Traumatic Brain Injury and Attempted Suicide among Veterans of the Wars in Iraq and Afghanistan

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T·R·A·C·T·S

Poll Question

What is your primary role in the VA?

a) Clinician or nurse
b) Student, trainee, or fellow
c) Researcher
d) Administrator, manager, or policy maker
e) Other

Poll Question

How familiar are you with traumatic brain injury (TBI)?

a) Very familiar
b) Somewhat familiar
c) Not familiar

Challenges of TBI Rehabilitation in OEF/OIF/OND Veterans
Outline

- The scope of the challenge: who is of particular concern for the VA in the coming years?
- Why does this cohort represent such a challenge?
- Considerations for treatment.

The Scope: TBI

- Since 2001, approximately 2.5 million U.S. armed forces were deployed in support of OEF/OIF/OND
- A substantial number of these Veterans have survived injuries that would have been fatal in previous wars
  - Mild traumatic brain injury (TBI) is considered the "signature injury" of the recent wars

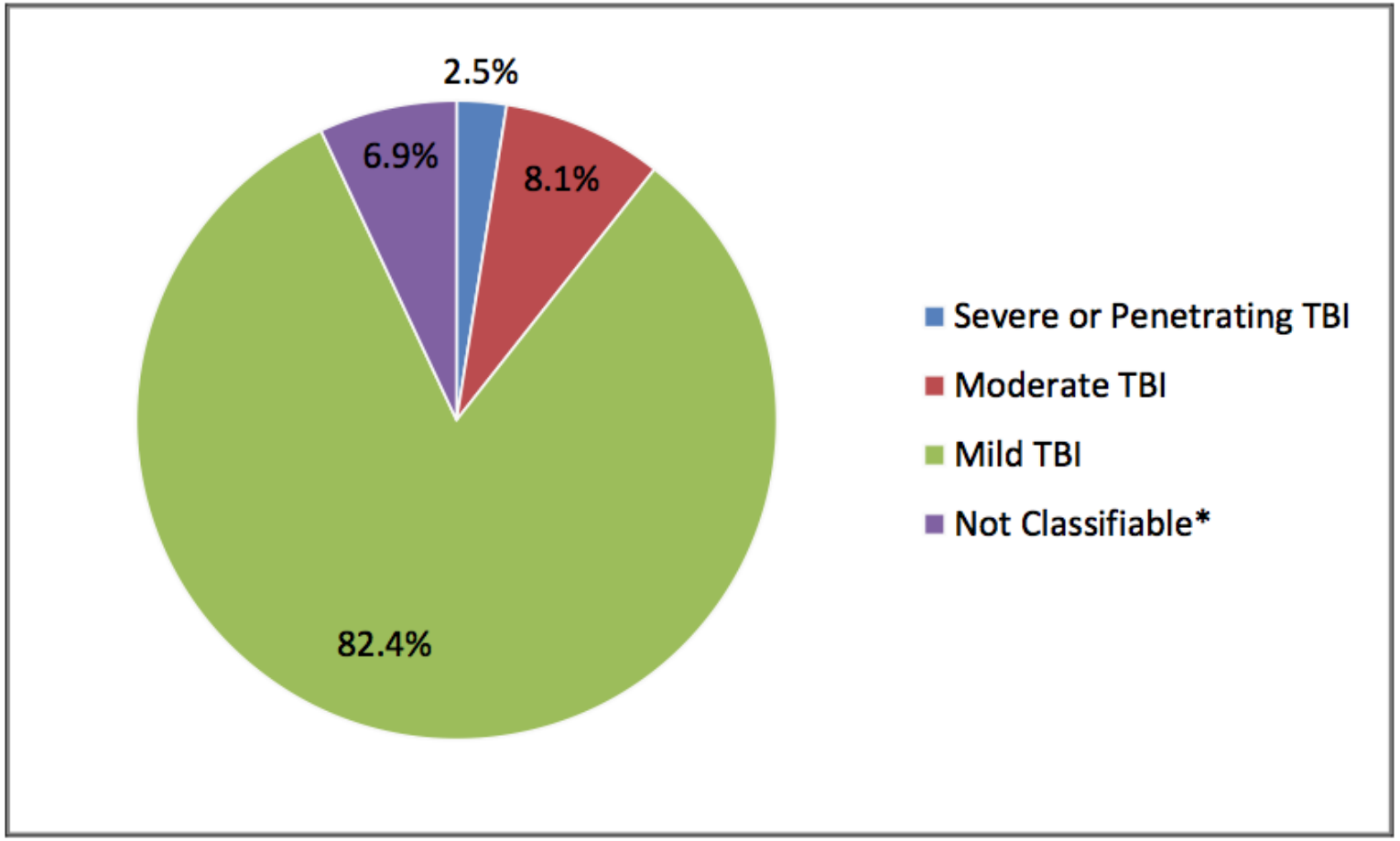
TBI Diagnosis and Severity Achieved by Consensus Diagnosis According to DOD and VA Criteria (2009)

Criteria	Mild	Moderate	Severe
Loss of Consciousness	0-30 minutes	>30 minutes & <24 hours	>24 hours
Alteration of Mental Status	0-24 hours	>24 hours; severity based on other criteria	
Posttraumatic Amnesia	0-1 day	>1 day & <7 days	>7 days
Glascow Coma Scale	13-15	9-12	<9

Management of Concussion/mTBI Working Group. Clinical Practice Guideline: Management of Concussion/Mild Traumatic Brain Injury. Washington, DC: US Department of Veterans Affairs and US Department of Defense; 2009.

Figure 2. Traumatic Brain Injury (TBI) 2000-2013 Q3 by Classification, Deployed and Not Previously Deployed Combined

(as of January 10, 2014)



Source: CRS communication with Dr. Michael Carino, Army Office of the Surgeon General, January 10, 2014. Data source is Defense Medical Surveillance System (DMSS), Defense and Veterans Brain Injury Center, http://www.dvbic.org/dod-worldwide-numbers-tbi.

Note: "Not Classifiable" indicates additional incident information is required prior to TBI categorization.

- In the US military, traumatic brain injury (TBI) is the most common type of physical injury sustained by these Veterans
  - *EXPLOSION OR BLAST INJURY* by explosive devices is the most common cause.

*Defense and Veterans Brain Injury Center, 2014

Setting the stage for complex physical and psychological illness:

BLASTS produce *SIMULTANEOUS* physical and psychological trauma

Posttraumatic Stress Disorder (PTSD) 2000-Dec 2012

mild TBI 2000-Aug 2012

Figure 1. Annual Post-Traumatic Stress Disorder Diagnoses in All Services

(as of December 7, 2012)

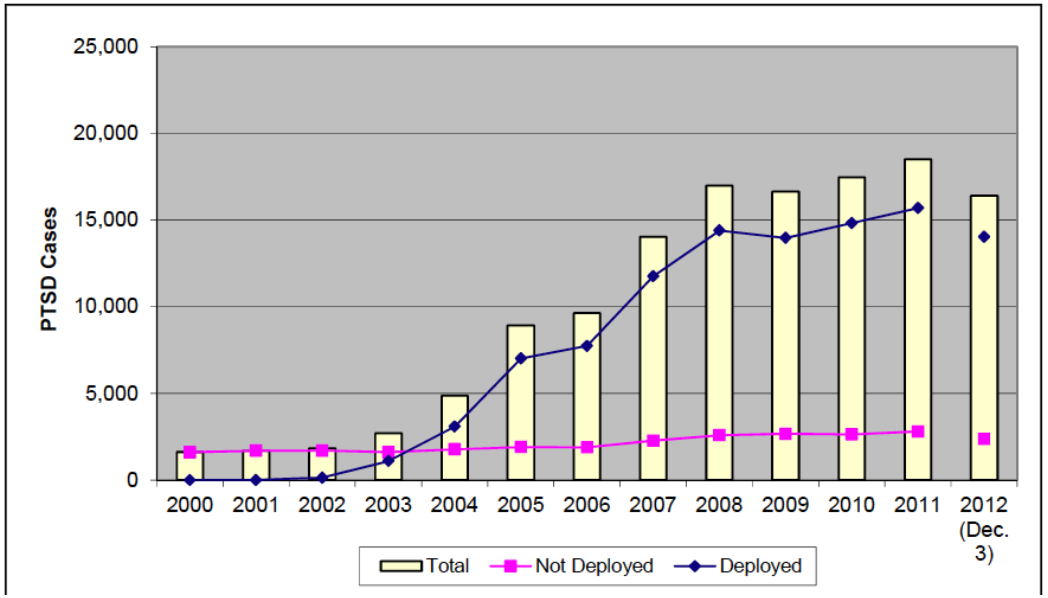
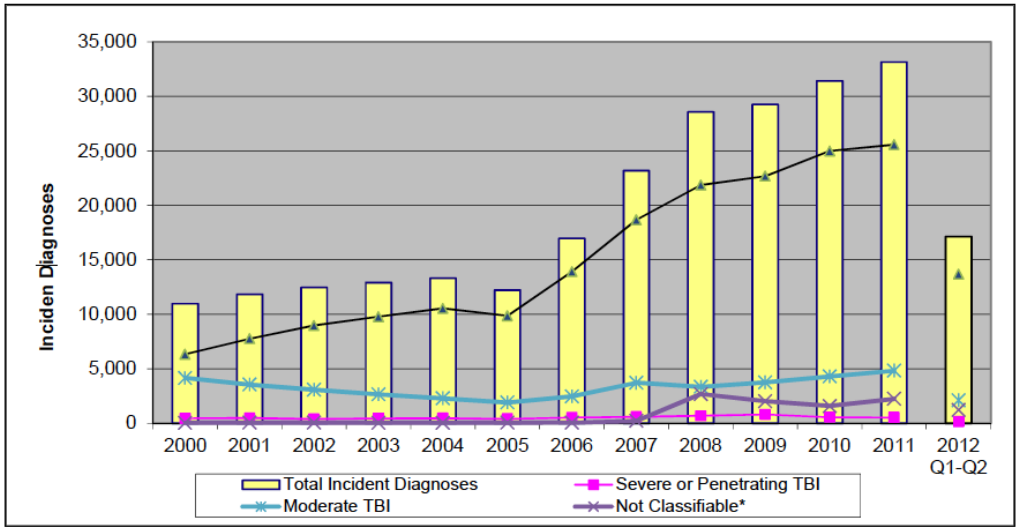


Figure 3. Traumatic Brain Injury (TBI) 2000-2012 Q2

(as of August 20, 2012)



Source: CRS communication with Dr. Michael Carino, Army Office of the Surgeon General, December 13, 2012. Data source is the Defense Medical Surveillance System (DMSS), Defense and Veterans Brain Injury Center, http://www.dvbic.org/dod-worldwide-numbers-tbi.

Translational Research Center for TBI and Stress Disorders (TRACTS)

Take a Veteran-centric approach to understand the complex interplay of biomedical, psychological, functional neural connectivity, & structural neural integrity factors in the mental and physical health of OEF/OIF/OND Veterans

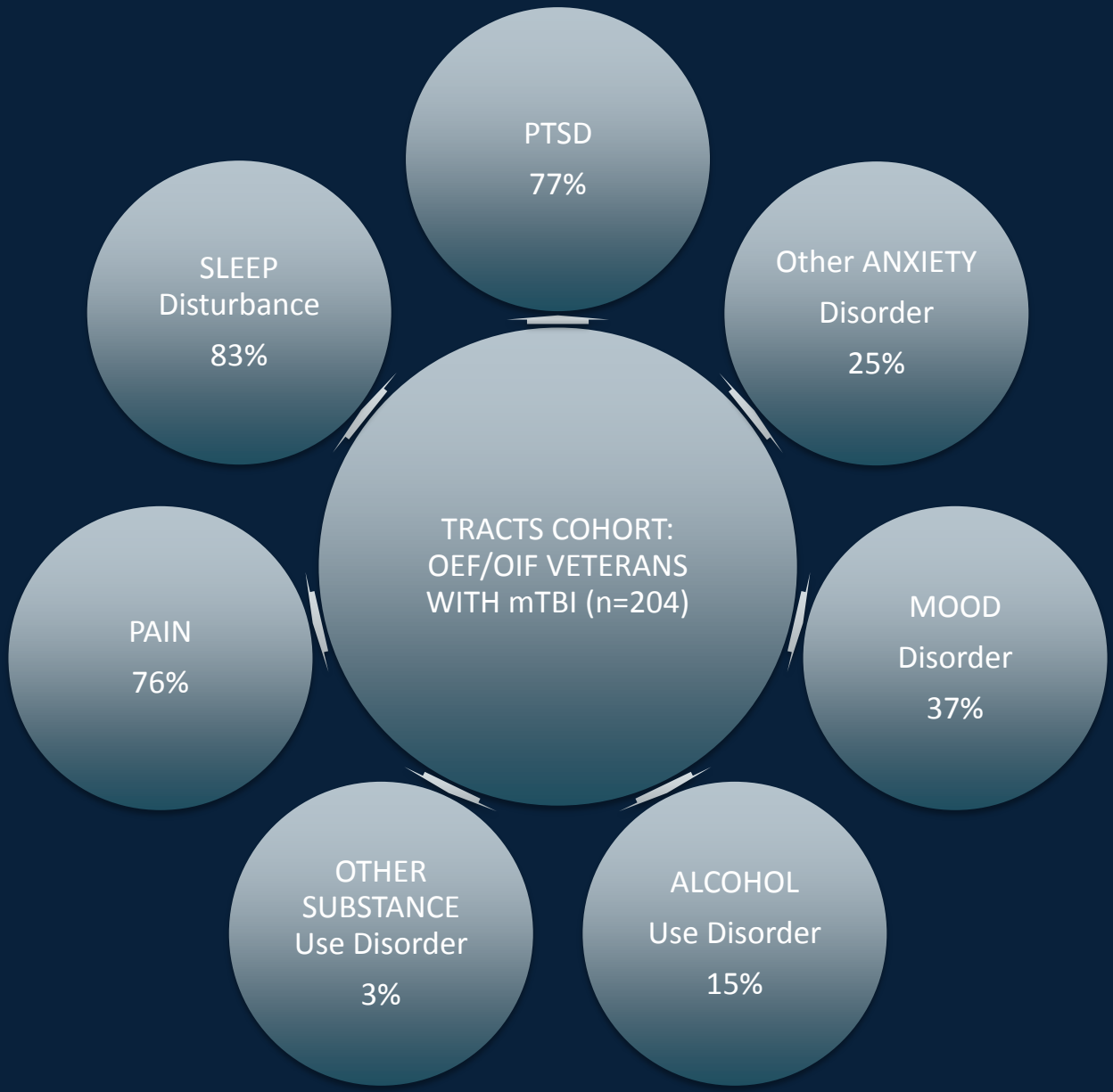
TRACTS Assessment Core

Medical/ Biological	Neuropsych Domains	Affective/ Psychosocial	Blast/TBI	Neuroanatomy S/F MRI
Blood Chemistry	Simple/Divided Attention	PTSD: CAPS & PCL-C	Boston Assessment of TBI-Lifetime	Cortical Volume
GWAS	Information Processing Speed	DSM-IV AXIS I: SCID	Ohio State University TBI ID	Cortical Thickness
Neuro-steriod	Executive Function	Traumatic Life Events Questionnaire	Neurobehavioral Symptom Inventory	Diffusion Tensor
	Declarative/Procedural Memory	Deployment Risk & Resiliency Inventory		Resting-State Networks
	Pre-morbid Function	Depression, Anxiety & Stress Scale-21		Functional Connectivity
	Perception	Pittsburg Sleep Quality Index		Task-Based fMRI
	Symptom Validity	McGill Pain Questionnaire		
	Psychomotor Speed	Alcohol, Nicotine		
		Sickness Impact Profile		

Why does this cohort represent such a challenge?

HETEROGENEITY!

mTBI is a Poly-Morbid Condition



SO WHAT?

MANY OF THE CO-MORBID CONDITIONS SHARE THE SAME UNDERLYING NEURAL STRUCTURES AND IMPACT COMMON COGNITIVE AND FUNCTIONAL SYSTEMS.

For example:

Not surprising….Shared Cognitive Dysfunction

Persistent mTBI	PTSD	Alcohol Abuse/ Dependence	Cardiovascular Risk	Pain	Sleep
Memory	Memory	Memory	Memory	Memory	Memory
Attention/ Concentration	Attention/ Concentration	Attention/ Concentration	Attention/ Concentration	Attention/ Concentration	Attention/ Concentration
Executive Functions	Executive Functions	Executive Functions	Executive Functions	Executive Functions	Executive Functions
Headache		Headache		Headache	Headache
Fatigue	Fatigue	Fatigue	Fatigue	Fatigue	Fatigue
Hyperarousal	Hyperarousal				
Avoidance	Avoidance	Avoidance		Avoidance	Avoidance
Light Sensitivity				Light Sensitivity	Light Sensitivity
Insomnia	Insomnia	Insomnia		Insomnia	Insomnia
Depression	Depression	Depression	Depression	Depression	Depression
Irritability/Anger	Irritability/Anger	Irritability/Anger		Irritability/Anger	Irritability/Anger
Dizziness	Re-experiencing	Dizziness	Dizziness		Dizziness

Poll Question

Are you familiar with the risks of suicidal behavior?

a) Very familiar
b) Somewhat familiar
c) Not familiar

Impact of TBI on Suicidal Behavior

- Suicidal behavior may be an important consequence of TBI
  - Pre-existing factors (e.g. impulsivity and sensation seeking)
  - Impact of current psychiatric conditions
- Studies of TBI and attempted suicide yielded conflicting results
- To date, only three studies have evaluated this association among Veterans

TBI and Attempted Suicide among Veterans: Cohort Study

- Sample: Veterans attending a mental health clinic in a large VHA system
- Results: Veterans who screened positive for TBI had a significantly higher proportion of attempted suicide compared to those who screened negative
- Limitations:
  - Only a few suicide attempts were observed over the study period
  - Psychiatric comorbidity was not evaluated

Schneider AL, Hostetter TA, Homaifar BY, et al. Responses to traumatic brain injury screening questions and suicide attempts among those seeking Veterans Health Administration mental health services. Front Psychiatry. 2016;7:59.

TBI and Attempted Suicide among Veterans: Case-control Study

- Sample: Veterans seeking mental health treatment at a large VA
- Results: TBI was not associated with risk of attempted suicide after adjusting for history of PTSD
- Limitations:
  - May not be generalizable to OEF/OIF Veterans who do not seek mental health treatment
  - Not assess other psychiatric comorbidities

Brenner LA, Betthauser LM, Homaifar BY, et al. Posttraumatic stress disorder, traumatic brain injury, and suicide attempt history among veterans receiving mental health services. Suicide Life Threat Behab. 2011;41(4):416 423.

TBI and Attempted Suicide among Veterans: Cross-sectional Study

- Sample: OEF/OIF Veterans referred to outpatient PTSD treatment at a VA center
- Results: No association of mild TBI with attempted suicide after adjusting for current PTSD
- Limitations:
  - Only included patients that currently met diagnostic criteria for PTSD
  - Not assess other psychiatric comorbidities

Barnes SM, Walter KH, Chard KM. Does a history of mild traumatic brain injury increase suicide risk in veterans with PTSD? Rehabil Psychol. 2012;57(1):18 26.

Potential Mediating Role of Psychiatric Conditions

- No studies examined the possible mediating role of comorbid psychiatric conditions on the association between TBI and attempted suicide
  - Quantification of the impact of psychiatric comorbidity has meaningful implications for
    - Targeted suicide prevention efforts
    - Improved treatment

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Original Contribution

Traumatic Brain Injury and Attempted Suicide Among Veterans of the Wars in Iraq and Afghanistan

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Objectives

- Evaluate the association between TBI and attempted suicide among OEF/OIF/OND Veterans.
- Determine if current psychiatric conditions mediate this association.

Study Sample

- National cohort of 273,591 Veterans who:
  - Deployed in support of OEF/OIF/OND
  - Received care in the VA between 2007 and 2012
  - Do not have bipolar disorder or schizophrenia

Data Sources

- VA databases
  - Demographics
  - Clinical
    - Inpatient hospitalizations
    - Outpatient clinic visits
  - VA Primary and Secondary TBI screens

TBI Assessment: VA Primary Screen

1. **Nature of the deployment injury:**
   a) Blast/explosion
   b) Fall
   c) Vehicular accident
   d) Fragment/bullet wound above the shoulders

2. **Clinical symptoms immediately following the injury event:**
   a) Losing consciousness
   b) Being dazed/confused
   c) Not remembering the event
   d) Concussion or head injury

3. **New or worsening symptoms following the event:**
   a) Memory problems
   b) Balance problems/dizziness
   c) Sensitivity to bright light
   d) Irritability
   e) Headaches
   f) Sleep problems

4. **Current symptoms occurring in the past week (same items as in question 3)**

TBI Assessment: VA Comprehensive TBI Evaluation

- Administered to OEF/OIF/OND Veterans who screen positive on VA primary TBI screen
- Consists of 24 standard questions, including:
  - Nature of injury
  - Severity of TBI
  - Current neurobehavioral symptoms
  - Psychiatric history
- Conducted by a clinician
  - At the end of evaluation, must confirm or rule out TBI diagnosis

Deployment TBI Exposure

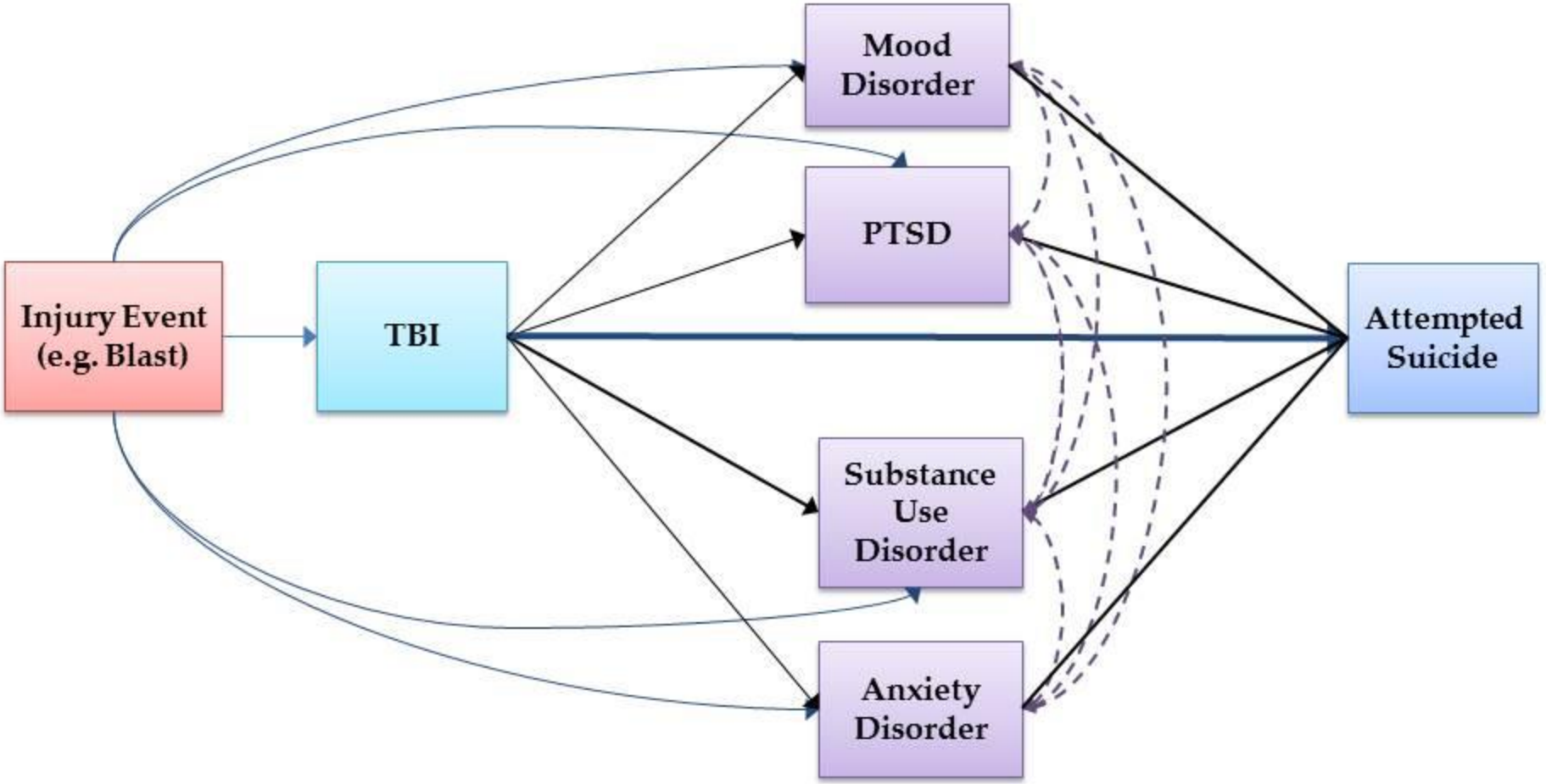
- **TBI** = confirmed TBI diagnosis on VA Comprehensive TBI Evaluation
- **No TBI** = not report deployment-related head injury on VA primary TBI screen

Attempted Suicide Outcome

- Non-fatal, attempted suicide recorded in emergency room visits and inpatient hospitalizations (ICD-9 codes: E950 – E959)
- Evaluated first attempted suicide in study period

Psychiatric Diagnosis Mediators

- Evaluated two ways:
  - Ordinal measure of co-occurrence
  - Separately for each psychiatric condition



Deployment	Post-Military		
	VA Primary TBI Screen	VA Secondary TBI Screen	Assessment of Current Psychiatric Conditions

Statistical Analysis

- Cox-proportional hazards model
- Mediation analyses:
  - Computed the direct and indirect effects of TBI on attempted suicide, adjusting for confounders
  - Calculated percent mediated
    - Proportion of the total effect explained by psychiatric mediator

Baseline Demographic and Clinical Characteristics

	TBI (n = 42,392)	No TBI (n = 231,199)
Demographics		
Age (Mean, SD)	28.2 (4.5)	28.7 (4.8)
Males	95.3%	82.1%
Baseline Psychiatric Conditions		
PTSD	**63.2%**	**9.7%**
Mood disorder	**30.8%**	**11.8%**
Anxiety disorder	**17.3%**	**7.7%**
Substance use disorders	**15.9%**	**4.8%**
Alcohol	**13.3%**	**3.9%**
Drug	6.5%	1.9%

TBI Severity and Mechanism of Injury

- Among Veterans with a deployment-related TBI:
  - Majority of the TBIs were mild (88%)
  - Blast was the most common mechanism of injury (74%)

Crude and Adjusted Association Between TBI and Attempted Suicide (FY 2007 – 2012)

	Unadjusted HR (95% CI)	Demographic Adjusted HR (95% CI)	Mediation Analysis	
			HR (95% CI)	PM
TBI vs. No TBI	**3.92 (3.30, 4.64)**	**3.76 (3.15, 4.49)**	**1.25 (1.07, 1.46)**	
Psychiatric conditions*			2.98 (2.59, 3.43)	**83%**

Note: Mediation model adjusted for demographic characteristics.
PM = % mediated.
** Ordinal measure of co occurrence (none, single diagnosis, and two or more diagnoses).*

Direct and Indirect Effects of TBI and Attempted Suicide, With Each Psychiatric Condition as Mediator (FY 2007 – 2012)

	PTSD		Mood Disorder		Anxiety Disorder		Substance Use Disorder	
	HR (95% CI)	PM	HR (95% CI)	PM	HR (95% CI)	PM	HR (95% CI)	PM
TBI vs. No TBI	**1.41 (1.19, 1.68)**		**2.01 (1.75, 2.32)**		**2.92 (2.56, 3.45)**		**1.88 (1.63, 2.17)**	
Psychiatric condition	2.62 (2.23, 3.07)	**73%**	1.88 (1.65, 2.14)	**48%**	1.30 (1.15, 1.48)	20%	1.98 (1.73, 2.25)	**51%**

Note: Mediation model adjusted for demographic characteristics.
PM = % mediated.

Summary

- Among OEF/OIF/OND Veterans receiving care at the VA, Veterans with deployment-related TBI had an increased risk of attempted suicide compared to those without at TBI
  - Three-fold increase in risk after adjusting for demographics
  - However, attenuated to 25% increase in risk when accounting for psychiatric comorbidity

Summary

- Mediation analyses suggested much of the association between TBI and attempted suicide was operated through psychiatric comorbidity
  - 83% of this association was mediated by the number of psychiatric conditions
  - PTSD had the largest impact, with 73% of the association mediated by PTSD

Strengths

- Prospective study design
- Large national sample
- Specific definition of attempted suicide
- Standardized measure of TBI

Limitations

- Study sample was limited to OEF/OIF/OND Veterans receiving care at the VA
  - Results may not be generalizable to all OEF/OIF/OND Veterans

Nevertheless:

This sample closely resembles the demographic characteristics of a national cohort of younger US Veterans

Eber S, Barth S, Kang H, et al. The National Health Study for a New Generation of United States Veterans: methods for a large scale study on the health of recent veterans. Mil Med.2013;178(9):966 969.

Limitations

- No information on psychiatric conditions prior to or during their military service
  - Residual confounding may be present

However:

Mediation analyses may reflect partial confounding adjustment if the proxy measure of psychiatric condition is correct

Conclusion

- Psychiatric comorbidity serves as an important mechanism through which TBI influences suicidal behavior
- Veterans with TBI and co-morbid psychiatric conditions, especially PTSD, are a vulnerable group that should be closely monitored for suicidal behavior

Use a Patient-Centered Approach!!
ONE SIZE WILL NOT FIT ALL

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Resources

- Translational Research Center for TBI and Stress Disorders (TRACTS)

  https://heartbrain.hms.harvard.edu/

Questions or Comments?

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