

Concussions and Traumatic Brain Injury: The How-To's of Diagnosis, Prognosis, and Disability Determination

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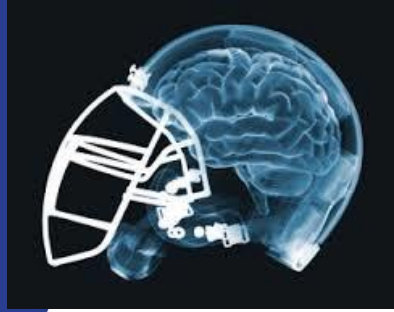
Concussion

Concussion

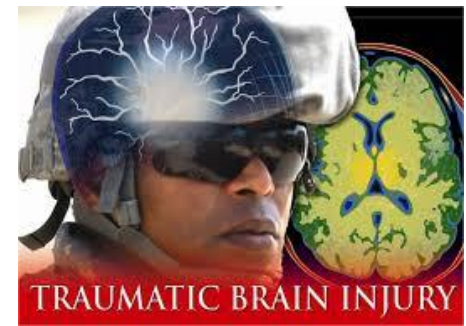
Assessment, Management and Rehabilitation

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Myths of mild TBI



- Concussions will inevitably lead to neurodegeneration and dementias, and there's little to do but hope for good genetics.
- One week of rest, preferably in a dark room, after a concussion is usually sufficient to allow for return to sports.
- Newer neuroimaging techniques, blood biomarkers and EEGs allow us to diagnose and prognosticate concussions.
- Safety equipment, including helmets and airbags have helped to reduce concussions.
- There are no evidence-based treatments for symptoms of concussion, it's all about natural recovery.
- Animal research has helped us to move closer understanding and managing human concussion.
- Stems cells hold good promise for future recovery



A concussion can ruin your whole day - watch #18 in Red at the bottom of the screen



Diagnosis of Concussion

- Acute trauma (acceleration and deceleration) + alteration or loss in consciousness = Concussion.
- Presence of Post-Traumatic Amnesia (PTA) (loss of memory for events after insult) may support more significant injury and higher likelihood of persistent issues.
- No role for diagnostic imaging (CT Scan) if stable or resolving neurologic symptoms at 30 minutes.
- No role for neuropsychological testing for 90+ days.
- No clinical role for MRI scan.



Concussions



- >4 million sports and recreational injury concussions annually in the U.S.
 - <50% of individuals seek care and are diagnosed
- >1.7 emergency department visits for concussion annually in the U.S.
 - No standardized approach to assessment or care
- >250,000 concussions from recent Gulf Wars (16% of all combat Servicemembers)



Injury caused by rotation and acceleration not direct skull trauma



Airbags prevent skull fractures and death, not concussions

mTBI = Concussion

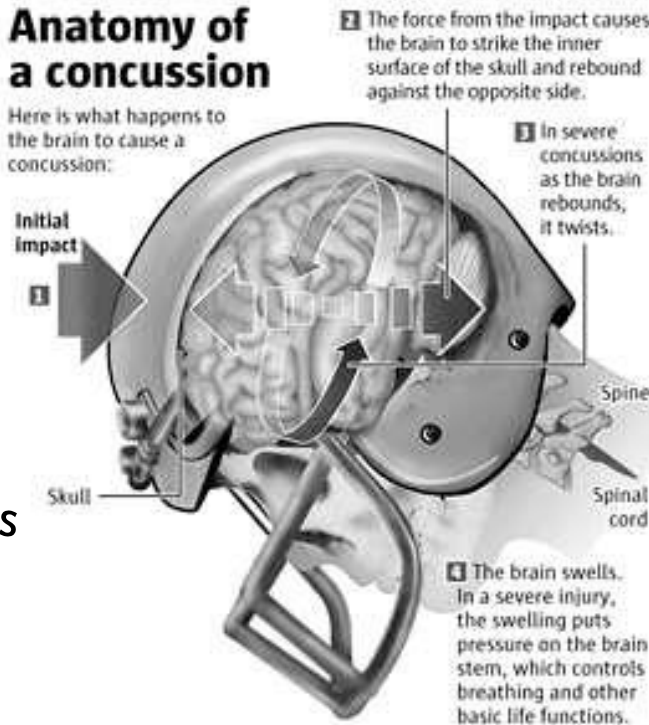
Poor memory for events before or after injury



Playing sports without helmets causes deaths but doesn't reduce concussions

Anatomy of a concussion

Here is what happens to the brain to cause a concussion:

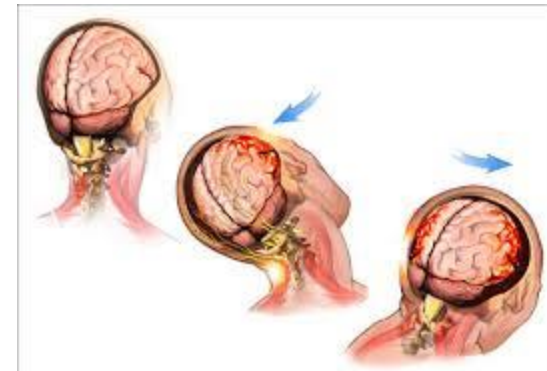


Sources: Dr. Jay Rosenberg of Kaiser Permanente Medical Care Neurology; American Academy of Neurology; The Human Body

MARK NOWLIN / THE SEATTLE TIMES

Concussion = mTBI

Up to 30 minutes of altered or loss of consciousness

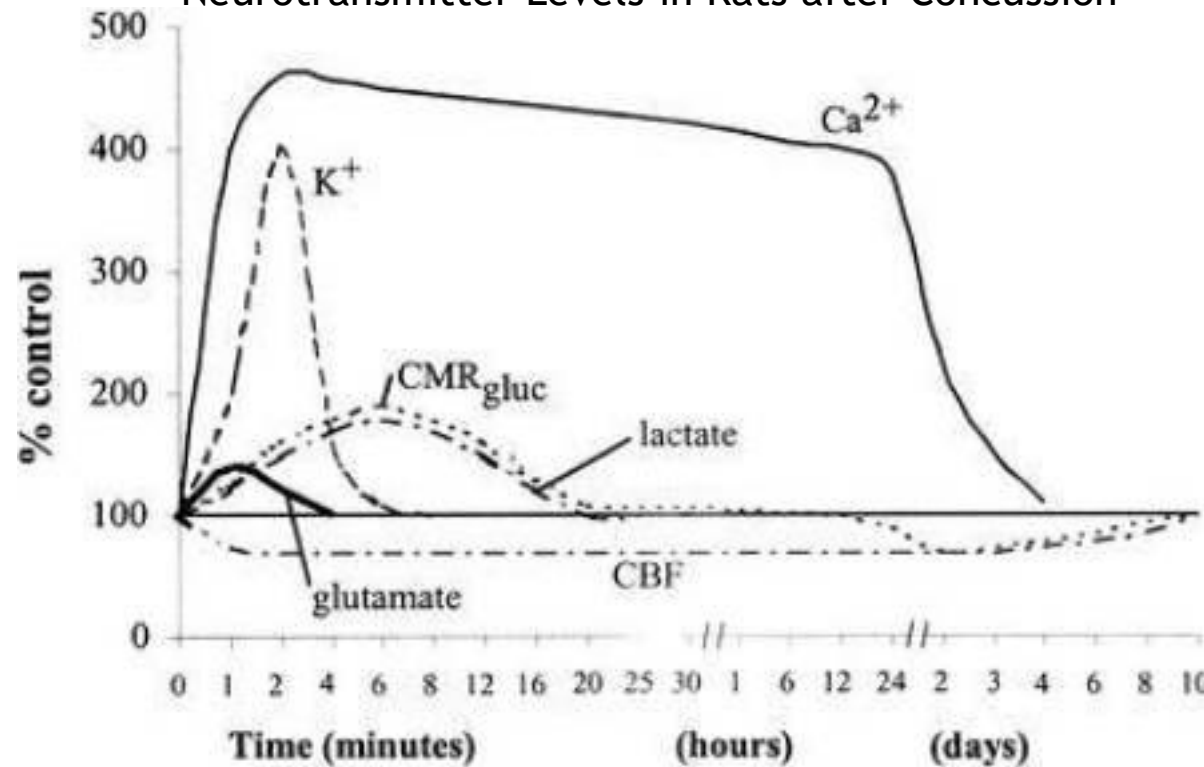


Helmets prevent skull fractures not concussions

Role of Animal Research



Neurotransmitter Levels in Rats after Concussion



Animal research in TBI has resulted in zero treatment breakthroughs

Rat-based football games would generate few concussions

It takes experimental rodents' brains 1 week to return to baseline neurotransmitter levels after a single concussion; Humans likely will take 4+ weeks

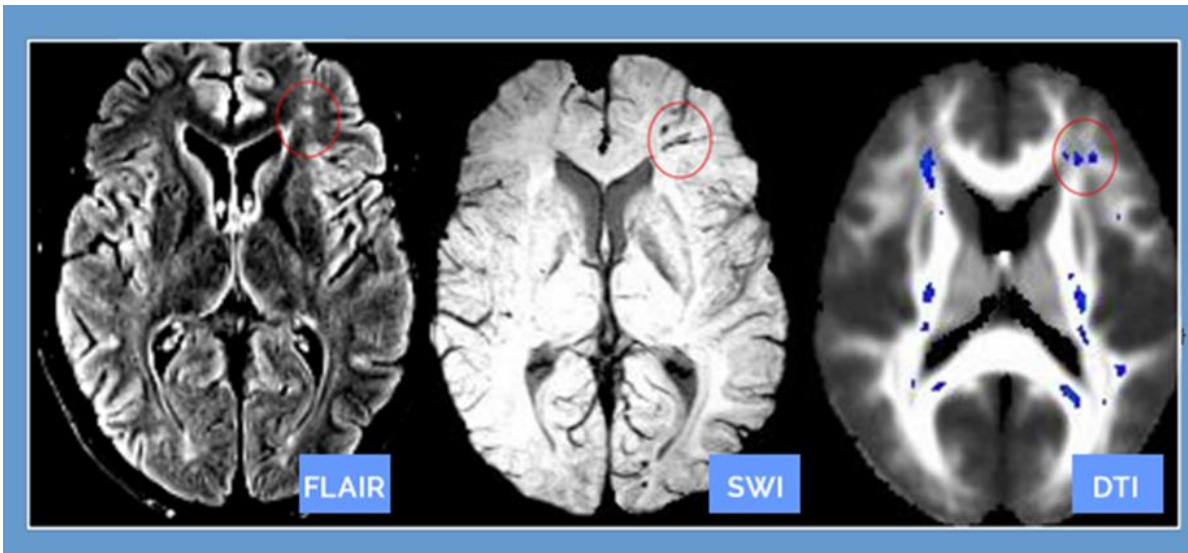
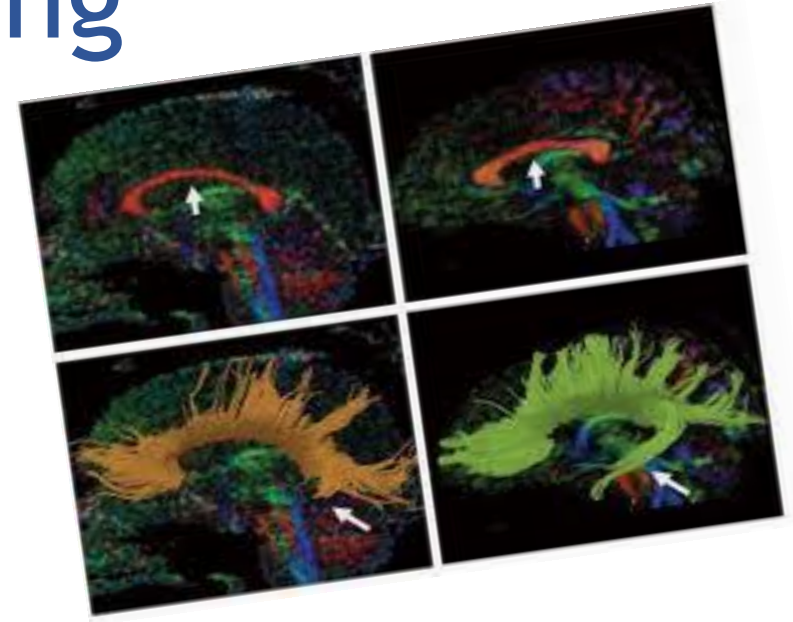
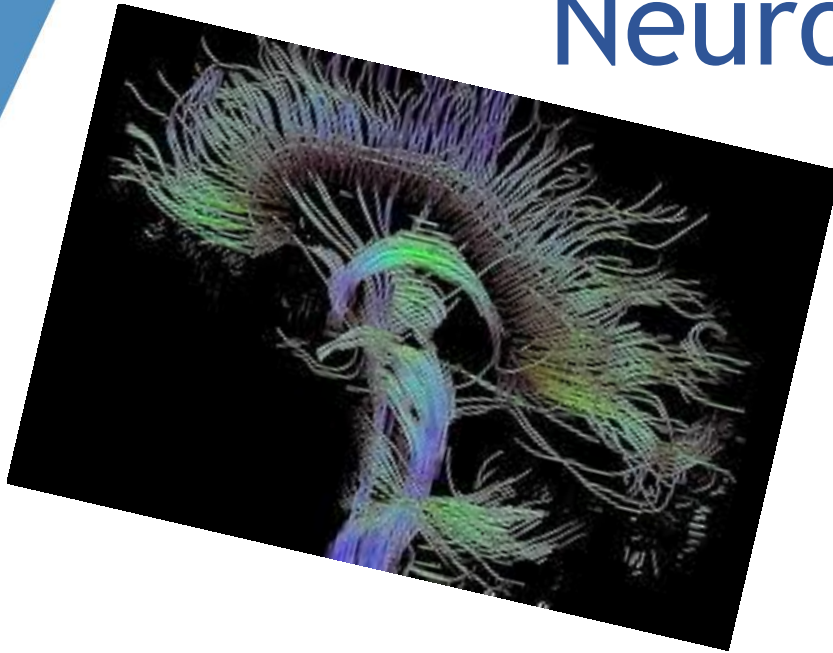
DoD-VA Clinical Practice Guidelines (CPGs)

- <https://www.healthquality.va.gov/>
- **Rehabilitation**
 - Concussion/mTBI: <https://www.healthquality.va.gov/guidelines/Rehab/mtbi/>
 - Amputation: <https://www.healthquality.va.gov/guidelines/Rehab/amp/>
 - Opioid Use: [Opioid Therapy \(OT\) for Chronic Pain](#)
 - Back Pain: [Lower Back Pain \(LBP\)](#)
 - Management of Hip/Knee OA: [The Non-Surgical Management of Hip & Knee Osteoarthritis \(OA\)](#)
 - Stroke Rehabilitation: [Stroke Rehabilitation](#)
- **Brain Injury-related**
 - PTSD: [Posttraumatic Stress Disorder \(PTSD\)](#)
 - Depression: [Stroke Rehabilitation](#)
- **Military-Related**
 - [Nuclear, Chemical and Biological Illness \(NBC\)](#)
 - [Management of Chronic Multisymptom Illness \(CMI\)](#)

Initial Evaluation

- **Establishing history of event is key to to evaluation.**
 - Define trauma
 - Define period of altered/lost consciousness
 - Define anterograde or retrograde amnesia period
 - Define chronicity of post-concussion symptomology
 - Validated questionnaires available for distant “concussive exposures.”
- Acute imaging (CT scan) indicated if persistent (>30 minutes) neurologic symptoms (N/V, numbness, imbalance, cognitive impairment) or recent repeat injury. No other imaging appropriate.
- No role for other diagnostics acutely unless additional trauma suspected.

Neuroimaging



While we have amazing technology, images and advancing science, it's unclear what to actually do with brain imaging for acute clinical care, long-term predictions or research

Biomarkers for mTBI

- Extensive research efforts to identify CSF, blood, urine and/or salivary biomarkers of TBI (all severity). Other modalities (qEEG, computerized eye tracking, cranial ultrasound) also used.
- Acute injury markers in CSF of moderate-severe TBI defined in rodents and have fair sensitivity but poor specificity in humans.
- No clear acute or chronic biomarkers for mild TBI (existing ones have no clinical utility).
- Diagnosis is best made by experienced clinician.



Symptom Etiology

- Early education and counseling on the causes and management of acute symptoms, and the likelihood of excellent recovery is the major determinant on outcome.
- Acute (1-2 weeks) symptoms after concussive injury are most commonly the result of musculoskeletal injury to the head and neck.
 - Headache
 - Visual changes
 - Dizziness
 - Pain with insomnia, irritability and cognitive issues



Symptom Etiology



- New symptoms that arise more than 2 weeks after injury are rarely directly related to the physical effects of the injury, but rather due to the affects of immobility, an alteration in normal activity, misinformation and psychological effects (iatrogenic, acute stress response, anxiety).
- Persistent symptoms after 4 weeks despite early activity, musculoskeletal care, education and counseling are rare and likely the result of psychologic dysfunction (which is highly amenable to treatment). If there are persistent neurologic issues, then these are best managed with activity, symptom management and reassurance.
- More commonly, there is inactivity, undertreatment and miseducation.

Symptom Etiology

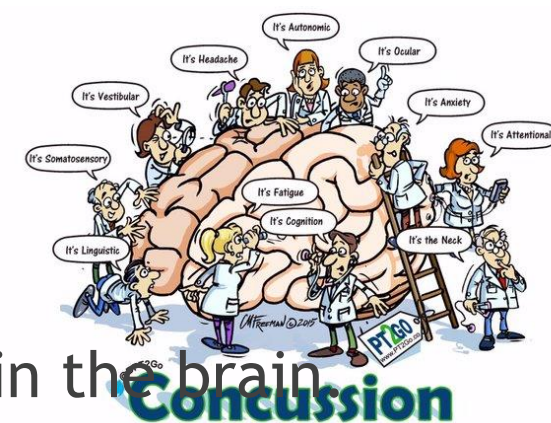


- There are limited data comparing differing causes of concussion and resulting symptoms or outcome.
- No definitive evidence that sports, vehicular and combat-associated etiologies result in differing symptoms or outcomes when taking into account the associated secondary physical and psychological injuries and co-morbidities.
- No definitive evidence supporting which factors, i.e., “severity” of concussion, type or severity of acute symptoms, imaging findings, age, or gender, result in differing long-term symptoms or outcomes.





Management of Concussion



- Explanation - transient, minimal disruptions of some signals in the brain
- Education - range of symptoms are predominantly related to the physical trauma, emotional stress from injury and concern over recovery.
- Reassurance- Rapid and full recovery likely, wide range of effective treatments and supportive clinicians available for care
- Reactivation - Return to physical and cognitive activity within 1-2 days. Full return to normal life when able to perform tasks effectively. Unclear if persistent symptoms have anything to do with actual brain healing.

Initial Management

They are actually called “mild” for a reason!!

- Carefully evaluate patient for evidence of trauma in excess of concussion (occult fracture, carotid dissection, ear drum, CSF leak) or outside head.
- Use standardized symptoms assessment protocol (Neurobehavioral Symptom Inventory, Rivermead Post-Concussion Questionnaire).
- Explain to patient the nature of concussion, the course of recovery and the positive prognosis.
- Provide specific f/u information and compassion!

Presenting a good prognosis has been shown to positively affect outcome

>95% will report full recovery at 1 year

Neurobehavioral Symptom Inventory

1. Feeling dizzy
2. Loss of balance
3. Poor coordination, clumsy
4. Headaches
5. Nausea
6. Vision problems, blurring, trouble seeing
7. Sensitivity to light
8. Hearing difficulty
9. Sensitivity to noise
10. Numbness or tingling on parts of body
11. Change in taste and/or smell
12. Loss or increase of appetite
13. Poor concentration, can't pay attention, easily distracted
14. Forgetfulness, can't remember things
15. Difficulty making decisions
16. Slowed thinking, difficulty getting organized, can't finish things
17. Fatigue, loss of energy, getting tired easily
18. Difficulty falling or staying asleep
19. Feeling anxious or tense
20. Feeling depressed or sad
21. Irritability, easily annoyed
22. Poor frustration tolerance, feeling easily overwhelmed by things

The rotational angle is more important than the intensity of the force - Watch # 24 Red in the top middle of the ice



Acute Concussion Management (0-14 days)

- Treat specific symptoms directly (modality, meds, education) and boldly (starting low and going slow doesn't work!), but keep in mind the interrelatedness of symptoms.
- Intensive musculoskeletal care (movement, pain management, return to full activity) is the key to all symptom management!
- No evidence that the common symptoms of concussion (H/A, insomnia, dizziness, memory impairment, irritability) should be managed any differently than the same symptoms without concussion.
- Most symptoms will resolve spontaneously in 1-2 weeks. Reassurance.
- No further testing indicated. More testing often leads to anxiety and false positives. Don't order tests unless you have a plan for the results!

Acute Concussion Management (1-14 days)

- Continued reassurance to patient (family) of good prognosis.
- Encourage early physical activity (walk, swim); no evidence that “symptoms” must restrict activity.
- Encourage rapid reintegration into school and work.
- Reduce stress (no tests in school for 2-4 weeks, but should go to school!)
- Prevent repeat injury.
- Repeat standard testing and exam at each visit and explain findings.
- Encourage use of written or virtual log.

Concussion Management (2-6 weeks)

- Symptoms that are responding to basic treatments should continue to be addressed this way. Provide education.
- New or recalcitrant symptoms can be approached with second line agents but consider bringing in formal physical and occupational therapy.
- Symptoms can still resolve spontaneously for first 3 months.
- No further testing at this point. Repeat standard testing and exam at each visit. Encourage use of written or virtual log.
- Continue to encourage physical activity, reassure, highlight improvements, downplay symptoms and support return to life activities.

Sports Concussions



- Return to school and play guidelines are based on “consensus.”
- Symptom management is main management tool, although symptom resolution and return to normal brain function do not appear to be simultaneous or necessarily related.
- Return to school immediately and titrate activity as symptoms managed and tolerated.
- Return to play when symptom free at rest and during activity/scrimmage.
- Psychologic issues play a major role in injury, recovery and management.

Guidelines for Return to School after Concussion

- Out of school at first if necessary, and then gradual re-entry as tolerated
- Avoid re-injury in sports, gym class and crowded hallways or stairwells
- Provide academic accommodations
- Regular communication



Non-Sport, Civilian Concussions



- Most common cause is MVC.
 - Airbags have decreased TBI fatality and increased mTBI.
 - Whiplash (neck) injury almost always accompanies mTBI.
 - Concussions are commonly overlooked with or without other trauma.
- Symptom management, education and reassurance remain the main management tools.
- Medicolegal issues complicate management and recovery.
- Elements of sport and combat mTBIs in MVC injury.



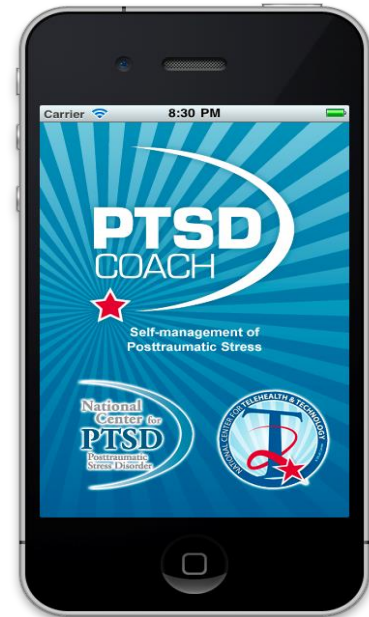
Concussion Management (7-12 weeks)

- Symptoms that are responding to basic treatments should continue to be addressed this way. Provide education.
- New symptoms are likely related to secondary overlay. Consider consulting TBI specialist (PM&R!!)
- Psychological counseling and care should begin, but no formal neuropsychological testing until 3+ months.
- Symptoms can still resolve spontaneously for first 3 months.
- No further testing at this point. Repeat standard testing and exam at each visit. Encourage use of written or virtual log.
- Encourage physical activity and return to life activities.

Concussion Coach



- *Concussion Coach* is a mobile phone application for Veterans and Service members who experience symptoms that may be related to brain injury.
- It can be used as a *stand-alone* education and symptom management tool, *or to augment* face-to-face care with a healthcare professional.
- Available in Apple App store (free)



Concussion Management (>12 weeks)

- Spontaneous resolution is unlikely. Provide education on next steps.
- Team-based rehabilitation is indicated, led by Psychologist.
- Repeat standard testing and examination at each visit.
- Obtain neuropsychological testing. Consider MRI/DTI for reassurance.
- Consider symptom-specific testing (CPT, ophtho, ENT)
- Encourage physical activity and return to life activities.

Post-Concussive Symptoms

- While persistent physical, cognitive, emotional, and/or sleep-related symptoms occur in 50+% of concussions, they usually resolve in 1-4 weeks.
- Symptoms presenting in the first 2 weeks after a concussion are commonly ascribed to the concussion, with “new” symptoms related to poor reactivation, misinformation and related psychological distress.



- Post-Concussive “Syndrome”
 - symptoms continuing for 3+ months
 - seen in 15-30% of concussions
 - continue for >1 year in <5%.

Common signs of concussion:



Dizziness



Nausea



Headaches



Light
Sensitivity



Confusion

Disability Determination

A concussion is an event.

- 70-85% of individuals are back to baseline by 90 days and >95% by 1 year.
- Focal neurologic dysfunction after mTBI is rare (<1%).
- Functional limitations after mTBI are rare.
- Individuals with persistent difficulty are limited by the specific symptoms (headache, dizziness, insomnia, inattention, irritability) or associated co-morbidities (PTSD, GAD, depression), not neurologic “damage.”
- DD should focus on identifying temporal relatedness of symptoms and apportioning impairment by symptomology.

Individuals and clinicians often attribute every future symptom to the concussive event

Immovable objects often present a problem for the brain





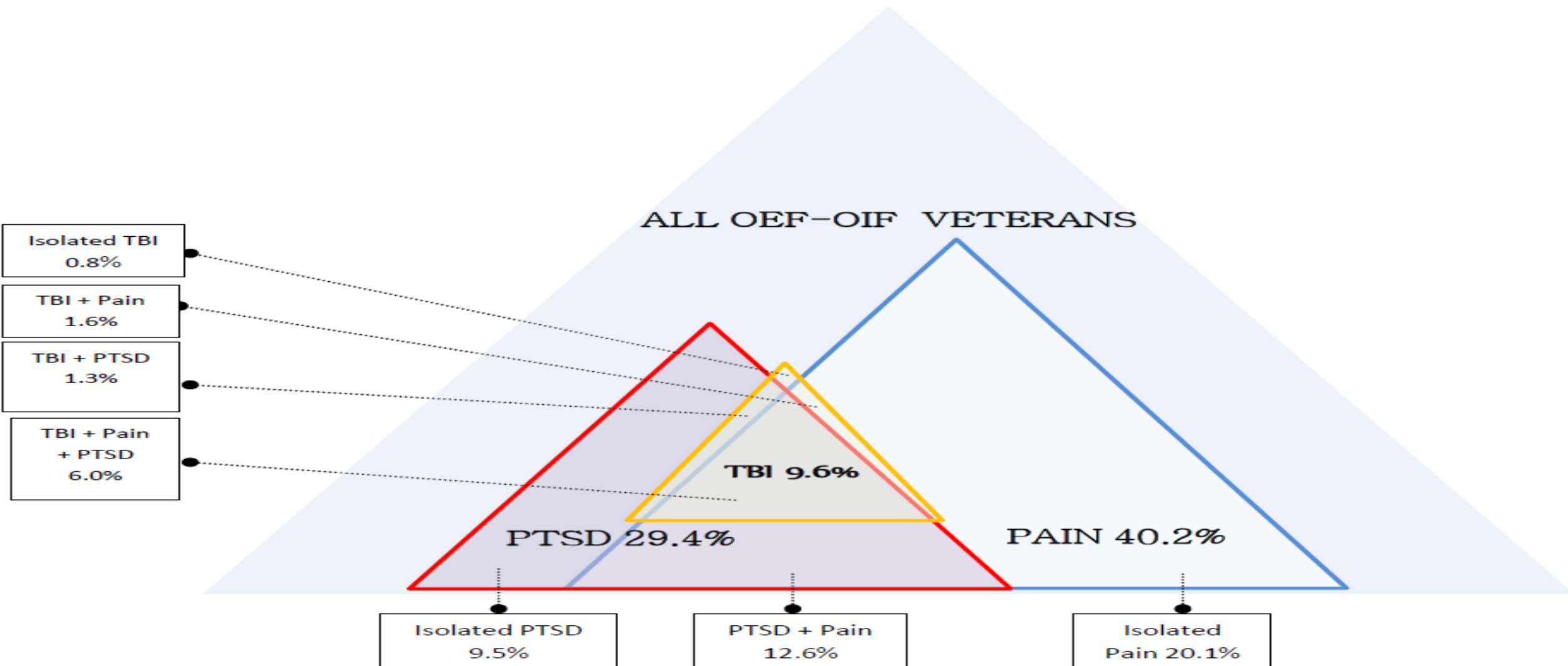
Combat Concussions



- 16-20% of OEF-OIF-OND Veterans who received VA medical care have confirmed TBI and 8% remain still symptomatic
 - ~250,000 total (of more than >1,100,000 screened) in VA
 - 90,000 symptomatic
 - >98% mild
 - <2% moderate-severe
 - >50% due to MVC
- 75% of Veterans with symptomatic mild TBI also have at least one mental health diagnosis, most commonly Post Traumatic Stress Disorder (PTSD)
- 90% will have either PTSD or chronic pain disorder



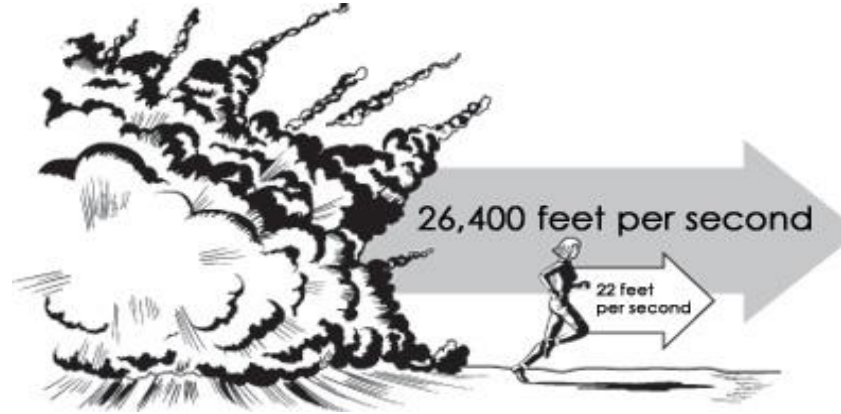
Figure 1
Three Year Incidence of TBI, PTSD and/or
Pain Diagnoses in OEF-OIF Veterans (2009-
2011)



One Explosion/Blast has Multiple Mechanisms of Injury



Wall of Air (Primary)



Blast Wind (Primary)



Flying Debris
(Secondary)



Displacement
(Tertiary)



Collapse Building
(Quaternary)

Is there an effect of Primary Wave?

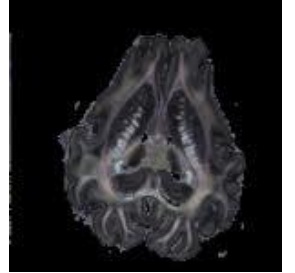


- The effects of flying debris/shrapnel, displacement and hypoxia on the body and brain are well documented.
- The effect of a low pressure/high pressure compression wave on organs/bones is variably understood.
- The effect of a low pressure/high pressure compression wave on the brain is not understood.



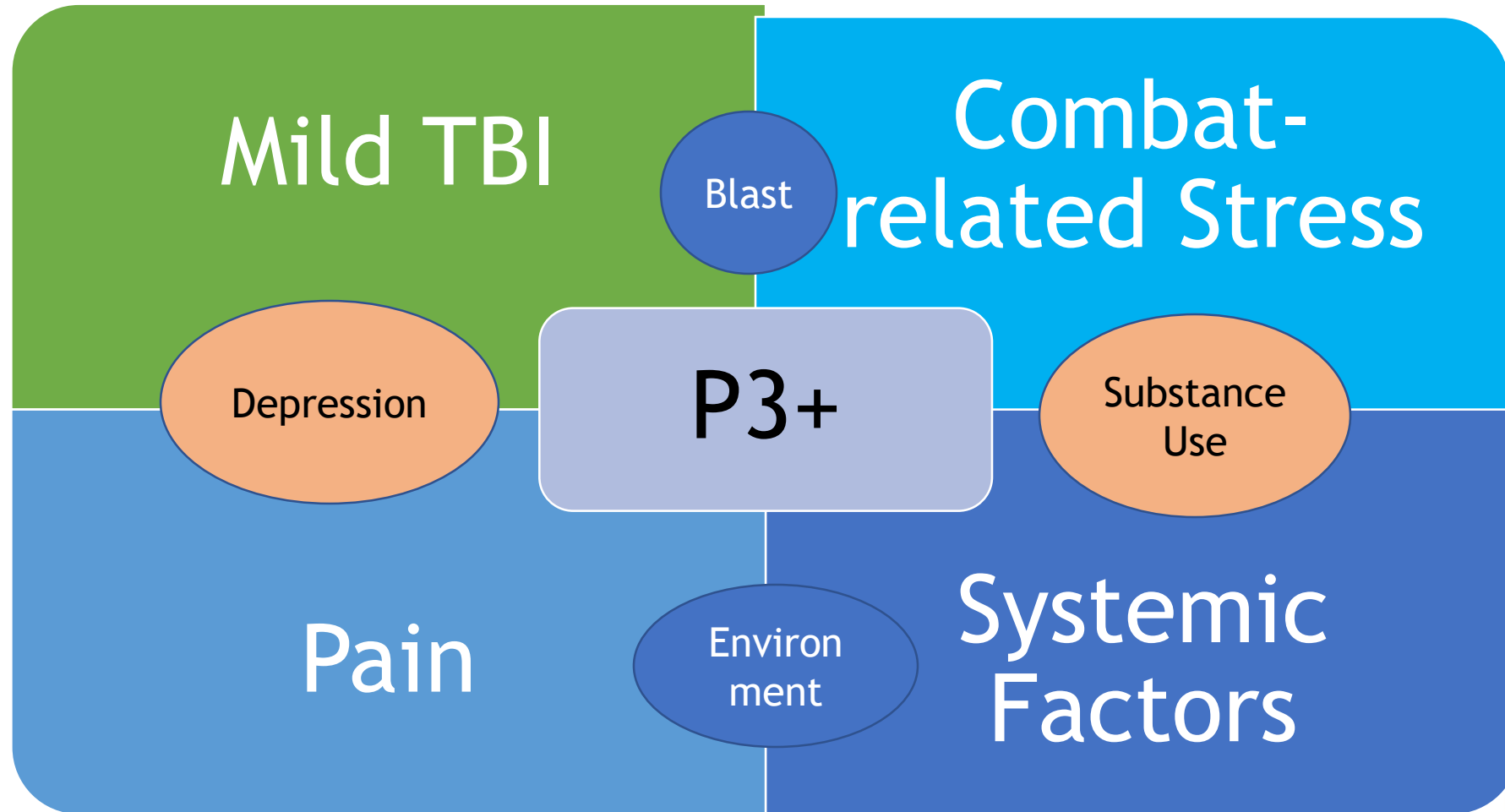
Impact of Primary Blast Wave

- At moderate intensity blast, theoretical modeling demonstrates
 - Skull distortion
 - Propagation of wave across skull and into underlying tissues
 - Entry of wave via small apertures (eyes, nose, ears)
- At moderate intensity blast, animal modeling demonstrates
 - Skull distortion and brain injury in immobilized rodents
 - Propagation of wave across skull and into underlying brain in immobilized swine
- Effect of mild intensity blast ?????

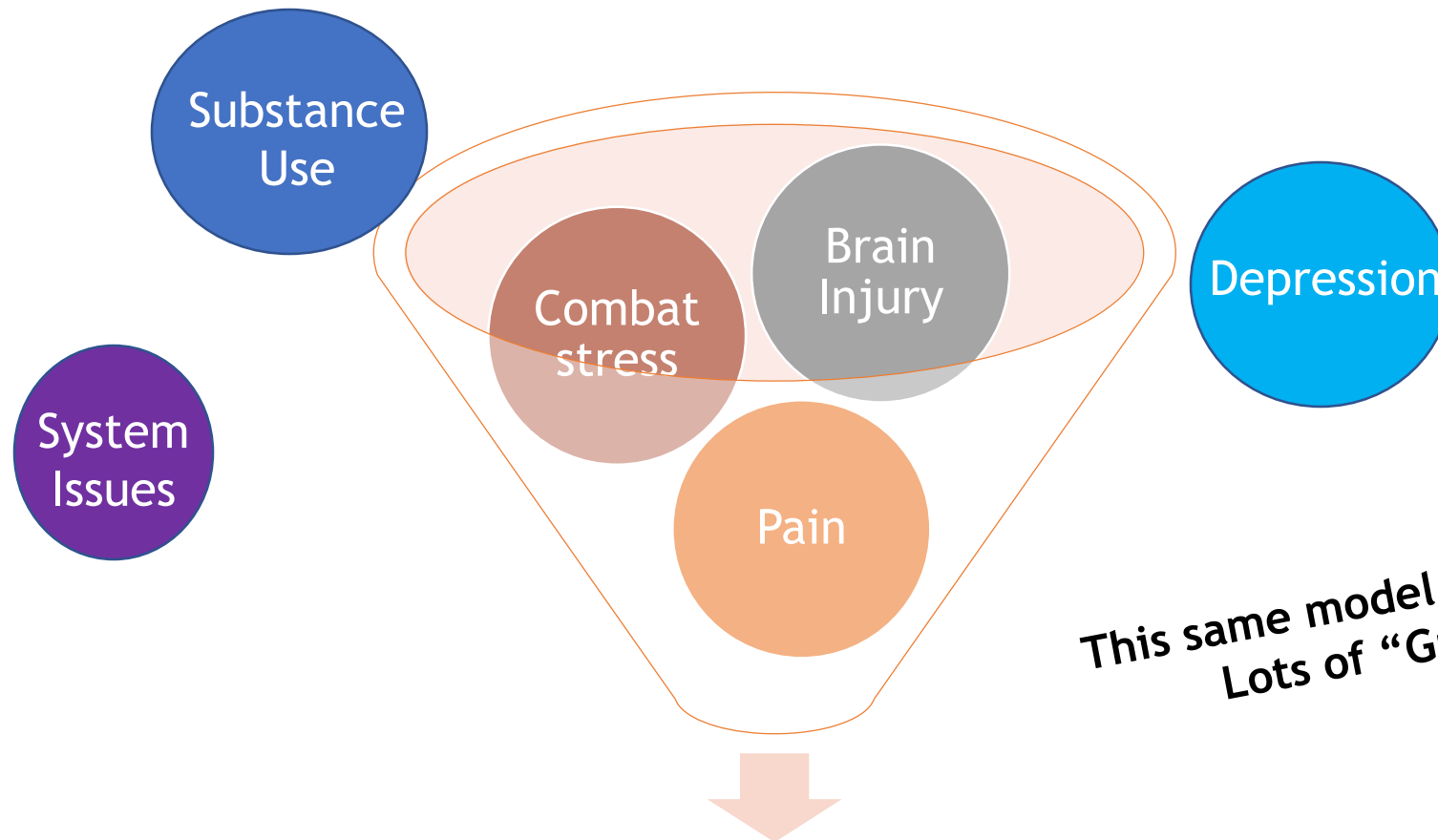


Breachers' Study demonstrated deficits only
in the long-time exposed teachers!

Post-Deployment Syndrome: A Complex Condition

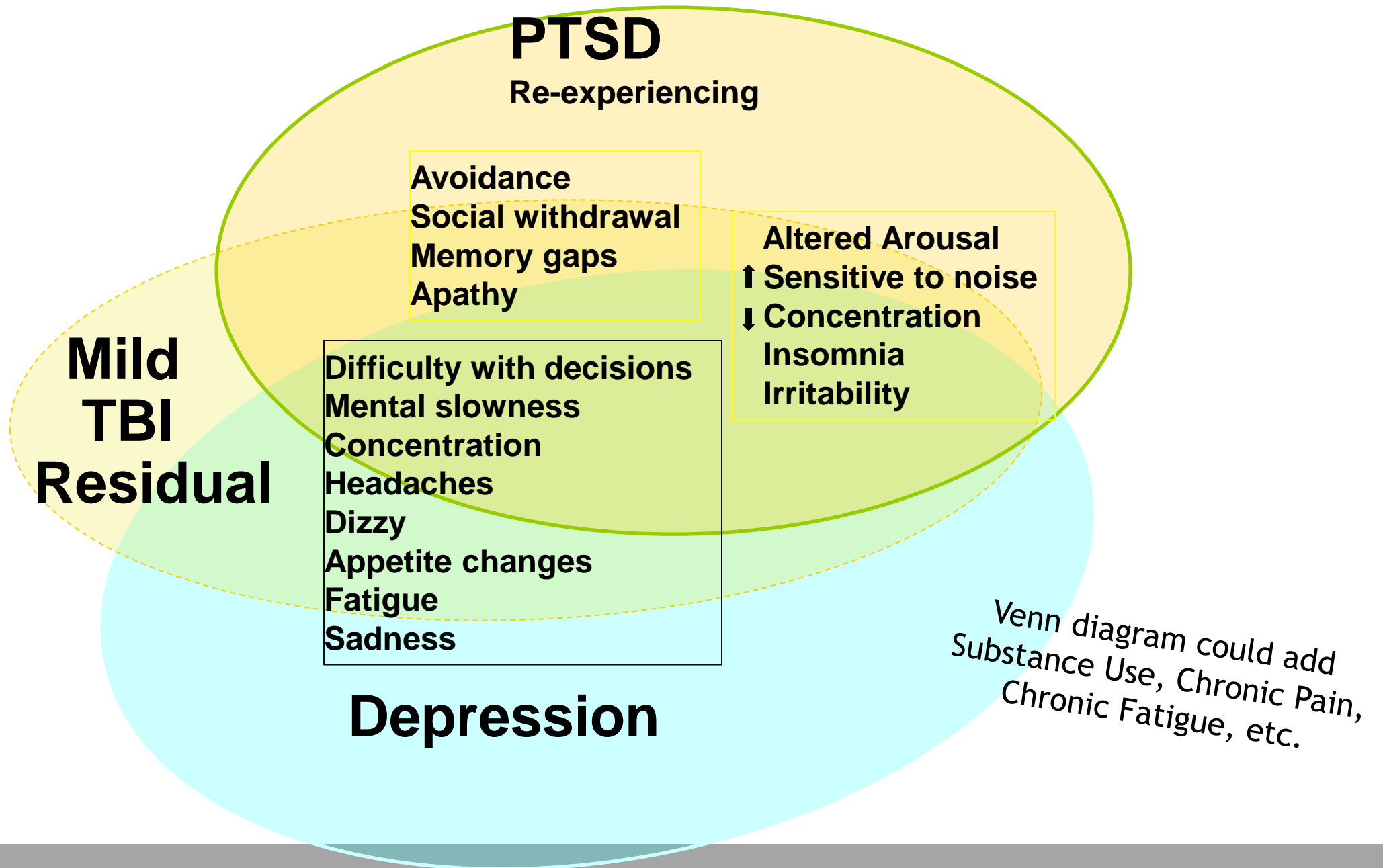


Post-Deployment “Gunk”



*This same model applies to athletes!!
Lots of “Gunk” in sports.*

Post-Combat Dysfunction



Challenges to Management



- Uncertainty of diagnosis
 - Gold standard test is the question concerning AOC/LOC
 - Imaging (CT Scan) normal >95% of time, high false positive rates on many “TBI tests,” and poor clinical correlations with testing.
- Few clinicians specialty trained
 - Carpenters like to use wood for everything!
- Overlap of symptoms with pain, depression, fatigue, stress and life.



“I’ve never met a TBI that I couldn’t diagnose!”

Challenges to Management

- Range of Treatment Options
 - Benign neglect successful >90% of the time.
 - Majority of complaints are related to either musculoskeletal or stress-related factors.
- Army of “specialists” and charlatans
 - Musculoskeletal
 - Vision
 - Vestibular
 - Cognitive
- Catalogues full of remedies



Brain Health Vitamins

Hyperbaric
Oxygen

Neural Biofeedback

Blue Light

Anti-inflammatory detoxification

Challenges to Management

- Individuals bring beliefs, fears and biases
 - Media is replete with concussion and dementia stories.
- Anxiety, misunderstanding, variable compliance, and symptom attribution affect efficacy.
- Differing opinions, prior experiences and outside influences (internet!) affect level of self-efficacy.
- Healthcare system favors testing and illness (Teslas don't pay for themselves!)



Challenges to Management

- **Lack of Integrative Health Care**

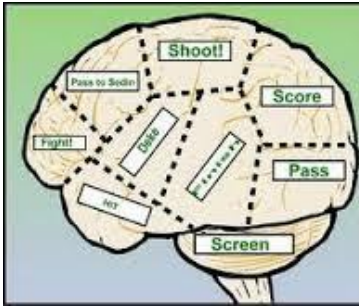
- Complexity of physical and psychological issues seen with concussion often leads to multiple clinicians.
- Each clinician may either limit care to single component of symptoms or have overlap.
- Coordination of care is rare.
- Use of varying types of care is also often siloed
 - Traditional Western Medicine
 - “Alternative” Eastern Medicine (only “alternative” to the West)
 - Exercise
 - Quackery



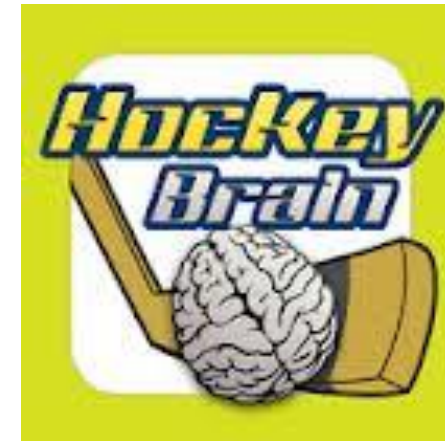
Post-Deployment Syndrome Management

- Education
 - Diagnosis - explain multiple contributors
 - Prognosis - optimism, self-actualization
 - Health Management - Fitness, Sleep, Diet, Mind/Body
- Interventions
 - Sleep - sleep hygiene, medications
 - Pain - pain management, non-narcotic medications (short term)
 - Behavior - counseling, mood stabilizers (at full dosing)
 - Cognition - adaptive strategies, assistive technology
 - Fatigue - sleep, fitness, diet, counseling
- Goals
 - Normalization
 - Deinstitutionalization
 - Return to productivity and activity
 - Reintegrate into social roles and activities





Q: Do TBI's predispose for late life degeneration?

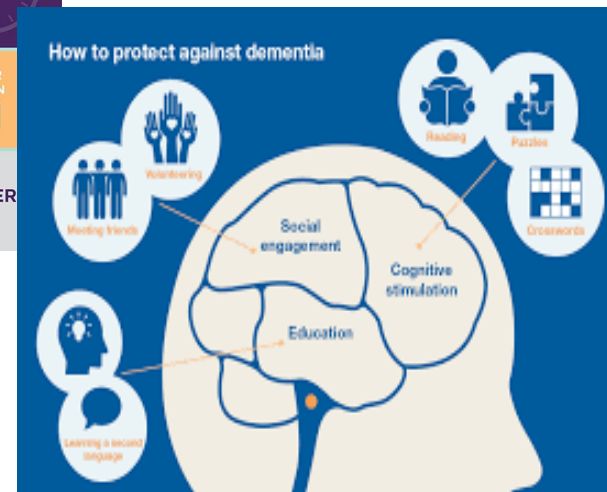


A: Yes

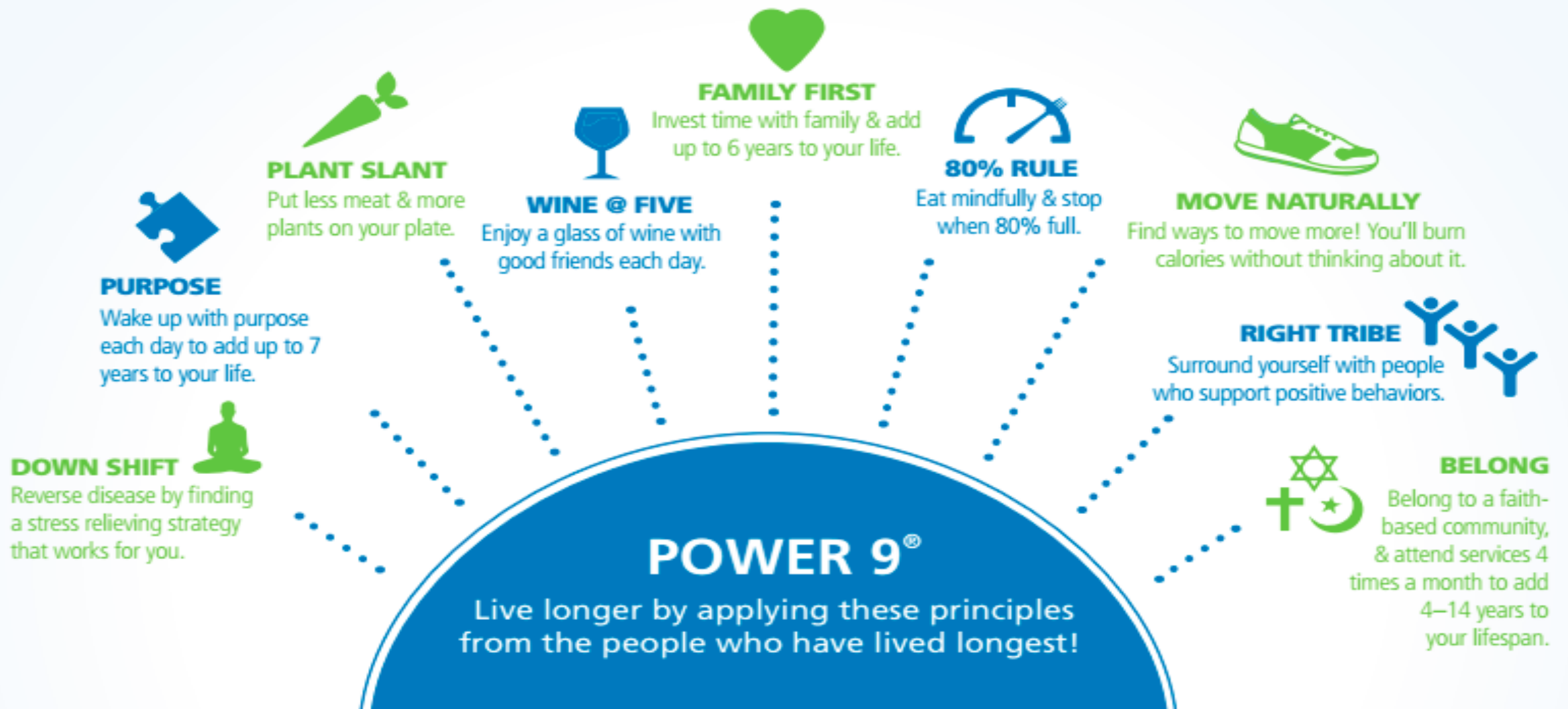
Dementia-related Factors



- Why does there seem to be an epidemic of dementia?
- Nine modifiable lifestyle factors account for up to 50% of all cases of dementia
 - Limited education in early life
 - hearing loss
 - Hypertension
 - Obesity
 - Smoking
 - Depression
 - Physical inactivity
 - Social isolation
 - Diabetes
- No single risk or protective factor is dominant.



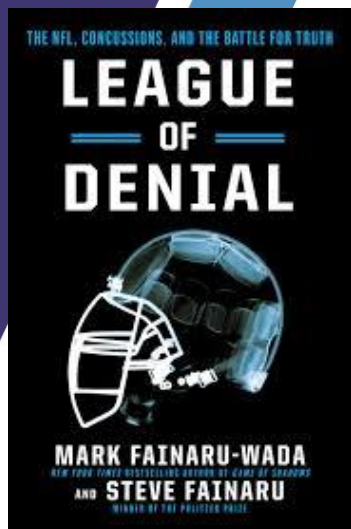
Ashby-Mitchell: Alzheim Res Ther 2017
Norton: Lancet Neurology 2014



75% of chronic diseases preventable

One-third of dementias preventable

**Diet, Exercise, Sleep, Stress Management, Pain Care,
Productivity, Social Integration, Family, Faith-Based Community**



Iraq War combatants (U.S.) with mTBI
report 1-150 mTBIs (~4 average).

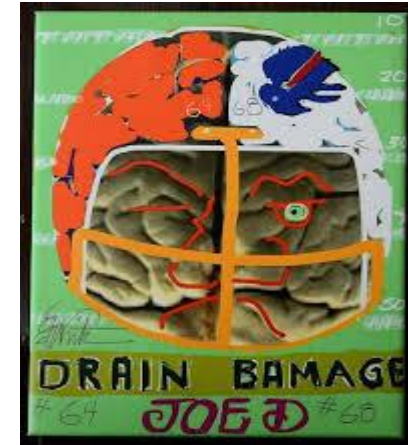
NFL players sustain 3,000-8,000
concussions during a lifetime of
sports.



Your speaker has sustained 6
concussions in his timid, little life.

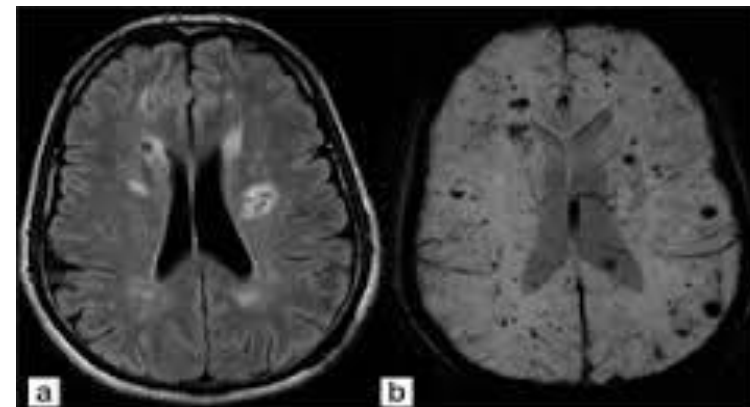
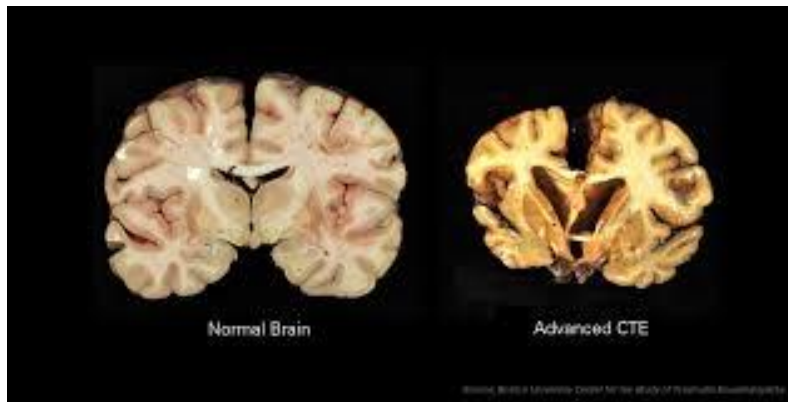
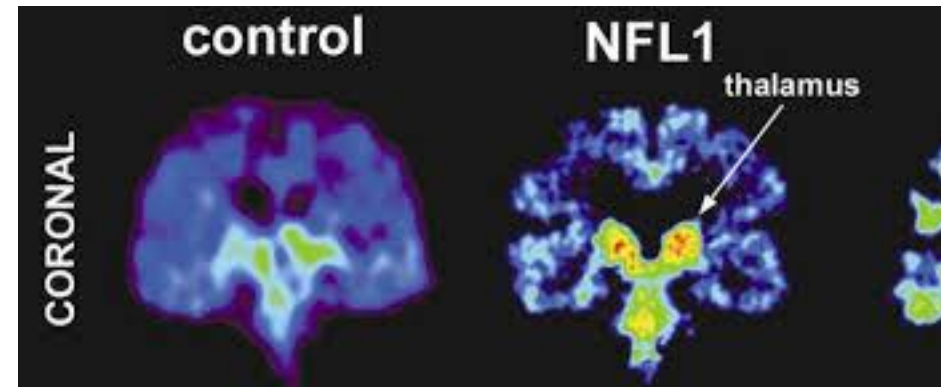
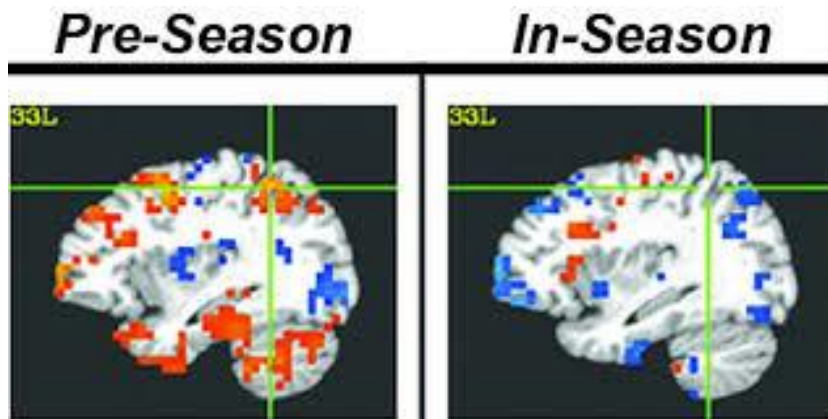


Chronic Traumatic Encephalopathy



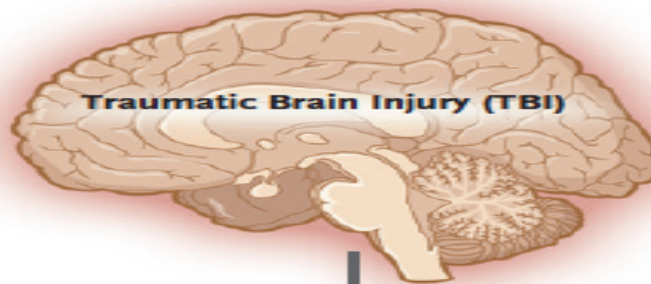
NFL players sustain 3,000-8,000 concussions during a lifetime of sports

Chronic Traumatic Encephalopathy



Chronic Traumatic Encephalopathy

- CTE (Punch Drunk, Dementia Pugilistica) begins insidiously, usually many years (5-20) after the patients have stopped playing sports, with inattention, mood and behavior disturbances, confusion, and memory loss, and progresses over many years (5+) to a stage of full blown dementia and Parkinsonism.
- The brain, in CTE, shows atrophy, dilatation of the lateral and third ventricles, and thinning of the corpus callosum.
- Microscopic examination reveals neuronal loss and **tau deposition** in neurons (**neurofibrillary tangles-NFTs**) and in astrocytes. This pathology involves the cerebral cortex (perivascular areas, deep), white matter, deep nuclei, and the brainstem.
- Beta amyloid deposition in the form of diffuse and less frequently neuritic plaques is seen inconstantly.



Diffuse axonal injury, mechanical tissue damage, ischemia, synaptic loss, neuronal dysfunction or demise

Impaired axonal transport, neuronal circuit disruption

Mild TBI

Contusion, mild edema, uncertain short-term pathology

Variable chronic cognitive or neuropsychiatric impairment; frequently associated with post-traumatic stress disorder

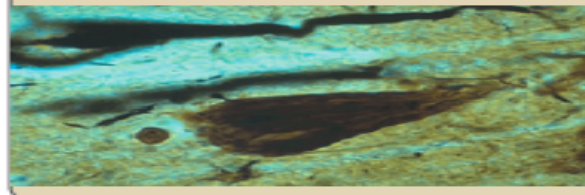
Mild Repetitive TBI

Axonal and cytoskeletal alterations, accumulation of abnormal protein aggregates

Tendency toward neuropathology modified by APOE $\epsilon 4$

Neurofibrillary tangles (tauopathy)

Dementia pugilistica; chronic traumatic encephalopathy; pugilistic parkinsonism



Severe TBI

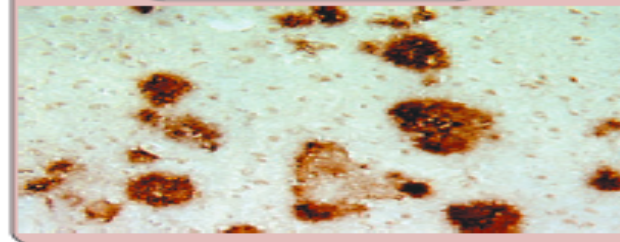
Chronically impaired neuronal homeostasis, accumulation of abnormal protein aggregates

OR

Reestablishment of neuronal homeostasis, clearance of abnormal protein aggregates

A β and tau pathology

Alzheimer's disease



Total or partial functional recovery, often with variable chronic cognitive or neuropsychiatric impairment

TBI and Degenerative Disorders

- Increasing evidence supports that
 - Even a single moderate to severe traumatic brain injury (TBI) is a risk factor for the development of Alzheimer's disease (AD) in later life.
 - Multiple mild TBIs (concussions) that aren't managed and have persistent symptoms and co-morbidities may lead to neurodegeneration (i.e., CTE).
 - A few pathological studies suggest that a single TBI may be associated with increased tau accumulation.
 - Definitive longitudinal studies are lacking → CENC

Counseling on TBI and CTE

- Acknowledge the individual's issues and concerns.
- Don't over explain or hedge your answer.
- The risk of developing dementia from a single concussion is zero. The risk of developing dementia from 10 concussions is just barely above zero.
- Undertreated symptoms (post-concussion, mental health, pain) may be a more relevant risk factor for dementia.
- Lifestyle factors, general wellness, and integration into society are biggest risk factors

Genetic testing has no role in clinical counseling or care

Chronic Effects of Neurotrauma Consortium

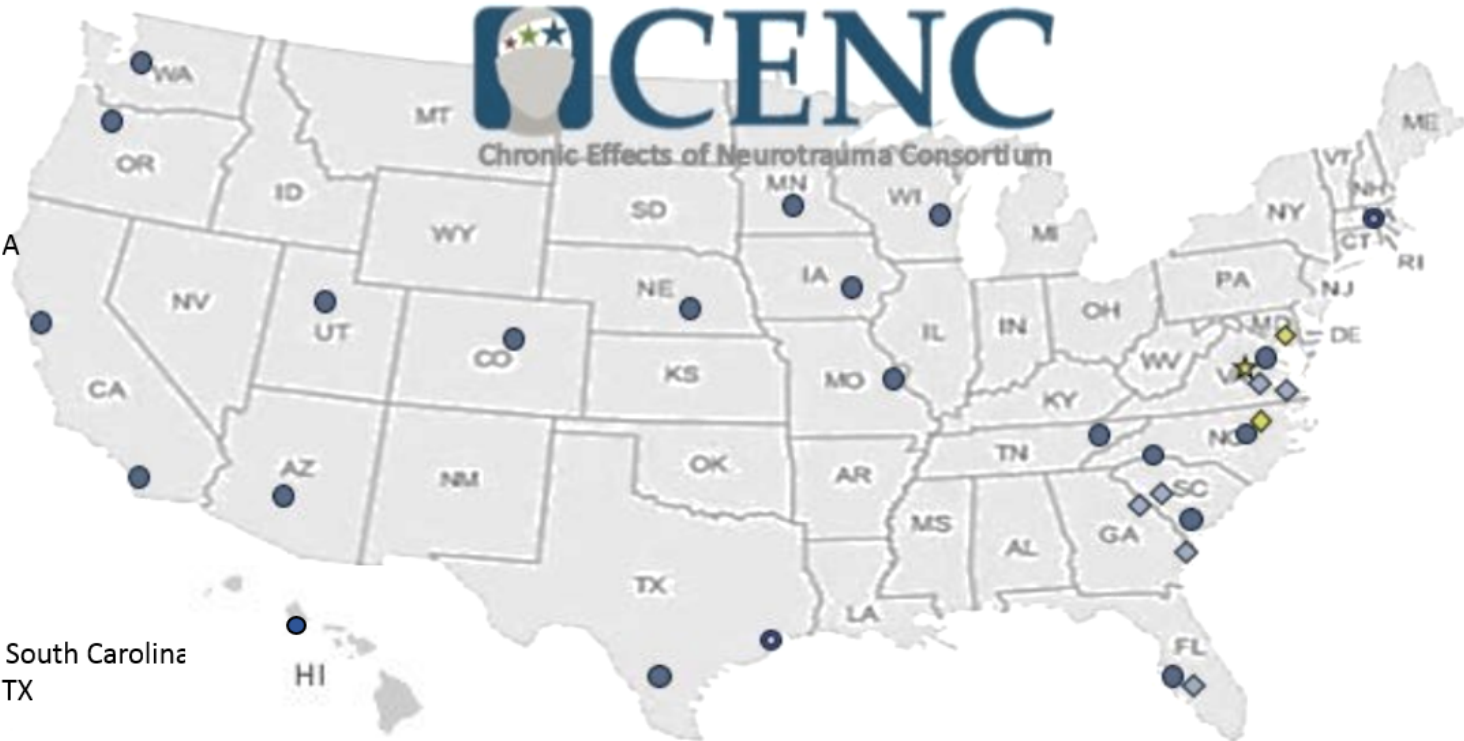
- Departments of Defense and Veterans Affairs funded nationwide research consortium to study the short- and long-term effects of repeated concussions in combat injured servicemembers and Veterans.
- Five year, \$62.2 million award begun October 2013, with 5-year renewal underway.
- 30+ Universities, 15 VA's and 12 MTFs working together
- Collaborations with NIH, NINDS, NIDILRR, NCAA and NFL research groups to jointly study civilian, sports and combat concussions.

CENC.RTI.ORG



CENC Sites

- Barrows Neurological Institute, Phoenix, AZ
- Baylor College of Medicine, Houston, TX
- Boston University, Boston, MA
- Brigham Young University, Provo, UT
- Duke University School of Medicine, Durham, NC
- Eisenhower Army Medical Center, Fort Gordon, GA
- Fort Belvoir Community Hospital, Alexandria, VA
- Fort Eustis, Fort Eustis, VA
- Fort Jackson, Columbia, SC
- Fort Lee, Fort Lee, VA
- Fort Stewart, Fort Stewart, GA
- Hunter Holmes McGuire VA, Richmond, VA
- James A. Haley Veterans Hospital, Tampa, FL
- Iowa City VA Health Care Center
- MacDill Air Force Base, MacDill AFB, FL
- Medical College of Wisconsin, Milwaukee, WI
- Medical University of South Carolina, Charleston, South Carolina
- Michael E. DeBakey VA Medical Center, Houston, TX
- Milwaukee VA Medical Center, Milwaukee, WI
- Minneapolis VA Health Care System
- Mountain Home VA Medical Center, Mountain Home, TN
- Northern California Institute of Research and Education, San Francisco, CA
- Roskamp Institute, Sarasota, FL
- RTI International, Durham, NC
- San Antonio Military Medical Center, San Antonio, TX
- San Francisco VA Medical Center, San Francisco, CA
- South Texas Veterans Healthcare Center, San Antonio, TX
- Uniformed Services University of the Health Sciences, Bethesda, MD
- University of Missouri St. Louis, MO



- University of Washington, Seattle, WA
- University of St. Louis, St. Louis, MO
- University of Hawaii, Manoa, HI
- University of Utah, Salt Lake City, UT
- University of Washington, Seattle, WA
- VA Boston Healthcare System
- VA Portland Health Care System
- VA San Diego Health Care System, San Diego, CA
- Virginia Commonwealth University, Richmond, VA
- WG Hefner VA Medical Center, Salisbury, NC

- ★ Coordinating Center/
Research Site
- ◆ Research Core
- Research Site/ Core
- Research Site
- ◆ Recruiting Site

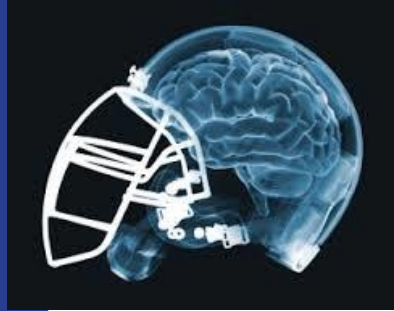
CENC Findings

- ▶ Of the more than 2,000 OEF/OIF participants recruited, in the sample with one or more mTBI's:
 - ▶ 2/3rds with persistent symptoms after combat concussions and related issues are still high functioning, employed and managing well in the community more than 9 years after injury
 - ▶ 1/3rd of the cohort with persistent symptoms are demonstrating ongoing and increasing difficulties that are requiring significant health care utilization.
- ▶ None of the participants are exhibiting signs of dementia on average 9 years (range 3-18 years) from last mTBI.
- ▶ Female subjects have greater symptoms than male.
- ▶ Servicemembers and Veterans with combat-related concussions and associated conditions (PTSD, pain, depression, substance use, elevated suicide risk) represent a unique and high-risk population.

CENC Findings

- Linkages have been identified between elevated lifetime risks for neuro-degeneration, including Alzheimer's dementia (2.3x) and Parkinson's disease (1.5x), chronic pain, opioid misuse, suicide and PTSD and combat-related concussion
- Multi-modal, high technology research assessment techniques have been developed that allow for more accurate diagnoses and clinical characterization, but from a clinical standpoint using a standard set of questionnaires (NSI, CAPS, BDI, VAS, PSQI) and basic physical exam is appropriate
- Longitudinal Observational Study (current n = 1,500) continues with annual re-assessment and monitoring for recovery and/or neurodegeneration patterns.
- Epidemiologic Study (1.6 million unique subjects) is exploring associations between mTBI/co-morbidities and persistence of symptoms (pain, opioid usage, behavioral), recovery patterns, health care utilization, and neurodegeneration.
- Interventional trials are being implemented using the Longitudinal Cohort.

Myths of mild TBI



- Concussions will inevitably lead to neurodegeneration and dementias, and there's little to do but hope for good genetics.
- One week of rest, preferably in a dark room, after a concussion is usually sufficient to allow for return to sports.
- Newer neuroimaging techniques, blood biomarkers and EEGs allow us to diagnose and prognosticate concussions.
- Safety equipment, including helmets and airbags have helped to reduce concussions.
- There are no evidence-based treatments for symptoms of concussion, it's all about natural recovery.
- Animal research has helped us to move closer understanding and managing human concussion.
- Stems cells hold good promise for future recovery

