Emerging Science in TBI Care: Diagnosis and Treatment

The Quadruple Aim: Learning & Growth, Readiness, Experience of Care

Kathy Helmick MS, CRNP, CNRN - Senior Executive Director, TBI

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### Emerging Science in TBI Care: Diagnosis and Treatment: The Quadruple Aim: Learning & Growth, Readiness, Experience of Care

**Performing Organization:**
Defense Centers of Excellence for Psychological Health & Traumatic Brain Injury, 2345 Crystal Drive, Crystal Park 4, Suite 120, Arlington, VA 22202

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**Subject Terms:**

<table>
<thead>
<tr>
<th>a. Report</th>
<th>b. Abstract</th>
<th>c. This Page</th>
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<tbody>
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**Limitation of Abstract:**
Same as Report (SAR)

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48
Agenda: Emerging Science and DoD Programs

- DoD Definition of TBI
- Severity of Injury
- Continuum of Care
  - Prevention
  - Surveillance
  - Screening/Assessment
  - Diagnosis
  - Case Management
  - Treatment
  - Rehabilitation
  - Reintegration
- The Way Ahead
DoD TBI Definition (Oct 07)

- Traumatically induced structural injury or physiological disruption of brain function as a result of external force to the head

- New or worsening of at least one of the following clinical signs
  - Loss of consciousness or decreased consciousness
  - Loss of memory immediately before or after injury
  - Alteration in mental status (confused, disoriented, slow thinking)
  - Neurological deficits
  - Intracranial lesion

- DoD definition parallels standard medical definition
  - CDC, WHO, AAN, ACRM
## Severity Rating for TBI

### Traumatic Brain Injury Description

<table>
<thead>
<tr>
<th>Severity</th>
<th>GCS</th>
<th>AOC</th>
<th>LOC</th>
<th>PTA</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>
</tr>
<tr>
<td>Moderate</td>
<td>9-12</td>
<td>&gt;24 hrs</td>
<td>&gt;30 min &lt;24 hrs</td>
<td>&gt;24 hrs &lt;7 days</td>
</tr>
<tr>
<td>Severe</td>
<td>3-8</td>
<td>&gt;24 hrs</td>
<td>≥24 hrs</td>
<td>≥7 days</td>
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</tbody>
</table>

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

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## TBI Clinical Standards: Severity, Stages, Environment

<table>
<thead>
<tr>
<th>Types of TBI</th>
<th>TBI Post-Injury Stages</th>
<th>Levels of TBI Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>Acute</td>
<td>In-theater</td>
</tr>
<tr>
<td>Moderate</td>
<td>Sub-Acute</td>
<td>CONUS</td>
</tr>
<tr>
<td>Severe</td>
<td>Chronic</td>
<td>In-patient</td>
</tr>
<tr>
<td>Penetrating</td>
<td></td>
<td>Outpatient</td>
</tr>
</tbody>
</table>

### Levels of TBI Care

- In-theater
- CONUS
- In-patient
- Outpatient
- Community
Possible Effects of mTBI

- **Acute**
  - Poor marksmanship
  - Slower reaction time
  - Decreased concentration

- **Chronic**
  - Reduced work quality
  - Behavioral problems
  - Emotional problems
  - “Unexplained“ symptoms

TBI-related impairments increase vulnerability to subsequent injury until full recovery occurs
TBI Milestones

- **AUG 03**: Walter Reed Army Medical Center
  - MANDATORY TBI screening for all medically evacuated personnel, regardless of injury or illness
- **SUMMER 05**: Wilford Hall Medical Center
  - MANDATORY TBI screening of all medically evacuated personnel
- **MAY 06**: Landstuhl Regional Medical Center
  - MANDATORY TBI screening for all medically evacuated personnel, regardless of injury or illness
- **AUG 06**: Deployment of the Military Acute Concussion Evaluation (MACE) tool
- **JAN 07**: In-Theater Clinical Practice Guidelines (Version 1.0)
- **APR 07**: VA Facilities
  - MANDATORY TBI screening
- **JAN 08**: Post-deployment Health Assessment & Reassessment (PDHA & PDHRA)
  - Addition of TBI screening questions
- **APR 09**: VA/DoD/DCoE Evidence Based guidelines for mild TBI
  - Cognitive rehabilitation consensus conference and clinical guidance package developed
- **MAY 09**: Pre-deployment Requirements
  - Mandatory cognitive baselines on SMs (NCAT/ANAM)
- **JUN 10**: DCoE initiated Directive Type Memorandum (DTM) #09-033

Numerous screening safety nets to ensure capture of SMs requiring intervention
What are Our Major Challenges?

- **Undetected TBI**
  - Screening/Detection (pre-, intra-, post-deployment)
  - Directive Type Memorandum (DTM)

- **Force Readiness/Cultural Barriers**
  - Line education
  - Partnering with the NFL

- **Improving Collaborations with VA, Academia and Civilian Organizations**

- **Deployment Related Assessments**
  - Neurocognitive Issues after Concussion – e.g. Testing after event or deployment

- **Effective treatments**
  - Repeat Concussions
  - Co-Morbidities

- **Research**
  - “Fast tracking” for objective markers diagnostic of mTBI
Continuum of Care

Prevention  Surveillance  Screening / Assessment  Diagnosis  Case Management  Treatment  Rehabilitation  Reintegration
Prevention

- Head-borne system
  - Improve protection from ballistic threats
  - Reduce injury from blast events
- Use of seat belts/ PPE
- Sports related injuries
  - Helmets
- Public awareness campaigns aimed at educational and prevention strategies
  - CDC: Head’s UP
### TBI Diagnoses (all severities) 2000–2010 Q3

<table>
<thead>
<tr>
<th>Year</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010 Q3</th>
<th>TOTAL</th>
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<tbody>
<tr>
<td></td>
<td>10,963</td>
<td>11,830</td>
<td>12,470</td>
<td>12,898</td>
<td>13,312</td>
<td>12,192</td>
<td>16,946</td>
<td>23,160</td>
<td>28,555</td>
<td>29,223</td>
<td>23,998</td>
<td>195,547</td>
</tr>
</tbody>
</table>

- **SOURCE:** [http://www.dvbic.org/TBI-Numbers.aspx](http://www.dvbic.org/TBI-Numbers.aspx)
- Compiled using electronic medical records – represent actual medical diagnoses of TBI in the US Military
How Big is the TBI Challenge?

Number of TBI Cases First Identified by Year

Data Source: www.DVBIC.org
Tracking the Impact: TBI Severity Data

TBI Severity by Year

Year

2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 3Q 2010

% of Cases

0% 10% 20% 30% 40% 50% 60% 70% 80% 90%

Mild (Concussion)
Moderate
Severe / Penetrating
Not Classifiable

Original Data Source: www.DVBIC.org

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Continuum of Care

Prevention  Surveillance  Screening / Assessment  Diagnosis  Case Management  Treatment  Rehabilitation  Reintegration
Policy Guidance for the Management of Concussion/mTBI in the Deployed Setting

- Directive-Type Memorandum (DTM) 09-033
- Issued 21 June 2010 by DEPSECDEF
- Involves commitment of line commanders and medical community
  - DCoE coordination with FHP/R, JS, CENTCOM, JTAPIC, Service TBI POC’s
- Describes mandatory processes for identifying those service members involved in potentially concussive events
  - Exposed to blast, vehicle collision, witnessed loss of consciousness, other head trauma
- DCoE developed specific protocols for management of concussed Service members and those with recurrent concussion
- Transition from symptom driven reporting to incident driven

**DESIRED END STATE:** the mitigation of the effects of potential concussive events on both Service member health, readiness and ongoing operations
Highlights from the DTM

- Mandatory **event driven protocols**, for exposure to potentially concussive events
- Requires a medical **evaluation and a rest** period
- All sports and **activities with risk** of concussion are prohibited until medically cleared
- Military Acute Concussion Evaluation (MACE) documentation will include **MACE 3-part score**
- Service Members diagnosed with mTBI will be given a **standardized educational sheet**
- New **protocols** for anyone sustaining 3 or more mTBIs within 12 months
GOAL: A *cultural change* in Warfighter management after concussive events: identification and documentation of the incident, treatment close to point of injury, and expectation of recovery with early treatment.

VISION: Every Warfighter trained to:
- Recognize the signs/symptoms
- Equipped to reduce the effects
  *And in the event of an injury –*
- Treated early to minimize the impact and maximize recovery from TBI.

MISSION: Produce an educated force trained and prepared to provide early recognition, tracking, treatment & documentation of TBI in order to protect Warfighter health.
MACE: Military Acute Concussion Evaluation

- Developed by DVBIC and released in Aug 2006
- Performed by medical personnel
- 3-Part Screening Tool – “CNS”
  - Cognition
  - Neurological Exam
  - Symptoms
- Alternate versions available
- Upcoming revision will include recurrent concussion questions
- Can be used during exertional testing to ensure that cognitive function remains intact
## Post Concussive Symptoms

<table>
<thead>
<tr>
<th>Physical</th>
<th>Emotional</th>
<th>Cognitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>Anxiety</td>
<td>Slowed processing</td>
</tr>
<tr>
<td>Dizziness</td>
<td>Depression</td>
<td>Decreased attention</td>
</tr>
<tr>
<td>Balance Problems</td>
<td>Irritability</td>
<td>Poor concentration</td>
</tr>
<tr>
<td>Nausea/vomiting</td>
<td>Mood lability</td>
<td>Memory problems</td>
</tr>
<tr>
<td>Fatigue</td>
<td></td>
<td>Verbal dysfluency</td>
</tr>
<tr>
<td>Visual disturbances</td>
<td></td>
<td>Word-finding</td>
</tr>
<tr>
<td>Sensitivity to light/noise</td>
<td></td>
<td>Abstract reasoning</td>
</tr>
<tr>
<td>Ringing in the ears</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 9.a. During this deployment, did you experience any of the following events? *(Mark all that apply)*

1. **Blast or explosion** *(IED, RPG, land mine, grenade, etc.)*
2. **Vehicular accident/crash** *(any vehicle, including aircraft)*
3. **Fragment wound or bullet wound above your shoulders**
4. **Fall**
5. **Other event** *(for example, a sports injury to your head)*. Describe:

### 9.b. Did any of the following happen to you, or were you told happened to you, IMMEDIATELY after any of the event(s) you just noted in question 9.a.? *(Mark all that apply)*

1. **Lost consciousness or got “knocked out”**
2. **Felt dazed, confused, or “saw stars”**
3. **Didn’t remember the event**
4. **Had a concussion**
5. **Had a head injury**

### 9.c. Did any of the following problems begin or get worse after the event(s) you noted in question 9.a.? *(Mark all that apply)*

1. **Memory problems or lapses**
2. **Balance problems or dizziness**
3. **Ringing in the ears**
4. **Sensitivity to bright light**
5. **Irritability**
6. **Headaches**
7. **Sleep problems**

### 9.d. In the past week, have you had any of the symptoms you indicated in 9.c.? *(Mark all that apply)*

1. **Memory problems or lapses**
2. **Balance problems or dizziness**
3. **Ringing in the ears**
4. **Sensitivity to bright light**
5. **Irritability**
6. **Headaches**
7. **Sleep problems**

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**Positive screen = concurrence to all four questions**

**Positive screen ≠ concussion diagnosis**

**Need clinician confirmation to diagnose concussion**
Computerized neurocognitive assessment tool

Purpose:
- Establish an accurate assessment of pre-injury cognitive performance for comparison in post-injury return to duty (RTD) decisions
  - One piece of clinical picture
  - Selective use for those with more clinically challenging cases
- Takes 20 minutes to complete

Current policy (May 08):
- All pre-deployers receive baseline cognitive testing with ANAM within one year of deployment
- Over 758K SM’s baselined through 31 Dec 2010

Other tools being studied head-to-head (H2H)
- Better assessment if injured SM is compared to their baseline scores as opposed to a normative databank
Continuum of Care

Prevention  Surveillance  Screening / Assessment  Diagnosis  Case Management  Treatment  Rehabilitation  Reintegration
Objective Markers of Concussion

Examples for possible objective markers of concussion: (not limited to):

Objective Test for Post Concussion Syndrome

- Pupillary response/visual tracking (*EYE-TRAC: Eye-Tracking Device*)
- Biomarkers – serum, saliva, skin (*BANDITS: Biomarker Assessment for Neurotrauma Diagnosis & Improved Triage System*)
- Imaging – Diffusion Tensor Imaging (DTI) (Blast related TBI using DTI)
- Electrophysiologic parameters – qEEG, event related potentials, heart rate (Hand Held Real time multichannel EEG : Brainscope Ahead M-100)
TBI Case Management Initiatives

- TBI CM SOP: get this at [www.dcoe.health.mil](http://www.dcoe.health.mil)
- TBI Community of interest newsletter
- DVBIC Regional Care Coordination program
- Coordination with Federal Recovery Coordination program
Please visit [www.dvbic.org](http://www.dvbic.org) to obtain contact information for your regional education or care coordinator.

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Continuum of Care

Prevention | Surveillance | Screening / Assessment | Diagnosis | Case Management | Treatment | Rehabilitation | Reintegration
What’s New in Treatment of TBI?

- **Clinical Practice Guidelines**
  - TBI clinical practice guidelines and clinical support tools profiles and analysis
  - Cognitive Rehabilitation in TBI
  - Management of Severe TBI treatment literature review
  - Altitude effects on TBI literature review
  - Sleep and TBI literature review
  - Neuroendocrine sequelae of TBI literature review
  - Toolkit for Treating mTBI and Co-Occurring Conditions

- **Rehabilitation / Recovery / Reintegration**
  - DVBIC - Virtual TBI Clinic (VTC)
  - National Intrepid Center of Excellence (NICOE)

- **Dissemination to the field**

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Co-Morbidities Associated with mTBI

- Sleep disorders
- Substance abuse
- Psychiatric illness
- Vestibular disorders
- Visual disorders
- Cognitive disorders


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Toolkit and Pocket Guide

Concussion and Co-occurring Psychological Health Conditions Toolkit
Concussion, PTSD, Acute Stress, Depression, Chronic Pain, Substance Use Disorder

Mild TBI Pocket Guide
Sample Treatments Undergoing Scientific Inquiry

- List not exhaustive
- Hyperbaric Oxygen
- Cognitive Rehabilitation
  - SCORE trial
- Neuroprotection Drugs
  - Docosahexaenoic acid (DHA)
  - Progesterone
  - NNZ – 2566
  - Growth Hormone
Treatment: Cognitive Rehabilitation

- Cognitive domains affected after TBI
  - Attention
    • Foundation for other cognitive functions/goal-directed behavior
    • Efficacy of attention training established
  - Memory
    • True memory impairment vs. poor memory performance from inattention
    • Evidence to support development of memory strategies and training in use of assistive devices (‘memory prosthetics’)
  - Social/Emotional
    • Evidence to support group sessions in conjunction with individual goal setting
  - Executive Function
    • Evidence to support training use of multiple step strategies, strategic thinking and/or multitasking

- Compensatory vs. restorative therapy
Implementation at 13 MTFs


Beginning in Aug 2010, each MTF will track outcome measures identified in the Clinical Guidance Document

Report back to the CPSC in February 2011
Cognitive Rehabilitation Research Efforts

- NDAA FY 10: RCT for cognitive rehab in TBI in returning OEF/OIF
- DVBIC SCORE trial: 4 arms, San Antonio. Set to begin in March 2011
- CDMRP BAA for studies: Final proposal review. Awards pending
- IOM study: evaluate certain interventions in cognitive rehabilitation for efficacy. Report due by October 2011
Resources

- National Resource Library
- Military OneSource
- DCoE 24/7 Outreach Call Center
- www.dvbic.org
- TBI Family Caregiver Guide
- www.Afterdeployment.org
- DCoE Facebook, Twitter, YouTube, Scribd
- Multiple Mobile Smartphone Applications
- DCoE Blog
- Yellow Ribbon Presentations
- Handbook for Family & Friends of Service Members Before, During, and After Deployment
Phase I Recommendation

“The committee recommends that the Department of Defense and the Department of Veterans Affairs oversee coordination and communication of the multitude of programs that have been created in response to the needs of Operation Enduring Freedom and Operation Iraqi Freedom service members, veterans, and their family members in an effort to maximize their reach and effectiveness. The committee also recommends that there be independent evaluation of these programs with standardized evaluation designs and assessment of outcomes.”
Cumulative Concussion and Longitudinal Effects

- Congressionally mandated 15 year longitudinal study (DVBIC executing)
- Brain banks
- Addition of MACE question on initial evaluation about cumulative concussion and DTM data
  - Follow Electronic Health Record through system and VA
Chronic Traumatic Encephalopathy

- Chronic Traumatic Encephalopathy
- Symptoms can include:
  - Memory disturbances
  - Behavioral changes
  - Personality changes
  - Parkinsonism
  - Speech abnormalities

Coronal sections immunostained for tau with monoclonal antibody AT8 and counterstained with cresyl violet
DoD TBI Research Initiatives

- Close collaboration among the line, medical, and research communities
- Key areas
  - Rapid field assessment of concussion (i.e., rapid eye movement tracking, biomarkers)
  - Novel therapeutics (i.e., omega-3, progesterone, Hyperbaric Oxygen trials, cognitive rehabilitation)
  - Blast dynamics (i.e., neuroimaging)

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National Intrepid Center of Excellence (NICoE)

- Located on NNMC campus in Bethesda, MD
- Dedicated 24 June 2010
- Serves SM (and their families!) with complex TBI and PH care needs
- Primarily evaluative in nature
  - Generally to be used by those who have refractory or difficult-to-diagnose/manage conditions
  - Provides case management and referral capabilities to leading experts in the field
- Initial Operating Capability: Oct 10
- Full Operating Capability: Oct 11

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TBI Way Forward

Detection & Screening
- Complete revisions of PDHA and PDHRA forms (to be finalized Jan 2011). DCoE review of TBI and PH portions.
- Neurocognitive Assessments: Continue pre-deployment neurocognitive testing and post-event testing where appropriate
- Develop rapid and effective screening tools for field use

Cultural Transformation
- Continue education to all service members
- Target TBI education to Combatant Commanders and leaders, bringing responsibility from medical into line
- Continue to encourage data sharing between DoD and VA

Treatment/Rehabilitation
- Continue training every provider treating TBI patients (Service coordination and leveraging)
- Develop provider education compliance metrics and evaluate the Services’ and MTF efforts to improve TBI care
TBI Way Forward (continued)

Treatment /Rehabilitation (cont’d.)

- TBI Programs to validate TBI protocols and procedures used by Military Health System (MHS)

Research

- Continue fast-track of promising TBI research
- Translate promising research into practice in an expedited fashion when a threshold of scientific rigor has been met to safely institute
- Neurocognitive Assessments: Complete head-to-head study of cognitive testing tools; explore potential defining of post-deployment normative cognitive scores
- Continue work with the VA and other public/private organizations to yield collaborations and products benefitting TBI care
TBI Way Forward (continued)

Information Technology

- Implement Web-based baseline NCAT data system – anticipated to begin field testing second quarter FY 11
- Increase IT infrastructure to support improved EHR communication across agencies and allows patient tracking
- Enterprise-wide solutions that allow for capture of medical data from point of injury through reintegration (to include VA)