30th Annual David Miller Memorial Trauma Symposium
Springfield, MO
0800hrs, October 11, 2018

Department of Defense Joint Trauma System

DHA
Defense Health Agency

COL (Ret) Russ S. Kotwal, MD MPH

Disclaimer

The views expressed in this presentation are those of the author and do not reflect the official policy or position of the Department of Defense or US Government, except where specifically indicated.

No conflict of interest.


SNOOK CEMETERY

DOD JTS:
INTRODUCTION AND OVERVIEW

The Joint Trauma System and the Fog of War

Stockinger ZT. *Mil Med*. 2018;183(Suppl 2):1-3.

"…the signature military medical advance of our decade-plus of war is the decision to create and implement a military trauma system."

"An effective military trauma system must advocate **organization, communication, and standardization,** each of which supports and reinforces the others."

Joint Trauma System

Department of Defense Center of Excellence for Trauma

MISSION:

- provide evidence-based Performance Improvement (PI) of trauma and combat casualty care
- reduce morbidity and mortality to lowest possible levels
- provide evidence-based recommendations on trauma care and trauma systems across the Department of Defense (DoD)

http://jts.amedd.army.mil/

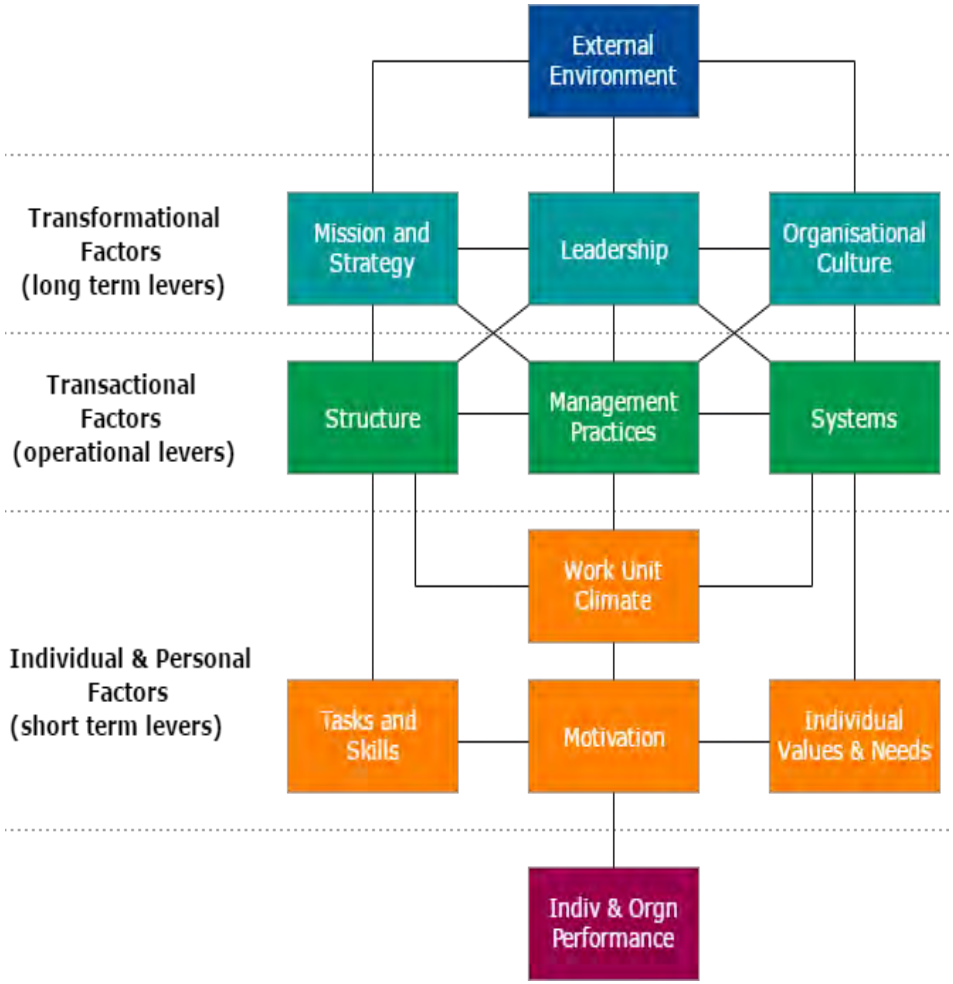
Performance Improvement vs Research

- **PERFORMANCE IMPROVEMENT (PI):** Systematic data-guided activity designed to effect health care delivery in near real-time.
  - **Indicators:** includes monitoring, data collection and assessment, evaluation of metrics, procedures, and/or standard clinical practices intended for modification or correction of deficiencies in a designated population.

- **RESEARCH:** Systematic investigation designed to develop or contribute to generalizable knowledge – includes development, testing, and evaluation; follows a highly structured federal regulatory process.
  - **Indicators:** includes testing of issues that go beyond current knowledge based on science and experience, random allocation of patients into different intervention groups, and deliberate delay of feedback of data from those monitoring the implementation, especially if done to avoid bias.

A well-designed health care system should have PI activities that ultimately prompt and prioritize Research initiatives.

Performance



1. **External Environment:** direct, indirect factors
2. **Mission & Strategy:** mission, vision
3. **Leadership**: leadership structure, role models
4. **Culture:** values, how people work together, influence on greater good
5. **Structure:** hierarchy, communication, decision making
6. **Mgmt Practices:** implementation of vision
7. **Systems:** policies & procedures that govern day-to-day work
8. **Climate:** what your people think and feel about each other, hopes and expectations
9. **Tasks & Skills:** individual abilities, positional requirements
10. **Motivation:** needed for change
11. **Values & Needs:** importance, job satisfaction
12. **Performance:** productivity, quality, efficiency, customer satisfaction

Burke WW, Litwin GH. A Causal Model of Organizational Performance and Change. Journal of Management. 1992;18(3):523-545.

The Joint Trauma System: History in the Making

Spott MA, Kurkowski CR, Burelison DR, Stockinger Z. *Mil Med*. 2018;183(Suppl 2):4-7.

Timeline

1996 – Concept of collecting combat trauma data for gap and trend analysis born from U.S. GAO report addressing shortcomings from Operation Desert Storm.

COL Holcomb sees tactical, operational, and strategic need to deploy a trauma system.

2002 – U.S. Army Surgeon General approved JTTR as a demonstration project.

2003 – LTC Eastridge deployed as first JTTS Trauma Medical Director, USCENTCOM.

2004 – ASD (HA) directs all Service medical departments to work together to establish a single centralized trauma registry.

2006 – JTTS formalized & modeled after civilian trauma system principles in ACS CoT "Resources for the Optimal Care of the Trauma Patient", Dr Spott first Director.

2010 – JTTS renamed JTS to signify operations beyond deployment and combat theater

2011 – S&F JTTR revamped into a robust, real-time, web-accessible system, the DoDTR.

2013 – ASD designates JTS as the DoD Center of Excellence for Trauma

2018 – JTS aligned under the Defense Health Agency

Memos, Policies, and Law

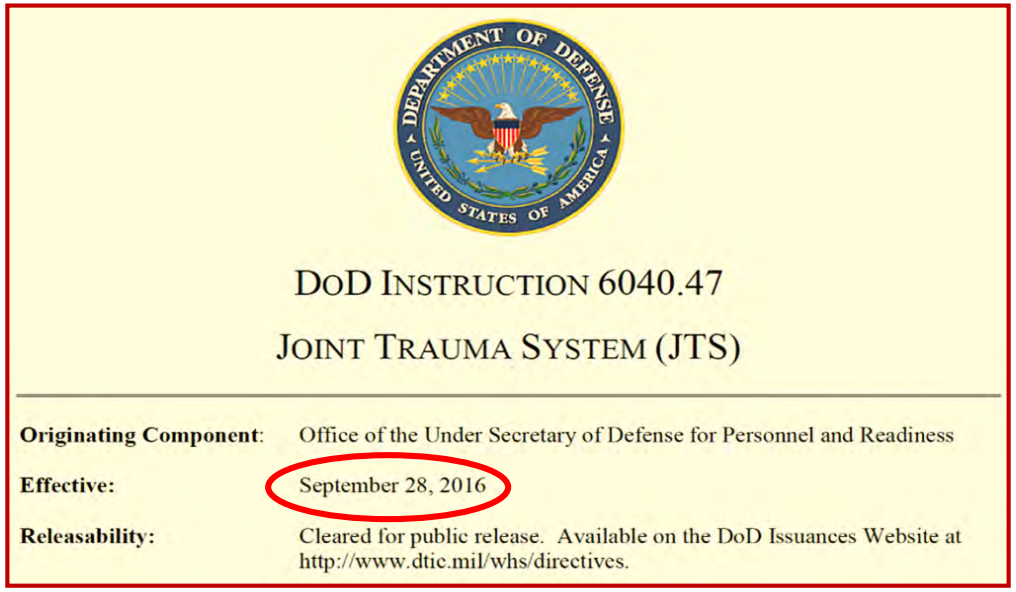
Memos:

- **ASD (HA) Policy Memo 04-031**, 22 Dec 04: Coordination of Policy to Establish a Joint Theater Trauma Registry
- **Health Affairs Action Memo**, 14 Dec 05: Joint Theater Trauma Records
- **US Army Institute of Surgical Research Memo**, 10 May 07: Collection of Trauma Registry Performance Improvement Data from all Level IV and V MTFs into the Joint Theater Trauma Registry
- **Office of the Surgeon General (OTSG) Memo**, 11 May 07: Improvements to the Joint Theater Trauma Registry (JTTR)

Policies and Law:

- **DoDI 6040.47**, Joint Trauma System (JTS), issued 28 Sep 2016
- **National Defense Authorization Act 2017**, signed 23 Dec 2016
- **DoDI 1322.24**, Medical Readiness Training (MRT), issued 16 Mar 2018

DoDI 6040.47



DoD INSTRUCTION 6040.47

JOINT TRAUMA SYSTEM (JTS)

Originating Component:	Office of the Under Secretary of Defense for Personnel and Readiness
Effective:	September 28, 2016
Releasability:	Cleared for public release. Available on the DoD Issuances Website at http://www.dtic.mil/whs/directives.

Purpose: In accordance with the authority in DoD Directive 5124.02, this issuance:

- Establishes policy, assigns responsibilities, and provides procedures to develop and maintain an enduring global trauma care capability that supports a full range of military operations, including a comprehensive DoD Trauma Registry (DoDTR).
- Establishes the Secretary of the Army as the Military Health System (MHS) Lead Agent for trauma care and recognizes the JTS as a DoD Center of Excellence (DCoE).
- Establishes an integrated Combatant Command (CCMD) Trauma System (CTS) modeled after the Joint Theater Trauma System (JTTS), and a requirement to input data into the DoDTR to support unique CCMD mission requirements.

NDAA 2017

Signed 12/23/16

S. 2943

One Hundred Fourteenth Congress
of the
United States of America

AT THE SECOND SESSION

Begun and held at the City of Washington on Monday, the fourth day of January, two thousand and sixteen

An Act

To authorize appropriations for fiscal year 2017 for military activities of the Department of Defense, for military construction, and for defense activities of the Department of Energy, to prescribe military personnel strengths for such fiscal year, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "National Defense Authorization Act for Fiscal Year 2017".

SEC. 2. ORGANIZATION OF ACT INTO DIVISIONS; TABLE OF CONTENTS.

(a) DIVISIONS.—This Act is organized into five divisions as follows:

(1) Division A—Department of Defense Authorizations.
(2) Division B—Military Construction Authorizations.
(3) Division C—Department of Energy National Security Authorizations and Other Authorizations.
(4) Division D—Funding Tables.
(5) Division E—Uniform Code of Military Justice Reform.

(b) TABLE OF CONTENTS.—The table of contents for this Act is as follows:

under the TRICARE program for par-
yees Dental and Vision Insurance Pro-

rans and civilians at military treatment

services in military health system.
y Department of Defense to entities car-
grams for costs of vaccines provided to

re Administration
edical and dental positions to civilian

tracts for TRICARE progr
Sec. 706. Establishment of high perfo
livery systems.
Sec. 707. Joint Trauma System.
Sec. 708. Joint Trauma Education an
Sec. 709. Standardized system for s
treatment facilities.

DoDI 1322.24

DoD INSTRUCTION 1322.24

MEDICAL READINESS TRAINING (MRT)

Originating Component:	Office of the Under Secretary of Defense for Personnel and Readiness
Effective:	March 16, 2018
Releasability:	Cleared for public release. Available on the DoD Issuances Website at http://www.esd.whs.mil/DD/.

Purpose: This issuance:

- In accordance with the authority in DoD Directive (DoDD) 5124.02, establishes policy, assigns responsibilities, and provides procedures for governing MRT for Service members and the DoD expeditionary civilians (DoD-EC).
- In accordance with Section 708 of Public Law 114-328, develops a standardized combat casualty care instruction for all Service members, including the use of standardized trauma training platforms.
- Establishes a requirement to record tactical combat casualty care (TCCC) certification in Service-designated training tracking systems.

Registry vs Electronic Health Record

- **REGISTRY:** Database system that uses observational methods to collect clinical and other relevant data, and is oriented around the ***systematic analysis*** of exposures, interventions and outcomes.
  - **Analysis**: Registries are designed and structured for analysis of medical and non-medical patient data, information, metrics, and outcomes, and are used in scientific research, performance improvement, and policy analysis.

- **ELECTRONIC HEALTH RECORD:** A patient health care management system that enables the delivery of care, and is oriented around the ***transactional*** details of patient care.
  - **Patient Management**: EHRs are designed and structured for the efficient management of patient care delivery through the recording of patient/provider interactions/transactions.

A well-designed health care system should have Registries that ultimately prompt and prioritize EHR data to be collected.

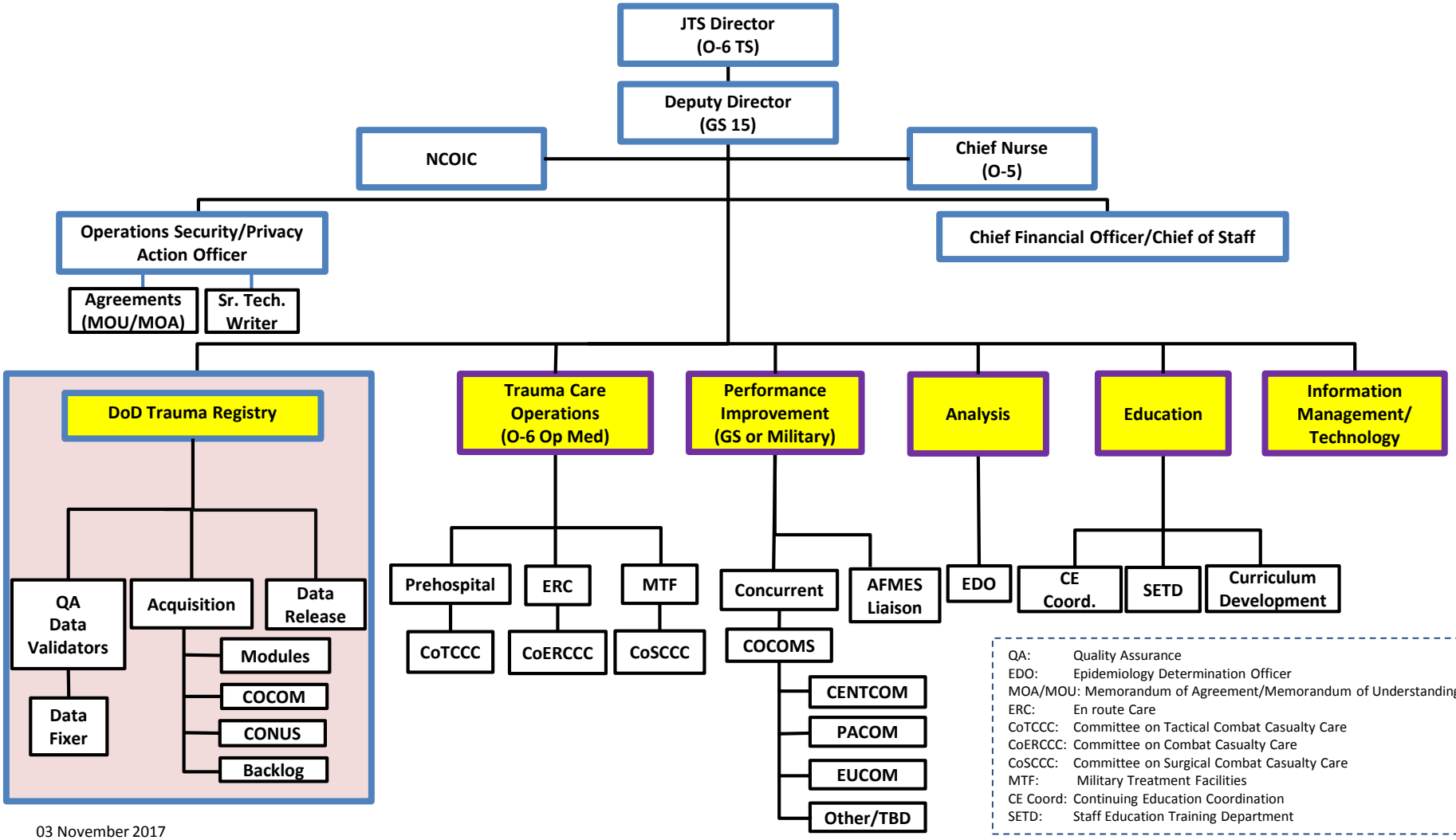
The DoD Trauma Registry Versus the Electronic Health Record

Spott MA, Kurkowski CR, Burelison DR, Stockinger Z. *Mil Med*. 2018;183(Suppl 2):8-11.

Registry	Health Record
Monitor and observe the course of injuries and treatment in individuals and populations	Document a patient's injuries and treatment
Understand variations in treatments and outcomes	Facilitate communication between providers
Examine factors that influence prognosis and quality of life	Support care of patient
Describe patterns of care, appropriateness of care, and disparities in the delivery of care	Collect health statistics
Assess effectiveness	Research of specific injuries and treatment
Monitor safety and harm	
Measure quality of care	
Study quality improvement	

Joint Trauma System

The Department of Defense Center of Excellence for Trauma



QA: Quality Assurance
EDO: Epidemiology Determination Officer
MOA/MOU: Memorandum of Agreement/Memorandum of Understanding
ERC: En route Care
CoTCCC: Committee on Tactical Combat Casualty Care
CoERCCC: Committee on Combat Casualty Care
CoSCCC: Committee on Surgical Combat Casualty Care
MTF: Military Treatment Facilities
CE Coord: Continuing Education Coordination
SETD: Staff Education Training Department

03 November 2017

Cost of JTS and DoDTR

Personnel:

- Approx. 80 (MIL, GS, CTR); trauma care leaders and providers, abstractors, coders, PI, epidemiologists and statisticians, information technology, education, etc.

Training:

- Abstraction, coding, analysis, software, HIPAA, etc.

Equipment

- Servers, computers, software, infrastructure

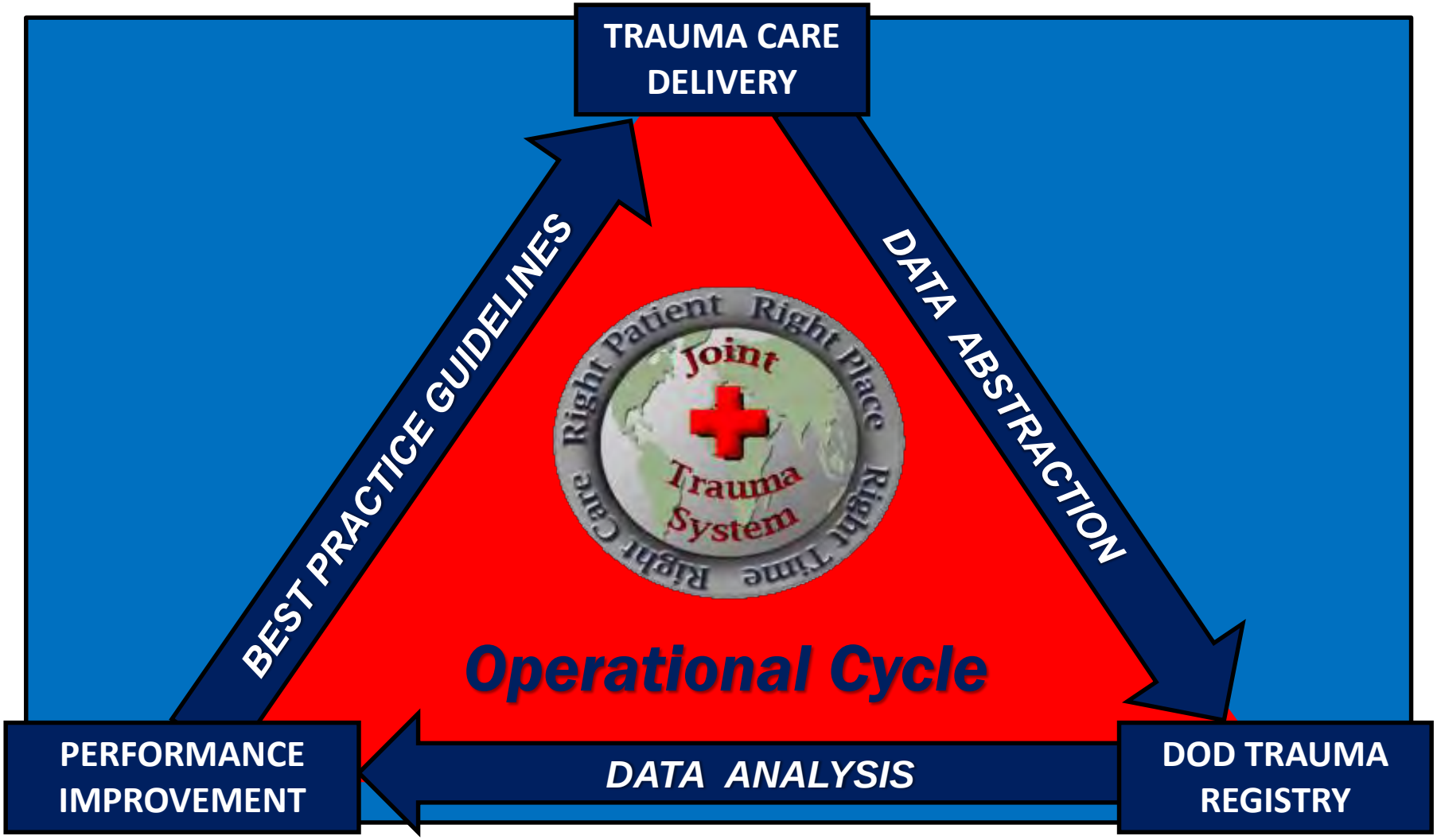
Budget:

- Approx. $10M/year annual operating budget

DoDTR:

- Digital Innovation report writer database, Oracle database, SAS and Stata statistical/analytical software programs

JTS Operational Cycle



BOLD, RESPONSIBLE PRACTICE OF BATTLEFIELD MEDICINE

JTS Global Continuum of Care

CASEVAC
MEDEVAC
1 Hour

Role 1
(POI, BAS)

MEDEVAC
1-24 Hours

Role 2
(FSTs)

STRATEGIC AE
24-72 Hours

Role 3
(CSH, EMEDS, EMF)

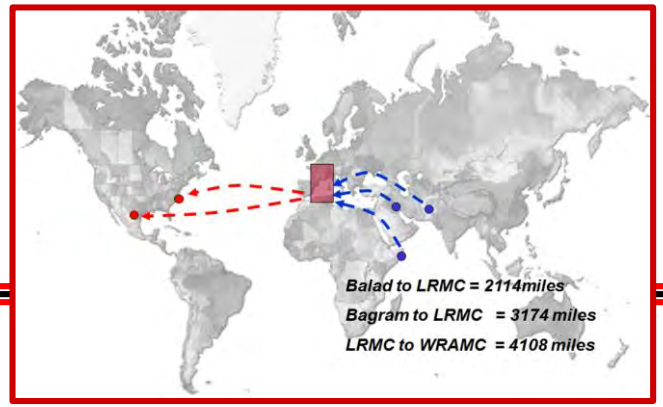
72 Hours Plus

Role 4 - OCONUS
(Definitive Care)

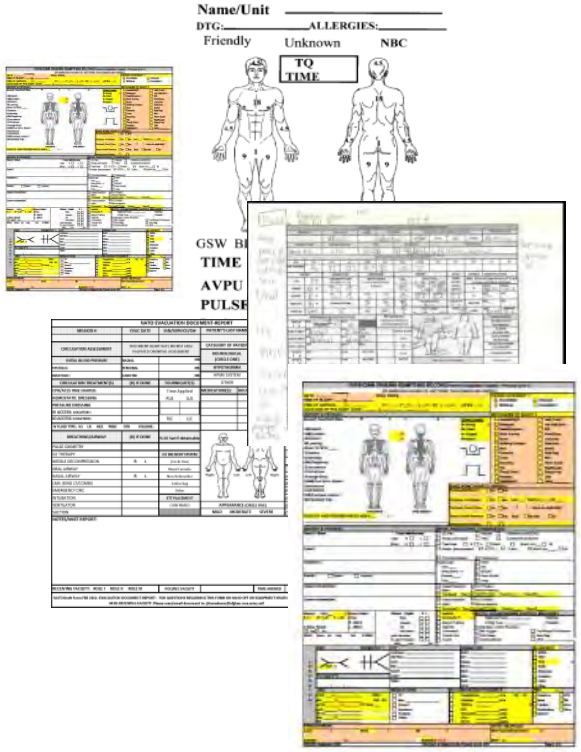
Post Acute Care

Role 4 - CONUS
(Definitive Care)

VA



Where do the data come from?



Out of Hospital TNC

WISPR
TMDS
DEERS
TRAC2ES
ISR Archive

In Hospital Care TNCs

Camp Bastion | KAF | BAF

"S&F"

Joint Trauma System — Right Patient Right Place Right Time Right Care

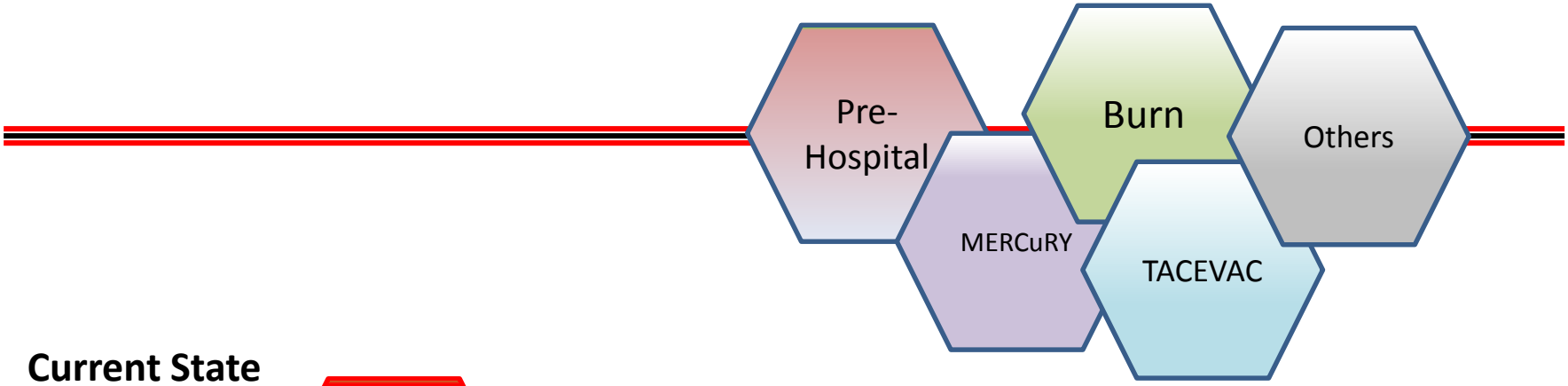
10% QA

DoDTR — Department of Defense Trauma Registry — United States Army Navy Air Force Marines

"Web"

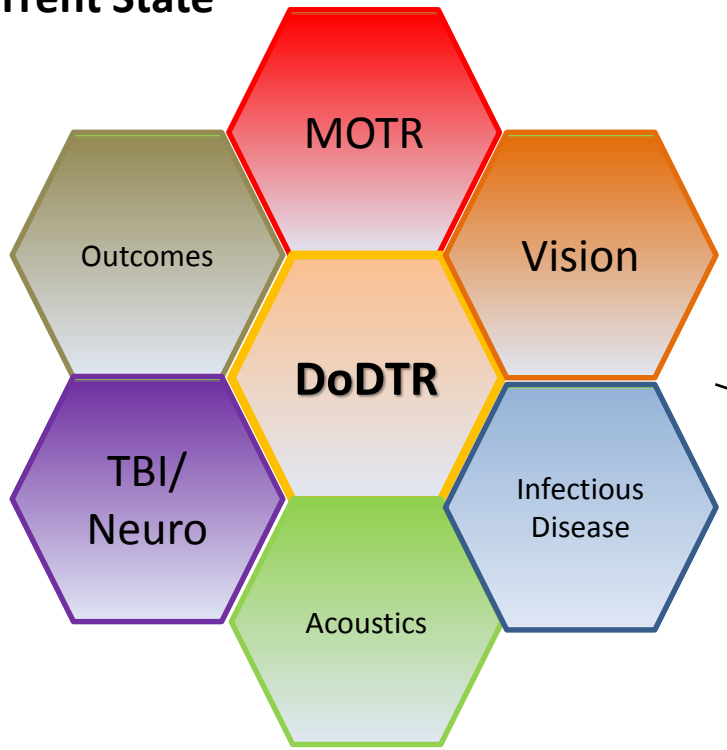
Role 4 OCONUS

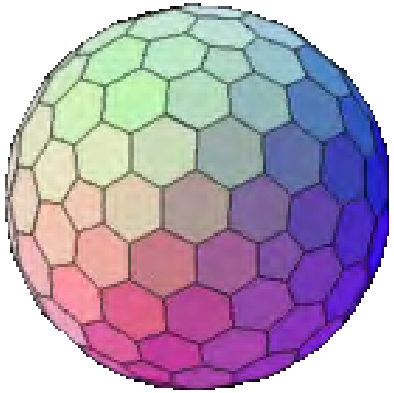
Role 4 CONUS



New Pieces

Current State

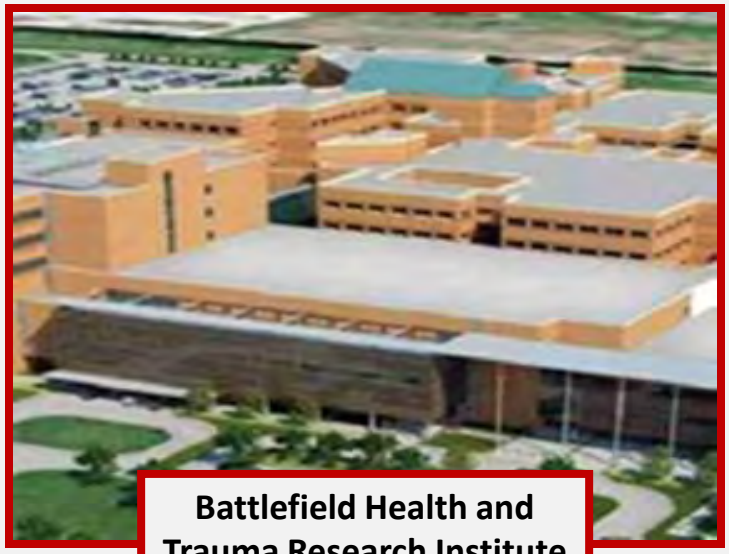




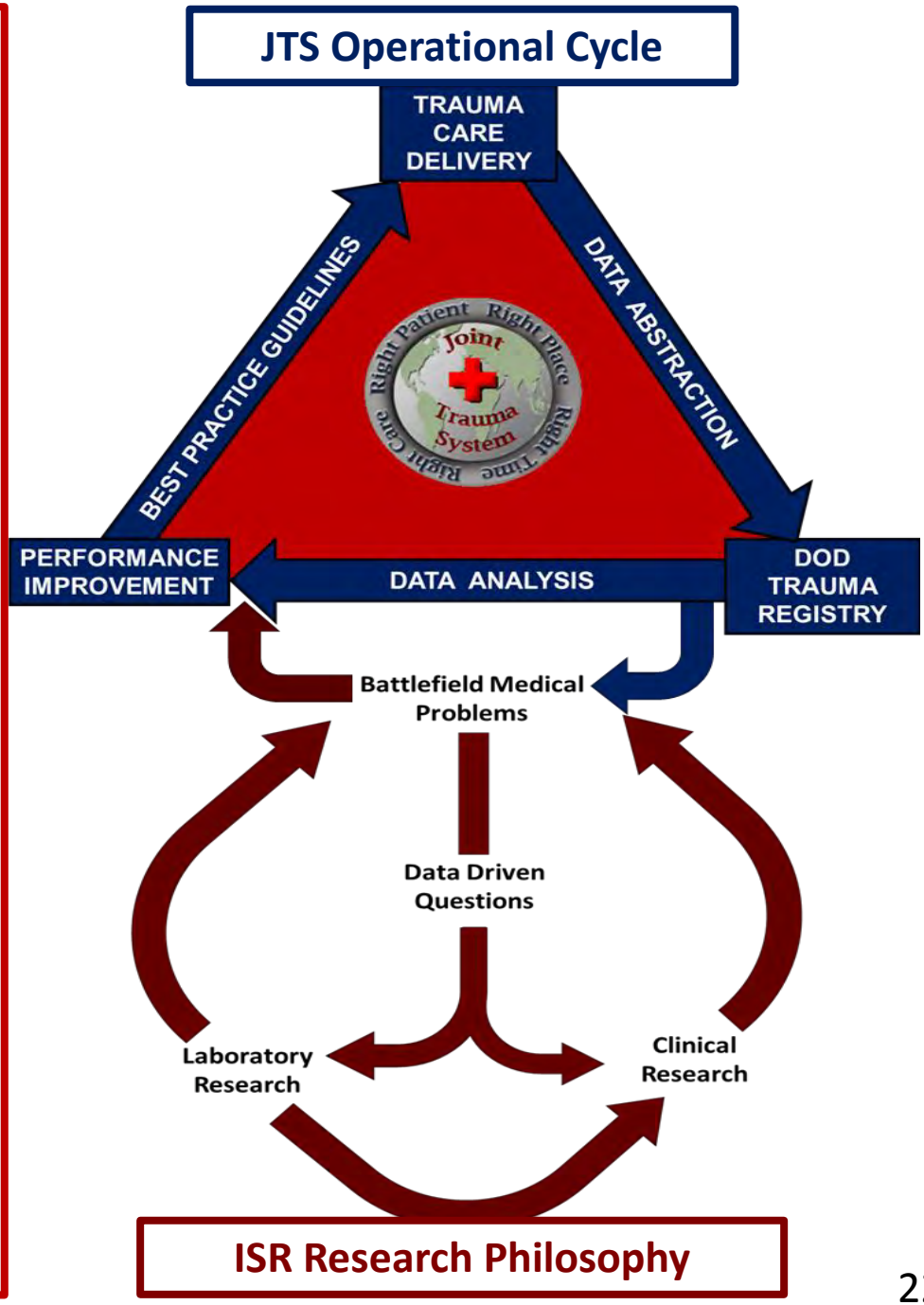
End State – 360º View

JTS and Research:

- **Research Priorities Driven by PI Data, Capability Gaps, Clinicians**
- **JTS optimally positioned physically and operationally at BHTRI / SAMMC**
  - **Support and infrastructure well established and highly productive**
  - **Center of mass for CCC research**
  - **Clinical CoE: Level I Trauma Center, Burn Center, Center for the Intrepid**



Battlefield Health and Trauma Research Institute



JTS and DoDTR

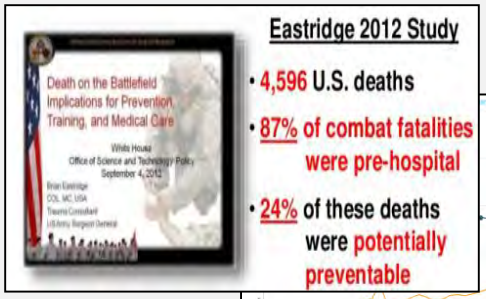
As of 10/04/2018:

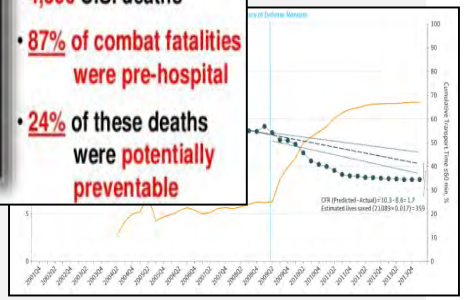
- First Casualty, 1/12/2002
- Last Casualty, 10/04/2018

- 84,746 separate casualty events
- 847 separate data fields to find for each casualty.

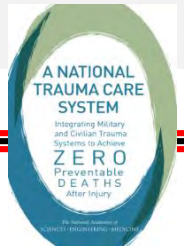
Results

- More than 40 Clinical Practice Guidelines
- More than 600 journal articles, posters, and podium presentations published from DoDTR data:
  - Death on the Battlefield (2012)
  - Golden Hour Study (2016)



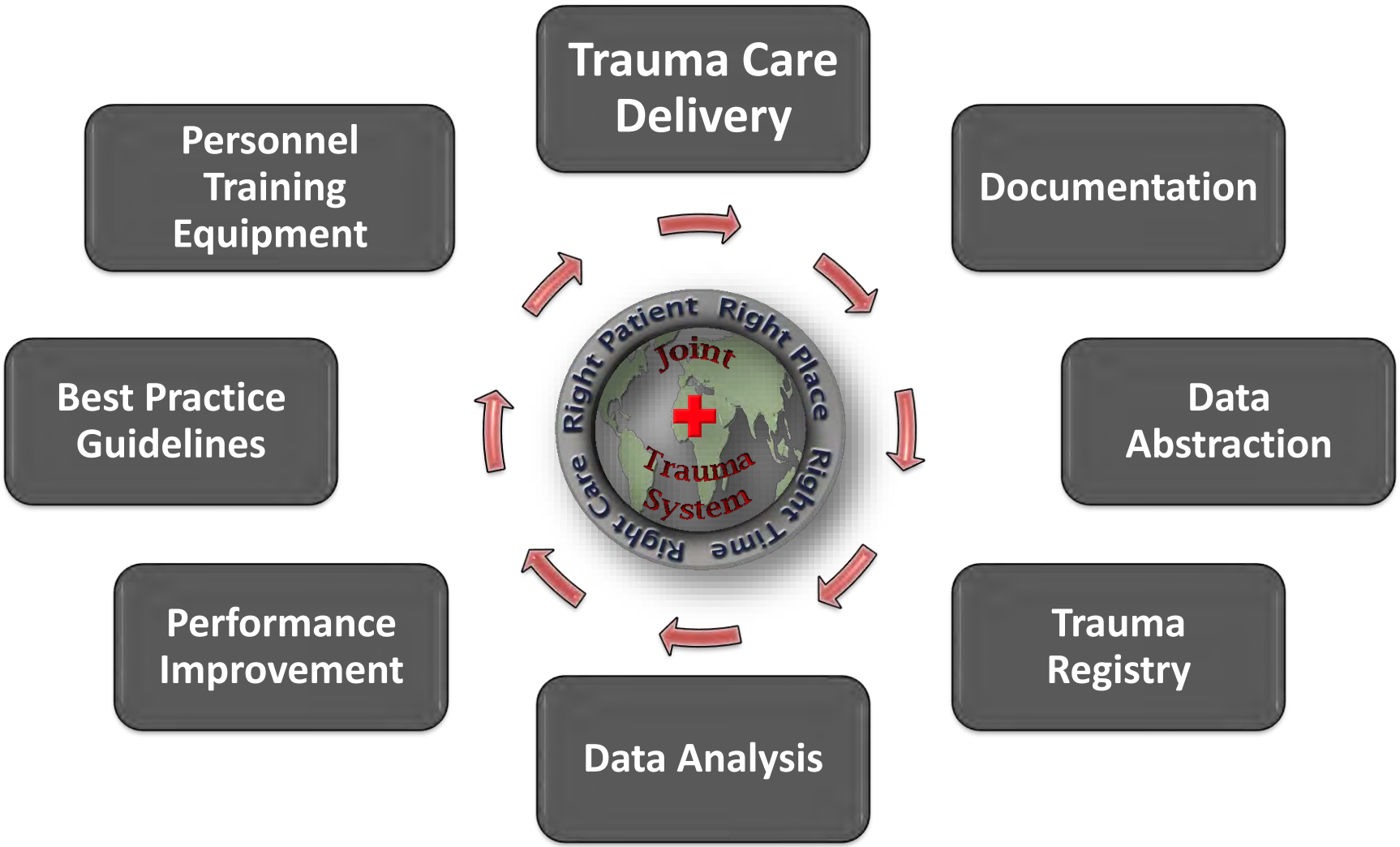


- USCENTCOM Reports (2012-14): SLB I, II
- USCENTCOM Report (2018)
- Dismounted Complex Blast Injury Report (2012)
- Military Compensation and Retirement Report (2015)
  - 1) Pay and retirement; 2) Health benefits; and 3) Quality of life programs
- IOM/NASEM Report – Zero Preventable Deaths (2016)
- DHB Lessons Learned from Mil Opns Report, 2001 – 2013 (2015)



DOD JTS:
SYSTEM EXAMPLES

Joint Trauma System Operational Cycle



Battlefield Epidemiology and Biostatistics

- Epidemiology
  - Study of health and disease in human populations
- Biostatistics
  - Application of statistics in the health-related fields
  - Statistics = the process of analyzing **data!**

- **PI Data** – **should be "system-based", not restricted to a facility**

POI → Tactical Evacuation (CASEVAC & MEDEVAC) → Role 2 → Intratheather Evacuation→ Role 3 → Intertheater Evacuation → Role 4 → Intertheather Evacuation → Role 4

Understanding Combat Casualty Care Statistics

Holcomb JB, Stansbury LG, Champion HR, Wade C, Ballamy RF. *J Trauma*. 2006;60(2):397-401.

Definitions standardize numbers and allow comparisons and trends.

Killed in Action (KIA)

KIA refers to the number of combat deaths that occur before reaching an MTF (battalion aid station, forward surgical, combat support and higher levels of hospital care), expressed as a percent of the Wounded in Action minus the RTDs.

$$\%\text{KIA} = \frac{\text{Deaths before MTF}}{\text{KIA} + (\text{WIA} - \text{RTD})} \times 100$$

Died of Wounds (DOW)

DOW is the number of all deaths that occur after reaching an MTF, expressed as a percentage of total wounded minus the RTDs.

$$\%\text{DOW} = \frac{\text{Died after reaching MTF}}{(\text{WIA} - \text{RTD})} \times 100$$

Case Fatality Rate (CFR)

CFR refers to the fraction of an exposed group—all those wounded in action including all those who die (at any level), expressed as a percent.

$$\text{CFR} = \frac{\text{KIA} + \text{DOW}}{\text{KIA} + \text{WIA}} \times 100$$

"Accurate understanding of the epidemiology and outcome of battle injury is essential to improving combat casualty care."

Understanding Combat Casualty Care Statistics

Holcomb JB, Stansbury LG, Champion HR, Wade C, Ballamy RF. *J Trauma*. 2006;60(2):397-401.

%KIA – Potential measure of:

1. **weapon lethality**
2. **effectiveness of prehospital care**
3. **availability of tactical evacuation**

%DOW – Potential measure of:

1. **precision of initial prehospital triage and care**
2. **optimization of evacuation procedures**
3. **application of a coordinated trauma system**
4. **effectiveness of MTF care**

CFR – Potential measure of: **overall battlefield lethality in a battlefield population**

Battlefield Epidemiology and Biostatistics

	WW II	Vietnam	Iraq	Afghanistan
% KIA	20.2	20.0	16.6	11.1
% DOW	3.5	3.2	5.9	4.3
CFR	19.1	15.8	10.0	8.6

Kotwal RS, Howard JT, Orman JA, et al. The Effect of a Golden Hour Policy on the Morbidity and Mortality of Combat Casualties. JAMA Surg. 2016;151(1):15-24.

Battlefield Epidemiology and Biostatistics

	Afghanistan (Sep 11, 2001 - Jun 15, 2009)	Afghanistan (Jun 16, 2009 – Mar 31, 2014)
% KIA	16.0	9.9
% DOW	4.1	4.3
CFR	13.7	7.6

Kotwal RS, Howard JT, Orman JA, et al. The Effect of a Golden Hour Policy on the Morbidity and Mortality of Combat Casualties. JAMA Surg. 2016;151(1):15-24.

Death on the Battlefield (2001-2011): Implications for the Future of Combat Casualty Care

Eastridge BJ, Mabry RL, Seguin P, et al. *J Trauma Acute Care Surg*. 2012;73: S431-S437.

J Trauma Acute Care Surg
Volume 73, Number 6, Supplement 5

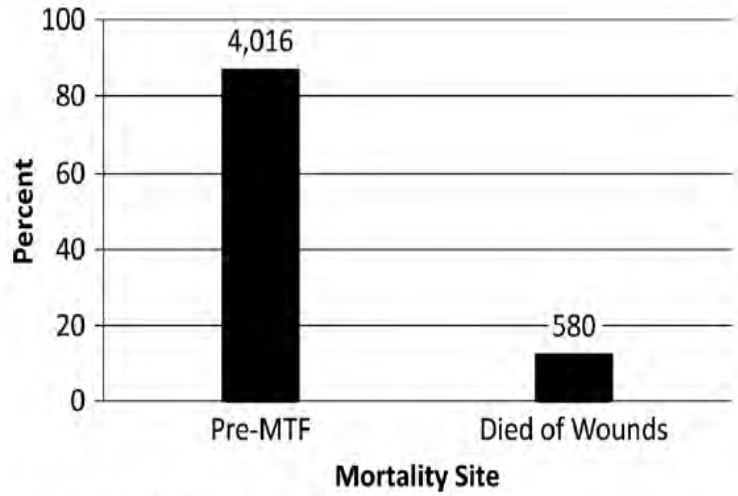


Figure 1. Battlefield mortality location.

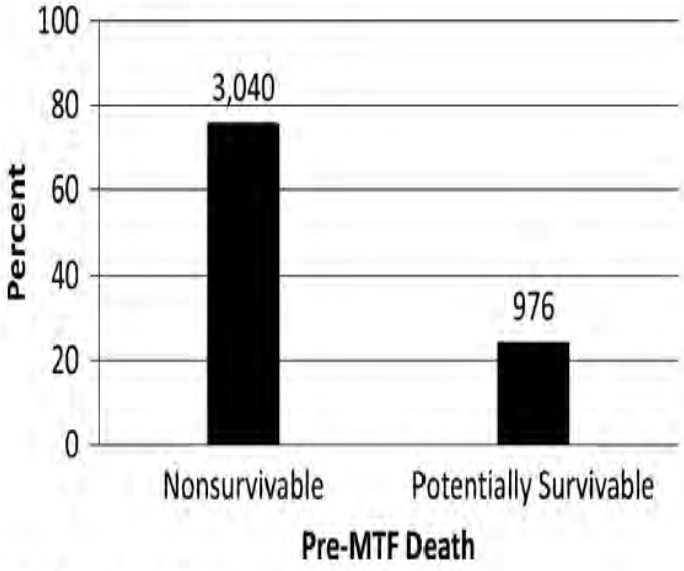


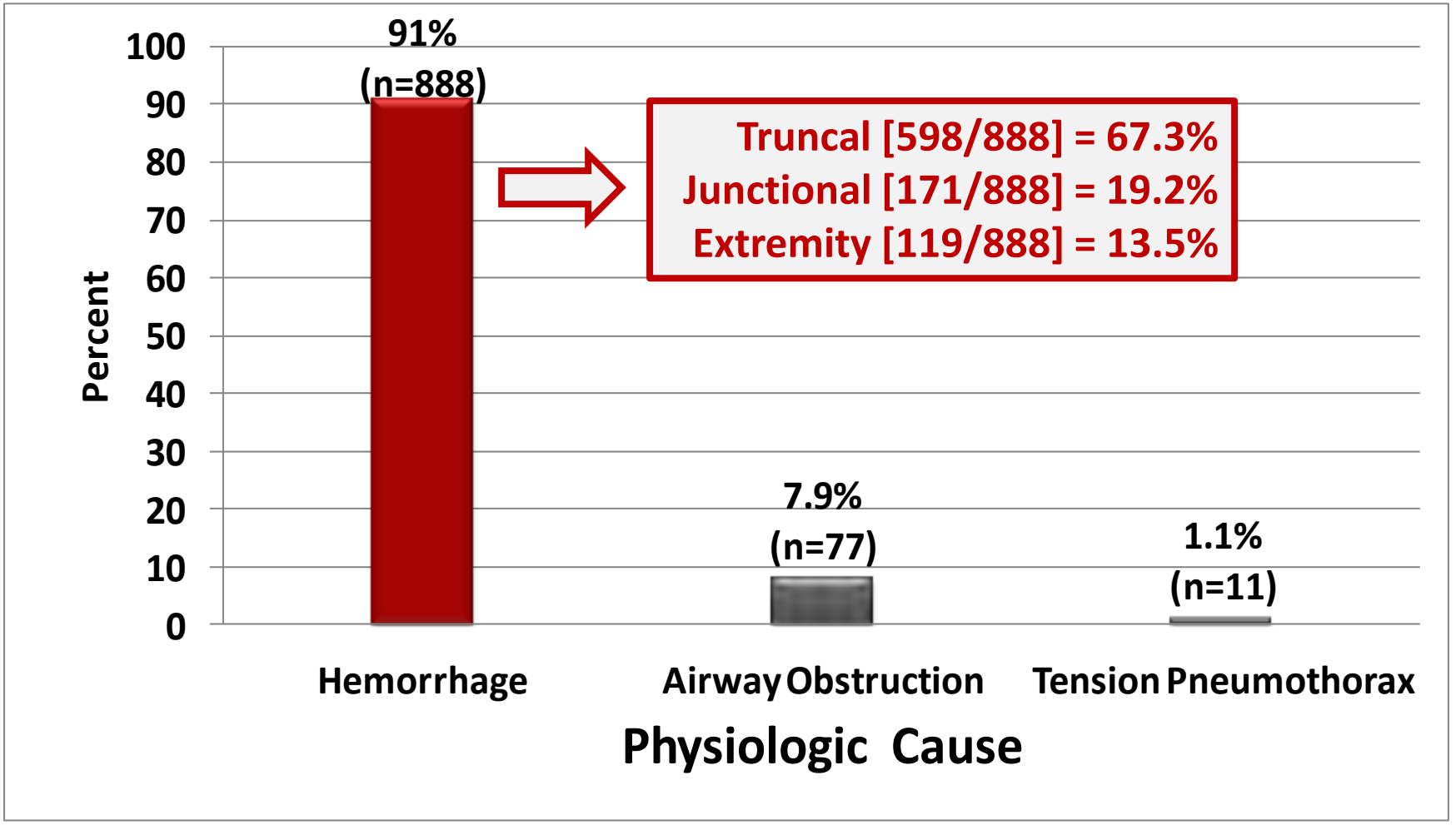
Figure 2. Survivability pre-MTF casualties.

≈ 87% Prehospital

≈ 25% PS

Death on the Battlefield (2001-2011): Implications for the Future of Combat Casualty Care

Eastridge BJ, Mabry RL, Seguin P, et al. *J Trauma Acute Care Surg*. 2012;73: S431-S437.



Priorities for treatment?

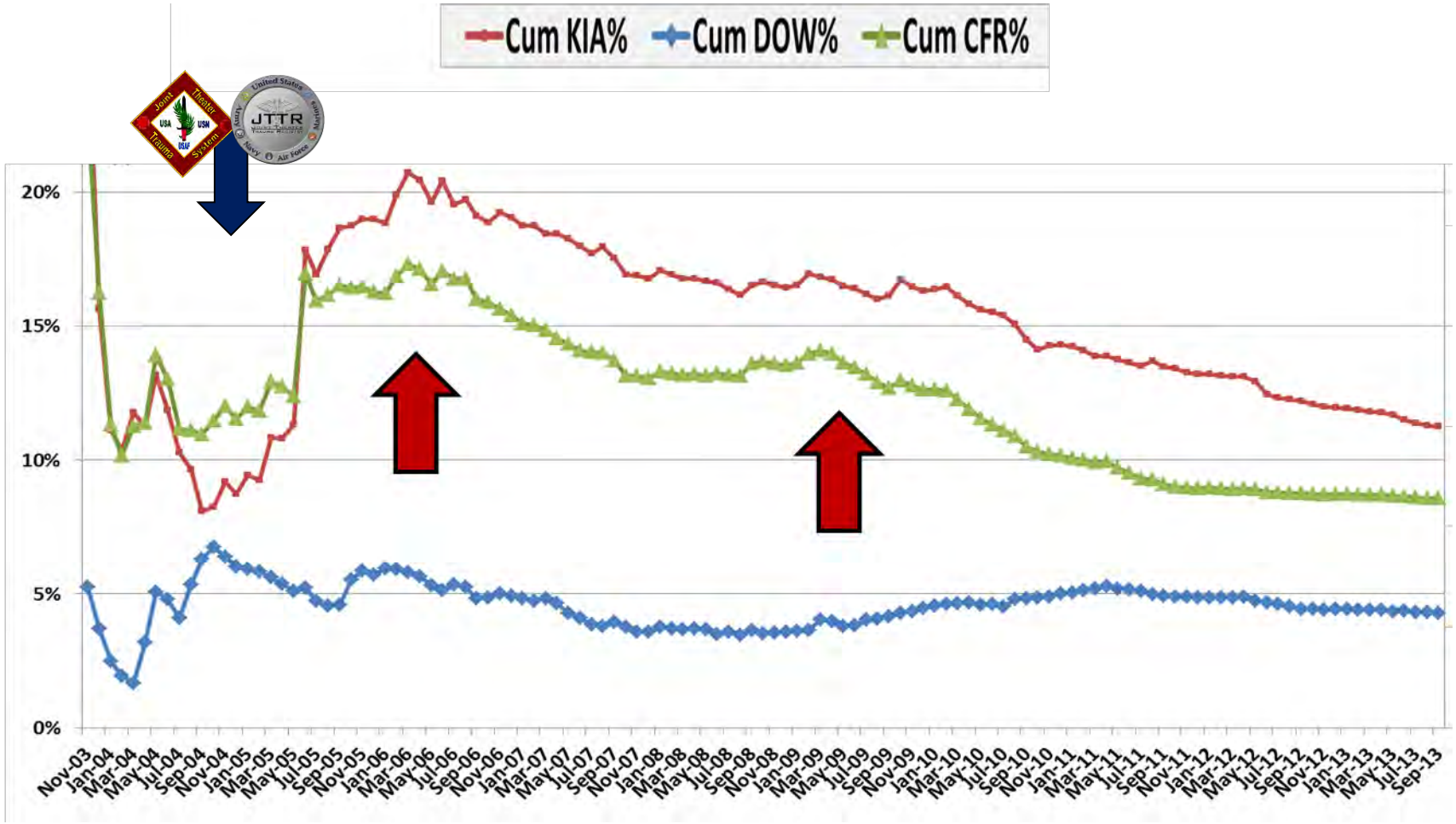
Hemorrhage Control (Non-Surgical, Prehospital)

Blood (DCR, Prehospital/Hospital)

Hemorrhage Control (DCS, Hospital)

OEF Cumulative Rolling Monthly Averages:

%KIA, %DOW, and CFR (Nov 2003 – Sep 2013)



Extremity Hemorrhage Control

Maughon – *Mil Med 1970* – Vietnam:

- 193 Extremity Hemorrhage Deaths / 2600 Battlefield Deaths = **7.4%**

Kelly – *J Trauma 2008* – Afghanistan and Iraq:

- 77 Extremity Hemorrhage Deaths / 982 Battlefield Deaths = **7.8%**

Eastridge – *J Trauma 2012* – Afghanistan and Iraq:

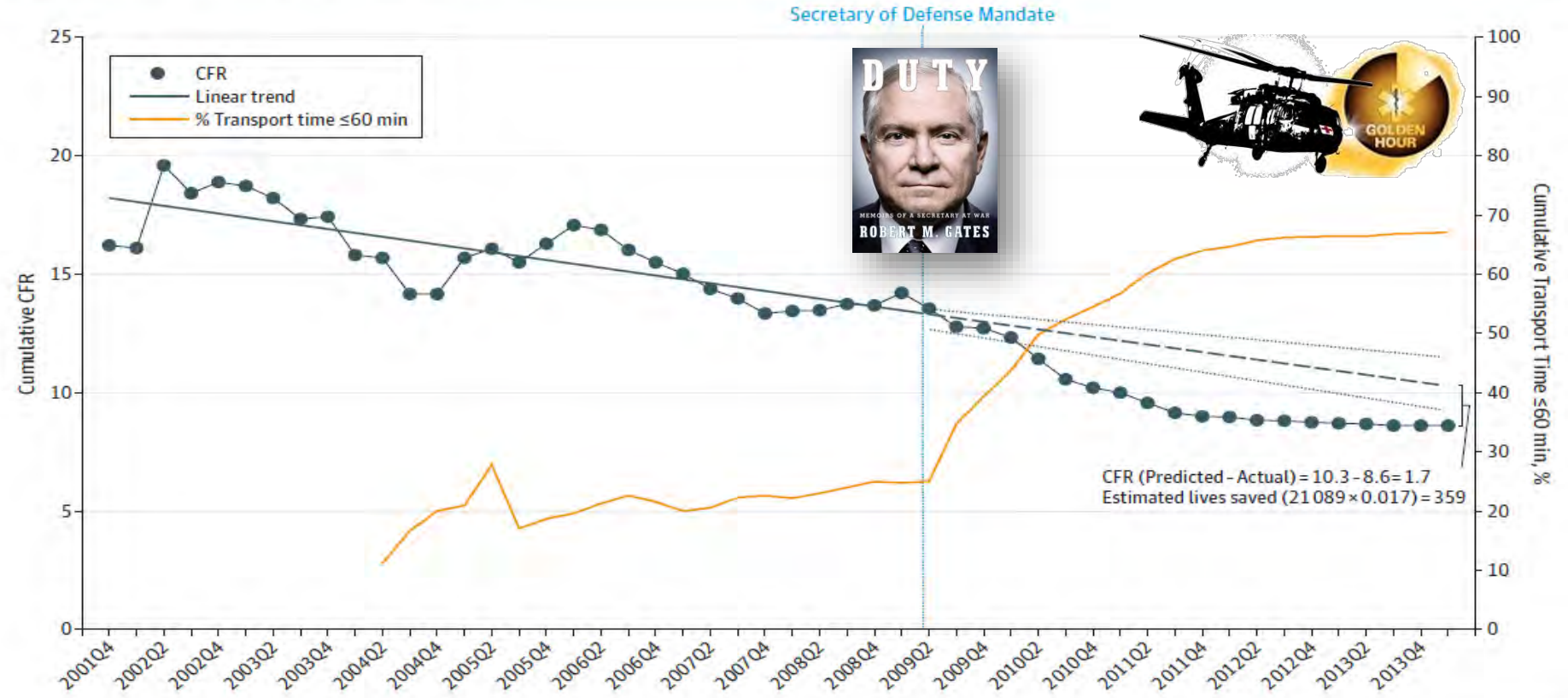
- 119 Extremity Hemorrhage Deaths / 4596 Battlefield Deaths = **2.6%**

Mandate & Enforce!

The Effect of a Golden Hour Policy on the Morbidity and Mortality of Combat Casualties

Kotwal RS, Howard JT, Orman JA, et al. *JAMA Surg*. 2016;151(1):15-24.

Figure 1. Case Fatality Rate and Transport Time



Trend in case fatality rate (CFR) based on linear model where CFR = 0.183 + (−0.002 × quarterly time period). Model R^2 = 0.625. Linear model projections (dashed line) surrounded by 95% CIs (dotted lines) predict a CFR of 10.3 (95% CI, 8.7-11.9) at the end of the study period compared with the CFR of 8.6 actually observed, for a difference of 1.7, which equates to potentially 359 lives saved. Logarithmic and higher-order polynomial models had inferior model fit characteristics compared with the linear model. Stratified regression analysis of transport time and CFR trends conducted separately for the periods before and after the mandate showed no association between transport time and CFR in the period before the mandate (regression coefficient, 0.058; P = .48), but they showed a highly significant association in the period after the mandate (regression coefficient, −0.141; P < .001) and an overall correlation coefficient of −0.96 (P < .001) for the association between transport time in 60 minutes or less and CFR.

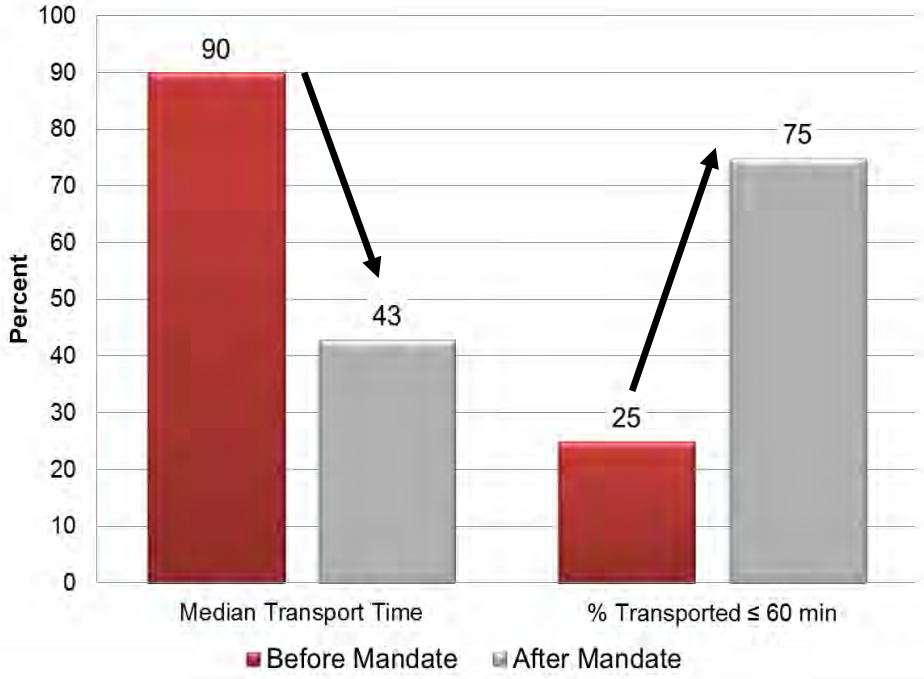
Table 1. US Military Combat Casualty Care Statistics in the Afghanistan Conflict and Historical Conflicts[a]

Combat Casualty Care Statistics	Afghanistan			Iraq	Vietnam	World War II
	Before Mandate	After Mandate	Total			
% RTD[b]	33.5	47.3[c]	45.2	58.0	34.9	19.9
% KIA[d]	16.0	9.9[c]	11.1	16.6	20.0	20.2
% DOW[e]	4.1	4.3	4.3	5.9	3.2	3.5
CFR[f]	13.7	7.6[c]	8.6	10.0	15.8	19.1
WIA, No.						
RTD ≤72 h	1018	7905	8923	18 526	82 092	~150 000
Non-DOW + non-RTD	1942	8411	10 353	12 623	148 323	581 586
DOW	83	380	463	798	4983	20 810
Total WIA	3043	16 696	19 739	31 947	235 398	752 396
KIA, No.	386	964	1350	2676	38 281	152 359
WIA + KIA, No.	3429	17 660	21 089	34 623	273 679	904 755

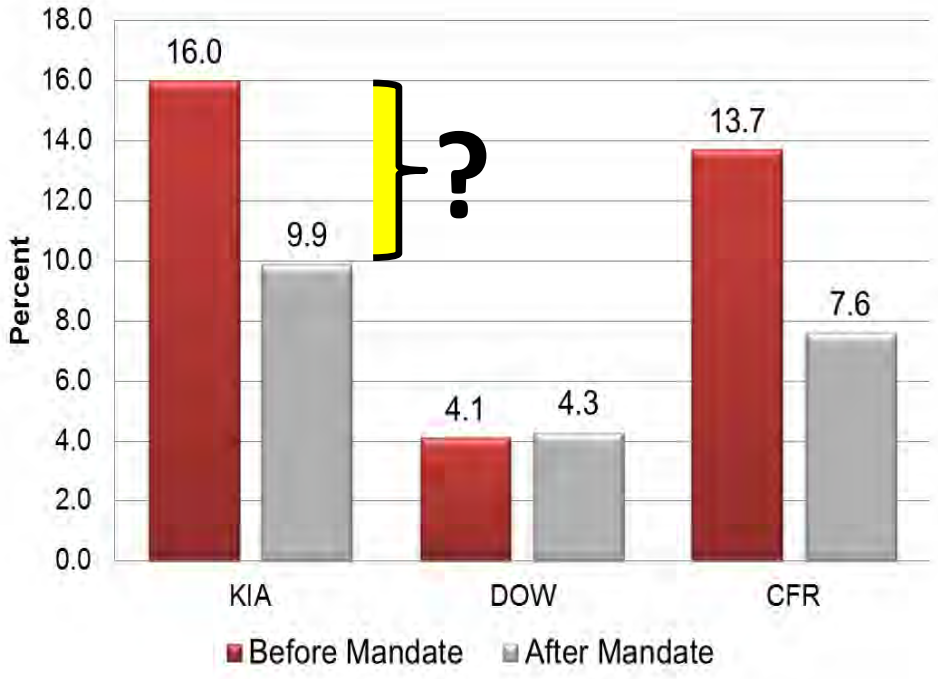
Re-Examination of a Battlefield Trauma Golden Hour Policy

Howard JT, Kotwal RS, Santos AR, et al. *J Trauma Acute Care Surg*. 2018;84(1):11-18.

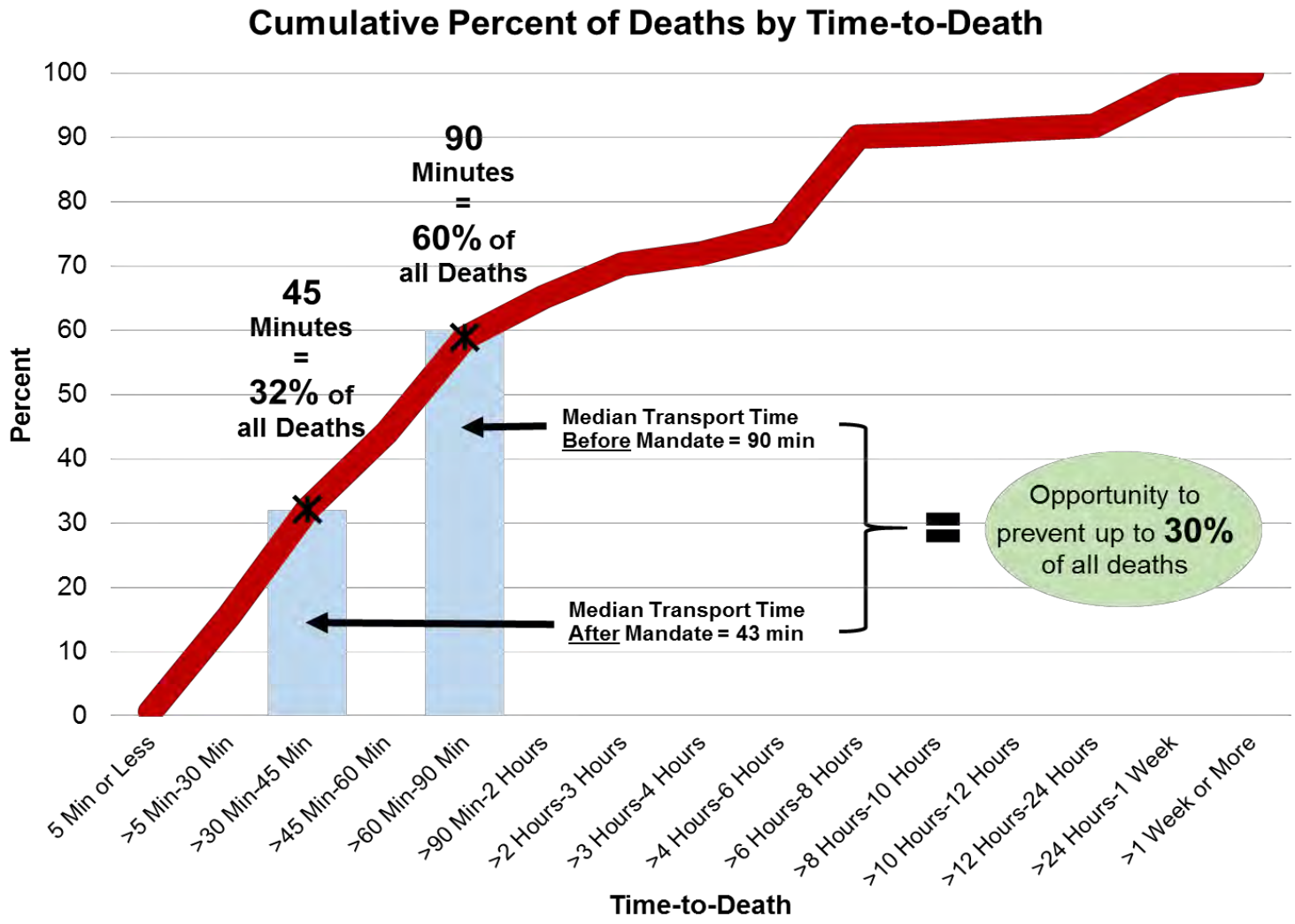
N=4,542



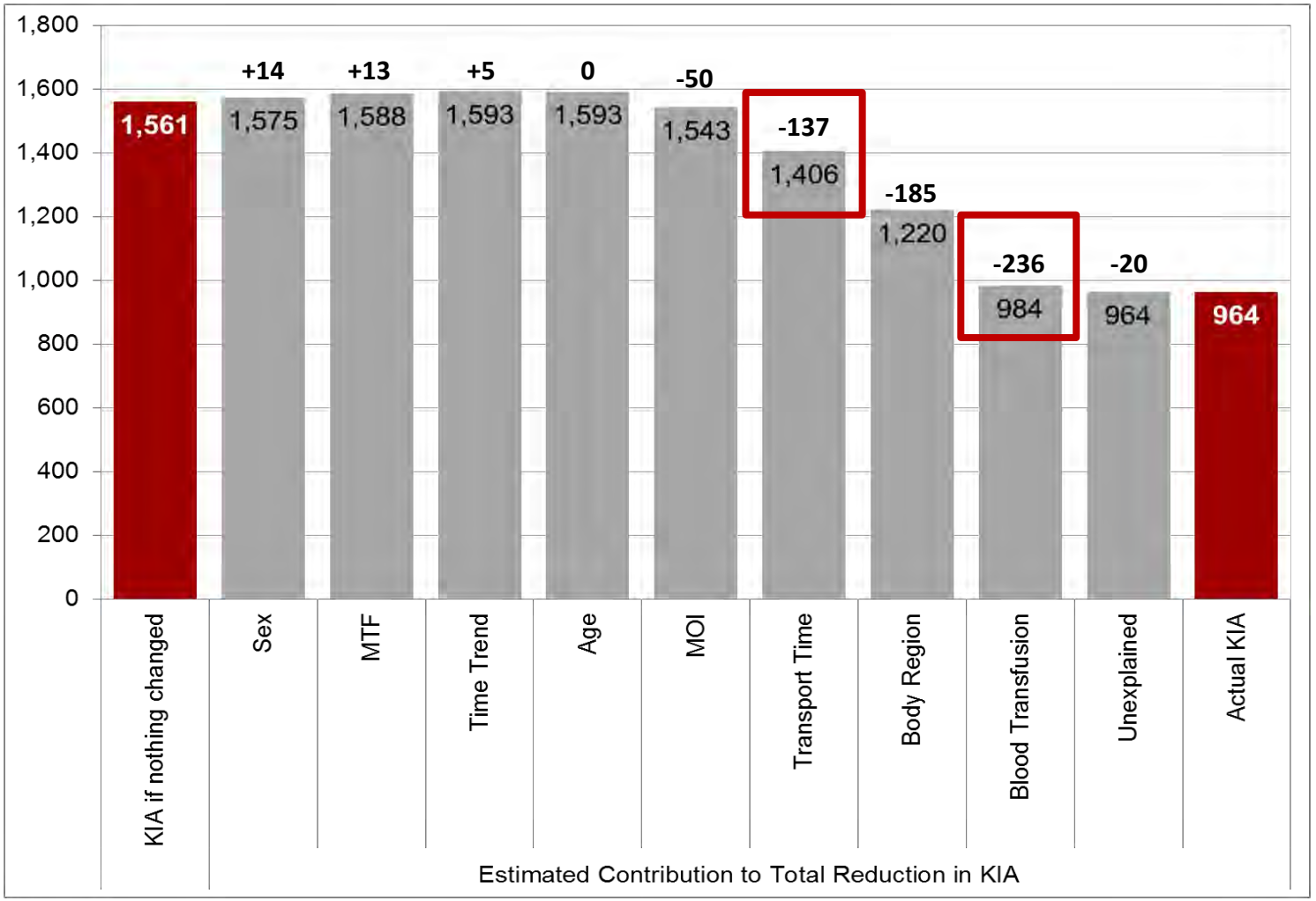
N=21,089 (WIA + KIA)



The "Cost" of Time



Estimated KIA Deaths and Lives Saved Attributable to Each Factor

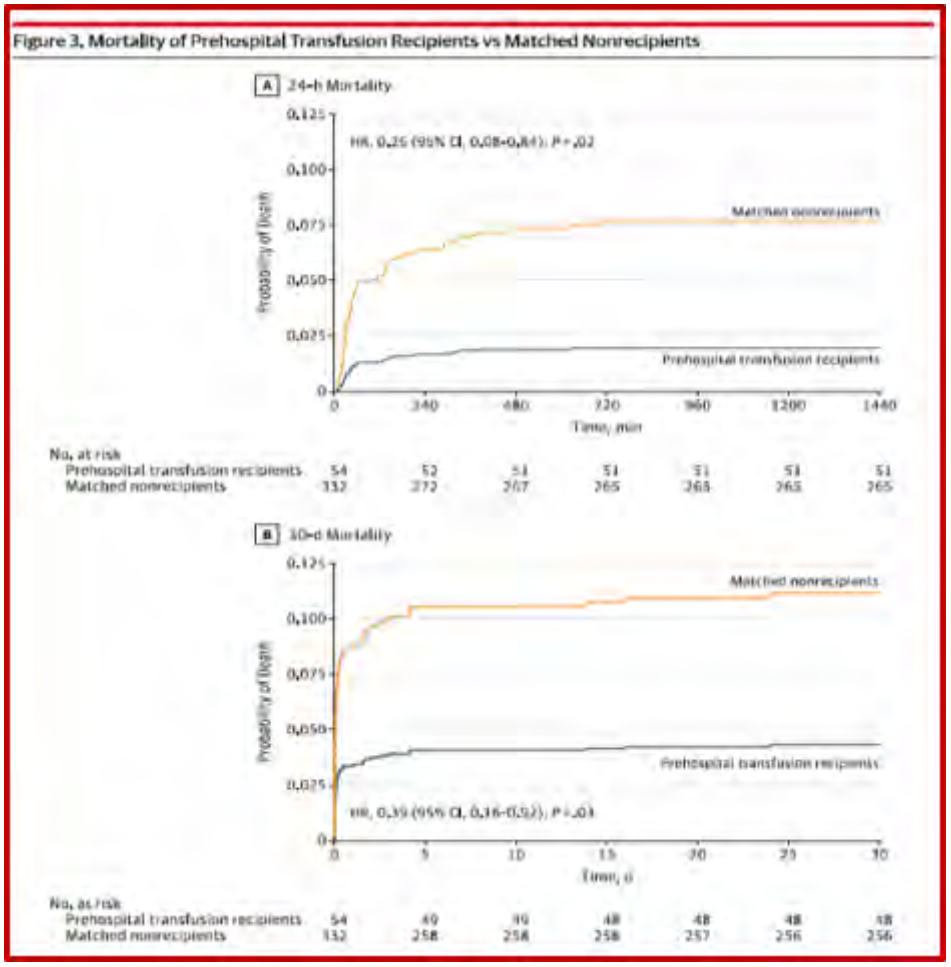


If nothing had changed in period after mandate…

…**597** more KIA deaths would have occurred in Afghanistan.

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

Shackelford SA, del Junco DJ, Powell-Dunford N, et al. *JAMA*. 2017;318(16):1581-91.



Medically evacuated US military combat casualties in Afghanistan

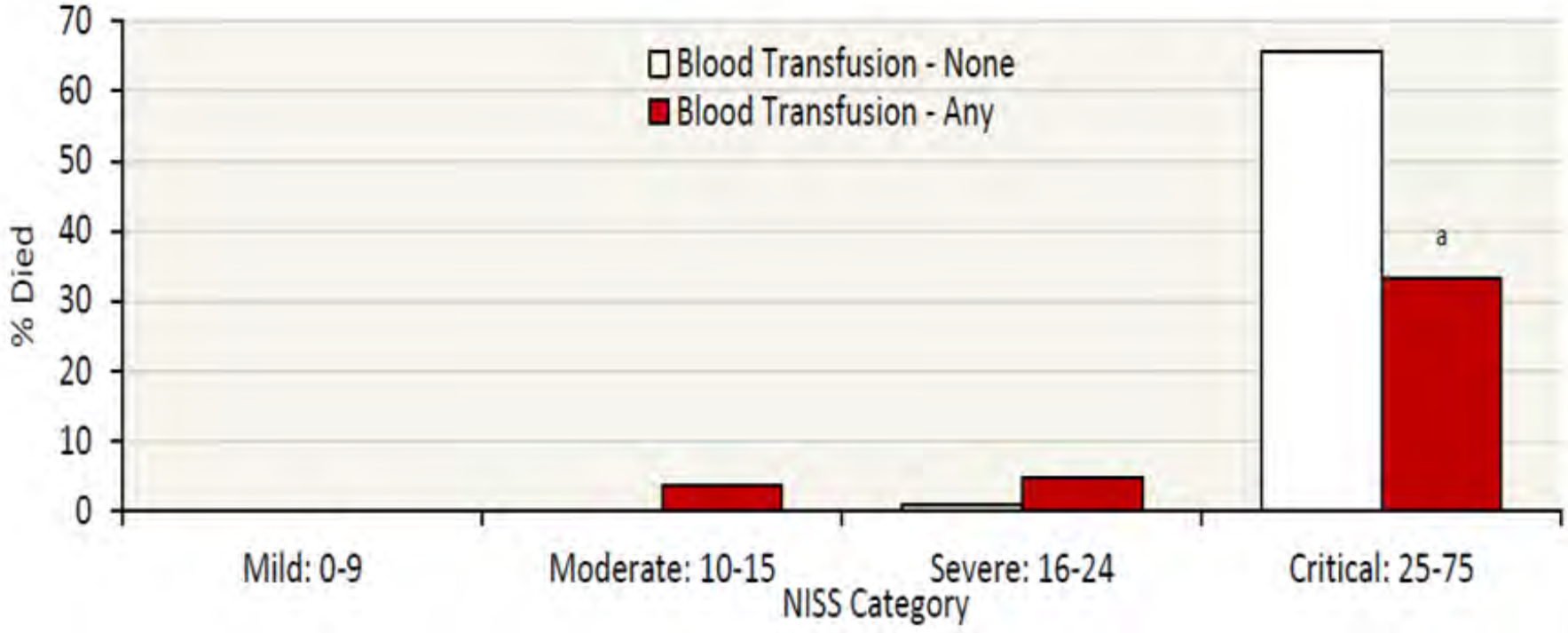
24-hr mortality significantly decreased for recipients of transfusions within 36 minutes

PH transfusion associated with greater 24-hr and 30-day survival than delayed or no transfusion

The Effect of Prehospital Transport Time, Injury Severity, and Blood Transfusion on Survival of US Military Casualties in Iraq

Kotwal RS, Scott LF, Janak JC, et al. *J Trauma Acute Care Surg*. 2018; 85(1):S112–S121.

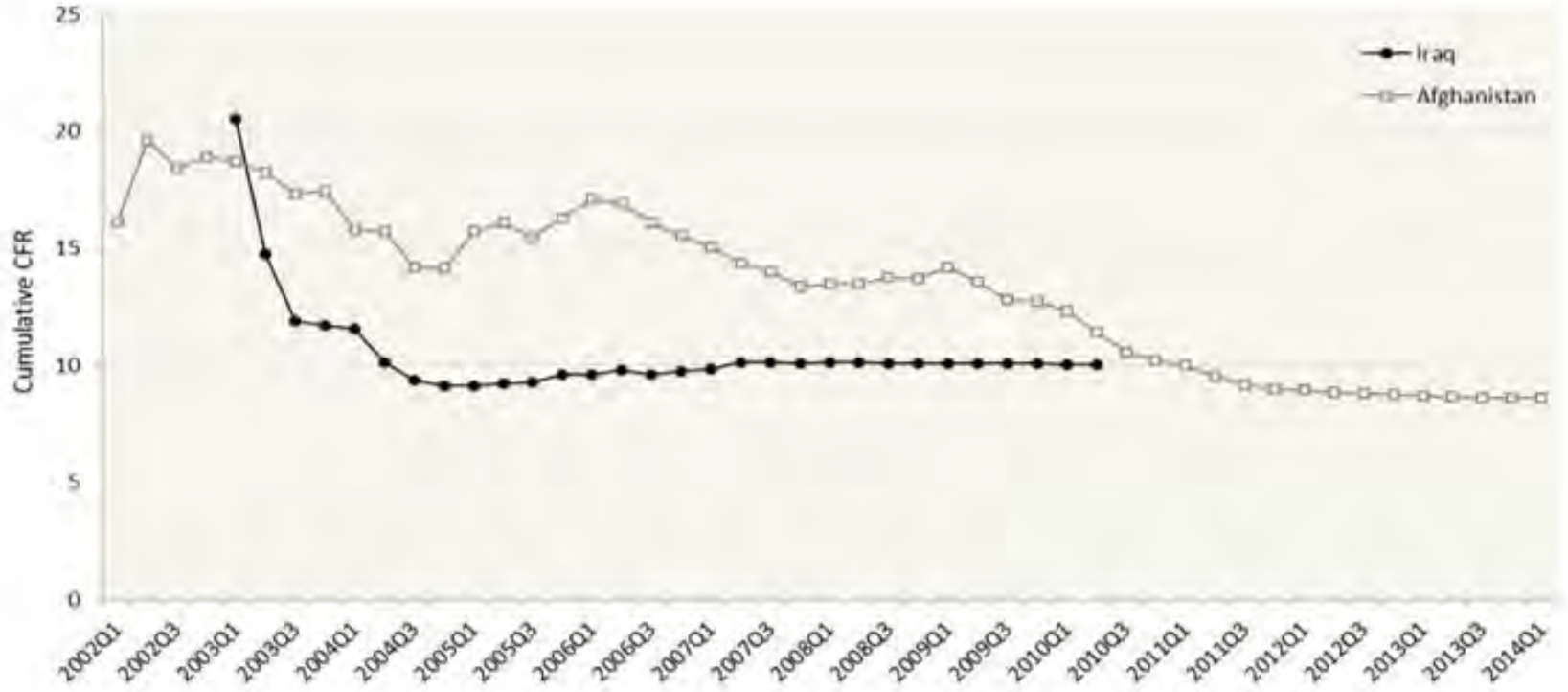
- Avg time, injury to MTF, < hour (mean[SD]=54.4 [26.1]; median[IQR]=50 [36-66])
- 67.6% transported within 60 min
- Early blood transfusion was associated with battlefield survival in Iraq, as it was in Afghanistan.



The Effect of Prehospital Transport Time, Injury Severity, and Blood Transfusion on Survival of US Military Casualties in Iraq

Kotwal RS, Scott LF, Janak JC, et al. *J Trauma Acute Care Surg*. 2018; 85(1):S112–S121.

A.



B.

	Total Numbers						Overall Combat Casualty Care Statistics			
	RTD ≤72 h	Non-DOW + non-RTD	DOW	WIA	KIA	WIA + KIA	%RTD[b]	%KIA[c]	%DOW[d]	CFR[e]
Iraq	18,526	12,623	798	31,947	2,676	34,623	58.0[f]	16.6[f]	5.9[f]	10.0[f]
Afghanistan	8,923	10,353	463	19,739	1,350	21,089	45.2	11.1	4.3	8.6

Total = 221,720

Table 1. US Military Combat Casualty Care Statistics in the Afghanistan Conflict and Historical Conflicts[a]

Combat Casualty Care Statistics	Afghanistan			Iraq	Vietnam	World War II
	Before Mandate	After Mandate	Total			
% RTD[b]	33.5	47.3[c]	45.2	58.0	34.9	19.9
% KIA[d]	16.0	9.9[c]	11.1	16.6	20.0	20.2
% DOW[e]	4.1	4.3	4.3	5.9	3.2	3.5
CFR[f]	13.7	7.6[c]	8.6	10.0	15.8	19.1
WIA, No.						
RTD ≤72 h	1018	7905	8923	18 526	82 092	~150 000
Non-DOW + non-RTD	1942	8411	10 353	12 623	148 323	581 586
DOW	83	380	463	798	4983	20 810
Total WIA	3043	16 696	19 739	31 947	235 398	752 396
KIA, No.	386	964	1350	2676	38 281	152 359
WIA + KIA, No.	3429	17 660	21 089	34 623	273 679	904 755

5,287 **43,264** **173,169**

How does this translate to US civilian sector?

PUTTING TRAUMA ON THE MAP

BRIDGING MILITARY AND CIVILIAN SECTORS TO IMPROVE TRAUMA CARE

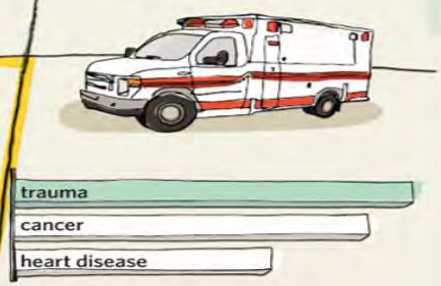
You may not think of it as a public health issue, but did you know that trauma—a potentially disabling or life-threatening injury that results from an event such as a motor vehicle crash, gun violence, or fall—is the **leading cause of death** in the United States for those ages 46 and under?

Current Landscape

$670 BILLION
Amount lost in productivity and medical care expenses due to trauma.

2 MILLION
Approximate number of Americans who have **died from trauma** since 2001.

Trauma is the **number one cause of years of productive life lost** before age 75—greater than either cancer or heart disease.

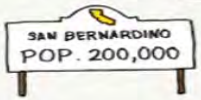


State of Trauma Care

Of the 147,790 U.S. deaths from trauma in 2014, roughly **20% might have been preventable** if appropriate and timely medical care had been delivered after injury. This equates to nearly **30,000 preventable deaths in a single year**.

2001-2016 = 450,000

200,000
Number of American lives—a population the size of the city of San Bernardino, CA—that could have been saved over the past decade if all U.S. trauma centers had **achieved outcomes similar to those at the highest-performing centers**.



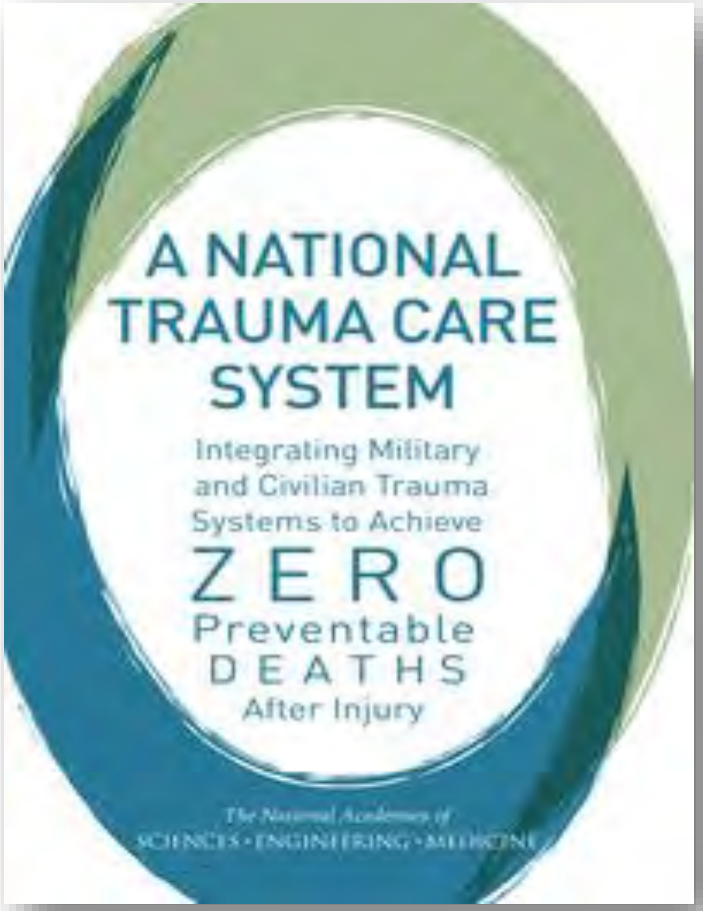
There is great variation in the quality of trauma care and outcomes for injured patients across the United States. In fact, there is a **2-fold difference in mortality rates** between the best- and worst-performing trauma centers. In other words, ***where* you are injured may determine *whether* you survive.**

98%
Military survival rate for casualties arriving at a treatment facility since the start of the wars in Afghanistan and Iraq. Innovations such as redesigned tourniquets have helped the military achieve this rate.

Closing the Gap

Given the military's success in reducing trauma deaths, the benefits of **closing the gap** between civilian and military trauma care may be enormous if such trauma care innovations and best practices can be thoroughly and rapidly translated into the civilian sector.

How does this translate to US civilian sector?

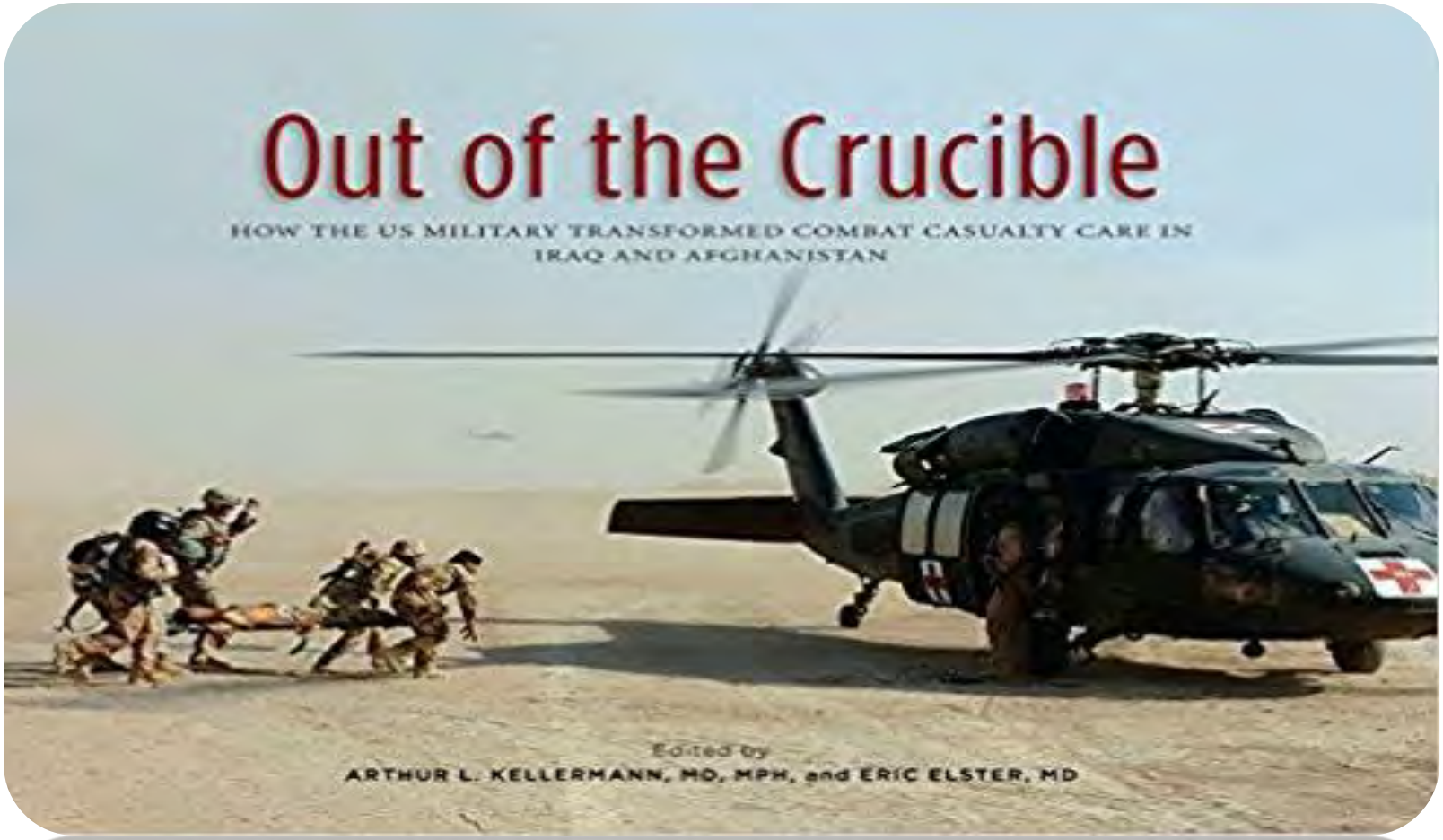


STOP THE BLEED

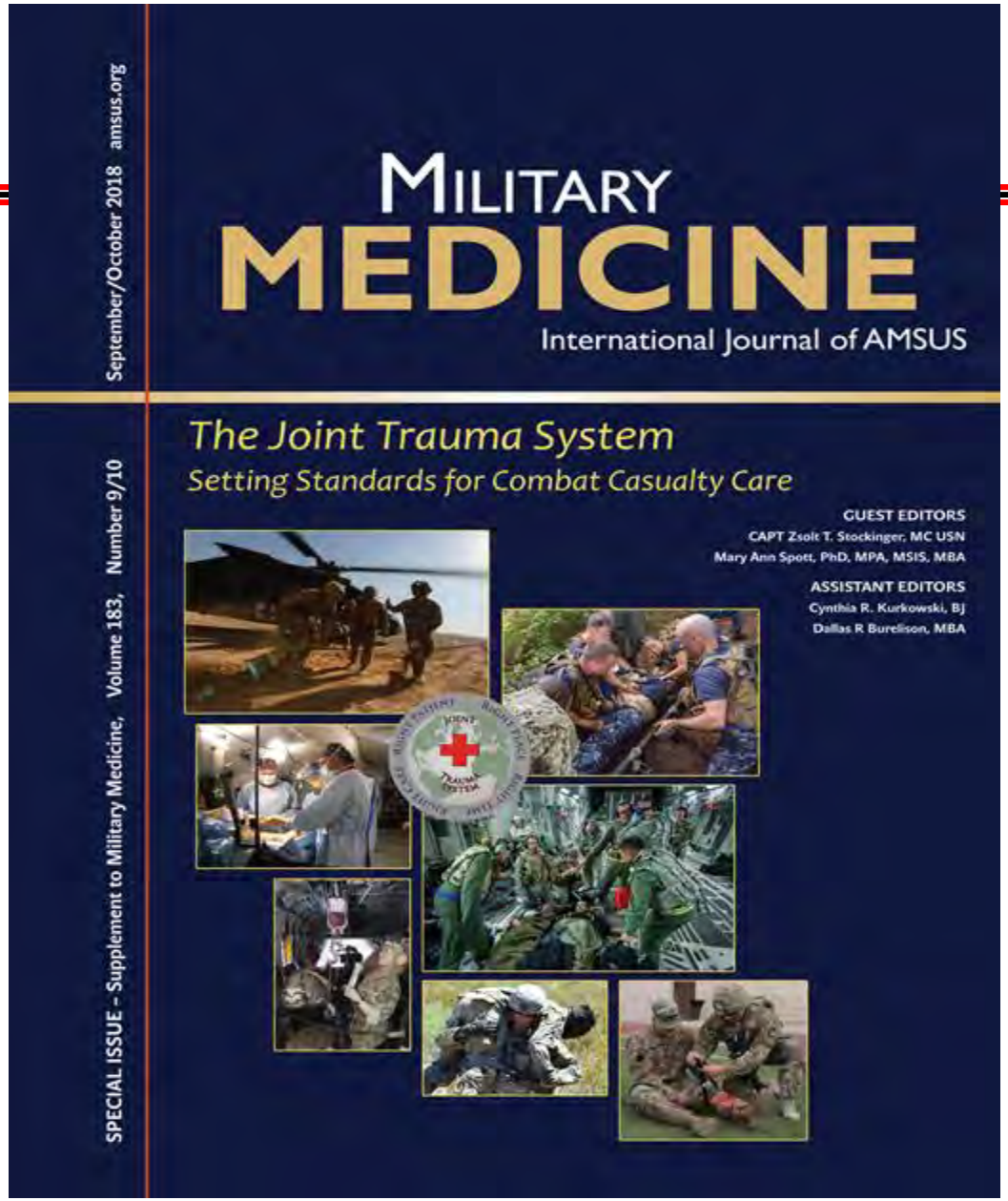
https://www.dhs.gov/stopthebleed

https://www.facs.org/about-acs/hartford-consensus

http://www.nationalacademies.org/hmd/Reports/2016/A-National-Trauma-Care-System-Integrating-Military-and-Civilian-Trauma-Systems.aspx



http://www.cs.amedd.army.mil/borden/



https://academic.oup.com/milmed/issue/183/suppl_2

Defense Health Agency

http://jts.amedd.army.mil/

COL (Ret) Russ S. Kotwal, MD MPH
US DoD Joint Trauma System
russ.s.kotwal.ctr@mail.mil
(210) 539-9174

http://jts.amedd.army.mil/