Utilizing a Trauma Systems Approach to Benchmark and Improve Combat Casualty Care

Eastridge, B, Wade, C, Spott, M, Costanzo, G, Dunne, J, Flaherty, S, West, S, Apodaca, A, Blackbourne, L, Casscells,SW

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Disclaimer

- The opinions or assertions expressed herein are the views of the authors and are not to be construed as official or as reflecting the views of the US Army or the US Department of Defense.

- Cleared per OPSEC standards U.S. Army

Disclaimer

- The Assistant Secretary of Defense commissioned a working group to develop outcomes and measures demonstrate the value created by the Military Health System
  - Joint Trauma System requested to develop metrics representative of combat casualty care

History of Surgical Benchmarks

- In the late 1980's, the VA faced a barrage of criticism over the quality of surgical care in their 128 hospitals
  - At issue:
    - operative mortality rates
    - perceived comparisons to national (private-sector norms)

History of Surgical Benchmarks

- In response, Congress passed U.S. Public Law 99-166 mandating the VHA to report its surgical outcomes annually:
  - on a risk-adjusted basis to factor in a patient's severity of illness
  - compared to national averages
- However, risk adjusted surgical outcomes and national averages did not exist

VA Response

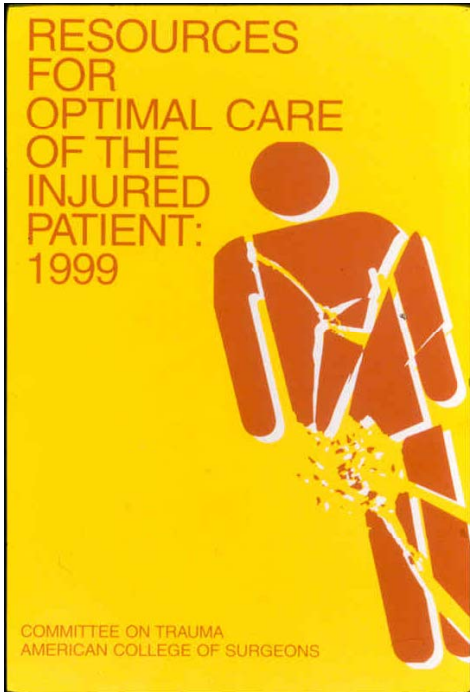
- The VA rigorously collected, modeled and analyzed their data
- Distributed and shared blinded data with and between sites
- Created feedback mechanism for best practices and implementation of focused quality improvement initiatives
- Developed and validated benchmarks

VA Quality Benchmark Results

- The VA NSQIP showed the following results from 1991-2001:
  - 27% decline in postoperative mortality
  - 45% decline in postoperative morbidity
  - Median postoperative length-of-stay declined from 9 days to 4 days (2 fewer days than the private sector for the same timeframe)

Trauma and Quality

- Major Trauma Outcome Study
- ACS-COT Resources for Optimal Care Of The Injured Patient
- ACS-COT Trauma Performance Resource Manual
- NTDB
- Trauma Quality Improvement Program TQIP



NTDB™
NATIONAL TRAUMA DATA BANK

General Benchmark Utilities

- Identify areas for improvement
- Find leaders in the field
- Identify best practices (clinical, structure, process)
- Advocacy
- Appropriate resource
- Measure progress

Essentials to Benchmark Injury Care

- Robust and current data platform
- System to expeditiously disseminate information (bidirectional)
- Attributional, non-punitive performance improvement process

Question

Could benchmarking be done to validate the impact of Joint Theater Trauma System performance improvement initiatives?

All About The Metrics

Must be relevant and realistic to context of the environment

JTTS Introduction

- Derived from the necessity to improve the outcomes of soldiers injured on the battlefield, the U.S. joint military forces developed and implemented the Joint Theater Trauma System (JTTS) and Joint Theater Trauma Registry (JTTR) using U.S civilian trauma system models.

JTTS Vision

That every soldier, marine, sailor, or airman injured on the battlefield or in the theater of operations has the optimal chance for survival and maximal potential for functional recovery.

Basis of Combat Casualty Care Benchmark Metrics

- JTTR
  - –Comprehensive initial database
    - Demographic
    - Mechanism
    - Anatomic
    - Physiologic
    - Acute outcomes
  - –Increased commitment tracked II/III through level V

Basis of Combat Casualty Care Benchmark Metrics

- JTTR
  - Largest combat Injury database in existence
  - All services injury data derived from level IIb, III, IV and V medical charts
    - Scoring of Injuries
    - Diagnosis and Procedures
    - Outcomes
  - ~25,000 US injury patients

Dissemination of Evidence-Based Best Practice

- JTTS Clinical Practice Guidelines
- Reviews at each medical treatment facility (Level III, LRMC, WRAMC, BAMC, Bethesda)
- Weekly Patient Management Conferences
- Monthly System-Wide Trauma conferences

Hypothesis

- Performance improvement initiatives implemented by the JTTS had a demonstrable positive effects on battlefield injury care.

Purpose

- Develop benchmark metrics in order to validate the impact of performance improvement initiatives on combat casualty care.

Methods

- JTTR captured mechanistic, physiologic, diagnostic, therapeutic, and outcome data on 18,377 injured patients from January 2004 through May 2008 for analysis.

Basis for Selection of Analyzed Outcome Metrics

- Hemorrhage
  - Most significant cause of potentially survivable on the battlefield
- Complications
  - Etiology of late post injury morbidity and mortality

Methods

- Outcome benchmark measures analyzed:
  - Mortality after transfusion 1-9 units red blood cells (RBC)
  - Mortality after transfusion ≥ 10 units RBC,
  - Aggregate complications.

Methods

- Control chart methodology utilized to establish normative references for each variable.
  - Statistical technique based upon probability distributions
  - Each variable had a calculated mean, upper control limit (UCL), and lower control limit (LCL) which represented the central tendency and the range of natural variation of plotted values.

Methods

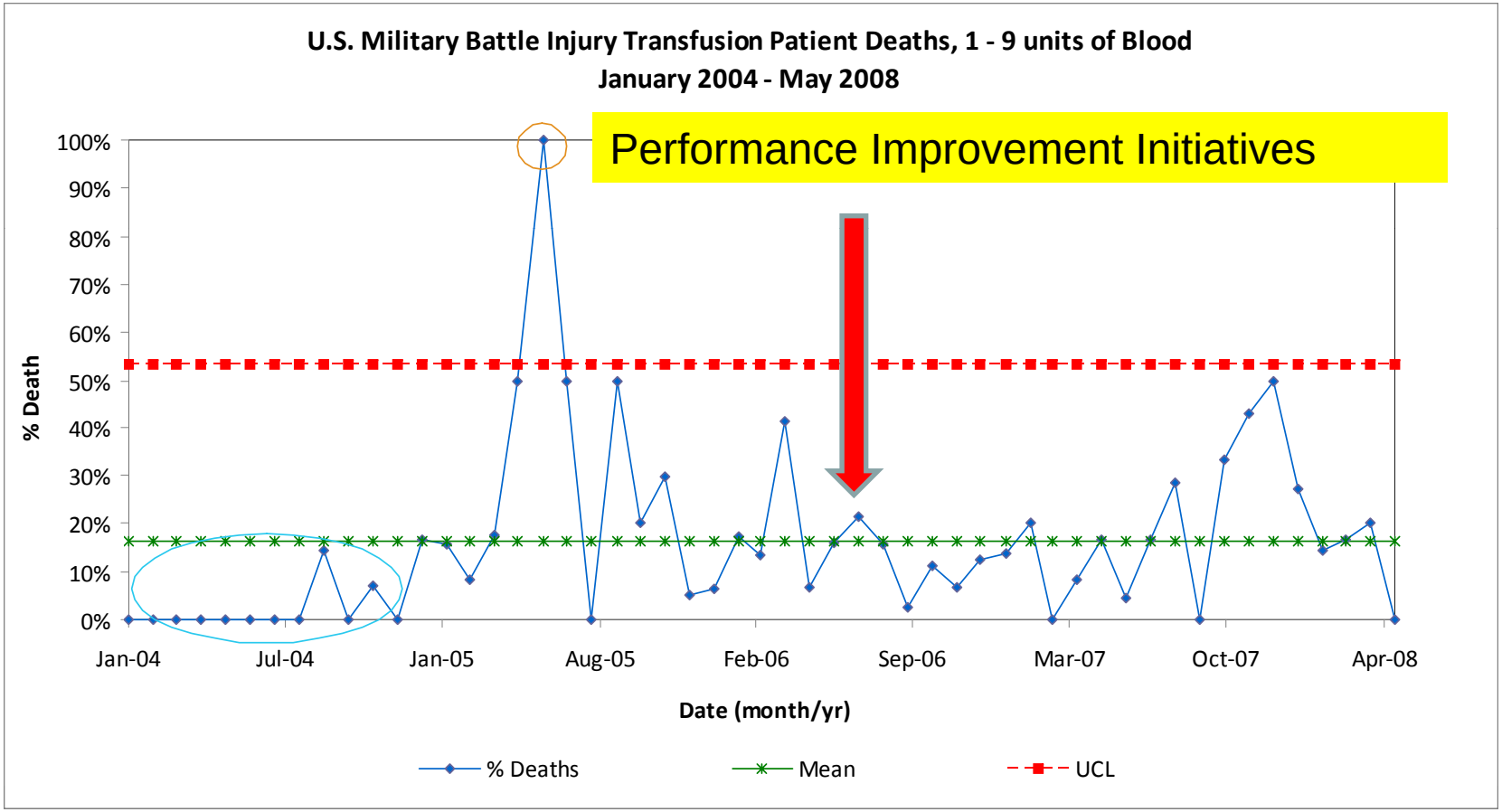
- Sentinel events defined as individual peaks for a single data point above the UCL.
- Mean shifts were identified as a series of eight consecutive values residing on the same side of the mean or center line.
- Trends were defined as six consecutive increasing or decreasing values.

General Results

- 66.4% of battlefield wounds were penetrating mechanism
- 23.3% of all patients had an ISS≥16
- 21.8% had a base deficit ≥5
- 30.5% patients required blood
- 6.8% required massive transfusion (>10 u RBC / 24 hours).

Non-Massive Transfusion Outcome Benchmark

Non-Massive Transfusion Mortality



Massive Transfusion Outcome Benchmark

Risk Factors Massive Transfusion

- Pattern recognition ~ coagulopathy during major trauma resuscitation?
- Physical injury pattern: bilateral amputation, amputation + torso injury
- Hypotensive from blood loss
- Base Deficit >6
- Hypothermic
- Coagulopathic (INR>1.5)
- Require damage control measures
- May require fresh whole blood
- Actual and Anticipated transfusion >4u PRBC in ED

Damage Control Resuscitation Overarching Goals

- Avoid dilution of coagulation factors by standard serial escalation resuscitation practices

  LR (3:1) → PRBC (10 units) → FFP → platelets → cryoprecipitate
- New paradigm
  - Parallel resuscitation rather than serial
- Early administration of the beneficial elements in fresh whole blood
  - Plasma and platelets, rFVIIa, cryoprecipitate
- Provide necessary volume
- Correct metabolism
- Early identification massive transfusion candidates

Pertinent CPG

- Fresh Whole Blood (FWB) Transfusion
- Fresh Whole Blood (FWB) Transfusion
- Hypothermia Prevention, Monitoring and Management

CPG Impact

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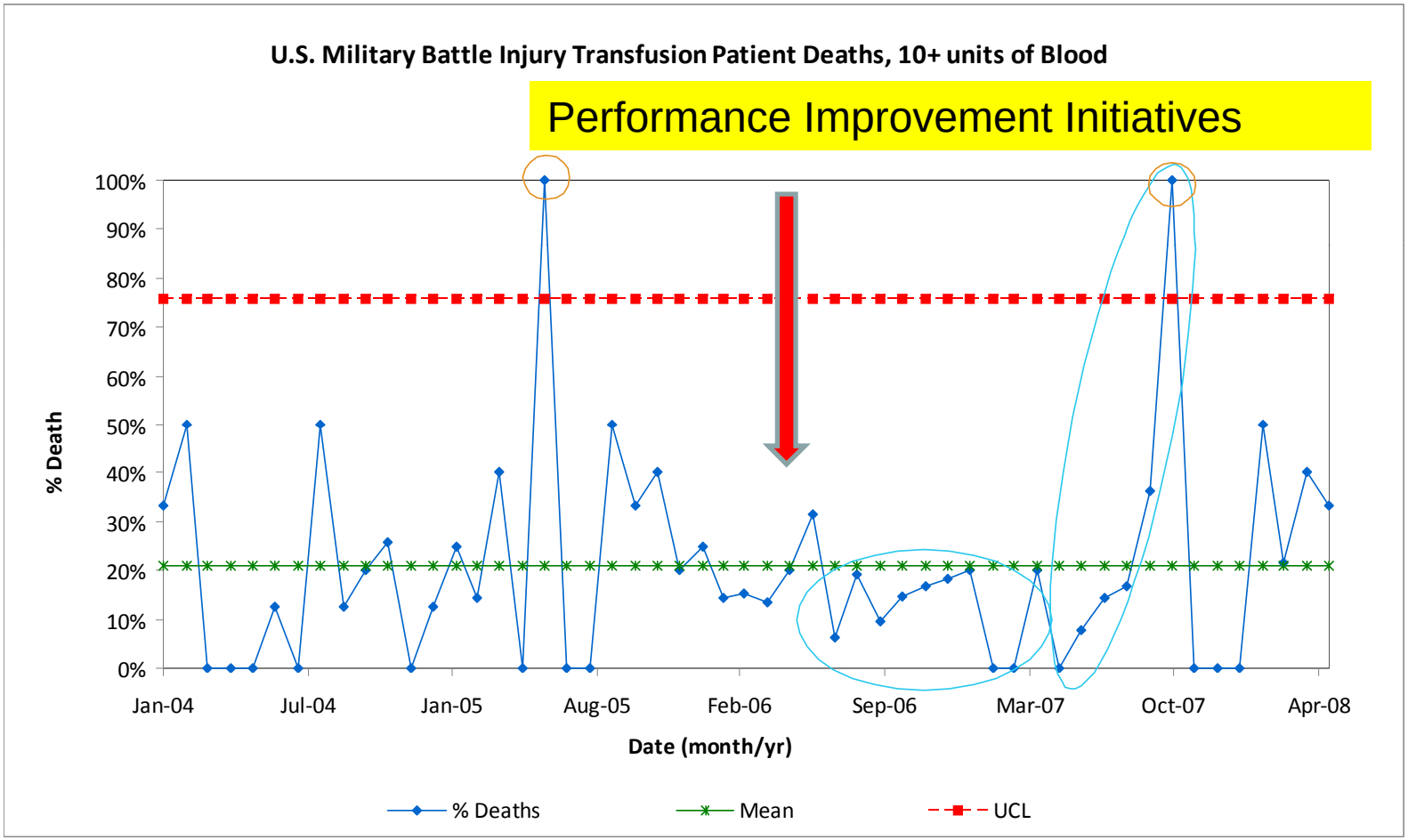
	Pre-CPG	Post-CPG	p	CPG Compliance
Massive Transfusion Mortality (≥10 u RBC / 24 hours) (Damage Control Resuscitation CPG)	**32 %**	**20 %**	**<0.05**	**85 %**

Eastridge, Am J Surg, Accepted Dec 2009

Massive Transfusion Mortality

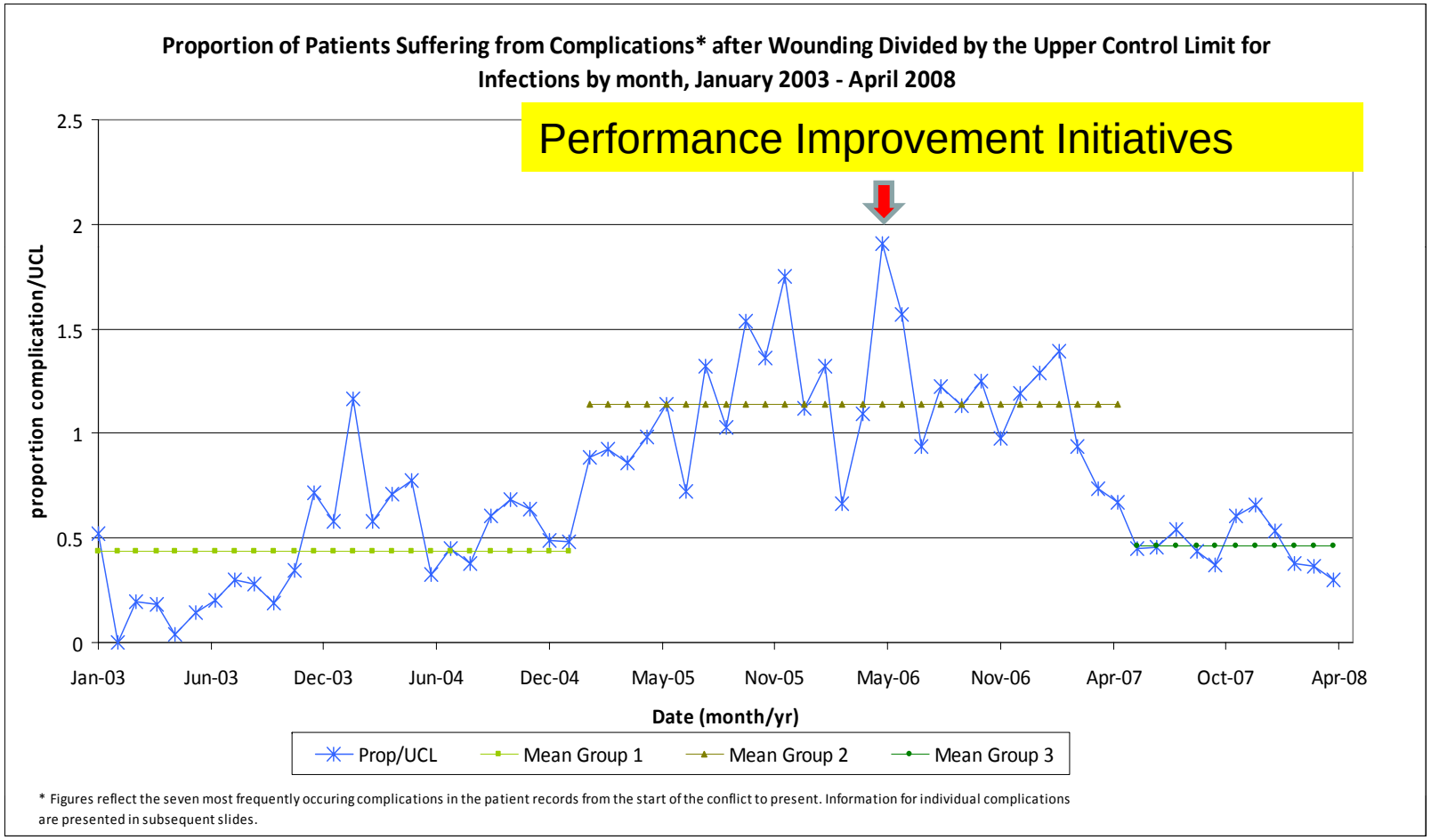


Post- Injury Complication Benchmark

Pertinent CPG

- Irrigation of War Wounds: Wound Debridement, Washout and Irrigation
- Ventilator Associated Pneumonia
- Vascular Injury (Fasciotomy)
- Prevention of Deep Venous Thrombosis
- Extremity Soft Tissue Wound/Amputation Management

Aggregate Complications



* Figures reflect the seven most frequently occuring complications in the patient records from the start of the conflict to present. Information for individual complications are presented in subsequent slides.

Summary

- Military has evolved an effective regionalization of trauma care after injury which has become the “standard of care” on the battlefield.
- Effective and efficient techniques for capturing and analyzing trauma data as well as for disseminating real-time data driven quality improvement measures.

Conclusions

- Clinical injury outcome benchmarks validate the beneficial impact of trauma system initiatives.
- Future studies are necessary to evaluate the impact of benchmarking on trauma system structure and process.