TBI Hospitalizations and Trauma Centers: Why it is important?

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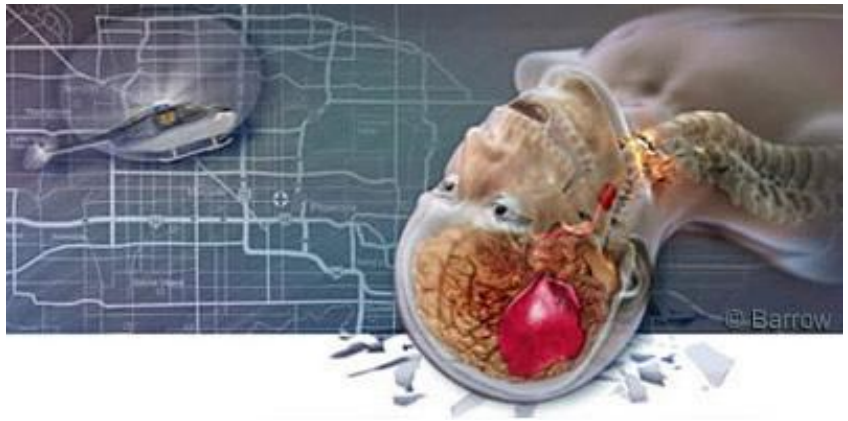

North America Brain Injury Society Conference
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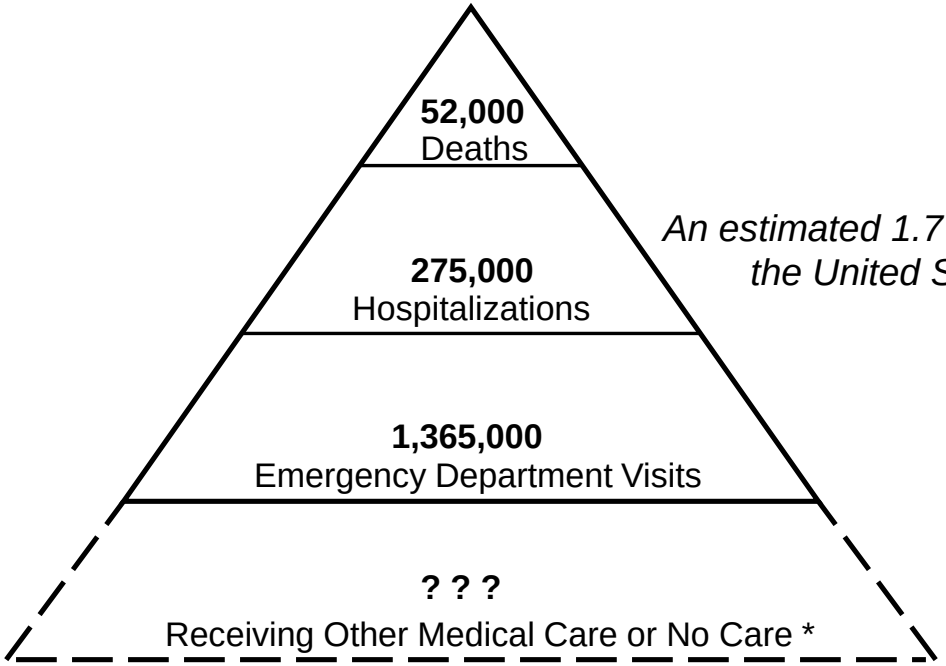
Discussion Objectives

- Share and discuss:
  - Epidemiology of Traumatic Brain Injury
  - Criteria for Hospitalizations
- Importance of Trauma Centers
  - Brain Trauma Foundation Guidelines
  - Neurosurgeon Access
  - Anti-Coagulation and the Elderly
  - Rehabilitation
  - Secondary insults
  - Transfers
- Proportion of Hospitalizations
  - Method (2 datasets)
  - Trauma Center
  - Non Trauma Center

Epidemiology of Traumatic Brain Injury: 1.7 Million TBIs annually (2002-2006)



An estimated 1.7 million TBIs occur in the United States each year

* Data for this category are not included in this report.
See "limitations" in the Appendix for more detail.

Of the 1.7 million TBIs occurring each year in the United States, 80.7% were ED visits, 16.3% were hospitalizations and 3.0% were deaths.

Faul M, Xu L, Wald MM, Coronado V, *Traumatic Brain Injury in the United States: Emergency Department Visits, Hospitalizations and Deaths, 2010*

Criteria for TBI Hospitalizations

- Glasgow Coma Score – Distribution *
  - 13-15 Mild TBI
    - No Intracranial Lesion (48.4%)
    - Intracranial Lesion (23.9%)
  - 9-12 Moderate TBI (9.6%)
  - 3-8 Severe TBI (9.8%)
  - Unknown (5.7%)
- Treatment practices differ (no clear guidance):
  - The usual practice has been to admit those patients with an associated intracranial hemorrhage (ICH) to an ICU and to obtain repeat head CT scans (*Washington CW, Neurosurgery, 2012*)
  - GCS of 13 most closely predicted a moderate TBI requiring hospitalizations (*Mena JH, The Journal of TRAUMA, 2012)*
  - The majority of working-age adults who were treated for brain injury at a hospital ED but not hospitalized did not begin work until one to 3 months after injury (*Boake C, Neurosurgery. 2005*)

* Langlois JA, et. al. Traumatic Brain Injury-Related Hospital Discharges Results from a 14-State Surveillance System, 1997 *Surveillance Summaries* June 27, 2003 / 52(SS04);1-18

Importance of Trauma Centers
Neurosurgeon Access

Level I
- Regional resource hospital that is central to trauma care system
- Provides total care for every aspect of injury, from prevention through rehabilitation
- Maintains resources and personnel for patient care, education, and research (usually in university-based teaching hospital)
- Provides leadership in education, research, and system planning to all hospitals caring for injured patients in the region

Level II
- Provides comprehensive trauma care, regardless of the severity of injury
- Might be most prevalent facility in a community and manage majority of trauma patients or supplement the activity of a Level I TC
- Can be an academic institution or a public or private community facility located in an urban, suburban, or rural area
- Where no Level I TC exists, is responsible for education and system leadership

Level III
- Provides prompt assessment, resuscitation, emergency surgery, and stabilization and arrange transfer to a higher-level facility when necessary
- Maintains continuous general surgery coverage
- Has transfer agreements and standardized treatment protocols to plan for care of injured patients
- Might not be required in urban or suburban area with adequate Level I or II TCs

Level IV
- Rural facility that supplements care within the larger trauma system
- Provides initial evaluation and assessment of injured patients
- Must have 24-hour emergency coverage by a physician
- Has transfer agreements and a good working relationship with the nearest Level I, II, or III TC

SOURCE: Adapted from the American College of Surgeons. Resources for the optimal care of the injured patient. Chicago, IL: American College of Surgeons; 2006.

Importance of Trauma Centers
Brain Trauma Foundation Guidelines

- Background: In 1995, evidence-based guidelines for the management of severe TBI were published and disseminated.

- Brain Trauma Foundation Guidelines (adoption)
  - 1994 Survey: Full Guideline Compliance = 16% (Hesdorffer, 2002)
  - 2007 Survey (173 Level I TCs and 215 Level II TCs) (Hesdorffer, 2007):
    - Full Adherence: 21%
    - Partial Adherence: rose from 17% to 45%
    - Lack of Guideline Adherence fell from 67% to 35% (Hesdorffer, 2007)
    - Routine intracranial pressure monitor use increased from 32.4% in 1991 and 50.8% in 2000 to 77.4% in 2006
    - Avoidance of steroids in TBI rose from 47.8% in 1991 and 52.4% in 2000 to 86.0% in 2006.

Importance of Trauma Centers
Brain Trauma Foundation Guidelines

- CDC researchers* conducted a study to assess the effectiveness of adopting the Brain Trauma Foundation (BTF) in-hospital guidelines for the treatment of adults with severe (TBI). This research indicated that widespread adoption of these guidelines could result in:
  - a 50% decrease in deaths (3,606 lives);
  - a savings of approximately $288 million in medical and rehabilitation costs; and
  - a savings of approximately $3.8 billion—the estimated lifelong savings in annual societal costs for severely injured TBI patients

- The current *Guidelines for Prehospital Management of Traumatic Brain Injury* recommend direct transport of TBI patients to a facility that offers CT scanning, neurosurgical care, ICP monitoring and treatment capabilities.

* Faul M, Wald MM, Rutland-Brown W, Sullivent EE, Sattin RW. Using a cost-benefit analysis to estimate outcomes of a clinical treatment guideline: Testing the Brain Trauma Foundation guidelines for the treatment of severe traumatic brain injury. The Journal of trauma 63 (6), 1271*2002-2006*

Importance of Trauma Centers
Anti-Coagulation and the Elderly

- US population is getting older
- Anti-Coagulant Usage - Patients with coagulopathy or those undergoing treatment with anticoagulants (e.g., warfarin or aspirin) are at increased risk for intracranial hemorrhage, increased severity of hemorrhage, and associated morbidity and mortality (CDC, 2012)*.
  - *Brewer , 2011* – After a GCS of 15, 29% of patients were diagnosed with and Intracranial hemorrhage.
  - *Chisholm , 2010*– Head injuries accounted for 46% of the deaths. Patients using anticoagulants were dying much quicker (9 vs. 23 days).
  - *Howard, 2009* – pre-injury warfarin use had a negative effect on the in-hospital mortality rate. This was more pronounced in head injuries.
  - *Ott, 2010* – Anticoagulants only increase mortality and length of stay if there is a head injury.
  - *Tauber, 2009* – Low-dose acetylsalicylate acid increases risk of ICH
  - *Wong, 2008* - patients on anticoagulants, patients on clopidogrel, aspirin or warfarin were more likely to die.

* CDC, Sasser, SM. et al *MMWR , Report and Recommendations,* 2012

Importance of Trauma Centers
Rehabilitation

Trauma Systems include rehabilitation

Importance of Trauma Centers
Secondary Injury and Transfers

- Transferred TBI patients are more likely to die:
  - Secondary referral may delay the initiation of appropriate therapy, increase the risk of adverse events and systemic insults during transport (*Hukkelhoven C, Intensive Care Med, 2005*)
  - Prevention of secondary prehospital risk factors such as hypoxia and hypotension is likely to improve patient prognosis in severe traumatic brain injury (TBI) (*Franschman G, J of Trauma, 2011)*
  - A type of secondary injury may also extend to the lung. Edematous lungs may contribute further to the secondary injury of the brain caused by hypoxia (*Graham DE, J Neuroscience, 1978*)
  - TBI is 28% more survivable in a TC (*Hass B, J Am Coll Surg 2009*)
  - After controlling for arterial hypotension, age, pupillary status, and initial GCS score, direct transport was found to result in significantly lower mortality by 50% than indirect transport to a trauma center (*Härtl R, Brain Injury, 2006)*

Research Question

How many TBI of the total hospitalizations occur at Trauma Centers?

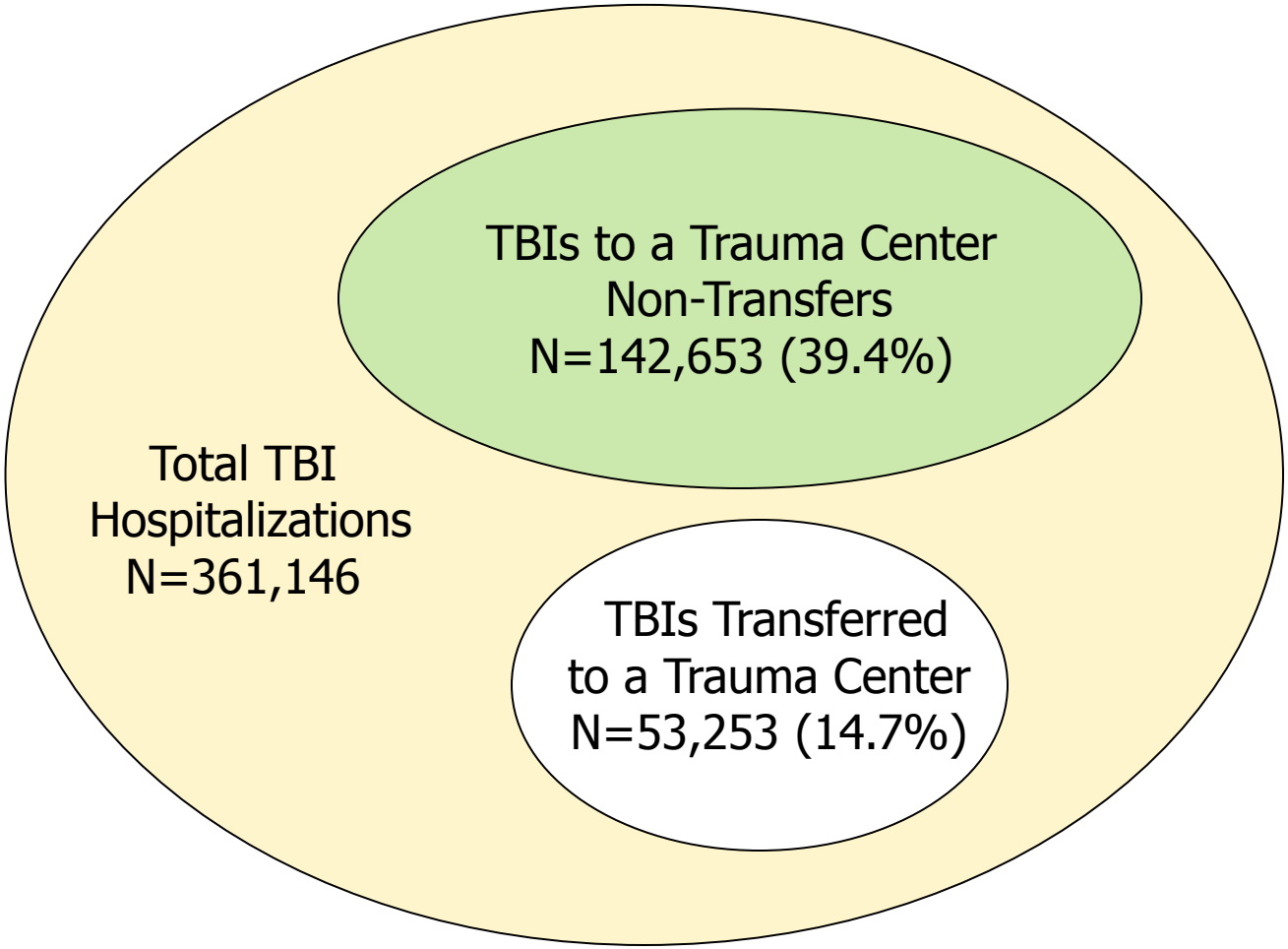
Proportion of Hospitalizations
Method (2 datasets)

- CDC definition using ICD codes
- Total Hospitalized TBIs in 2009: National Hospital Discharge Survey (NHDS)
  - National Estimates of all Injuries
  - Weighted Data
- Total Hospitalized TBIs in Trauma Centers in 2009: National Trauma Data Bank
  - Contains patient data from Level I and Level II Trauma Centers
  - Weighted data

Proportion of Hospitalizations

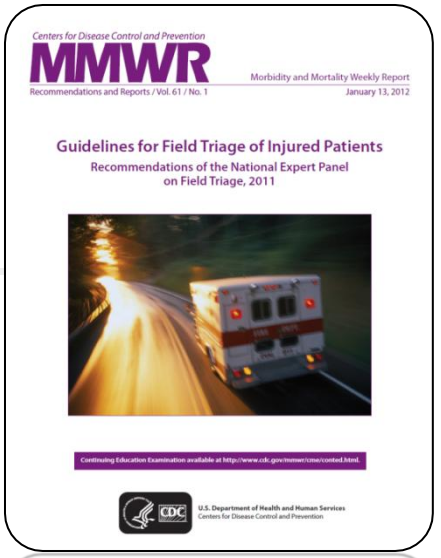
Results: Trauma Center Hosp Admissions = 54%

- Trauma Center TBI Hospitalizations N=196,235 (54.3%)
- Low number of TBIs seen in a Level I or Level II trauma center
- High transfer rate to Trauma Centers (14.7%)



* The transfer status of 329 Trauma Center Cases is unknown

Why is it Important?



- Prehospital Transport Decisions
  - Field Triage Guideline
  - Medical Control/Direction
  - Better survival at Trauma Centers
- Difficult to distinguish boarder-line critical cases
  - CT scan not always ordered
  - Patient can degrade
  - Neurosurgical services less available in rural areas

Next Steps

- Need better tools to enhance clinical judgment on the injury scene:
  - Cognitive testing (GCS is crude)
  - Technological advance needed
  - Rapid assessment bio-marker
    - Ubiquitin C-terminal Hydrolas (UCH-L1)
    - Some promise (*Papa, J Trauma Acute Care Surg, 2012*)
  - Future refinement of the Field Triage Guideline

TBI Hospitalizations and Trauma Centers: Why it is important

Abstract

Among all injuries, traumatic brain injury (TBI) stands out as a major burden in terms of injury-related mortality and costs. Most moderate to severe TBI is seen in hospital settings. While level I or level II trauma centers have access to neurosurgical care on a 24-hour basis, the proportion of TBI-related hospitalized patients seen in these settings has never been answered in the literature. When comparing trauma center hospitalizations to all hospitalizations, differences in multiple trauma, or multiple injuries, and length of stay (LOS) across hospital settings were expected.

Methods: Using CDC-defined TBI coding definitions from the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM), the total number of TBI hospitalizations was obtained using 2009 data from the National Hospital Discharge Survey. A TBI case was defined as TBI alone or in conjunction with other injuries or conditions. The total number of TBI-related hospitalizations seen at level I or II trauma centers was calculated with ICD-9-CM TBI codes using 2009 admission data from the National Trauma Data Bank.

Results: For 2009, the total number of US TBI-related hospitalizations, including people who died while hospitalized, was 361,146. The total number of patients hospitalized with TBI alone or in conjunction with another injury or condition at a level I or II trauma center was 196,235. Thus, 54% of all TBI-related hospitalizations occurred in level I or II trauma centers. The LOS for all TBI-related hospitalizations was 5.92 days (95% CI: 5.22-6.62). The LOS for all TBI-related hospitalizations at a level I or II trauma center was 6.62 days (95% CI: 6.06-7.18). Multiple trauma among TBI patients was more common in trauma centers (83%) compared to all hospitalizations for TBI alone or in conjunction with other injuries or conditions (63%).

Conclusion: Utilization of trauma center resources for TBIs may be low considering the established lower mortality rate associated with treatment at trauma centers. The presence of multiple trauma appears to be a determining factor in trauma center care admissions. Given that adherence to the Brain Trauma Foundation guidelines is higher for severe TBI in trauma centers, a better understanding of hospital destination decision making is needed for TBI injured patients.

Thank You - Any Questions?