



Prevalence of TBI and Chronic Effects of Blast-Related Trauma In the Military

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An injured U.S. Air Force airman is rushed through "Hero's Highway" to the emergency room on Balad Air Base, Iraq, Jan. 15, 2008. "Hero's Highway" is a canopy with an American flag that serves as a transition area between the helipad and the ER. U.S. Air Force photo by Master Sgt. John R. Nimmo Sr.



DCoE Overview



Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury (DCoE) is the lead agency for the Department of Defense (DoD) accountable for the advancement of psychological health and traumatic brain injury (TBI) prevention and care in the Military Health System (MHS).

We are responsible for creating, evaluating and integrating psychological health and TBI practices and policies across the Services.

- Identify priorities and gaps in policy, practice and research
- Create clinical tools and recommendations
- Promote scientific or evidence-based care practices
- Lead program evaluation efforts and effectiveness studies, assess cost-saving measures



Defense and Veterans Brain Injury Center



Mission: To serve active duty service members, their beneficiaries, and veterans with traumatic brain injuries through state-of-the-science clinical care, innovative clinical research and educational programs, and support for force health protection services as the DoD's TBI Center of Excellence





Mission Essential Components



Research

- Clinical Investigations
- Translation of Research
- Congressionally Mandated Studies
- Epidemiological Research
- Research Analysis
- Quality Process Improvement and Program Evaluation

Clinical Affairs

- Identification & Sharing Best Practices
- Clinical Guidelines & Recommendations
- Care & Consultation
- TBI Surveillance
- Recovery Support Program
- TBI Health Outcomes

Education

- Development of Educational Tools & Resources
- TBI Awareness and Training
- Product Distribution
- Congressionally Mandated Family Caregiver Resources
- Regional Education Coordination Program
- Outreach



DVBIC Regional Map



TBI Regional Education Coordinator and Recovery Support Specialist Sites and Catchment Regions

Veterans Affairs Palo Alto Health Care System
Palo Alto, CA (11 MTF, 10 VA)
Color = Coordinating Region

Naval Hospital Camp Pendleton, CA (29 MTF, 7 VA)
Color = Coordinating Region

Naval Medical Center San Diego, CA
Color = Coordinating Region

Joint Base Elmendorf-Richardson Anchorage, AK (3 MTF, 0 VA)
Color = Coordinating Region



Evans Army Community Hospital Fort Carson, CO (13 MTF, 2 VA)
Color = Coordinating Region

Minneapolis Veterans Affairs Medical Center Minneapolis, MN (12 MTF, 25 VA)
Color = Coordinating Region

Walter Reed National Military Medical Center Bethesda, MD (11 MTF, 25 VA)
Color = Coordinating Region

Veterans Affairs Boston Healthcare System Boston, MA
Color = Coordinating Region

DVBIC Headquarters Silver Spring, MD

Fort Belvoir, Fort Belvoir, VA (19 MTF, 20 VA)
Color = Coordinating Region

Hunter Holmes McGuire Veteran Affairs Medical Center Richmond, VA (16 MTF, 11 VA)
Color = Coordinating Region

Naval Hospital Camp Lejeune, NC (10 MTF, 6 VA)
Color = Coordinating Region

Womack Army Medical Center Fort Bragg, NC (7 MTF, 8 VA)
Color = Coordinating Region

Carl R. Darnall Army Medical Center Fort Hood, TX (9 MTF, 8 VA)
Color = Coordinating Region

James A. Haley Veterans Hospital Tampa, FL (26 MTF, 13 VA)
Color = Coordinating Region

San Antonio Military Medical Center San Antonio, TX (13 MTF, 6 VA)
Color = Coordinating Region



Major Highlights



- State-of-the-Science Clinical Recommendations
- Capture of Mild TBI outcomes
- Research into Long-Term Effects following TBI
- TBI Awareness Campaigns
- Focus on Garrison and Youth Sports Concussion
- Neurocognitive Initiatives
- Standardized and Integrated MHS TBI Pathways of Care



Traumatic Brain Injury (TBI)

(Memorandum: TBI Updated Definition and Reporting, April 6, 2015)



DoD Definition:

A traumatically induced structural injury or physiological disruption of brain function as a result of an external force, that is indicated by new onset or worsening of at least one of the following clinical signs, immediately following the event:

- Any period of loss of or decrease of consciousness, observed or self-reported (**LOC**)
- Any loss of memory for events immediately before or after the injury (**PTA**)
- Any alteration in mental status (confusion, slowed thinking, disorientation) (**AOC**)

DoD definition parallels standard medical definition of Centers for Disease Control, World Health Organization, American Academy of Neurology, and American Congress of Rehabilitation Medicine



Concussion



- Primarily a physiologic injury (most have complete recovery)
 - Electrophysiologic
 - Neurometabolic
 - Synaptic
- May not be primarily a structural or tissue injury



Severity of Diagnosed TBI Among Service Members



DoD Numbers for Traumatic Brain Injury Worldwide – Totals

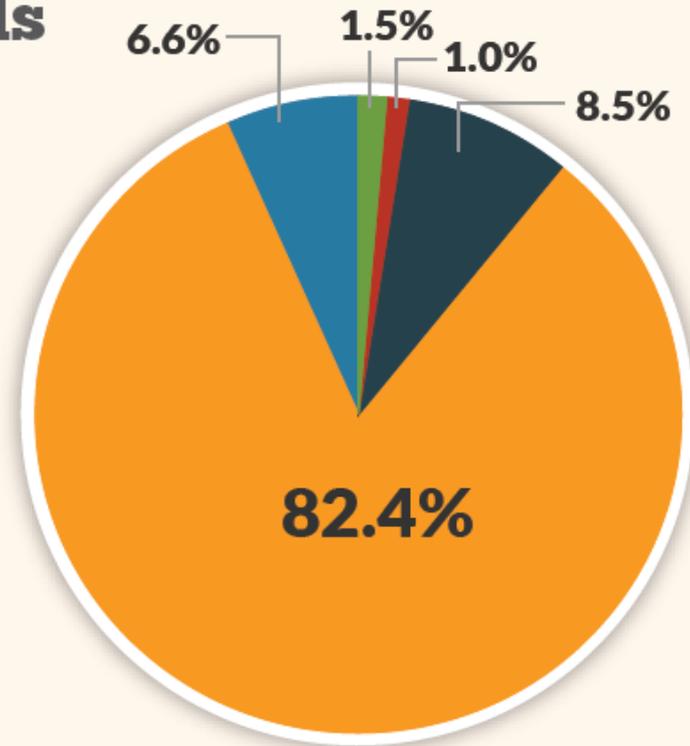
2000-2015 Q1-Q2

Penetrating	4,904
Severe	3,463
Moderate	28,192
Mild	274,568
Not Classifiable	22,042

Total - All Severities 333,169

Source: Defense Medical Surveillance System (DMSS), Theater Medical Data Store (TMDS) provided by the Armed Forces Health Surveillance Center (AFHSC)

Prepared by the Defense and Veterans Brain Injury Center (DVBIC)



2000-2015 Q1-Q2 , as of Aug 18, 2015

Total of 333,169 Service Members have been diagnosed with at least one TBI since year 2000 to 30 June 2015



Service Members Diagnosed with First-time TBI



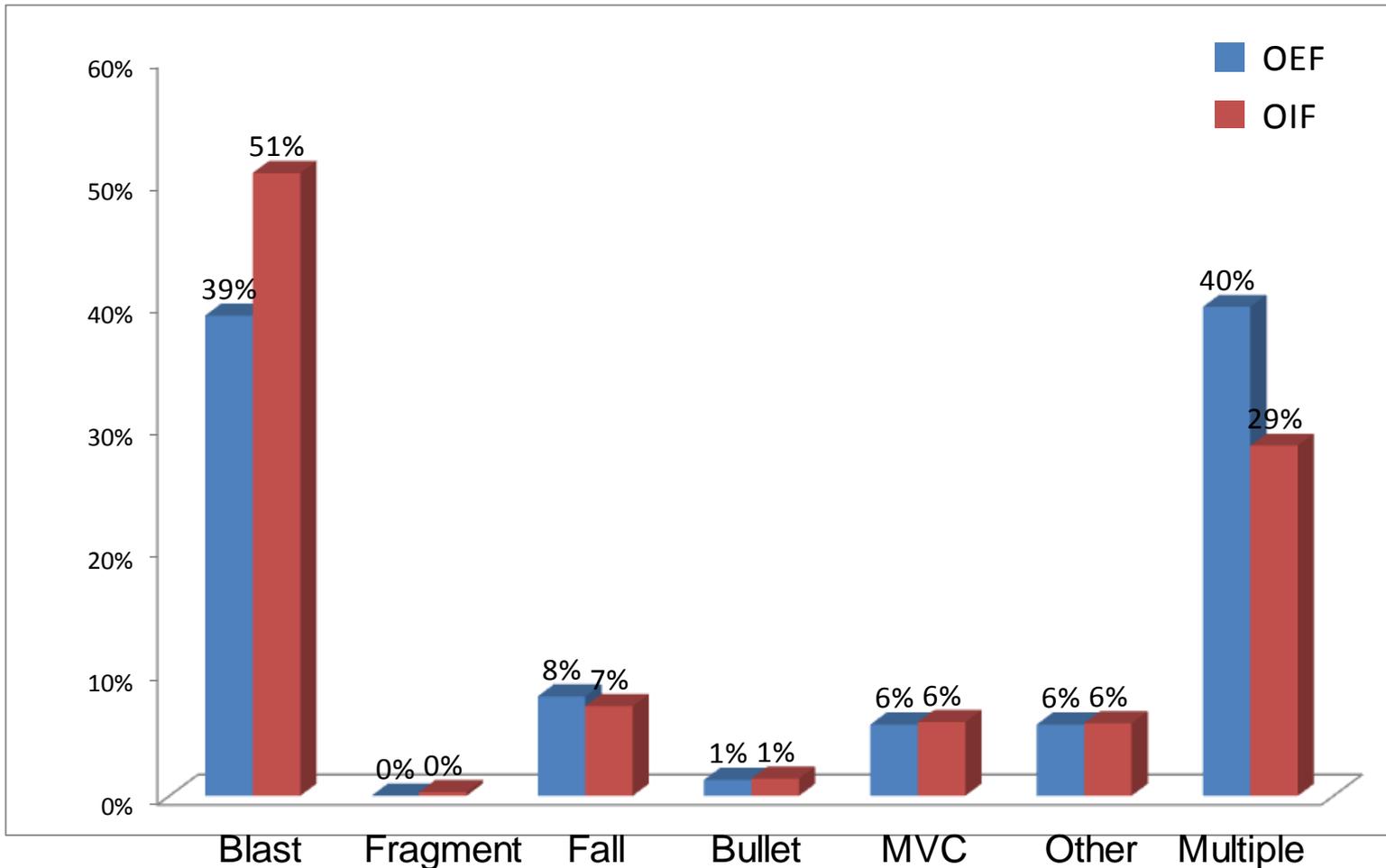
Over 80 percent of all TBIs are diagnosed in the non-deployed setting

Over 82 percent of all TBIs are mild, also known as 'concussion'

YEAR	Service Members Diagnosed with TBI
2000	10,958
2001	11,619
2002	12,407
2003	12,815
2004	14,468
2005	15,530
2006	17,036
2007	23,218
2008	28,538
2009	28,958
2010	29,442
2011	32,907
2012	30,801
2013	27,646
2014	25,111
2015 (Q1-2)	11,715
Total	333,169



OEF/OIF Mechanism of Injury



Numbers represent cases with a reported combat operation of OEF/OIF and a U.S. Armed Forces affiliation. Blast includes vehicle blast events. Data Source: DVVIC Cumulative dataset



Policy Guidance for the Management of Concussion/mTBI in the Deployed Setting



Department of Defense Instruction (DoDI) 6490.11

- Issued 18 September 2012 following termination of Directive Type Memorandum (DTM) 09-033, which was issued 21 June 2010
- Involves commitment of line commanders and medical community
- 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
- Specific protocols for management of concussed service members and those with recurrent concussion
- Transition from symptom-driven reporting to incident-driven
- Reporting requirements to track those involved in potentially concussive events

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



Mandatory Event Screening & Reporting



Any service member in a vehicle associated with a blast event, collision, or rollover

Presence within 50 meters of a blast (inside or outside)

A direct blow to the head or witnessed loss of consciousness

Exposure to more than one blast event (the service member's commander shall direct a medical evaluation)

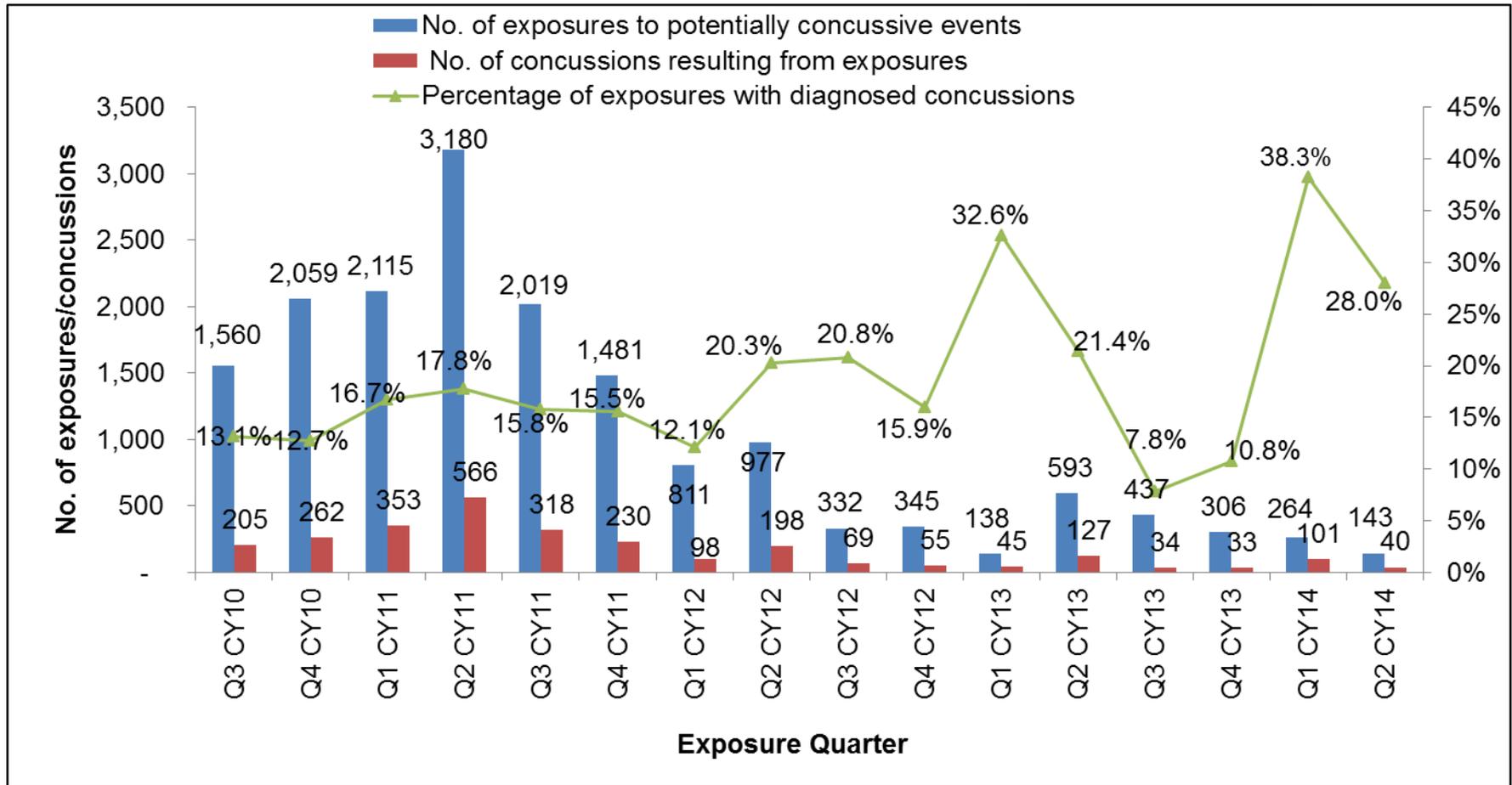
Mandatory
24-hour
downtime*
&
medical
evaluation

* Commanders may delay or postpone 24-hour downtime based on mission requirements

•Reference: Department of Defense Instructions (DoDI) 6490.11



Exposures to Potentially Concussive Events and Concussions Resulting from Exposures

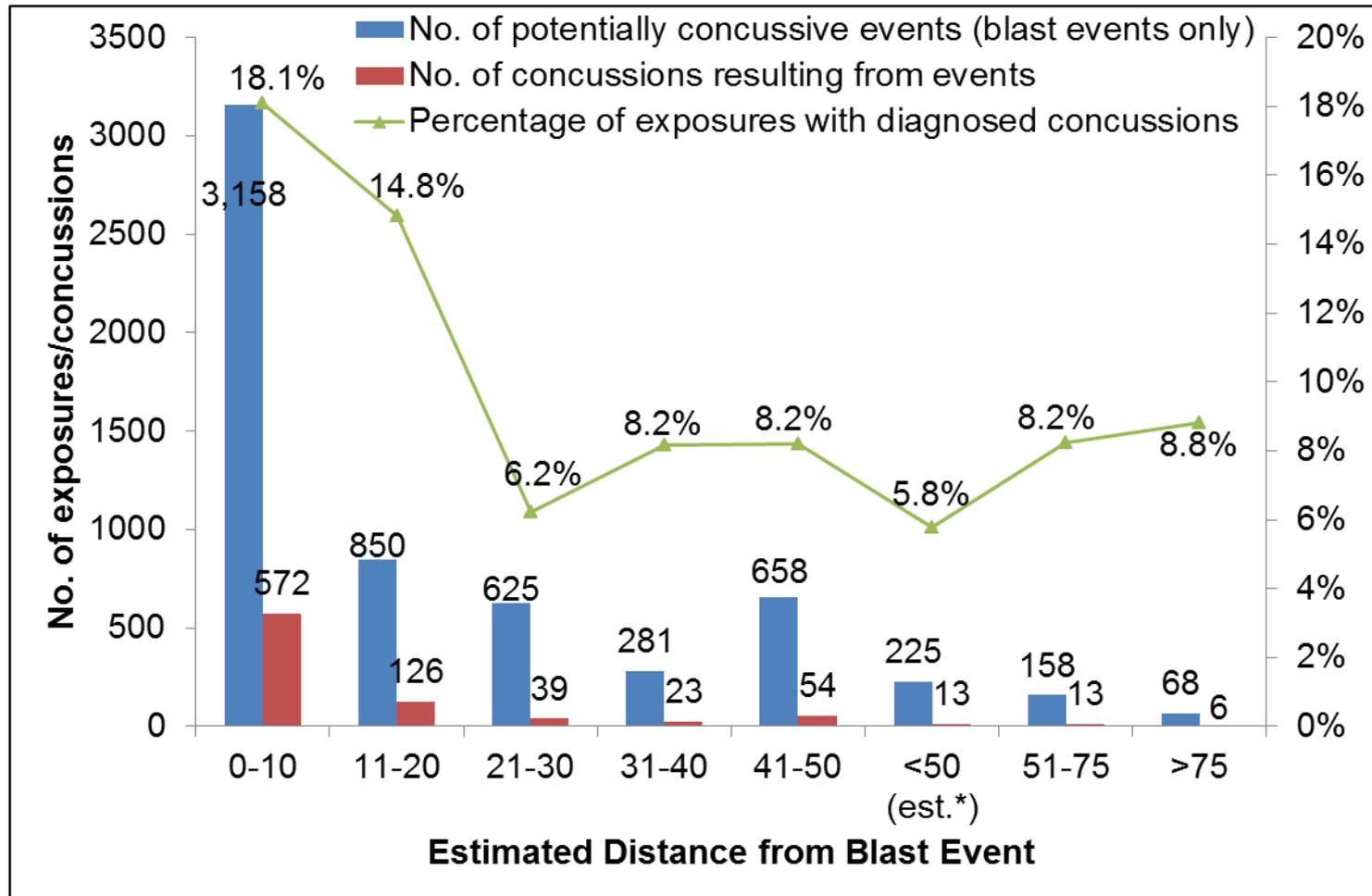


During August 2010 – June 2014, BECIR identified 16,760 Exposures; 2,734 Concussion dx; and 16.3% Concussion of all exposures

Note: Exposures include events with unknown medical records.



Distances from Blast Events and Concussions Resulting from Blasts

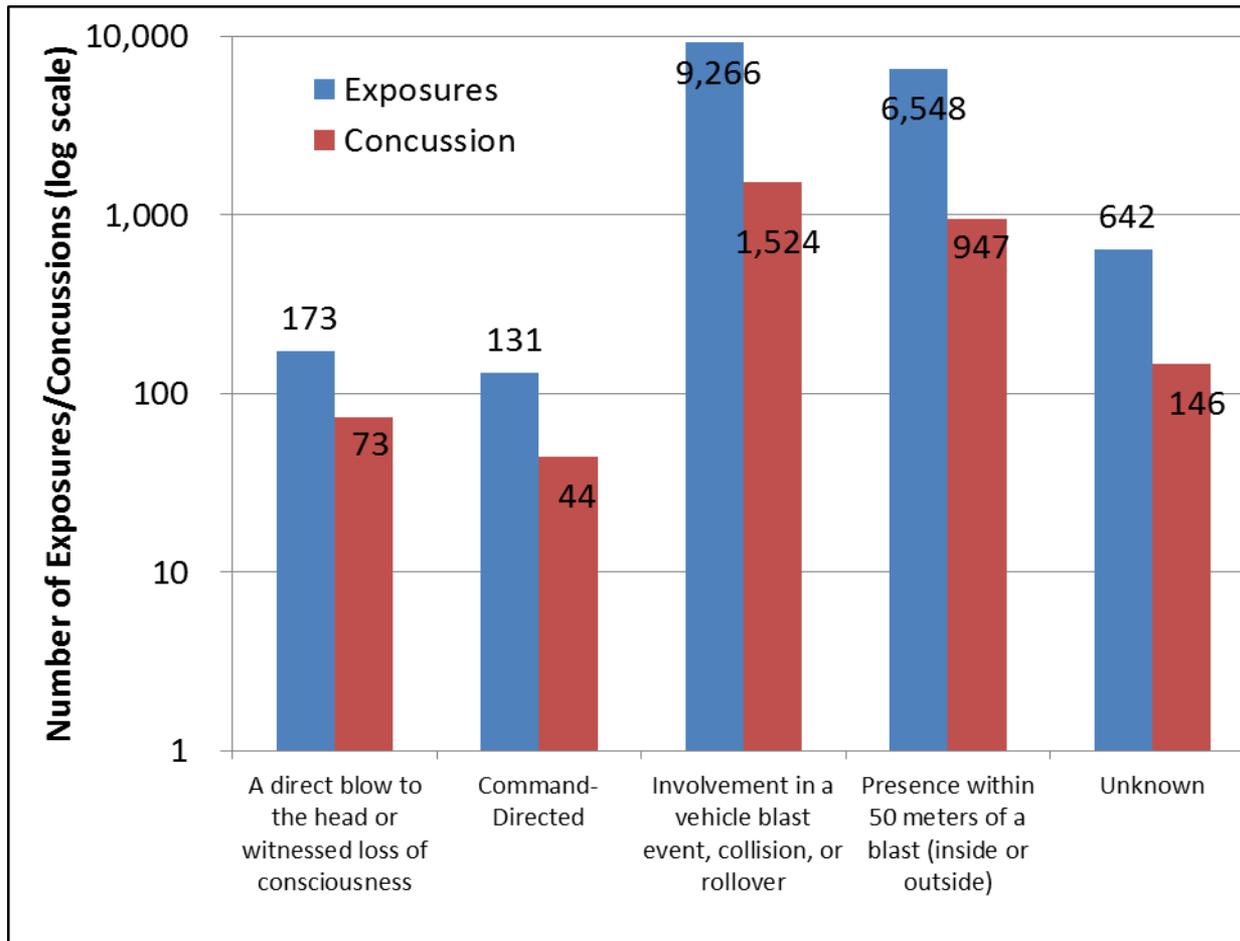


Period: Aug 2010 – Jun 2014

Note: Exposures include events with unknown medical records



Event Types of Potentially Concussive Events and Concussions Resulting from Exposures



Period: Aug 2010 - Jun 2014 Source: BECIR Report

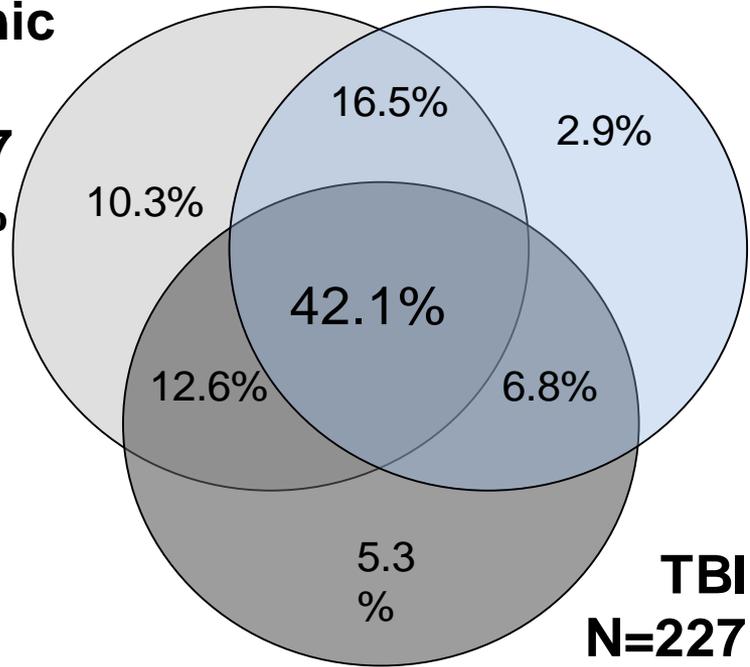
Note: Exposures include events with unknown medical records



Comorbidities Associated with mTBI



Chronic Pain
N=277
81.5%



PTSD
N=232
68.2%

TBI
N=227
66.8%

- Sleep Disorders
- Substance Abuse
- Psychiatric Illness
- Vestibular Disorders
- Visual Disorders
- Cognitive Disorders

Source: Lew et al. (2009). "Prevalence of Chronic Pain, Posttraumatic Stress Disorder, and Persistent Postconcussive Symptoms in OIF/OEF Veterans: Polytrauma Clinical Triad", Dept. of Veterans Affairs, Journal of Rehabilitative Research and Development, Vol. 46, No. 6, pp. 697-702, Fig. 1



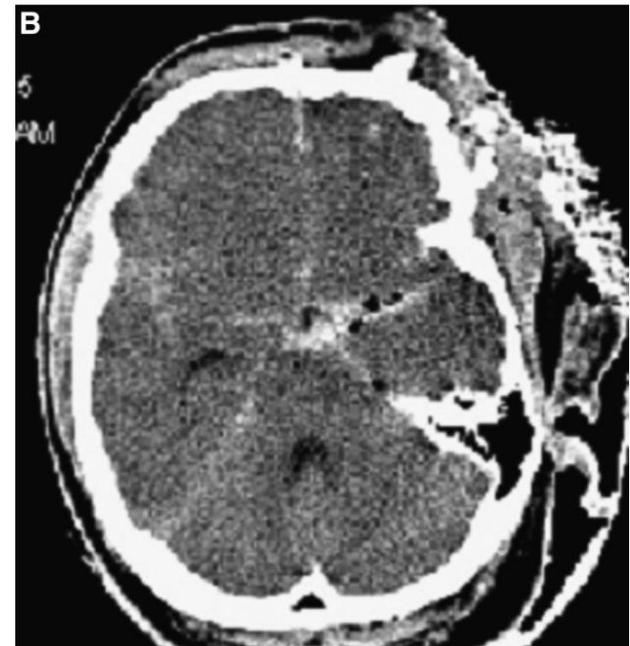
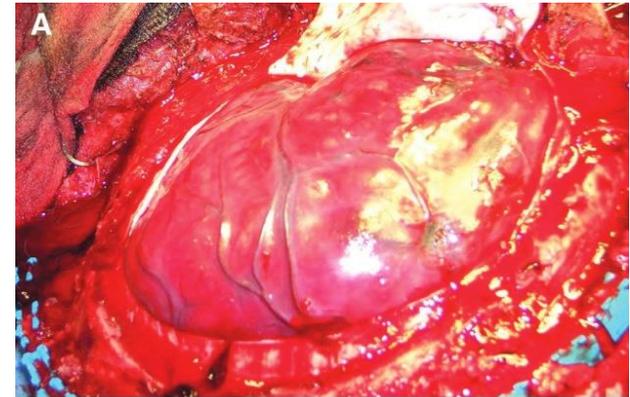
Diffuse Injury and Swelling with Blast



This patient was exposed to a close-range IED blast while riding in an open vehicle approximately 2 hours prior to this intraoperative photo.

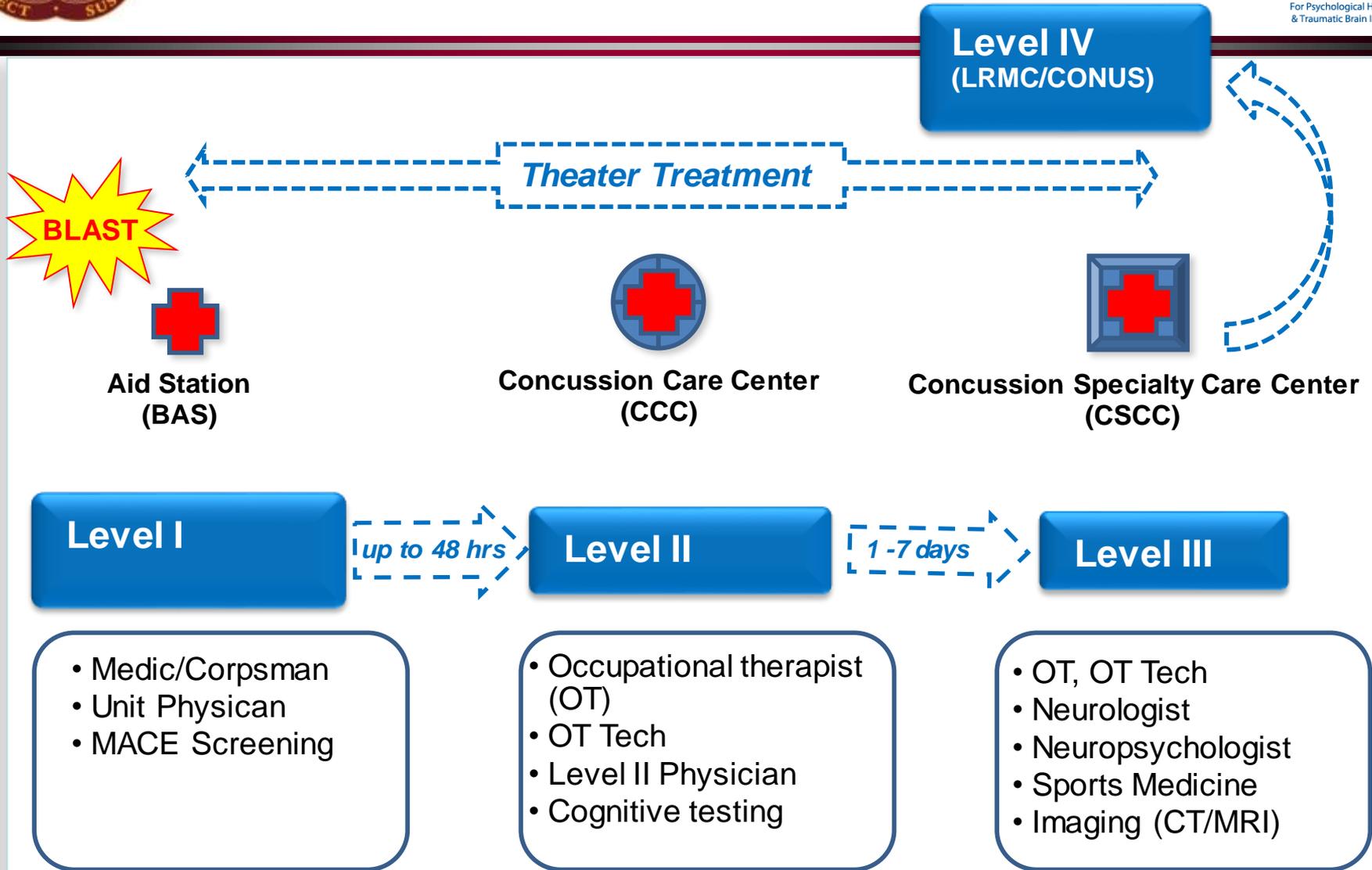
- Photo taken after a decompressive craniectomy and dural opening that reveals the severe brain hyperemia and edema often associated with these injuries
- CT image from the same patient, showing traumatic subarachnoid hemorrhage in the basilar cisterns

Source: Ling et al. (2009, June). *JOURNAL OF NEUROTRAUMA* 26:815–825



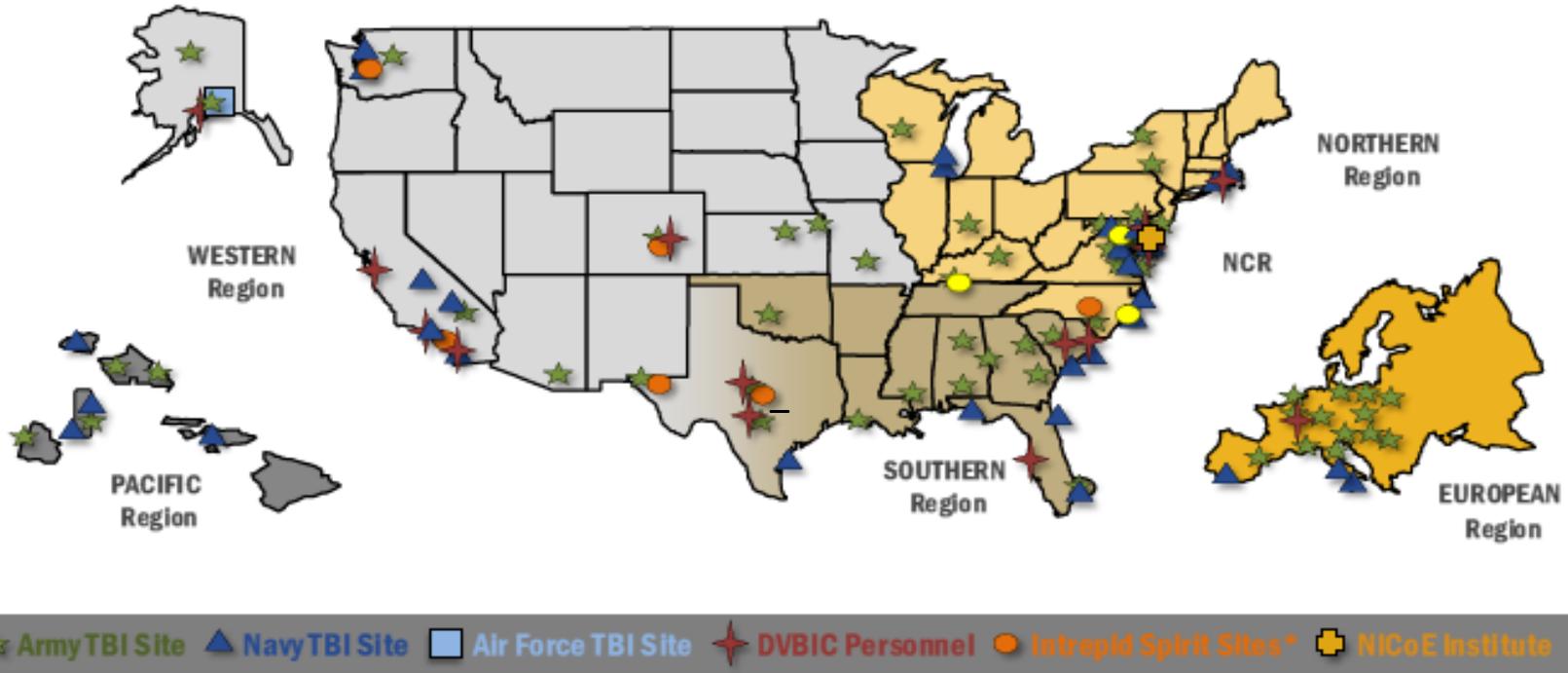


Concussion Care Center Model





TBI Capabilities in the MHS



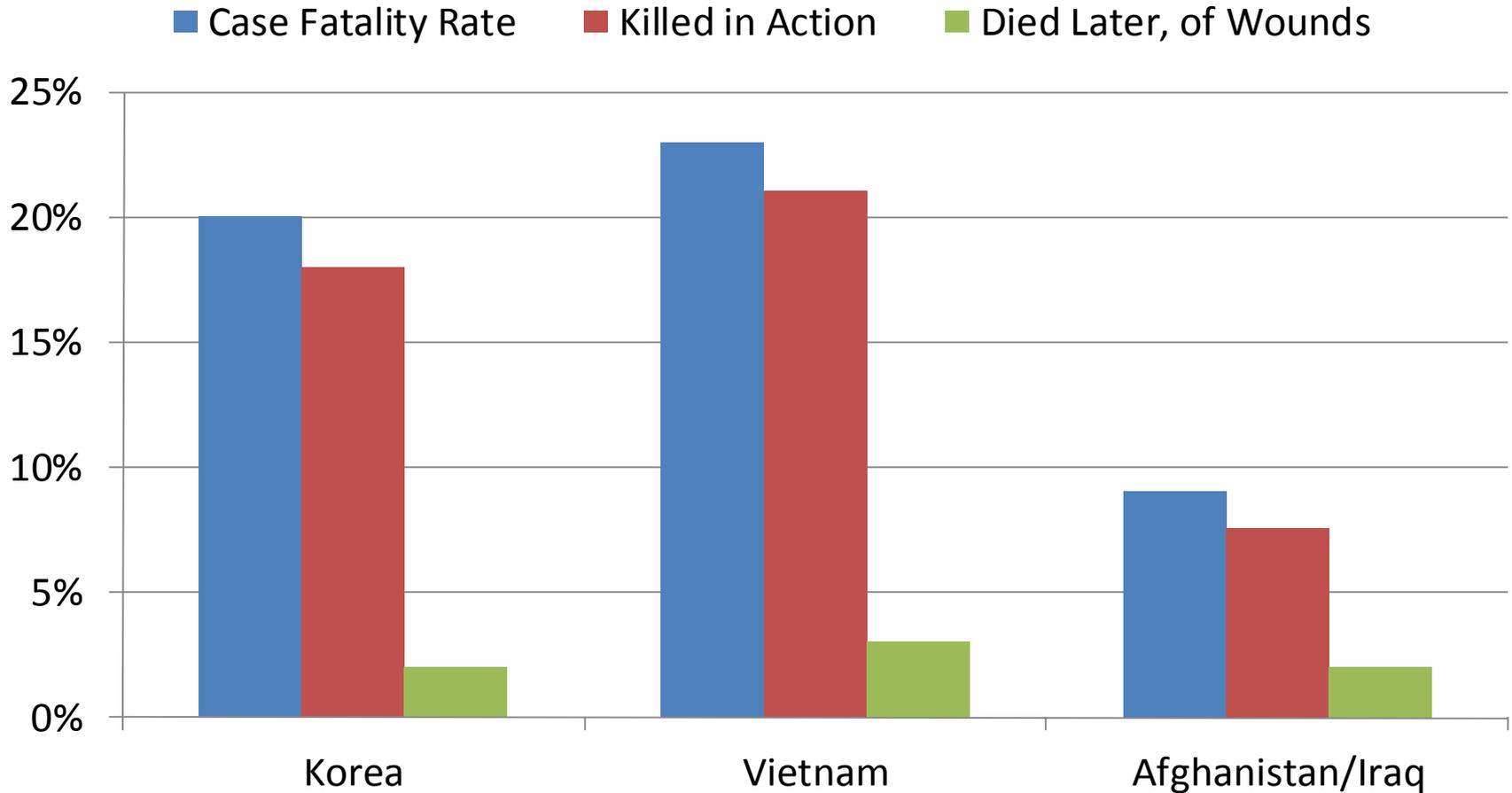
*Active Sites Highlighted in Yellow

Observations:

- Army, Navy and Air Force are already working together to deliver a system of care for patients with TBI and associated psychological health issues.
- There is an opportunity to clarify roles and responsibilities in the existing network of care that includes the NICOE and the nascent Spirit sites.



Combat Casualty Care Has Improved



Data presented by LTC Kyle N. Remick, Sept. 24, 2015

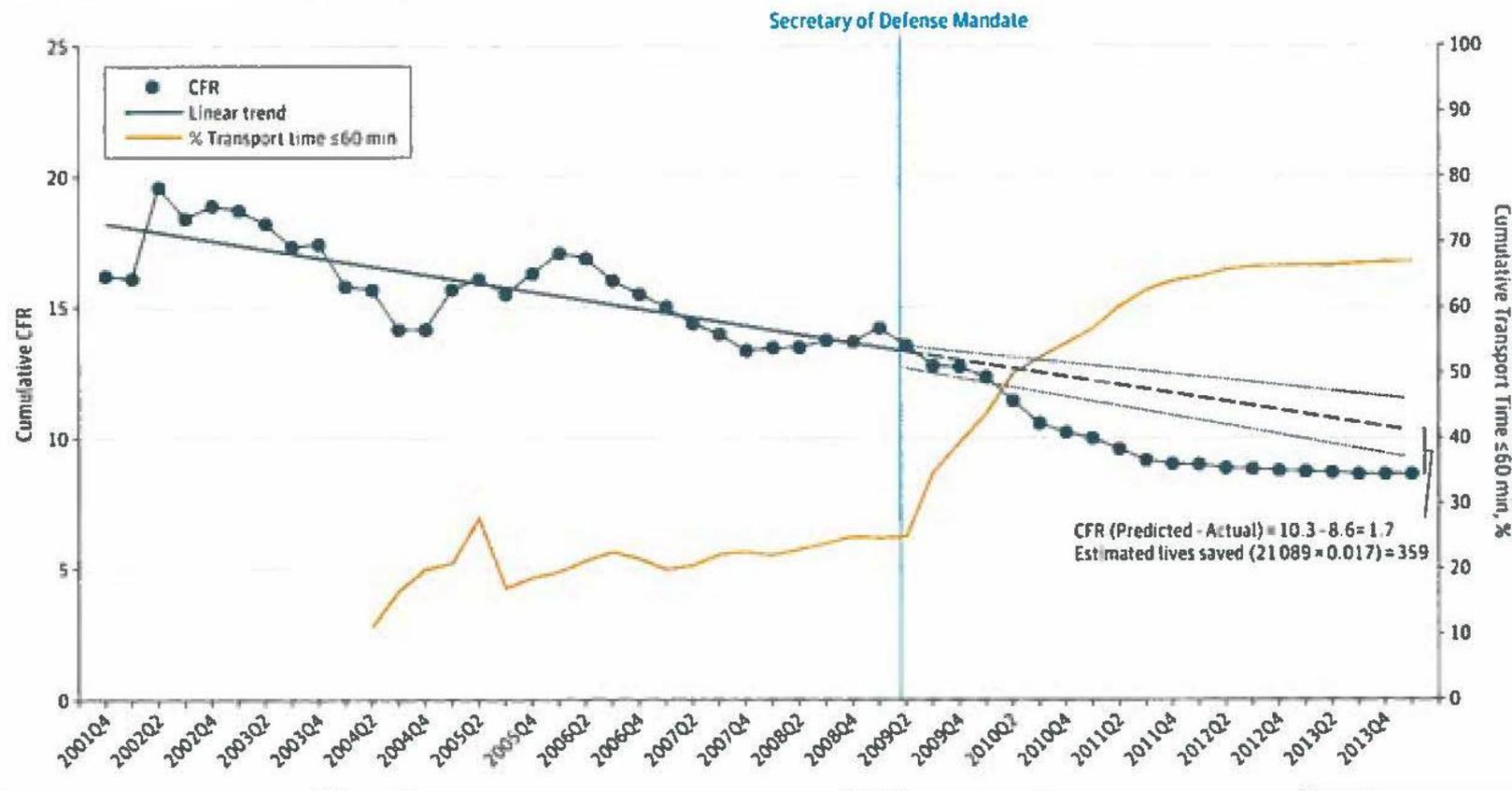


Transport Time < 60 Min

SECDEF Gates Mandate, 2009



Figure 1. Case Fatality Rate and Transport Time



Kotwal R.S. et al. (2015, Sept). The effect of the golden hour policy on the morbidity and mortality of combat casualties. JAMA Surg E-pub



Comparisons with Vietnam, and the Significance of Blast



- ◎ OIF/OEF killed-to-Injured ratio: 1-to-8 (1-to-2.5 in Vietnam)
- ◎ Combat related mortality:
 - > Vietnam: 1,704/100,000
 - > OIF/OEF: 212-262/100,000
(Source: Army Times, June 16, 2009)
- ◎ 66% of wounded in Operation Iraqi Freedom (OIF) were from blast injury (Joint Theater Trauma System [JTTS])
- ◎ 41% of soldiers exposed to blast have evidence of a TBI (JTTS)
- ◎ TBI = 32% of battle injuries seen at WRAMC (DVBIC data as of 03/31/2008)
- ◎ 21% of air evacuation patients from OIF had at least 1 head/neck ISS code





Concussion Outcomes



Injury event with LOC, AOC or PTA followed by:

- Rapid Recovery (acute)
 - Spontaneous resolution of all symptoms (typically dizziness, dazed) within 7 days
- Delayed recovery (subacute)
 - Dizziness, headaches, memory problems for 8-89 days
- Prolonged Symptoms (chronic)
 - Headaches, sleep problems, behavioral problems, cognitive problems for 90 days or longer



Acute post-traumatic stress symptoms and age predict outcome in military blast concussion



- Prospective, observational study of 38 U.S. military personnel with blast-related concussive traumatic brain injury, evaluated acutely at two sites in Afghanistan
- Enrolled between March and September 2012
- All subjects returned to duty (avg. 7 days) and did not require evacuation
- Subjects were evaluated at 6–12 months later in St. Louis

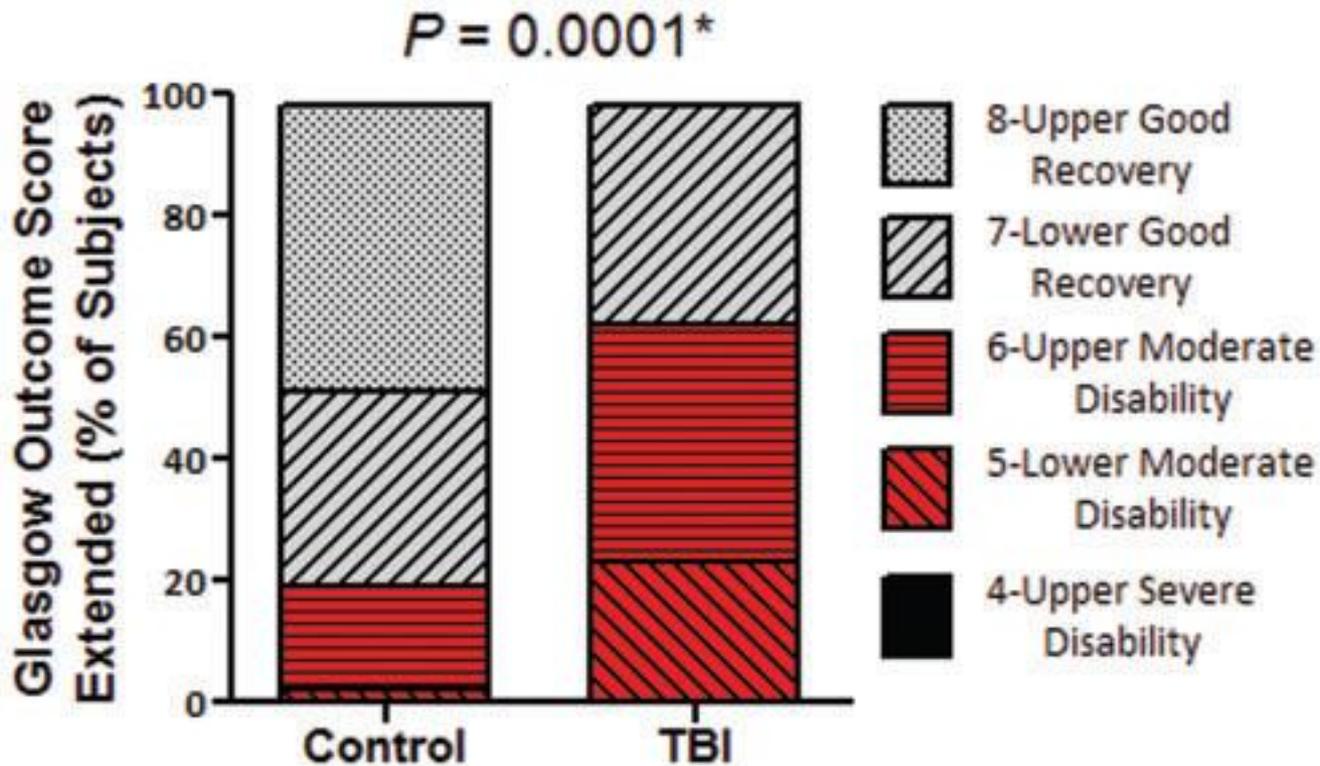
Mac Donald, C. L., Adam, O. R., Johnson, A. M., Nelson, E. C., Werner, N. J., Rivet, D. J., & Brody, D. L. (2015). BRAIN.



Acute post-traumatic stress symptoms and age predict outcome in military blast concussion



At 6–12 months follow-up, 63% of subjects with traumatic brain injury and 20% of controls had moderate overall disability.



Global measure of outcome 6–12 months after enrollment indicates worse outcomes in TBI subjects versus controls. *Mann-Whitney U-test.

Mac Donald, C. L., Adam, O. R., Johnson, A. M., Nelson, E. C., Werner, N. J., Rivet, D. J., & Brody, D. L. (2015).



CTE in the Military



- The link between single or multiple concussions and chronic traumatic encephalopathy (CTE) needs to be much better defined through:
 - Well-designed longitudinal studies
 - Valid imaging studies that permit a premorbid determination of those who might be at risk
 - High-quality, pre-clinical studies



Blast vs Non-blast

Symptom complaints following reports of blast versus non-blast mild TBI: Does mechanism of injury matter?

- Belanger HG, Proctor-Weber Z, Kretzmer T, Kim M, French LM, Vanderploeg RD. Clin Neuropsychol 2011 Jul;25(5) 702-15
- Blast (n=298) and Non-blast (n=92) patients completed NSI and Posttraumatic Stress Disorder Checklist (PCL)
- Mechanism of injury was not found to be associated with severity of symptoms
- Symptom reporting was higher in those with with higher levels of PTSD symptoms
- Hearing difficulty was only symptom that varied significantly between groups. Blast injured patients had more hearing difficulties



Long-Term Effects of Single or Multiple Concussions



DoD has several programs in place to better understand the long-term effects of TBI:

- DoD has developed a brain bank through the Center for Neuroscience and Regenerative Medicine (CNRM)
- DoD and the Department of Veterans Affairs have jointly sponsored the Chronic Effects of Neurotrauma Consortium (CENC)
- DoD's Congressionally Mandated 15-Year Longitudinal Study
- DoD developed an interagency National Research Action Plan (NRAP) in 2013 in collaboration with the Departments of Veterans Affairs, Health and Human Services and Education (addresses PTSD, TBI and Suicide)

- NFL and NCAA Grand Challenge partnerships



U.S. Navy photo by Mass Communication Specialist 1st Class Curtis K. Biasi

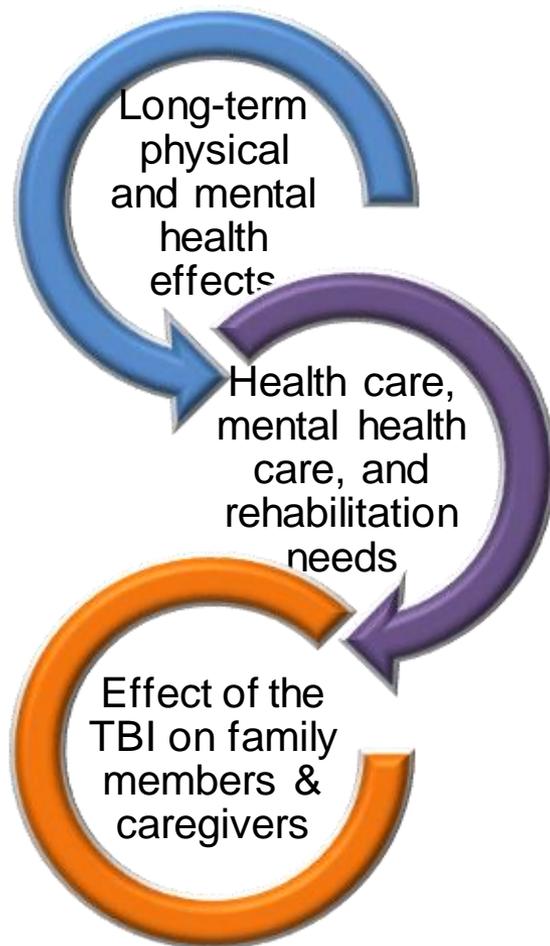


15 Year Longitudinal Studies

on the Effects of TBI on Service Members & Veterans:
Interagency Collaborations



NDA FY2007, Sec 721



Exploring the Natural History of TBI within a Military Cohort – A 15-Year Longitudinal Database and Blood Banking Study

Lead site: WRNMMC
Contributing agencies: DoD, VA

Improved Understanding of Medical And Psychological Needs in Veterans and Service Members with Chronic TBI (I-MAP)

Lead site: Tampa VA
Contributing agencies: DoD, VA, NIDRR

Health-Related Quality of Life in Caregivers of Service Members with Military-Related TBI

Lead site: WRNMMC
Contributing agencies: DoD, VA (in development)



15-Year Longitudinal Study



Exploring the Natural History of Traumatic Brain Injury within a Military Cohort – A 15-Year Longitudinal Database and Blood Banking Study

Enrollment

- 1) 1,600 mild, moderate, or severe TBI
- 2) 800 non-TBI injured trauma controls
- 3) 400 non-injured healthy controls

Timeline

Activities	FY	09-12	13	14	15-26
Regulatory Approval		■			
Participant Recruitment		■	■	■	■
Participant Follow-up		■	■	■	■
Data Analysis					■
Dissemination					■