



Risk of Traumatic Brain Injury, Post-Traumatic Stress Disorder, and Suicide in OEF/OIF Veterans

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Objectives

- Operation Enduring Freedom/Operation Iraqi Freedom and Mental Health
- Veteran/Military Personnel and Suicide
- TBI and Suicide
- PTSD and Suicide



**Projected U.S. Veterans
Population: 23,067,000
{Female 1,824,000-8%}**

**Total US
Population**

310,238,161

**Number of Total
Enrollees in VA Health
Care System
(FY 09): 8,061,000**

*1.9 million warriors have
deployed for Operation
Iraqi Freedom (OIF) and
Operation Enduring
Freedom (OEF)*

“In times of war, there are collective and individuals shifts in perceptions, thought and behavior. All of this is necessary so that man [woman] is able to go to war. No one is immune to it.”

*HOW IS ONE TO COPE
WITH THESE SHIFTS UPON
RETURNING HOME?*

Vetter 2007



“What Kind of War-Zone Stressors Did Soldiers in Iraq Confront?”

- Preparedness (or lack thereof)
- **Combat exposure**
- Aftermath of battle
- Perceived threat
- Difficult living and work environment
- Perceived radiological, biological, and chemical weapons exposure
- Sexual or gender harassment
- Ethnocultural stressor
- Concerns about life and family disruptions



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Mental Health Problems Post Deployment

	OIF (n=222,620)	OEF (n=16,318)
Combat Experiences (Any)	144,978 (65.1%)	7,499 (46.0%)
Any MH Concern	42,506 (19.1%)	1,843 (11.3%)
Suicidal Ideation	Some – 2,411 (1.1%) A lot – 467 (.2%)	Some – 107 (.7%) A lot – 20 (.1%)
Psychiatric Hospitalization in the First Year Post Deployment	1,214 (5.9%) (Distinct Individuals)	45 (2.9%) (Distinct Individuals)

Hoge, Auchterloine, &
Milliken 2006



*Approximately 1/3 of OIF
veterans accessed mental
health services in their first
year post-deployment*

Hoge, Auchterloine &
Milliken 2006



OEF/OIF and TBI

- TBI is most common physical injury for combatants in Afghanistan and Iraq
- explosion or blast injury is most common
- 2006 survey of more than 2,500 recently returned army infantry soldiers: 5% reported injuries with LOC during a yearlong deployment, 10% reported injuries with altered mental status
- RAND report with even higher rates:
19% with probable TBI on survey of almost 2,000 previously deployed service personnel.
- Terrio et al. with similarly high rate (23%) of clinician-confirmed TBI in a U.S. Army brigade combat team with at least one deployment

320,000 veterans have experienced a probable TBI during deployment

PTSD and OEF/OIF

- Exposure to combat greater among those deployed to Iraq
- The percentage of study subjects who met screening criteria for major depression, generalized anxiety disorder, or PTSD
 - Iraq 15.6%-17.1%
 - Afghanistan 11.2%



Alcohol Problems Post-Deployment

- 11.8% for Active Duty
- 15.0% for Reserve/Guard



Milliken, Auchterloine, &
Hoge 2007

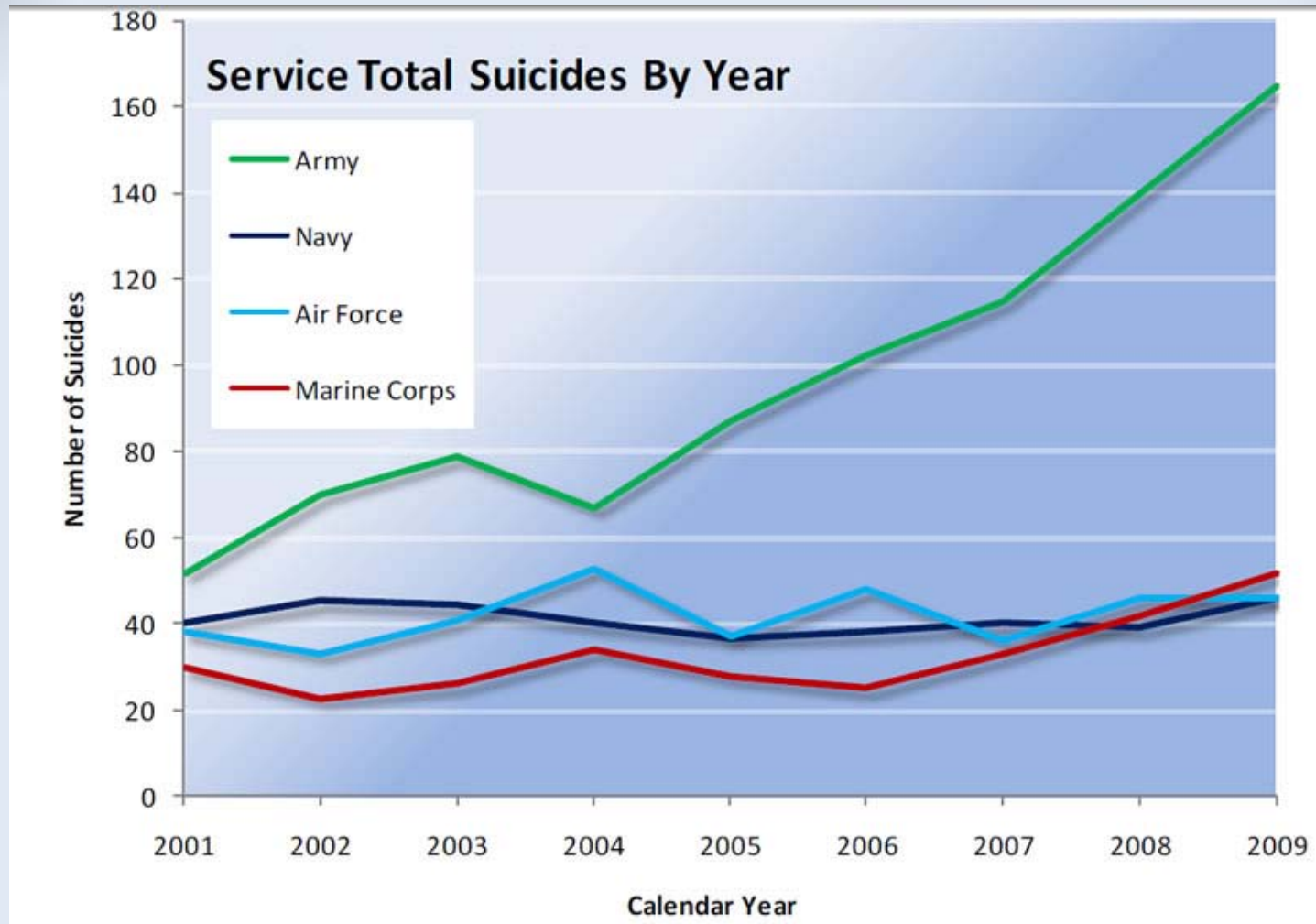
Army findings indicate that suicide is on the rise among Soldiers, with 2006 having the highest number of confirmed cases since 1990

5 years from 2005 to 2009,
more than 1,100 members of
the Armed Forces took their
own lives, an average of 1
suicide every 36 hours

*Army Suicides more
than doubled*



[HTTP://WWW.PRNEWSWIRE.COM/NEWS-
RELEASES/JOINT-DOD-TASK-FORCE-
RELEASES-REPORT-ON-PREVENTING-
SUICIDE-IN-US-MILITARY-101313419.HTML](http://www.prnewswire.com/news-releases/joint-dod-task-force-releases-report-on-preventing-suicide-in-us-military-101313419.html)



<http://www.health.mil/dhb/downloads/Suicide%20Prevention%20Task%20Force%20final%20report%208-23-10.pdf>



Suicide and Army

- Suicide rate has continued to climb despite increased efforts and programs for suicide prevention and intervention
- Historically, being in the military was a protective factor for suicide
 - Military rate being well below the civilian rate
- Since 2005, the Army's suicide rate has exceeded that of the U.S. civilian population

<http://www.health.mil/dhb/downloads/Suicide%20Prevention%20Task%20Force%20final%20report%208-23-10.pdf>



Veterans are Potentially at Increased Risk for Suicide

Thompson (2002)	Suicide rate 2-3X general population's. Depression, psychotic disorders, and substance abuse associated.
Price (2004)	Major depression and drug dependence with largest effect on the timing of suicidality.
Zivin (2007)	Male, white race, substance abuse associated. Younger veterans (age 18-44) with higher rates. Service connection as protective factor.
Desai (2007)	Higher rates in younger and older veterans. Bipolar disorder with highest rates. PTSD/anxiety disorders marginally protective. \$100 per capita increased spending \approx 6% reduction in suicide.
Kaplan (2007)	Suicide rate \approx 2X general population's. White race, \geq 12 years education, activity limitations with greater risk.

Kaplan (2007)

- Most prior authors used VA data
- National Health Interview Survey 1986-1994
- Compared suicide risk veterans v. general population
- Nearly twice as likely to die of suicide (adjusted hazard ratio 2.04, 95% CI 1.10 to 3.80)
- Reflects risk among entire U.S. veteran population
- *But what is the impact of OEF/OIF?*

CBS "Suicide Epidemic"

- Sought data from all 50 states on death record suicides for vets and non-vets
- 45 states with 6256 veteran suicides in 2005
- Reports age and gender adjusted suicide rates of 18.8-20.8 per 100,000 for vets vs. 8.9 per 100,000 in general population
- Vets age 20-24 with rates 2-4 times civilian rates (22.9-31.9 per 100,000 vs. 8.3 per 100,000)

TBI 101

General Definition of TBI

- Application to the brain of an external physical force or rapid acceleration and/or deceleration forces
 - not due to congenital, degenerative, vascular, hypoxic-ischemic, neoplastic, toxic-metabolic, infectious, or other causes
- Produces an immediately apparent physiological disruption of brain function manifested by cognitive or neurological impairments
- Results in partial or total functional disability (regardless of the duration of such disability)

American Congress of Rehabilitation Medicine Definition of Mild TBI:

- A traumatically induced physiological disruption of brain function, as manifested by at least *one* of the following:
 - any period of loss of consciousness (LOC)
 - any loss of memory for events immediately before or after the accident (posttraumatic amnesia, PTA)
 - any alteration in mental state at the time of the accident (e.g., feeling dazed, disoriented, or confused)
 - focal neurologic deficit(s) that may or may not be transient

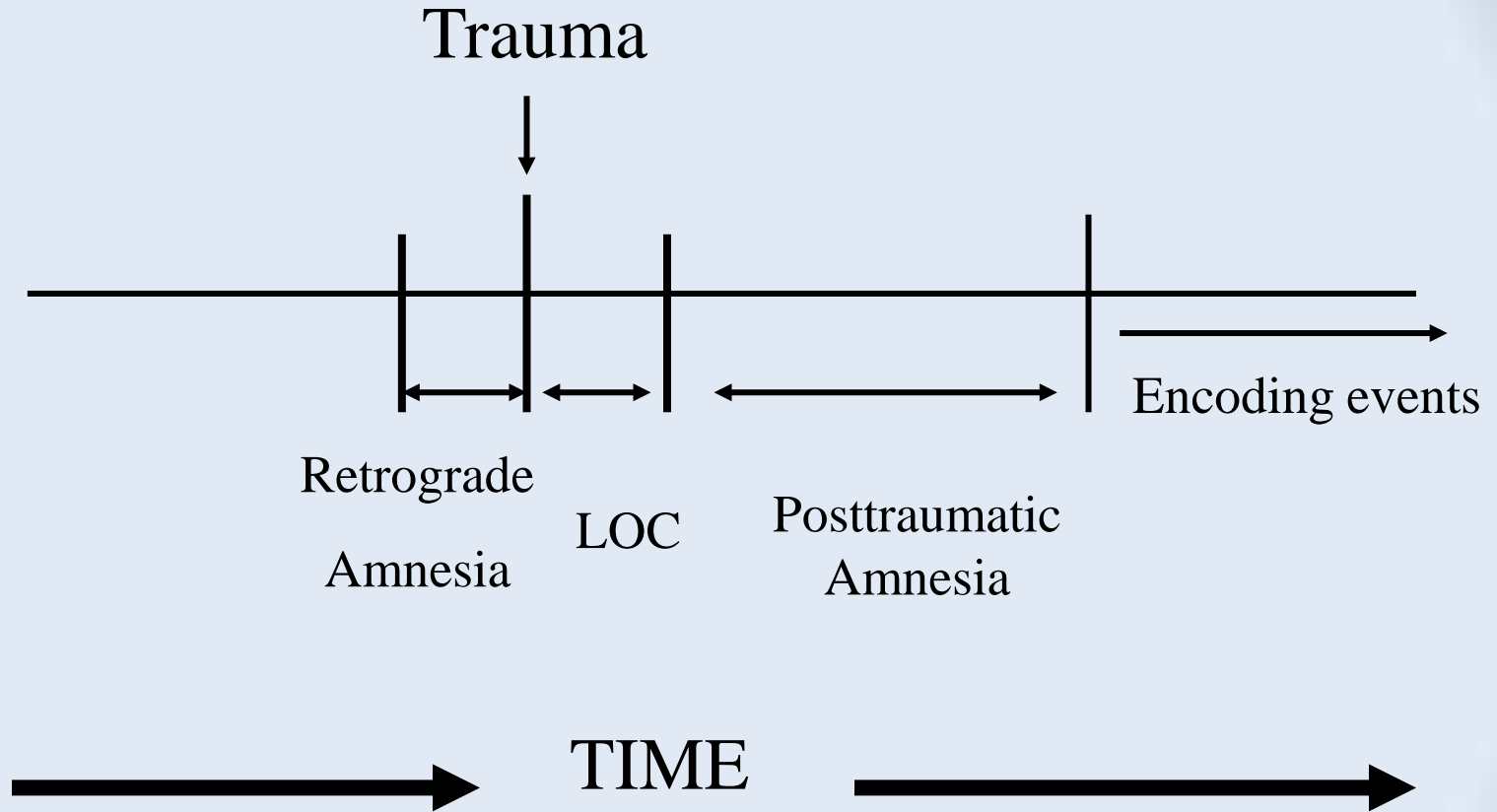
Kay, T., Harrington, D. E., Adams, R. E., Anderson, T. W., Berrol, S., Cicerone, K., Dahlberg, C., Gerber, D., Goka, R. S., Harley, J. P., Hilt, J., Horn, L. J., Lehmkuhl, D., & Malec, J. (1993). Definition of mild traumatic brain injury: Report from the Mild Traumatic Brain Injury Committee of the Head Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine. *Journal of Head Trauma Rehabilitation*, 8(3), 86-87.



American Congress of Rehabilitation Medicine Definition of Mild TBI:

- The severity of the injury does not exceed the following:
 - LOC \leq 30 minutes
 - after 30 minutes, Glasgow Coma Scale = 13-15
 - PTA \leq 24 hours
- TBI producing disturbances that exceed these criteria is classified as moderate or severe

Posttraumatic Amnesia



Recovery from Mild TBI

- 1st week post-TBI: 90% (or more) endorse postconcussive symptoms
- 1 month post-TBI: ~50% are recovered fully
- 3 months post-TBI: ~66% are recovered fully
- 6-12 months post-TBI: ~10% still symptomatic
- Those who remain symptomatic at 12 months are likely to continue experiencing postconcussive symptoms thereafter

Recovery from Moderate-to-Severe TBI

- About 35-60% of persons with moderate to severe TBI will develop chronic neurobehavioral and/or physical symptoms related to TBI
 - more severe initial injury increases the likelihood of incomplete neurological, neurobehavioral, and functional recovery
- Successful return to work and/or school is inversely related to the severity of persistent neurobehavioral and physical symptoms

Self-diagnosis of TBI

- “Gold standard” for diagnosis of TBI remains self-report and requires caution:
 - under-reporting vs. over-reporting
 - poor understanding of TBI
 - misunderstanding symptoms as reflective of TBI when other diagnoses offer better explanations
 - stigma vs. secondary gains
- Avoid missed opportunities to target other treatable conditions (PTSD, MDD, etc.)

Self-diagnosis of TBI

- mTBI without evidence in the medical record require careful evaluation of the history and other available evidence
 - use ACRM definition of mild TBI as an anchor for the clinical history
 - interview witnesses, if any, to the injury
 - review medical, neurological, and neuropsychological evaluations (including comparison to pre-injury whenever such data can be obtained)
 - review (by visual inspection, not just reports) any structural neuroimaging (CT, MRI) for findings consistent with *traumatic* brain injury
- Biomechanical trauma frequently co-occurs with psychological trauma, especially in combat settings

TBI in a VA Mental Health Setting

TBI – 4 (n=509)

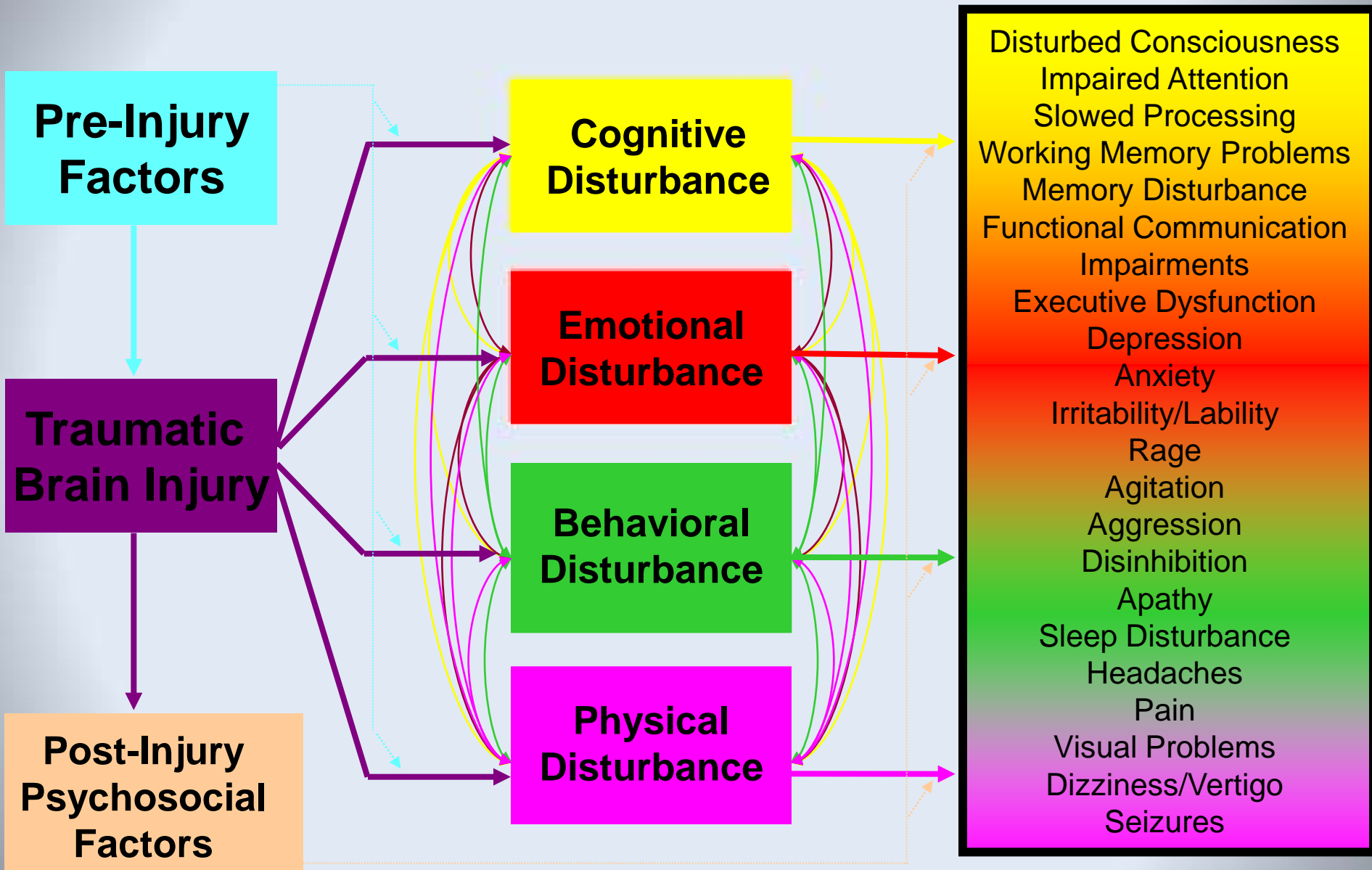


Question	Have you ever been hospitalized or treated in an emergency room following an injury? (If yes) Did you injure your head or neck?	Have you ever been knocked out or unconscious following an accident or injury?	Have you ever injured your head or neck in a car accident or from some other moving vehicle accident?	Have you ever injured your head or neck in a fight or fall?
# Yes	207	226	169	210
% Yes	41%	44%	33%	41%

Brenner, L., Homaifar, B., Huggins, J., Olson-Madden, J., Harwood, J., Nagamoto, H.
 Use of a Traumatic Brain Injury Screen in a Veteran Mental Health Population: Prevalence,
 Validation and Psychiatric Outcomes



A Model of Influences on Neurobehavioral Outcome after TBI



(Adapted from Silver and Arciniegas 2006)

Pre-Injury Factors

- Age and gender
- Baseline intellectual function
- Psychiatric problems & substance abuse
- Sociopathy
- “Risk-taking” and “novelty-seeking” behavior
- Premorbid behavioral problems
- Social circumstances and SES
- Neurogenetic (ie, APOE-4, COMT, ?other)

Injury Factors

- **Biomechanical Injury**
 - acceleration/deceleration
 - translational/rotational
 - angular acceleration/deceleration
 - cavitation (“microexplosive”)
 - diffuse axonal injury (DAI)
- **Cytotoxic Injury**
 - cytoskeletal & axonal injury
 - disturbance of cell metabolism
 - Ca^{++} and Mg^{++} dysregulation
 - free radical release
 - neurotransmitter excitotoxicity
- **Secondary Injury**
 - traumatic hematomas
 - cerebral edema
 - hydrocephalus
 - increased intracranial pressure (ICP)
 - systemic complications
 - hypoxia/hypercapnia
 - anemia
 - electrolyte disturbance
 - infection

Injury Factors: Translation, Rotation, & Angular Acceleration Forces

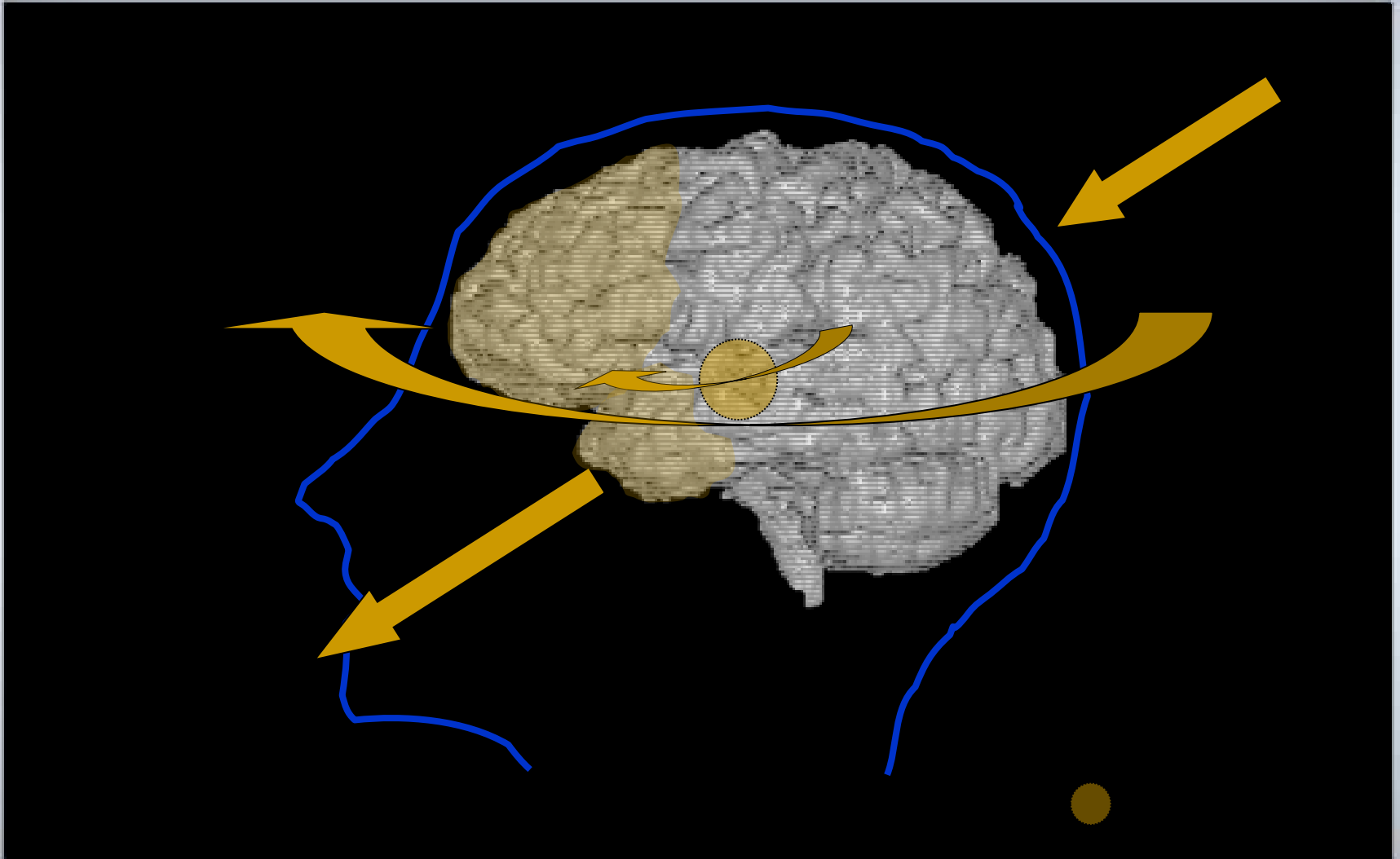


Figure adapted from Arciniegas and Beresford 2001

Post-injury Factors

- Untoward medical complications
- Failure to receive timely medical, neurological, psychiatric, or other needed rehabilitative services
 - early engagement in neurorehabilitation is associated with improved functional outcomes
- Lack of education regarding the course of recovery and interpretation of symptoms
- Lack of family, friends, or resources to support recovery
- Premature return to work/school with ensuing failure to perform at expected levels
- Poor adjustment to or coping with disability by injured person or family
- Litigation or other legal entanglements

Posttraumatic Cognitive Impairments

- In the acute and late periods following TBI, the domains of cognition most commonly affected by TBI include:
 - arousal/disturbances of consciousness
 - processing speed/reaction time
 - attention (selective, sustained, alternating, divided)
 - working memory
 - memory (new learning, retrieval, or [usually] both)
 - functional communication (use of language)
 - executive function

(Reviewed in: Bigler 2007; Arciniegas and Silver 2006; Nuwer 2005;
Meythaler et al. 2001)



Common Posttraumatic Emotional and Behavioral Problems

- Depression
- Mania
- Pathological Laughing and Crying
- Anxiety
- Irritability or loss of temper (“rage episodes”)
- Disinhibition
- **Agitation/Aggression** (“socially inappropriate behavior”)
- Apathy (loss of drive to think, feel, and/or behave)
- Psychosis

Common Mild TBI/Posttraumatic Symptoms

- Headache
- Sleep Disturbances
- Fatigue
- Dizziness
- Light sensitivity
- Sound sensitivity

Immediately post-injury 80% to 100% describe one or more symptoms

Most individuals return to baseline functioning within a year

Common TBI Symptoms -
NOT to be confused with
the injury itself

TBI is a historical event



Simpson & Tate (2007)

Suicide risk compared to general population...
Standardized Mortality Ratios and 95% CI

Males with TBI	3.9	3.13-4.59
Females with TBI	4.7	3.06-7.06
Age at injury < 21	3.5	1.92-6.27
21-40	4.7	3.35-6.50
41-60	5.2	3.73-7.17
>60	2.5	1.55-4.01
Concussion	3	2.82-3.25
(Severe) Lesion	4.1	3.33-4.93
Comorbid Substance Abuse	7.4	4.32-12.82

PTSD 101

Definition of PTSD

An anxiety disorder resulting from exposure to an experience involving direct or indirect threat of serious harm or death; may be experienced alone (rape/assault) or in company of others (military combat)



DSM-IV Criteria - PTSD

- Re-experiencing symptoms (nightmares, intrusive thoughts)
- Avoidance of trauma cues and Numbing/detachment from others
- Hyperarousal (increased startle, hypervigilance)



Symptoms of PTSD

- ✓ Recurrent thoughts of the event
- ✓ Flashbacks/bad dreams
- ✓ Emotional numbness (“it don’t matter”); reduced interest or involvement in work our outside activities
- ✓ Intense guilt or worry/anxiety
- ✓ Angry outbursts and irritability
- ✓ Feeling “on edge,” hyperarousal/ hyper-alertness
- ✓ Avoidance of thoughts/situations that remind person of the trauma
- ✓ Depression

Potential Consequences of PTSD

Social and Interpersonal Problems:



- Relationship issues
- Low self-esteem
- Alcohol and substance abuse
- Employment problems
- Homelessness
- Trouble with the law
- Isolation

Those with PTSD at Increased Risk for Suicidal Behavior

14.9 times more likely to attempt
suicide than those without PTSD
(community sample)

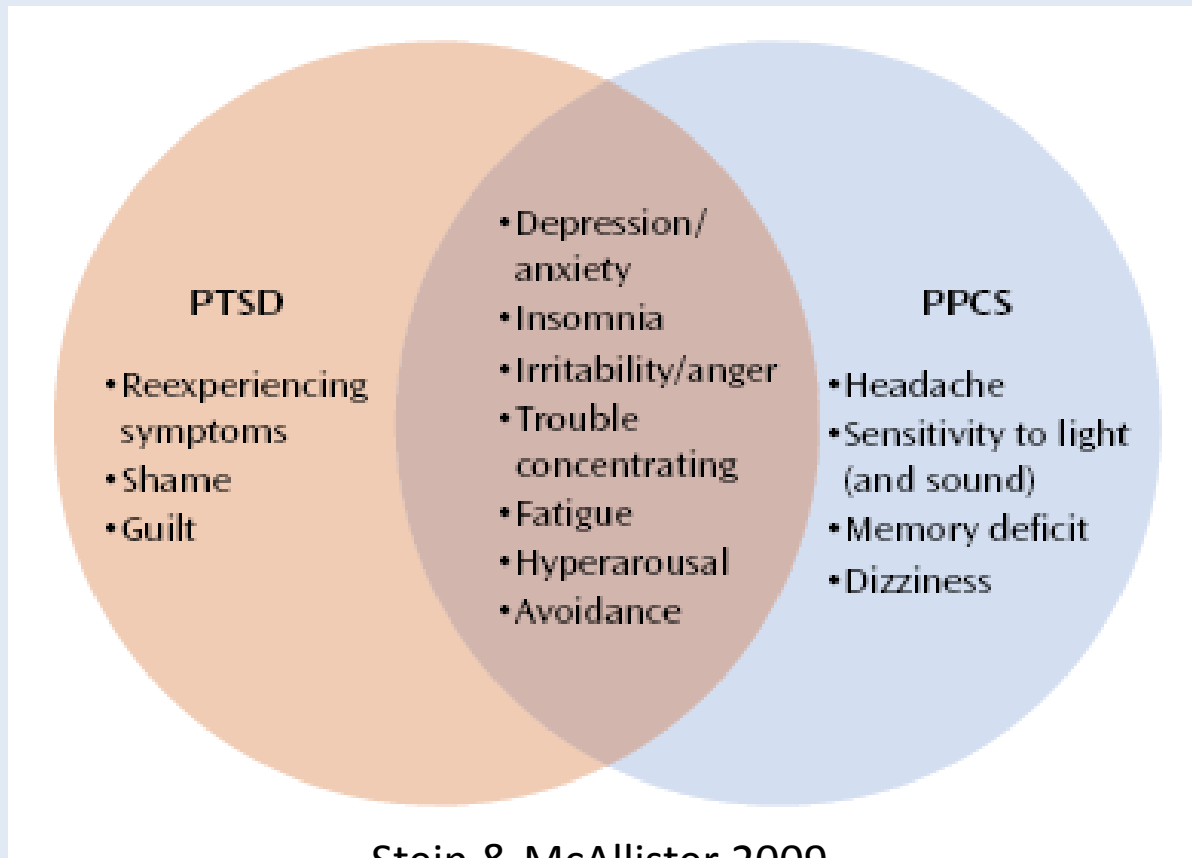
Why?

- **Veteran Population**

- Survivor guilt (Hendin and Haas, 1991)
- Being an agent of killing (Fontana et al., 1992)
- Intensity of sustaining a combat injury (Bullman and Kang, 1996)



Interface of TBI and PTSD

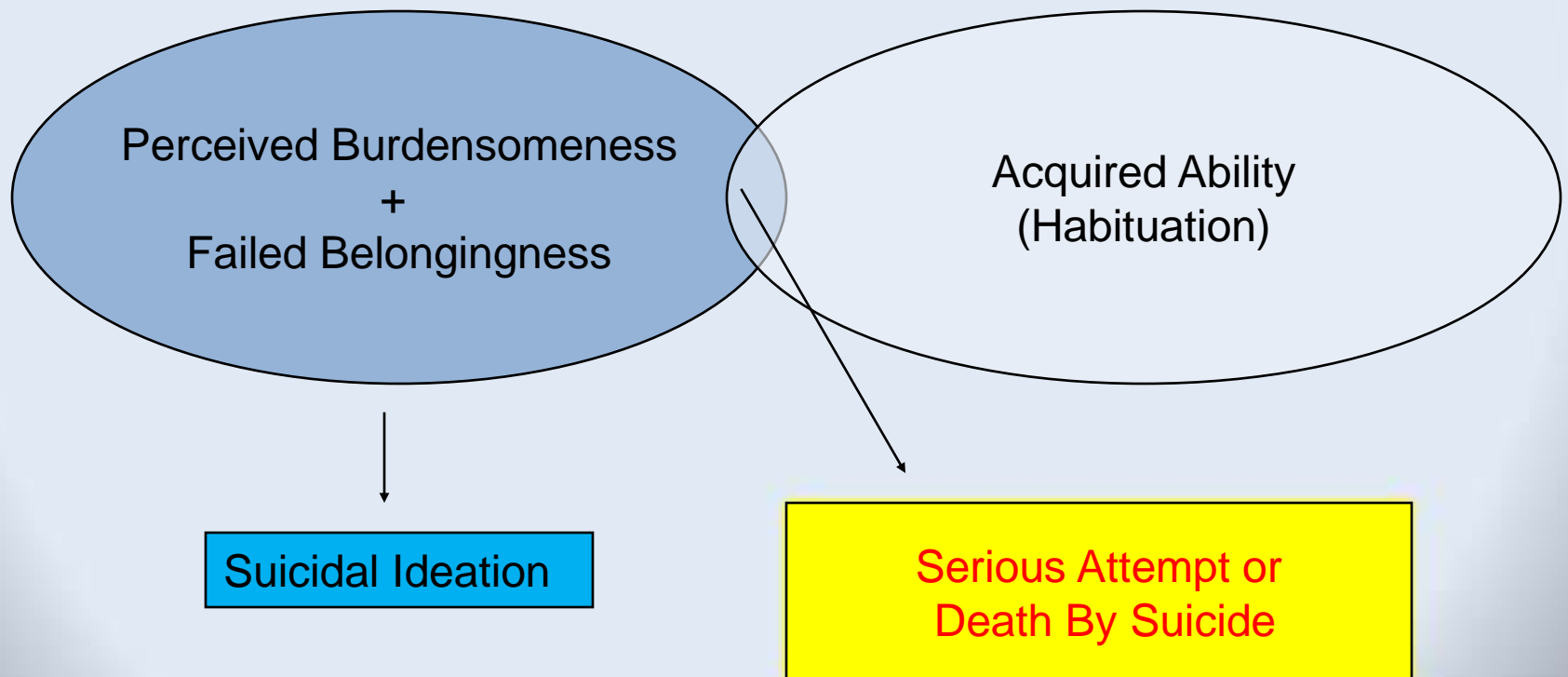


Unfortunately, the overlap also seems to involve suicide risk.

Interpersonal-Psychological Theory of Suicide Risk Joiner 2005

**Those who
desire death**

**Those capable
of suicide**



Aggression → **Suicide**

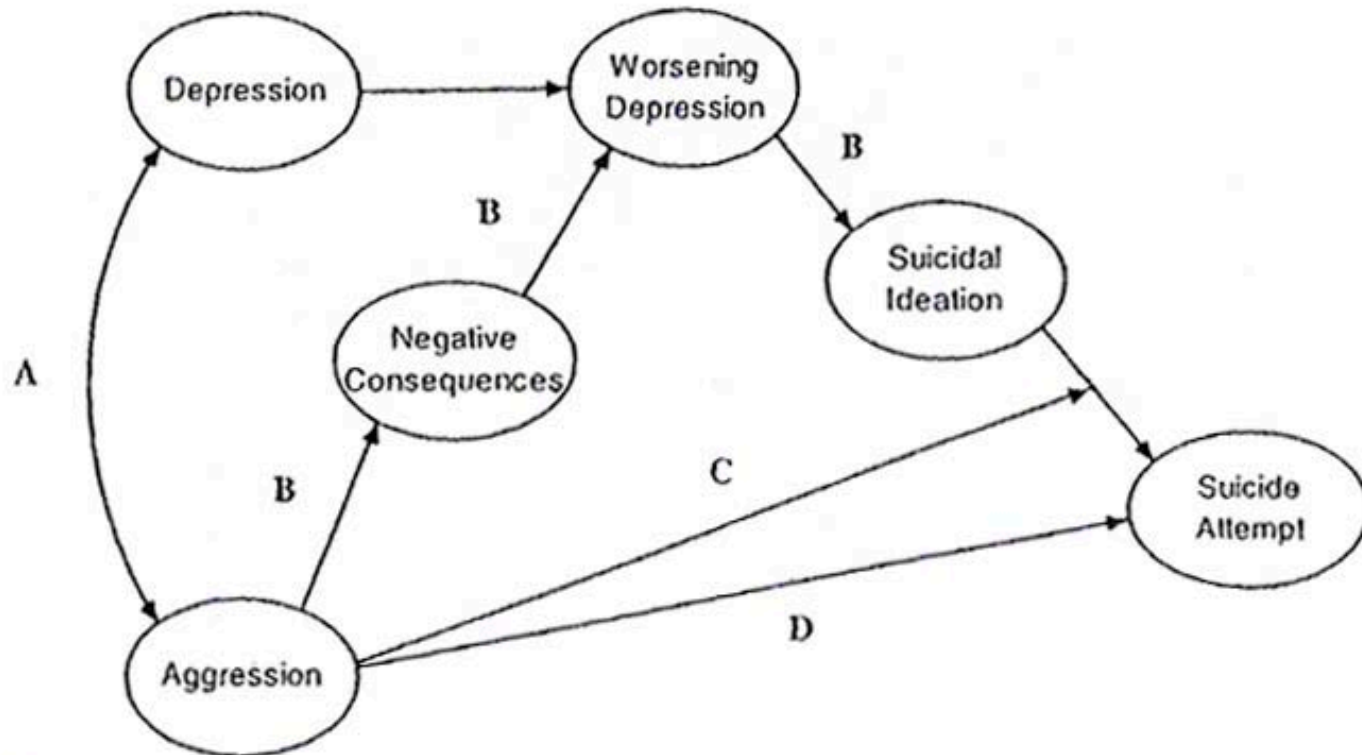
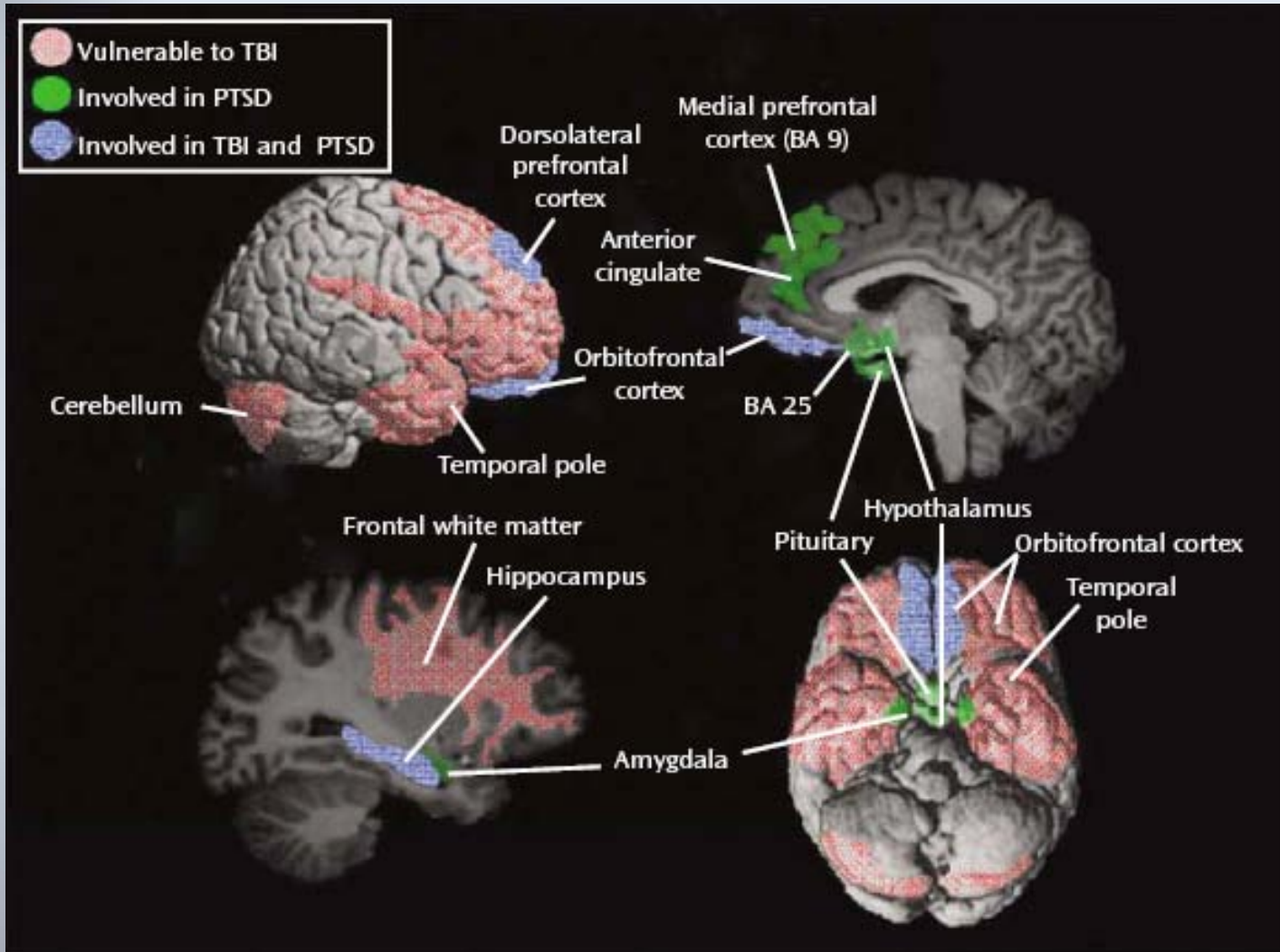


Fig. 1 Theoretical model of non-causal (*Path A*), indirect (*B*), moderating (*C*), and direct (*D*) effects of aggression on risk for suicidal thoughts and behavior

Shared Anatomy of TBI & PTSD



This shared anatomy also implicates aggression

Stein & McAllister 2009

“Across America, Deadly Echoes of Foreign Battles”

January 13, 2008



Matthew Sepi, left, shot two people, one fatally, after he was confronted in a Las Vegas alley in 2005. Seth Strasburg, right, is serving a prison term of 22 to 36 years for shooting and killing Thomas Tiffany Varney on Dec. 31, 2005.

Cases, Victims, and Charges

The Cases

The New York Times found 121 cases in which veterans of Iraq and Afghanistan committed a killing in this country, or were charged with one, after their return from war.



Branch of military



Where they served*



*Two Iraq war veterans also served in Afghanistan.

The victims



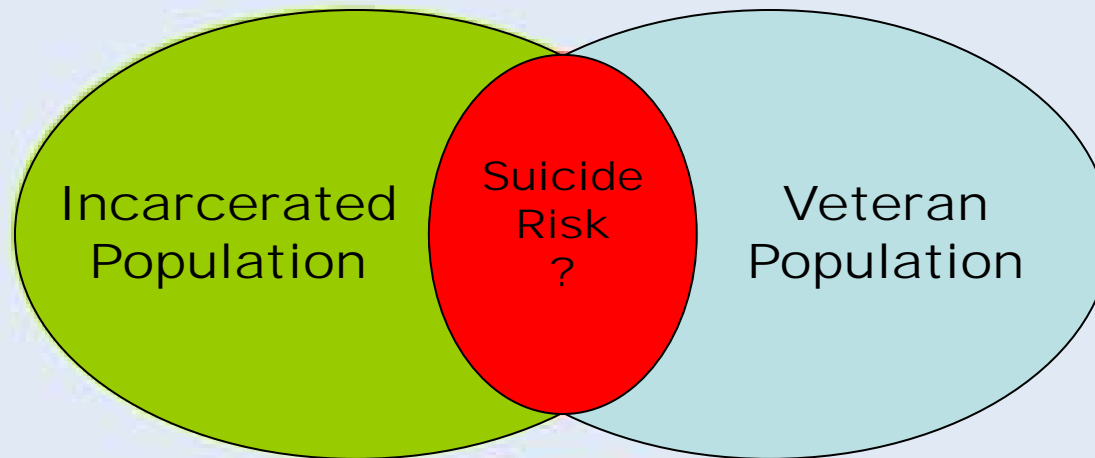
Charges



No charges (*suicides, killed by the police*)

* In four cases, the victim was also in the military.

Suicide Among Incarcerated Veterans



Incarcerated Veterans lie at the intersection of two populations with elevated suicide rates. The risk incurred by this status remains unknown.

Wortzel HS, Binswanger IA, Anderson CA, Adler L:
Suicide Among Incarcerated Veterans. *Journal of the American Academy of Psychiatry and the Law* 37(1):82-91, 2009

Release from Prison — A High Risk of Death for Former Inmates

Background

Period immediately after release may be challenging for former inmates and involve substantial health risks. Binswanger et al. (2007) studied the risk of death among former inmates after release from Washington State prisons.

Methods

Retrospective cohort study of all inmates released from Washington State Department of Corrections from July 1999 through December 2003. Prison records linked to National Death Index. Mortality rates among former inmates compared with other state residents with indirect standardization and adjustment for age, sex, and race.

Results

Of 30,237 released inmates, 443 died during a mean follow-up period of 1.9 years. Overall mortality rate 777 deaths per 100,000 person-years. **Adjusted risk of death among former inmates was 3.5 times** that among other state residents (95% confidence interval [CI], 3.2 to 3.8). **During first 2 weeks after release, risk of death among former inmates was 12.7** (95% CI, 9.2 to 17.4) times that among other state residents, with markedly elevated relative risk of death from drug overdose (129; 95% CI, 89 to 186). **Leading causes of death among former inmates were drug overdose, cardiovascular disease, homicide, and suicide.**

Conclusions

Former prison inmates are at high risk for death after release from prison, particularly during first 2 weeks. Interventions are necessary to reduce the risk of death after release from prison.

CRICC Grant:

Veteran Status and the Risk of Death Following Release from Prison

Principal Investigator: Hal S. Wortzel, MD

Mentor: Ingrid A. Binswanger, MD, MPH

Mentor: Lawrence E. Adler, MD

Merge existing data base with VBA to identify Veterans and determine:

- 1) What is the mortality rate of Veterans after release from prison, and how does it vary over time?**
- 2) Do Veterans have a higher risk of death after release from prison than non-Veterans?**
- 3) Are Veterans more prone to specific causes of death (such as suicide) upon release?**
- 4) Among Veterans released from prison, does service connection and VA benefits provide a protective effect?**
- 5) Does the protective effect offered by service connection and VA benefits vary by cause of death?**

Aggression as a Target for Suicidality

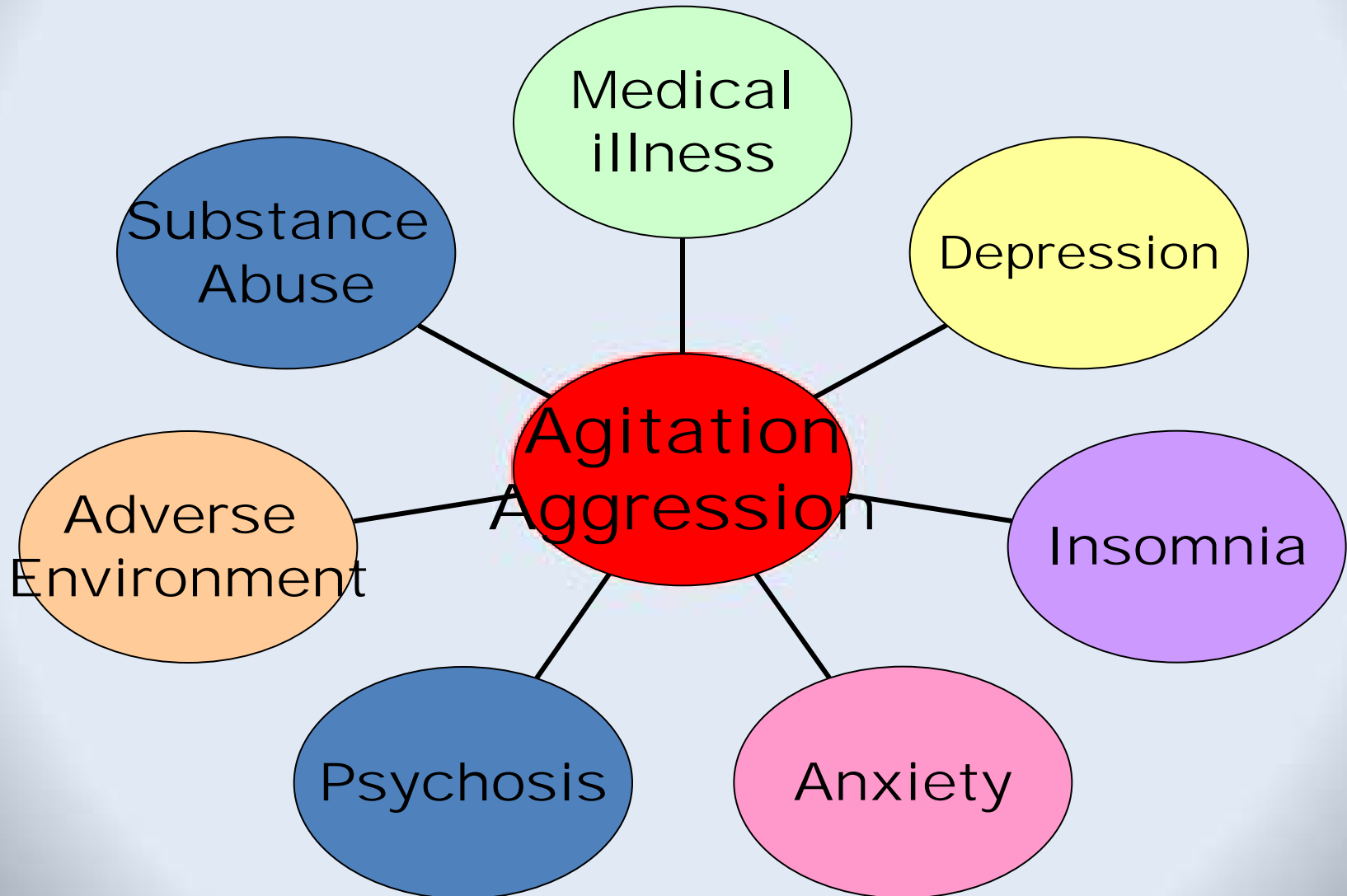


Figure adapted from Silver 2005

Summary

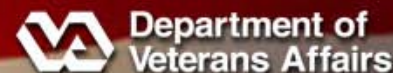
- OEF/OIF veterans at high risk for TBI and PTSD
- TBI and PTSD both carry increased risk for suicide
- Need to identify and target these conditions with our best evidence-based practices
- Be particularly vigilant for depression and/or substance abuse in the setting of TBI and/or PTSD; both magnify suicide risk even further
- Assess hopelessness and suicidal ideation proactively in this population
- Recognize risk regardless of time post-injury
- Aggression, burdensomeness, and belongingness may be novel targets to engage and thereby enhance patient safety



**IT
TAKES
THE
COURAGE AND STRENGTH
OF A WARRIOR
TO ASK FOR HELP.....**

**If you're in an emotional crisis
call 1-800-273-TALK "Press 1 for Veterans"**

www.suicidepreventionlifeline.org



THANKS!

Hal.Wortzel@va.gov

