Medical Examiner Role in Trauma System Development

Brian Eastridge, MD

Top 5 Leading Causes of Death (per age category) in US

Rank	<1	1-4	5-9	10-14	15-24	25-34	35-44	45-54	55-64	65+	Total
1	Congenital Anomalies 4,795	Unintentional Injury 1,218	Unintentional Injury 780	Unintentional Injury 759	Unintentional Injury 11,886	Unintentional Injury 17,207	Unintentional Injury 16,948	Malignant Neoplasms 44,834	Malignant Neoplasms 115,260	Heart Disease 489,722	Heart Disease 614,348
2	Short Gestation 4,173	Congenital Anomalies 399	Malignant Neoplasms 436	Suicide 425	Suicide 5,079	Suicide 8,569	Malignant Neoplasms 11,267	Heart Disease 34,791	Heart Disease 74,473	Malignant Neoplasms 413,885	Malignant Neoplasms 591,699
3	Maternal Pregnancy Comp. 1,974	Homicide 364	Congenital Anomalies 192	Malignant Neoplasms 436	Homicide 4,144	Homicide 4,139	Heart Disease 10,368	Unintentional Injury 20,010	Unintentional Injury 18,030	Chronic Low. Respiratory Disease 124,893	Chronic Low. Respiratory Disease 147,101
4	SIDS 1,545	Malignant Neoplasms 321	Homicide 172	Congenital Anomalies 196	Malignant Neoplasms 1,569	Malignant Neoplasms 3,824	Suicide 6,706	Suicide 8,787	Chronic Low. Respiratory Disease 36,492	Cerebro-vascular 113,398	Unintentional Injury 136,053
5	Unintentional Injury 1,161	Heart Disease 149	Heart Disease 89	Homicide 158	Heart Disease 953	Heart Disease 3,341	Homicide 2,988	Liver Disease 8,627	Diabetes Mellitus 13,342	Alzheimer's Disease 92,604	Cerebro-vascular 133,103

Data Source: National Vital Statistics System, National Center for Health Statistics, CDC.
Produced by: National Center for Injury Prevention and Control, CDC using WISQARS™.

Access to Trauma Center Care (Level I / II)

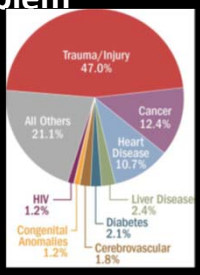
Branas, MacKenzie, E, et al: Access to Trauma Centers in the United States. JAMA. 2005; 293:2626-2633.

National Trauma System Vision

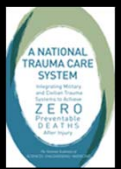
A unified effort is needed to ensure the delivery of optimal trauma care to save the lives of Americans injured within the United States and on the battlefield.

Trauma System Scope of the Problem

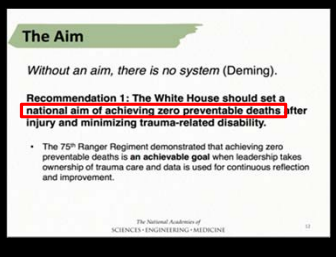
- Potentially survivable injuries US military operations
  - 1,273 / 4,574 (27.6%)
- Potentially survivable injuries US civilian population 2014
  - 147,790 x 0.276 = 40,790



A National Trauma Care System: Integrating Military and Civilian Trauma Systems to Achieve Zero Preventable Deaths after Injury



What are the numbers of Preventable Deaths in civilian trauma?

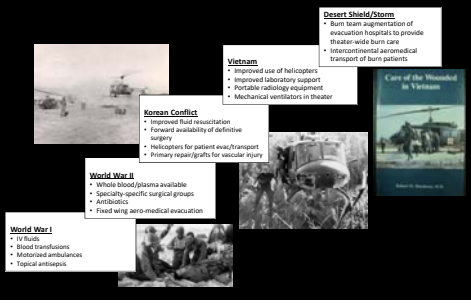


NASEM Zero Preventable Death Specific ME Recommendations

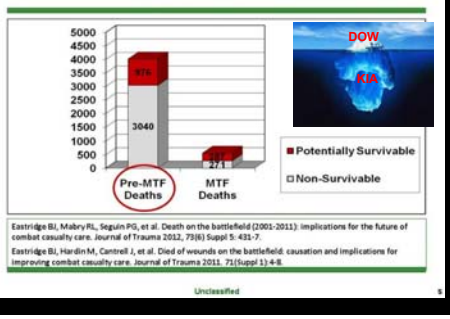
Gap:
Linkages are incomplete or entirely missing among prehospital care; hospital-based acute care; rehabilitation; and medical examiner data.
"A critical but often neglected source of data—particularly in civilian systems—is autopsy reports on trauma deaths, which could be used to determine the preventability of fatalities based on a common, accepted lexicon."

Recommendation 5:
The Secretary of Health and Human Services and the Secretary of Defense, together with their governmental, private, and academic partners, should work jointly to ensure that military and civilian trauma systems collect and share common data spanning the entire continuum of care

History of Battlefield Medical Lessons

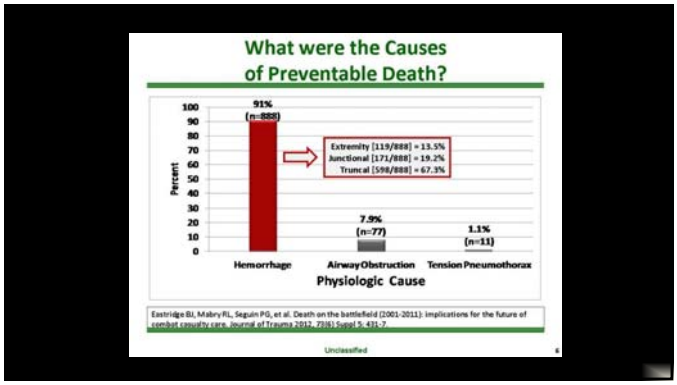


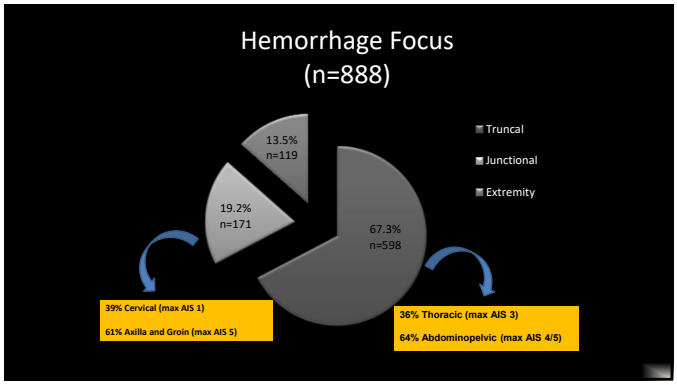
Where Can We Save the Most Lives?

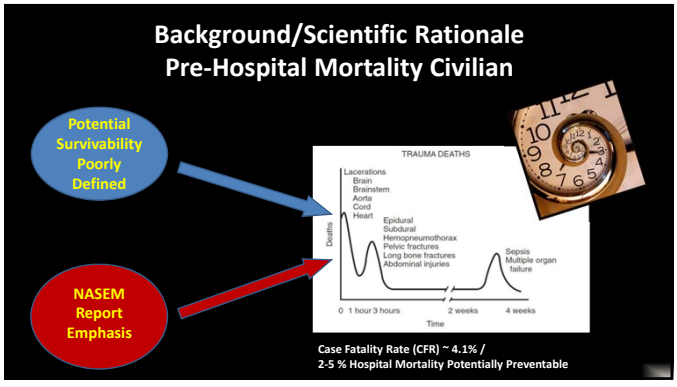


Eastridge BJ, Mabry RL, Seguin PG, et al. Death on the battlefield (2001-2011): implications for the future of combat casualty care. Journal of Trauma 2012, 73(6) Suppl 5: 431-7.
Eastridge BJ, Hardin M, Cantrell J, et al. Died of wounds on the battlefield: causation and implications for improving combat casualty care. Journal of Trauma 2011. 71(Suppl 1):4-8.

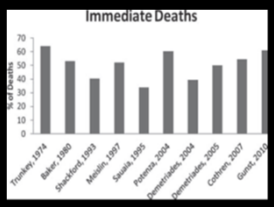
Unclassified

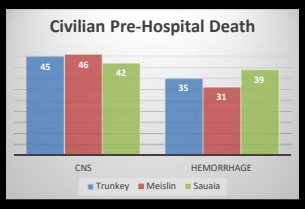

What were the Causes of Preventable Death?
Percent
91% (n=888)
7.9% (n=77)
1.1% (n=11)
Extremity [119/888] = 13.5%
Junctional [171/888] = 19.2%
Truncal [598/888] = 67.3%
Hemorrhage
Airway Obstruction
Tension Pneumothorax
Physiologic Cause
Eastridge BJ, Mabry RL, Seguin PG, et al. Death on the battlefield (2001-2011): implications for the future of combat casualty care. Journal of Trauma 2012; 73(6) Suppl 5: 431-7.
Unclassified


Hemorrhage Focus (n=888)
13.5% n=119
19.2% n=171
67.3% n=598
Truncal
Junctional
Extremity
39% Cervical (max AIS 1)
61% Axilla and Groin (max AIS 5)
36% Thoracic (max AIS 3)
64% Abdominopelvic (max AIS 4/5)


Background/Scientific Rationale
Pre-Hospital Mortality Civilian
Potential Survivability Poorly Defined
NASEM Report Emphasis
TRAUMA DEATHS
Deaths
Lacerations
Brain
Brainstem
Aorta
Cord
Heart
Epidural
Subdural
Hemopneumothorax
Pelvic fractures
Long bone fractures
Abdominal injuries
Sepsis
Multiple organ failure
0
1 hour
3 hours
2 weeks
4 weeks
Time
Case Fatality Rate (CFR) ~ 4.1% /
2-5 % Hospital Mortality Potentially Preventable

Civilian Injury Death Pre-Hospital





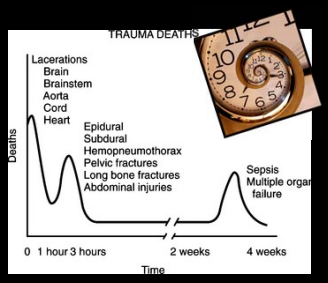
Sauaia A, Moore FA, Moore EE, Moser KS, Brennan R, Read RA, Pons PT. Epidemiology of trauma deaths: a reassessment. *J Trauma*1995;38(2):185–193.
Meislin H, Criss EA, Judkins D, Berger R, Cuenny C, Parks B, Spaite DW, Valenzuela TD. Fatal trauma: the modal distribution of time to death is a function of patient demographics and regional resources. *J Trauma* 1997;43(3):433–440.
Trunkey DD, Lim RC. Analysis of 425 consecutive trauma fatalities: an autopsy study. *J Am Coll Emerg Phys* 1974;3(8):368–371.

Timing of Death After Injury

Survivable?

Civilian Trauma deaths occur in a trimodal distribution:

- Death within minutes ~ 50%
  - Neurologic and vascular injuries.
- Death within hours ~ 30%
  - Hypoxia and hypovolemia.
- Death within days ~ 20%
  - Sepsis, MODS



Survivability (Optimal Anatomic / Physiologic)

Assumption: Optimal Resuscitative / Surgical Conditions

Non-Survivable

Head / Neck

- Decapitation
- Brain evisceration
- Head crush with skull fragmentation and extensive parenchymal brain destruction
- Transection spinal cord C3 and above

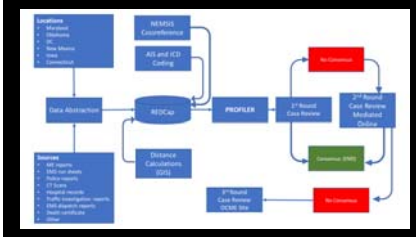
Torso

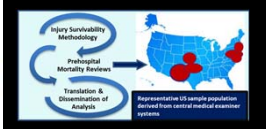
- Torso dismemberment
- Torso crush with extensive injury / loss of investing soft tissue associated with massive internal organ injury / avulsion
- Cardiac avulsion
- Aortic injury, uncontained by mediastinum
- Liver avulsion
- Massive open pelvis with major vascular injury / hemi-pelvectomy

Multiinstitutional Multidisciplinary Injury Mortality Investigation in Civilian PreHospital Environment (MIMIC)

- Advances in care in both trauma centers and trauma systems have substantially reduced death and disability associated with injury
- Substantial opportunity to further reduce deaths in pre-hospital setting.
  - Potential liabilities in civilian and military pre-hospital care must be identified and remediated in order to reduce the number of potentially preventable deaths on the battlefield and in the civilian environment.
- Purpose of proposal is to characterize the causes of pre-mortality from trauma
- Identify potential high yield areas for research and development in pre-hospital medical care, injury prevention, and trauma systems.

Multiinstitutional Multidisciplinary Injury Mortality Investigation in Civilian PreHospital Environment (MIMIC)





Greater System Benefits

Trauma

- Performance improvement
  - Engineering
  - Medical devices / procedures
  - EMS value validation
  - Injury Prevention
- Collaboration between trauma and ME communities

Medical Examiner

- Funding for advanced radiological imaging
- Improve mechanistic information
- Interaction between trauma and ME communities
- Bridge the gap between ME and trauma care providers data sets