	ANY

- Rh negative red blood cells are generally used for women of childbearing age (< 50) if Rh type is unknown and urgent transfusion is needed

## TRANSFUSION PRACTICE

---

### A case for stocking O D+ red blood cells in emergency room trauma bays

*Erin Meyer and Lynne Uhl*

**TRANSFUSION 2015;55:791–795.**

- January 2001 and August 2011: 498 ED O– RBC units were transfused to 268 patients; 88% were given to patients who qualified for group O, D+ RBCs per institutional policy
- 39 (15%) patients were D-, 18 (46%) eventually required transfusion with D+ RBCs
- 4 (1.5%) were D- patients were of child bearing potential (<50 yrs), only 3 survived to discharge

## Prehospital low-titer cold-stored whole blood: Philosophy for ubiquitous utilization of O-positive product for emergency use in hemorrhage due to injury

**Ashley C. McGinity, MD, Caroline S. Zhu, Leslie Greebon, MD, Elly Xenakis, MD, Elizabeth Waltman, MBA, Eric Epley, Danielle Cobb, MD, Rachelle Jonas, Susannah E. Nicholson, MD, Brian J. Eastridge, MD, Ronald M. Stewart, MD, and Donald H. Jenkins, MD, San Antonio, Texas**

*J Trauma Acute Care Surg*  
*Volume 84, Number 6, Supplement 1*

- In 124 total MTP patients, only one female of childbearing age that received an MTP was RhD-negative.
- Utilization of low-titer cold-stored O RhD-positive whole blood would be safe and best serve our community



## GIVE Rh+ WB

in the prehospital setting:

100 Rh- women receive Rh+ WB;

3-30 develop Rh isoimmunization;

Rhlg administration reduces risk to 1%;

**0.3 develop Rh isoimmunization**



250 YEARS

**DO NOT GIVE**  
Rh+ WB in the prehospital setting:  
500 women of childbearing age  
die of hemorrhage

250 YEARS

# RhD Alloimmunization Risk Mitigation

---

AABB Standards 31<sup>st</sup> Ed

5.15.2

*Rh-negative recipients shall receive Rh-negative Whole Blood or Red Blood Cell components.*

*5.15.2.1 The transfusion service shall have a policy for the use of Rh-positive red-cell containing components in Rh-negative recipients.*





Make the Leap  
...HLA!

# Transfusion Related Acute Lung Injury (TRALI) Risk Mitigation

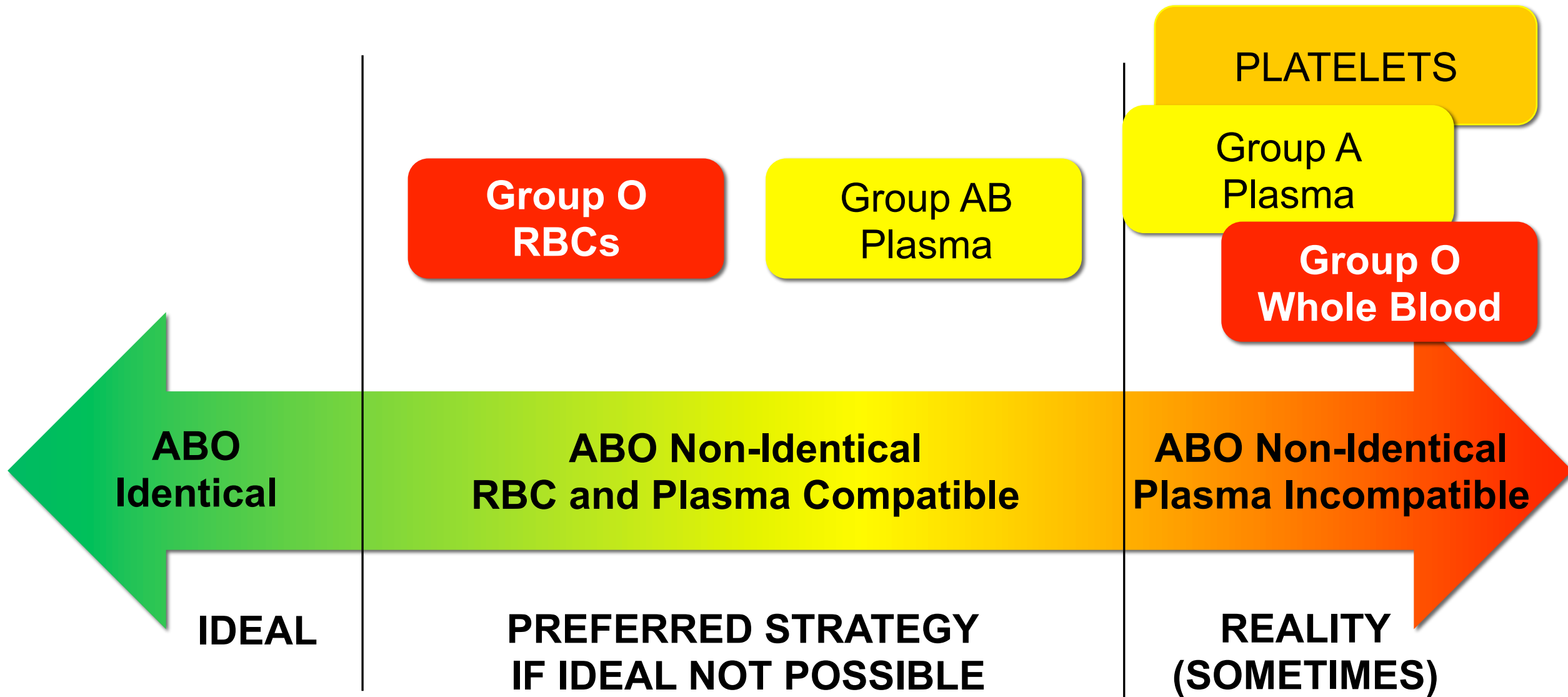
---

AABB Standards 29<sup>th</sup> Ed.

5.4.1.2

*Plasma and whole blood shall be from males, females who have not been pregnancy, or females who have been tested since their most recent pregnancy and results interpreted as negative for HLA antibodies.*





**H O W D O I . . . ?**

---

**How do I implement a whole blood program for massively bleeding patients?**

*Mark H. Yazer,<sup>1</sup> Andrew P. Cap,<sup>2</sup> Philip C. Spinella,<sup>3</sup> Louis Alarcon,<sup>4</sup> and Darrell J. Triulzi<sup>1</sup>*

**TRANSFUSION 2018;58;622–628**

# ABO Incompatibility Risk Mitigation

---

Develop policies that guide the practice of transfusing group O WB to patients of unknown ABO group, including “low titer” threshold:

- Pittsburgh: less than 50 (immediate spin saline)
- Mayo Clinic: less than 200 (immediate spin)
- US Army: less than 256





# ABO Incompatibility Risk Mitigation

---

Develop policies that specify the maximum quantity of WB per patient:

- Pittsburgh: up to 6 units per adult trauma patient
- San Antonio: No upper limit, consult with Transfusion Medicine after 8 units issued



# ABO Incompatibility Risk Mitigation

---

Consider active surveillance for complications related to incompatibility:


- Pittsburgh and San Antonio Military Medical Center: measure lactate dehydrogenase, total bilirubin, and haptoglobin on the day of WB receipt and for the next 2 days



## ORIGINAL RESEARCH

---

### **Safety profile of uncrossmatched, cold-stored, low-titer, group O+ whole blood in civilian trauma patients**

*Jansen N. Seheult <sup>1</sup>, Marshall Bahr,<sup>2</sup> Vincent Anto,<sup>3</sup> Louis H. Alarcon,<sup>4,5</sup> Alain Corcos,<sup>4,5</sup> Jason L. Sperry,<sup>4,5</sup> Darrell J. Triulzi,<sup>1,6</sup> and Mark H. Yazer<sup>1,6</sup>*

TRANSFUSION 2018;00;00–00

- 102 non–group O recipients of 1 to 4 LTOWB units analyzed
- No clinical or biochemical evidence of hemolysis detected

# Rh Alloimmunization Risk Mitigation

---

Develop policies that guide the practice of transfusing group O WB to patients of unknown Rh type:

- Pittsburgh: Adult Level 1 or 2 hospitals stock only D+ WB; females under the age of 50 are not eligible to receive WB; Pediatric Level 1 stocks D– WB
- San Antonio: stocks only D+ WB for all patients



# Transfusion Related Acute Lung Injury (TRALI) Risk Mitigation

---

Develop policies minimize risk for TRALI:

- Pittsburgh: only collects WB units from male donors
- San Antonio: only collects WB units from male donors



# Conclusions

---

1. Risk of clinically significant hemolysis due to ABO incompatibility from transfusion of LTOWB appears to be low.
2. One can make a case for providing RhD+ LTOWB to all traumatically injured adult patients.
3. LTOWB should be risk reduced for TRALI (i.e. collected from males, never pregnant females, or females tested negative for HLA antibodies).