Exploiting PI Value: Trauma Center / Medical Examiner Relationship

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Disclosures

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Multiinstitutional Multidisciplinary Injury Mortality Investigation in Civilian PreHospital Environment

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Objectives

• Describe the role and function of the death investigation system in the US
• Provide a template for trauma systems to integrate medical examiners PI process
  – Provide accurate data to classify injury
• Develop value of trauma team / system and medical examiner system collaboration to improve trauma systems and reduce preventable trauma deaths

Access to Trauma Center Care (Level I / II)

[Map showing access to trauma centers in the USA]
Injury as a Public Health Issue

Fundamental Gap

Missing Dead: Trauma System Blind Spot

- 1. portion of a field that cannot be seen or inspected with available equipment
- 2. failure to exercise judgment or discrimination
- 3. lack of understanding or impartiality
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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
  - $147,790 \times 0.276 = 40,790$

- Europe and Australia similar rates

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.
NASEM FINDINGS & RECOMMENDATIONS

- The Aim (Rec 1)
- Role of Leadership
  - National-Level Leadership (Rec 2)
  - Military Leadership (Rec 3)
  - Civilian Sector Leadership (Rec 4)
- Integrated Military–Civilian Framework for Learning to Advance Trauma Care
  - Improving the Collection and Use of Data (Recs 5 and 9)
  - Collaborative Research Infrastructure in a Supportive Regulatory Environment (Recs 7 and 8)
  - Systems and Incentives for Improving Prehospital Trauma Care
  - Quality (Rec 10)
  - Developing Expertise (Recs 6 and 11)

PREHOSPITAL INJURY MORTALITY

Impact potential for RDCR
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Background/Scientific Rationale
Pre-Hospital Mortality Civilian

- Impact Not Well Quantitated
- Potential Survivability Poorly Defined
- NASEM Report Emphasis

Background/Scientific Rationale
Pre-Hospital Mortality Combat

Where Can We Save the Most Lives?

What were the Causes of Preventable Death?

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Anatomic / Physiologic Cause of Death

- 67.3% (n=598) - Thoracic
- 36% (n=369) - Cervical
- 64% (n=641) - Abdominopelvic
- 13.5% (n=119) - Junctional
- 19.2% (n=171) - Extremity
- 39% (n=391) - Axilla and Groin


TRANSITIONAL INJURY MORTALITY FROM FIELD TO HOSPITAL
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Gates Effect

Conclusions:
A 2009 initiative by Secretary of Defense Gates reduced the time between critical injury and definitive care for combat casualties in Afghanistan. Despite evidence of increased severity and complexity of wounds from explosive devices, the combination of reduced prehospital transport time and increased treatment capability are likely contributors to casualty survival.

Prehospital Time
Noncompressible Torso Hemorrhage (All)

Impact of Pre-Hospital Time and Torso Injury Severity Total 2012-2014 (N=42,135)

Alarhayem, Eastidge, et al: Mortality in Trauma Patients with Hemorrhage from Torso Injury Occurs Long Before the “Golden Hour”
Presented at Southwestern Surgical Congress April 2016
Time is the Enemy
Prehospital Time in Noncompressible Torso Hemorrhage (GSW)

- High grade torso injury, AIS grades > 4, associated with significant hemorrhage.
- Rise in patient mortality was exhibited in high grade injury demonstrated at prehospital times < 30 minutes
- Highlights critical nature of prehospital time in patients with non-compressible torso hemorrhage.
- Evacuation times < 30 minutes not realistic, particularly in rural or austere environments,
- Future efforts should be directed toward the development of therapies to increase the window of survival in the prehospital environment.

Junctional Hemorrhage and Prehospital Time Impact on Injury Mortality

- Mortality Impact of Prehospital Time and Junctional Injury Severity


Alarhayem, Eastridge: Highlighting the Need for Novel Strategies to Control Complex Sources of Hemorrhage and Temporize Survival to Definitive Care. Presented MHSRS 2016
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SBP and Time to OR
Impact on Mortality after Injury

HOSPITAL INJURY MORTALITY
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Civilian Injury
Hemorrhage Mortality

Prehospital First 24 hours After 24 hours


Military Classification
Potentially Preventable DOW

Per cent of patients per group

Non Survivable (n = 271) Potentially Survivable (n = 286)

49 % 51 %

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**Potentially Survivable Death Causality**

- Hemorrhage: 80%
- Traumatic Brain Injury: 9%
- Multiple Organ Failure: 8%
- Other (Airway, PTX,...): 3%

**Potentially Preventable Hemorrhage Mortality Causality by Anatomic Region**

- Truncal: 48%
- Extremity: 31%
- Junctional: 21%
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Timing of Battlefield Trauma Death

- **Acute (<1 hour)**
  - Civilian: 45%
  - Baghdad: 80%
- **Early (1-4 hrs)**
  - Civilian: 34%
  - Baghdad: 17%
- **Late (>7 days)**
  - Civilian: 20%
  - Baghdad: 3%

Source: Martin et al., J Trauma 2009

Combat Hospital Death

- **Brain**
- **Hemorrhage**
  - 62%
- **Hypoxia**
- **MODS**

Related to: Martin et al., J Trauma 2009

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"Therapeutic Turnip"
Trauma Case Fatality Rate

"Why" Inspires Our Drive to Improve Performance

TED 2009
"How great leaders inspire action"
43,779,867 views
What is Our “WHY”?  

- Willingness to act  
- Make lives better by eliminating suffering and death associated with injury  
- Not be satisfied with good enough or constrained by “the way it’s always been done”
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Model Trauma System Plan 2006

If this opportunity to ascertain the specific cause of death is to be grasped, complete autopsies must be performed routinely on those who have died as the result of injury. Furthermore, the findings in large numbers of autopsies must be critically analyzed in order to point the way to necessary changes in treatment.

IOM Report 1966
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NASEM Findings ME Systems 2003

“The current practices of medicolegal death investigation in this country are in substantial need of improvement.

Need accurate data on the circumstances and causes of death

Valuable to public health which accrues to the benefit of the nation as a whole.”

NASEM Zero Preventable Death

Specific Recommendations for ME system Integration

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
Value of a Functional Medical Examiner System

“On first glance, official identification of human remains and certification of the cause of death appear to be mundane endeavors that serve mainly private needs of families, insurers, and litigants. In truth, however, valid and reliable data on the circumstances and causes of deaths serve a variety of important public needs, including fair and accurate adjudication in criminal and civil cases, maintenance of accurate vital statistics, effective public health surveillance and response, advances in health and safety research, and improvement in quality of health care.”

- Mortality review (CD 16–6). Trauma-related mortalities systematically reviewed and mortalities with opportunities for improvement identified for peer review
  - Total trauma-related mortality rates.
    - DOA (dead on arrival with no additional resuscitation efforts)
    - Died in the emergency department despite resuscitation efforts
    - In-hospital (including operating room)
- Mortality rates by Injury Severity Scale (ISS) subgroups
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Trauma System
Medical Examiner
Collaboration Goal

- 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.
  - Opportunities for trauma system improvement in pre-hospital environment must be identified and remediated in order to reduce the number of potentially preventable deaths.

Relationship Impacts
Pillars of a Modern Trauma System

- Prevention
- Acute Care
  - Data integration
  - Communications systems
  - EMS
  - Trauma Centers
- Rehabilitation
- Framework for Disaster Preparedness
- Framework for other time sensitive diseases
Coroner

- Coroner
  - Public official, appointed or elected, who makes inquiries into deaths and completes death certificates.
    - Determines cause/manner of death
    - Decides if foul play
    - May or may not have medical training
Medical Examiner

• Medical Examiner
  – Physician who evaluates medical history and physical exam of deceased to determine cause and manner of death.
  • Must receive special training in forensic pathology
  • Forensic Pathology – unnatural or suspicious disease or injury

Manner and Cause of Death

Expect a Different Vernacular

• Mechanism – biochemical or physiological abnormality produced by the cause of death that is incompatible with life.
• Manner of Death – homicide, suicide, natural causes, accidental or undetermined.
• Cause – disease or injury that initiated the lethal chain of events that lead to death
Prompts for Autopsy

- As required by law
  - Per state statute and administrative rule
- Sudden or unexpected deaths
- Under suspicious circumstances
- Result of an injury

Deaths Uniformly Investigated

1. Persons who die suddenly when in apparent good health, those who are unexpected to die, or those who are without medical treatment for fatal diseases.
   - Public Health Threat (bacterial meningitis)
   - Death in public places (electrocution in public place)
   - Maternal Death
   - Death outside of medical facility
Deaths Uniformly Investigated

2. Deaths caused by unnatural causes

Examples:
– Acts of violence
– Drug related
– Trauma / Asphyxiation
– Weather
– “Accident”

Components of Death Investigation

• Report of death to medical examiner / coroner
• Determination of circumstances of death
• Scene investigation
• Post-mortem examination
• - External exam
• - Autopsy
• - Toxicology (e.g., the presence of alcohol, drugs)
• Certification of cause and manner of death
• Report of findings to interested parties
• Judicial / medicolegal testimony
Determinants of Autopsy Rate
Influential Factors

<table>
<thead>
<tr>
<th>Law</th>
<th>Consent</th>
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</thead>
<tbody>
<tr>
<td>• Statutory requirement</td>
<td>• Religion</td>
</tr>
<tr>
<td>• Penalties for breach of law</td>
<td>• Ethnic origin</td>
</tr>
<tr>
<td><strong>Request</strong></td>
<td>• Cultural attitudes</td>
</tr>
<tr>
<td>• Clinical specialty</td>
<td>• Media portrayal of autopsies</td>
</tr>
<tr>
<td>• Perceived benefits of autopsy</td>
<td>• Public (secular) perceptions</td>
</tr>
<tr>
<td>• Premortem investigations</td>
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</tbody>
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Quality of Death Investigation
Issues

- 2,200 separate death investigation jurisdictions in US
- Variety of organizational locations (e.g., law enforcement agencies, departments)
- Lack of standardized methods for investigating deaths
- Lack of standardized definitions (e.g., manner, cause of death)
- Inadequate training for many medical examiner / coroner / death investigators
- Inadequate resources for conducting investigations
Death Investigation Data
Barriers to Quality and Completeness

• Variety of data collection and management methods
• Inadequate budget for medical examiners systems
• Records not centralized in many states
• Lack of coordinated data collection by federal agencies
• ME no uniform understanding value to trauma team / system
• Autopsy observations difficult to AIS code
  – “Blunt force trauma”
  – Large liver laceration vs 15 cm liver laceration extending to vena cava

Recommendations
ME Integration to Improve Trauma Center / Systems Performance

• Improve collaboration trauma center / system and ME
  – TMD / TPM liaison with ME
  – Encourage ME participation M&M
• Increase ME recognition of importance to trauma system of high-quality death investigations and data
• Provide scoring tool / guidance to ME to make reports AIS / ICD 10 codable
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Recommendations
ME Integration to Improve Trauma Center / Systems Performance

- Develop research / surveillance of injury regional ME system
- Integrate / link ME data with trauma center / system data
- Integrate / operationalize ME in regional preparedness and response
- Standardized practices of communication and data dissemination with ME system

Trauma / ME Mortality PI Reviews

Not preventable
- System provided appropriate and timely care
- Evaluation and management was appropriate according to relevant clinical guidelines

Potentially preventable
- System generally provided appropriate care, opportunities for improvement identified.
- Evaluation and management generally appropriate. Some deviations from standard

Preventable
- Delivery of care was suboptimal
- Death not expected, opportunity for improvement
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Survivability

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, uncontrolled by mediastinum
- Liver avulsion
- Massive open pelvis with major vascular injury / hemipelvectomy

Framework of the Taxonomy

Severity of harm (AHRQ degrees of resulting harm)

Type of health care service or intervention provided

Type of individual involved (physician, nurse, etc.) and type of setting (hospital, pre-hospital, clinic, etc.)

I. Impact

II. Type

III. Domain

IV. Factors

- System
- Human
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Injury Scoring Tool

<table>
<thead>
<tr>
<th>Region</th>
<th>AIS</th>
<th>AIS(Warning)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head, neck, spine</td>
<td>1</td>
<td>Minor</td>
</tr>
<tr>
<td>Face excluding nose, mouth, eyes, ears</td>
<td>2</td>
<td>Moderate</td>
</tr>
<tr>
<td>Thorax, thoracic spine, diaphragm</td>
<td>3</td>
<td>Serious</td>
</tr>
<tr>
<td>Abdomen and Lumbar spine</td>
<td>4</td>
<td>Severe</td>
</tr>
<tr>
<td>Extremities, including pelvis</td>
<td>5</td>
<td>Critical</td>
</tr>
<tr>
<td>External or other injuries</td>
<td>6</td>
<td>Maximal (Correvably unrecoverable)</td>
</tr>
</tbody>
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Important Guidance ME

- Philosophy of value of quantitative description of injury
- More detail better
- AIS / ISS training

GIS Mortality Review Tool

Geographic Information Systems

- Evaluate trauma system responsiveness
- Methodology for reliably measuring prehospital time and distance to definitive care
Importance of Context

Where You Live Should Not Determine If You Live

Del Rio to University Hospital = 152mi
Ground Transport ≈ 2hr 33min | Air Transport ≈ 54min

Del Rio to SAMMC = 160mi
Ground Transport ≈ 2hr 40min | Air Transport ≈ 57min

Operationalizing Mortality PI Process

Joint Trauma System Operational Cycle

Armed Forces Medical Examiner System
Autopsy
System level PI

Research Priorities Driven by PI Data, Capability Gaps, Clinicians
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Potential System Benefits

Trauma
- Military / civilian trauma system evolution
- Performance improvement
  - Engineering
  - Medical devices / procedures
  - EMS value validation
  - Injury Prevention
- Integration of ME and injury data sources
- Collaboration between trauma and ME communities

Medical Examiner
- Support for enhanced ME systems / resources
- Funding for radiological imaging / advanced technology
- Bridge the gap between ME and trauma care providers

Bridging the Chasm

Medical Examiner System

Trauma System

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