Traumatic Brain Injury and Polytrauma in the VA System
The opinions or assertions contained herein are the private views of the author and are not to be construed as reflecting the views of the Department of Veterans Affairs.
Medical Care of OIF/OEF Veterans

- Prolonged/multiple tours of duty
- High involvement of National Guard/Reserve components
- Female veterans
- Blast injuries common
- High survival rates
Polytrauma

- Two or more injuries to physical regions or organ system
- One of which may be life-threatening

Resulting in:
- Physical limitation
- Cognitive deficits
- Psychological/Social dysfunction
- Functional Disability

http://www.polytrauma.va.gov/definitions.asp#polytrauma
Polytrauma/Brain Injuries
New Era of Injuries and Rehabilitation

- Head (31.5%)
- Upper Extremity (30%)
- Torso (11%)
- Pelvis (4%)
- Lower Extremity (23%)

OIF/OEF
Complex Injuries
Rehabilitation Care

Polytrauma Center
Polytrauma Triad

Lew et al. JRRD 2009;46:697-702
- PTSD
  - Re-experiencing
  - Avoidance
  - Social withdrawal
  - Memory gaps
  - Apathy

- Mild TBI Residua
  - Difficulty with decisions
  - Mental slowness
  - Concentration
  - Headaches
  - Dizzy
  - Appetite changes
  - Fatigue
  - Sadness
  - Suicidality

- Substance Use (Poly)
  - Altered Arousal
  - Sensitive to noise
  - Insomnia
  - Irritability

- Depression
  - Pain
  - Medication effects
  - Pain

- Pain
  - Mental slowness
  - Concentration
  - Headaches
  - Dizzy
  - Appetite changes
  - Fatigue
  - Sadness
  - Suicidality
Traumatic Brain Injury

- Defined as “alteration in brain function manifesting as confusion, altered level of consciousness, seizure, coma, or focal sensory/motor deficit resulting from blunt or penetrating force to the head”
# Traumatic Brain Injury

## CLOSED TBI
- No violation of dura
- Typically related to forces applied to head
- Brain lesions seen include coup-contre coup contusions, hematomas, axonal injury (diffuse)

## PENETRATING TBI
- Requires violation of dura
- Fragment injury
  - Bullet
  - Shrapnel
  - Skull
- Projectile carries force
- Higher risk of seizure, infection
Traumatic Brain Injury
Figure 1  Complex injurious environment because of blast: primary blast effects, that is, effects of the blast wave itself (primary blast injury); secondary blast effects caused by particles propelled by blast-force (secondary, that is, penetrating blast) injury; and tertiary blast effects caused by acceleration and deceleration of the body and its impact with other objects (tertiary blast injury similar to 'coup–contrecoup').
# Severity Rating for TBI

## Traumatic Brain Injury Description

| Severity  | GCS  | AOC       | LOC          | PTA       | Imaging
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>13-15</td>
<td>≤24 hrs</td>
<td>0-30 min</td>
<td>≤24 hrs</td>
<td>Normal</td>
</tr>
<tr>
<td>Moderate</td>
<td>9-12</td>
<td>&gt;24 hrs</td>
<td>&gt;30min &lt;24 hrs</td>
<td>&gt;24hrs &lt;7 days</td>
<td>Abnormal</td>
</tr>
<tr>
<td>Severe</td>
<td>3-8</td>
<td>&gt;24hrs</td>
<td>≥24 hrs</td>
<td>≥7 days</td>
<td>Abnormal</td>
</tr>
</tbody>
</table>

- **GCS** - Glasgow Coma Score
- **AOC** - Alteration in consciousness
- **LOC** - Loss of consciousness
- **PTA** - Post-traumatic amnesia
Military TBI Incidence

DoD Numbers for Traumatic Brain Injury Worldwide – Totals

2000-2012

<table>
<thead>
<tr>
<th>Severity</th>
<th>Count</th>
</tr>
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<tbody>
<tr>
<td>Penetrating</td>
<td>4,213</td>
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<tr>
<td>Severe</td>
<td>2,709</td>
</tr>
<tr>
<td>Moderate</td>
<td>21,779</td>
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<tr>
<td>Mild</td>
<td>219,921</td>
</tr>
<tr>
<td>Not Classifiable</td>
<td>18,188</td>
</tr>
</tbody>
</table>

Total - All Severities 266,810

Source: Defense Medical Surveillance System (DMSS), Theater Medical Data Store (TMDS)

Prepared by MHS Office of Strategic Communications

2000-2012, as of 13 Feb. 2013

www.dvbic.org/TBI-Numbers.aspx
Military TBI Epidemiology

DoD Numbers for Traumatic Brain Injury
Worldwide - Incidence by Armed Forces Branch

No. of cases
25,000
20,000
15,000
10,000
5,000
0

Calendar year
'00 '01 '02 '03 '04 '05 '06 '07 '08 '09 '10 '11 '12

Army
Navy
Air Force
Marines

Source: Defense Medical Surveillance System (DMSS), Theater Medical Data Store (TMDS)
Prepared by MHS Office of Strategic Communications
Updated 13 Feb. 2013
Military TBI Epidemiology

DoD Numbers for Traumatic Brain Injury
Worldwide - Incidence by Severity

No. of cases

30,000
25,000
20,000
15,000
10,000
5,000
0

Calendar year

Mild
Moderate
Severe
Penetrating
Unclassified

Source: Defense Medical Surveillance System (DMSS), Theater Medical Data Store (TMDS)

Prepared by MHS Office of Strategic Communications

Updated 13 Feb 2013
Injury

Preinjury Functioning

Brief PTA

Mild TBI

Ongoing Cognitive Problems

Moderate TBI

Severe TBI

Ongoing Cognitive Problems

Retrograde Amnesia

Coma

PTA

Months

3

6

9

12
Consequences of TBI

MODERATE/SEVERE
- Hemiparesis/plegia
- Sensory deficits
- Disorders of consciousness/cognition
- Seizures
- Aphasia

MILD
- Headaches
- Dizziness
- Cognitive symptoms
- Insomnia
- Mood changes
Regional Cortical Vulnerability Predicts Cognitive Sequelae

- **Dorsolateral prefrontal cortex**
  - (executive function, including sustained and complex attention, memory retrieval, abstraction, judgement, insight, problem solving)

- **Orbitofrontal cortex**
  - (emotional and social responding)

- **Anterior temporal cortex**
  - (memory retrieval, face recognition, language)

- **Amygdala**
  - (emotional learning and conditioning, including fear/anxiety)

- **Hippocampus**
  - (only partially visible in this view - declarative memory)

- **Ventral brainstem**
  - (arousal, ascending activation of diencephalic, subcortical, and cortical structures)
Treatment of Polytrauma

- High survival rates (90+% in theater)
- Aeromedevac System is key
Treatment of Severe Polytrauma

- Combat Support Hospital
  - In Theater
  - Stabilization/Triage
- Landstuhl Regional Medical Center
  - Germany
  - Further stabilization and care
- Stateside Military Treatment Facilities (MTFs)
  - Walter Reed
  - Brooke Army Medical Center
  - Portsmouth/Balboa
Treatment of Severe Polytrauma

- Amputee soldiers
  - Rehab primarily through MTF
  - Possible return to duty
- Spinal Cord Injury (SCI)
  - Short stay in MTF
  - VA SCI rehab provides care
Severe TBI/Polytrauma

- Neurosurgical care/stabilization takes place in MTFs
- Rehab in the VA Polytrauma Rehabilitation Centers
  - Interdisciplinary (PT/OT/Speech/Rec Therapy/MH)
  - Military Liaisons in place
  - Inpatient unit with resources for:
    - Behavioral Issues
    - Emerging Consciousness
Polytrauma System of Care

Polytrauma Rehabilitation Centers (5)
  Regional referral centers

Polytrauma Network Sites (22)
  VISN level referral sites

Polytrauma Support Clinics (80)
  Facility level teams

Polytrauma Points of Contact (50)
  Referral and care coordination
Polytrauma System of Care - Locations

Legend
- Level 1 Polytrauma Rehabilitation Center
- Level 2 Polytrauma Network Site
- Level 3 Polytrauma Support Clinic Team
- Level 4 Polytrauma Point of Contact

Drive Time in Minutes
- 0-15 Minutes
- 15 - 30 Minutes
- 30 - 60 Minutes
- 60 - 90 Minutes
- 90 - 120 Minutes
- 120-240 Minutes
- 8 Hours

% Within Drive Time Bands: 86.8%
- Users Within Drive Time Bands
- Users NOT Within Drive Time Bands

Map Created By: Eric R. Litt
Map Data Provided By: VHA Physical Medicine & Rehabilitation Service, VHA Planning System Support Group, and AAC Medical SAS Datasets
Funding Source: HHS/NIH/OD/OSR, VHA Office of Research and Development
Project # DH06-010-1 PI: DC Cawley, PhD
Map Creation Date: August 14, 2007
ArcMap 9.2
Polytrauma Veterans Returning Home

- Severe Polytrauma veterans are often closely connected to VA system due to warm hand off
- Geographic/insurance issues may limit engagement in VA system
- Overwhelming majority of returning veterans have mild TBI, musculoskeletal pain, and MH issues – Likely never evaluated in military
Returning OIF/OEF Veterans

- Aggressive screening for PTSD/TBI/Depression at Primary Care level
- Referrals for comprehensive evaluations as indicated
Total OEF/OIF Veterans Screened: 579,047

Veterans with Self-Reported Prior TBI: 17,945 (3.1%)

Veterans Requiring Further Evaluation: 114,554 (19.8%)

Veterans Consenting to Further Evaluation: 108,688 (94.9%)

Veterans Completed Evaluation: 81,459 (75.0%)

TBI Confirmed: 45,168 (7.8% of total screened)

TBI Ruled Out: 36,291 (39.4% of total + screens)
Comprehensive Evaluation Data

- Scholten et al. Brain Injury 2012
- Comparison of symptoms and characteristics of veterans completing comprehensive evaluation

Table I. Characteristics of $n=55,070^*$ Veterans evaluated for TBI.

<table>
<thead>
<tr>
<th>Variable</th>
<th>$n$</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>3210</td>
<td>6</td>
</tr>
<tr>
<td>Male</td>
<td>51794</td>
<td>94</td>
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<tr>
<td>Age, years; $M (SD) = 32.2 (8.9)$</td>
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<td></td>
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<tr>
<td>19–29</td>
<td>28,899</td>
<td>52</td>
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<tr>
<td>30–39</td>
<td>14,153</td>
<td>26</td>
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<td>40–67</td>
<td>11,733</td>
<td>21</td>
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<tr>
<td>Marital status</td>
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<td></td>
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<tr>
<td>Single, never married</td>
<td>16,582</td>
<td>30</td>
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<tr>
<td>Married or living with partner</td>
<td>26,894</td>
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<td>Separated or divorced</td>
<td>11,195</td>
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<td>Widowed</td>
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<td>&lt;1</td>
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<td>Pre-military education</td>
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<tr>
<td>&lt; High school</td>
<td>963</td>
<td>2</td>
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<tr>
<td>High school or equivalent</td>
<td>30,406</td>
<td>56</td>
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<tr>
<td>Some college or technical school</td>
<td>19,477</td>
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<tr>
<td>College graduate</td>
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<td>Graduate school</td>
<td>784</td>
<td>1</td>
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<tr>
<td>Variable</td>
<td>TBI</td>
<td>No TBI</td>
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<tr>
<td>-------------------------------------------------------------------------</td>
<td>-----------</td>
<td>------------</td>
</tr>
<tr>
<td></td>
<td>(n = 30267)</td>
<td>(n = 20934)</td>
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<tr>
<td>Moderate-to-very severe symptoms in last 30 days</td>
<td></td>
<td></td>
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<tr>
<td>Irritability, easily annoyed</td>
<td>25846</td>
<td>16284</td>
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<tr>
<td>Sleep disturbance</td>
<td>25562</td>
<td>16180</td>
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<tr>
<td>Forgetfulness</td>
<td>24972</td>
<td>14306</td>
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<tr>
<td>Anxious or tense</td>
<td>24273</td>
<td>14946</td>
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<tr>
<td>Headaches</td>
<td>23553</td>
<td>13352</td>
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<tr>
<td>Poor concentration</td>
<td>23021</td>
<td>12948</td>
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<tr>
<td>Poor frustration tolerance, easily overwhelmed</td>
<td>22697</td>
<td>13692</td>
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<tr>
<td>Fatigue</td>
<td>20816</td>
<td>12472</td>
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<tr>
<td>Hearing difficulty</td>
<td>19845</td>
<td>11288</td>
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<tr>
<td>Slowed thinking, difficulty organizing, difficulty finishing things</td>
<td>19377</td>
<td>10487</td>
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<tr>
<td>Depressed or sad</td>
<td>18936</td>
<td>11805</td>
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<tr>
<td>Sensitivity to noise</td>
<td>17709</td>
<td>10111</td>
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<tr>
<td>Sensitivity to light</td>
<td>16770</td>
<td>9132</td>
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<tr>
<td>Difficulty making decisions</td>
<td>16738</td>
<td>9055</td>
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<tr>
<td>Numbness of tingling in parts of body</td>
<td>15181</td>
<td>8854</td>
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<tr>
<td>Change in appetite</td>
<td>14321</td>
<td>8123</td>
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<tr>
<td>Vision problems, blurring, trouble seeing</td>
<td>13327</td>
<td>7384</td>
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<tr>
<td>Feeling dizzy</td>
<td>12356</td>
<td>6099</td>
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<tr>
<td>Poor co-ordination</td>
<td>12280</td>
<td>5768</td>
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<tr>
<td>Loss of balance</td>
<td>11749</td>
<td>5736</td>
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<tr>
<td>Nausea</td>
<td>9015</td>
<td>4496</td>
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<tr>
<td>Change in taste or smell</td>
<td>6377</td>
<td>3091</td>
</tr>
<tr>
<td>Moderate-to-very severe symptom interference in last 30 days&lt;sup&gt;b&lt;/sup&gt;</td>
<td>21160</td>
<td>12371</td>
</tr>
</tbody>
</table>

<sup>a</sup>Logistic regression models were used to compute odds ratios, adjusting for age, gender, race and ethnicity.
<sup>b</sup>No of individuals with symptom interference information was 28514 for TBI and 19009 for no TBI cases.
# Management of the Polytrauma Patient

<table>
<thead>
<tr>
<th>MODERATE/SEVERE TBI</th>
<th>MILD TBI/MSK/PTSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional goal driven rehabilitation</td>
<td>Symptom driven treatments</td>
</tr>
<tr>
<td>Cognitive rehabilitation has varying efficacy based on cognitive domain</td>
<td>Foster engagement in system of care for MH needs in addition to medical needs</td>
</tr>
<tr>
<td>ADL/iADL</td>
<td>Prevent decline in level of function</td>
</tr>
<tr>
<td></td>
<td>Employment/Re-integration</td>
</tr>
</tbody>
</table>