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ABSTRACT

248 words

BACKGROUND The Veterans Health Administration screens for traumatic brain injury (TBI) among all its patients who were deployed to Afghanistan or Iraq. This paper reports patient-level results of the screening program in 2008 and 2009 including rates of referrals and utilization.

METHODS We based rates of positive screens on all screened patients from October 2007 through March 2009 as captured in VHA electronic records of screenings. We derived rates of TBI confirmed by comprehensive evaluations only from October 2008 through July 2009 as captured in VHA electronic evaluations records. We obtained patient characteristics from Department of Defense and VHA data.

RESULTS Of 216,335 VHA patients screened from October 2007 through March 2009, we estimate that 14.6% had traumatic brain injury. For patients with a confirmed brain injury, the proportion using only VHA services was higher (86%) than for those with brain injury ruled out (77%). Patients with confirmed brain injury were more likely to have referrals (82% compared to 64%), but lack of referrals did not prevent the patients from getting VHA care. In the year after screening, 96% of evaluated patients with referrals received outpatient care, while 90% of those with no referral did so.

CONCLUSIONS The VHA TBI screening process is inclusive, providing follow-up evaluation to almost 25% of screened servicemembers, 59% of whom are diagnosed with TBI. Clinicians refer virtually all those evaluated for further VHA care. Generalizability of the rate of traumatic brain injury is limited to those who seek Veterans Administration health care.

Traumatic brain injury (TBI) is a leading injury among forces deployed since 2001 to combat areas such as Afghanistan and Iraq (Operation Enduring Freedom and Operation Iraqi Freedom or OEF/OIF).[1-3] Mild TBI (commonly called concussion) represents the majority of TBI cases among OEF/OIF servicemembers and veterans.[2,4-5] The Defense and Veterans Brain Injury Center, for example, classified only 1.8% of all military TBI cases reported by the Department of Defense (DOD) from 2002 through 2009 as "Penetrating" and 1.0% as "Severe", while 82% were "Mild".[6] Mild TBI is difficult to identify because it can occur with no visible head injury and because of the difficulty in documenting key determinants of TBI severity (e.g., altered consciousness) during combat.[7] Further, symptoms of mild TBI are common to or exacerbated by other conditions, such as post-traumatic stress disorder (PTSD),[8-9] also common in this cohort.[10]

Identifying TBI is essential; timely and appropriate treatment can mitigate its physical, emotional, and cognitive effects. While no gold standard for treating mild TBI exists, clinicians often treat the symptoms with medications and physical or behavioral therapy, and patients can be educated about symptoms and the course of recovery.[11-13] Some symptoms can become chronic and affect work and family life for years,[14-15] even after separation from the military.[16-20]

Veterans deployed to a theater of combat operations after November 11, 1998, are currently eligible for up to five years of health care services through the Veterans Health Administration (VHA).[21] In fiscal year (FY) 2010 alone, VHA expects over 400,000 OEF/OIF patients (20-25 percent of those eligible).[22]

To identify patients who may have had TBI, VHA policy, using its national electronic medical record system for clinical reminders, is to screen all individuals who report OEF/OIF deployment.[23] This initial screen contains four sequential sets of questions regarding:

1. Events (e.g., blast, fall, vehicle accident) associated with increased risk for TBI;

2. Immediate symptoms following the event, e.g., disorientation or memory loss;

3. New or worsening symptoms following the event, e.g., balance, headaches, irritability;

4. Symptoms within the past week, e.g., balance, headaches, irritability.

A screen is positive if a person responds positively to any question within each set. The clinical reminder then prompts the clinician to discuss the results with the patient, offer referral for comprehensive evaluation, and document either the patient's referral or refusal.

Not all patients who screen positive have TBI. Positive screens may be due to the presence of other conditions, e.g., PTSD or inner ear injury.[24] Based on its experience with Veterans from past conflicts, VHA screening is intentionally inclusive, referring patients with lower probability of having TBI to ensure that those needing care receive appropriate assessment and treatment.[1,25] For Veterans with positive screens, VHA policy requires a comprehensive evaluation within 30 days of post-screen referral. Using a defined protocol administered by a clinician, the Comprehensive TBI Evaluation collects information about the origin of the injury, assesses neurobehavioral symptoms, includes a targeted physical examination and psychiatric history, confirms or rules out a diagnosis of TBI, and lists possible follow up care.[26]

This study's primary goal is to evaluate VHA's screening and evaluation program for TBI in order to improve the delivery of care. Specifically, this paper uses merged VHA and DOD data to: 1) identify positive screens for TBI among the deployed population using VHA services; 2) calculate the proportion of positive screens that received comprehensive evaluations; 3) compute the rates of TBI diagnoses, and 4) examine referrals for care and VHA utilization levels. This description differs from VHA aggregate reports in matching evaluations both to clinical reminders and to VHA utilization. Patient-level information is essential to evaluate the

screening process in order to identify ways to improve clinical care for deployed servicemembers.

METHODS

Data Sources

This study initially included all VHA patients with an electronic TBI screening record from April 1, 2007, through June 30, 2009 and all patients with an electronic comprehensive evaluation from October 1, 2007 through August 7, 2009. Patients' education, military rank, service branch (e.g., Army) and component (e.g., Reserves) came from the Defense Management Data Center (DMDC) database, the largest DOD archive of personnel data. VHA datafiles provided patients' age, gender, marital status, VHA inpatient and outpatient services, and estimates of VHA costs for utilization in FY 2008. Creation of the analytic files and variables required extensive examination to remove invalid records such as "Test" cases (about 1%); identify records for veterans versus those still on active duty; and match the service member to the most recent DMDC record to ascertain education levels, rank and service component.

Study Population

From April 2007 through June 2009, VHA screened 324,607 patients for TBI (excluding an unknown number who declined to be screened). About 36,400 screenings were captured electronically each quarter, of which an average 7,600 were positive for TBI and should have had a referral for a comprehensive evaluation. Electronic documentation of the comprehensive evaluations became available in FY 2008 and grew to over 4,000 a quarter. The median number of days between a screening and a documented evaluation was 38; the mean was 103.

We based our rates of completing a comprehensive evaluation only on those patients who VHA screened between October 1, 2007, and the end of March 2009. This approach excluded

screenings before the start of FY 2008, for which a Comprehensive TBI Evaluation could have been conducted before entry into the database was possible. It allowed four months (more than the mean number of days) after the last screening for a comprehensive evaluation to occur and be entered into the database (through July 2009). The number of screenings included for calculating the rates for completed evaluations was thus only 216,335 of the initial 324,607 (66.6%).

We also excluded patients with evaluations but no record of an initial screening during this period. For the entire period from April 2007 through July 2009, there were 2,995 of these cases. They could have resulted from screenings that occurred before April 2007, patients referred from a DOD provider for more assessment, or VHA patients with some other symptom requiring evaluation for TBI. Including them would create a positive bias in our estimates of Veterans who completed comprehensive evaluations.

Key Variables

Traumatic Brain Injury. There is no gold standard for designating mild TBI and no specific diagnostic code for it. VHA's Comprehensive TBI Evaluation includes several questions that bear on the designation of TBI and whether it was blast-related. For the present paper, we used the clinical evaluator's judgment that the history and clinical course were "consistent with a diagnosis of TBI" in calculating rates of TBI.

Rate of Confirmed TBI. In FY 2008, evaluators could list the outcome of the evaluation as "uncertain" and refer the patient for more evaluation (e.g., by a neuropsychologist), but this option was dropped in FY 2009. For evaluations in FY 2009, the percentage of TBI cases that were ruled out was within one point of the percentage in FY 2008, while that for confirmations in FY 2009 was roughly equal to the sum of confirmations and uncertains in FY 2008. This

pattern suggests that clinicians eventually confirmed most of the "uncertain" cases in FY 2008 as TBI. Therefore, we elected to be conservative and base our point estimate for the rate of confirmed TBI among patients with a Comprehensive TBI Evaluation only on data for FY 2009.

RESULTS

This analysis identified 216,335 screened patients for the 18 months from October 2007 through March 2009. Of these, 7,746 reported that they had a prior diagnosis of TBI and 208,589 were asked the screening questions (Figure 1). Of the latter group, 21.5% (44,781) reported experiencing a blast, explosion, vehicle accident, head or neck wound, or fall, plus altered consciousness and symptoms (such as memory or sleep problems, headaches, etc.) that persisted to the week before the screening (Figure 1, Screen Q 4). These patients should have been referred for a comprehensive evaluation to determine whether the symptoms were consistent with a TBI diagnosis. The percentage of all screened patients with a positive screen or self-reported prior diagnosis was thus 24.3% ((44,781+7,746)/248,916).

How many patients with a positive screen actually had a Comprehensive TBI Evaluation?

Figure 1 shows that 54.6% (24,461) of VHA patients who screened positive between October 2007 and March 2009 had a comprehensive evaluation by July,31, 2009 (allowing at least 120 days for the follow-up evaluation). Of these, we estimate that 57.7% had a TBI diagnosis confirmed by the evaluator. Of the patients reporting a prior TBI diagnosis, only 2,338 (30.2%) also had a comprehensive evaluation (Figure 1) with a TBI confirmation rate of 80.5%.

Prior diagnoses or positive screens were not the only paths to a comprehensive evaluation. Figure 1 shows that of the 163,808 (208,589 - 44,781) patients with negative screens, 1,009 also had a comprehensive evaluation. The referral path for these patients is unknown and has no specific pattern, but perhaps clinical concern about reported symptoms led

to referrals for additional assessment. Of these, an estimated 47.5% had a TBI diagnosis confirmed by the clinical evaluators.

Of the 216,335 VHA patients with a screening during the study period, 24.7% (53,536) screened positive, reported a prior TBI diagnosis, or received an evaluation despite an initial negative screening. Of these, we estimate that 59.0% had TBI confirmed. This rate implies that 14.6% (59% of 24.7%) of all VHA patients deployed to OEF/OIF had a TBI.

Patient characteristics and the rate of screening for TBI

VHA patients deployed to OEF/OIF are predominantly male enlisted servicemembers with a high school education (Table 1). Almost half of our study population (46.4%) were married in FY 2008 and 2009. The study population served primarily in the Army or Marines (77.1%) for less than 8 years (74.7%). Their average age in FY 2008 was 33, but enlisted servicemembers were 32 on average; officers, 42.

Risk for TBI should reflect the types of military assignments the patients performed. Assignment information was not available from the DMDC, but lower positive TBI screening rates reflected other characteristics related to the patients' military jobs (Table 1). For example,

- Women had a rate, 12.7%, that was about half that for men, 26.4%.
- Those with at least some college education had a much lower rate (16.3%) than servicemembers with no more than a high school diploma (25.9%).
- Officers/warrant officers screened positive half as often (12.8%) as enlisted servicemembers, (25.6%).
- Rates for regular Air Force or Navy personnel were about 1/3 those in the Army or Marines (11.2% compared to 33.8%).

- Patients with more than 8 years of military service were about 2/3 as likely to have a positive screen compared to those with fewer years.
- Patients with a positive screen were younger on average (31 years in FY 2008) than the overall OEF/OIF patient population (33 years).

Were patients referred for treatment and given VHA services?

To address this question, we analyzed the data of all 34,900 patients who were both screened and evaluated after April 1, 2007 (about 7,000 of which did not meet inclusion criteria for the calculations reported above). The VHA's protocol for the comprehensive evaluation lists five options for a "Follow up plan" and additional information about referrals for care. We compared these referrals with actual VHA utilization.

Table 2 shows that for 80% of patients who completed a Comprehensive TBI Evaluation the clinical evaluator indicated that they would "use VHA only" for their treatment plan. For the evaluated patients with a confirmed TBI, the proportion using only VHA was higher (at 86%) than for those with TBI ruled out during the comprehensive evaluation (77%). The latter group had more patients (10.6% versus 2.5%) judged to have "No services needed".

Patients with confirmed TBI were more likely to have at least one referral for VHA care listed in the comprehensive evaluation compared to those with TBI ruled out (82% compared to 64%, respectively). Lack of referrals did not prevent the patients from getting VHA care, however. For patients with at least one referral marked on the evaluation, 96% received VHA outpatient care in the following year, while 90% of those who had no referral marked received VHA outpatient care in the following year.

In 2008, 74.3% (241,271) of all TBI screened patients initially included in this study used some VHA health services at a total cost of $931 million (not including pharmacy). Thus, 4.3%

of the 5.58 million patients served by VHA that year accounted for 2.4% of the actual medical care expenditures that year.[27] The average cost per patient was $3,857 with a range from less than $100 to over $700,000. Most of this average cost reflected outpatient care, which almost three quarters of screened VHA patients received in FY 2008; only 3.5 percent of all screened patients had VHA inpatient care that year. Outpatients with positive TBI screens were 85% more costly on average than outpatients with negative screens (~$4500 compared to ~$2400).

DISCUSSION

Our study found that 53,536 (24.7%) OEF/OIF servicemembers screened in VHA between October 2007 and March 2009 screened positive, had a prior TBI diagnosis or received an evaluation despite an initial negative screening. Of these, 51.9% (27,808) had documentation of a Comprehensive TBI Evaluation. Our best estimate of the rate of confirmed TBI among the total screened population is 14.6%. This rate is consistent with or lower than rates reported elsewhere.[6,25-26,28]

The difference between the proportions with positive screens and confirmed diagnoses suggests that VHA's TBI screening and evaluation process succeeded in being inclusive, providing a second evaluation opportunity to about 10% of screened servicemembers who ultimately were evaluated as having a condition other than TBI and were referred for care for those conditions. These rates do not apply to all OEF/OIF-deployed servicemembers, just to those who seek VHA health care. Other Veterans (or those still on active duty) may never have experienced a severe injury, may have suffered a TBI whose symptoms resolved, or may have private or military health care coverage that allows them to seek care for their TBI-related symptoms at non-VHA providers. At the other end of the spectrum, some Veterans may have persistent symptoms, but have not sought help. Outreach remains an essential part of VHA and

DOD programs. Proper TBI screening prior to separation from the military is also important, as is the transition from care in the military to that in VHA or with other providers.

VHA patients screened for TBI averaged much lower healthcare costs than the average VHA patient. This difference reflects the fact that these deployed servicemembers are about half the age of other VHA patients. Within the group who were screened, those with positive TBI screens tended to be more costly than those with negative screens. Future analyses will examine the variations in utilization and costs, especially in relation to the symptoms reported by those receiving a Comprehensive TBI Evaluation.

Non-deployed Veterans and civilians who may have experienced TBI are likely to have different symptoms than Veterans who suffered TBI during deployment since the source of injury is different for the two groups. The deployed Veterans' TBI may result from blast exposure, which affects the brain very differently than blows from objects or falls.[29] Most non-combat-related TBIs will be due to blows to the head rather than explosions. In addition, deployed Veterans with TBI experience the emotional impact of witnessing injuries to and deaths of others.

This paper improves on prior studies of the rates of TBI in OEF/OIF veterans in that prior work relied on self-reports of post-deployment symptoms in samples of servicemembers or veterans.[25-26,28] Our work replicates and extends this previous research by tracking clinical evaluators' diagnoses and linking the comprehensive evaluations with records of VHA utilization.

The results of this study include several important limitations. We lack information about the actual injuries other than patients' self-reports, but that is consistent with VHA's current practice. In the future, technology may provide live-action video or other records of

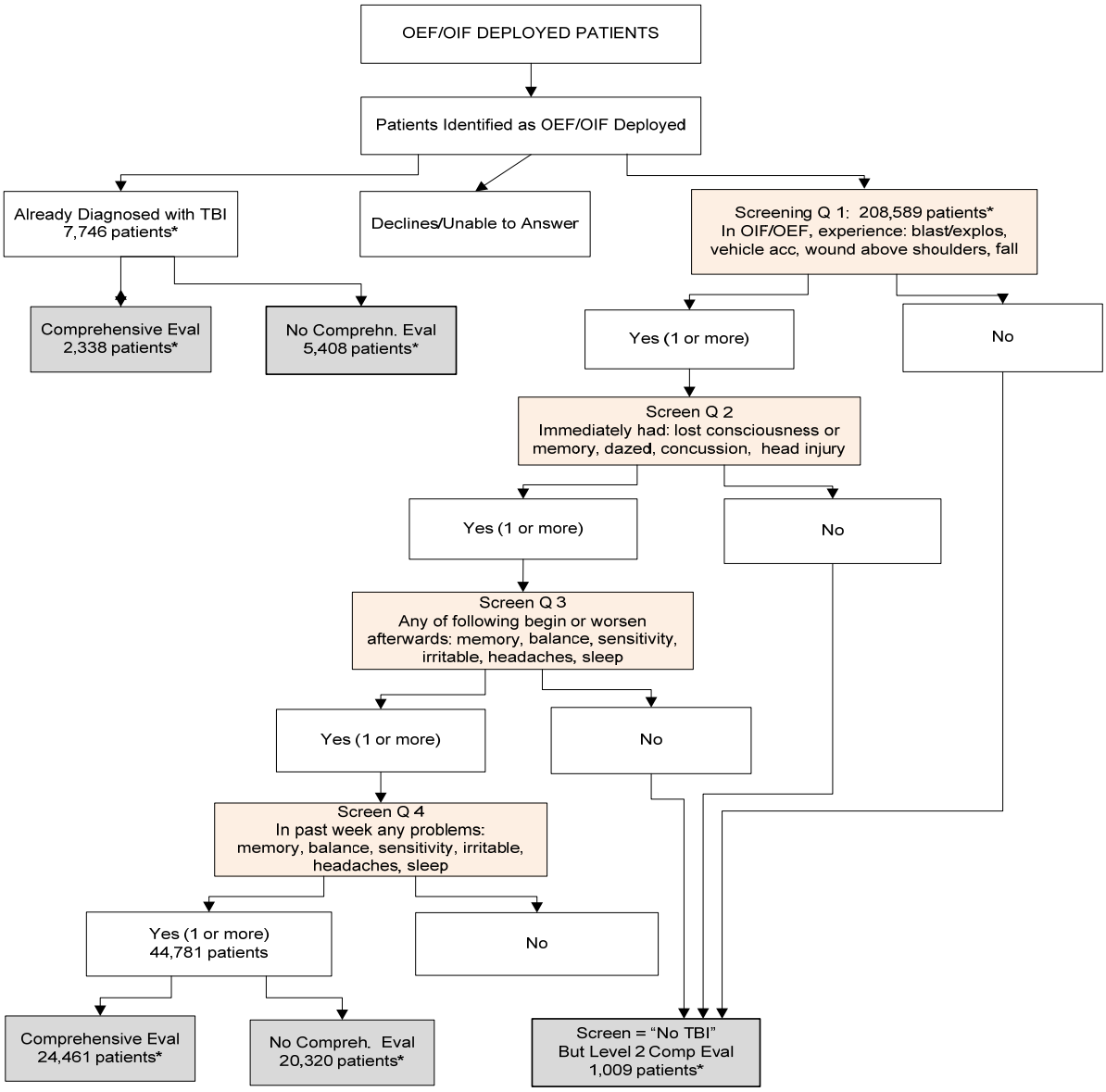
what happens in combat; for the current generation, however, careful assessments by trained clinicians are the standard. This standard also applies to military injuries sustained in non-combat situations where the technology is not used.

Another limitation is that we cannot confirm whether evaluators' TBI assessments are standardized. Future analyses will examine factors related to variations across VHA medical centers regarding specific diagnoses or conditions, types of referrals and follow-up care for specific conditions (e.g., PTSD), as well as differences by gender and service components. This approach will provide clinicians and policymakers with information about the outcomes of the evaluation process within VHA that can lead to improvements.

Our estimates of clinicians' confirmations of TBI are based on the Comprehensive TBI Evaluations documented in the electronic database that became available in October 2007. Evaluators have not always entered the results of the assessments into this database, especially during the initial months of FY 2008.

Finally, VHA's screening and evaluation databases currently allow researchers to look at veterans' health care issues only for a point in time in the post-deployment continuum. However, the cohort of OEF/OIF Veterans will be important for longitudinal studies of the long-term impact of various types of injuries.[30] A longitudinal cohort for research was not established after the Vietnam War; this is an important new opportunity for finding treatments that will help Veterans and others who suffer from TBI.

FIGURE 1: PATIENTS HAVING TBI SCREENING PROCESS
OCTOBER 2007 - MARCH 2009



* Number of patients includes only unique SSNs for the endpoint (box) shown.

TABLE 1: VHA TBI Screening Outcomes by Patient Characteristics

	Total Screened Patients		Patients with a Positive Screen, Prior Dx or other referral for Evaluation	
	Number	% of Total	Number	% of Total
Total	216,335		53536	24.7
Gender				
Male	189,806	87.7	50,159	26.4
Female	26,535	12.3	3,370	12.7
Marital Status				
Married	100,286	46.4	24,903	24.8
Not currently married*	111,908	51.7	28,093	25.1
Unknown	4,141	1.9	540	13.0
Education				
High School or less	146,675	67.8	37,950	25.9
Some college or higher	44,230	20.4	7,217	16.3
Unknown	25,430	11.8	8,369	32.9
Rank				
Enlisted	200,695	92.8	51,291	25.6
Officer or Warrant Officer	14,962	6.9	1,921	12.8
Service and Component				
Army or Marines				
Regular	62,548	28,9	21,129	33.8
Reserves	57,079	26.4	14,808	25.9
Guard	47,101	21.8	11,868	25.2

Air Force or Navy				
Regular	27,524	12.7	3,079	11.2
Guard or Reserves	21,396	9.9	2,327	10.9
Unknown	687	0.3	325	47.3
Years of Military Service				
0-3	87,034	40.2	23,838	27.4
4-7	74,544	34.5	19,540	26.2
8 or more	54,079	25.0	9,834	18.2

*Includes “Never Married”

Table 2 Follow-up Plan for Patients with Comprehensive TBI Evaluation, by TBI Status

	Total		Confirmed TBI		TBI Ruled Out	
	N	%	N	%	N	%
Total	34,900	100.0	17,637	100.0	12,292	100.0
Follow-up Plan						
VHA Services Only	27,843	79.8	15,155	85.9	9,428	76.7
Both VHA/non-VHA Services	3,288	9.4	1,668	9.5	1,143	9.3
Non-VHA Services Only	335	1.0	134	0.8	203	1.7
Patient refused/not interested	472	1.4	184	1.0	154	1.3
No services needed	1,878	5.4	443	2.5	1,298	10.6
Unknown	1,084	3.1	53	0.3	66	0.5
% with any referral by evaluator	73.4		82.3		63.8	

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