

## Program development and defining characteristics of returning military in a VA Polytrauma Network Site

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**Abstract**—The conflicts in Iraq and Afghanistan have resulted in a new generation of combat survivors with complex physical injuries and emotional trauma. This article reports the initial implementation of the Polytrauma Network Site (PNS) clinic, which is a key component of the Department of Veterans Affairs (VA) Polytrauma System of Care and serves military personnel returning from combat. The PNS clinic in Palo Alto, California, is described to demonstrate the VA healthcare system's evolving effort to meet the clinical needs of this population. We summarize the following features of this interdisciplinary program: (1) sequential assessment, from initial traumatic brain injury screening throughout our catchment area to evaluation by the PNS clinic team, and (2) clinical evaluation results for the first 62 clinic patients. In summary, this population shows a high prevalence of postconcussion symptoms, posttraumatic stress, poor cognitive performance, head and back pain, auditory and visual symptoms, and problems with dizziness or balance. An anonymous patient feedback survey, which we used to fine-tune the clinic process, reflected high satisfaction with this new program. We hope that the lessons learned at one site will enhance the identification and treatment of veterans with polytrauma across the country.

**Key words:** brain concussion, brain injuries, hearing disorders, needs assessment, neuropsychology, pain, physical medicine, posttraumatic, rehabilitation, stress disorders, vision disorders.

## INTRODUCTION

As a result of major advances in body armor technology and battlefield medicine, many military personnel are now surviving injuries that would have been fatal in previous wars [1–2]. In particular, the conflicts in Iraq and Afghanistan have resulted in a new generation of combat survivors who frequently have complex physical injuries and emotional trauma [3–6]. The Department of Veterans Affairs (VA) healthcare system has often been acknowledged for its exemplary care of veterans. However, the steady influx of new patients presents a challenge to the

**Abbreviations:** NSI = Neurobehavioral Symptom Inventory, OEF/OIF = Operation Enduring Freedom/Operation Iraqi Freedom, PCS = postconcussion syndrome, PNS = Polytrauma Network Site, PCL = Posttraumatic Stress Disorder Checklist, PTSD = posttraumatic stress disorder, TBI = traumatic brain injury, VA = Department of Veterans Affairs.

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system. This challenge arises not only from the increased demand for clinical services but also from returning soldiers' complex combat-related injuries, which were not typically seen in prior wars [2–4].

VA clinical directives described these injuries as “polytrauma,” which is defined as concurrent injury to the brain and several body areas or organ systems that results in physical, cognitive, and psychosocial impairments [7]. Patients with polytrauma typically present with traumatic brain injury (TBI) and other disabling conditions [3,7]. Recognizing that returning soldiers would require specialized medical care and comprehensive rehabilitation, the U.S. Congress allocated additional funding for the VA to establish the Polytrauma System of Care [8]. This multicomponent system includes 4 current regional Polytrauma Rehabilitation Centers (a fifth is under construction), 21 Polytrauma Network Sites (PNSs), and a multitude of local Polytrauma Support Clinic Teams and Polytrauma Points of Contact.

The Polytrauma System of Care aims to maximize the accessibility and efficiency of an infrastructure for the care of returning military personnel. In this article, we used the PNS in Palo Alto, California, as an example of how the VA healthcare system has evolved to meet the needs of stakeholders. The Palo Alto PNS clinic became operational in July 2006 and receives outpatient referrals from northern California, Nevada, Hawaii, the Pacific islands, and the Philippines. It consists of a physical medicine and rehabilitation physician (physiatrist), neuropsychologist, social worker, occupational therapist, physical therapist, speech-language pathologist, and optometrist. The team provides clinical evaluations and care coordination for patients who do not have urgent inpatient treatment needs but do have physical, cognitive, or emotional problems that affect their daily lives.

This article reports the initial implementation of the Palo Alto PNS clinic, which is a component of the Polytrauma System of Care for military personnel returning from combat. We describe the evolution of the Palo Alto PNS clinic as well as the clinical characteristics of its first 62 patients. We hope that the lessons learned at this site will enhance the identification and treatment of veterans with polytrauma across the country.

## METHODS

In the initial 7 months of the Palo Alto PNS clinic's operation (July 2006 to February 2007), the clinical team

tried several strategies for improving the screening, evaluation, and provision of care. Through coordinated team efforts and feedback from the patients and their families, successive changes were implemented in the screening process to ensure coordinated care by an interdisciplinary team. In the next sections, we describe development of the following procedures: (1) TBI screening throughout the local healthcare system and the clinic appointment process and (2) interdisciplinary team assessment and clinical characteristics of PNS patients who screened positive for TBI.

### Screening and Appointments

The VA initiated a postdeployment screening for returning soldiers in December 2005. The objective was to screen for medical and psychological disorders due to deployment-related health risks. Therefore, the VA decided that an Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) returnee's first point of contact with any VA clinic would automatically trigger an electronic clinical reminder for postdeployment screening. Initially, this screening focused on the following risk factors: posttraumatic stress disorder (PTSD), depression, alcohol use, and physical symptoms/signs, such as fever, skin rash/lesions, gastrointestinal upset, and pain. At the Palo Alto VA, the screening process was revised in May 2006 to include the detection of TBI. Veterans would be referred to the PNS clinic for further evaluation if they answered “yes” to any of the following questions:

1. Have you ever been in a blast/explosion (or close proximity), vehicular crash, or fall?
2. Have you ever been rendered unconscious?
3. Have you ever had head trauma?

We recognized that these screening questions were not sufficiently specific and would result in many false positives. Therefore, the Palo Alto team designed and implemented a new electronic PNS consult form that contained a list of clarifying questions for the referral source to answer and forward to the PNS care coordinators (social worker and occupational therapist). After reviewing the consult form responses and verifying the appropriateness of the referral, the care coordinators contacted the patient by telephone to determine whether (1) functional deficits still existed and (2) the patient was willing and available to come for an in-person clinical appointment. The care coordinators electronically documented these telephone encounters to capture both clinical information and workload. A clinical appointment was made after the patient agreed to be evaluated in person.

### Interdisciplinary Assessment and Clinical Characteristics

The patients' PNS clinic appointments were initially structured as sequential 40- to 45-minute evaluations by the physiatrist, neuropsychologist, occupational therapist, physical therapist, optometrist, speech-language pathologist, and social worker. Considering the nature of polytrauma, instead of having the physiatrist submit consultation requests to individual team members, the team decided collectively to perform interdisciplinary screening evaluations on all patients who came for their appointments.

The PNS clinic was initially scheduled once a week and was able to evaluate and provide a treatment plan for up to five patients each session. The approach is collaborative and patient-centered. Each clinical specialist obtains relevant input from the patient and any family member present. Each specialist then compares and discusses his or her findings with other team members in a concluding meeting to develop a coordinated, comprehensive, and individualized treatment plan. At the end of the clinic, the team discusses its findings and recommendations with each patient and family member. Due to the increasing number of referrals, the clinic has now been expanded to three times a week plus a monthly Saturday clinic.

### History-Taking and Physical Examination

Because of the potential effects of TBI on patients' memory and speech, the history-taking process can become tangential and inefficient. This is a concern for clinicians attempting to maintain relatively brief appointments with successive patients. Therefore, the supervising clinicians in each discipline developed structured interview and examination forms to systematically gather the essential data from PNS patients. This standardized approach ensures that essential data are not missed, which is critical for both clinical follow-up and research. **Appendix 1** shows the template for the polytrauma clinic physician form (available online only at <http://www.rehab.research.va.gov/>). Postconcussion symptoms were integrated into the history-taking form, while somatic complaints (such as location of pain) were gathered during the physical examination. As a rule, the electronic notes were completed the day of the clinic visit.

### Neuropsychological Evaluation

In the first month of the PNS clinic, our neuropsychologist evaluated the clinical utility of conducting a 40-minute neuropsychological screening. This screening

consisted of a 20-minute interview and a 20-minute testing period. The interview focused on the patient's responses to the Neurobehavioral Symptom Inventory (NSI), which assesses symptoms of postconcussion syndrome, and to the PTSD Checklist (PCL). The testing included single measures of attention, processing speed, learning and/or recall, and executive control—the cognitive functions most frequently affected by TBI. However, we soon realized that this brief assessment did not provide a sufficiently sensitive and reliable clinical picture of the interview, test results, and behavioral observations. The battery lacked several important psychological and neuropsychological elements (sensitivity) and did not allow us to check the consistency of test results within cognitive domains (reliability), suggesting an unacceptable vulnerability to false positives and false negatives. Therefore, we revised our procedure to provide more time for the neuropsychological evaluation, typically before the patient's appointment with the rest of the PNS interdisciplinary team.

The initial neuropsychological assessment was expanded to include a 20-minute waiting room questionnaire, a 30-minute interview, a 90- to 120-minute testing period, and a debriefing period (3 hours total). These additions broadened the coverage of cognitive functions and facilitated consistency checks between two or more tests in each cognitive domain. In addition to the NSI and PCL, the questionnaire included the brief Beck Depression Inventory and the Beck Anxiety Inventory. The testing period was expanded to include the Neuropsychological Assessment Battery-Screening Module, Wisconsin Card Sorting Test, Trail-Making Test, Grooved Pegboard Test, Wechsler Processing Speed Index and Working Memory Index, Wechsler Test of Adult Reading, and Shipley-Hartford Vocabulary and Abstraction tests.

Results of the neuropsychological evaluation were used to assign initial working diagnoses. Neuropsychological diagnosis requires a complex clinical decision that integrates many factors, including premorbid function and culture, motivation, and consistency of findings across tests. Each patient's premorbid function was estimated both from history (e.g., education, employment, military rank, and responsibilities) and psychometric indices (e.g., vocabulary and word-reading ability). In general, an initial diagnosis of cognitive disorder was assigned when patients performed more than 1.5 standard deviation below their estimated premorbid functioning on two or

more neuropsychological indices (i.e., fifth-percentile rank or below). When the military medical records documented continuity between injury event and current functional impairment, the diagnosis was further specified as “due to TBI.” If documentation was unavailable (the majority of cases), then diagnosis of cognitive disorder was listed as “not otherwise specified” and accompanied by a statement that multiple etiologies were possible (see the “Discussion” section). Diagnoses of PTSD, depressive disorders, and anxiety disorders were based on the screening questionnaires (using published norms) followed by clinical interviews (using criteria of Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition).

### *Hearing Screening*

The speech-language pathologist who performed the speech-language evaluation also performed the hearing screening with the Welch-Allyn Handheld Audiometer (Skaneateles Falls, New York). Four frequencies were tested for each ear: 500, 1,000, 2,000, and 4,000 Hz at 40 dBnHL (decibels normal hearing level). If patients could not hear any of these frequencies at 40 dBnHL, they “failed” the screening and were referred to the audiology service for further evaluation. History on the onset and nature of tinnitus was also gathered during the visit.

### *Vision Screening*

The PNS vision screening protocol is shown in **Appendix 2** (available online only at <http://www.rehab.research.va.gov/>). During the screening, the optometrist asked a series of 20 self-report questions concerning visual status and also rated the patient’s gross physical presentation (e.g., independent ambulation, wheelchair use). In addition, the functional vision screen included measures of near and distance visual acuity, visual fields, binocular function, and color vision (see **Appendix 2**). The examination of visual function was considered a vision screening, and any findings outside of normal ranges were considered a possible dysfunction. Further workup was recommended to quantify detected problems and provide treatment strategies. Visual acuity was classified as “normal/near normal” for acuity of  $\geq 20/60$ , “visually impaired” for acuity of 20/70 to 20/100, “legally blind” for acuity  $\leq 20/200$ , and “blind” for no light perception. This examination did not assess ocular health, so all patients were referred for a comprehensive eye examination.

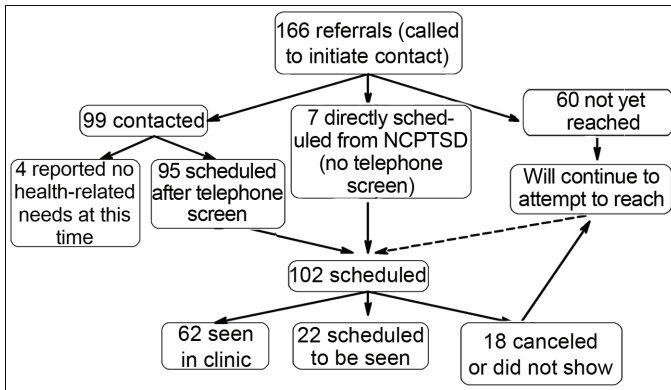
### *Patient Satisfaction Survey*

We used an anonymous customer feedback form developed in August 2006 to assess patient satisfaction and provide an opportunity for suggestions (see **Appendix 3**, available online only at <http://www.rehab.research.va.gov/>). After obtaining local approval, we distributed the form to 44 consecutive patients at the end of their appointments. All of these patients completed the survey in private before leaving the clinic. Early in the Palo Alto PNS clinic’s implementation, many patients requested a written summary to help them review, remember, and follow up on the multifaceted assessment and plan. Therefore, we developed a summary sheet on which each PNS specialist writes his or her conclusions and recommendations. This sheet includes each specialist’s contact information, in case patients have additional questions or concerns.

## **RESULTS**

As seen in **Figure 1**, the Palo Alto PNS clinic received 166 referrals between July 2006 and February 2007. Of the 99 referred patients contacted by the care coordinator, 95 were scheduled for a clinic visit and 4 had no immediate health needs. An additional 7 referrals from the National Center for PTSD were scheduled for clinic appointments without additional telephone screening. Of the 166 referrals, 60 could not be reached by repeated telephone calls.

During this study, 102 patients were scheduled and 62 (59 males, 3 females) came and were evaluated at the Palo Alto PNS clinic, with the other referrals scheduled for future clinic appointments. These patients were almost all veterans of the Iraq and Afghanistan conflicts; 89 percent were OEF/OIF returnees, 5 percent were older veterans from prior wars, and 6 percent did not have combat-related injuries (the latter two small groups were retained in the present analyses to accurately represent the population flagged by the screening process). Of the 62 patients evaluated, 79 percent reported being affected by explosive blasts in combat and the remainder reported being injured as follows: 8 percent motor vehicle accidents, 8 percent blunt traumas, and 3 percent penetrating head injuries. One patient was not physically injured at all. Of note, 50 percent of those evaluated in the Palo Alto PNS clinic reported loss of consciousness immediately following the



**Figure 1.** Patient referral to Palo Alto Polytrauma Network Site clinic between July 2006 and February 2007. NCPTSD = National Center for Posttraumatic Stress Disorder.

traumatic event, while 31 percent reported only alteration of consciousness. In most cases, the sequence of events could not be documented because of the circumstances in which they occurred.

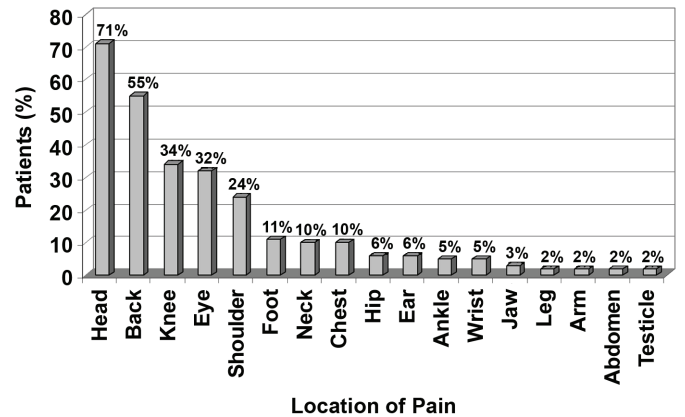
**Self-Reported Symptoms (Postconcussion Symptoms and Pain)**

The **Table** lists the prevalence of various symptoms among the patients seen in the Palo Alto PNS clinic. International Classification of Diseases-10th Revision criteria for postconcussion syndrome (PCS) include a history of TBI with three or more of the following: headache, dizziness, fatigue, irritability, concentration, or memory problems and heightened reactivity to stress, emotions, or substance use. Three or more PCS symptoms were reported by 97 percent of patients. More than 70 percent of patients reported sleep disturbances, hyperarousal symptoms, mood symptoms, headaches, and cognitive complaints. A wide variety of somatic symptoms affecting sensory and motor functions were also reported by 40 to 69 percent of patients.

Pain was a prevalent issue in this group of patients, with 97 percent complaining of pain. As summarized in **Figure 2**, the most common pain symptoms were headache (71%) and back pain (55%). These were followed by pain in the knees (34%), eyes (32%), shoulders (24%), and feet (11%). While headache is a common symptom after TBI [9], additional effort is needed to further characterize the nature of reported headaches, including their correlation with patients’ cognitive and emotional symptoms. Regarding pain in the back, knees, shoulders, and feet,

**Table.** Postconcussion symptoms reported by patients in Palo Alto Polytrauma Network Site clinic.

Symptom	% of Patients
Sleep Disturbances	84
Irritability	84
Attention/Concentration Problems	79
Mood Swings	76
Memory Problems	76
Anxiety	74
Headaches	71
Light/Noise Sensitivity	69
Depression	66
Visual Disturbances	66
Tinnitus	58
Excessive Fatigue	58
Balance Problems	42
Dizziness	40



**Figure 2.** Pain symptoms reported by patients of Palo Alto Polytrauma Network Site clinic.

none of the 62 patients has so far demonstrated indications leading to recommendations for surgical intervention. All were treated with conservative management, such as medication, physical therapy, and psychological services.

**Neuropsychological Findings**

**Figure 3** summarizes the initial neuropsychological assessment results for the two most frequent diagnoses, PTSD and cognitive disorder. Both diagnoses had a high prevalence (PTSD = 71% and cognitive disorder = 55%), and co-occurrence of these diagnoses was considerable



		Cognitive Disorder		Total
		+	-	
PTSD	+	Both 42%	PTSD Only 29%	71%
	-	Cognitive Only 13%	Neither 16%	29%
Total		55%	45%	

**Figure 3.**

Initial neuropsychological evaluation: Diagnosis of cognitive disorder and posttraumatic stress disorder (PTSD). + = present, - = absent.

(42%). Significant depressive symptoms (not shown) were present in 52 percent of patients; 100 percent of these patients had a diagnosis of PTSD and 62 percent cognitive disorder. A large subgroup (29%) was found to have PTSD but no cognitive disorder. Many of these patients were already being treated for PTSD that was diagnosed before their referral to the Palo Alto PNS clinic. In most cases, patients' PTSD symptoms were related to memories of multiple experiences during their combat deployment, as well as to any physical injury they had sustained. (Detailed neuropsychological findings, which are beyond the scope of this article, will be presented elsewhere.)

### Auditory Dysfunction

The majority of patients (58%) complained of tinnitus, which in all cases was perceived as a high-pitched noise. While 44 percent complained of difficulty with hearing, only 35 percent failed the hearing screening test. Some patients who reported "hearing difficulty" might have had a central auditory processing disorder rather than a peripheral hearing loss. However, further research is needed to substantiate this hypothesis. While peripheral hearing loss often occurs as a result of noise exposure and traumatic impact to the skull [10], the prevalence of central auditory processing disorder among patients with blast-related TBI remains to be explored.

### Visual Dysfunction

A very frequent pattern emerged from the vision screening examinations. The majority of patients showed normal to near-normal corrected visual acuity and visual fields. However, 75 percent self-reported a vision problem, including photosensitivity (59%). Oculomotor problems were evident in 70 percent of patients and included convergence dysfunction (46%), pursuit and/or saccadic dysfunction (25%), accommodation dysfunction (21%), strabismus (11%), and fixation dysfunction or nystagmus (5%). The high percentage of binocular vision disorders may account, at least partially, for self-reported reading difficulties in 84 percent of the patients. Of these patients, 70 percent stated that the reading problem began after their concussive injury. These data indicate a very high prevalence of vision-related problems in this post-combat population. These problems could result from brain concussion and/or peripheral optical injuries, and further research to identify causative factors is warranted.

### Patient Satisfaction Survey

Patient feedback has also helped fine-tune the PNS program. The patient satisfaction survey (**Appendix 3**, available online only at <http://www.rehab.research.va.gov/>) has allowed us to assess the extent to which patients believe the clinic process addresses their concerns and has helped PNS staff focus on issues that patients believe need improvement. For example, largely on the basis of patients' requests, we began giving patients a structured written summary of findings and recommendations. We received anonymous feedback from 44 patients. All of them indicated that the staff members were courteous, provided enough information, and answered their concerns in an understandable fashion. All respondents also indicated that they were involved in the clinical decisions and understood their next care step. Six patients (14%) felt that their concerns were not addressed. Two patients (4%) identified problems with the interdisciplinary process, including too many interruptions and lack of privacy during the team meeting. The other four patients did not describe their concerns further. Overall, 96 percent stated that the quality of care was excellent (71%) or very good (25%), 2 percent stated that it was good, and 2 percent did not provide a rating. None expressed overall dissatisfaction. We consider these results more favorable than expected and conclude that adding patient feedback to the program development led to a high level of congruence between the patients' concerns and the clinic's services.

Thus, the focus on coordination at every step, within the professional team and among patients, clinicians, and involved family members, has resulted in more efficient initial screening, more effective assessment tools, and better communication of findings to those served.

## DISCUSSION

In this article, we used the clinical experience of the Palo Alto PNS clinic to illustrate how the VA healthcare system has evolved to meet the needs of stakeholders. Among this sample of military personnel returning from combat, PCS, PTSD, poor cognitive performance, head and back pain, and auditory and visual symptoms were highly prevalent. These symptoms and poor scores on cognitive and sensorimotor examinations should not be interpreted as conclusive evidence of brain injury sequelae. This caution applies especially to patients with a history of mild TBI accompanied by one or more comorbid conditions (PTSD, depression, pain, sensory impairments, etc.), as was the case for most of these patients.

We state this caution for several reasons. First, a diagnosis of mild TBI is not determined by testing but rather by careful history-taking regarding trauma with alteration of consciousness. Second, the symptoms of PCS are not unique to TBI. Many PCS symptoms have a high base rate in the general population and are not necessarily associated with measures of cognitive function [11–12]. Third, the symptomatic, cognitive, and sensorimotor effects of mild TBI largely overlap those of comorbid conditions prevalent in this sample, notably PTSD, depression, chronic pain, impaired sleep cycles, substance use, and numerous medical conditions [13–15]. Fourth, the possibility of secondary benefits (e.g., discharge from duties, financial compensation for service-connected conditions, enhanced clinical services) can lead a subset of patients to intentionally or unconsciously produce poor test results (factitious and somatoform effects); therefore, effort must be carefully assessed during assessment.

The co-occurrence of PTSD and cognitive disorder in 42 percent of these combat returnees deserves special attention. Indeed, many more patients had these two diagnoses together than PTSD alone (29%) or cognitive disorder alone (13%) (**Figure 3**). In people who have a history of mild TBI, the presence of PTSD has been shown to increase the risk for persistent postconcussion symptoms [16]. Conversely, among people exposed to

life-threatening events, comorbid TBI may alter the profile of PTSD symptoms [17]. We are currently conducting analyses to further delineate the complex relationship among these syndromes in combat returnees.

The following elements are essential to the sequential assessment and treatment of postconcussion symptoms: (1) complete description of altered consciousness and history of functioning from immediately after potential injury events to the present, (2) counseling that targets postconcussion symptoms as early as possible by instilling coping and adaptive strategies, (3) psychotherapy and medical treatments to address any continuing conditions that affect cognitive functions and are potentially reversible (emotional disorders; vision, hearing, and vestibular impairments; orthopedic needs), and (4) comprehensive neuropsychological evaluation to guide further rehabilitation if cognitive difficulties continue despite these interventions or are atypical of known comorbidities. Thus, in serving this initial cohort of PNS patients, we developed invaluable collaborations with numerous professionals in the healthcare system, including the National Center for PTSD, and primary care and mental health clinicians in VA centers throughout the Palo Alto VA's catchment area.

In April 2007, the VA Central Office issued a directive that institutionalized mandatory procedures for screening and evaluating possible TBI in all OEF/OIF veterans. These new screening procedures reflect the lessons learned during the initial development of the PNS program in Palo Alto and collaborating VA medical centers nationwide, especially the centers in Minneapolis (Dr. Sigford), Richmond (Dr. Cifu), and Tampa (Dr. Vanderploeg), which are our partners in the Defense and Veterans Brain Injury Center consortium. The directive included the following methodological modifications:

1. The screening procedures were revised to focus on four areas: (a) history of injury events that may increase risk for TBI, (b) symptoms related to alteration of consciousness appearing immediately after the traumatic event, (c) new or worsening TBI symptoms after the traumatic event, and (d) persistence of these symptoms into the present. Answering "yes" to all four screening questions constitutes a positive TBI screen. (For the four screening questions and flow chart, see **Appendix 4**, available online only at <http://www.rehab.research.va.gov/>.)
2. A positive screen is followed by an interview that includes the NSI and a structured history for assessing appropriate referrals to clinical services before the full PNS team evaluation.

3. Comprehensive neuropsychological evaluation is then conducted in a subset of patients after interventions for potentially reversible medical and psychological conditions have been used.

## CONCLUSIONS

VA PNS clinics have been established to provide returning service members with required clinical services. We have found that an interdisciplinary team approach is an efficient tool for evaluating and planning treatment for this population's various medical and psychological health problems. We hope that the lessons learned at the Palo Alto PNS will enhance the identification and treatment of veterans with polytrauma across the country.

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