



Blood Products for Ground EMS

Eric Bank, Assistant Chief, HCESD 48 Fire-EMS
Samuel Kordick, Sr Clinical Supervisor,
CCEMS

Wave



Thanks to the following

United States Army

75th Ranger Regiment

Major Andrew Fisher, 7249th MSU, USAR

Dr. John Holcomb, UT McGovern School of Medicine

Gulf Coast Regional Blood Center

Dr. David Reiningger, EMS Medical Director HCESD 48

Dr. Levon Vartarian, EMS Medical Director CCEMS

Department of Emergency Medicine, UT McGovern
School of Medicine

Memorial Hermann Red Duke Trauma Institute

A microscopic view of blood cells, including red blood cells and white blood cells, set against a dark blue background. The red blood cells are prominent, appearing as biconcave discs in various shades of red and pink. The white blood cells are smaller and more irregular in shape, appearing in lighter shades of blue and green. The overall composition is artistic and scientific, with a focus on the cellular structure of blood.

Topics

- Trauma Care
- Blood Studies
- Whole Blood LTOW Program
- Medicine Patients and LTOW
- Guidelines to Care
- Logistics
- Questions



A tale of two Patients + 1

Patient #1

Let's turn back the clock to 1994:

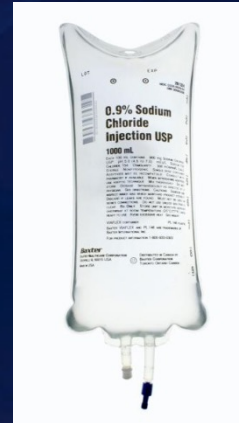
- Patient presents in a car, after being assaulted with a knife.
 - Pt. is semiconscious,
 - Ashen, Cool and Diaphoretic, HR 130's, B/P 60/systolic,
 - Multiple defense wounds on bilateral arms with brachial artery injuries,
 - 8" deep laceration to the right upper abdomen.

How would you treat this patient ?

- Now remember it's 1994 in an "unnamed city with a very famous bell".
 - Pt. was extricated from the vehicle,
 - Bleeding control attempted by pressure dressing,
 - Pt. received multiple liters of room temp Normal Saline,
 - Pt. transported to a Level-1 Trauma Center.

Upon arrival bleeding was limited, with an improvement in B/P. The visible bleeding was saline in color with tinges of blood, and the pt.'s skin color has changed from ashen to pale white. B/P is better and bleeding less, mission accomplished right ?

1990's Trauma Care



Patient #2

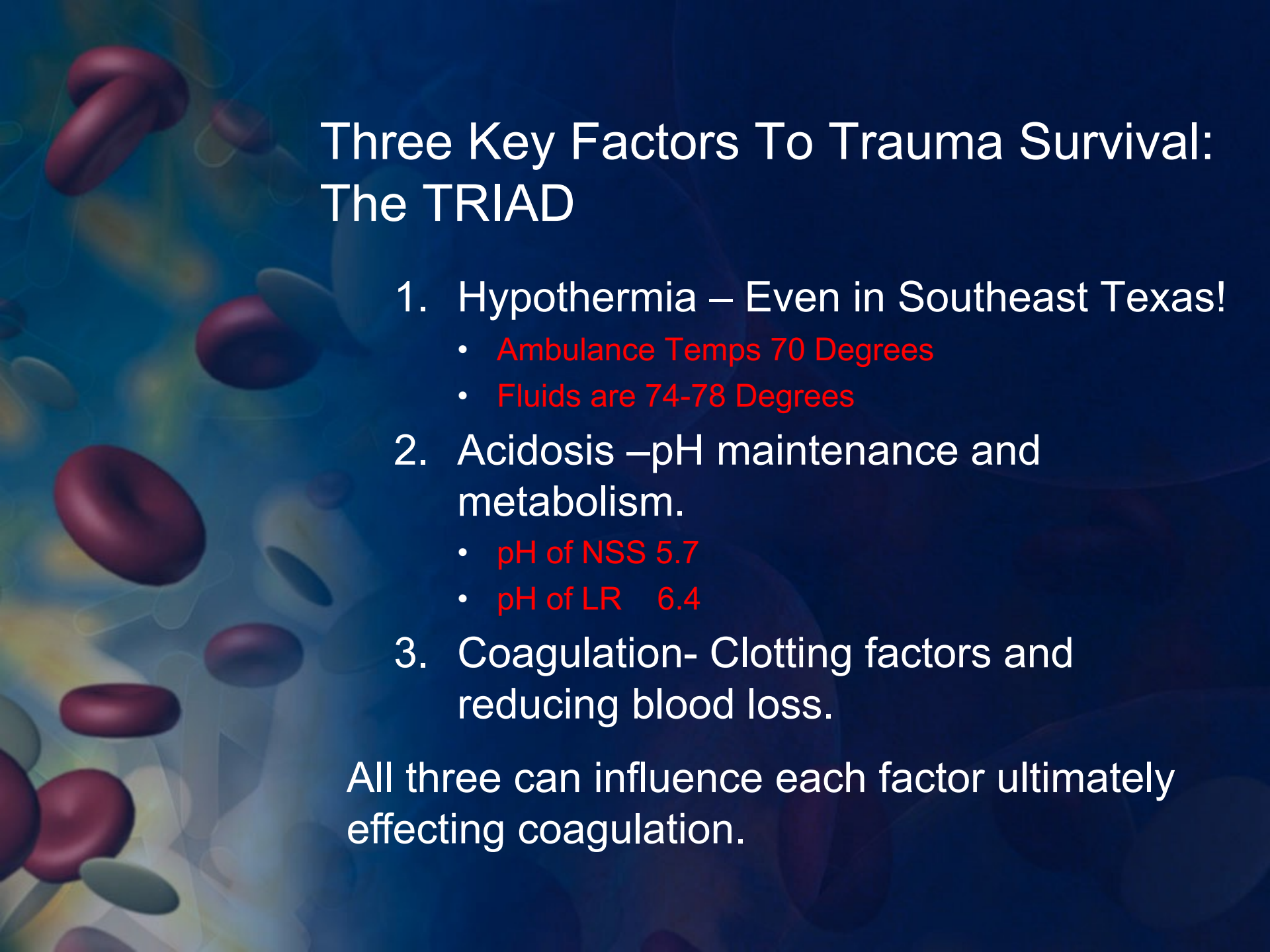
Let's move forward to October 2016:

- Pt. presents prone with a large caliber GSW to the right mid-back.
 - Pt is semiconscious,
 - Ashen, Cool and Diaphoretic, HR 127, B/P 75 systolic,
 - Abdomen is firm to the touch, no exit wound is present.

How would you treat this patient ?

- Different Mechanism, similar vitals and penetrating trauma
 - Pt. was rapidly extricated from the home, aircraft secured due to distance and traffic.
 - Enroute to the LZ, pt. received:
 - (2) 20g IV's (Yes, for TRAUMA!),
 - 50ml of warmed Plasma Lyte,
 - 1 unit of warmed Low Titer A+ Plasma,
 - 1 unit of warmed O- PRBCS

Pt. was transferred to the flight crew with improved color, HR 99, BP 130/systolic. Pt. contact to lift off was less than 15 min. with blood products on board. Mission accomplished?

A microscopic view of blood cells, including red blood cells and white blood cells, is visible in the background of the slide. The red blood cells are prominent, showing their characteristic biconcave shape and reddish color. The white blood cells are smaller and more irregular in shape, with some showing nuclei. The background is a dark blue, and the overall image has a slightly blurred, artistic feel.

Three Key Factors To Trauma Survival: The TRIAD

1. Hypothermia – Even in Southeast Texas!
 - Ambulance Temps 70 Degrees
 - Fluids are 74-78 Degrees
2. Acidosis –pH maintenance and metabolism.
 - pH of NSS 5.7
 - pH of LR 6.4
3. Coagulation- Clotting factors and reducing blood loss.

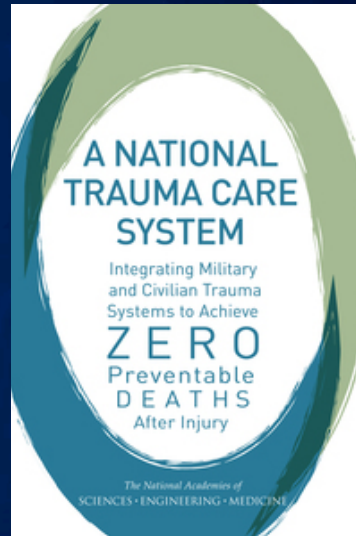
All three can influence each factor ultimately effecting coagulation.

EMS Trauma Care

1. First major change is in the mid 1990s where fluid studies indicate less is more
2. 2008 Enhanced Hemorrhage Control with Tourniquets and Hemostatic Dressings
3. 2014 Studies indicate C-Spine immobilization and log spine boards are not effective for blunt care and higher mortality for penetrating trauma
4. 2016 Parted Blood Products for Ground EMS

Think about ACLS and CPR and the number of changes in care that have taken place since the mid 90s

National Academies of Medicine 2016 Paper



Focuses on integrating civilian and military medicine to achieve zero preventable deaths, endorsed by the American College of Surgeons, Committee on Trauma

Blood vs. Crystalloid



Let's review a few recent studies.

The background of the slide features a dark blue gradient with several red blood cells (RBCs) depicted in various shades of red and pink. Some RBCs are in sharp focus, while others are blurred, creating a sense of depth. The overall aesthetic is medical and scientific.

Prehospital Transfusion of Plasma and Red Blood Cells in Trauma Patients.

Holcomb JB, Donathan DP, Cotton BA, Del Junco DJ, Brown G, Wenckstern TV, Podbielski JM, Camp EA, Hobbs R, Bai Y, Brito M, Hartwell E, Duke JR, Wade CE.

Abstract Objective: Earlier use of plasma and red blood cells (RBCs) has been associated with improved survival in trauma patients with substantial hemorrhage. We hypothesized that prehospital transfusion (PHT) of thawed plasma and/or RBCs would result in improved patient coagulation status on admission and survival

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- 1,667 patients 19% (137) received blood products from Life Flight, remaining 81% (1,530) underwent standard fluid resuscitation.
- **Patients who didn't get blood products during transport were more likely to be acidotic**
- **Patients who got blood products were less likely to receive an abundance of fluid**
- There were no differences in 0- to 6-hour RBC, plasma, or overall transfusions, however:
- **Patients who got blood products ended up getting fewer platelet transfusions and had significantly lower substantial bleeding at the hospital than patients who got standard fluid therapy.**
- Only 1.9% (18) of the 942 units of blood products were wasted and unusable during the 20-month study period.

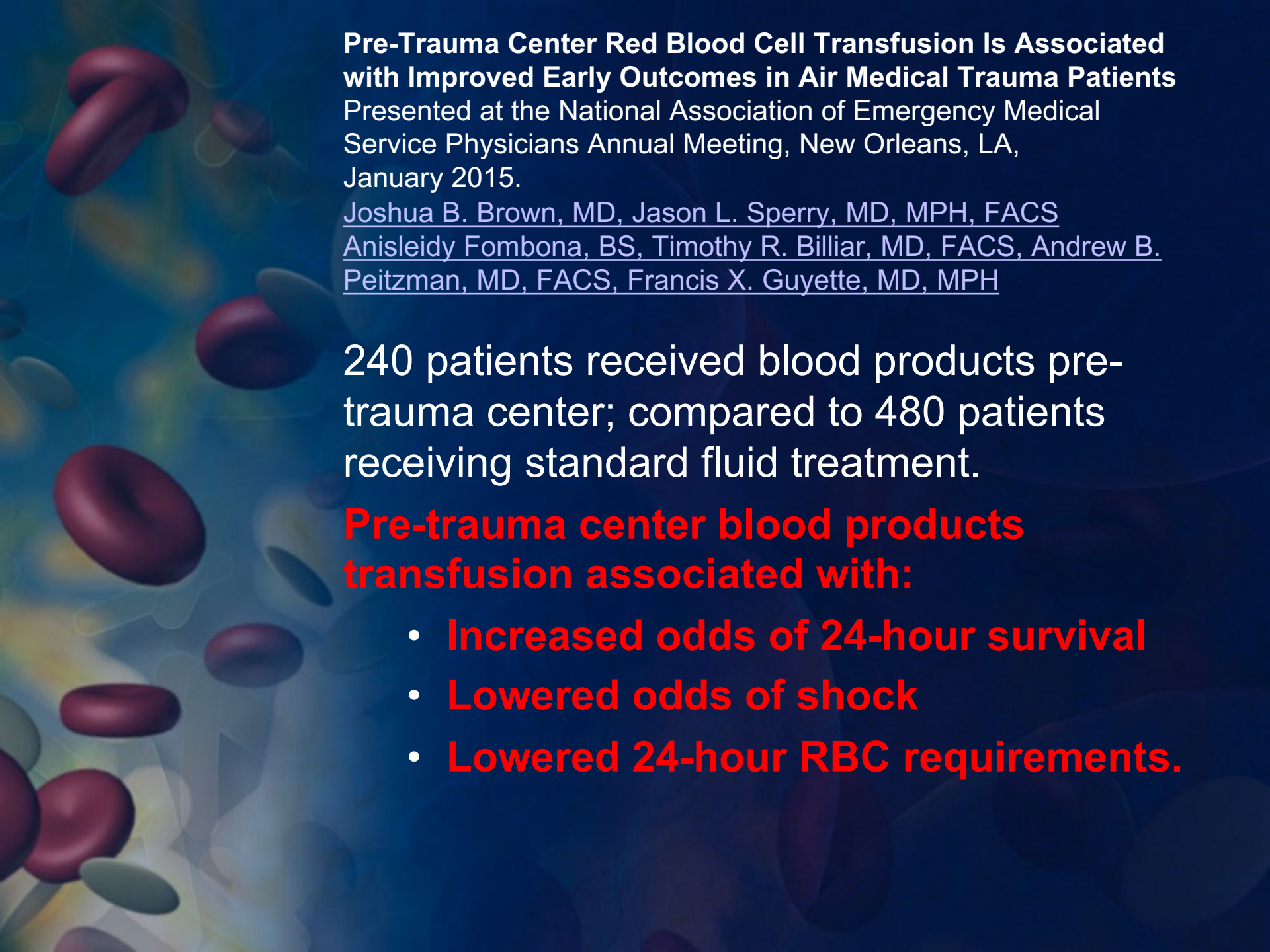


Pre-Trauma Center Red Blood Cell Transfusion Is Associated with Improved Early Outcomes in Air Medical Trauma Patients

Presented at the National Association of Emergency Medical Service Physicians Annual Meeting, New Orleans, LA, January 2015.

Joshua B. Brown, MD, Jason L. Sperry, MD, MPH, FACS
Anisleidy Fombona, BS, Timothy R. Billiar, MD, FACS, Andrew B. Peitzman, MD, FACS, Francis X. Guyette, MD, MPH

Background-Hemorrhage is the leading cause of survivable death in trauma and resuscitation strategies including early RBC transfusion have reduced this. Pre-trauma center (PTC) RBC transfusion is growing and preliminary evidence suggests improved outcomes. **The study objective was to evaluate the association of PTC RBC transfusion with outcomes in air medical trauma patients.**

The background of the slide features a dark blue gradient with a microscopic view of blood. Numerous red blood cells, depicted as biconcave discs in shades of red and maroon, are scattered across the frame. Interspersed among them are lighter, translucent shapes representing plasma or other fluid components. The overall effect is a textured, scientific aesthetic.

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240 patients received blood products pre-trauma center; compared to 480 patients receiving standard fluid treatment.

Pre-trauma center blood products transfusion associated with:

- **Increased odds of 24-hour survival**
- **Lowered odds of shock**
- **Lowered 24-hour RBC requirements.**

A microscopic view of blood cells, including red blood cells and platelets, is shown on the left side of the slide. The background is a dark blue gradient.

TCCC Military Trauma Guidelines

The resuscitation fluids of choice for casualties in hemorrhagic shock, listed from most to least preferred:

1. **Whole Blood**
2. **Plasma, RBCs, Platelets 1:1:1 Ratio**
3. **Plasma and RBCs 1:1 Ratio**
4. **Freeze Dried Plasma**
5. **Liquid or Thawed Plasma Alone or RBCs Alone**
6. **Crystalloids Hextend, Lactated Ringers or Plasma Lyte**

Whole Blood in the Field

ROLO

- Spring 2015, Ranger Regiment requested support for ROLO (Ranger O Low Titer) program
- **Goal:** Identify low-titer Group O WB donors prior to deployment of personnel from CONUS
- Program initiated at Ft. Benning, GA with 3rd Battalion, 12 May 2015
- Screening coordinated with Sullivan Memorial Blood Center, Ft. Benning, GA



Recent Combat Data on Whole Blood

Fresh whole blood use by forward surgical teams in Afghanistan is associated with improved survival compared to component therapy without platelets

Shawn C. Nessen, Brian J. Eastridge, Daniel Cronk, Robert M. Craig, Olle Berséus, Richard Ellison, Kyle Remick, Jason Seery, Avani Shah, and Philip C. Spinella

The Journal of **TRAUMA**[®] *Injury, Infection, and Critical Care*

Warm Fresh Whole Blood Is Independently Associated With Improved Survival for Patients With Combat-Related Traumatic Injuries

Philip C. Spinella, MD, Jeremy G. Perkins, MD, Kurt W. Grathwohl, MD, Alec C. Beekley, MD, and John B. Holcomb, MD

Comparison of platelet transfusion as fresh whole blood versus apheresis platelets for massively transfused combat trauma patients

Jeremy G. Perkins, Andrew P. Cap, Philip C. Spinella, Andrew F. Shorr, Alec C. Beekley, Kurt W. Grathwohl, Francisco J. Rentas, Charles E. Wade, John B. Holcomb, and the 31st Combat Support Hospital Research Group

Recent Civilian Data on Whole Blood

A Randomized Controlled Pilot Trial of Modified Whole Blood versus Component Therapy in Severely Injured Patients Requiring Large Volume Transfusions

Bryan A. Cotton, MD, MPH,† Jeanette Podbielski, BSN,† Elizabeth Camp, MSPH,† Timothy Welch, NREMT-P,†*

*Deborah de
Beth Hartwell*

Prehospital blood transfusion programs: Capabilities and lessons learned

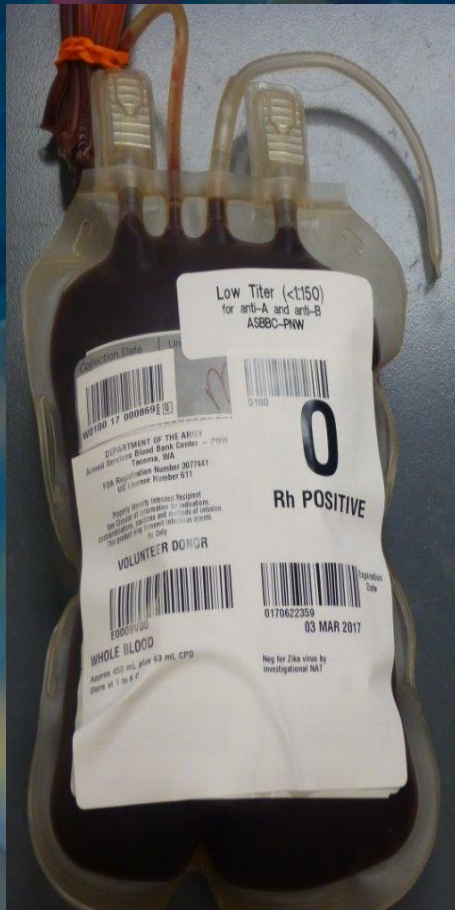
Martin D. Zielinski, MD, James R. Stubbs, MD, Kathleen S. Berns, MS, Elon Glassberg, MD, Alan D. Murdock, MD, Eilat Shinar, MD, Geir Arne Sunde, MD, Steve Williams, RN, Mark H. Yazer, MD, Scott Zietlow, MD, and Donald H. Jenkins, MD, San Antonio, Texas

Initial safety and feasibility of cold-stored uncrossmatched whole blood transfusion in civilian trauma patients

Mark H. Yazer, MD, Byron Jackson, MD, Jason L. Sperry, MD, Louis Alarcon, MD, Darrell J. Triulzi, MD, and Alan D. Murdock, MD, Pittsburgh, Pennsylvania

Why Whole Blood ?

It's simple!



Don't make things worse (clear fluids)!

Give the patient what he or she is losing!

Keep it simple (one product)!

Low-Titer Whole Blood Safety Profile

- WWII
 - Practically all transfusions during WWII were group O whole blood, regardless of titer or Rh factor
 - Of 256 ABO incompatible group O whole blood transfusions, there were three mild hemolytic reactions reported
 - All ABO IgM anti—A and anti—B titers were $>1:500$
 - One Soldier received 75ml of a unit with an IgM anti—A titer of 1:8000
 - This prompted the US Army Blood Program to define LTOWB as IgM anti—A and anti—B level was $<1:250$

Korean War

- Over 400,000 units of LTOWB were transfused in the Korean War
- All units transfused on the Korean peninsula was Rh negative
- There were **no adverse reactions** associated with this protocol
- Vietnam War
 - Over 230,300 LTOWB whole blood transfusions, 1967-1969
 - 1 severe hemolytic transfusion reaction
 - High titer (> 256) Group O whole blood used accidentally (mislabelled)



That +1 Patient: Medicine Based

- Symptomatic bleeding, regardless of cause needs to be treated
- We initially added medicine guidelines to cover these patient's since we carried blood. What we learned is we treated them 4 times as much as trauma patients
- Hemorrhagic shock from all forms of bleeding should be treated the same
- The Trauma Triad is still in effect for bleeding from medical based causes

First Whole Blood Transfusion

Medicine Patient

- First Whole Blood Transfusion , Medicine Patient
 - Mid 30s female with syncope while shopping , 2 weeks post partum
 - Hemodynamically unstable HR >120 BP 70/Systolic
 - Map of 60
 - Pts is pale, temp is low grade 96.5 and POC lactate is 4.7mmo/L
 - Difficulty catching her breath
 - Vaginal bleeding x 2 weeks in Hemorrhagic shock
- Patient Received 1 unit or 570ml of Warmed Whole Blood
 - Syncope Resolved
 - Hemodynamically Stable HR 64 B/P 98/ Systolic
 - Map of 64
 - Skin color improved, Temp 97.7

A microscopic view of blood cells, including red blood cells and white blood cells, set against a dark blue background. The red blood cells are prominent, showing their characteristic biconcave shape and reddish-brown color. The white blood cells are smaller and more irregular in shape, appearing as lighter, more translucent spheres. The overall composition is artistic and scientific, emphasizing the cellular components of blood.

Patient Guidelines:

- Confirm Products are Universal Donor
 - Low Titer (<256) O+ for Most Patients
 - O- for Females < 50 years of age and Pediatrics
- While more complicated than IV fluid this is essentially the same goal
- Incident reactions are less than 1%
- Always use the fluid warmer
- Train P2 medics to use Blood Ys, it saves time on administrations,
- Don't be afraid to ask for help
- Patient presentation and vitals are your best guide
- Document all aspects of care, including speaking to the patient or family about giving blood products

Universal Patient Guideline

(B) Assure Scene safety. Primary Survey / Control Severe Traumatic Bleeding per guideline

BCS IV– Base fluid start on a Blood Y no less then 20-gauge catheter x (2) utilize warm fluids

Inclusion Criteria 12 and older (Should have 2 or more of the following)

1. Hemodynamically Unstable
 - HR > 120
 - Systolic B/P 90 mmHg or less
2. Penetrating Injury or Blunt Trauma with significant injury
3. Positive FAST (If available)
4. Hemoglobin < 6.0 (Intended as a guideline for medical patients)

Note if criteria is not met, and feel the need is there, contact the on call Medical Director

Confirmation Procedure

1. Confirm patent administration site if any question exists utilize a new site
2. Identify the patient meets criteria above and/or medical director order
3. Record baseline vitals
4. (2) EMS personnel must confirm the tag and the blood product match including number, blood type, Rh factor, expiration date and fluid amount
5. Both confirming personnel must sign the accompanying blood component tag

Administration

1. (P) H and H via Meter and Lactate. If unavailable, do not delay blood product administration.
2. Place flat thermometer on patient's forehead.
3. Whole Blood 1 unit IV/IO via blood Y. Flow through blood warmer to completion and / or hemodynamic stability. Repeat PRN x 1. Utilize low titer O+ for most patients, utilize low titer O- for female patients < 50.
4. In the event the bleeding is controlled, IE Tourniquet is applied and bleeding is stopped, proceed to administer blood back to normotensive levels.
5. In the event Whole Blood is not available Low Titer A Liquid Plasma and O- PRBCs may be given in pairs to reach permissive hypotension with hemodynamic stability. Repeat PRN x 1.

Note Well & Treatment Options

1. Consistently watch for transfusion reaction. If any exists, stop transfusion, change all lines and utilize BCS. Bag all blood products to be returned to the blood bank and, if needed, go to the Allergic Reaction guideline to treat.
2. If only one line can be started, start with plasma followed by PRBC.
3. Full report to the receiving level 1 or designated medical center about blood transfusion.
4. If any question exists contact the on call Medical Director.
5. Do not delay transport to initiate blood products. Start enroute to the receiving facility.
6. Do not give medications through the Whole Blood IV set. Utilize alternate access.
7. Medical Patients can be treated PRN with this guideline.
8. In the event only O+ is available, contact the online medical director for guidance with female patients < 50.

Whole Blood Administration—Adult

Indications	Equipment Required	Assessment Requirements
<p>Trauma or medical patient with suspected blood loss.</p> <p>Must be at least 12 years old.</p> <p>Must have two or more of the following:</p> <ul style="list-style-type: none"> • HR > 100 bpm with suspected blood loss • Sys. BP \leq 100 mmHg • Penetrating injury or significant blunt traumatic injury • Hemoglobin of 7 or less 	<p>100 mL normal saline</p> <p>Blood-Y tubing</p> <p>IV Catheter \geq 20 ga. X 2</p> <p>Quin Flo Warmer and disposable circuit</p> <p>H & H Meter</p> <p>Low Titer Group O Whole Blood (gender dependent)</p>	<p>Blood pressure, cardiac monitoring, ETCO2 monitoring.</p> <p>Pre- and post-administration VS including GCS</p> <p>H & H (as applicable)</p> <p>Temperature Monitoring</p>

Purpose

- Whole blood replaces fluid volume, hemoglobin, plasma proteins, platelets, and clotting factors lost due to hemorrhage. Whole blood can improve perfusion, oxygen delivery, and hemorrhage control.
- Emergency mass transfusion of uncrossmatched blood products has a risk for minor transfusion reactions; low-titer whole blood has the lowest risk and type O has universal type compatibility.
- The Rh-factor (negative or positive) does not have to be a direct match for emergency transfusions, however, if an Rh-negative female patient receives Rh-positive blood, they can develop antibodies leading to potential complications during pregnancy.
- Select **O-positive whole blood** for all males and females > 50 years old and of non-child bearing age.
- Select **O-negative whole blood** for pediatric patients ages 1–18 and for females < 50 years old or of child-bearing age.

Procedure

1. A person meeting the criteria may refuse the blood transfusion for religious, social, or personal reasons if he/she is awake, alert and oriented. The reason for refusal must be clearly documented in the PCR.
2. In the case of a refusal of blood transfusion, administer Plasmalyte according to protocol
3. Establish two IV access sites with at least a 20 ga. Catheter. Connect directly to a Blood Y administration set with Plasmalyte as base fluid if delay is blood is imminent. If WB is readily available minimize clear fluid administration. Use the WB as the resuscitation replacement for the loss.
4. Ensure IV line patency by flushing site with 10 ml of NS
5. **Record baseline vital signs.**
6. Perform H & H, if available, and record in PCR (do not delay blood product administration)



Transfusion Reactions

Monitor pt. for reaction S/S, similar to drug reactions, including developing a fever.

Minor reactions such as fever are common

- Treat PRN and continue transfusion
 - PO or IV Tylenol
- If reaction worsens, stop transfusion and treat accordingly PRN

Severe Reactions are rare

- Stop Transfusion and replace IV Lines with Crystalloid
- Follow Guidelines or Protocols for Allergic Reactions,
- Do not dispose of blood products or tubing used;
- Contact Blood Bank.

A microscopic view of blood cells, including red blood cells and white blood cells, swimming in a fluid medium. The background is a deep blue, and the cells are rendered in various shades of red, white, and yellow.

Administration Set Up

- IV access with a minimum of 20g catheter, 18g is preferred,
- Place a Saline Lock (makes for easier swaps as needed),
- Run Plasma Lyte or NS on a Blood Y tubing,
- Attach Qin Flow Fluid Warmer
- Place set in warmer and run.

A microscopic view of blood cells, including red blood cells and white blood cells, swimming in a fluid medium. The red blood cells are biconcave and reddish-brown, while the white blood cells are larger and more irregular in shape, appearing lighter in color. The background is a dark blue gradient.

Administering Medications

Medications can be administered through the blood Y tubing:

- Stop blood product flow,
- Flush with 10-20cc of saline,
- Administer medication,
- Flush with 10-20cc of saline,
- Resume blood product flow.

Maintenance or drip medications should be administered on a secondary line.

The background of the slide features a dark blue gradient with a microscopic view of blood cells. Several red blood cells, depicted as biconcave discs, are scattered across the frame. Some are in sharp focus, while others are blurred, creating a sense of depth. The overall aesthetic is clinical and scientific.

From Medicine to Logistics

*Step 1: **Gaining medical direction:*** Through researching local and military studies our Medical Directors felt that the medicine and science was sound.

*Step 2: **Convince the Blood Bank*** to get on board!

*Step 3: **Develop Logistics and Maintenance***

- What are usage level and guidelines?
- How do you replace it? (and pay for it!)
- How you hand off a patient for flight?
- How do you bill for it?

Step 4: Convince and partner with the Trauma Centers and Local Partner Hospitals.

From concept to inception, our program took a little over 1 year.

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CCEMS 2017 Data

- 77 patients received:
 - 52 units of plasma
 - 47 units of PRBC
 - 25 units of low-titer whole blood
- 60% medical (mostly GI bleed)
- 30% trauma:
 - 40% GSW
 - 26% stabbing/cuts
 - 22% motor vehicle collision
 - Remainder from falls, assaults

CCEMS 2017 Data

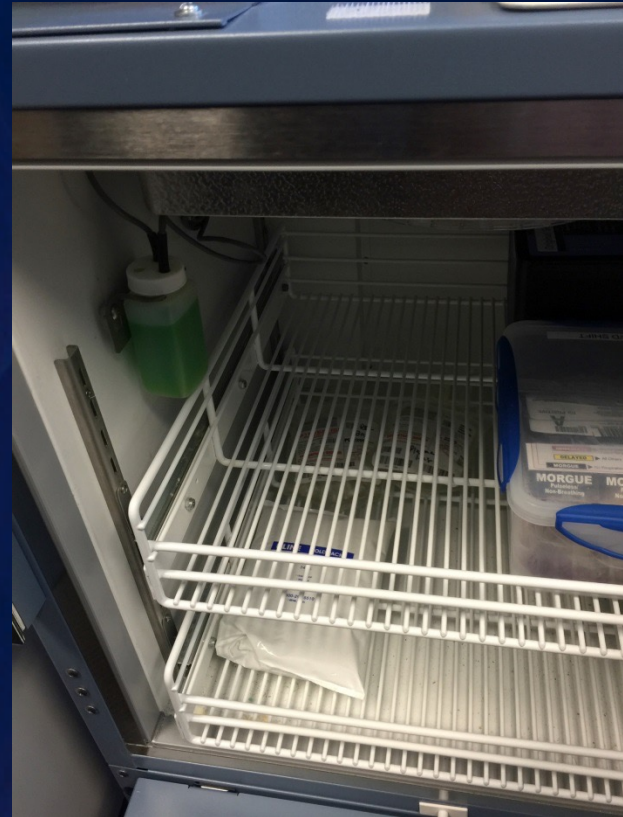
	Pre-Blood	Post-Blood	Change
MAP	73	82	↑ 9
Shock Index <i>(HR/SBP)</i>	1.2	0.99	↓ 0.21

HCESD 48 Data Slide

2017 Raw Data

1. 20 Units to 14 patients
2. 10 Medicine and 4 Trauma
3. All where noted to be Hypothermic to start 95-98 Degrees
4. Average Pre Administration MAP 55
5. Average Post Administration Map 73
6. None where out of criteria (If anything we feel we missed some opportunity)

Station Storage



Helmer Blood Refrigerator, multiple thermometers and alarms, including cellular connectivity. Keeps blood between 3-5 degrees Celsius

The background of the slide features a dark blue gradient with a faint, artistic illustration of various blood cells, including red blood cells and white blood cells, floating and moving across the frame.

Storage in the Field

1. Maintain 1-4 Degrees Celsius
2. Non Motorized and Non Electric to reduce vibrations
3. Easy Access
4. Texas Summer Resistant
5. Portable
6. Easy to Maintain
7. Consistent Measure Of Internal and External Temps
8. Hold 2-4 Units of 500ml Blood Bags

Cooler in Response Vehicle



Cooler Panels

Changed in 12 or 24 hour increments based on weather:

- Remove panels from freezer, allow to cure for 30 minutes.
- Wipe panels down and exchange.
- Monitor temp range.
- Keep vehicle under cover when possible.
- If not possible to cover, keep vehicle running.
- No moving parts to cause vibrations and damage cells.
- Products are kept in small plastic container so they are not in direct contact with cooler panels.

QinFlow Warrior



Ability to deliver fluids at 37 degrees Celsius

Hemoglobin Meter



- Used to confirm findings, not as a primary indicator,
- Acute changes are not going to show immediately,
- Needs more blood than the Glucose Meter,
- Need to use the Pipette.

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Replacement

- Document usage and attach copy of the blood tag to the record.
- Remove replacement supply from Helmer.
- Contact Gulf Coast Regional Blood Center to request replacement.

Back to the Future ?

- Whole Blood, currently deployed in Theater with 75th Rangers
 - FDA Approved for use in the US
- Freeze Dried Plasma
 - Not Currently FDA approved
 - Being used by the Military in theater
 - Being used in other countries
 - Originally used in WW-II
- Advanced Hemostatic Agents
 - Foam Deployment Device
 - Direct Injection Hemostatic Sponges (X-Stat)
- Pre-Hospital Trauma Care
 - Ultrasound
 - REBOA

Lessons Learned

1. Take the Blood Cooler to the Hospital
2. Train all staff in administration
3. Add blood Y's to the ambulances
4. Actively Monitor Temperature
5. Have a medical director business card
to give to the receiving Hospital
6. Look for missed opportunities

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Questions or Discussion?

Samuel Kordick
CCEMS
Senior Clinical Supervisor
skordick@ccems.com

Eric Bank
HCESD 48 Fire-EMS
Assistant Chief of EMS
Eric.Bank@hcesd48.org

Questions or Discussion

Eric.Bank@hcesd48.org

skordick@ccems.com

Wave