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State of Qatar

14th PAN ARAB TRANSFUSION MEDICINE CONFERENCE QATAR 2024

Inspiring Transfusion Excellence Across Arab Nations

30 November to 2 December 2024

Sheraton Grand Doha Resort & Convention Hotel, Doha, Qatar

Low Titer Group O Whole Blood Use in Massive Transfusion

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TICU Medical Director

Norman E. McSwain Jr. MD Spirit of Charity

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Disclosure Statement

I make the following declaration in relation to this CPD Activity :

- This complies with the Ministry of Public Health in Qatar Department of Healthcare Professions MoPH-DHP accreditation standards.
- There is NO Conflict of Interest.
- There is no plagiarism or copyright infringement.
- The content is balanced and free of bias, either commercial or non-commercial.

Epidemiology and Outcomes

- Trauma most common cause of death
  - 1-46 years of age in US
- Hemorrhage most common cause of medically preventable death
- Hemorrhagic death occurs fast
  - 85% of hemorrhagic deaths in-hospital occur within 6 hours
  - Median time to death is between 1 to 3 hours after admission
- **Rapid treatment of traumatic hemorrhage**
  - **Greatest impact on survival**

Eastridge et al. *J Trauma* 2013.
Kotwal et al. *Arch Surg* 2011.
Spinella et al. Blood Reviews 2009
Blessing TO, Injury 2016

Fox, E.E. Shock 2017. 2.
Holcomb, J.B., Jama, 2015. 3.
Sauaia, A. Journal of Trauma and Acute Care Surgery, 1995.
Demetriades, D. J Am Coll Surg, 2004.

Preventable Deaths from Hemorrhage After Trauma

- 148,000 US civilian traumatic deaths
- **30,000 potentially preventable** trauma deaths due to **hemorrhage** per year in the US
  - ***25,000*** *of these deaths occur in* ***prehospital*** *phase of resuscitation*

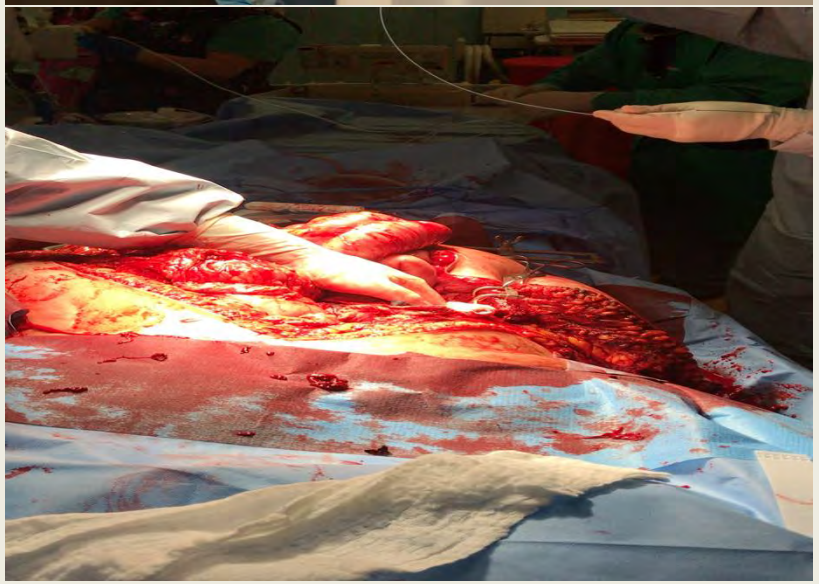
National Academy Sciences Report: National Trauma System, 2016

Functional Fixation.....

Bleeding Patient Life is on the Clock

Damage Control Resuscitation

Damage Control Resuscitation



After 800 MTP events, mortality due to hemorrhagic shock remains high and unchanged despite several in-hospital hemorrhage control advancements; is it time to move the pendulum ?

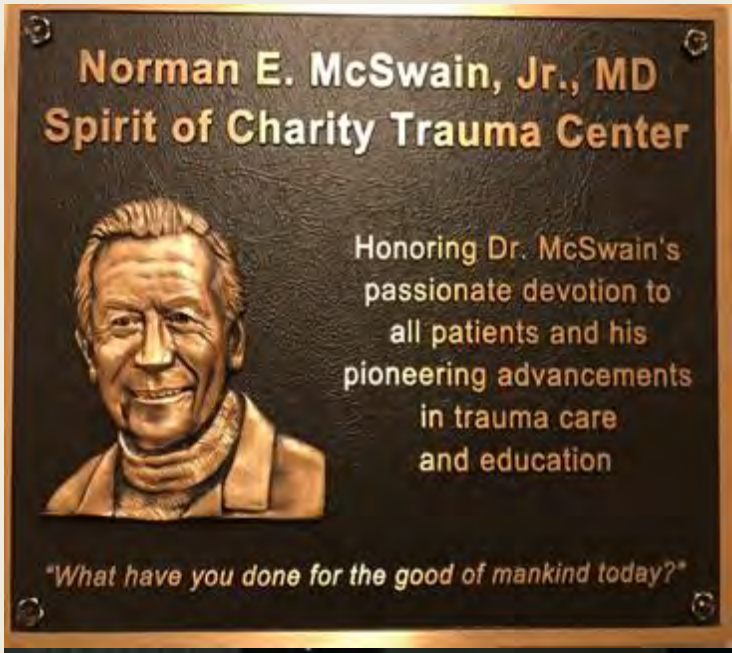
Shock Dec 2021

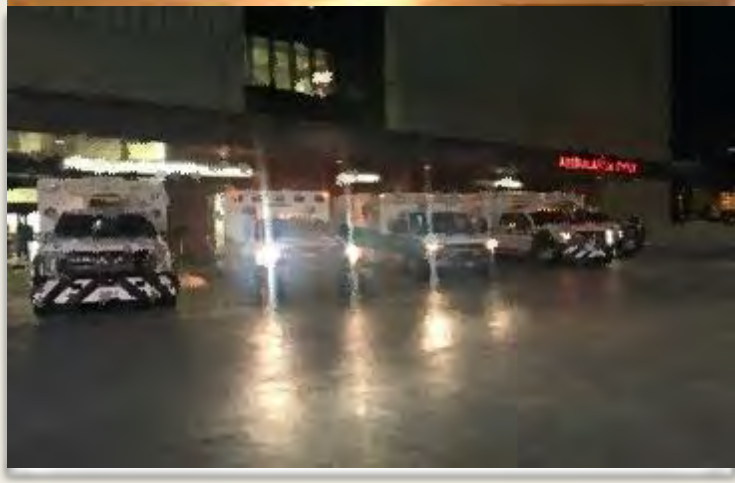
We hypothesized that mortality over time would be decreased in later years, which would have utilized many of these advancements

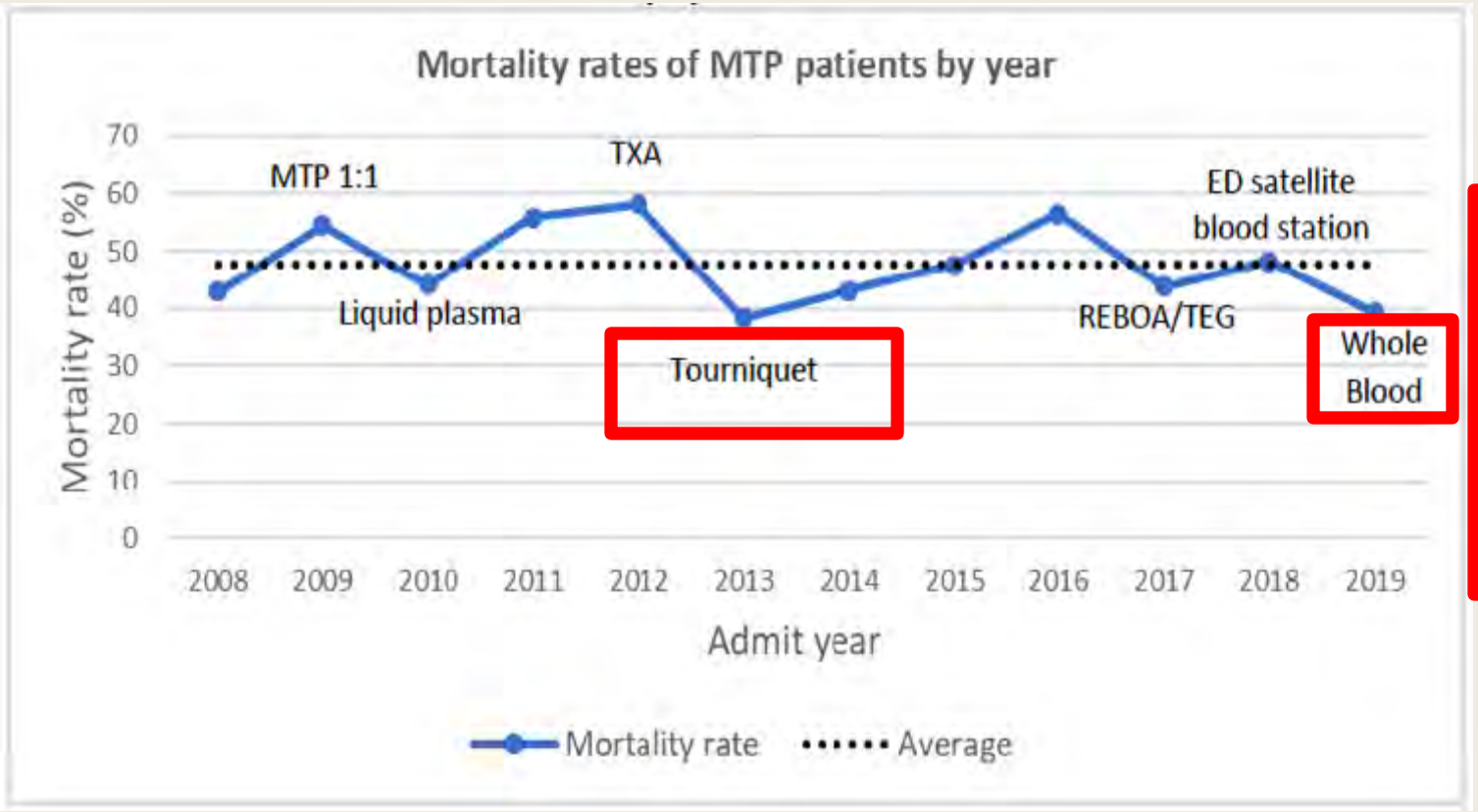
METHODS

- Retrospective review of all MTP patients treated at UMC Level I trauma center from 2008 – 2019
- Interventions by y

MTP 1:1 ratio (2009
Liquid plasma (2010
TXA (2012)
Tourniquets (2013)
REBOA/TEG (2017)
ED satellite blood st
Whole blood transfu







Mortality Rate Per Intervention: unchanged 38.3% to 56.6% (P = 0.26)

Average Mortality Rate: 390/824 (47.3%)

Results: MTP mortality rates/year

Blood Failure

- Blood is an organ and can fail like any other organ
- Term emphasizes the ***interaction*** between blood cells, plasma, endothelium
  - Promote a balanced approach to resuscitation
- ***Unbalanced resuscitation***
  - Exacerbates dysfunction of another biologic systems

Trauma Induced Blood Failure

Traumatic Injury

Trauma Induced Blood Failure: Frequent at Admission

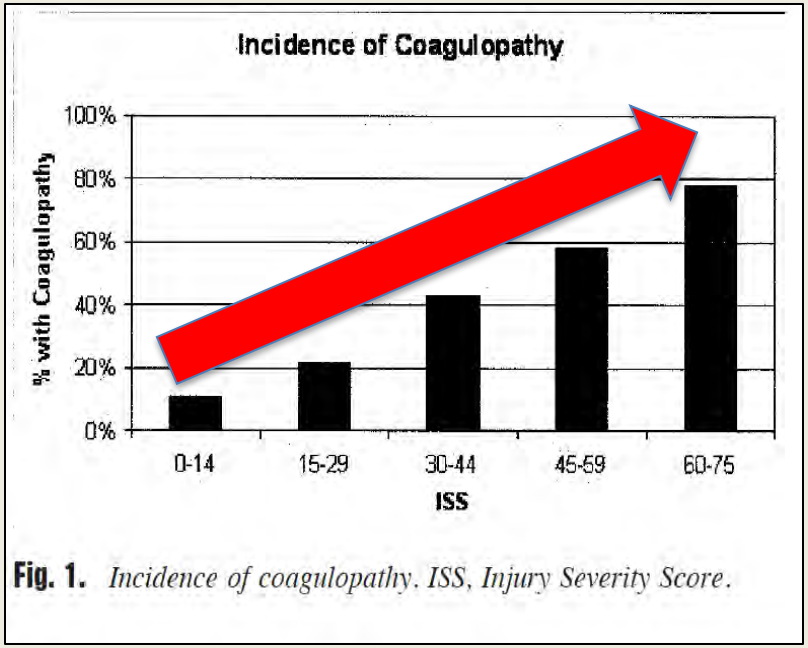


Fig. 1. *Incidence of coagulopathy. ISS, Injury Severity Score.*

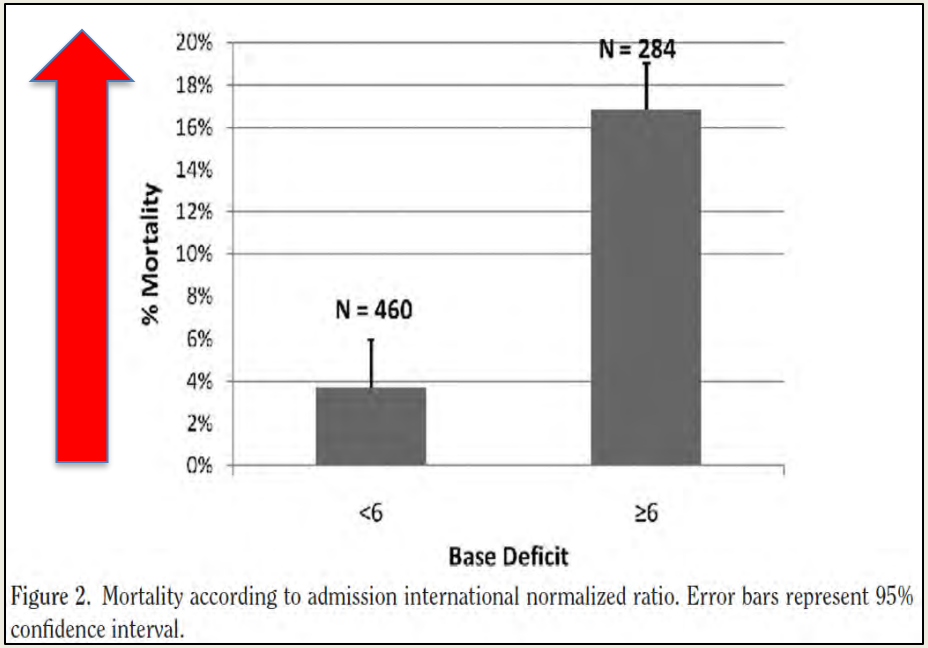


Figure 2. Mortality according to admission international normalized ratio. Error bars represent 95% confidence interval.

Rodriguez EG. Jam Coll Surg. 2017
Brohi. J Trauma. 2003

Patregnani J. Ped Crit Care Med.2012
Muszynski J. Shock. 2014

G

CURRENT OPINION

Blood transfusion management in the severely bleeding military patient

Curr Opin Anesthesiol 2018, 31:000–000
DOI:10.1097/ACO.0000000000000574

Jennifer M. Gurney[a,b] *and Philip C. Spinella*[b,c]

Table 1. Damage control resuscitation principles

Pre-hospital
- Rapid recognition of life-threatening hemorrhagic shock
  - Point-of-care devices: near infrared spectroscopy; INR; lactate level may be of value
- Prevent hypothermia
- Hemorrhage control with mechanical hemostatic adjuncts:
  - Tourniquet/junctional tourniquet
  - Pressure dressings/thrombin and fibrin-impregnated gauze
  - REBOA
  - Intraabdominal foams (investigational)
- Hemostatic resuscitation
  - Whole blood is optimal
  - Component therapy with plasma (dried, liquid, or thawed), RBCs, and platelets in 1 : 1 : 1 ratio
- Permissive hypotension for patients without traumatic brain injury[a]
- Avoid crystalloid resuscitation
- Consider TXA administration if less than 3 h from time of injury[b]
- Consider source of fibrinogen (fibrinogen concentrate or cryoprecipitate)
- Avoid hypocalcemia
  - In prolonged evacuations, empiric calcium administration for every 4–6 units of RBCs or WB

Every minute counts: Time to delivery of initial massive transfusion cooler and its impact on mortality

David E. Meyer, MD, Laura E. Vincent, RN, Erin E. Fox, PhD, Terence O'Keeffe, MBChB, Kenji Ina Eileen Bulger, MD, John B. Holcomb, MD, *and* **Bryan A. Cotton, MD**, *Houston, Texas*

J Trauma Acute Care Surg
Volume 83, Number 1

TABLE 3. Multivariate Regression Predicting 30-d Mortality

	OR	95% CI	*p*
Time to receipt of first cooler, min	1.05	1.01–1.09	0.016
Anatomic injury severity (ISS)	1.05	1.03–1.06	<0.001
Disturbed arrival physiology (w-RTS)	0.61	0.53–0.69	<0.001
Randomization group (1:1:2)	1.46	0.92–2.29	0.102
RI, units	1.03	0.60–1.44	0.184

Median (IQR) time from arrival to MTP activation was 9 (3-20) min
Median (IQR) time from MTP activation to delivery of blood products was 8 (5-11) min

Options for Trauma Induced Blood Failure

- Hemostatic resuscitation needed for
  - Shock
  - Endothelial, Hemostatic, Immune Dysfunction
- Resuscitation strategy is either
  - RBCs, plasma, platelets
  - Low titer Whole Blood
- Prehospital and in-hospital scenarios

Whole Blood Definitions

- Warm fresh whole blood – Transfused immediately or stored up to 8 hours at 22C. Can be stored an additional 24 hours at 4C.
- Cold whole blood – Stored at 1- 6C
  - Fresh if transfused within 48 hours
  - CPD, CP2D – Stored up to 21 days
  - CPDA – 1 Stored up to 35 days

Types of Whole Blood

- ABO specific
  - Military data with warm fresh whole blood
- Group O Whole Blood
  - Low titer (Anti A and B < 256)
  - Civilian data with cold whole blood

Volume and Concentrations Between Component Therapy vs. Warm Whole Blood

VS

Component Therapy: *680 mL*
RBC unit + PLT unit + FFP unit + Cryo unit
- *Red blood cell concentration: 29%*
- *Platelets: 80,000*
- *Coagulation factors: 65%*

Whole Blood: 500 mL
A single WB unit
- *Red blood cell concentration: 38-50%*
- *Platelets: 150,000-400,000*
- *Coagulation factor concentration: 100%*

Standard Amounts of Anti-coagulants and Additives in Reconstituted Whole Blood vs. Whole Blood

Component Therapy per Unit:

6 x RBC (AS-5)	6 x 120 ml = 720ml
6 x FFP	6 x 50 ml = 300ml
1 x aPLT	1 x 35 ml = 35ml
	Total =1055ml

Whole Blood per Unit:

6 x 63ml = 378ml

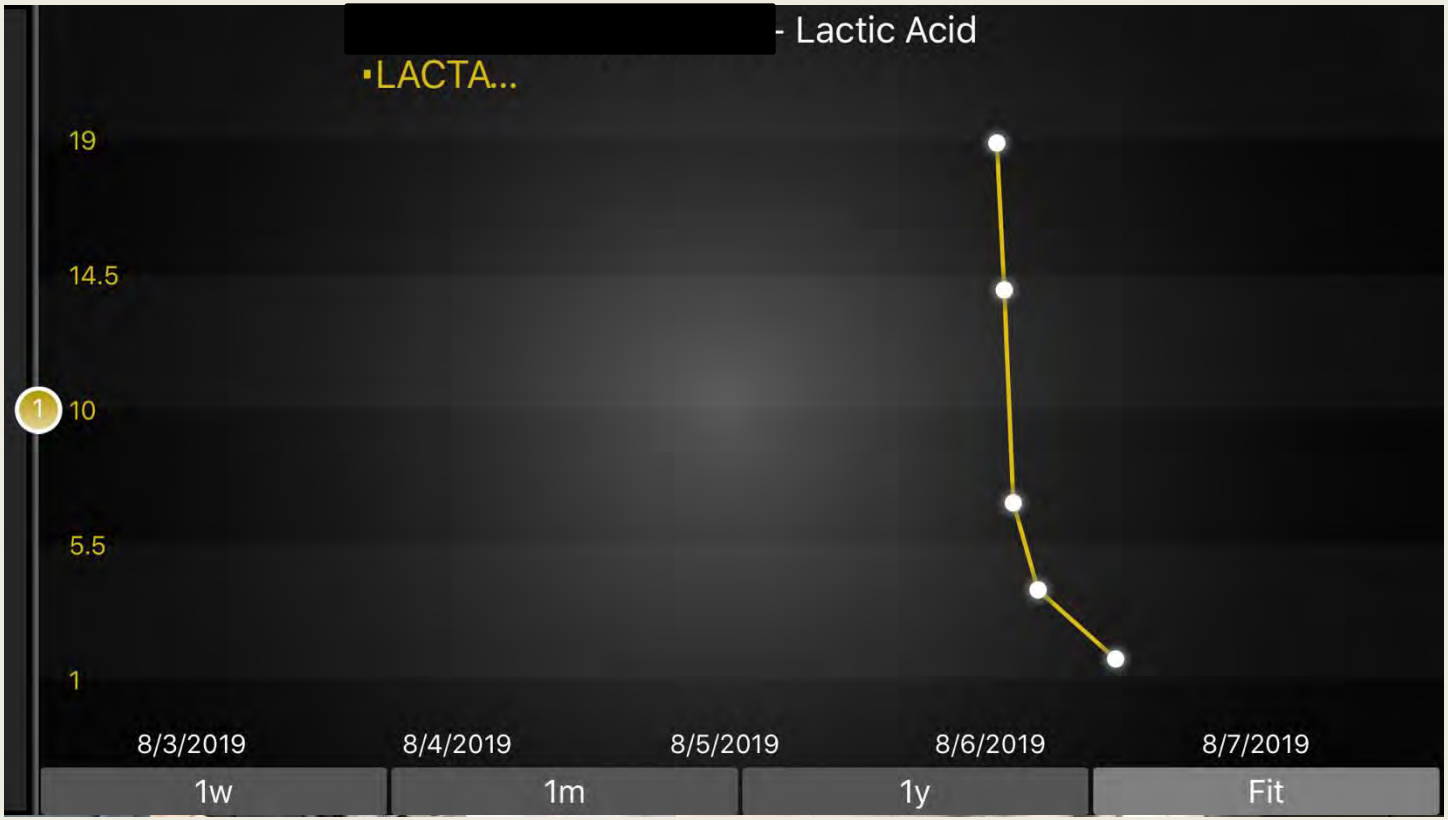
Total= 378ml

There is 3 times the volume of anticoagulant and additives with reconstituted whole blood from components compared to whole blood

Spinella PC, J Trauma. 2009;66:S69-76

Logistical and Administrative Benefits of WB

6 + 6 + 1 + 1 = 14 or 5 ?

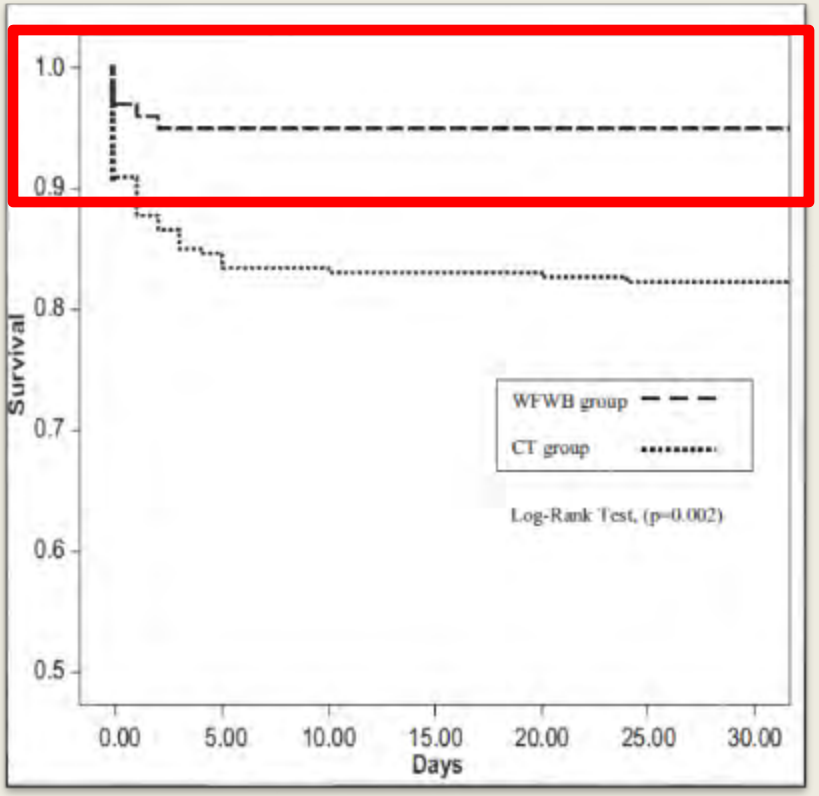

[redacted] - Lactic Acid
LACTA...
19
14.5
1
10
5.5
1
8/3/2019
8/4/2019
8/5/2019
8/6/2019
8/7/2019
1w
1m
1y
Fit

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

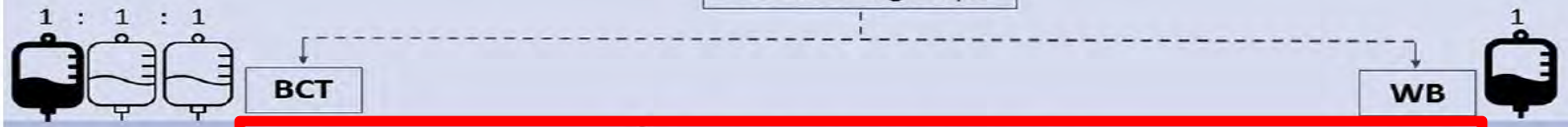
J Trauma. 2009;66:S69–S76.



Single Institution Trial Comparing Whole Blood (WB) vs Balanced Component Therapy (BCT): 50 Years Later

Patients presenting in need of ≥ 1 unit blood/blood product (N = 253)

Treatment groups



BCT		WB
16.7%	In-hospital mortality	23.3%
2 (2 – 5)	1st 24-hour blood volume given	2 (0 – 4)*
3 (1 – 5)	Ventilator days	1 (0 – 4)*

SI

Prospective, observational study. Continuous variables are presented as median (interquartile 25 – interquartile 75). * Indicates P < 0.05.

Duchesne et al. J Am Coll Surg, April 2021

JACS

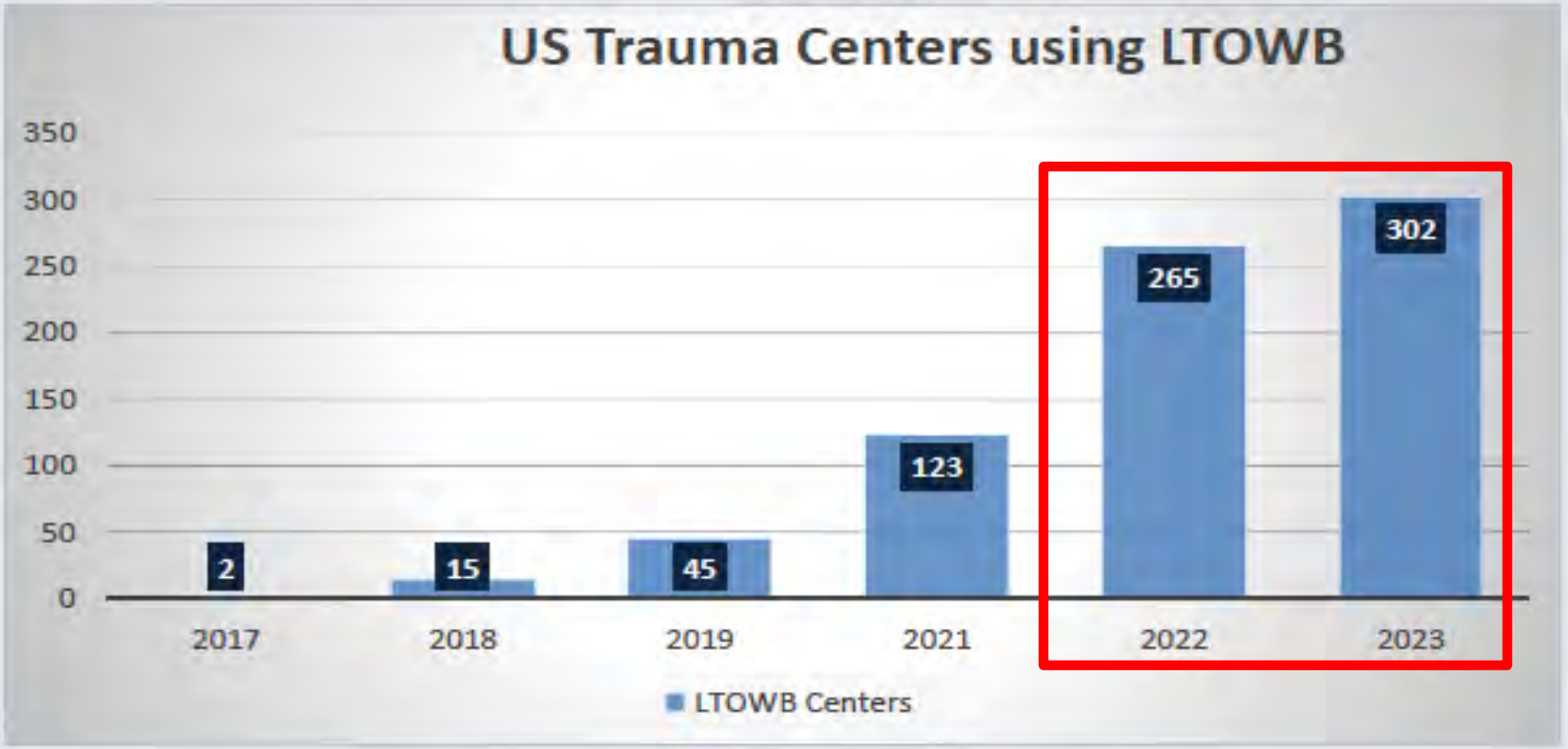
TROOP

Trauma Resuscitation with Low-Titer Group O Whole Blood or Products

UAB CENTER FOR INJURY SCIENCE
The University of Alabama at Birmingham

UTHealth
The University of Texas Health Science Center at Houston
School of Public Health

LTOWB in the US



141 Ground EMS programs (<2% of all)
At least 50% of Air EMS programs

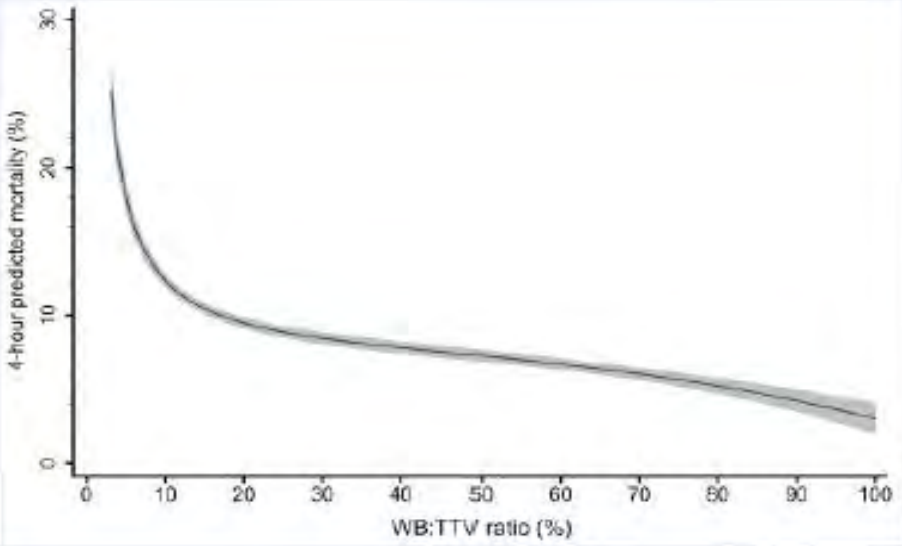
Meta Analysis of LTOWB in Trauma Patients

- Meta-analysis of 24 studies
  - 58,717 patients
  - 5,164 received LTOWB
- LTOWB compared to CT was associated with improved
  - **24-hour survival: RR (95% CI) =1.07 (1.03-1.12)**
  - **28/30-day/in-hospital survival: RR (95% CI) 1.05 (1.01-1.09)**

Morgan K, Spinella PC, Khalil EA, Feeney EV, Gaines B, Leeper C. 2024 Jul 1;52(7):e390-e404. Crit Care Med

LTOWB Dose and Outcomes

- 12,275 adults, (TQIP)
  - 501 US trauma centers
- WB independently associated with
  - Reduced 24-hour mortality
    - aOR: 0.77 (95%CI: 0.66 – 0.90)
  - Reduced 30-day mortality
    - aOR: 0.78 (95%CI: 0.68 – 0.89)
- **Each 10% increase in WB:TTV**
  - **6% relative reduction in 24 hr and 30 day mortality (p<0.05)**
- **> 30% WB:total blood ratio independently associated with improved survival**



Brown J, Spinella PC, Leeper CM, Neal M et al. Ann Surg. 2024 May 6.

Transfusion-related cost comparison of trauma patients receiving whole blood versus component therapy

Ciaraglia, Angelo MD; Myers, John C. MD; Braverman, Maxwell DO; Barry, John BS; Eastridge, Brian MD; Stewart, Ronald MD; Nicholson, Susannah MD, MS; Jenkins, Donald MD

Author Information

Journal of Trauma and Acute Care Surgery 95(1):p 62-68, July 2023. | **DOI:** 10.1097/TA.0000000000003933

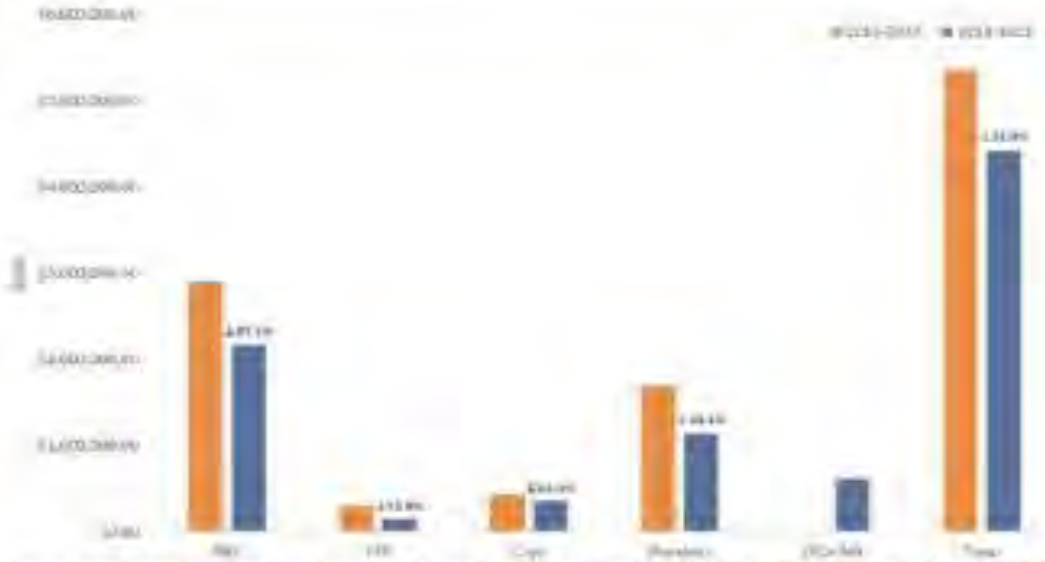


Figure 2. Average annual cost and percent reduction per blood product before (2016–2017) and after (2018–2021) initiation of whole blood transfusion program. Cryo, cryoprecipitate.

- After initiating LTOWB program for trauma patients
  - CT group 472 patients (2016-2017)
  - LTOWB group 376 patients (2018-2021)
- 21% reduction, mean annual cost-all products

blood 1991 77: 930-936

Comparison of the hemostatic effects of fresh whole blood, stored whole blood, and components after open heart surgery in children

CS Manno, KW Hedberg, HC Kim, GR Bunin, S Nicolson, D Jobes, E Schwartz and WI Norwood

	Cold FWB	Blood (1:1:1)	P value
24 hr blood loss (ml/kg)	44.8 (±6)	74.2 (±9)	0.03
24 hr blood loss (ml/kg) < 2 yrs	51.7 (±7.4)	96.2 (±11)	0.001
PTT (30 min)	39.7(±3.4)	43.3 (±1.8)	0.06
Fibrinogen (mg/dl)	195 (±5.6)	184 (±4.8)	0.07
PLT aggregation (30 min)		most reduced ADP, epinephrine, collagen	0.02

Risk/Benefit Assessment
LTOWB compared to blood components

Advantages of LTOWB	Risks of LTOWB
More potent product Higher Hb, plasma, platelets per volume	Incompatible plasma/immune complexes? Theoretical risk.
Cold platelets – improved hemostasis (RCT data)	Waste? Reduced/eliminated if used in non trauma massive bleeding
Increased storage duration of platelet product	
Less risk of ABO incompatible transfusion reactions than ABO compatible components	
Less bacterial contamination risk	
Logistical advantages Quicker transfusion of balanced product One product vs four products	

SHOCK, Vol. 41, Supplement 1, pp. 70–75, 2014

LOW TITER GROUP O WHOLE BLOOD IN EMERGENCY SITUATIONS

Geir Strandenes,[*†] Olle Berséus,[‡] Andrew P. Cap,[§] Tor Hervig,[*‖] Michael Reade,[¶] Nicolas Prat,[§] Anne Sailliol,[††] Richard Gonzales,[‡‡] Clayton D. Simon,[§§] Paul Ness,[‖‖] Heidi A. Doughty,[¶¶] Philip C. Spinella,[§***] and Einar K. Kristoffersen[*‖]**

[*]Department of Immunology and Transfusion Medicine, Haukeland University Hospital; and [†]Norwegian Naval Special Operation Commando, Bergen, Norway; [‡]Department of Transfusion Medicine, Örebro University Hospital, Örebro, Sweden; [§]US Army Institute of Surgical Research, FT Sam Houston, Texas; [‖]Institute of Clinical Science, The University of Bergen, Norway; [¶]Australian Defense Force Joint Health Command, Canberra, Australian Capital Territory; [**]French Military Medical Service, Clamart, France; [††]Commander French Military Blood Transfusion Center, Clamart, France; [‡‡]Director, US Army Blood Program and [§§]US Army Transfusion Medicine Consultant to the Surgeon General San Antonio Military Medical Center, JBSA–Fort Sam Houston, Texas; [‖‖]Transfusion Medicine Division, Johns Hopkins Medical Institutions, Baltimore, Maryland; [¶¶]NHS Blood and Transplant, Birmingham, England, United Kingdom; and [***]Division of Pediatric Critical Care, Department of Pediatrics, Washington University in St Louis, St Louis, Missouri

ABO compatible - 1:80,000 risk of fatal hemolytic reaction

Incompatible plasma – 1: 120,000 risk of mild to moderate reaction

Conclusions

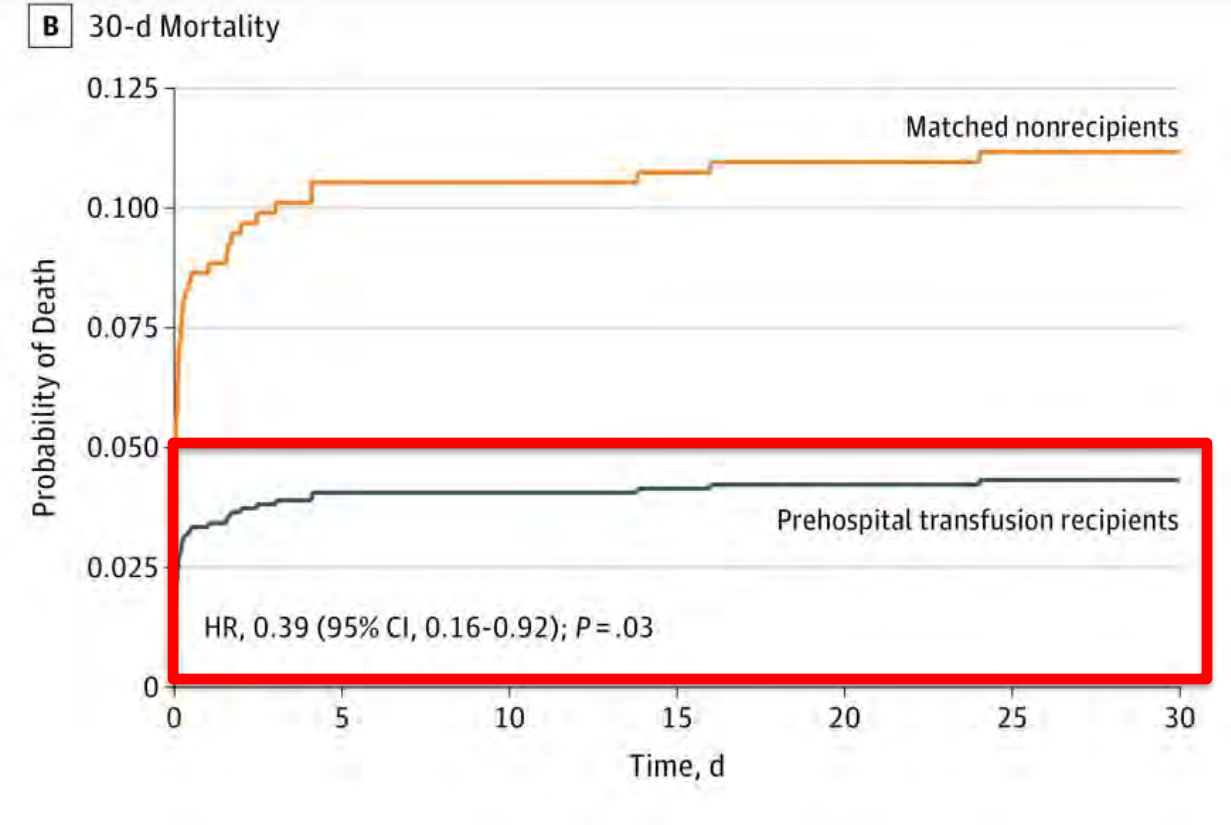
- Whole blood based resuscitation ***optimal*** for Trauma Induced Blood Failure
- Low Titer Whole blood optimal compared to blood components in 1:1:1 ratio
  - Logistics, Efficacy, Safety
- ***Prehospital benefit might be higher than in-hospital benefits***

JAMA | Original Investigation

Association of Prehospital Blood Product Transfusion During Medical Evacuation of Combat Casualties in Afghanistan With Acute and 30-Day Survival

JAMA. 2017;318(16):1581-1591.

Stacy A. Shackelford, MD; Deborah J. del Junco, PhD; Nicole Powell-Dunford, MD; Edward L. Mazuchowski, MD, PhD; Jeffrey T. Howard, PhD; Russ S. Kotwal, MD, MPH; Jennifer Gurney, MD; Frank K. Butler Jr, MD; Kirby Gross, MD; Zsolt T. Stockinger, MD



Is it time to adopt Circulation CAB first approach in patients with hemorrage?

Penetrating Trauma Case Scenario


23:10:21Z
X83107676

Penetrating Trauma Case Scenario:

First Poll Question:

Based on patient's vitals the best thing EMS can do is:

- Press on the gas ! scoop and run
- Stay and play
- Scoop and Control


23:13:18Z
X83107676
We're losing him

Penetrating Trauma Case Scenario:

Second Poll Question:

With impending cardiac arrest, priority number one will be:

- Airway with Intubation
- Breathing with chest tube
- Circulation
- Nothing…..we need to rush him to the hospital!

Penetrating Trauma Case Scenario:

Third Poll Question:

In the presence of hemorrhagic hypovolemic shock, the best fluid to give by EMS is:

- Crystalloids
- 3% Saline
- Albumin
- No fluids
- PRBC / Whole Blood
- FFP


23:17:58Z
X83107676

Penetrating Trauma Case Scenario:

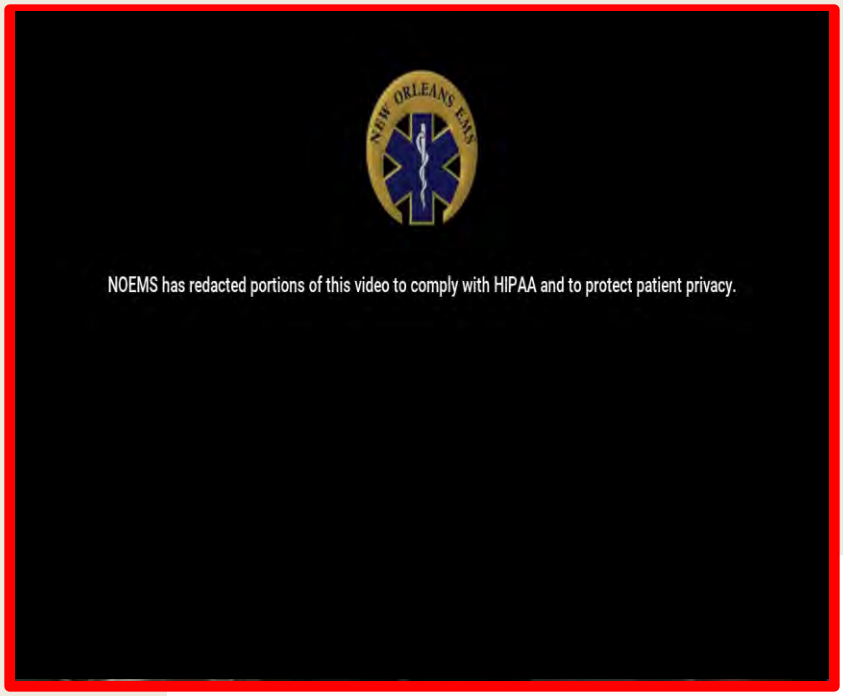
Fourth Poll Question:

Based on this case scenario, has your current point of view changed regarding ABC vs CAB?

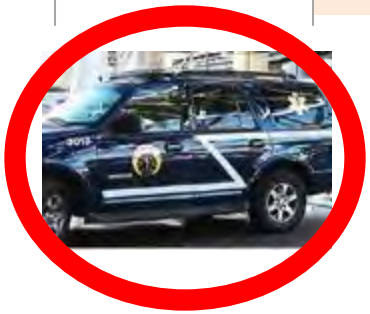
- No!!!!!!!
- Yes

NOEMS ARC

In 10/2021 NOEMS started prehospital ***Advanced Resuscitative Care (ARC)*** bundle for our urban ground EMS system ***with prioritization of a circulation first*** approach in trauma patients with hemorrhagic shock



Injury Phase	Response Interval	Scene Phase	Transport Phase	ED Phase	Intervention Phase	Definitive Hemorrhage Control	Acute Recovery Phase
Event Notification Dispatch		EMS arrival Assessment Patient packaging	EMS arrival Assessment Patient packaging	Transfer of care ED evaluation Treatment	Hybrid ER		ICU



Pre-hospital ARC *Bundle*

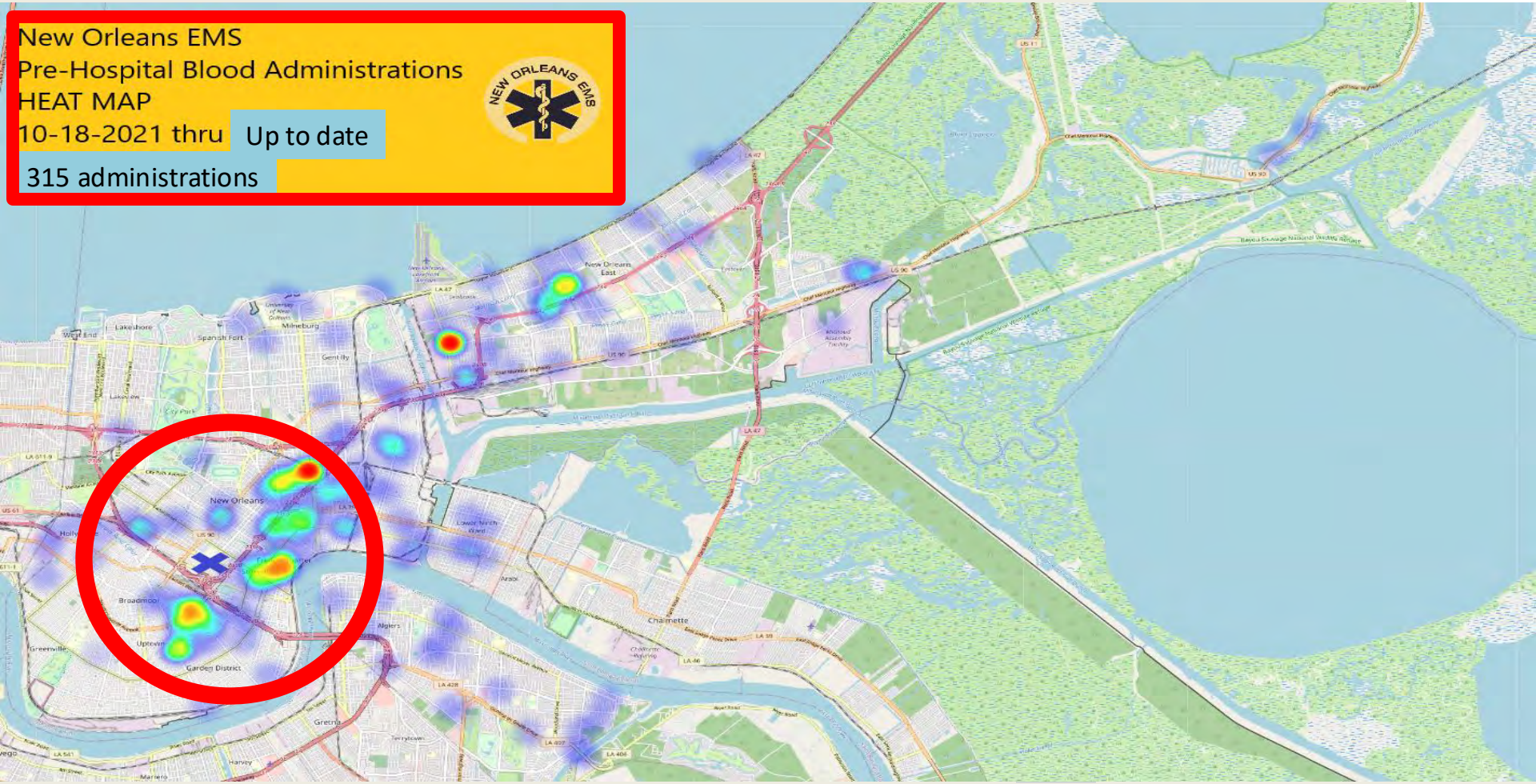
Bundle triggers:

SBP ≤ 70 mmHg

or

SBP ≤ 90 mmHg & HR > 110 at EMS arrival on-scene

Pre-hospital ARC bundle



FASTER REFILL IN AN URBAN EMS SYSTEM SAVES LIVES: A PROSPECTIVE PRELIMINARY EVALUATION OF A PREHOSPITAL ADVANCED RESUSCITATIVE CARE BUNDLE

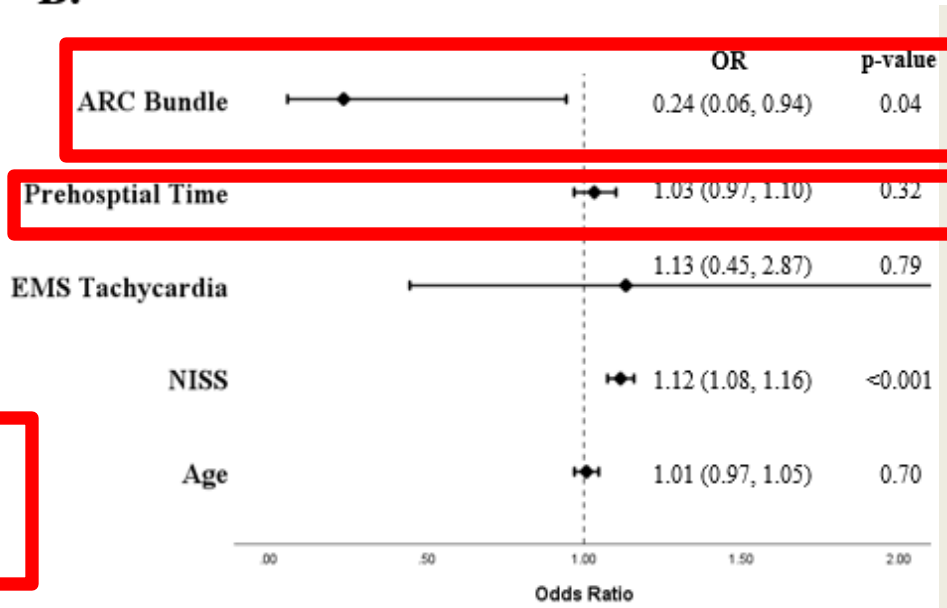
Broome JM, Nordham K, Tatum D, Piehl M, De Maio V, Nichols E, Dransfield T, Rayburn D, Marino M, Smith A, Taghavi S, Harris C, Lacy E, Avegno J, Duchesne J

A.

Variable	HC (n=144)	ARC Bundle (n=51)	P-value
EMS Characteristics			
SBP, mmHg	80 (62-88)	71 (60-83)	0.22
HR, bpm	101 (72-126)	103 (72-136)	0.35
Shock Index	1.20 (0.87-1.60)	1.22 (0.77-1.77)	0.92
Endotracheal Intubation	11 (8%)	0 (0%)	0.04
911 call to hospital arrival	20 (15-24)	24 (20-31)	<0.01
Hospital Characteristics			
ED SBP, mmHg	107 (80-124)	114 (88-140)	0.42
ED HR, bpm	97 (75-121)	79 (62-101)	0.01
ED Shock Index	0.88 (0.70-1.26)	0.79 (0.50-1.03)	0.01
New ISS	17 (4-27)	18 (12-34)	0.07
24 Hour Mortality	27 (19%)	3 (6%)	0.03
In-hospital Mortality	33 (23%)	5 (10%)	0.04

Historic Controls (HC), Advanced Resuscitative Care (ARC) Systolic Blood Pressure (SBP), Heart Rate (HR), New Injury Severity Score (NISS), Emergency Department (ED)

B.



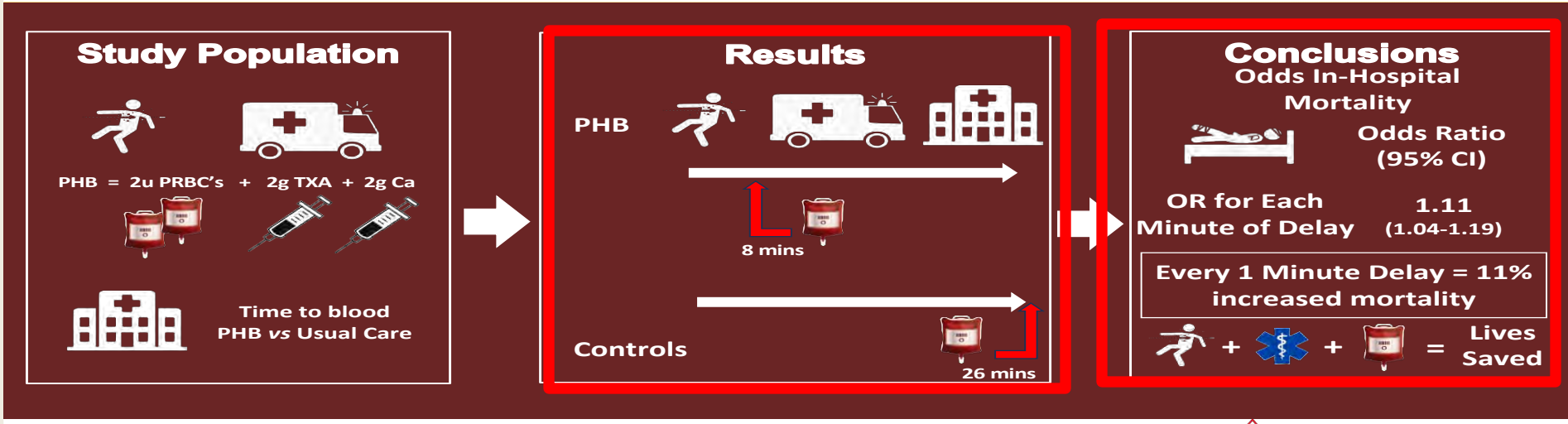
JTACS Jan 2024

Impact of prehospital "xABC" Resuscitation Sequence in Patients with Severe Hemorrhage

Conclusion: In prehospital hypotensive patients with penetrating injuries, advanced resuscitative care focused on utilizing blood products first prior to intubation improves patient mortality. Standardization of prehospital circulation-first management in this patient population warrants special consideration.

Variable	ARC (n=62)	ABC (n=31)	P-value
Age	35 (24-43)	31 (25-40)	0.90
EMS Characteristics			
SBP, mmHg	78 (66-88)	70 (0-80)	0.79
HR, bpm	114 (84-136)	116 (55-140)	0.05
Shock Index	1.48 (0.94-1.77)	1.57 (1.36-2.05)	0.09
GCS	8 (3-15)	5 (3-15)	0.43
Total Prehospital Interval	22 (16-26)	20 (15-25)	0.176
Hospital Characteristics			
ED SBP, mmHg	110 (84-136)	66 (0-93)	0.02
ED HR, bpm	92 (69-121)	95 (0-129)	0.12
ED Shock Index	0.85 (0.60-1.27)	1.31 (1.09-1.63)	<0.01
ED GCS	15 (14-15)	3 (3-12)	<0.01
In-hospital Mortality	10 (13%)	9 (47%)	<0.001

Every Minute Matters: Extending the Continuum of Care Through Early Prehospital Blood Administration



Duchesne J, McLafferty BJ, Broome JM, et al. Every minute matters: Improving outcomes for penetrating trauma through prehospital advanced resuscitative care. *J Trauma Acute Care Surg*. May 1, 2024.

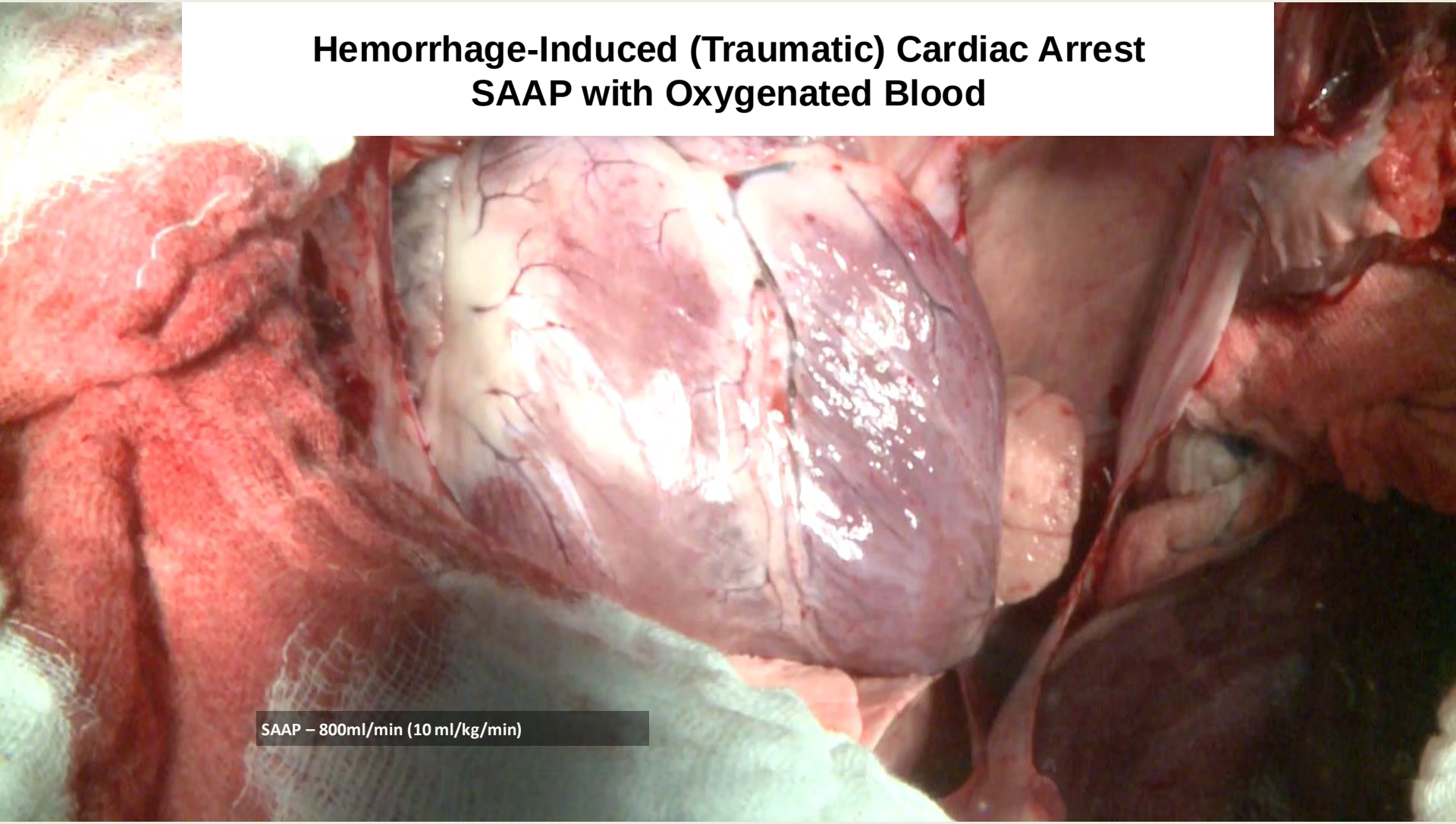
Author twitter handles:
@Tulane_Surgery;
@JakeBroome; @MarkPiehl

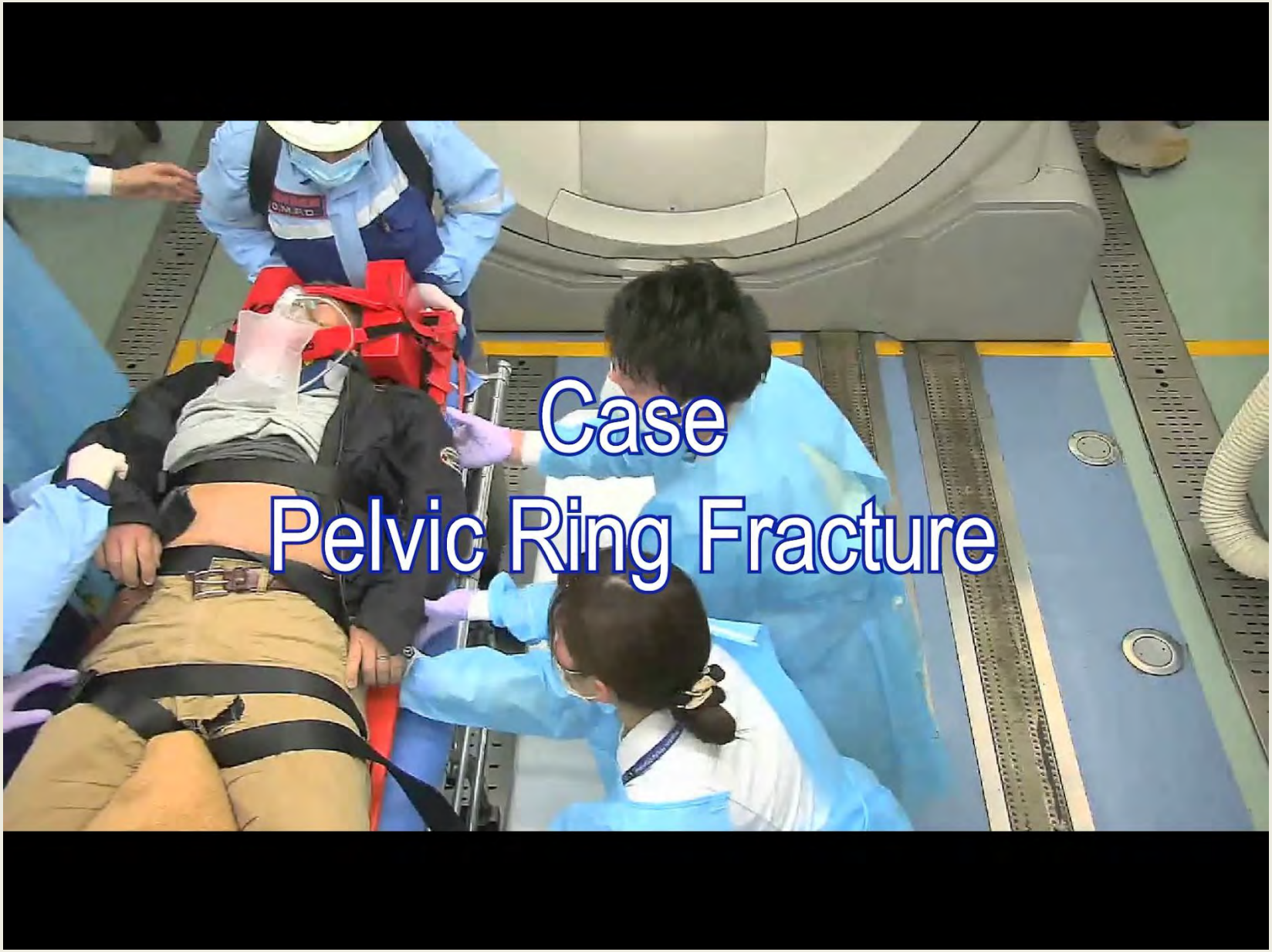
Western Trauma Association

Conclusion: Compared to patients who first received blood after hospital arrival, resuscitation with blood products was started 19 minutes earlier after initiation of a PHB program despite a 5-minute increase in prehospital time. A survival for early PHB use was demonstrated, with an 11% mortality increase for each minute delay to blood administration. Early interventions such as PHB may help minimize "dead zones" in trauma care by bringing effective resuscitation closer to the point of injury.

Western Trauma Association 2024: Winner Scalea Award Competition

Hemorrhage-Induced (Traumatic) Cardiac Arrest
SAAP with Oxygenated Blood




Case
Pelvic Ring Fracture

Low Titer Group O Whole Blood Use in Massive Transfusion

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