Blood, Beds, and Plasma:
Urgent Needs for the Future Operating Environment

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0910-1010 ET

Presenter

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COL Gurney has worked with Joint Trauma System since 2012 in in several different capacities. She has dedicated her career to improving care of the combat casualty, making her an ideal candidate to lead JTS.

COL Gurney helped run the world-renowned Burn Care Unit as the Deputy Director, where she is the go-to expert for Burn Care and a teacher to residents. She provides strategic guidance to the JTS trauma care delivery team as Chief of Trauma Systems Development. She chaired the JTS Defense Committees of Trauma, leading over 150 subject matter experts in prehospital, surgical, and en route care in a multidisciplinary and tri-service collaboration to guide DoD trauma care.

COL Gurney has led efforts to better surgical practices and procedures across the globe, from working with Honduran surgeons to share knowledge to reviewing combat mortalities in South CCMD to assessing the African CCMD trauma system through surveys of Role 1 and Role 2 care and onsite visits. As the Army State representative to the American College of Surgeons Committee on Trauma, COL Gurney supported the development of the military-civilian partnership guide. She helped develop the Combat Readiness metrics for deploying surgeons. Referred to the Joint Knowledge, Skills and Abilities Project, COL Gurney has been a leader in establishing the detailed expectations for expeditionary surgery. She was first to evaluate the epidemiology and trends of injury among U.S. female service members in the Iraq and Afghanistan wars.

COL Gurney joined the U.S. Army while at Boston University Medical School. She was Chief of General Surgery at Landstuhl Regional Medical Center in Germany from 2011 to 2013 and the William Beaumont Army Medical Center from 2007-2009. She deployed seven times, serving as the Theater Trauma Director in Operation Inherent Resolve in her last deployment to Iraq. Her tenure resulted in the Central Command's most comprehensive analysis of whole blood utilization in combat trauma and directly led to the adoption of whole blood use in the prehospital setting in several civilian regional trauma systems.

COL Gurney received a Legion of Merit with a 'C' (combat) device, three Bronze Star Medals, a Combat Action Badge, and the Defense Meritorious Service Medal for wartime service. She has had the opportunity to work at every level of care after Role 1 in the deployed battlefield trauma system.

Disclosures

- COL Jennifer Gurney has no relevant financial or non-financial relationships to disclose relating to the content of this activity.
- The views expressed in this presentation are those of the author and do not necessarily reflect the official policy or position of the Department of Defense, nor the U.S. Government.
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- Commercial support was not received for this activity.

Learning Objectives

At the conclusion of this activity, participants will be able to:

1. Explain the importance of plasma in trauma healthcare.
2. Analyze logistical challenges of blood product delivery in combat operations.
3. Discuss advances in modern pathogen reduction technology and blood safety testing strategies.
4. Identify strategic mitigation approaches such as innovation in blood products, logistics, and partnerships to enhance resilience and readiness.

Agenda

- Global Threats and Risk
- Military Wartime Lessons Learned & Readiness
- Blood Planning Factors
- Blood and Beds Analysis
- How do we mitigate: WBB, Plasma, Data

Agenda

- **Global Threats and Risk**
- Military Wartime Lessons Learned & Readiness
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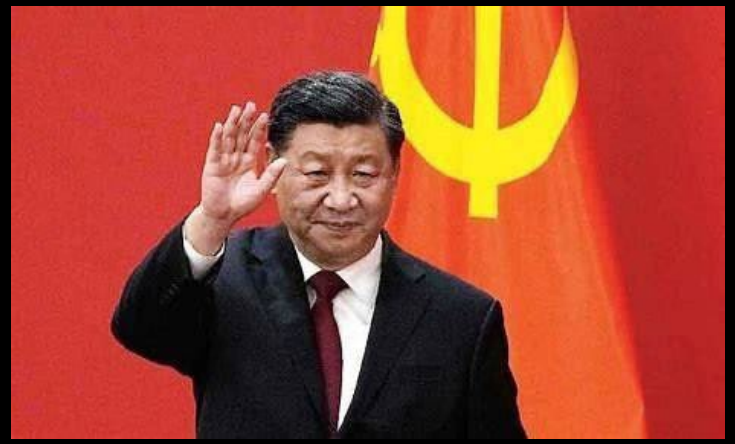
Tomorrow's War

- Large scale combat operations(LSCO) with near peer adversary (NPA)
- Multidomain
  - Land, sea, air, space, cyber
- Imminent threat to our homeland

Yesterday's War

- World War 2 (WW2) ➔Large scale combat operations
- Critical capabilities developed and fielded in record time **AT SCALE!**
  - US military as **>12M** by 1945, from a start of **458,365** in 1940

Global Threats



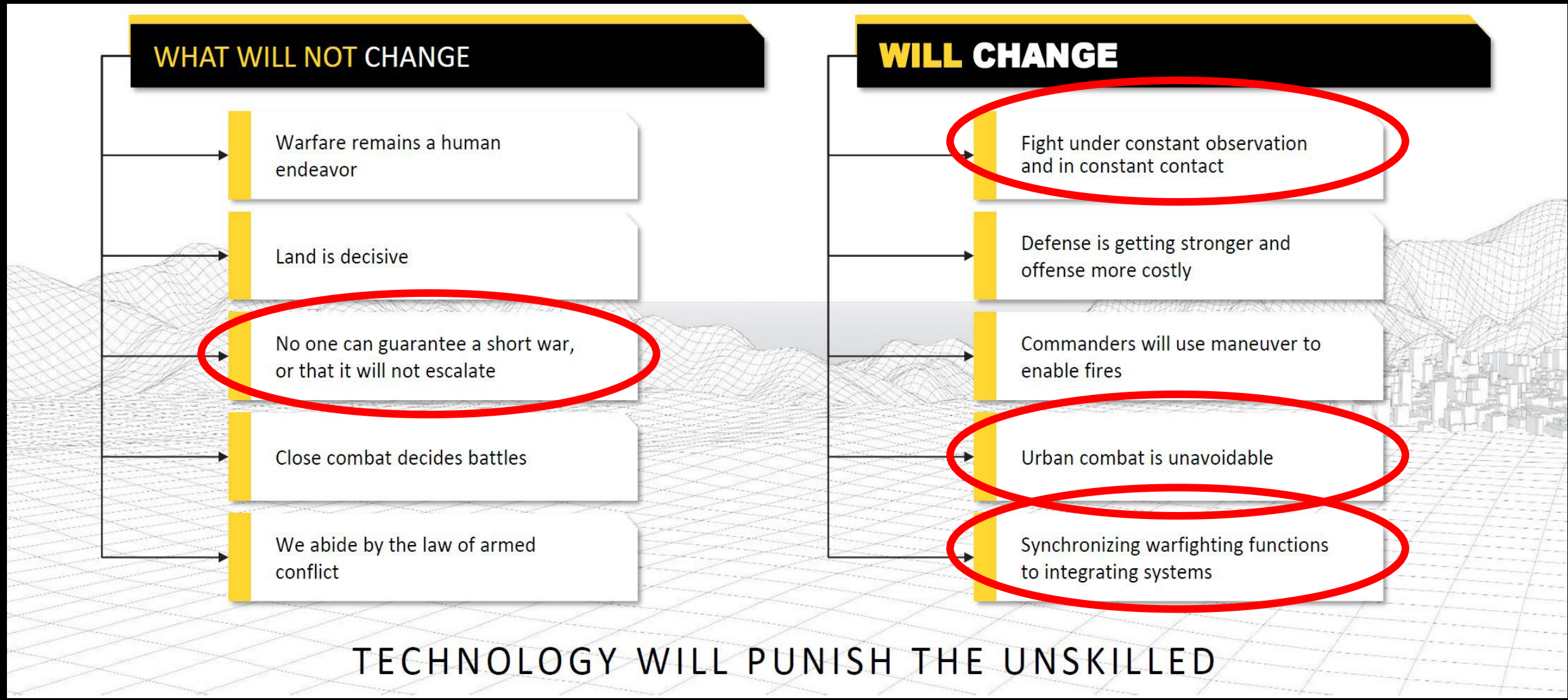
China is committed to taking control of Taiwan by 2027

Vladimir Putin warns of wider conflict over Ukraine and expansion of North Atlantic Treaty Organization (NATO)

North Korea’s Kim threatens ‘offensive actions’ against US

Pentagon ‘Concerned’ About Indications of Imminent Attack by Iran

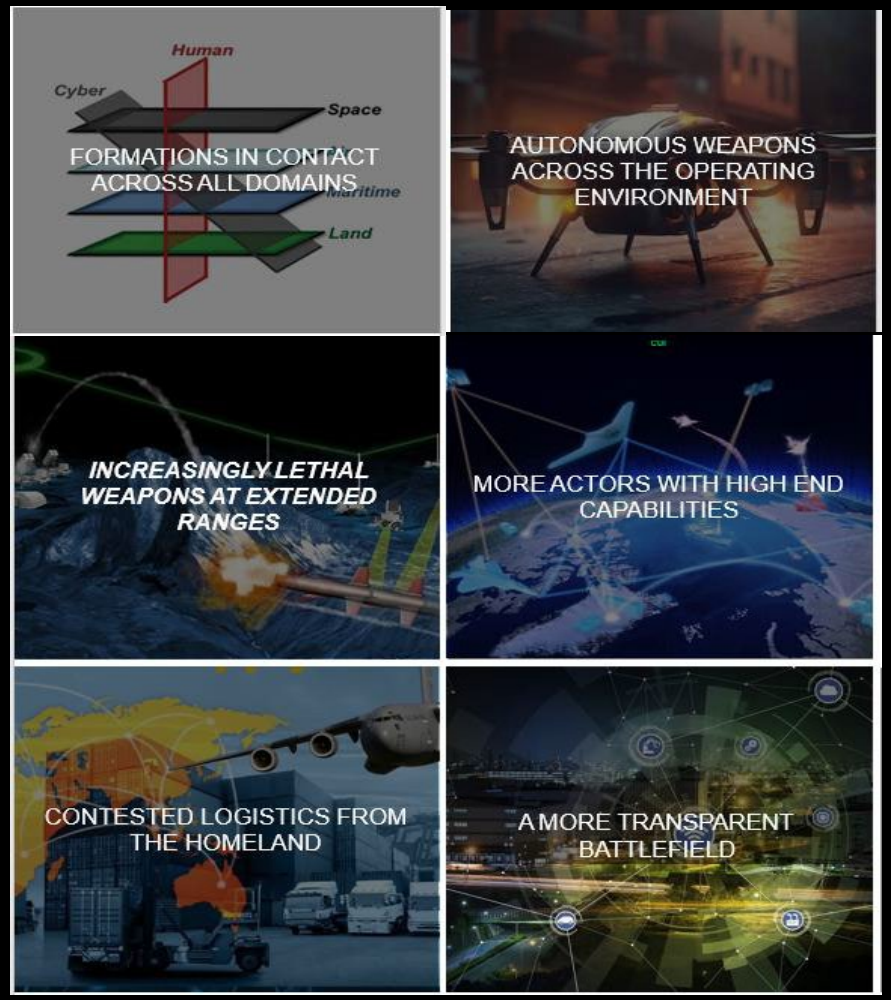
Future Warfare: Implications and Observations



Slide courtesy of Army Futures Command

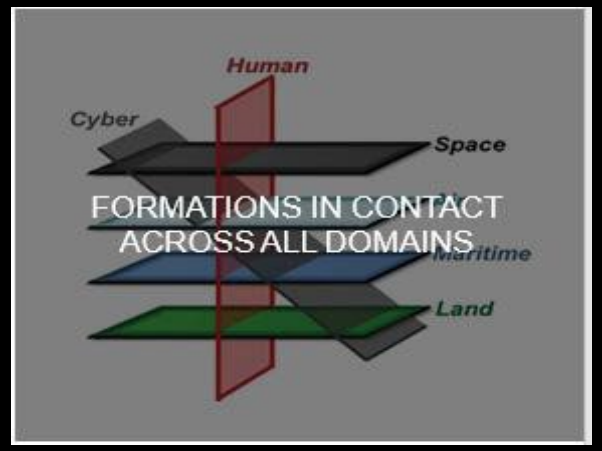
TECHNOLOGY WILL PUNISH THE UNSKILLED

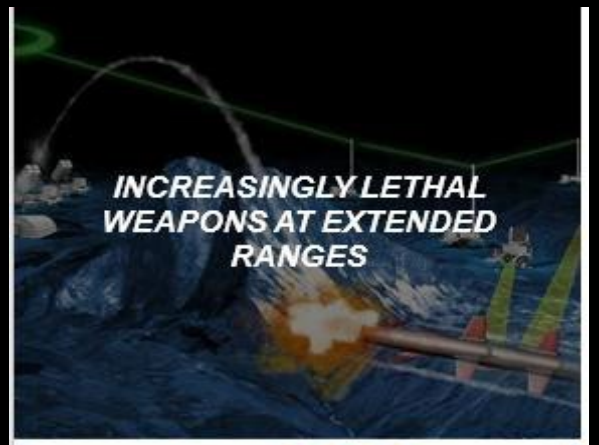
Future Operational Environment: 2030-2040 (1 of 3)



Slide courtesy of Army Futures Command

Future Operational Environment: 2030-2040 (2 of 3)





Is Military Medicine Ready?

Is Military Medicine Ready? (1 of 7)

Fight under constant observation and in constant contact

What have we learned?

War Impact on US 2001-2024

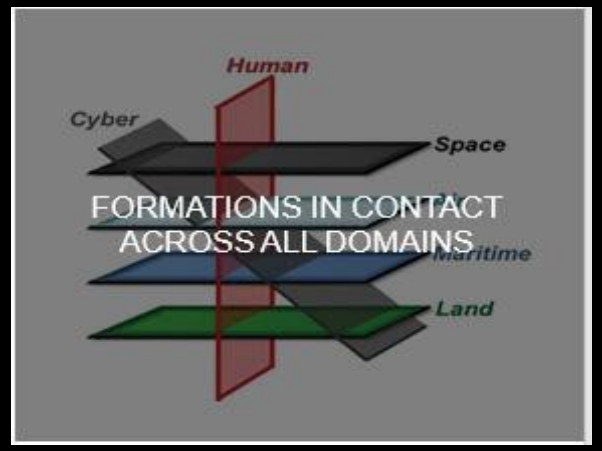
- Societal insulation
  - Distance
  - Minimal domestic threat
- Personal impact limited
  - Deployment
  - Service member wounded or killed
- Economy stable
- Basic resources available
- Jobs / professions business as usual
- Lessons learned translated civilian trauma -- MCPs

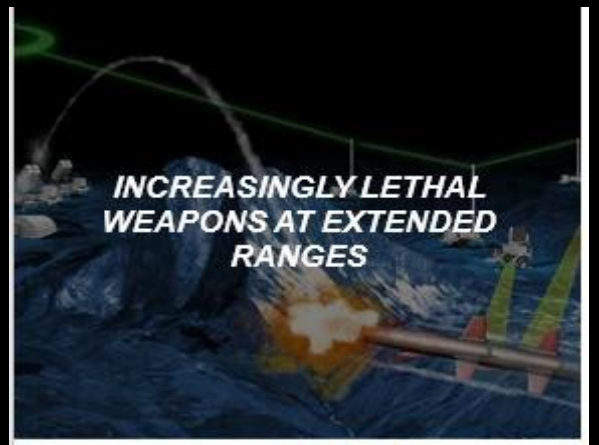
Is Military Medicine Ready? (2 of 7)

Is Military Medicine Ready? (3 of 7)

- Flesh vs. Machine
- Witness human devastation on social media
  - Is the American public ready?
- One Way ‘Suicide’ Unmanned Arial Systems (UAS)
- Peer enemies that do not follow Geneva Convention
- Medical teams targeted
- Will to fight?
- Will to defend?
- Will to care for casualties?
  - Medics ‘dropping like flies’ in Ukraine
  - Average age of medic in Ukraine ~ 44yo

Future Operational Environment: 2030-2040 (3 of 3)





Is Military Medicine Ready?

Is Military Medicine Ready? (4 of 7)

No one can guarantee a short war, or that it will not escalate

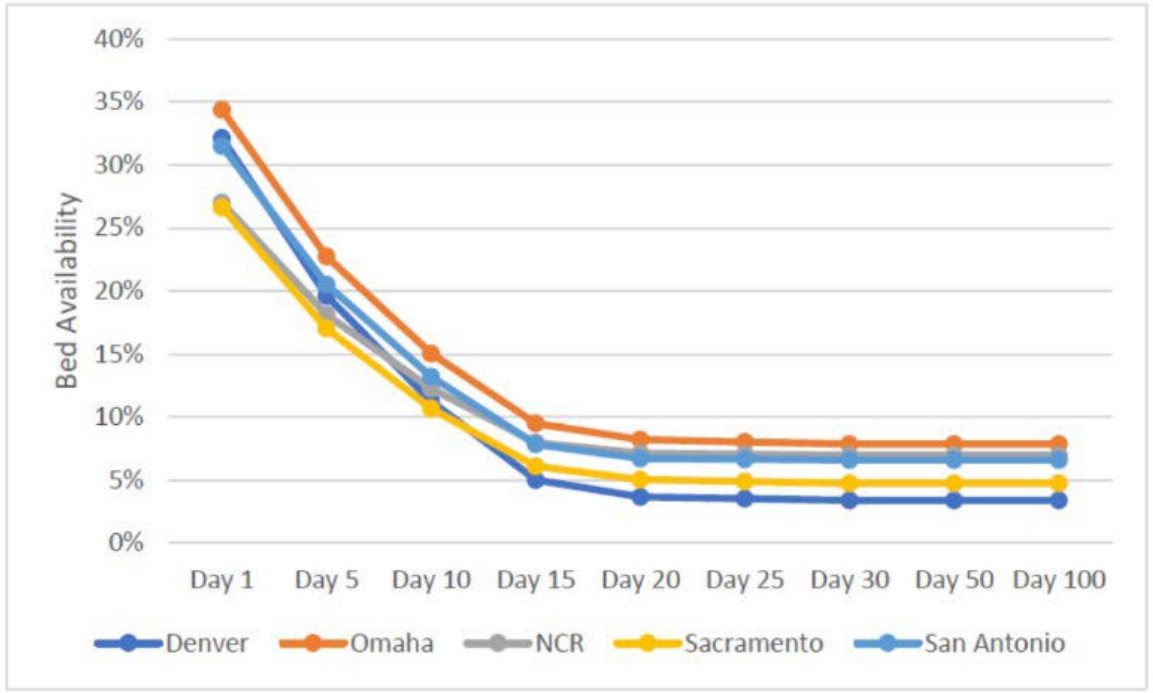
Urban combat is unavoidable

Is Military Medicine Ready? (5 of 7)

Scope of the Problem

NDMS Activation Will Rapidly Saturate US Domestic Hospitals in FCC Airheads

Figure 8. NDMS Medical Surge Mode Bed Availability



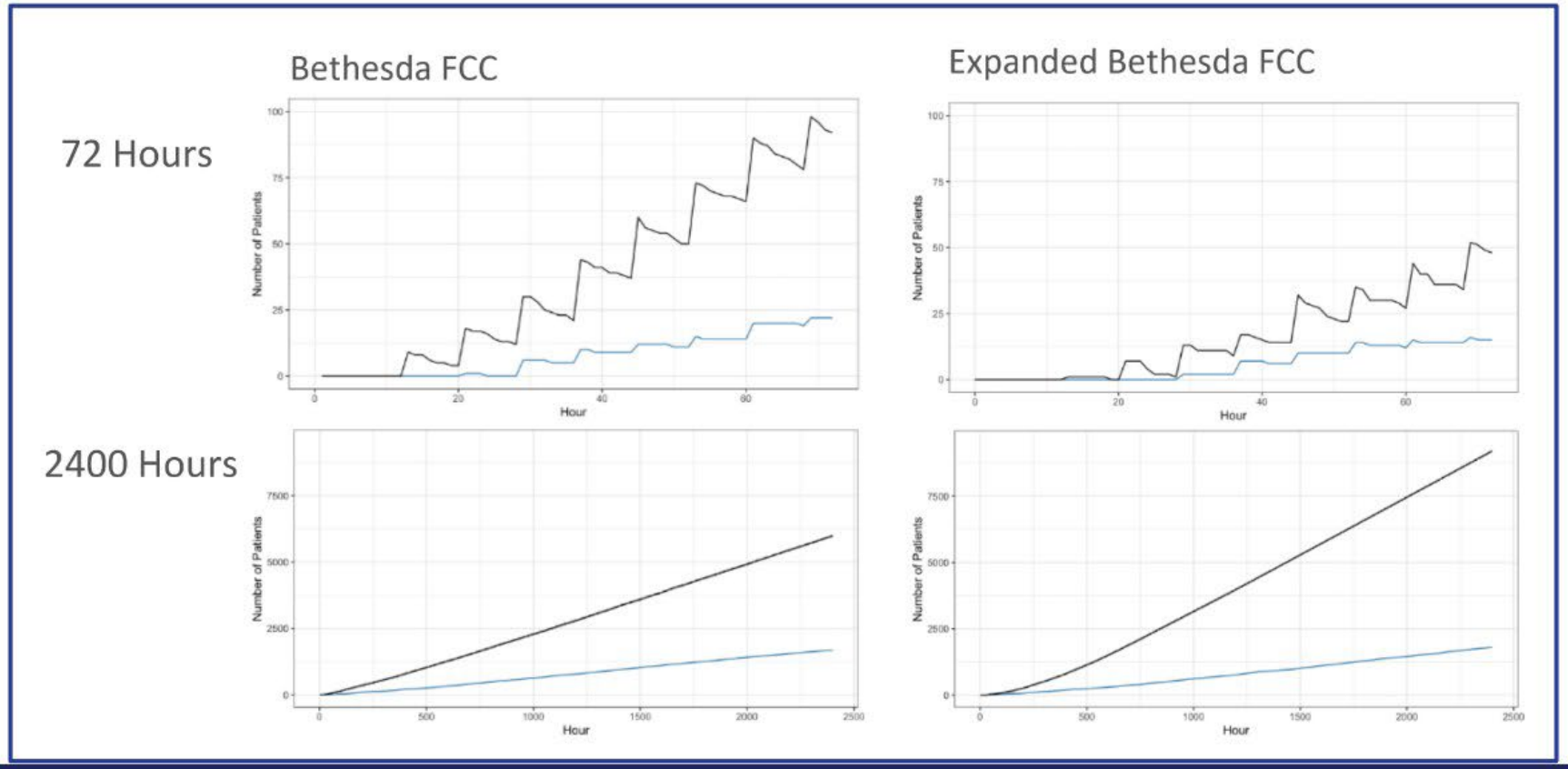
Do we have capacity?

From USU: Modeling Data
NDMS MHS/TRICARE Surge Model Summary
Department of Defense National Disaster Medical System Pilot Program
National Center for Disaster Medicine and Public Health, Feb 2024

Is Military Medicine Ready? (6 of 7)

Patient Wait Count

The number of patients that are waiting **12 or more hours** for their first bed



All beds occupied in 72 hours

Is the civilian health care system ready?

Is Military Medicine Ready? (7 of 7)

- The most recent Joint Staff JME found **current DoD health capabilities are inadequate** to meet LSCO
- The VA and private sector **do not currently have the capacity** to meet National Disaster Medical System (NDMS) requirements in support of LSCO
- This will be **further exacerbated by the mobilization** of reserve component medical capability
- Placing a strain on surge capacity of the U.S. healthcare system **operating with <15% excess bed capacity**
- The benefit delivery mission and support to Defense Support to Civil Authorities will **compete for resources**

Theater Evacuation Capability Degraded

Challenges Faced by Military Health System (MHS)

- Focus on **outpatient digital care** and lack of focus on **volume**, **acuity**, **complexity** and **trauma**.
- An active-duty patient population that rarely needs surgery, lack of >65 recapture, ➔ **providers struggle to maintain their skills**.
- Severe shortages of skilled surgeons, especially **trauma surgeons**, on active duty and in the reserves.
- Loss of **medical lessons learned** from wartime.
- **Combat Support vs. Direct Care Missions**

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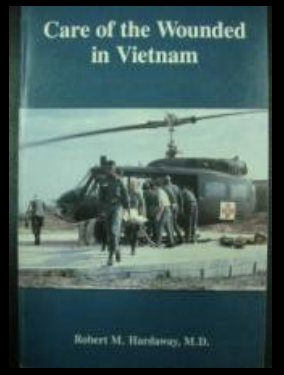
History of Battlefield Medical Innovation



World War I
- IV fluids
- Blood transfusions
- Motorized ambulances
- Topical antisepsis

World War II
- Whole blood/plasma available
- Specialty-specific surgical groups
- Antibiotics
- Fixed wing aero-medical evacuation

Korean Conflict
- Improved fluid resuscitation
- Forward availability of definitive surgery
- Helicopters for patient evac/transport
- Primary repair/grafts for vascular injury

Vietnam
- Improved use of helicopters
- Improved laboratory support
- Portable radiology equipment
- Mechanical ventilators in theater

Desert Shield/Storm
- Burn team augmentation of evacuation hospitals to provide theater-wide burn care
- Intercontinental aeromedical transport of burn patients

OEF / OIF
- Military trauma system (JTS / DoDTR)
- Damage control resuscitation
- Tactical Combat Casualty Care
- Tourniquet
- Understanding of preventable death
- Combat casualty care research

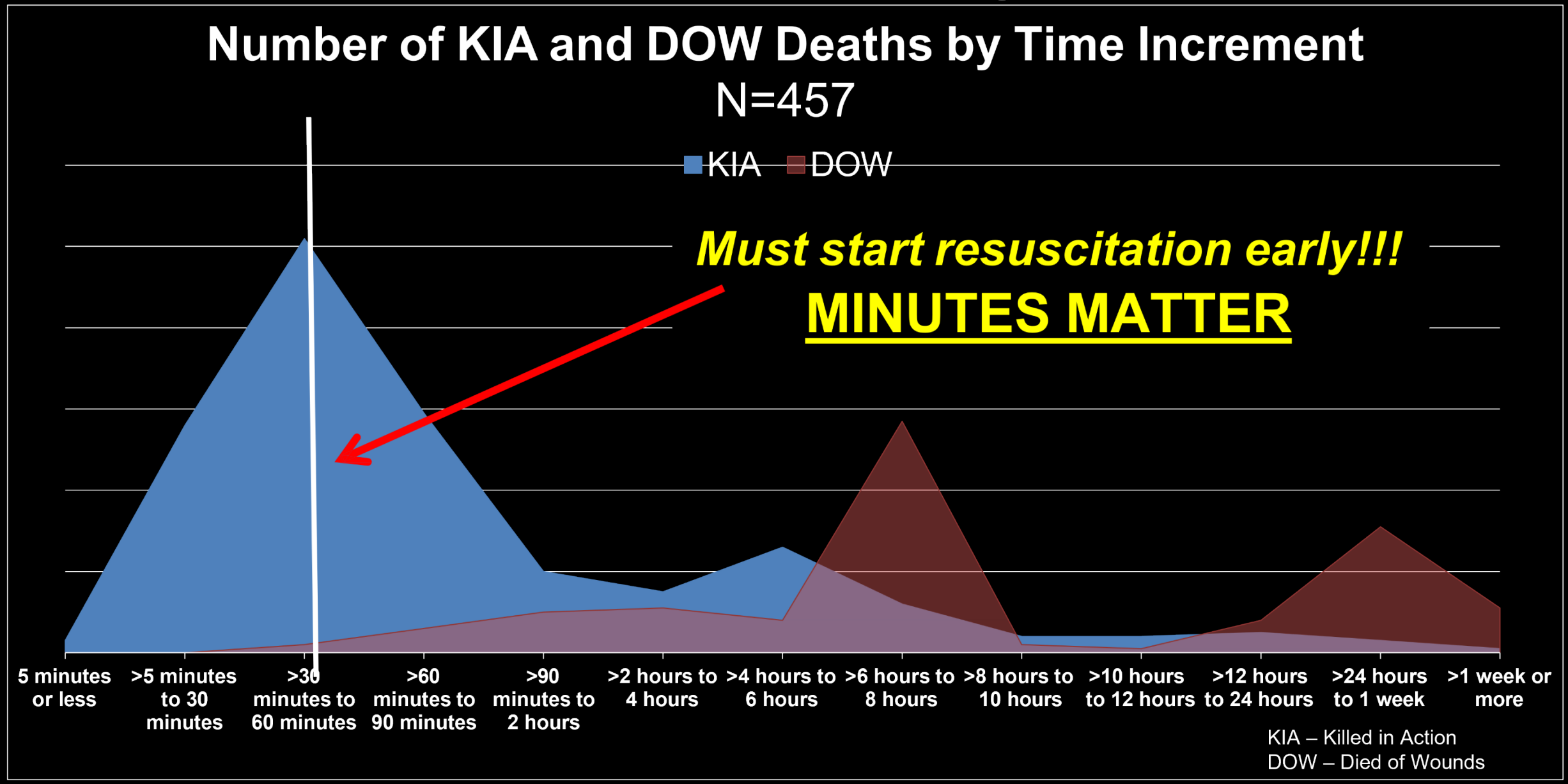
Future LSCO

?

“The Only Victor in War is Medicine”

- DUSTOFF
- PEDRO
- VAMPIRE
- Various SPEC OPS
- MERT
- Transport Times
- Tourniquets
- **BLOOD**

Death from Hemorrhage -- EARLY



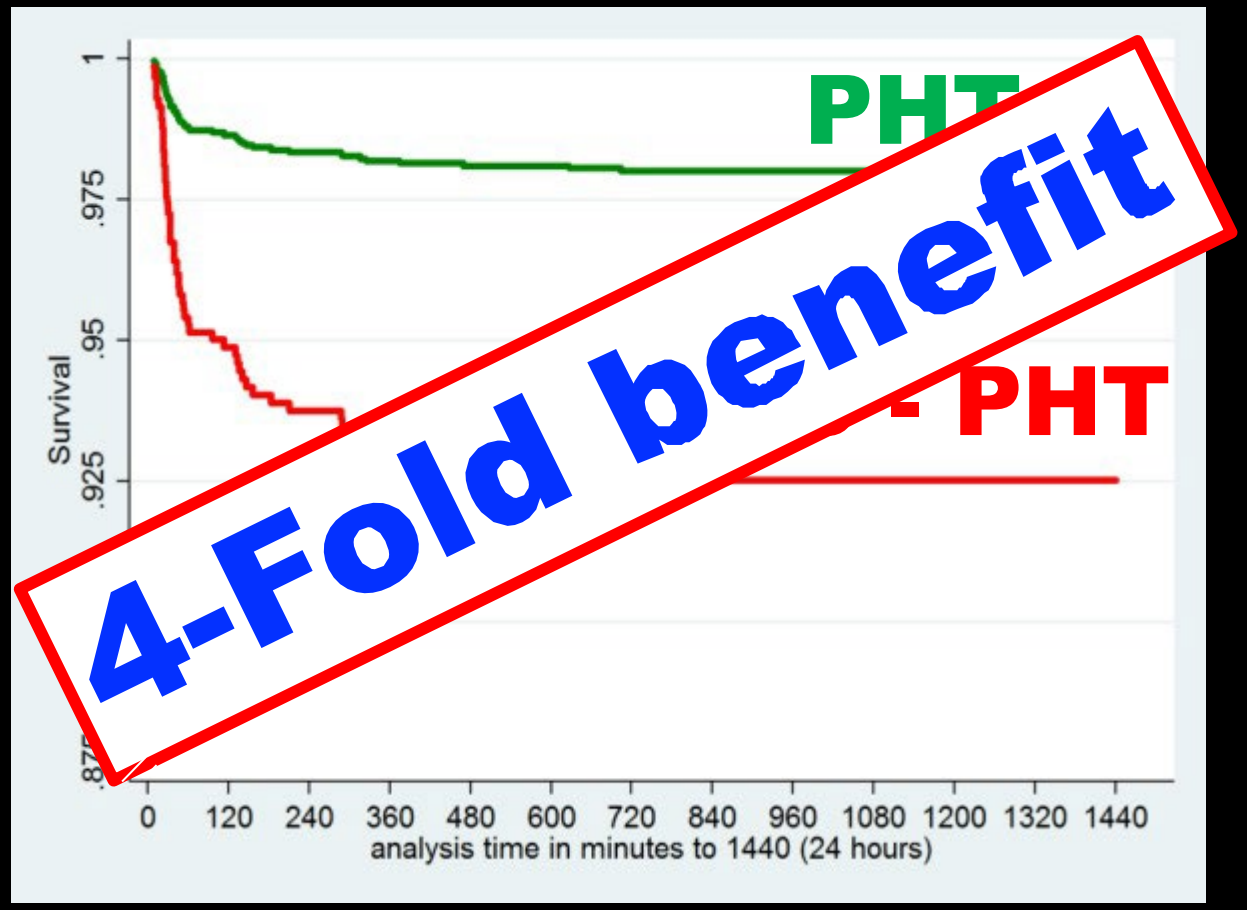
JAMA | Original Investigation

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

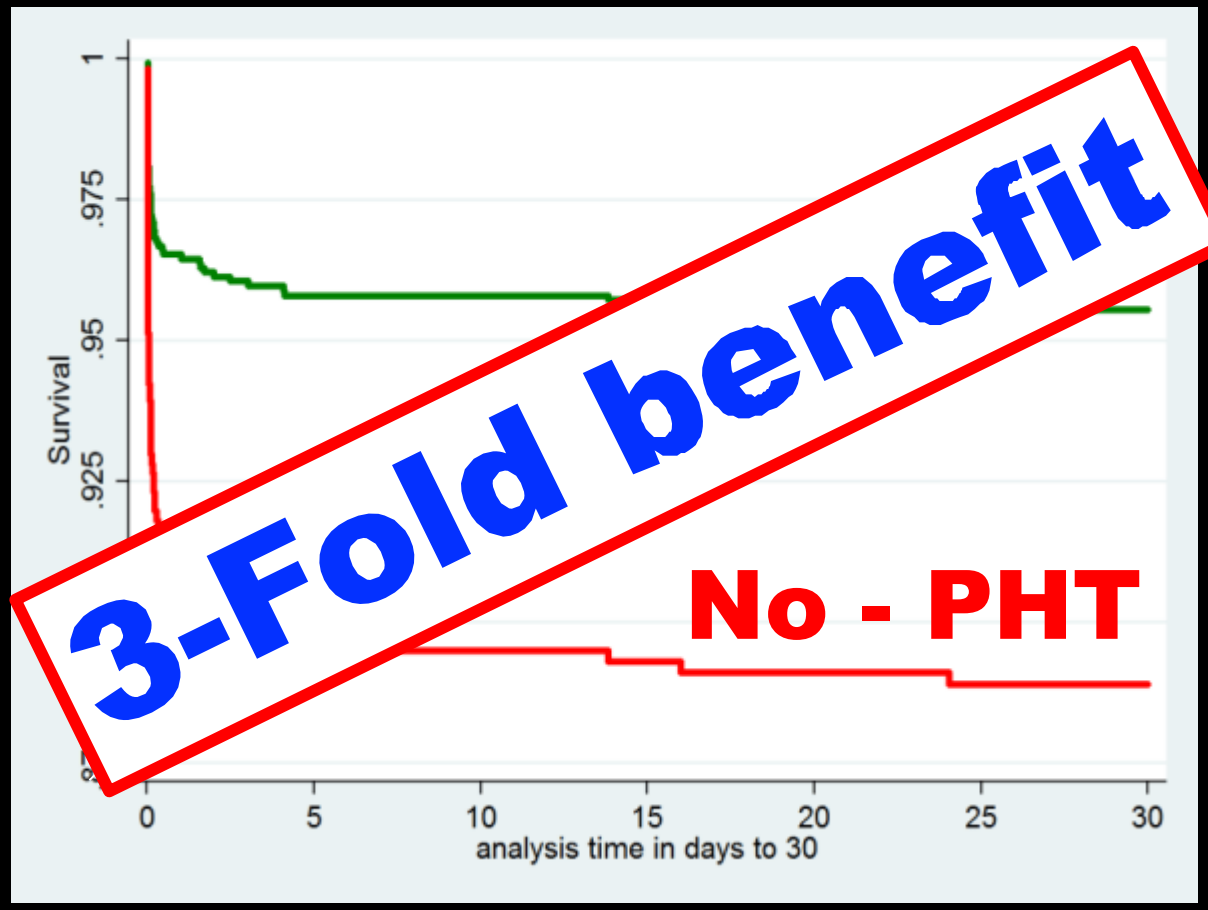
Stacy A. Shackelford, MD; Deborah J. del Junco, PhD; Nicole Powell-Dunford, MD; Edward L. Mazuchowski, MD, PhD; Jeffrey T. Howard, PhD; Russ S. Kotwal, MD, MPH; Jennifer Gurney, MD; Frank K. Butler Jr, MD; Kirby Gross, MD; Zsolt T. Stockinger, MD

Adjusted Mortality

24 hour survival



30 day survival



Pre-hospital blood transfusion saves lives

Largest reduction in risk of death in first 60 min

Minutes Matter → need early interventions

EAST PLENARY PAPER

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 Inaba, MD, Eileen Bulger, MD, John B. Holcomb, MD, *and* Bryan A. Cotton, MD, *Houston, Texas*

Every minute of delay between the activation of MTP and the arrival of the first blood cooler regardless of ratio, **resulted in a 5% increase in the odds of mortality**.

In fact, it appears that decreasing the time to blood product administration is **one of the modifiable risk factors that affect mortality in the exsanguinating trauma patient**.

Every minute of delay increases mortality risk by 5%

Prehospital Plasma (1 of 3)

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 JULY 26, 2018 VOL. 379 NO. 4

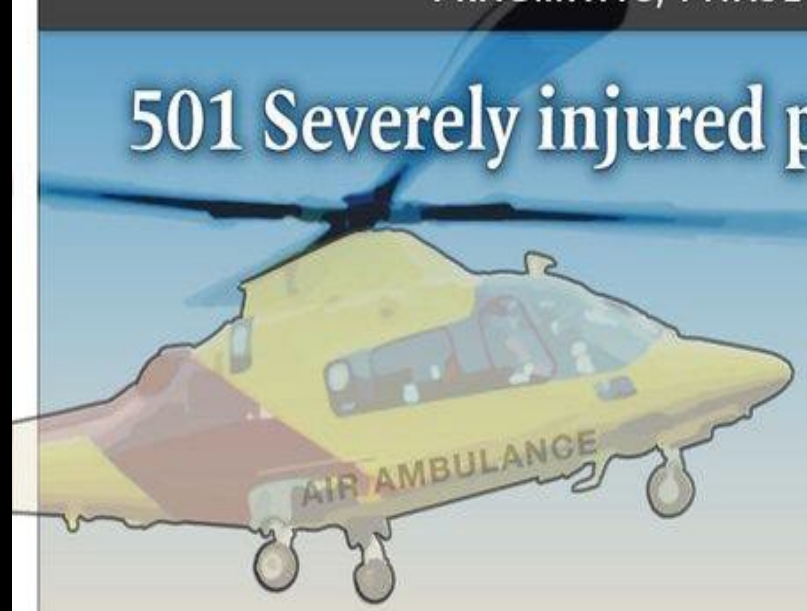
Prehospital Plasma during Air Medical Transport in Trauma Patients at Risk for Hemorrhagic Shock

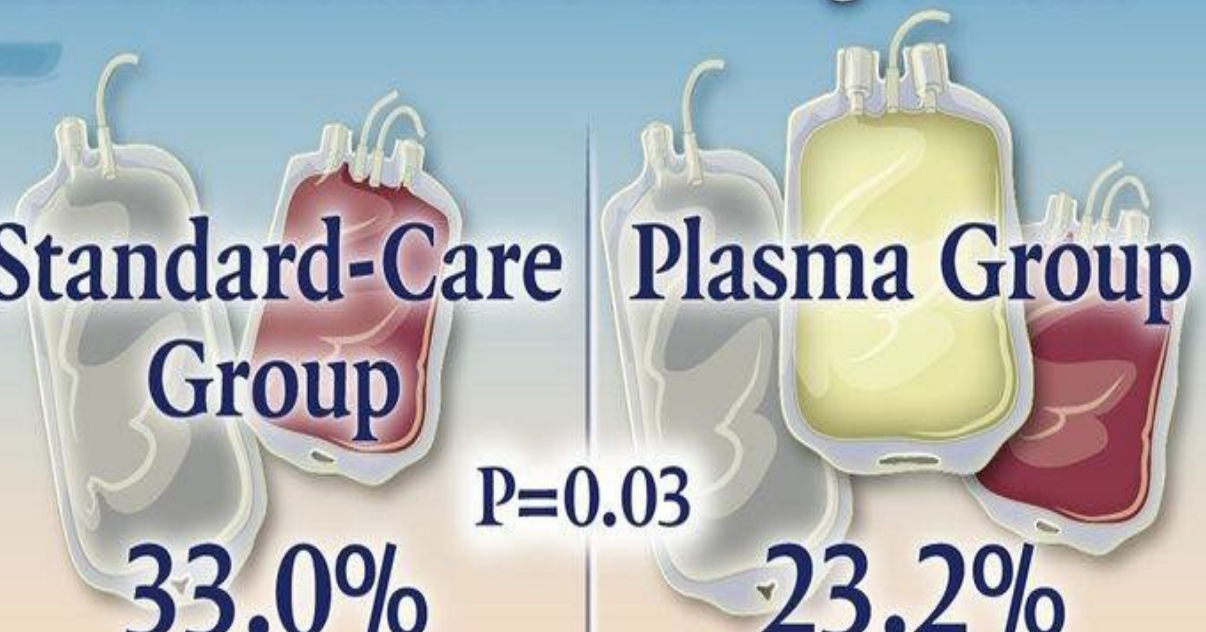
J.L. Sperry, F.X. Guyette, J.B. Brown, M.H. Yazer, D.J. Triulzi, B.J. Early-Young, P.W. Adams, B.J. Daley, R.S. Miller, B.G. Harbrecht, J.A. Claridge, H.A. Phelan, W.R. Witham, A.T. Putnam, T.M. Duane, L.H. Alarcon, C.W. Callaway, B.S. Zuckerbraun, M.D. Neal, M.R. Rosengart, R.M. Forsythe, T.R. Billiar, D.M. Yealy, A.B. Peitzman, and M.S. Zenati, for the PAMPer Study Group*

Prehospital Plasma during Air Medical Transport in Trauma Patients

PRAGMATIC, PHASE 3, MULTICENTER, CLUSTER-RANDOMIZED TRIAL

501 Severely injured patients at risk for hemorrhagic shock





	Standard-Care Group	Plasma Group
Mortality at 30 days	33.0%	23.2%
Nonfatal adverse events	0.07% (2/271)	2.6% (6/230)

P=0.03

The NEW ENGLAND JOURNAL of MEDICINE

Sperry et al. 2018

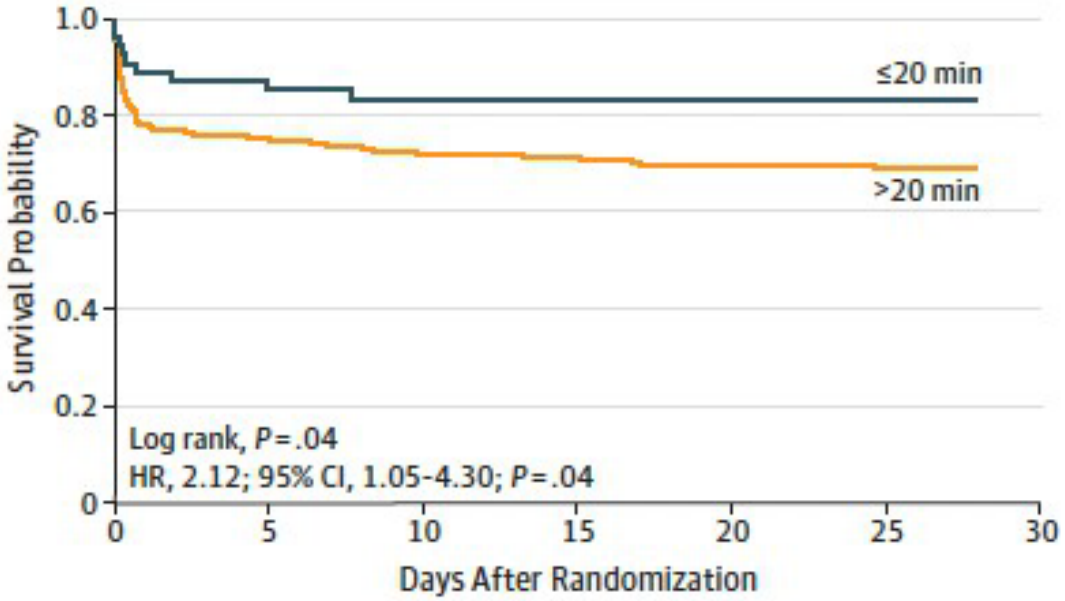
Prehospital Plasma (2 of 3)

JAMA Surgery | Original Investigation

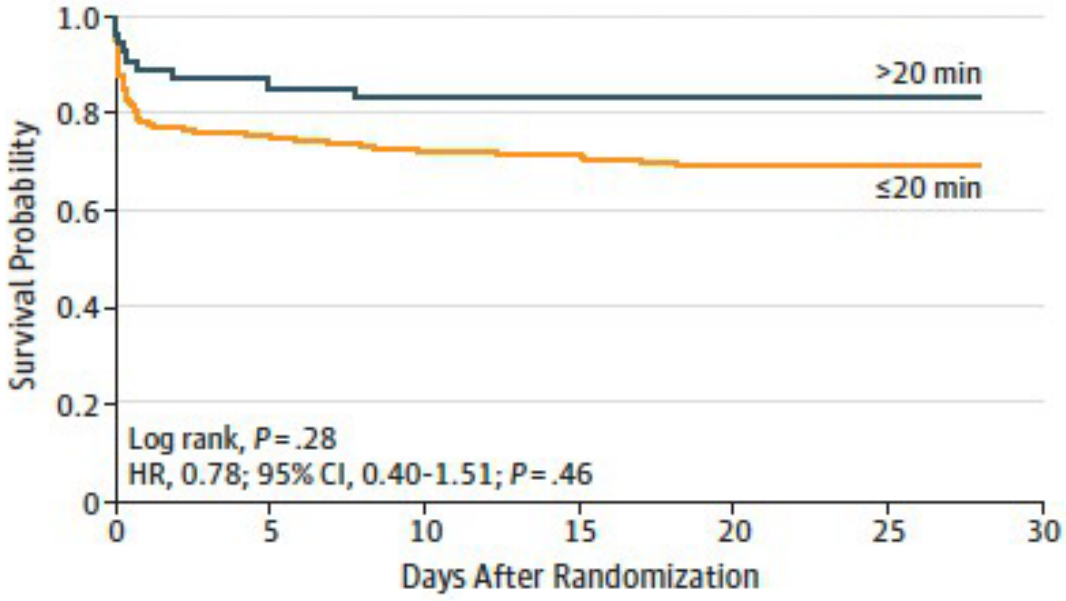
Association of Prehospital Plasma Transfusion With Survival in Trauma Patients With Hemorrhagic Shock When Transport Times Are Longer Than 20 Minutes

A Post Hoc Analysis of the PAMPer and COMBAT Clinical Trials

E Transport time >20 vs ≤20 min in standard care group

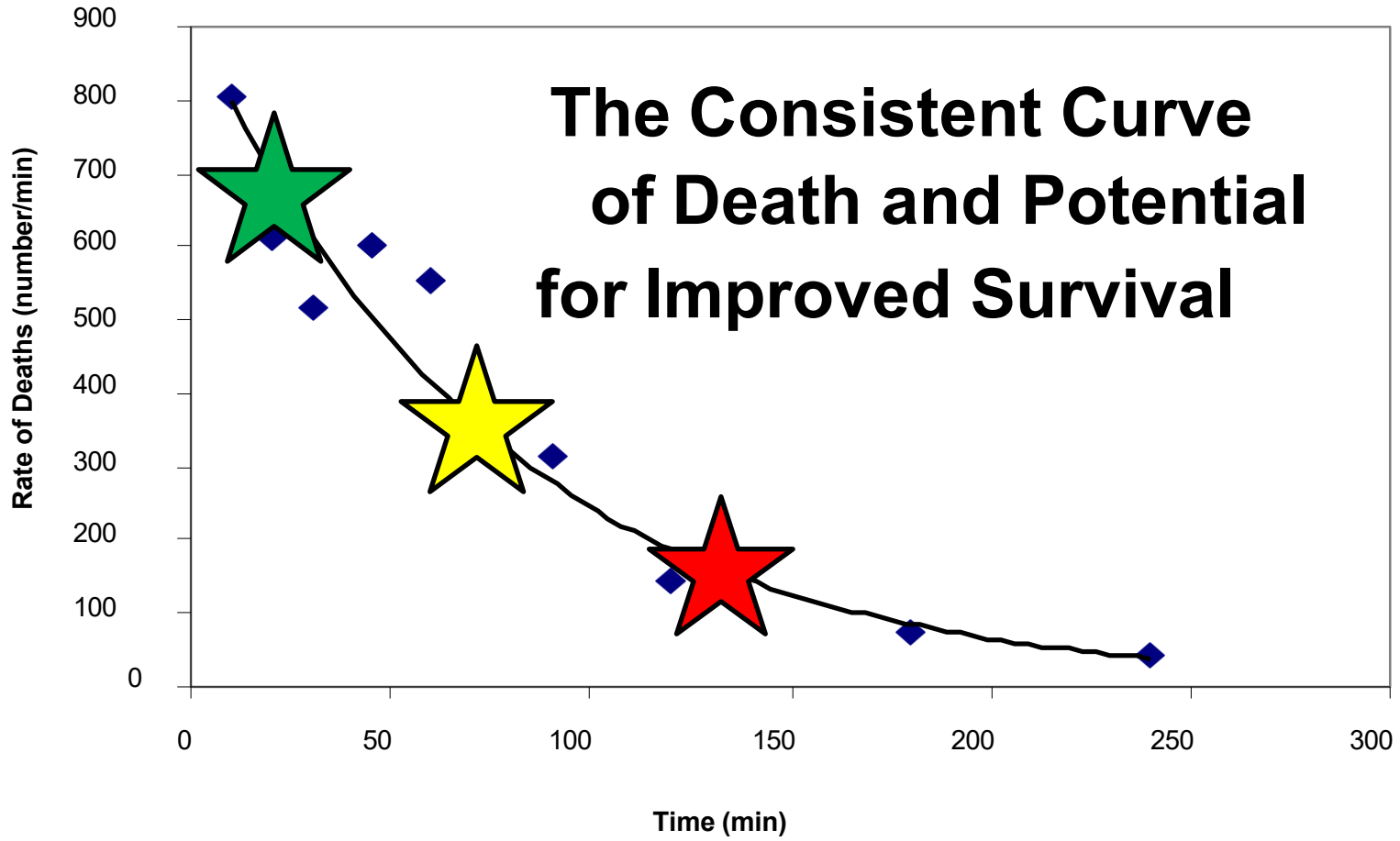


F Transport time >20 vs ≤20 min in plasma group



Transport Time and Preoperating Room Hemostatic Interventions Are Important: Improving Outcomes After Severe Truncal Injury

John B. Holcomb, MD, FACS



At minute

128

55

28

Minutes Matter!

It’s all about the

<36 minutes

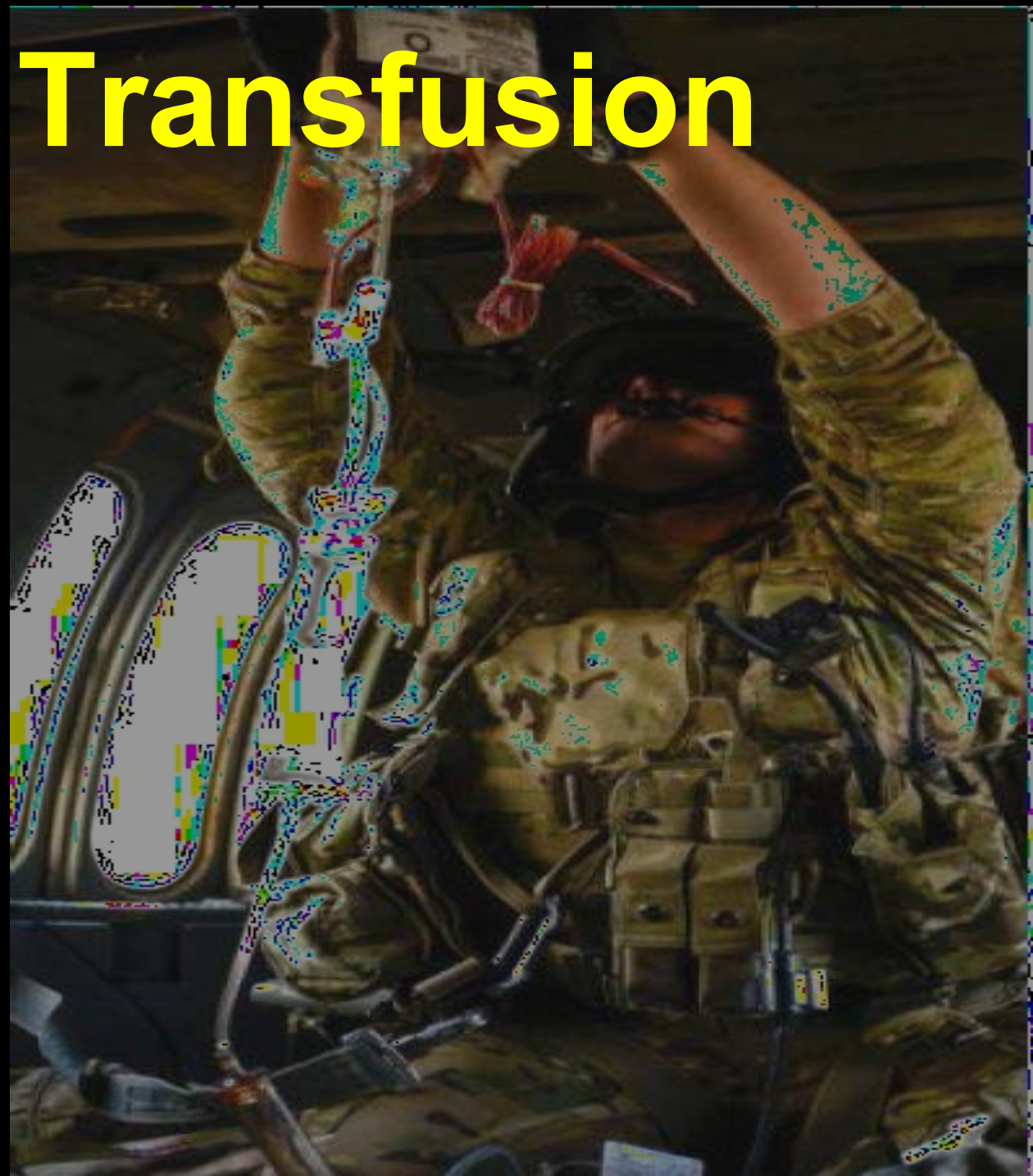
<20 minutes

TIME IS MORE IMPORTANT

THAN LOCATION

EARLY

- Will we be able to get to casualties?
- Medical teams are targets
- Mitigating risk in future environment:
  - Cover
  - Subterranean
  - Expand use of whole blood



WW 2 Statistics (1 of 3)

	European Theatre	Mediterranean Theatre	Pacific Theatre	
1. Admissions to Medical Units				
All Causes	2,935,313	1,529,105	2,599,768	
Disease	2,157,221 (73.4%)	1,212,993 (79.3%)	2,159,443 (82.7%)	
Non-battle Injury	382,523 (13.0%)	185,408 (12.1%)	332,008 (12.7%)	
Battle Wounded	395,569 (13.4%)	130,704 (8.5%)	108,317 (4.1%)	
2. Dead (to May 1945)	113,952	37,849		42
3. Fixed Beds Available (30 April-1945)	200,350	29,000		45
4. Ground Force Strength V.E. Day (May 7, 1945)	1,703,613	178,205		

Cutler EC Am J Surg 1947; 73:637-650

WW 2 Statistics (2 of 3)

- **Low Titer O Whole Blood:** 387,462 units collected in US and shipped overseas
  - 123,284 total units collected in a single week (June 1945) for US & overseas use
  - 14,928 sent overseas in a single week during battle of Iwo Jima, 1945

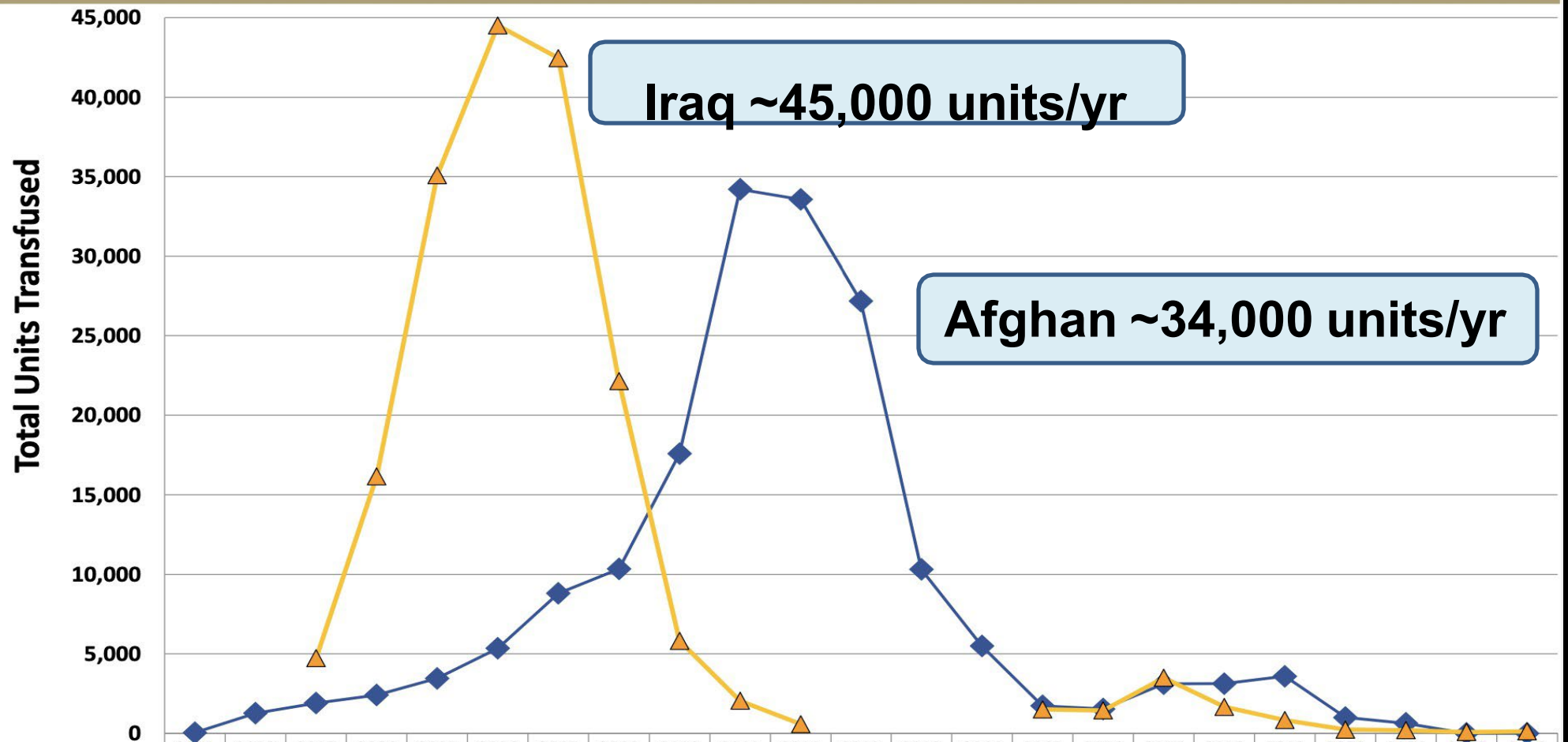
WW 2 Statistics (3 of 3)

- **Dried Plasma:**
- **>10 MILLION units collected**
  - **Production:**
    - **>3M units of 250ml**
    - **>2.3M units of 500ml**


WW 2 COMPARED
to GWOT

ASBP
Armed Services Blood Program

OEF/OFS Compared to OIF/OND/OIR Blood Products Transfused by YEAR



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
OEF-OFS	52	1,274	1,907	2,410	3,461	5,351	8,807	10,340	17,586	34,198	33,561	27,172	10,309	5,493	1,735	1,540	3,119	3,130	3,592	1,003	633	0	0
OIF-OIR	N/A	N/A	4,724	16,152	35,088	44,521	42,466	22,142	5,822	2,055	584	N/A	N/A	N/A	1,508	1,448	3,495	1,669	840	235	204	83	130
Total Units	52	1,274	6,631	18,562	38,549	49,872	51,273	32,482	23,408	36,253	34,145	27,172	10,309	5,493	3,243	2,988	6,614	4,799	4,432	1,238	837	83	130

Operation Enduring Freedom/ Operation Iraqi Freedom/ Operation New Dawn (OEF/OIF/OND) Operation Freedom's Sentinel (OFS) Operation Inherent Resolve (OIR)

Conflict	Units of Blood Collected	Collection Rate
World War II (June 1945 – 1 Week)	123,284 Units	123,284 units/week
Iraq & Afghanistan (Peak Year – 1 Year)	51,273 Units	985 units/week

125-fold difference!

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

The Use of Fresh Wh… Transfusion

Thomas B. Repine, … r, MD, and Lorne Blackborne, MD

Fresh whole … anistan is associa… to component …elets

Shawn C. Nessen, B… Robert M. Craig, Olle Berséus, Richard Ellison, K… y, Avani Shah, and Philip C. Spinella

Whole Blood Improves Survival

Whole blood at the tip of the spear: A retrospective cohort analysis of warm fresh whole blood resuscitation versus component therapy in severely injured combat casualties

Jennifer M. Gurney, MD, FACS[a,b,c,*], Amanda M. Staudt, PhD[d], Deborah J. del Junco, PhD[b], Stacy A. Shackelford, MD, FACS[b,c], Elizabeth A. Mann-Salinas, PhD[a,b], Andrew P. Cap, PhD, MD[a,c], Philip C. Spinella, MD[e], Matthew J. Martin, MD, FACS[c,f]

Improved survival in critically injured combat casualties treated with fresh whole blood by forward surgical teams in Afghanistan

Jennifer Gurney[1,2] *Amanda Staudt,*[1] *Andrew Cap,*[1,3] *Stacy Shackelford,*[2] *Elizabeth Mann-Salinas,*[2] *Tuan Le,*[1] *Shawn Nessen,*[3] *and Philip Spinella*[4]

- Lower mortality in patients who received warm fresh whole blood (WFWB)
- Mortality difference observed the most in the sickest patients
- Findings support warm fresh whole blood use for hemorrhage control as well as expanded study in military and civilian trauma settings

→associated with improved survival & logistical advantages

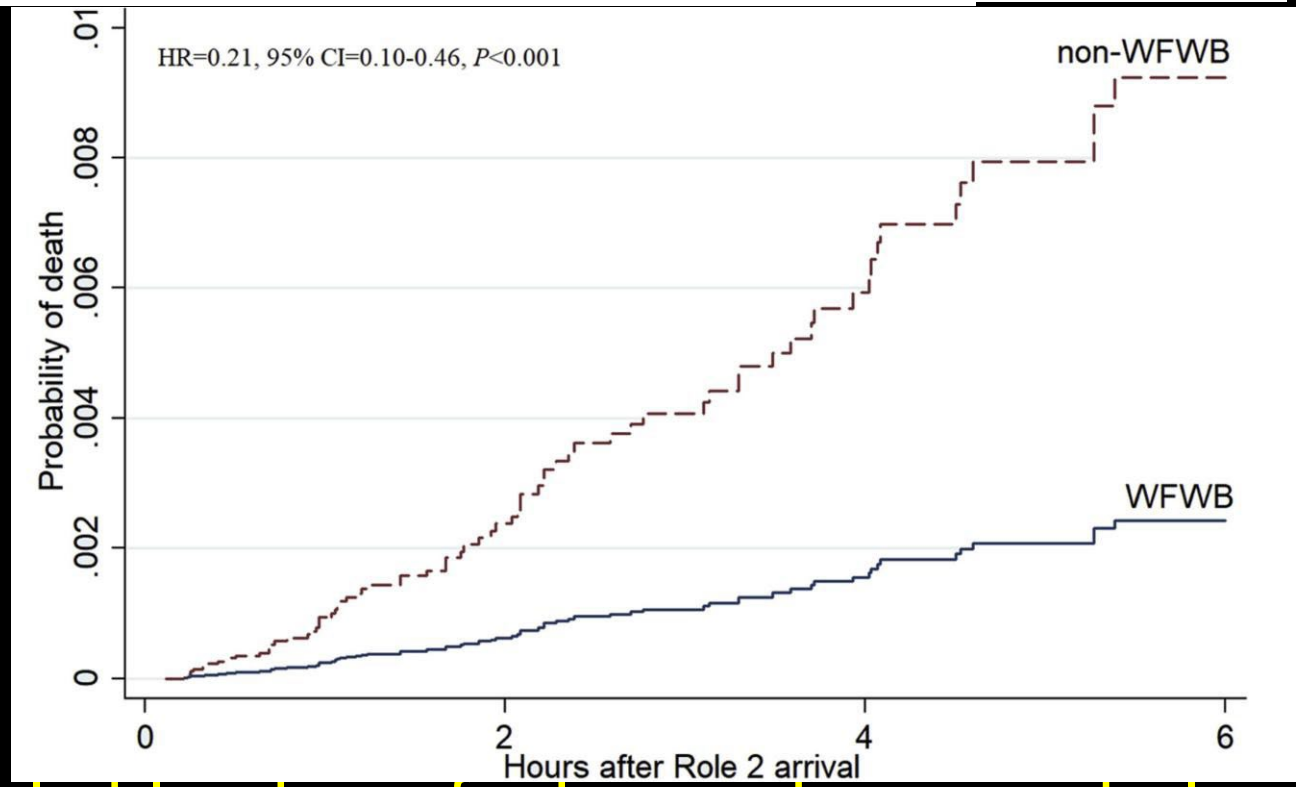
Whole blood at the tip of the spear: A retrospective cohort analysis of warm fresh whole blood resuscitation versus component therapy in severely injured combat casualties

SURGERY

Jennifer M. Gurney, MD, FACS[a,b,c,*], Amanda M. Staudt, PhD[d], Deborah J. del Junco, PhD[b], Stacy A. Shackelford, MD, FACS[b,c], Elizabeth A. Mann-Salinas, PhD[a,b], Andrew P. Cap, PhD, MD[a,c], Philip C. Spinella, MD[e], Matthew J. Martin, MD, FACS[c,f]

February 2022,

- Casualties transfused in Afghanistan from 2008 to 2014
  - N = 1,105 combat casualties
  - 221 WFWB vs 884 with components
- WFWB resuscitation →associated with a significant reduction in 6-hr mortality versus components, with a dose-dependent effect



Findings support warm fresh whole blood use for hemorrhage control as well as expanded study in military and civilian trauma settings

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What about blood planning?

The thin red line: Blood planning factors and the enduring need for a robust military blood system to support combat operations

J Trauma Acute Care Surg
Volume 97, Number 2, Supplement

Jennifer M. Gurney, MD, FACS, Andrew P. Cap, MD, PhD, John B. Holcomb, MD, FACS, Amanda M. Staudt, PhD, MPH, Matthew D. Tadlock, MD, FACS, Travis M. Polk, MD, FACS, Crystal Davis, MS, Jason B. Corley, MS, MT (ASCP) SBB, Martin A. Schreiber, MD, FACS, FCCM, Andrew Beckett, CD, MD, MSc, FRCSC, FACS, Mary Ann Spott, PhD, Stacy A. Shackelford, MD, FACS, Jan-Michael Van Gent, DO, FACS, Jonathan D. Stallings, PhD, Matthew J. Martin, MD, FACS, *and* **Leslie E. Riggs, MS**, *Houston, Texas*

- Must maintain the viability of the Armed Services Blood Program (ASBP)
- Planning factors for LSCO must be considered and ASBP supported
- Lessons learned with blood planning factors in combat have been forgotten in the past and risk being forgotten in the present

The thin red line: Blood planning factors and the enduring need for a robust military blood system to support combat operations

J Trauma Acute Care Surg
Volume 97, Number 2, Supplement

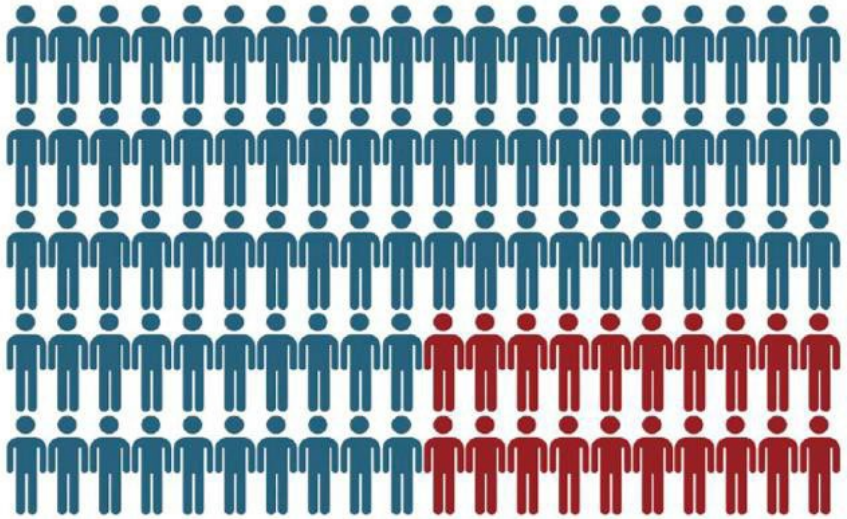
Jennifer M. Gurney, MD, FACS, Andrew P. Cap, MD, PhD, John B. Holcomb, MD, FACS, Amanda M. Staudt, PhD, MPH, Matthew D. Tadlock, MD, FACS, Travis M. Polk, MD, FACS, Crystal Davis, MS, Jason B. Corley, MS, MT (ASCP) SBB, Martin A. Schreiber, MD, FACS, FCCM, Andrew Beckett, CD, MD, MSc, FRCSC, FACS, Mary Ann Spott, PhD, Stacy A. Shackelford, MD, FACS, Jan-Michael Van Gent, DO, FACS, Jonathan D. Stallings, PhD, Matthew J. Martin, MD, FACS, *and* **Leslie E. Riggs, MS**, *Houston, Texas*

TABLE 2. WB Planning Periodic Automatic Resupply (PAR) Recommendations

Theater Medical Assets	Description	Recommended PAR Level (Units WB/ WBE) Per 72 h	Walking Blood Bank
Role 1 (ex: BCT)	3 unit WB per trained medic	3	At least 90% or unit members prescreened
Role 1 or Role 2 non-surgical (ex: ASMC/C-MED)	Nonsurgical resuscitation team	30	At least 50 presecreened donors available
Role 2 (ex: FRSD 20 PAX)	10 surgical cases/day, average 4 units/case	120	At least 100 presecreened donors available
Role 3	24 surgical cases/day, average 6 units/case	240	At least 50 presecreened donors available
MEDEVAC/Air Evacuation/ Critical Care Air Transport	Units per aircraft	8	At least 90% or unit members prescreened

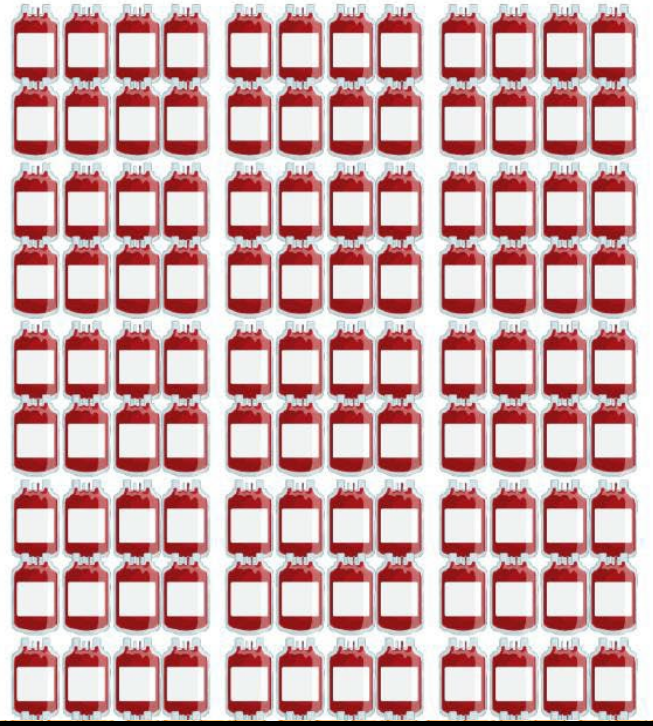
This number best estimates the starting blood level in a new theater of operations. Blood PAR should be adjusted dynamically based on operational activity and resupply availability.

20% Massive trauma patients require Transfusion



8 Whole Blood Equivalents (WBE*) per transfused patient

= 160 WB



Whole Blood is Operationally Better

Blood is a Lesson….Re-learned

- Blood program in WWII: $15,870,000 (1945 dollars)
- That's **$282,751,867.62** in 2025 dollars

What's the current budget of ASBP?

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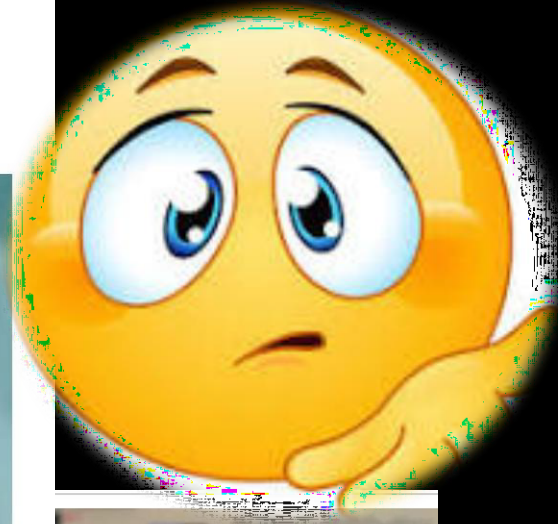
Is Civilian Medicine Ready?

Imagine A Hospital With No Spare Blood

OCTOBER 22, 2019 · 1:52 PM ET

By Tim McDonnell

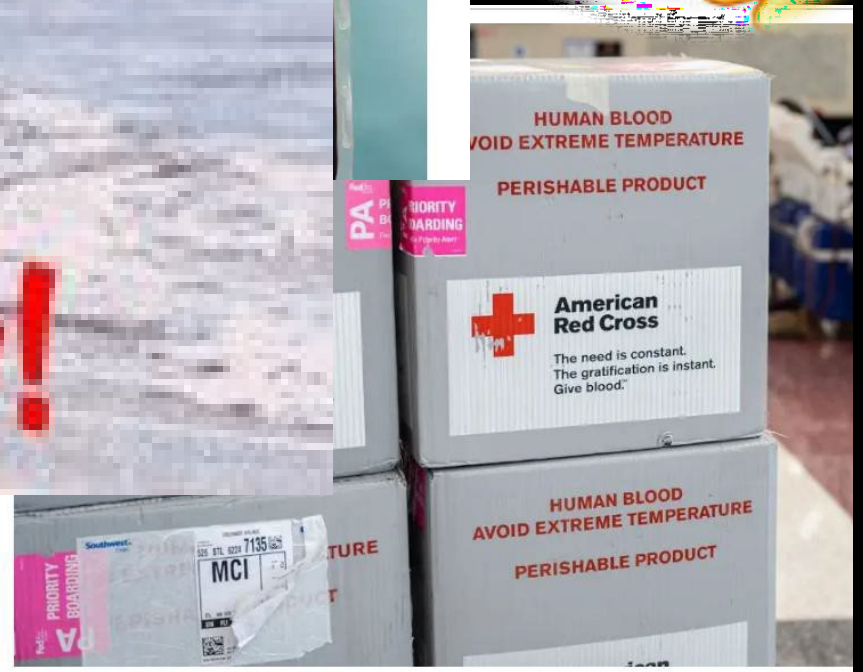


Experts Sug
Address Glo

Short-term strategies could improve care for people in world's 'blood deserts'

By MILES MARTIN | Brigham and Women's | February 15, 2024 | Care Delivery

3 min read



Red Cross Blood Shortage Linked Back to Extreme Heat

THE WHITE HOUSE
WASHINGTON

December 10, 1951

TO THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES:

I have asked the Director of the Office of Defense Mobilization to provide within that office a mechanism for the authoritative coordination of an integrated and effective program to meet the nation's requirements for blood, blood derivatives and related substances.

At his direction, the Health Resources Advisory Committee, Office of Defense Mobilization, has established a Subcommittee on Blood for this purpose. This Subcommittee will be concerned with the development of a single National Blood Program encompassing all phases of the problem.

I desire that other departments and agencies of the Federal Government coordinate their activities in the blood field through this mechanism.

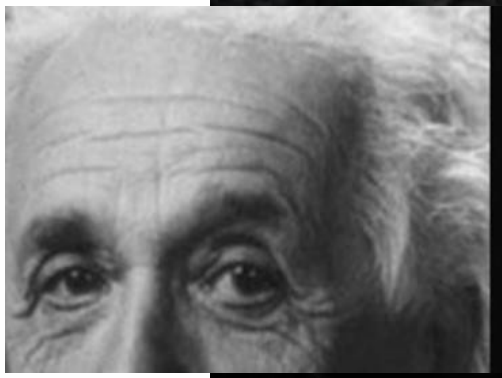
Harry Truman

SCUDDER ORATION ON TRAUMA

Blood and War—Lest We Forget

David B Hoyt, MD, FACS

JACS 2009;209(6):681-686



The only mistake in life is the lesson not learned.

— Albert Einstein —

Let’s go back to history…

History

“The vital role which whole blood played in the care of the wounded has been adequately dealt with elsewhere, but the essential planning that made possible the

treatment of the greater portion of the wounded in the is a story that needs to be told ”

- COL James B. Mason

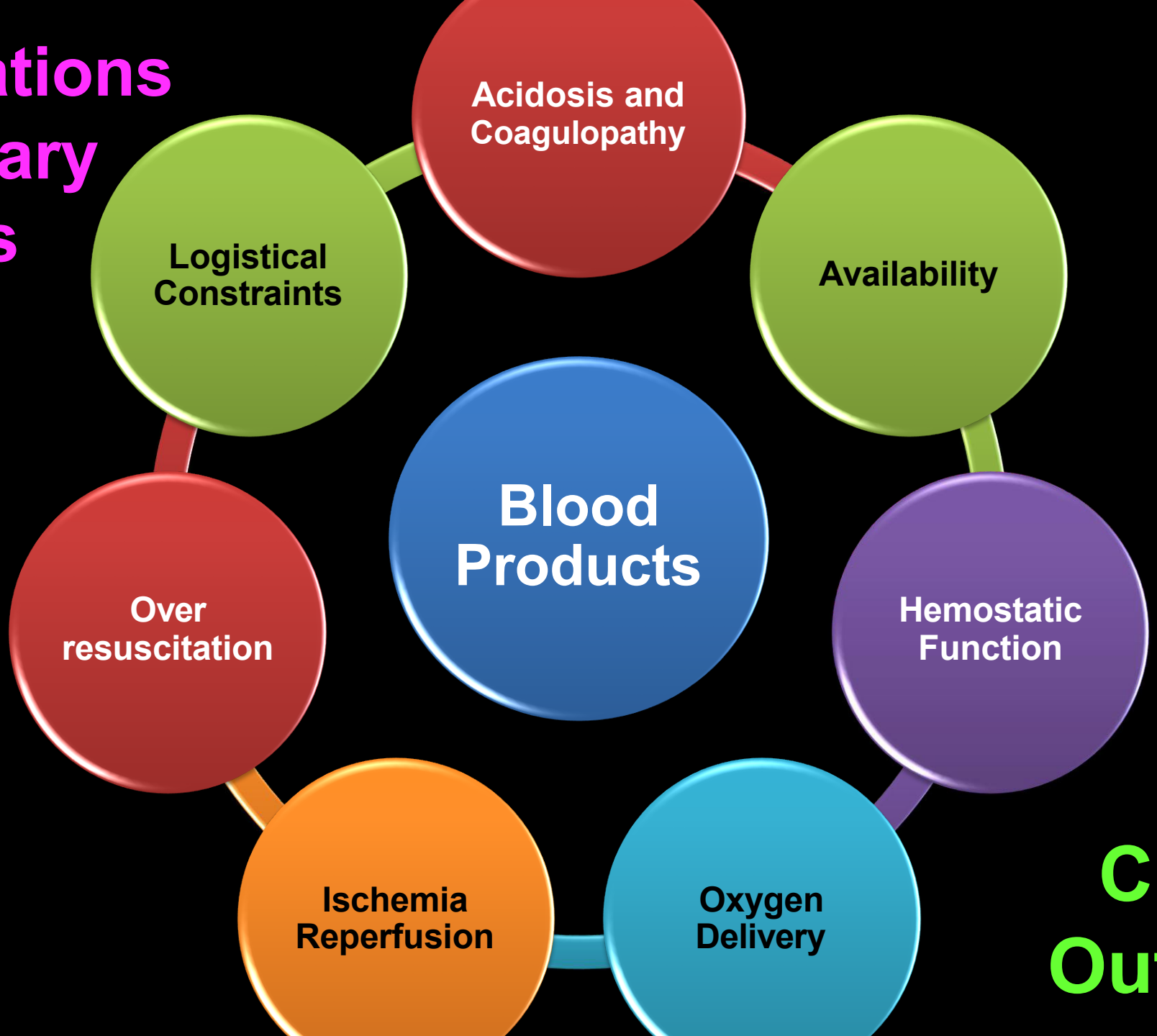
History, continued

"The vital role which whole blood played in the care of the wounded in World War II has been adequately dealt with elsewhere, but the essential planning that made possible the provision of over 385,000 pints of whole blood for the treatment of the greater portion of the 386,075 wounded in the European theater of operations is a story that needs to be told "

- COL James B. Mason, June 1948

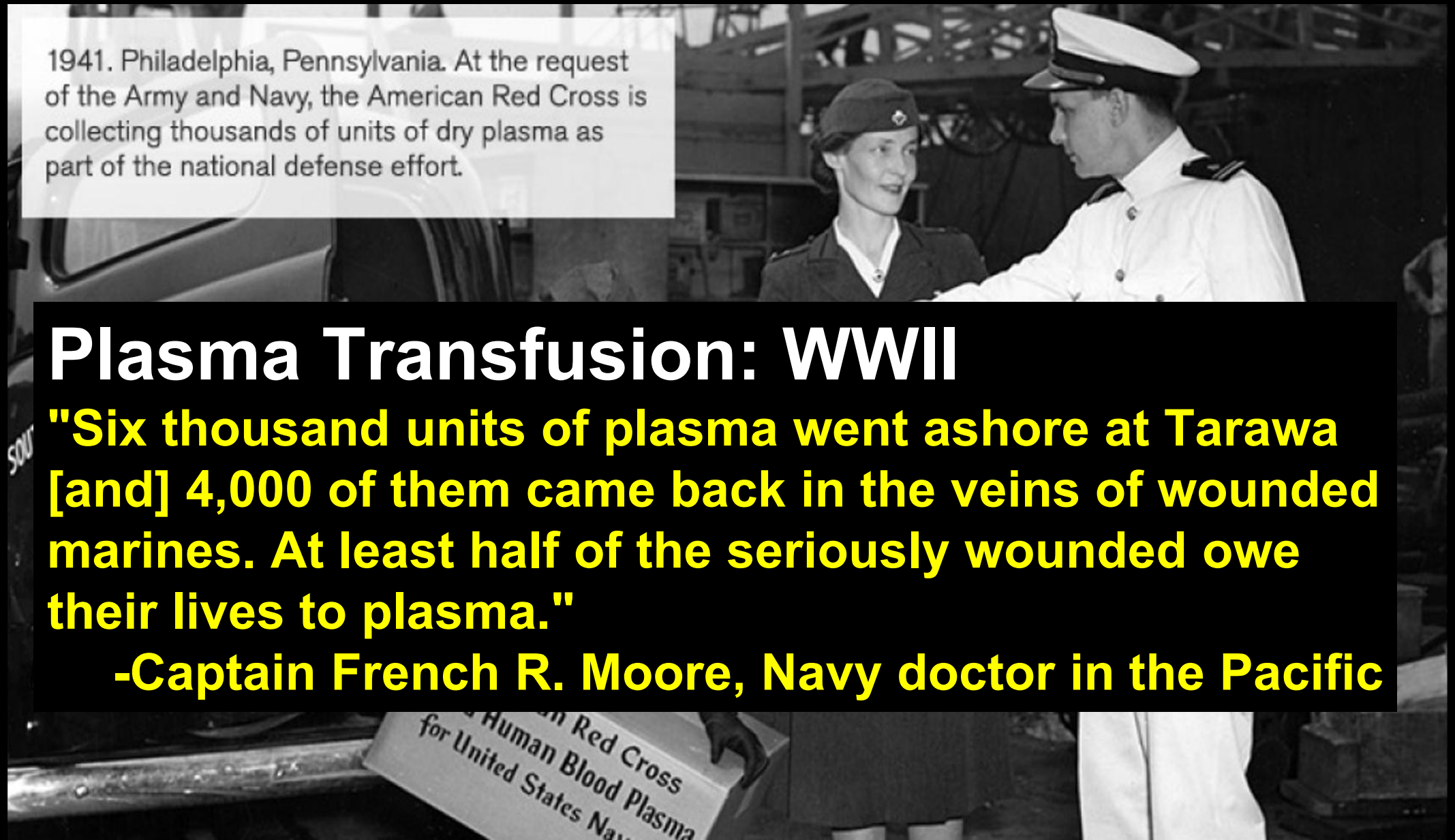
We will need a lot of blood

Considerations for Military Settings



Clinical Outcomes

FREEZE DRIED PLASMA



Plasma Transfusion: WWII

"Six thousand units of plasma went ashore at Tarawa [and] 4,000 of them came back in the veins of wounded marines. At least half of the seriously wounded owe their lives to plasma."

-Captain French R. Moore, Navy doctor in the Pacific

FIGURE 169.—Official poster of Armed Forces Blood Donor Program instituted September 1951.

Prehospital Plasma (3 of 3)

Plasma as a bridge to blood

Golden Hour Extender

FDP – Logistical Advantages

Freeze Dried Plasma (FDP)	LTOWB / FWB
Long Shelf Life (2-5 yr)	21 day shelf life
No Refrigeration	Temp sensitive
Easy to carry	Bulky
No transfusion rxn	Risk with FWB
Fast	WBB: 15-45 min

Improved availability for point of injury and austere / remote settings

Agenda

- Global Threats and Risk
- Military Wartime Lessons Learned & Readiness
- Blood Planning Factors
- Blood and Beds Analysis
- How do we mitigate: WBB, Plasma, Data

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Is the MHS ready for LSCO?

Planning must optimize

1) CAPABILITY (BLOOD)
2) CAPACITY (BEDS)

CAPABILITY

CAPACITY

Is the MHS ready for LSCO?, continued

Planning must optimize

1) **CAPABILITY (BLOOD)**
2) **CAPACITY (BEDS)**

- **Understanding the resources needed to acutely manage ↑ numbers of combat casualties is critical**
  - Plan for the potential of overwhelming casualties: 30K/month

- **Blood supply will be a limiting factor depending on:**
  - Casualty volume and transport times/availability of transport
  - Injury patterns and injury severity

Objective

Planning must optimize

1) CAPABILITY (BLOOD)
2) CAPACITY (BEDS)

To describe the blood utilization and length of acute hospital stay for combat casualties over 20 years of conflict in the Global War on Terror.

Methods

Deployed HEROES
Hemostatic Emergency Resuscitation Of Traumatic Exsanguinating Shock

- Retrospective, observational
- Data: Department of Defense Trauma Registry (DoDTR)
- Setting: US military MTFs in combat settings
- Population: All US military combat casualties from 2001 to 2020

Planning Factors

Blood: 1000 patients/day x % treated at each role x % transfused at each role x median units transfused

Bed Days: 1000 patients/day x % treated at each role x median LOS

Bed Days for transfused patients: 1000 patients/day x % treated at each role x % transfused at each role x median LOS

Combat surgical workload in Operation Iraqi Freedom and Operation Enduring Freedom: The definitive analysis

Caryn A. Turner, MPH, Zsolt T. Stockinger, MD,
and **Jennifer M. Gurney, MD, FACS**, *Fort Sam Houston, Texas*

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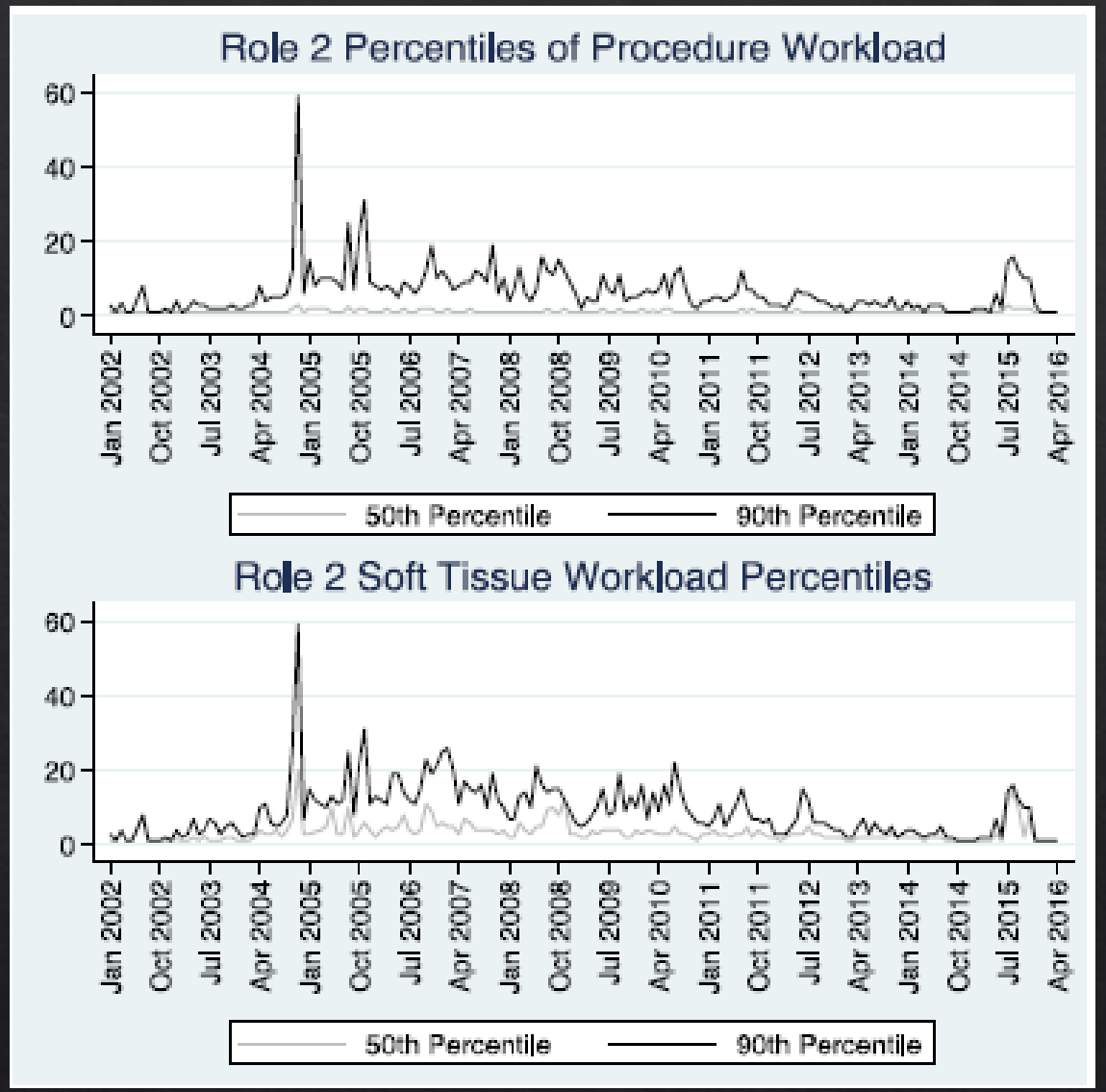

Figure 3. Top: *50th* and *90th percentiles* of *procedures* at R2 MTFs between 2002 and 2016. Bottom: *50th* and *90th percentiles* of *soft tissue* procedures performed at R2 MTFs between 2002 and 2016.

Combat surgical workload in Operation Iraqi Freedom and Operation Enduring Freedom: The definitive analysis

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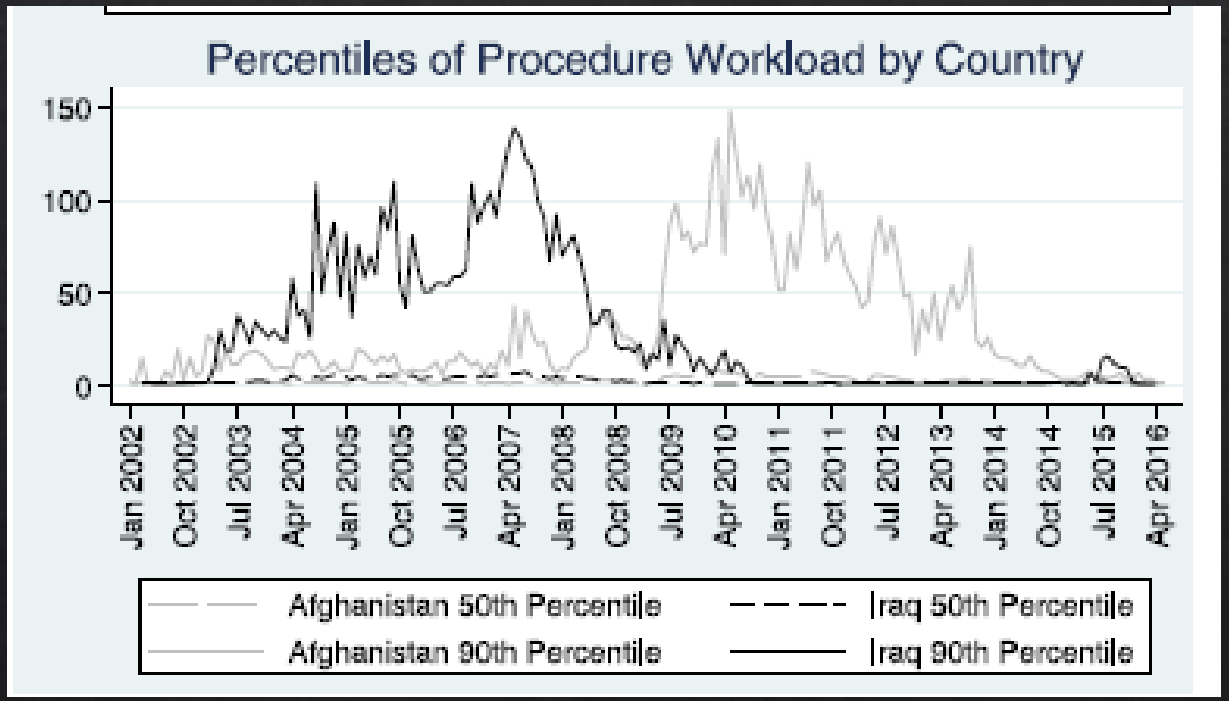
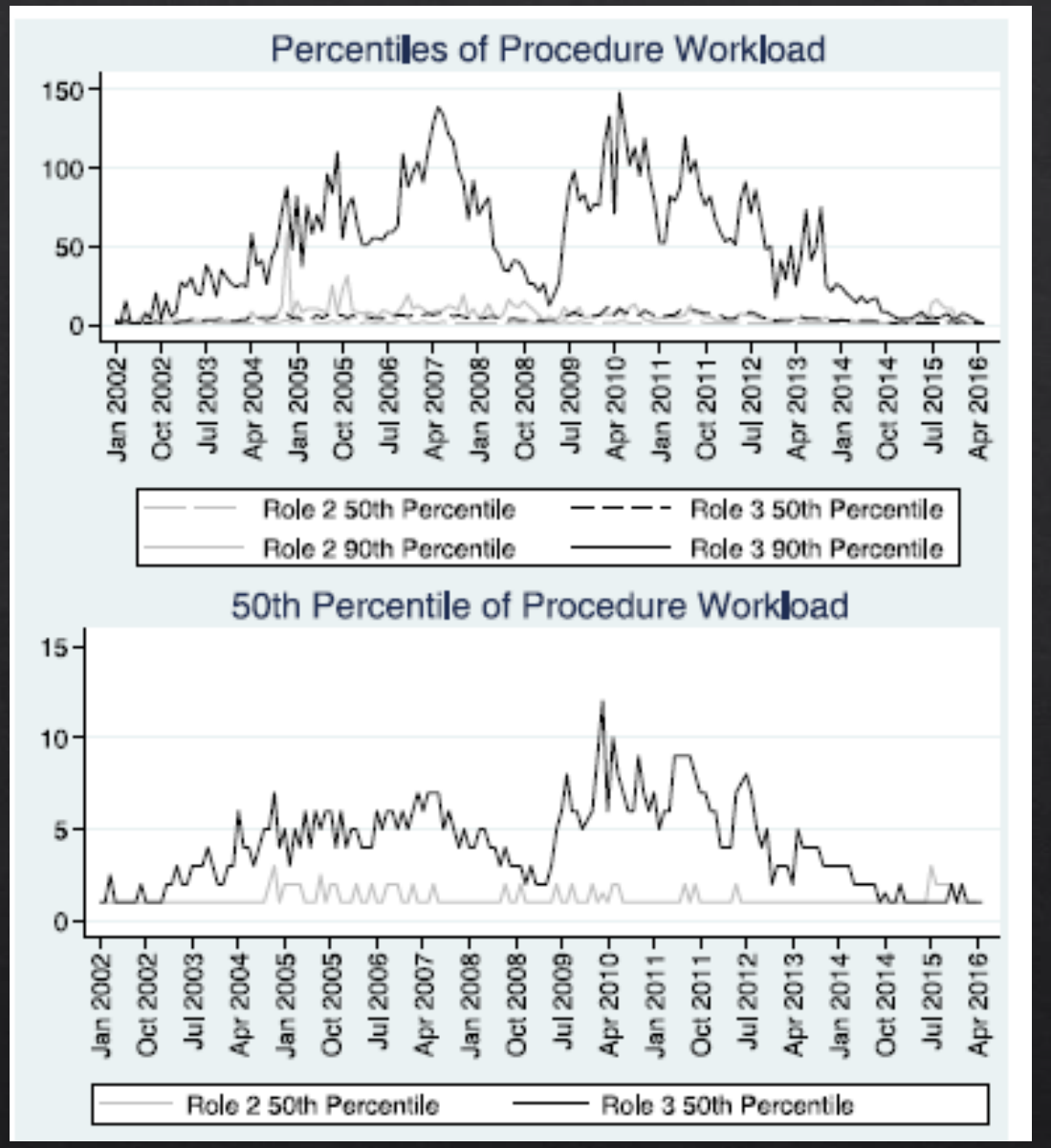


Workload by theater of Operations Iraq vs. Afghanistan



Workload comparing Role 2 vs. Role 3 MTFs (2002-2016)

Blood Unit Planning Factors

Role 2
Assumed Patients / Day

2001-2020	OIF 2007	OEF 2010
1000	1000	1000

Role 3
Assumed Patients / Day

2001-2020	OIF 2007	OEF 2010
1000	1000	1000

Blood Unit Planning Factors, continued

Role 4 OCONUS Patients

2001-2020	OIF 2007	OEF 2010
1000	1000	1000

Role 4 CONUS Patients

2001-2020	OIF 2007	OEF 2010
1000	1000	1000

Bed Days Planning Factors

Role 2

Role 2	2001-2020	OIF 2007	OEF 2010
Patients	1000	1000	1000
Treated (%)	26	17	25
LOS	0	0	0

Role 3

Role 3	2001-2020	OIF 2007	OEF 2010
Patients	1000	1000	1000
Treated (%)	89	94	98
LOS	1	1	1

Burden of Beds --> Role 3 during COIN

Bed Days Planning Factors, continued

OCONUS Role 4

OCONUS Role 4	2001-2020	OIF 2007	OEF 2010
Patients	1000	1000	1000
Treated (%)	52	57	43
LOS	3	3	2
Bed Days Planning Factor	**1553**	**1707**	**868**

CONUS Role 4

CONUS Role 4	2001-2020	OIF 2007	OEF 2010
Patients	1000	1000	1000
Treated (%)	23	21	21
LOS	12	9	13
Bed Days Planning Factor	**2718**	**1896**	**2780**

Burden of Beds --> ~2800 bed days for daily casualty generation

Bed Days Planning Factors for Monthly Beds Needed

OCONUS Role 4	CONUS Role 4
30000	30000
46,604	81,541

Burden of Beds --> ~46K beds OCONUS Role 4 and >80K beds needed monthly in US

Bed Days for Casualties Needing Blood

Role 2

Role 2	2001-2020	OIF 2007	OEF 2010
Patients	1000	1000	1000
Treated (%)	26	17	25
Transfused (%)	7	6	1
LOS	0	0	0
Planning beds for transfused patients	**0**	**0**	**0**

Role 3

Role 3	2001-2020	OIF 2007	OEF 2010
Patients	1000	1000	1000
Treated (%)	89	94	98
Transfused (%)	14	18	16
LOS	1	1	1
Planning beds for transfused patients	**120**	**170**	**158**

Bed Days for Casualties Needing Blood, continued

OCONUS Role 4

OCONUS Role 4	2001-2020	OIF 2007	OEF 2010
Patients	1000	1000	1000
Treated (%)	52	57	43
Transfused (%)	10	16	16
LOS	3	3	2
Planning beds for transfused patients	**154**	**277**	**142**

CONUS Role 4

CONUS Role 4	2001-2020	OIF 2007	OEF 2010
Patients	1000	1000	1000
Treated (%)	23	21	21
Transfused (%)	23	19	22
LOS	12	9	13
Planning beds for transfused patients	**630**	**364**	**621**

Bed Days Planning Factors for Monthly Beds Needed, continued

	Bed Days Planning Factor/month	Bed Day Planning Factor for Transfused Patients/month
Role 2	0	0
Role 3	26614	3603
OCONUS Role 4	46604	**4633**
CONUS Role 4	81541	**18892**

Burden of Beds --> ~4.6K and 18.9K 'high acuity beds' needed monthly for 1K casualties / day

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- **How do we mitigate: WBB, Plasma, Data**

Technology and Innovation in Prehospital Transfusion

- Portable blood refrigerators
- Telemedicine support to point of care / point of need
- Better hemostatic agents for prehospital and Role 2 providers
- DATA!!! Need to collect accurate data on transfusion…*and outcomes*

Engage Maneuver Commanders

Chief of Staff of the Army Recommended Articles
March 2024

"Services and combatant commands do not need to wait for authority to implement their pre-deployment requirements. The operational Army can initiate its own screening requirements now and begin establishing WBBs (walking blood banks) for training and combat."

Capt. Kyle Nielsen, an emergency medicine physician from 173rd Infantry Airborne Brigade, explains the importance of using a Thermal Angel (equipment used to warm blood) during a class on walking blood banks in their Role 2 prolonged field care training 13 September 2019 during Exercise Saber Junction 2019 at the Grafenwoehr Training Area, Germany. (Photo by Pfc. Ashunteia' Smith, U.S. Army)

Blood Types and Titers

Saving Lives on the Battlefield with Blood Far Forward

Lt. Col. D. Max Ferguson, U.S. Army

Who owns donor screening?

Military Health System Mitigation Strategies

- **Improved capability and expanded capacity to treat casualties at or near the point of injury**
- **Ability to sustain combat casualties in a prolonged care environment**
- **Provide an agile, resilient, and global network of treatment facilities, storage sites for medical supplies, and transportation assets**
- **Resilient industrial base for medical supplies**
- **Preparation for homeland support and homeland defense missions**

Blood Mitigation Strategies

- JTS Joint WBB Training Curriculum
- Type A for A & Type O for Everyone Else (A4A; O4E^2)
- Expand whole blood use to Type Specific at all Role 3 (and Role 2)
- Must build resiliency in supply chains
- Storage capacity
- Research on prolonging shelf life of blood
- FDP production expansion

Conclusions

- Given the potential for LSCO (> 30,000 casualties/month) the DoD must anticipate and plan for the blood requirements and length of stay for these resource intensive patients
- These findings highlight the increased blood demands and inpatient bed days required to provide high quality care for combat casualties in the military health care system
- LSCO will overwhelm military and civilian healthcare systems

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Questions?

Thank you

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1. Visit the registration page at https://www.dhaj7-cepo.com/content/2025-sep-ccss. From there, register for the event or log in to your account if already registered.
2. Once logged in and registered, on the event page, select “Get Started” (located in the menu below the event title on desktop and at the bottom of the page on mobile devices). Note: This tab will not appear unless you are registered and logged in to your account.
3. Under the “Get Started” tab, scroll down to a session you attended and select “Claim credit.”
4. Proceed to take the evaluation and posttest to obtain your certificate after the session has ended.

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