The purpose of this article is to raise nurses’ awareness of the significance and potential public health impact of combat-related blast-induced neurotrauma (BINT) in U.S. troops returning from Afghanistan and Iraq. A comprehensive review of the current literature on BINT was completed by the author, based primarily on combat-related blast exposure in the military population. She found that it is necessary to theorize about potential etiologies for mild traumatic brain injury in the military population since the literature suggests that neurological and psychological trauma resulting from military duty may be linked to exposure to blasts. Identification of potential risk factors for BINT in the military population provides direction for scientific inquiry into this emerging phenomenon. Gaps in current knowledge and its health implications for future scientific study in nursing are presented.

Search terms: Military, military injuries, concussion, mild traumatic brain injury, blast and explosion injury, brain injury, combat blast injuries, BINT, neurotrauma

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Afghanistan and Iraq. The pace of deployments is unprecedented. Deployments are longer; redeployment is common; and breaks from combat are infrequent. Combat-related mild traumatic brain injury (mTBI) or concussion, and posttraumatic stress disorder (PTSD) are designated the “signature injuries” of these conflicts. The ratio of wounded troops to troop fatalities (7.37:1) is higher than in any previous military conflict because of use of improved body armor and advances in battlefield medical response and evacuation. Many of those wounded would have died in past wars, and new clinical symptoms, such as those related to BINT, are manifesting in this population (Balasco, 2007; Brunner, 2007; IOM, 2008; Tanielian & Jaycox, 2008). The opportunity for shaping nursing practice and generating new knowledge for this emerging phenomenon is vast. Knowledge and identification of this injury in the military and veteran population, who are seen by nurses in the community, may hasten these young adults’ recovery through seamless care coordination between government and community health systems. In addition, new knowledge generated by nurse researchers may provide guidelines or a scientific basis for recovery interventions for those who suffer from BINT.

The opportunity for shaping nursing practice and generating new knowledge for this emerging phenomenon is vast.

### BINT Incidence and Presentation

An estimated 320,000, or 19.5% of all U.S. troops deployed to Iraq or Afghanistan, have symptoms related to BINT, which accounts for over 92% of all battlefield injuries (DVBIC, 2006, 2008; Tanielian & Jaycox, 2008). Warden (2006) noted that the number of TBIs in these wars is higher than in previous wars because of the frequency of blast attacks using large amounts of explosives, estimating that 88% of injuries seen in the battlefield are because of blasts.

The current literature on BINT in U.S. troops serving in Afghanistan and Iraq suggests conflicting views on its cause, pathophysiology, screening, diagnosis, treatment, and subsequent care coordination through multiple specialties and agencies. This new phenomenon demonstrates that current medical thought on mild BINT (concussion) may be outdated. In addition, as indicated in Table 1, mild BINT and PTSD have many similar symptoms and are comorbid in 43.9% of mild BINT cases, complicating diagnosis and treatment (IOM, 2008; Schneiderman, Braver, & Kang, 2008; Tanielian & Jaycox, 2008).

Although invisible to the naked eye, BINT is reported to cause debilitating changes in mood, thought, and behavior. Physical symptoms associated with BINT include migraine headaches, insomnia, blurred vision, dizziness, vertigo, tinnitus, and nausea.

### Table 1. Comparison of the Symptoms of Posttraumatic Stress Disorder (PTSD) and Post-Concussion Syndrome (PCS)

<table>
<thead>
<tr>
<th>Similarities</th>
<th>PTSD differences</th>
<th>PCS differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insomnia</td>
<td>Reexperiencing</td>
<td>Headache</td>
</tr>
<tr>
<td>Memory problems</td>
<td>Avoidance</td>
<td>Dizziness</td>
</tr>
<tr>
<td>Poor concentration</td>
<td>Emotional numbing</td>
<td>Nausea/vomiting</td>
</tr>
<tr>
<td>Fatigue</td>
<td>Hyper-vigilance</td>
<td>Noise/light intolerance</td>
</tr>
<tr>
<td>Depression</td>
<td>Exaggerated startle</td>
<td>Blurred vision</td>
</tr>
<tr>
<td>Anxiety</td>
<td></td>
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</tbody>
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and vomiting with exertion (Anderson, 2008; Management of Concussion/mTBI Working Group, 2009). Other manifestations of BINT include memory and concentration problems, verbal and written language problems, emotional lability and depression, fatigue, light and noise intolerance, anxiety, and irritability (Hosek, Kavangh, & Miller, 2006; Schneiderman et al., 2008; Thompson, Scott, & Dubinsky, 2008).

Most of these symptoms are self-limiting and disappear within 3 months, barring exposure to a second impact injury in the interim. About 5–15% of individuals with BINT have persistent symptoms that require neurological evaluation and treatment (DVBIC, 2006, 2008; Management of Concussion/mTBI Working Group, 2009; Tanielian & Jaycox, 2008). BINT injuries are cumulative. If the initial injury does not heal and a second injury occurs, then symptoms may worsen and become permanent (Collins et al., 2002). These injuries adversely affect the quality of life for military troops and their families. All of the effects noted above can arise from a single mild blast exposure. Simply feeling the blast wave is sufficient to cause injury, even without loss of consciousness (Colarusso, 2007; IOM, 2008; Martin, Lu, Helmick, French, & Warden, 2008).

The current estimated prevalence of Iraq combat veterans with some level of TBI is 10–20% (150,000–320,000 individuals). Among those veterans with combat-related TBI injuries, over 80% involve BINT without visible physical injuries (IOM, 2008; Tanielian & Jaycox, 2008). BINT’s lack of external trauma results in service members not seeking medical treatment or being ridiculed or punished for seeking treatment due to military stigma and clinicians’ lack of awareness of this phenomenon.

Etiology of BINT

Fundamental gaps exist in our knowledge about the mental health and cognitive needs of service members returning from combat. Other knowledge gaps include the adequacy of military and community healthcare systems, the lived experiences of active duty service members and veterans needing services, and the factors related to whether and how this injured population seeks care. Care management and medical treatment of BINT are likely to change drastically over the next several years as more scientific discoveries are made to increase current knowledge and understanding of this silent but potentially catastrophic epidemic.

Anderson (2008), DePalma, Burris, Champion, and Hodgson (2005), Okie (2005), and Taber, Warden, and Hurley (2006) maintained that primary closed brain injury develops over a few hours or days, leading to cell damage, and that associated physical and psycho-
logical symptoms can occur as a result of injury to several areas of the brain. Victims may sustain very different injury severities depending upon type of exposure and distance from the deflecting blast waves. According to Collins et al. (2002), mTBI is cumulative, and repeated injuries before initial healing occurs may lead to more severe brain injury and permanent impairment.

**Individual, Family, and Societal Effects of BINT**

BINT sufferers report cognitive disorders such as short-term memory loss, lack of anger and aggression control, and the inability to do simple problem solving, interfering with daily activities, exercise, and work duties. If ignored or not understood by others, BINT symptoms and behaviors may lead to lasting problems in interactions with friends, families, coworkers, and public authorities. This increases the service member’s risk for isolation, job failure, depression, substance abuse, further injury, criminal violence, suicide, and homelessness. Increasing incidence of major depression, suicide, and suicide attempts among returning veterans may be related to BINT (DVBIC, 2006, 2008; Martin et al., 2008; McCrea et al., 2002; Roberts, 2008). Afflicted individuals may behave inappropriately, or not as expected, because they are unable to receive, store, process, accumulate, or retrieve information effectively. Sensory input can be unreliable, and they may have difficulty processing information. This type of brain dysfunction interferes with employment or other performance-based activities. Service members with undiagnosed BINT may exhibit a lack of inhibitions that results in difficulty adhering to social rules, inability to perceive interpersonal cues, aggression, violence against themselves or others, or adverse reactions to stressful or demanding situations. Furthermore, the service member may have limited awareness of changes in his/her behavior and/or intensification of some preexisting problem behaviors.

A recent investigation (USACHPPM, 2009) of eight homicides perpetrated by six soldiers from one unit at Fort Carson over a 12-month period is an example of BINT injuries’ potential for societal public health implications. The investigation’s goal was to assess the potential impact of military waiver policies on the observed criminal activity and the adequacy of mental health services provided by the military. Most of these soldiers were under 21 years of age when they voluntarily enlisted in the U.S. Army, and many had been awarded medals for good conduct during their service. These soldiers were deployed to Afghanistan and Iraq multiple times for 12–15-month tours. Although they survived the physical wounds that would have killed soldiers in earlier conflicts, they returned home suffering from invisible combat wounds. Unfortunately, their complaints and symptoms were ignored, neglected, punished, and ridiculed. They failed to adjust to redeployment so the cycle of killing continued when they returned home. This brigade’s returning soldiers were also involved in beatings, alcohol and drug abuse crimes, domestic violence, shootings, stabbings, and suicide after their return to the United States (Philippi, 2009).

These findings are consistent with recent research on combat exposure and subsequent adverse behavioral outcomes. The USACHPPM (2009) report suggested that a combination of many preexisting personal risk factors and combat intensity/exposure may have increased the risk for these violent behaviors. Military stigma and lack of referral to the Army Substance Abuse Program, a required screening, were identified as barriers to the soldiers’ seeking and receiving further medical evaluation and treatment for mental health problems. The IOM (2008) and Tanielian and Jaycox (2008) studies both maintained that preventing or alleviating the short-term consequences of these conditions and early interventions might have a significant indirect long-term benefit and that focusing treatment solely on ameliorating specific symptoms is too narrow.

Some evidence of an association between mTBI and substance abuse has been reported (Walker, Cole, Logan, & Corrigan, 2007). Whether these associations
make substance abuse more likely with mTBI is unclear. Martin et al. (2008) reported that at the DVBIC, they found that patients with mTBI sometimes self-medicated with alcohol or nonprescribed drugs to manage their symptoms. Substance abuse only worsened cognitive or emotional difficulties for these patients.

BINT does not always result in symptoms and long-term neurocognitive deficits. However, it places the injured service member at risk of additional blast exposures and more severe injury. Diagnosis and treatment are now based on scientific research with significant gaps. The IOM (2008) study indicated that these gaps result in a consequent failure to identify individuals with probable BINT. The researchers further asserted that the failure to identify BINT stems from poor documentation of blast exposures, which increase a service member’s risk of long-term neurocognitive deficits. Of those who reported symptoms suggestive of mTBI in the Tanielian and Jaycox (2008) study, 57% had not been evaluated by a physician for brain injury. These service members’ explanation for not seeking medical evaluation included barriers to getting treatment, lack of confidentiality, risk to future job assignments, and risk to military career advancement.

Even though most mTBI/BINT patients recovered completely, those with poorer short-term recovery outcomes were likely to exhibit depression and anxiety, and 58% reported chronic pain (headache), which was associated with longer treatment and poorer quality of life (Hoge et al., 2008; Tanielian & Jaycox, 2008). Medication management may be problematic because of memory, self-awareness and time management problems, missed doses, and negative side effects from poly-pharmaceutical treatment. In addition, prescribed drugs may be ineffective. An individual’s need for treatment and specialty services will involve multiple transitions across Department of Defense (DoD), Veterans Affairs, and community medical systems that involve extensive travel, making coordination and management of care challenging (Comper, Bisschop, Carnide, & Tricco, 2005; Francisco, Walker, Zasler, & Bouffard, 2007).

Tanielian and Jaycox (2008) described the potential public health consequences of post-combat mental health and cognitive conditions as a surge of negative outcomes that, in the absence of intervention, will impair a broad range of quality of life areas over the life span of the afflicted individual. Furthermore, the authors asserted that attention to external events and circumstances, such as the presence or absence of other stressors and support, determines whether or not this negative cascade of events will occur. This conjecture suggests that BINT can be treated with psychosocial interventions.

The Tanielian and Jaycox (2008) study developed a micro-simulation model to forecast the economic costs of BINT over time. The researchers maintained that unless treated, long-term and wide-ranging negative consequences could occur. These consequences include diminished work productivity, and family and social functioning and relationships (divorce, parenting, and problems with children). BINT increases the risk for violent behaviors, including suicide and violent crime, unhealthy behaviors (smoking, overeating, unsafe sex), substance abuse, and physical health morbidity. Based on that premise, annual per case costs of mTBI associated with cognitive conditions

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**BINT increases the risk for violent behaviors, including suicide and violent crime; unhealthy behaviors (smoking, overeating, unsafe sex); substance abuse; and physical health morbidity.**
stemming from combat in Afghanistan and Iraq were estimated at $27,259–$32,759. Costs were even higher if mTBI was comorbid with PTSD or major depression. These expenditures do not include the potential costs of substance abuse, violent crime, suicide, homelessness, family strain, and military personnel loss. Using the number of cases diagnosed by June 2007 (2,726), Tanielian and Jaycox projected that the first-year costs of mTBI injuries would range from $591 million to $910 million dollars. This expenditure does not include costs for individuals who have not sought treatment or have not been formally diagnosed.

The likelihood of continued deployments with exposure to blasts into the next decade is high. A continued U.S. military presence in Iraq and a heightened presence in Afghanistan will likely result in an increase in cases. Tanielian and Jaycox (2008) also emphasized that loss of productivity to the DoD and decline in military readiness from mTBI account for 47–57% of total costs for this injury. Public concern over the handling of such injuries is widespread. Military and government leaders have moved quickly to study how such injuries are currently handled, to quantify the problem, and to formulate policy.

Public Health Implications

Consequences of BINT may lead to long-term outcomes for individuals, families, and society in general, with the potential for lifelong consequences that require costly, long-standing services and support. Tanielian and Jaycox (2008) asserted that sufficient resources can act as a buffer. Sufficient resources can protect individuals and minimize the immediate consequences of these disabling conditions. They also asserted that significant vulnerabilities and additional sources of stress can intensify the negative consequences of these conditions. Their study suggested the need for confidential programs to provide injured service members with a supportive environment because many of them are geographically distant from extended family and friends. Education and support groups, as complements to traditional interventions addressing symptoms, may help these young adults to develop the skills to cope with these potentially enduring conditions. Interventions must be easy to access and confidentiality assured because of the stigma for troops who fear negative career repercussions or ridicule. This strategy will increase total force readiness and retention by encouraging individuals to seek needed health care before problems become critical (IOM, 2008; Tanielian & Jaycox, 2008).

One additional public health implication is the need for evidence-based treatment and management of BINT that includes alternative modalities. Acupuncture for pain and anxiety management, and neurofeedback to treat cognitive and attention deficits may be more effective in addressing problems without the high incidence of drug abuse, serious adverse side effects, and non-adherence that occur with current poly-pharmaceutical treatment of BINT. These modalities are being introduced in a limited number of military treatment facilities with predominantly anecdotal evidence of their effectiveness in this population.

Tanielian and Jaycox (2008) asserted that benefits to the DoD in retention and increased productivity would outweigh the costs of evidence-based care and scientific research to develop strategies that alter the personal attitudes of service members toward seeking medical care for BINT symptoms. Savings related to medical costs, increased productivity, and decreased suicides would result in significant savings to the DoD. Other public health implications of BINT include the need to improve service member and family understanding of the injury, treatment modalities, and their high likelihood of recovery through health promotion educational interventions. All treatment modalities must be evidence based, patient centered, efficient, equitable confidential, and timely. The DoD has already initiated training in evidence-based practices for clinical providers, but efforts are not integrated into a larger system redesign that values and provides incentives for quality of care. Military health systems require additional clinical provider training, but they
also need to monitor the providers’ client outcomes through performance feedback from patients and other healthcare professionals involved in the care of BINT patients.

Veterans of Afghanistan and Iraq may feel out of place in Veterans Affairs hospitals, which treat primarily older veterans with chronic illnesses. Another public health strategy is to offer alternative care settings such as veteran centers (nonmedical centers), home visits, telephonic follow-up, community-based case management, and other community-based services where confidentiality can be maintained. Tanellian and Jaycox (2008) claimed that the availability of resources to address service members’ vulnerabilities can alter the immediate consequences of BINT symptoms, particularly because the cognitive deficits from BINT frequently result in impairment in productivity, independence, and interpersonal relationships.

According to Martin et al. (2008), nursing plays a major role in assessing, identifying, and educating the BINT population. Injured troops affected by BINT, particularly the Reserve Forces, originate from a wide geographic area and will eventually demobilize from the military to seek health care in their home communities. It is important for nurses and other providers in the community to be familiar with combat-related BINT and screen for it in young adult populations who have experienced combat as they transition out of the military environment.

Furthermore, the Management of Concussion/mTBI Working Group (2009) contended that, as with other chronic conditions, the focus of management for persistent symptoms resulting from BINT should shift to the psychological and social effects on the patient, the spouse, or significant other. Referral to a structured program that promotes community integration may be needed for individuals with persistent symptoms that impede their return to pre-injury participation in customary roles. Overall, the most important point for a neurotrauma program for this population is to allow anonymity for the service members to access services voluntarily and “off the record.” This might include access at locations away from the military base, by anonymous telephone call (crisis/help lines), or Web site access, with the ability to make arrangements and get information online for support groups, chat rooms, or one-to-one consultation.

Active duty troops and veterans of Afghanistan and Iraq are young, healthy, and productive members of society, but 30% of them are affected by PTSD, major depression, and BINT, all of which are difficult to detect. Current literature is limited, and studies are in conflict about the long-term outcomes of BINT and whether it translates into any lasting impairment. Another public health implication is that a better understanding of the full range of problems (emotional, economic, social, health, and other quality of life deficits) that confronts individuals with BINT is needed. Research regarding the costs and benefits of different treatments and methods to promote immediate treatment for these individuals are paramount for effective public policy formulation (Kennedy et al., 2007).

Elected decision makers and military leaders recognize that they have a responsibility to safeguard the physical and mental health of our military force to sustain military force readiness. They must also develop mechanisms to address service-connected injuries and their personal and social consequences. Why should U.S. citizens pay the cost of long-term service-connected injuries and disabilities of our active duty service members and veterans when these disabilities can be prevented with early identification, prompt treatment, and rest?

The Need for Research

Taber et al. (2006) alleged that scientific experts know virtually nothing about the sequelae of exposure to multiple blasts, especially when an individual does not sustain severe injuries requiring medical evacuation. According to the IOM (2008) study, limited scientific knowledge on the prevalence of BINT exists. There is ambiguity in the definitions and understand-
ing of the possible long-term repercussions of exposure to blasts. Prompt identification, accurate diagnosis, treatment and care coordination, and management policies and procedures must be developed to hasten the recovery of afflicted troops and restore them to full productivity (IOM, 2008; Tanielian & Jaycox, 2008). These activities, however, can only occur in the context of research that identifies diagnostic features and effective evidence-based interventions for BINT.

Nursing leaders, researchers, and advance practice clinicians have a tremendous opportunity to contribute to the growing body of knowledge on BINT by investigating this injury and effective recovery strategies. Nursing must take the lead in generating scientific knowledge and creating clinical best practices so that we, as a profession, can maximize the recovery of military service members and veterans injured by blasts. The nursing profession must accept the challenge of filling the knowledge gaps identified in this article. Nursing leaders and researchers can engage in political advocacy for service members and veterans by developing strategies to promote recovery and disseminating this information to our nation’s leaders. Then the nursing profession will not only shape our country’s health, but also allow these individuals who have sacrificed so much to live as healthy and fully productive members of society.

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