

## TRAUMATIC BRAIN INJURY

BY

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USAWC STRATEGY RESEARCH PROJECT

## **TRAUMATIC BRAIN INJURY**

by

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## **ABSTRACT**

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The costs of military service on a nation, a Soldier, and a family are substantial. Some of the costs are readily apparent; others are less apparent but just as important. Unlike the physical wounds of war, Traumatic Brain Injury (TBI) is often invisible to the eye, to other service men, to family members and to society in general. Approximately 20% of service members returning from Iraq and Afghanistan report experiencing a traumatic brain injury during the deployment. This strategic research project will increase awareness and understanding of TBI and address the challenges associated with identification, diagnosis, and treatment of TBI in the military. It will examine the short and long term post concussive symptoms associated with TBI. It will examine the impact of TBI on military readiness and the socioeconomic impact it has on Soldiers, their families, and the nation. It will also examine the potential lure to abuse the Veterans Administration (VA) and Department of Defense (DoD) disability system for financial gain. Finally, it will recommend the creation of a DoD policy to redeploy or relocate from the battlefield service members who sustained multiple concussive events during their deployment.

## TRAUMATIC BRAIN INJURY

The costs of military service on a nation, a Soldier, and a family are substantial. Some of the costs are readily apparent; others are less apparent but just as important. Unlike the physical wounds of war, Traumatic Brain Injury (TBI) is often invisible to the eye, to other service men, to family members and to society in general. The signature wounds from Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) are Post-Traumatic Stress Disorder and TBI. Approximately 20% of service members returning from Iraq and Afghanistan report experiencing a traumatic brain injury during the deployment.<sup>1</sup> Based on electronic medical records, the Department of Defense (DoD) calculated that 20,199 service members were diagnosed with TBI in 2009.<sup>2</sup> Of these 15,828 were classified as mild and 2,086 as moderate. Another 175 had severe traumatic brain injuries and 171 had penetrating brain injuries.<sup>3,4</sup>

Several factors contributed in making TBI a signature injury of the current armed conflict. First, the media and congressional focus on the debilitating conditions caused by TBI in association with sports (e.g. boxing, hockey and football), OEF/OIF, and motor vehicle accidents heightened the public's and military's awareness and concern of TBI. For example, Mohammad Ali, Kurt Warner, Kyle Turley and Steve Young are all professional athletes whose careers were cut short or whose quality of life were greatly diminished due to the effects of TBI. Each of them had experienced repeated blows to the head that left them dazed, confused and sometimes unconscious. The cumulative effects of the brain trauma directly impacted their ability to continue their professional sports career and for some, significantly affected their quality of life. The National Football League (NFL) has been recognized for its leadership in sports concussion

research, prevention and treatment. For the past few years the football world has focused on diagnosing, managing, and preventing concussions and figuring out how many concussions a player can have before he should call it quits. As a result several high school athletic sports programs developed guidelines to screen for and manage players who suffer a concussive event (mild TBI).

Second, the current weaponry such as, improvised explosive devices (IEDs), and rocket-propelled grenades, results in a greater chance of TBI when compared to small arms or other ballistic weapons. The explosions or blast by rocket-propelled grenades, IEDs, and land mines can produce blast-related trauma, particularly blast-related traumatic brain injury. IEDs are the most common cause of TBI in the theater of combat. The consequences of IED caused blasts include primary, secondary, tertiary and quaternary injuries. Primary injuries refer to the effects of the wave-induced changes in atmospheric pressure following the blast, resulting in possible damage to body parts with air fluid interfaces, such as lungs, bowels and the middle ear. Secondary injuries refer to damage caused by objects put into motion following the blast and then hitting people. Tertiary blast injury is the result of an individual being thrown or moved into a solid object such as a wall. These types of injuries are associated with acceleration/deceleration forces and blunt force trauma to the brain similar to that observed following high speed motor vehicle accidents. Finally, quaternary blast injury include all blast related effects not accounted for with the primary, secondary, and tertiary effects such as asphyxia, burns, significant blood loss or inhalation of toxic gases resulting from the explosion.<sup>5,6,7</sup> TBI can occur as a result of any of these types of blast injuries.

Third, the use of body armor, the rapid availability of life saving medical care, and access to state-of-the-art care have led to unprecedented survival rates for patients with a variety of injuries including TBI. Therefore, a larger percentage of casualties than ever before will have some degree of TBI following a blast.<sup>8</sup> For example, in the period January 2003—February 2005 all patients admitted to Walter Reed Army Medical Center who had been exposed to blasts were routinely evaluated for brain injury, and 59% of them were found to have TBI. Of those injuries, 56% were moderate or severe, and 44% were mild.<sup>9</sup>

The identification, diagnosis, and long term and short term effect of TBI is poorly understood, leaving a significant gap in knowledge on how extensive the problem is and the required health care capability needed to address it.<sup>10</sup> TBI affects mood, thoughts and behavior, yet it often goes unrecognized and unacknowledged. Access to care for follow up treatment is also difficult. Fifty-seven percent of those who reported experiencing a probable TBI were never evaluated by a physician.<sup>11</sup> To shorten this knowledge and capability gap, Congress and DoD currently fund medical research and development focused on TBI. For example, the DoD Fiscal Year (FY) 2010 budget on medical research and development increased by hundreds of millions of dollars bringing the total DoD expenditures on health care to \$47 billion in 2010.<sup>12</sup> Much of the research will focus on the wounded, ill, and injured, many with TBI and post traumatic stress disorder (PTSD). DoD also increased the number of authorized health care providers to meet the treatment needs of TBI and PTSD patients.

With the recent increased awareness and increased diagnostic recognition of TBI, commanders and leaders must understand and embrace their responsibility to



encourage prompt medical care for TBI. This responsibility starts in the battlefield and requires early recognition of brain injuries followed by examinations and care rendered in accordance with clinical practice guidelines. All service members need to be aware and understand what TBI is and the potential short and long term costs and consequences associated with it. If undetected, TBI puts service members at risk for a significant lifelong neurological disability. Increasing the awareness and understanding of TBI amongst senior military leaders and instituting a policy requiring service members who have sustained multiple concussive events during their deployment to redeploy from the battlefield or to be suspended from combat patrol, will mitigate the risk of service members suffering a significant debilitating TBI.

TBI can significantly impact military readiness. A mild TBI may severely impair soldier combat effectiveness leading to poor marksmanship, delayed reaction time and decreased concentration.<sup>13</sup> It can also create a significant socioeconomic impact on service members, their families, and the nation.

This strategic research project will increase awareness and understanding of TBI and address the challenges associated with identification, diagnosis, and treatment of TBI in the military. It will examine the short and long term post concussive symptoms associated with TBI. It will examine the impact of TBI on military readiness and the socioeconomic impact it has on Soldiers, their families, and the nation. It will also examine the potential lure to abuse the Veterans Administration (VA) and DoD disability system for financial gain. Finally, it will recommend the creation of a DoD policy to redeploy or relocate from the battlefield service members who sustained multiple concussive events during their deployment.

## What is TBI?

A traumatic brain injury is the result of a blow or jolt to the head or penetrating head injury that disrupts the normal function of the brain, often producing an immediate change in consciousness, orientation, awareness, or recall of events surrounding the injury. The consequences of TBI can be temporary or permanent, and many factors combine to result in highly individualized injuries. TBI severity may range from mild (a brief change in mental status or consciousness) to severe (an extended period of unconsciousness or amnesia after injury). Not all blows/jolts to the head result in a TBI.

The vast majority of TBI cases in the armed forces—approximately 77 percent—involve mild TBI.<sup>14</sup> The terms concussion and mild TBI are interchangeable.

Concussions can result in serious symptoms, and people who survive multiple concussions may have problems that are more serious. The signs and symptoms of concussion include feeling dazed, confused, “seeing stars,” being knocked out (even momentarily), headache, dizziness, memory and balance problems, nausea, brief vomiting, difficulty concentrating, irritability, blurred vision, and ringing in the ears.<sup>15</sup> Mild TBI can affect the individual behaviorally: increased impatience, anger, frustration, impulsivity, substance abuse and becoming withdrawn; emotionally: depression, anxiety, hopelessness, apathy, irritability and emotional numbness; physically: headaches, fatigue, numbness, sensory changes (touch, taste, smell, vision, hearing), vertigo, nausea and impairments in fine motor speed and coordination; cognitively: confusion, disorientation, alterations in judgment, and increased distractibility; and socially: changes in abilities to engage in hobbies and leisure activities, isolation, and increased alienation from others. Such symptoms are, however, also common in the general population and cannot be considered as pathognomonic per se. The effect of

mild TBI is still poorly understood, leaving a large gap in knowledge related to how extensive the problem is or how to address it.<sup>16</sup> The emotional, behavioral, cognitive, health and social effects of moderate to severe TBI are more pronounced than in mild TBI.

According to Douglas J. Mason, Psy.D, a neuropsychologist who specializes in the diagnosis and rehabilitation of people with brain injuries, “The effects of head trauma are treatable and the brain can heal when given the appropriate treatment.”<sup>17</sup> The early identification, diagnosis and treatment of TBI improve the speed of recovery and decrease the risk for a significant lifelong neurological disability or premature death.

#### Long-Term Consequences of TBI

The literature clearly documents that there are long-term negative repercussions with moderate to severe TBI. The 2009 report by the Institute of Medicine (IOM) on the long-term health effects of TBI in the military identified an association between moderate and severe TBI with neurocognitive deficits in memory, attention, and executive functions; unprovoked seizures, higher rates of major depression, increased aggressive behavior, decreased social functioning, and neurodegenerative diseases—for example, dementia of the Alzheimer type or Parkinsonism and suggestive evidence of an association with psychoses generally appearing in the second and third years after TBI. Moderate to severe TBI decreases the probability of post-injury employment in people who were workers before they were injured, lengthens the time it takes them to return to work (if they do return), and decreases the likelihood that they will return to the same positions. The diagnosis of TBI has been associated with an increased risk for disciplinary problems and premature discharge from the military.<sup>18</sup> A recent RAND study

estimated that traumatic brain injuries from OEF/OIF have cost the nation \$554 million in treatment and lost productivity.

TBI also adversely affects leisure and recreation, social relationships, functional status, quality of life, and independent living. With regard to mild TBI the IOM study concluded that the evidence was inadequate and insufficient with respect to long-term adverse social functional, including unemployment, diminished social relationships, and decrease in the ability to live independently. The study did not find an association between increased drug and alcohol use with TBI alone.

Direct medical costs of treatment are only a fraction of the total costs related to psychological and cognitive injuries. Lost productivity, reduced quality of life, homelessness, domestic violence, the strain on families, and suicide contribute to a higher indirect long term costs to the service member, their families and the nation. Estimates of the one year cost of mild TBI range from \$27,259 to \$32,759 per case.<sup>19</sup> Productivity losses account for 47 to 57 percent of the total costs, whereas treatment accounts for 43 to 53 percent in these estimates. Estimates of the one year cost of moderate or severe TBI costs range from \$268,902 to \$408,519 per case.<sup>20</sup> TBI-related death is the largest cost component (70 to 80 percent of total costs). Currently there is no data available to estimate the dollar costs associated with homelessness, domestic violence, family strain and substance abuse as a result of TBI.

Delivering timely and effective mental health care and restoring veterans to full mental health has the potential to reduce these longer term costs significantly.<sup>21</sup> The President's Commission on Care for America's Returning Wounded Warriors in 2007 found that for moderate to severe TBI, rehabilitation—along with clinical pathways and

early consultation—improves efficiency, optimizes outpatient care and decreases hospital lengths of stay. Patients with severe TBI experienced fewer complications and spent less time in the hospital if they were given clearly defined goals and a structured progression of rehabilitation services. Early consultation with a physiatrist (physical medicine specialist) and prompt referral to rehabilitation programs apparently improved functional outcomes for these patients. Similarly patients with moderate to severe TBI recovered their personal independence faster when they were provided with a comprehensive and integrated outpatient rehabilitation program.<sup>22</sup> Therefore, it is important when considering the direct costs of care to place it in context of the potentially higher indirect, long-term costs of providing no care or inadequate care.

### Diagnostic Challenges

The majority of patients with mild TBI recover quickly with minimal medical intervention. However, there is a subset that develops lingering symptoms that interfere with social and occupational functioning. The possibility that a significant number of military personnel may have had a brain injury while deployed to Iraq or Afghanistan made the identification, diagnosis and treatment of returning service members with related symptoms a top priority for policy makers.

Diagnosis of mild TBI can be difficult to determine due to the individualized nature of the injury, and the fact that symptoms vary from impairments in fine motor speed and coordination to changes in abilities to engage in hobbies and leisure activities.<sup>23</sup> Identification and diagnosis of TBI associated with a blast may not be identified acutely for several reasons initially. The blast-related TBI may occur simultaneously with other obvious life threatening physical injuries, requiring healthcare providers to focus primarily on the life threatening injuries and overlook mild to

moderate TBI. Sometimes a service member will not report a concussion from a blast in fear of being medically evacuated or separated from their unit. Also since blast exposure is so common in the combat zones and almost everyone has experienced some form of acute symptoms of concussion, it may not appear problematic to the service member until he returns home from the deployment.<sup>24</sup> The military's warrior culture of "selfless service," "mission first," and "physical and mental toughness" reinforces the service member's decision to ignore their symptoms and "tough it out." Avoiding evaluation and treatment until the mission is complete and when they return home can be troublesome. The symptoms associated with TBI are not limited to TBI. By the time the service member returns home, the TBI symptoms could be confused with symptoms associated with readjusting to life back home.<sup>25</sup> This confusion could result in further delay in diagnosing and treating TBI.

*Stigma.* The stigma associated with mental health problems may also deter service members from disclosing TBI related symptoms. Due to the stigma of mental health problems, some service members reluctantly disclose symptoms which delays treatment and may lead to worse outcomes of care. The military culture values and esteems physical and mental toughness. In this culture service members suffering mental health problems fear being ostracized, humiliated, and belittled. They also fear negative career repercussions for seeking help. In some units the commander may require identification of service members undergoing mental health services through special markings or clothing (e.g. service member wear reflective training vests with signs identifying them as high-risk individuals).<sup>26</sup>

In 2008 RAND conducted a survey of 1,965 service members who deployed either to Afghanistan or Iraq as part of OEF or OIF. The survey queried service members on barriers to seeking mental health services. The results of the survey identified four key barriers to seeking mental health services. They are:

- 45% of those surveyed felt getting treatment would not be kept confidential and would constrain future job assignments and career advancement.
- 45% of those surveyed feared being denied a security clearance.
- 38% of those surveyed feared that coworkers would have less confidence in him/her if they found out.
- 40% of those surveyed perceived little or no benefit from mental health services.

Logistical barriers to mental health treatment, such as time, money and access, were mentioned less frequently but may still be important barriers for many individuals.

Reducing the stigma to seek mental health services requires a shift in military culture. Statements and policy generated from senior military leaders requiring respectful and dignified treatment of servicemen seeking mental (behavioral) health services and encouraging servicemen to seek assistance if they are experiencing challenges is insufficient in changing this stigma. Statements and policy letters will lack credibility unless service men consistently witness positive outcomes (career and personal) for those who sought behavior health services. Successful junior and senior leaders who openly discuss their growth experiences with behavior health services and demonstrate through their example that it did not hinder their career progression, will encourage others to seek behavior health if needed.

Commanders and leaders are responsible for the mental and physical well-being and care of service men and women. They play a critical role in encouraging service members to seek prompt medical care for TBI. The cultural change required to remove the stigma surrounding mental health must begin with the commander and the leaders in the command. It is important for commanders and leaders to be aware of the importance of dealing with TBI and the issues surrounding it. Service men and women look to their leaders for positive influence. The tone the commander sets towards TBI and behavioral health affects how their subordinates view it. If the commander believes TBI and behavioral health issues are a sign of weakness or insignificant, so will the staff and their subordinates.

Under the pressure to prepare their unit for combat, win battles and keep their men alive, commanders and leaders may feel that they can't afford to worry about a service member's behavioral health. For example, leaders may hide alcohol problems to keep a service member deployable. Such an action is a disservice to the service member and the military. Alcohol abuse may be a symptom of something bigger, PTSD, TBI, Major Depression or suicidal ideation. Commanders and leaders need to understand that when they assess a unit's readiness for combat operations this includes mental preparedness.

Bravery, bravado, machismo are common characteristics of a warrior. These characteristics combined with the invisible nature and lack of understanding of TBI among service members cause service members to underestimate the seriousness of TBI and delay treatment for TBI. Football players have a similar mindset. The euphemistic terminology that pervades in the media, calling concussive events as



“dings” or “getting your bell rung,” has contributed to a perception that the problem isn’t serious. Service members with concussive symptoms of dizziness and headache may be reluctant to seek medical attention for fear of appearing “weak.” However, they would not hesitate to seek medical attention for an injury of a less serious nature because the symptoms and injury are visible, for example a sprained ankle or laceration.

Delaying medical evaluation and treatment for TBI increases the difficulty in diagnosing and treating TBI. The individualized nature of TBI symptoms and the fact that the symptoms of TBI can mimic other co-morbid conditions (i.e. combat stress, depression, etc.) makes diagnosis and treatment of TBI more challenging. For example, the patient may be suffering from combat stress or depression as a result of the blast event making it difficult for medical providers to determine what symptoms are due to concussion and which symptoms are due to the combat stress or depression. Thus early diagnosis and treatment of TBI will help clear the fog generated from other co-morbid conditions. Co-morbid conditions and the stigma associated with mental health conditions probably create the greatest fog and friction in detecting, diagnosing, and treating TBI, especially mild TBI.

*Co-Morbid Conditions: Post Traumatic Stress Disorder (PTSD) and Post Concussive Syndrome (PCS).* A common misunderstanding is that one cannot completely heal from mild TBI and will suffer long term effects from mild TBI. Contrary to this popular misconception, these physical injuries will heal. Quoting Dr. (BG) Loree Sutton, special assistant to the Assistant Secretary of Defense (Health Affairs) for Psychological Health and Traumatic Brain Injury (TBI), “One of the myths out there is that mild traumatic brain injuries, or concussions, means that somehow your brain is

broken forever. No, it's an injury. If you have some long term, later symptoms that pop up, that's probably post-traumatic stress. That's probably not related to the concussion"<sup>27</sup>

There is limited but suggestive evidence of an association between TBI and PTSD. The neurologic deficit from a TBI may exacerbate PTSD symptoms because of a greater inability to self regulate and inhibit behavioral responses. The individual's ability to emotionally cope with a traumatic event in the immediate aftermath of a concussive event may be diminished. Studies concluded that combat-incurred-mild TBI approximately doubled the risk for PTSD and the strongest factor associated with PCS was PTSD.<sup>28</sup> Mild TBI combined with PTSD are associated with higher rates of other psychological problems including depression, substance abuse, and suicidal behavior.<sup>29,30,31,32,33</sup>

Symptoms of PTSD can mimic symptoms of mild TBI. Although PTSD and TBI are distinct disorders, diagnostic confusion between the two disorders can result because both can stem from the same traumatic experience and some symptoms of PTSD overlap those of TBI. PTSD may also impede the natural course of recovery for TBI patients.<sup>34</sup> The overlapping of the emotional aspects of stress associated with TBI requires integrated and interdisciplinary treatment methods. In one study injuries involving loss of consciousness were associated with greater work-related difficulties and unmet psychological needs. PTSD mediated the relationship between mild TBI and all of those outcomes.<sup>35</sup>

At present, there is no test that reliably shows whether a person does or does not have PTSD. Instead the diagnosis is based mainly on a detailed clinical interview by a

qualified behavioral health professional. The course of PTSD varies. In an interview with BrainLine, the Director of the National Intrepid Center of Excellence (NICoE), James Kelly, MD, stated: "...(T)here's growing evidence that post-traumatic stress disorder is a type of brain injury...There are areas of the brain that are specifically injured in some way physiologically that change it. And individuals with PTSD can look as bad or in some cases worse on neuropsychological testing than people who had the mild traumatic brain injury."<sup>36</sup> Four-fifths of people diagnosed with PTSD also have a major depressive disorder, or some other psychiatric condition, such as substance abuse.<sup>37</sup> Therefore, it is important to assess PTSD in OEF/OIF veterans who screen positive for mild TBI.

A small percentage of service members may develop PCS which means their symptoms, if not treated, will not go away. Research suggests that long-term PCS from TBI are not specifically related to head injury but also related to a number of clinical factors and potentially distressing exposures which have no plausible link to head injury.<sup>38</sup> In veterans of the Iraq war, PCS have been more strongly correlated with PTSD and depression than that with concussion.<sup>39</sup> This raises the issue of whether PCS are part of the complex expression of psychological distress. Psychiatric epidemiology consistently finds an association between physical and psychological symptoms-the more one has of one the more one has of the other.<sup>40</sup>

It is also well established that anxiety and depressive disorders are common in patients who present to primary care with unexplained symptoms.<sup>41</sup> PCS are often an expression of psychological distress. This suggestion is supported by studies that find that PCS are associated with factors which have no link to head injury (e.g. being in a

relationship) and potentially traumatic exposures which do not cause any physical damage (e.g. seeing dead bodies).<sup>42</sup>

The likelihood that the condition will trigger a negative cascade of consequences over time is greater if the initial symptoms of the condition are more severe and the afflicted individual has other sources of vulnerability (e.g. unstable family relationships, low socioeconomic status (SES), and a prior history of psychopathology). Studies consistently show that individuals afflicted with PTSD, Major Depressive Disorder, or TBI experience worse consequences when they must simultaneously confront other sources of stress. In contrast, other sources of strength (e.g., supportive family relationships, high SES, high education) may serve as buffers, even for those whose symptoms are relatively severe.

An additional complicating factor is the potential lure to abuse the Veterans Administration (VA) and DoD disability system for financial gain. A service member who is injured and cannot continue in military service navigates the military disability system and then the VA disability system. Each system rates the member's disability level and each has a disability compensation package. For example, The VA's system compensates for the inability to earn what a non-disabled veteran earns.<sup>43</sup>

There is a lack of consensus on an accepted medical definition for PCS or impairments due to the ambiguity and complexity of dysfunction surrounding the condition. Within the DoD and VA, TBI disability evaluations and ratings similarly are inconsistent, due to the absence of clear criteria and standardized training for raters who rate the level of disability and compensation.<sup>44</sup> As a result the VA created a disability category called "residuals of TBI." The 2008 federal regulation creating the

category assigns a 40% disability to persons who have three or more subjective symptoms that “moderately” interfere with functioning or who have “objective evidence” of “mild impairment of memory, attention, concentration, or executive functioning resulting in mild functional impairment.” The “residuals of TBI” disability can result in a substantial compensation package especially when combined with other disabilities or retirement benefits.

Certain service members need to stay on active-duty status in order to receive necessary medical and rehabilitation care. This leads to an increased amount of time service members remain in medical hold-over status. Service members close to their 20 years of service may be lured to stay in medical hold status until the 20-year mark in order to qualify for full retirement benefits, particularly if the disability rating is less than 30 percent.

The literature demonstrates a strong association between compensation and persistence of symptoms after concussion.<sup>45</sup> The VA/DoD disability system is at risk for abuse by healthy service members who may intentionally report non-existent symptoms in order to receive compensation. The subjective nature of PCS makes it difficult for health providers to determine the true magnitude of impairment caused by PCS.

Thus, efforts to identify, diagnosis and treat these conditions should be made as early as possible. Early interventions are likely to pay long-term dividends in improved outcomes for years to come.<sup>46</sup> Thus, it is critical that service members and veterans who seek evaluation and treatment receive all the help and care that we can provide.

### Repetitive Concussions

Currently many service members who survived multiple concussive or sub-concussive events resulting from a blast suffer significant brain damage. Service

members and their leaders must understand that the cumulative effect from repetitive concussive events reduces the brain's ability to recover. A national Collegiate Athletic Association (NCAA) football study found an association between the number of reported prior concussions in NCAA football players and the likelihood of sustaining another concussion.<sup>47</sup> The study found that players reporting more than three prior concussions were three times more likely to sustain another concussion than players who reported no prior concussions. Players reporting two prior concussions were two times more likely to sustain another concussion. Players that reported only one prior concussion were 1.4 times more likely to sustain another concussion. The study also found that a prior history of concussion may be associated with slower recovery of neurological function. Sustaining repetitive concussive events before the brain heals from the initial concussion increases the chances of long term effects or brain atrophy, and cumulative neuropsychological deficits.<sup>48,49</sup> Research at the U.S. Military Academy shows that immediately going back out and being injured again, even if the second concussion is only minor, can prove fatal.<sup>50</sup> This is referred to as second impact syndrome (SIS) and is caused by a loss of the automatic control of blood vessels in the brain.

Former football players who suffered multiple concussions were five times more likely to develop symptoms of a condition considered to be a precursor to Alzheimer's disease and three times more likely to become clinically depressed, says Kevin Guskiewicz, professor and director of the Center for the Study of Retired Athletes at the University of North Carolina-Chapel Hill. According to Ann McKee, neuropathologist and associate professor of Neurology and Pathology at Boston University and Director of Neuropathology Core, multiple concussions can cause chronic traumatic

encephalopathy (CTE). CTE is a progressive neurological disorder found in people who have suffered some kind of brain trauma. CTE has many of the same manifestations as Alzheimer's: it begins with behavioral and personality changes, followed by disinhibition and irritability, before moving on to dementia. CTE appears later in life as well, because it takes a long time for the initial trauma to give rise to nerve-cell breakdown and death.

The research of Kevin Guskiewicz and concussion specialist Robert Cantu showed that individuals with multiple repetitive sub-concussive trauma are more susceptible to brain damage. The study showed that the cumulative exposure of sub-concussive events increased an individual's vulnerability to a significant concussive event and brain damage.<sup>51</sup>

Service members who have sustained prior concussions should be educated regarding their increased risk of repeat concussions. Often the service member is not aware of their brain damage and perceives they are ok, when in fact, their cognitive abilities have been compromised and they are at a high risk for permanent brain damage if they suffer a successive concussive event. Leaders and health providers must also be educated on the increased risks and dangers associated with repetitive concussion for their service men and the slower recovery time associated with it.

#### TBI Screening and Comprehensive Soldier Fitness

For the past few years DoD significantly increased resources in research, education, prevention, treatment and rehabilitation for TBI. As a result, significant progress towards understanding and mitigating TBI has increased. Addressing all the ways DoD continues to improve prevention, identification, diagnosis, treatment and rehabilitation of TBI is beyond the scope of this paper.

Standardized TBI screenings is one key improvement the DoD instituted to provide early identification, diagnosis, and treatment of TBI. The screening process helps DoD understand the magnitude of the problem and helps decision makers effectively allocate scarce healthcare resources. The Army's Comprehensive Soldier Fitness initiative is another tool to mitigate PTSD and hopefully clear the fog between PCS and PTSD.

*Pre and Post Deployment Screenings.* In 2008 DoD instituted a pre and post deployment screening for concussion/TBI. As of 2008 all service members deploying must have a pre-deployment neurocognitive test to establish a baseline to make it easier to evaluate those who experience a traumatic brain injury. To help establish that baseline, service members must have an Automated Neuropsychological Assessment Metrics (ANAM) within 12 months of deployment. Currently over 372,000 baseline assessments have been conducted. The screening process will help identify redeploying service members with undiagnosed TBI or service members with PCS. Service members who screen positive are further evaluated by a clinical health provider. The health provider clinically determines whether the service member actually has TBI and whether follow on health care services are needed.

The use of a precognitive baseline will help identify and measure declines in cognitive functioning following an identified brain injury. However, ongoing research demonstrates that the impact of war zone deployment on cognitive performance needs to be further examined before testing results are implemented for purposes that may include the identification of mild TBI post deployment.<sup>52</sup> For example, a major study conducted cognitive testing before and after deployment. The study found that



deployment alone (independent of head injury, depressive symptoms, or stress) was associated with changes in some measures of attention, learning, and memory in the post-deployment evaluation.<sup>53</sup> Further, a clinical diagnosis of TBI upon return from deployment may be imprecise because alteration of consciousness in combat could result from acute stress, sleep deprivation, other war chaos.<sup>54, 55</sup>

Another challenge to the initial post deployment survey is some service members may choose not to report symptoms, fearing that it will require further evaluation and delay their return to family or limits their military activities. To illustrate, in the post deployment health assessment, only five percent of active-duty service members and six percent of reservists report symptoms consistent with PTSD. But, in the reassessment, 27 percent of active-duty members and 42 percent of reservists note mental health concerns.<sup>56</sup>

Senior force managers must be cautious when using TBI screening results to determine the prevalence of TBI in the population and the proper allocation of medical resources. Reliance solely on Pre and Post Deployment screening results can result in oversupply of medical personnel and equipment in some areas, while other medical services suffer from shortages and decreased access to care. The TBI screening does not identify the level of impairment and the level of clinical treatment needed. Not all individuals who screen positive for TBI need treatment. Therefore, there may be a tendency to overestimate the prevalence or cost of TBI which can deflect resources away from other pressing needs.

*Military Acute Concussion Evaluation (MACE)*. Clinical diagnosis at the time of injury is the “gold standard” to identify and validate TBI. Addressing the need to

promptly identify, diagnosis and treat service men who may be suffering from TBI, the Army in July 2008, issued an Army All Activities Alert on concussions. The alert stated that all deployed Soldiers involved in a “blast, fall, vehicle crash or direct impact incident who lose consciousness or become dizzy afterward must be seen by a licensed medical provider as soon as possible.” Commenting on the Army’s initiatives to promptly identify, diagnosis and treat service members Dr. Robert M. Gates, Secretary of Defense, stated “The military now has more thorough reporting mechanisms, requiring that anyone affected by a blast or blunt trauma in theater go through an evaluation and screening. We have a single TBI registry and a single point of responsibility—the Defense and Veterans Brain Injury Center—to consolidate all TBI-related incidents and information.” This proactive approach towards TBI identification, diagnosis and treatment makes an important shift towards early identification, diagnosis and treatment. Early diagnosis and treatment of TBI will help identify and differentiate between other co-morbid conditions. The TBI registry will also provide insights and data for researchers to understand the effect of TBI, its long term consequences and the effectiveness of current treatment modalities.

Medics use the Military Acute Concussion Evaluation (MACE) to determine if a service member sustained a TBI. The MACE is a questionnaire developed by the Defense and Veterans Brain Injury Center (DVBIC) to quickly assess the possibility a person has incurred a TBI. If the service member screens positive for a possible TBI, the service member is clinically evaluated for TBI. The clinical guidelines for “Primary Care Management of Concussion in a Deployed Setting” state if a Soldier’s symptoms persist for more than seven days, he should be referred to a level 2 or level 3 health

care facility for an examination with an ANAM. Recently the MACE needed to be modified due to service members cheating on the test. Service members not wanting to risk being taken out of the fight for TBI rehabilitation discovered and distributed the answers to the MACE test to each other. It is unknown if the answers to the new MACE test have been discovered and distributed to service members.

*Comprehensive Soldier Fitness.* Prevention and early intervention will help mitigate the effects of PTSD and TBI. Prevention efforts identify and enhance factors that help protect individuals from developing PTSD if they experience a traumatic event. The Army hopes the new Comprehensive Soldier Fitness program will help identify individuals at risk for developing PTSD and equip them with coping strategies to prevent the condition from occurring and to make any case that does emerge as manageable as possible. “There’s a perception out there that everyone who goes to combat gets post-traumatic stress. That’s just not true. Science tells us that the majority of people who go to combat have a growth experience. They’re challenged by something very, very difficult, and they succeed,” said General George W. Casey, Jr. Chief of Staff of the Army. “The whole purpose of this program is to increase the number of people in the Army who have that growth experience when facing difficult challenges.”<sup>57</sup> Another tool the Army uses to build resiliency in the Soldier is “battlemind training” which helps train deploying soldiers about the realities of battle and the potential emotional responses to combat. According to former Surgeon General Kevin C. Kiley, “the Army has found that soldiers who undergo the most intense, realistic training before deploying to combat tend to experience the fewest associated mental health problems.”<sup>58</sup>

Prompt identification and treatment enhance the chances of recovery. The National Co-Morbidity Survey, a large nationally representative mental health survey, found that individuals who receive treatment for PTSD typically experience symptoms for about three years, whereas those who do not receive treatment experience symptoms for about 5 years.<sup>59</sup> The initial onset of PTSD symptoms can occur days, weeks or even years after the traumatic event is experienced. The National Co-Morbidity Survey also demonstrated that men who experience combat trauma are more likely to have chronic or delayed onset of PTSD symptoms.<sup>60</sup> These efforts to strengthen cognitive coping skills and resiliency during combat stress and difficult stressful challenges may help clear some of the fog of symptoms masking PCS.

The Comprehensive Soldier Fitness initiative not only targets the Soldier, but the family that supports the Soldier. It strives to build family resiliency to shoulder the burdens associated with a nation at war, from multiple deployments of a spouse, child, or parent to the long term care-giving responsibility for a loved one suffering with TBI or PTSD.

### Conclusion and Recommendation

In order to promptly identify, diagnosis, treat, and mitigate TBI in theater, the DoD needs to change the policy associated with blast exposure from a self reporting mechanism to an incident triggered reporting mechanism. The Army's current policy requires all deployed Soldiers involved in a "blast, fall, vehicle crash or direct impact incident *who lose consciousness or become dizzy afterward must be seen* by a licensed medical provider as soon as possible." The policy should include all those involved with a blast or event that may result in TBI to stand down for 24 hours and be evaluated by a medical provider as soon as possible. Since service members may unknowingly sustain

a concussion or sub-concussive injury, they may not seek medical attention following a blast. As a result they risk sustaining a repetitive concussive event before their brain heals, which could result in significant brain damage or significant PCS.

The vast majority of people who sustain a mild TBI/concussion recover spontaneously without the need for specialized assessment or medical care.<sup>61,62</sup> For others, a concussion may have lingering effects and returning them to duty too soon can exacerbate their symptoms. The amount of time a service member may need to be placed on temporary exclusion from combat patrols or duties could be quite short, a week to two weeks for those who sustain their first or second TBI/concussion. This time of duty restrictions gives the brain time to heal. It is especially important for service members whose job puts them at risk for sustaining another concussive event. The change in policy will help identify, educate and treat those service members who fail to report concussive symptoms due to ignorance or for any of the other reasons previously discussed in this paper.

Another recommendation is that Soldiers who sustained three or more concussions during their deployment need to either redeploy home or be placed in a location in theater where the risk of sustaining another concussive event is low. This will give the brain the additional time it needs to heal, reduces the risk of permanent brain damage and lingering PCS associated with a repetitive concussion, and conserve the fighting force. The brain recovers significantly slower after sustaining three concussive events, so it is important that work and combat limitations be established to prevent multiple concussive events. The nature of the current conflict requires the military to redeploy their service members over and over again, in and out of theater. The military

needs to preserve these service members and their experience, knowledge, wisdom and skills for follow on deployment.

Admiral Mullen is also proposing a similar initiative, and the Marines already have a similar policy in place. The military estimates the cost of this recommendation in troops removed from combat may be minimal. About 1% to 2% of the 15,000 to 20,000 U.S. service members in Afghanistan are routinely exposed to roadside bombs. This equates to about 140 to 400 service members sidelined during a period of several months.

The prevention and mitigation of potential TBI is a command and leadership issue. Commanders and leaders are responsible for the health and welfare of service members, family members and their civilian staffs. Increasing the military's systemic efforts to address this important and costly injury through prompt medical intervention and education has the potential to mitigate the effects of TBI and increase total force readiness and retention. Waiting for evidence of a functional impairment before seeking treatment decreases the chances for a full functional recovery. Requiring individuals to promptly seek needed health care before a problem develops to a critical level or functional impairment, will return service members to duty faster in full capacity. It will minimize the impact of secondary effects and ultimately reduce disability.

The change in policy helps ensure our service members and the nation who entrusts their sons and daughters to the military that the DoD is doing everything in its power to prevent and alleviate TBI. The policy change will sustain a fitter and stronger military.

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