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PTSD Diagnostic Validity in Veterans Affairs Electronic Records of Iraq and Afghanistan Veterans

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Objective: Administrative planning and policy decisions frequently rely on diagnostic data extracted from large electronic databases. However, the accuracy of this diagnostic information is uncertain. The present study examined the degree to which various diagnoses of posttraumatic stress disorder (PTSD) within Department of Veterans Affairs (VA) electronic databases were concordant with PTSD diagnostic status determined by standardized diagnostic interview. ***Method:*** We interviewed 1,649 veterans of the Iraq and Afghanistan wars using the PTSD Module of the Structured Clinical Interview for *DSM–IV* (SCID). Participants also completed other interview-based and self-report measures of psychopathology and provided consent to access their electronic medical records (EMRs). ***Results:*** Concordance between database diagnosis and SCID diagnosis was 72.3% for current PTSD and 79.4% for lifetime PTSD. We observed associations between concordance status and combat exposure, PTSD symptom presentation, comorbid anxiety and depression, and psychosocial impairment. Veterans with false-negative PTSD diagnoses in the EMR were more likely to report lower levels of combat exposure, panic, and PTSD avoidance symptoms. Veterans with false-positive PTSD diagnoses in the EMR were more likely to report treatment seeking for emotional problems and less overall functional impairment. ***Conclusions:*** Although the majority of participants were concordant for PTSD status, over 25% of EMR diagnoses differed from those obtained in the diagnostic interview, with varying proportions of false positives and false negatives. Overall, those individuals with the most and least severe symptom presentations in the diagnostic interview were more likely to be accurately classified.

Keywords: PTSD, veterans, diagnosis, electronic medical record, electronic health record

During the 1980s, interest in electronic medical record keeping rose steadily, leading to an Institute of Medicine report (IOM; Dick & Steen, 1991) that recommended widespread adoption of computer-based patient records by 2001. This report and a follow-up IOM report (Dick, Steen, & Detmer, 1997) highlighted the emerging information management capabilities that such systems could provide health care organizations. These reports underscored possibilities of improved care and more efficient service delivery and recommended the establishment of an electronic medical record (EMR) that "clearly delineates the patient's clinical problems and the current status of each" (Dick et al., 1997, p. 180). To this day, federal initiatives provide incentives for the adoption of this technology (Blumenthal, 2011), and larger, urban hospitals have widely adopted these tools (Jha et al., 2009), incorporating many common data elements, such as demographics, progress notes, and problem lists. Outside of large urban hospitals, physicians have been slow to adopt EMRs (DesRoches et al., 2008; Ford, Menachemi, Peterson, & Huerta, 2009), even though adopters report improved service quality (Linder, Ma, Bates, Middleton, & Stafford, 2007), efficiency (Chaudhry et al., 2006), and overall satisfaction (DesRoches et al., 2008).

Like other large, contemporary health care systems, the Department of Veterans Affairs (VA) has also adopted an electronic health record system. Referred to as the Veterans Health Information Systems and Technology Architecture (VistA), it is an integrated system of both nationally mandated and locally adapted software applications. VistA use dramatically increased since its

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debut in 1983, and it now includes over 100 applications (S. H. Brown, Lincoln, Groen, & Kolodner, 2003) and has improved the quality of service delivery across the nation (Byrne et al., 2010).

The National Patient Care Database (NPCD) is the VA's centralized database for VistA system data from across the country. It contains patient demographics, electronic health records, data related to the provision of services for administrative and billing purposes, and other information. This database is commonly used by researchers interested in extracting data in mass quantities for the purpose of determining prevalence and correlates of conditions of interest. The Computerized Patient Record System (CPRS) is a user-friendly interface that presents VistA/NPCD data similarly to a paper medical record and is used in clinical settings. Various such applications allow access to data regarding clinical warnings, test results, reports, progress notes, and diagnoses entered by clinicians associated with a particular patient. This large centralized database is composed of various applications and subsystems that contain diagnostic information.

Encounter records document services rendered to patients, including who provided the service, the date and the condition treated, using *International Classification of Diseases, Ninth Revision* (ICD-9) and *Current Procedural Terminology* codes, which are mandatory for all encounters. The file also includes a *Problem List* for each patient (i.e., a list of ICD-9 diagnoses assigned by health care providers for patients receiving treatment within the VA). It is notable that many of these fields require special attention by the clinician and a deliberate effort to change the record. In practice, it is unclear to what extent the Problem List is monitored or updated after a diagnosis has been entered on this list.

Data from the NPCD are essential for determining the prevalence and correlates of posttraumatic stress disorder (PTSD) and other mental disorders among Iraq and Afghanistan war veterans using VA health care services. For instance, using the ICD-9 diagnostic codes in the NPCD, Kang and Hyams (2005) found that 10% of 48,733 veterans who received health care at VA facilities between 2003 and 2004 possessed a PTSD diagnosis. Similarly, Seal, Bertenthal, Miner, Sen, and Marmar (2007) observed that 13% of 103,788 Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) veterans first seen at VA facilities between 2001 and 2005 received a diagnosis of PTSD.

An important underlying assumption of these and other studies is that the ICD-9 data in the NPCD accurately represent patients' PTSD diagnostic status. Yet, in all of the aforementioned studies, diagnostic information from various parts of the NPCD was never confirmed using standardized diagnostic interviews with interrater reliability estimates. Studies of the accuracy of other EMR diagnoses, such as diabetes (Harris et al., 2010), depression (Trinh et al., 2011), cardiovascular disease or pulmonary diseases (Liaw et al., 2012), and hypertension (Szeto, Coleman, Gholami, Hoffman, & Goldstein, 2002) suggest that an assumption of complete diagnostic accuracy is incorrect. Potential explanations for diagnostic misclassification in the EMR both within and outside of the VA include insufficient documentation practices (Schiff & Bates, 2010); billing or reimbursement incentives (Farmer, Black, & Bonow, 2013); patient self-report biases that either minimize or exaggerate symptom reports (Castro & Keane, 2011); clinicians' use of unreliable, invalid, and/or incomplete assessment methods (Jackson et al., 2011; Rosen et al., 2004; Shear et al., 2000); or any combination thereof.

In three studies, researchers investigated the extent to which the PTSD diagnostic information in the VA databases reflects actual PTSD diagnostic status, and they arrived at widely divergent results. Magruder et al. (2005) found fewer than half of the PTSD cases identified using the Clinician-Administered PTSD Scale (CAPS; Blake et al., 1990) had any indication of PTSD in VistA. Conversely, only a small proportion of veterans (3.4%) with a PTSD diagnosis in CPRS failed to meet CAPS diagnostic criteria. Frayne and colleagues (2010) found that two occurrences of a PTSD diagnosis or one diagnosis by a mental health professional in either outpatient or inpatient encounter data provided the best positive predictive value for self-reported PTSD. Finally, Gravely and colleagues (2011) found that PTSD Checklist (PCL; Weathers, Litz, Herman, Huska, & Keane, 1993) scores of 50 or higher were associated with PTSD according to encounter data.

Results of these prior studies confirm that similar to other EMR diagnoses, PTSD is susceptible to diagnostic classification errors and that these errors do not reflect equivalent rates of false positives and false negatives. However, each of the prior studies has notable methodological limitations, such as varying operational definitions of PTSD and sampling procedures as well as infrequent use of diagnostic interviews as a standard of comparison. None of the studies has evaluated both Problem List and Encounter PTSD diagnoses concurrently in the same sample. Consequently, we examined the extent to which a PTSD diagnosis in the VA NPCD (Problem List or Encounter) can be confirmed by structured interview assessment; moreover, we sought to identify covariates or predictors of both types of misclassification errors (i.e., false positive, false negatives). Overall, we attempted to provide a better understanding of the factors contributing to misclassification or concordance of PTSD diagnosis, while addressing many of the methodological shortcomings of prior studies. We chose to investigate the question in a large, clinical cohort: the Veterans After-Discharge Longitudinal Registry (Project VALOR). The design and methods of this national registry cohort, which were recruited from random lists of veterans who served in Iraq and Afghanistan between 2001 and 2009, includes standardized assessment of diagnostic status and psychosocial function, in addition to extensive medical record data on all participants (R. C. Rosen et al., 2012). This data set provides a unique opportunity to calculate the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for different indicators of PTSD in both the Problem List and Encounter data compared with results of a diagnostic interview for PTSD serving as the standard for comparison. Project VALOR's methodology further improves on prior research by allowing us to calculate the validity of VA Problem List and Encounter data with both lifetime and current PTSD diagnostic status determined by diagnostic interview. This is important because PTSD status may change as a function of treatment or fluctuations in symptomatology over time. We also examined the extent to which background or clinical characteristics of the participants predicted concordance between indicators of PTSD status in the VA Problem List and Encounter data and diagnostic interview data.

Method

Participants and Procedure

Project VALOR participants are all veterans who either separated from active duty after serving in OEF/OIF/Operation New Dawn (OND) or completed at least one Reserve/Guard deployment in support of OEF/OIF/OND. In addition, they must have undergone a mental health evaluation at a VA facility, as indicated by a diagnostic interview or psychotherapy procedure code, between July 2008 and December 2009, and must not have been participating in a clinical trial at the time of enrollment. From this source population, we aimed to enroll at least 1,200 men and women with a recent diagnosis of PTSD in the NPCD and 400 men and women without such a diagnosis. For the purpose of study enrollment, consistent with Gravely et al. (2011), we defined the presence of PTSD as at least two instances of a diagnosis of PTSD (primary or secondary ICD-9 code[1]309.81) by a mental health professional associated with two separate visits in the encounter data from the NPCD within the prior year. Individuals who met this criterion were randomly selected from the NPCD at a rate of 3:1 relative to a comparison group of veterans, similarly randomly selected, who had also used VA mental health services (on at least one occasion) but had no occurrence of a PTSD diagnosis in the Encounter data from 2002 to the time of selection (2009–2011). Female veterans were intentionally oversampled at a rate of 1 female: 1 male to enable gender comparisons.

Project VALOR team members at the VA Environmental Epidemiology Service randomly selected a roster of potential participants according to the sampling criteria described previously. VA Boston study staff telephoned veterans and provided additional study details until targeted enrollment was met. Of those contacted by phone (N = 4,391), 2,712 (61.8%) consented to participate. Consented participants were scheduled for a telephone interview with a doctoral-level clinician and asked to complete a packet of self-administered questionnaires prior to the interview (either online or by mail). Of consented participants, 2,169 (80.0%) completed the questionnaires and 1,649 (60.8%) completed both the questionnaires and the diagnostic interview. These 1,649 male and female veterans constitute the Project VALOR Registry.

Those who agreed to participate provided informed consent verbally over the telephone in accordance with the research protocol approved by all local Institutional Review Boards and the Human Research Protection Office of the U.S. Army Medical Research and Materiel Command. After study staff received verbal consent from the veteran, they scheduled a date and time for the telephone interview and reminded the participant to complete the self-administered questionnaire prior to the interview. Participants were compensated $50 for their participation in the registry.

Measures

Trained doctoral-level diagnosticians assessed both current (past month) and lifetime (either past or current) PTSD over the telephone using the PTSD Module of the Structured Clinical Interview for *DSM–IV* (SCID; First & Gibbon, 2004). Interviewers were blind to diagnostic status in the Problem List and Encounter Database. We held regular meetings of assessment personnel to discuss cases in order to ensure diagnostic reliability and to prevent rater drift. We examined the number of PTSD symptoms as well as overall *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (*DSM–IV*) PTSD diagnosis. Interrater reliability for the SCID computed on the basis of a randomly selected subsample was 96% for both lifetime (κ = .87) and current diagnosis (κ = .91). In addition, trained research assistants accessed participants' files and collected PTSD diagnostic status information from the Patient Problem List. Data were abstracted from the EMR concurrently with the collection of self-report questionnaire and interview data. We then used these data, as well as the study inclusion criteria (i.e., at least two instances of a diagnosis of PTSD by a mental health professional associated with a scheduled clinical Encounter), to examine the extent to which the PTSD diagnostic information in the Problem List and Encounter Database reflected actual PTSD diagnostic status in veterans.

Presence of probable traumatic brain injury (TBI) was assessed using highly structured interview questions created to reflect current TBI classification standards (American Congress of Rehabilitation Medicine, 1993) and indicators of brain injury severity informed by the current literature (e.g., duration of loss of consciousness and posttraumatic amnesia; A. W. Brown et al., 2005; Wilde, Bigler, Pedroza, & Ryser, 2006). Participants were asked whether they ever experienced a head injury or blast exposure that led to altered consciousness, memory loss, seizures, or brain surgery. Participants who endorsed exposure and at least one of these conditions were asked additional questions about each head injury they experienced.

Participants also completed a battery of online questionnaires. *Stressful life events* were counted using the Life Events Checklist (Blake et al., 1995). Respondents indicated which of 17 stressful events had "happened to" them, were "witnessed" or "learned about." *Combat exposure* was assessed using two scales from the Deployment Risk and Resilience Inventory (DRRI; King, King, Vogt, Knight, & Samper, 2006): The *Combat Experiences* scale, which assesses typical warfare experiences, such as being shot at, firing a weapon, and witnessing injury and death, is measured on a 5-point scale ranging from 1 (*never*) to 5 (*daily or almost daily*). The *Aftermath of Battle* scale assesses exposure to additional stressors that may occur following combat, including handling human remains and witnessing human suffering, with items rated "yes" or "no." We also assessed postdeployment *scial support* using the DRRI *Post-deployment Social Support* scale, which examines the extent to which family, friends, and other members of the community provide emotional support and instrumental assistance. Items are rated on a 5-point scale ranging from 1 (*Strongly disagree*) to 5 (*Strongly agree*). *Anxiety and depression* were assessed using the Patient Health Questionnaire (PHQ; Spitzer, Kroenke, & Williams, 1999), a self-report version of the Primary Care Evaluation of Mental Disorders that assesses the presence and frequency of various symptoms, which can be coded either continuously or categorically. Categorization of major depressive syndrome, panic syndrome, or other anxiety syndrome was made using published PHQ cutoffs. *Sleep difficulty* was assessed using the Sleep Problems Scale (Jenkins, Stanton, Niem-

[1] Although *DSM* criteria are used for the purposes of determining a diagnosis, within VA databases, corresponding ICD diagnoses are used for coding purposes.

cryk, & Rose, 1988), a five-item questionnaire that asks respondents to rate the numbers of days they have experienced a variety of sleep problems in the past month. These responses are grouped into six categories ranging from 1 (*Not at all*) to 6 (*22–31 days*). *Anger* was measured using the Dimensions of Anger Reactions (Hawthorne, Mouthaan, Forbes, & Novaco, 2006), a five-item instrument that assesses anger on a 5-point scale ranging from 0 (*Not at all*) to 4 (*Very much*). *Substance abuse* was measured using the Alcohol Use Disorders Identification Test (Saunders, Aasland, Babor, de la Fuente, & Grant, 1993), a 10-item screening questionnaire, and the Two Item Conjoint Screen (R. L. Brown, Leonard, Saunders, & Papasouliotis, 2001). *Suicide risk* was assessed using the suicide module of the Mini International Neuropsychiatric Interview (Sheehan et al., 1998), yielding a total risk score. *Functional impairment* was assessed using the Inventory of Psychosocial Functioning (IPF; Marx et al., 2009), an 80-item self-report measure designed to assess multiple dimensions of functional impairment in the past 30 days. Items are rated on a 7-point scale ranging from 1 (*never*) to 7 (*always*). The IPF yields an overall mean score and scores for seven scales: Romantic Relationships, Family, Work, Friendships and Socializing, Parenting, Education, and Day-to-Day functioning. Participants also were asked to report whether they sought help for emotional problems either during or postdeployment, within or outside the VA.

Statistical Analyses

We categorized participants on the basis of concordance status by comparing PTSD on the SCID with two criteria in VA databases: (a) PTSD in the patient Problem List and (b) two PTSD encounter diagnoses in the NPCD. This resulted in four groups per criterion: (a) those with PTSD in the database and on the SCID (concordant for PTSD); (b) those with PTSD in the database but not according to the SCID; (c) PTSD on SCID only and; (d) no PTSD in either the database or the SCID (concordant for absence of PTSD). We used chi-square, Kruskal–Wallis, and Mann–Whitney tests to calculate p values for differences in the covariates of interest across the four groups, as well as pairwise differences comparing EMR cases with versus without a SCID-based diagnosis and EMR noncases with versus without a SCID-based diagnosis. In subsequent analyses, we combined individuals concordant for PTSD and those concordant for no PTSD into a single concordant group and examined the prevalence of concordant diagnoses and predictors of discordance relative to this group.

To identify potential predictors of concordance status, we examined univariate associations between each covariate of interest and concordance status in logistic regression models. Covariates with a p value $< .1$ were retained for inclusion in a backward stepwise regression model-building procedure. We used multinomial logistic regression models, with concordant diagnoses as the referent group, to examine multivariable-adjusted associations between covariates of interest and PTSD concordance status. Starting with a full model that included all predictors identified in the univariate analyses described previously, we removed the variable with the largest nonsignificant p value and reran the analysis with the new reduced model. We continued this process until all covariates included in the model were associated with concordance status with a p value $< .1$.

The final multivariable multinomial logistic regression model was adjusted for combat exposure, level of postdeployment social support, IPF total score, number of Cluster C and Cluster D symptoms for lifetime PTSD on SCID, presence of panic or anxiety disorder, and reported treatment seeking for emotional problems. Age and gender were also included in the models. Because a small minority of participants ($n = 176$) had missing data on one or more variables, we included only those individuals with complete data ($n = 1{,}473$) in the final multivariate analysis.

As a sensitivity analysis, we imputed the missing data in 25 data sets with standard techniques using the Markov Chain Monte Carlo methods for multiple imputation (MI) and then averaged the parameter estimates obtained from each model using the MI data sets (Yuan, 2011). Other covariates considered but not adjusted for in our final model included marital status, education, household income, military branch, area of deployment, history of military sexual trauma (MST), history of TBI, self-reported health, history of major depression, alcohol use, anger reactions, and sleep problems.

Post hoc analyses were conducted to identify variables differentially associated with the two types of discordant diagnoses in our final multinomial logistic regression model, and additional analyses examined variation by gender. We also used chi-square tests to compare symptomatology (Question B1 on the current SCID, etc.) by concordance group. Area under the receiver operator curve (AUC) was used to compare definitions of PTSD diagnosis. AUC ranges from 0.5 to 1, where 1 indicates a perfect test and 0.5 represents a test that only performs as well as chance. All analyses were conducted using SAS 9.2.

Results

Using at least two instances of a PTSD diagnosis by a mental health professional associated with two separate encounters in the NPCD administrative data within the prior year as an indicator of the presence of PTSD, 1,213 participants were classified as PTSD cases at study entry, and 436 were classified as noncases. Using the Problem List as an indicator, 1,175 participants were classified as PTSD cases, and 474 were classified as noncases. SCID interviews revealed 1,039 current (past month) PTSD cases and 610 noncases (lifetime 1,251 cases and 371 noncases). On average, study participants were 37.5 years of age (range = 22–69 years), and our sample included 825 women (50.0%). Characteristics of study participants in Project VALOR are shown in Table 1.

The overall concordance rate between PTSD status in the NPCD encounter data (two encounters) and current PTSD status on the SCID was 72.3%, with 19.1% of participants positive for PTSD in the NPCD encounter data only and 8.6% positive for current PTSD on the SCID only (see Table 2). The concordance between PTSD in NPCD encounter data and lifetime PTSD status on the SCID was also slightly higher; 79.4% of participants were concordant for PTSD diagnostic status, 8.5% were positive for PTSD in the NPCD only, and 12.1% were positive for lifetime PTSD on the SCID only.

Results using the Problem List data were similar, although concordance was slightly higher on the basis of this measure. Specifically, concordance between PTSD status in the Problem List and current PTSD status on the SCID was 73.2%, with 17.5% of participants positive for PTSD in the Problem List only and

Table 1
Characteristics of 1,649 Participants in Project VALOR

Covariate	Overall (N = 1,649)	M (SD) or %
Age	1,649	37.5 (9.9)
Female (%)	1,649	50.0
Race/ethnicity	1,649	
Black (%)		15.1
Hispanic (%)		12.8
White (%)		66.5
Other/unknown (%)		5.6
Military branch	1,649	
Army (%)		90.4
Marines (%)		9.6
Married or living with partner (%)	1,649	58.3
Fair or poor self-reported health (%)	1,649	37.5
History of military sexual trauma (%)	1,601	12.1
History of mild traumatic brain injury (%)	1,627	37.8
Major depressive syndrome (%)	1,649	41.8
Panic syndrome (%)	1,649	39.2
Other anxiety syndrome (%)	1,649	33.5
Treatment seeking for emotional problems (%)	1,648	87.4
Moderate/high suicide risk (%)[a]	1,647	11.5
AUDIT alcohol use total score	1,641	6.2 (6.6)
Dimensions of Anger Reactions-5 score	1,647	9.8 (5.5)
Jenkins sleep questionnaire mean score	1,616	3.3 (1.4)
DRRI combat exposure total score	1,644	32.6 (12.7)
DRRI postwar social support total score	1,634	49.3 (11.4)
IPF grand mean score	1,639	3.5 (0.9)
SCID lifetime PTSD total symptom score	1,616	11.8 (4.7)

Note. AUDIT = Alcohol Use Disorders Identification Test; DRRI = Deployment Risk and Resilience Inventory; IPF = Inventory of Psychosocial Functioning; SCID = Structured Clinical Interview for *DSM–IV*; PTSD = posttraumatic stress disorder.
[a] Mini-International Neuropsychiatric Interview suicide risk score ≥ 9.

9.3% positive for current PTSD on the SCID only (see Table 2). The concordance between PTSD in Problem List and lifetime PTSD status on the SCID was slightly higher; 78.5% of participants were concordant for PTSD diagnostic status, 7.7% were positive for PTSD in the Problem List only, and 13.7% were positive for lifetime PTSD on the SCID only.

Sensitivity, specificity, positive predictive value, and negative predictive values for both current and lifetime PTSD diagnosis are presented in Table 3. Using current PTSD diagnosis according to the SCID as the standard for comparison, PTSD in the Problem List had a slightly higher AUC of 0.69 for diagnosis of PTSD compared with an AUC of 0.67 for PTSD using two encounter diagnoses in the NPCD. Consequently, Problem List diagnosis was used to establish concordance or discordance in subsequent analyses.

There were 886 participants with PTSD both in the Problem List and on the SCID-based diagnostic interview for current PTSD (true positives), 289 had PTSD according to the Problem List only (false positives), 153 had PTSD on the SCID only (false negatives), and 321 were found not to have PTSD based on both the Problem List and the SCID (true negatives).

Characteristics of the participants by PTSD concordance status are displayed in Table 4. The prevalence of fair/poor self-reported health, major depressive/anxiety syndromes, history of MST and TBI, and treatment seeking for emotional problems all differed significantly between the four concordance groups, as did mean age and the mean scores for all assessments. True positives were older on average (M = 38.0 years) than false positives (M = 36.9 years), and false negatives were older on average (M = 38.6 years) compared with true negatives (M = 36.0 years). There were fewer females (47.5%) in the true positive group compared with 54.7% in the PTSD in the false-positive group. Compared with false positives, true positives were more likely to have assessment scores indicating problems with alcohol use, anger reactions, sleep problems, and psychosocial functioning, in addition to the lowest levels of postwar social support.

In our final multinomial logistic regression model (see Table 5), several covariates were significantly associated with discordance between PTSD diagnoses from the Problem List and SCID interview for current PTSD. Compared with true positives and true negatives, false negatives had significantly lower

Table 2
Concordance Between PTSD Status From Electronic Medical Record (EMR) Problem List and SCID-Based Diagnostic Interview in 1,649 Project VALOR Study Participants

PTSD assessment	PTSD in NPCD Encounter data[a]	PTSD in EMR Problem List[b]	Current PTSD on SCID	Lifetime PTSD on SCID
PTSD in NPCD Encounters[a]	100%			
	88.4%	100%		
	Problem List only: 4.7%			
PTSD in EMR Problem List[b]	Encounter only: 7.0%			
	72.3%	73.2%	100%	
	SCID only: 8.6%	SCID only: 9.3%		
Current PTSD on SCID	EMR only: 19.1%	EMR only: 17.5%		
	79.4%	78.5%	85.6%	100%
			Lifetime but not current	
	SCID only: 12.1%	SCID only: 13.7%	PTSD: 14.4%	
Lifetime PTSD on SCID[c]	EMR only: 8.5%	EMR only: 7.7%		

Note. PTSD = posttraumatic stress disorder; SCID = Structured Clinical Interview for *DSM–IV*; NPCD = National Patient Care Database.
[a] At least two instances of a diagnosis of PTSD (International Classification of Disease–9–CM code 309.81) associated with a clinical Encounter with a mental health professional within the past year. [b] On the basis of 1,649 participants with data on PTSD problem list information. [c] Twenty-seven patients from an initial pilot study are missing Lifetime PTSD on SCID.

Table 3
Sensitivity, Specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV) for Current and Lifetime PTSD Diagnosis[a]

Variable	Sensitivity	Specificity	PPV	NPV
EMR Problem List vs. SCID (current)	85.3%	52.6%	75.4%	67.7%
Encounter diagnosis vs. SCID (current)	86.4%	48.4%	74.0%	67.7%
Problem List vs. SCID (lifetime)	82.2%	66.3%	89.2%	52.5%
Encounter diagnosis vs. SCID (lifetime)	84.3%	62.8%	88.4%	54.3%

Note. PTSD = posttraumatic stress disorder; EMR = electronic medical record; SCID = Structured Clinical Interview for *DSM–IV*.
[a] Base rates for current PTSD = 0.63; lifetime PTSD = 0.77.

levels of combat exposure (OR = 0.64; 95% CI [0.53, 0.78] per 10-unit increase in DRRI combat exposure total score) and were less likely to report symptoms consistent with panic disorder as assessed by the PHQ (OR = 0.63; 95% CI [0.42, 0.93]). False negatives had significantly lower IPF scores (OR = 0.79; 95% CI [0.64, 0.97] per one-unit increase in grand mean score), fewer Cluster C symptoms (OR = 0.69; 95% CI [0.62, 0.77]), and a higher number of Cluster D symptoms (OR = 1.34; 95% CI [1.14, 1.58]) for lifetime PTSD, compared with true positives and negatives. False positives were also less likely to report an anxiety disorder other than panic disorder (OR = 0.64; 95% CI [0.44, 0.92]), and were more likely to report treatment seeking for emotional problems (OR = 2.65; 95% CI [1.54, 4.55]), compared with true positives and negatives. The associations observed with several covariates differed significantly for the two types of discordant diagnoses compared with

Table 4
Characteristics of 1,649 Participants in Project VALOR by Concordance Between PTSD Status in Electronic Medical Record (EMR) Problem List and SCID-Based Diagnostic Interview for Current PTSD

Covariate	Concordant for PTSD (n = 886)	PTSD in EMR only (n = 289)	p[a]	PTSD on SCID only (n = 153)	Concordant for no PTSD (n = 321)	p[b]
Age (*M* and [*SD*])	38.0 (9.6)	36.9 (10.3)	.015	38.6 (10.1)	36.0 (9.9)	.002
Female (%)	47.5	54.7	.03	52.3	51.7	.91
Race/ethnicity			.10			.046
Black (%)	10.8	9.7		17.0	10.9	
Hispanic (%)	9.4	10.4		11.1	8.7	
White (%)	53.8	60.6		48.4	61.7	
Other/unknown (%)	26.0	19.4		23.5	18.7	
Military branch			.50			.73
Army (%)	90.7	92.0		89.5	88.5	
Marines (%)	9.3	8.0		10.5	11.5	
Married or living with partner (%)	58.1	60.2	.53	59.5	56.4	.52
Fair or poor self-reported health (%)	48.2	30.1	<.001	34.0	16.5	<.001
History of military sexual trauma (%)	15.5	11.5	.10	13.3	2.9	<.001
History of mild traumatic brain injury (%)	47.8	29.9	<.001	30.3	20.8	.02
Major depressive syndrome (%)	56.8	26.6	<.001	45.1	12.5	<.001
Panic syndrome (%)	52.9	29.4	<.001	34.0	12.8	<.001
Other anxiety syndrome (%)	46.2	20.4	<.001	32.7	10.6	<.001
Treatment seeking for emotional problems (%)	94.8	91.4	.03	90.2	62.0	<.001
Moderate/high suicide risk (%)[c]	15.6	9.4	.009	8.5	3.4	.02
AUDIT alcohol use total scored (*M* and [*SD*])	7.0 (7.1)	5.2 (5.8)	<.001	6.4 (6.4)	5.0 (5.2)	.046
Dimensions of Anger Reactions-5 score (*M* and [*SD*])	11.6 (5.2)	8.3 (5.0)	<.001	10.0 (4.9)	6.2 (4.9)	<.001
Jenkins sleep questionnaire mean score (*M* and [*SD*])	3.8 (1.2)	3.0 (1.4)	<.001	3.4 (1.3)	2.3 (1.5)	<.001
DRRI combat exposure total scored (*M* and [*SD*])	36.2 (13.2)	31.2 (11.8)	<.001	29.1 (9.1)	25.2 (8.8)	<.001
DRRI postwar social support total scored (*M* and [*SD*])	46.5 (10.7)	52.6 (10.4)	<.001	48.0 (10.1)	54.6 (12.1)	<.001
IPF grand mean scored (*M* and [*SD*])	3.8 (0.9)	3.2 (0.9)	<.001	3.6 (0.8)	2.9 (0.8)	<.001
SCID lifetime PTSD total symptom score (*M* and [*SD*])	14.3 (1.6)	11.7 (3.0)	<.001	13.2 (1.8)	8.1 (4.2)	<.001

Note. PTSD = posttraumatic stress disorder; SCID = Structured Clinical Interview for *DSM–IV*; AUDIT = Alcohol Use Disorder Identification Test; DRRI = Deployment Risk and Resiliency Inventory; IPF = Inventory of Psychosocial Functioning.
[a] p values comparing individuals concordant for PTSD and those with PTSD in EMR only, calculated using Mann–Whitney tests (continuous variables) or chi-square tests (categorical variables). [b] p values comparing individuals concordant for no PTSD and those with PTSD on SCID only, calculated using methods noted above. [c] Mini-International Neuropsychiatric Interview suicide risk score ≥ 9.

Table 5
Odds Ratios and [95% Confidence Intervals] for Statistically Significant Predictors of Discordance in PTSD Status From Electronic Medical Record (EMR) Problem List and SCID Interview for Current PTSD in 1,649 Project VALOR Study Participants With Complete Data for All Covariates

Covariate[a]	Concordant for PTSD status[b]	PTSD in EMR only	PTSD on SCID only	*p* value for heterogeneity[c]
Combat exposure[d]	1.00 (ref)	0.99 [0.86, 1.14]	**0.64 [0.53, 0.78]**	<.001
DRRI support[d]	1.00 (ref)	1.02 [1.00, 1.03]	1.00 [0.98, 1.02]	.089
Inventory of Psychosocial Functioning[e]	1.00 (ref)	**0.79 [0.64, 0.97]**	1.05 [0.82, 1.34]	.058
Number of Cluster C symptoms for lifetime PTSD[f]	1.00 (ref)	**0.69 [0.62, 0.77]**	1.03 [0.89, 1.19]	<.001
Number of Cluster D symptoms for lifetime PTSD[f]	1.00 (ref)	**1.34 [1.14, 1.58]**	1.24 [0.99, 1.56]	.572
Panic syndrome	1.00 (ref)	0.83 [0.59, 1.15]	**0.63 [0.42, 0.93]**	.257
Presence of other anxiety syndrome[g]	1.00 (ref)	**0.64 [0.44, 0.92]**	0.89 [0.59, 1.34]	.192
Treatment seeking for emotional problems	1.00 (ref)	**2.65 [1.54, 4.55]**	1.18 [0.63, 2.21]	.041

Note. PTSD = posttraumatic stress disorder; SCID = Structured Clinical Interview for *DSM–IV*; DRRI = Deployment Risk and Resilience Inventory. Boldface values indicate statistically significant results.
[a] Model adjusted for all covariates listed plus categorical age (<30, 30–39, 40–49, or ≥50 years) and gender. [b] Concordant for PTSD or no PTSD based on EMR Problem List and current SCID. [c] *p* value from chi-square test for difference in associations for each covariate with each type of discordant diagnosis. [d] DRRI combat exposure total score; odds ratio per 10-unit increase in score. [e] Odds ratio per one-unit increase in grand mean score. [f] Cluster C: persistent avoidance of stimuli associated with the trauma and numbing of general responsiveness not present before the trauma; Cluster D: persistent symptoms of increased arousal not present before the trauma. [g] Anxiety syndrome other than panic syndrome.

those concordant for PTSD. *P* values from chi-square tests for differences in the associations of each covariate with each type of discordance were statistically significant for combat exposure, number of Cluster C symptoms for lifetime PTSD, and treatment seeking for emotional problems, indicating that the direction of the associations between these covariates and each type of discordant diagnosis differs (e.g., covariates are more strongly associated with one type of discordant diagnosis). Results were unaltered when we performed a sensitivity analysis using MI of missing data. In general, the concordance results stratified by gender were similar to those for men and women combined, and there were no statistically significant interactions with gender (results not presented).

The specific criterion PTSD Cluster B, C, and D symptoms varied across the four concordance groups, with chi-square tests indicating significant differences associated with each symptom ($p < .001$ for each). Across PTSD symptom clusters, the highest number of symptoms in each case was in the true positive group. The next highest symptom rate reported was in the false-positive group, followed by the false-negative group, with the lowest frequency of symptoms in the true negative group (see Figure 1).

Discussion

Our analyses revealed that more than one quarter of current PTSD diagnoses and more than one fifth of lifetime PTSD diagnoses in the Problem List were discrepant from those obtained by structured diagnostic interview. These results raise concerns about the validity of a significant number of PTSD diagnoses contained in VA EMRs. Importantly, we noted varying proportions of misclassification, including both false-positive and false-negative diagnostic errors, which may have important implications for policy, research, and clinical care. For current PTSD, we observed approximately twice as many false positives as false negatives. The inverse was true for lifetime diagnoses. A higher proportion of current false positives and lower proportion of lifetime false negatives may be the result of participants who met criteria for PTSD in the past having recovered by the time of the interview. Higher lifetime false negatives may reflect diagnoses for which assessment or treatment was never sought and thus was only observed by retrospective inquiry. Receiver operating characteristic AUC analyses suggested that relative to PTSD diagnoses from the NPCD, PTSD diagnoses gleaned from patients' problem lists may be marginally more accurate. This may be the result of increased attention by clinicians, rather than the simple recording of a provisional or routine diagnosis required for billing purposes. Our findings differed from those obtained by Magruder and colleagues (2005), with our results showing higher sensitivity, but substantially lower specificity. The PPV for our results based on EMR Problem List lifetime diagnoses (89%) was slightly higher than that observed by Frayne and colleagues (2010; 82%); however, we observed a lower NPV for Problem List based diagnoses (53% vs. 88%). For current PTSD, we observed a PPV somewhat lower than Gravely and colleagues (2011; 75% vs. 82%), though they did not report NPV. Possible explanations for these differences may include differences in samples (age, era, geographical distribution, etc.) as well as differences in diagnostic criteria or assessment methodology.

Differences in the prevalence of current and lifetime PTSD in our population versus others will also influence observed differences in the PPV and NPV. In our study, 63% had current PTSD, and 77% had lifetime PTSD based on SCID diagnoses, which is substantially higher than the overall 11.5% reported by Magruder and colleagues (2005). Although the other studies cited did not report PTSD prevalence, we would expect them to be in the same range based on population estimates. Analysis of covariates or predictors of misclassification demonstrated that higher levels of combat exposure and panic symptoms were associated with decreased risk of false negatives, which may reflect the influence of these factors on clinical reporting. Reported treatment seeking for emotional difficulties was associated with an increased risk of false positives for current PTSD. One explanation for this is the possibility that some individuals could be communicating more

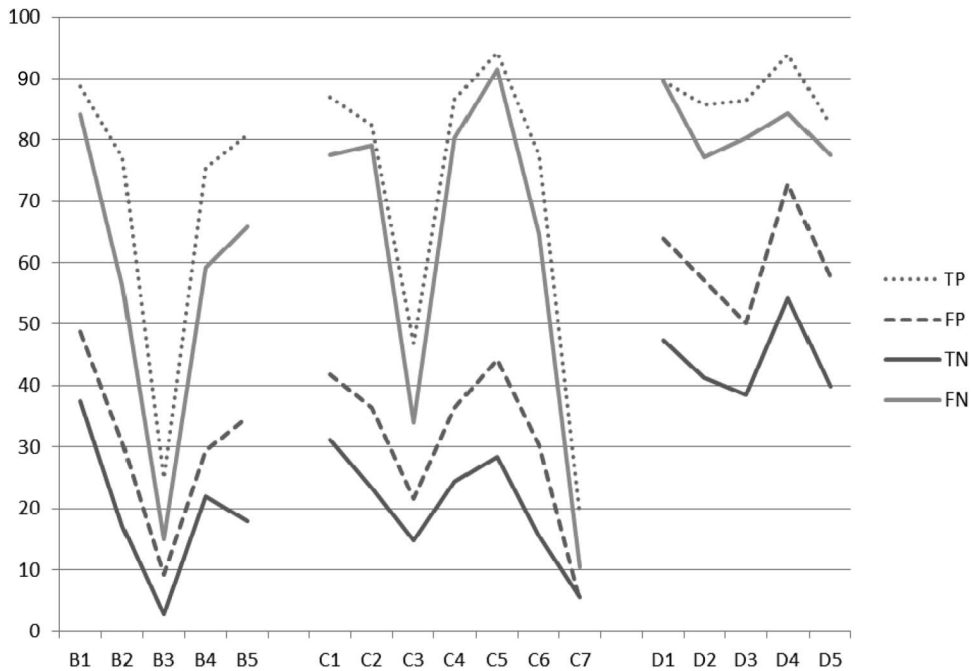

Figure 1. Percentage with posttraumatic stress disorder (PTSD) symptoms by concordance status. TP = true positive; FP = false positive; TN = true negative; FN = false negative. B, C, and D = PTSD Cluster B, C, and D symptoms.

distress, although not necessarily a greater number of symptoms. This may be due to elevated symptom reports in a clinical setting versus a research interview, or may reflect undocumented improvements due to treatment, a potential weakness of problem list diagnoses. Finally, symptom profiles also affected the risk of false positives, with more avoidance symptoms decreasing the risk and more hyperarousal symptoms increasing the risk. This may be due to a perception that some symptoms are more emblematic of PTSD. Although less than 30% of the sample endorsed dissociative experiences and that less than 50% endorsed psychogenic amnesia, this finding is consistent with other reports of symptom prevalence. For instance, Holowka, Marx, Kaloupek, and Keane (2012) found these to be among the least frequently endorsed symptoms among Vietnam combat veterans with PTSD.

Another notable finding was that veterans presenting with either the most or the fewest symptoms had the highest proportion of concordant diagnoses in the SCID and Problem List. This is not surprising again, given that differential diagnosis is likely to be less challenging under such conditions, resulting in a higher probability of agreement.

In accounting for misclassification errors, various explanations are possible. Medical decision-making research supports several alternative hypotheses in this regard (Norman & Eva, 2010). For instance, a diagnosis that was appropriate in the past may no longer apply, due to successful treatment or remission over time. However, this explanation is unlikely to account for more than a small proportion of discordant diagnoses in our population. On the basis of the SCID assessment, 14.4% of participants qualified for a lifetime diagnosis of PTSD but did not meet current PTSD criteria. Insufficient knowledge, patient or institutional pressures, atypical symptom presentation, and cognitive biases or other information-processing errors might have influenced misclassification errors (Norman & Eva, 2010). Of course, it is also possible that in some instances, discordance may be related to discrepancies or errors in the SCID interview rather than in the electronic record. It is conceivable that some clinicians conducted even more in-depth assessments than the SCID and had access to other sources of information (e.g., collateral reports), which could arrive at divergent, but more valid, results.

A further explanation includes the possibility that such discordance indicates more difficult diagnostic distinctions that may be less rigorously assessed in routine clinical assessments than in research protocols. The use of chart diagnosis to define PTSD status (or other psychopathology) can be contrasted with more rigorous approaches in psychological and psychiatric research. Most of the research literature on the diagnosis of PTSD relies on standardized, validated instruments, such as screens, questionnaires, or structured interviews. In clinical settings, however, routine diagnosis of mental health problems does not frequently make use of such standardized measures, even during formal assessments (Jackson et al., 2011). Rather, clinicians typically use more informal assessment methods for formulating a diagnosis, which may persist after being entered into the medical record.

It is the case that in some instances, the presence or absence of one symptom can affect a patient's overall diagnosis. In general, the group with SCID-only PTSD diagnoses (false negatives) had symptom profiles that most closely resembled the group that was concordant for both SCID and medical record diagnosis, consistent with the idea of diagnostic complexity accounting for discordance. Surprisingly, less functional impairment was associated with higher risk for false positives, although this may also indicate improvement from a previous condition. A final possibility is that

participants are more likely to exaggerate symptoms in a clinical setting, compared with a confidential phone interview.

These results also have important implications for further research. To the extent that some studies of the prevalence, etiology, and course of PTSD among VA treatment-seeking samples rely on NPCD or EMR diagnoses, this may be cause for concern. Similarly, examinations of genetic, biological, social, and psychological factors associated with PTSD may be compromised or may yield weakened or obscured relationships. For instance, the Million Veteran Program (U.S. Department of Veterans Affairs, 2013) is a national effort by the VA that examines genetic factors associated with various health conditions, including PTSD. The fact that a significant proportion of diagnoses may be due to misclassification errors, with more than twice as many false positives as false negatives in the Problem List or Encounter data, could significantly hamper efforts of researchers to detect putative associations. Given the centrality of proper identification of cases (i.e., phenotypes), important research into risk and resiliency factors and healthcare utilization may be similarly affected by inaccurate measurement. Given our results here, similar questions remain about the validity of other behavioral health and mental health diagnoses.

Finally, diagnostic inaccuracies in the EMR may have implications for clinical care. Within any health care system, accurate diagnosis is crucial for reimbursement and billing and providing the best clinical care to those who need it. However, diagnostic errors in medicine contribute to inefficient or inappropriate treatment, poor use of limited resources, and can also result in patient harm (Newman-Toker & Pronovost, 2009). Given the rising economic and personal costs associated with mental illness, more work in this area is urgently needed.

Although these results are from a sample of veterans using VA services, VA hospitals are not unlike other larger healthcare organizations across the country. In fact, the VA health care system is the largest health services delivery network in the country, and recent studies suggest that the care provided within the VA is equivalent or better quality care than in other health care systems, with fewer errors (Asch et al., 2004; Trivedi et al., 2011). This suggests the possibility of even higher rates of more misclassification in other healthcare settings. Furthermore, with many veterans seeking health care outside the VA, clinicians in varied settings serving this population ought to pay careful attention to diagnostic issues. Although the VA was an early adopter of computerized medical records, EMRs are increasingly becoming the norm. Indeed, as the country moves toward standardized systems, this issue will become even more important. The Department of Health and Human Services mandates the use of problem lists in order to receive federal certification of EMRs, and their use is also required for Joint Commission accreditation (Wright, Maloney, & Feblowitz, 2011). Thus, with increased availability of Problem List and administrative data, the odds of these data being used to inform policy decisions similarly increases, highlighting the importance of continued attention to integrity and accuracy of these data.

Among the limitations of this study are a disproportionally low rate of participation by Marines, lack of supporting information about how medical record diagnoses were made, lack of objective measures of treatment engagement, and restriction of our sample to combat exposed veterans who had undergone a mental health assessment. Furthermore, our sample consists of veterans who have obtained at least some services through the VA. Although the majority (57%) of OEF/OIF/OND veterans have obtained some VA health care, a substantial minority have not (U.S. Department of Veterans Affairs, 2013). Veterans who use the VA may be less likely to have private health insurance or other financial resources and may be more symptomatic than the veteran population, in general. Finally, participants were selected on the basis of two visits with a health care professional in order to increase the odds of enrolling participants with true PTSD into the registry; however, this may have biased the sample by excluding veterans who only used VA mental health services on one occasion. Strengths of this study include the use of a national sample with equal numbers of male and female veterans and the use of standard clinical diagnostic instruments in the assessment of PTSD.

In summary, diagnostic misclassification occurred in more than one quarter of the cases analyzed in the current study, suggesting that greater attention needs to be paid to increasing diagnostic accuracy for clinical or research purposes when using EMRs. Specifically, more rigorous assessment (and documentation thereof) ought to be encouraged. Health care systems should mandate minimum standards, including psychometrically sound interviews and/or inclusion of validated, self-report measures to improve diagnostic accuracy (e.g., CAPS; PCL). Furthermore, mandating regular review of problem lists and updating of active and inactive problems is likely to reduce the rate of misclassification errors. Although EMR keeping remains a powerful tool for clinical care and research, it behooves the psychological community and the healthcare community more broadly to devote sufficient attention to how these data are collected, maintained, and used.

References

American Congress of Rehabilitation Medicine. (1993). Definition of mild traumatic brain injury. *Journal of Head Trauma Rehabilitation, 8,* 86–87.

Asch, S. M., McGlynn, E. A., Hogan, M. M., Hayward, R. A., Shekelle, P., Rubenstein, L., . . . Kerr, E. A. (2004). Comparison of quality of care for patients in the Veterans Health Administration and patients in a national sample. *Annals of Internal Medicine, 141,* 938–945. doi:10.7326/0003-4819-141-12-200412210-00010

Blake, D. D., Weathers, F. W., Nagy, L. M., Kaloupek, D. G., Gusman, F. D., Charney, D. S., & Keane, T. M. (1995). The development of a clinician-administered PTSD scale. *Journal of Trauma Stress, 8,* 75–90. doi:10.1002/jts.2490080106

Blake, D. D., Weathers, F. W., Nagy, L. N., Kaloupek, D. G., Klauminser, G., Charney, D. S., & Keane, T. M. (1990). A clinician rating scale for assessing current and lifetime PTSD: The CAPS-1. *Behavior Therapist, 18,* 187–188.

Blumenthal, D. (2011). Implementation of the federal health information technology initiative. *New England Journal of Medicine, 365,* 2426–2431. doi:10.1056/NEJMsr1112158

Brown, A. W., Malec, J. F., McClelland, R. L., Diehl, N. N., Englander, J., & Cifu, D. X. (2005). Clinical elements that predict outcome after traumatic brain injury: A prospective multicenter recursive partitioning (decision-tree) analysis. *Journal of Neurotrauma, 22,* 1040–1051. doi:10.1089/neu.2005.22.1040

Brown, R. L., Leonard, T., Saunders, L. A., & Papasouliotis, O. (2001). A two-item conjoint screen for alcohol and other drug problems. *Journal of the American Board of Family Practice, 14,* 95–106.

Brown, S. H., Lincoln, M. J., Groen, P. J., & Kolodner, R. M. (2003). VistA—U.S. Department of Veterans Affairs national-scale HIS. *Inter-*

national Journal of Medical Informatics, 69, 135–156. doi:10.1016/S1386-5056(02)00131-4

Byrne, C. M., Mercincavage, L. M., Pan, E. C., Vincent, A. G., Johnston, D. S., & Middleton, B. (2010). The value from investments in health information technology at the U.S. Department of Veterans Affairs. *Health Affairs, 29,* 629–638. doi:10.1377/hlthaff.2010.0119

Castro, F., & Keane, T. M. (2011). Issues in assessment of PTSD in military personnel. *Treating PTSD in Military Personnel: A Clinical Handbook,* 23.

Chaudhry, B., Wang, J., Wu, S., Maglione, M., Mojica, W., Roth, E., . . . Shekelle, P. (2006). Systematic review: Impact of health information technology on quality, efficiency, and costs of medical care. *Annals of Internal Medicine, 144,* 742–752. doi:10.7326/0003-4819-144-10-200605160-00125

DesRoches, C. M., Campbell, E. G., Rao, S. R., Donelan, K., Ferris, T. G., Jha, A., . . . Shields, A. E. (2008). Electronic health records in ambulatory care—A national survey of physicians. *New England Journal of Medicine, 359,* 50–60. doi:10.1056/NEJMsa0802005

Dick, R. S., & Steen, E. B. (Eds.). (1991). *The computer-based patient record: An essential technology for health care*. Washington, DC: National Academy Press.

Dick, R. S., Steen, E. B., & Detmer, D. E. (Eds.). (1997). *The computer-based patient record: An essential technology for health care* (Rev. ed.). Washington, DC: National Academy Press.

Farmer, S. A., Black, B., & Bonow, R. O. (2013). Tension between quality measurement, public quality reporting, and pay for performance. *Journal of the American Medical Association, 309,* 349–350. doi:10.1001/jama.2012.191276

First, M. B., & Gibbon, M. (2004). The Structured Clinical Interview for DSM–IV Axis I Disorders (SCID-I) and the Structured Clinical Interview for *DSM–IV* Axis II Disorders (SCID-II). In M. J. Hilsenroth & D. L. Segal (Eds.), *Comprehensive handbook of psychological assessment: Vol. 2. Personality assessment* (pp. 134–143). Hoboken, NJ: Wiley.

Ford, E. W., Menachemi, N., Peterson, L. T., & Huerta, T. R. (2009). Resistance is futile: But it is slowing the pace of EHR adoption nonetheless. *Journal of the American Medical Informatics Association, 16,* 274–281. doi:10.1197/jamia.M3042

Frayne, S. M., Miller, D. R., Sharkansky, E. J., Jackson, V. W., Wang, F., Halanych, J. H., . . . Keane, T. M. (2010). Using administrative data to identify mental illness: What approach is best? *American Journal of Medical Quality, 25,* 42–50. doi:10.1177/1062860609346347

Gravely, A. A., Cutting, A., Nugent, S., Grill, J., Carlson, K., & Spoont, M. (2011). Validity of PTSD diagnoses in VA administrative data: Comparison of VA administrative PTSD diagnoses to self-reported PTSD Checklist scores. *Journal of Rehabilitation Research and Development, 48,* 21–30. doi:10.1682/JRRD.2009.08.0116

Harris, S. B., Glazier, R. H., Tompkins, J. W., Wilton, A. S., Chevendra, V., Stewart, M. A., & Thind, A. (2010). Investigating concordance in diabetes diagnosis between primary care charts (electronic medical records) and health administrative data: A retrospective cohort study. *BMC Health Services Research, 10,* Article 347. doi:10.1186/1472-6963-10-347

Hawthorne, G., Mouthaan, J., Forbes, D., & Novaco, R. W. (2006). Response categories and anger measurement: Do fewer categories result in poorer measurement? Development of the DAR5. *Social Psychiatry and Psychiatric Epidemiology, 41,* 164–172. doi:10.1007/s00127-005-0986-y

Holowka, D. W., Marx, B. P., Kaloupek, D. G., & Keane, T. M. (2012). PTSD symptoms among male Vietnam veterans: Prevalence and associations with diagnostic status. *Psychological Trauma: Theory, Research, Practice, and Policy, 4,* 285–292. doi:10.1037/a0023267

Jackson, J. C., Sinnott, P. L., Marx, B. P., Murdoch, M., Sayer, N. A., Alvarez, J. M., . . . Speroff, T. (2011). Variation in practices and attitudes of clinicians assessing PTSD-related disability among veterans. *Journal of Trauma Stress, 24,* 609–613. doi:10.1002/jts.20688

Jenkins, C. D., Stanton, B. A., Niemcryk, S. J., & Rose, R. M. (1988). A scale for the estimation of sleep problems in clinical research. *Journal of Clinical Epidemiology, 41,* 313–321. doi:10.1016/0895-4356(88)90138-2

Jha, A. K., DesRoches, C. M., Campbell, E. G., Donelan, K., Rao, S. R., Ferris, T. G., . . . Blumenthal, D. (2009). Use of electronic health records in U.S. hospitals. *New England Journal of Medicine, 360,* 1628–1638. doi:10.1056/NEJMsa0900592

Kang, H. K., & Hyams, K. C. (2005). Mental health care needs among recent war veterans. *New England Journal of Medicine, 352*(13), 1289. doi:10.1056/NEJMp058024

King, L. A., King, D. W., Vogt, D. S., Knight, J., & Samper, R. (2006). Deployment Risk and Resilience Inventory: A collection of measures for studying deployment-related experiences of military personnel and veterans. *Military Psychology, 18,* 89–120. doi:10.1207/s15327876mp1802_1

Liaw, S.-T., Chen, H.-Y., Maneze, D., Taggart, J., Dennis, S., Vagholkar, S., & Bunker, J. (2012). The quality of routinely collected data: Using the "principal diagnosis" in emergency department databases as an example. *Electronic Journal of Health Informatics, 7,* e1.

Linder, J. A., Ma, J., Bates, D. W., Middleton, B., & Stafford, R. S. (2007). Electronic health record use and the quality of ambulatory care in the United States. *Archives of Internal Medicine, 167,* 1400–1405. doi:10.1001/archinte.167.13.1400

Magruder, K. M., Frueh, B. C., Knapp, R. G., Davis, L., Hamner, M. B., Martin, R. H., . . . Arana, G. W. (2005). Prevalence of posttraumatic stress disorder in Veterans Affairs primary care clinics [Multicenter study]. *General Hospital Psychiatry, 27,* 169–179. doi:10.1016/j.genhosppsych.2004.11.001

Marx, B. P., Schnurr, P. P., Rodriguez, P., Holowka, D. W., Lunney, C., Weathers, F., . . . Keane, T. M. (2009). *Development of a functional impairment scale for active duty service members and veterans*. Paper presented at the Annual Meeting of the International Society for Traumatic Stress Studies, Atlanta, Georgia.

Newman-Toker, D. E., & Pronovost, P. J. (2009). Diagnostic errors—The next frontier for patient safety. *Journal of the American Medical Association, 301,* 1060–1062. doi:10.1001/jama.2009.249

Norman, G. R., & Eva, K. W. (2010). Diagnostic error and clinical reasoning. *Medical Education, 44,* 94–100. doi:10.1111/j.1365-2923.2009.03507.x

Rosen, C. S., Chow, H. C., Finney, J. F., Greenbaum, M. A., Moos, R. H., Sheikh, J. I., & Yesavage, J. A. (2004). VA practice patterns and practice guidelines for treating posttraumatic stress disorder. *Journal of Traumatic Stress, 17,* 213–222. doi:10.1023/B:JOTS.0000029264.23878.53

Rosen, R. C., Marx, B. P., Maserejian, N. N., Holowka, D. W., Gates, M. A., Sleeper, L. A., . . . Keane, T. M. (2012). Project VALOR: Design and methods of a longitudinal registry of post-traumatic stress disorder (PTSD) in combat-exposed veterans in the Afghanistan and Iraqi military theaters of operations. *International Journal of Methods in Psychiatric Research, 21,* 5–16.

Saunders, J. B., Aasland, O. G., Babor, T. F., de la Fuente, J. R., & Grant, M. (1993). Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption–II. *Addiction, 88,* 791–804. doi:10.1111/j.1360-0443.1993.tb02093.x

Schiff, G. D., & Bates, D. W. (2010). Can electronic clinical documentation help prevent diagnostic errors? *New England Journal of Medicine, 362,* 1066–1069. doi:10.1056/NEJMp0911734

Seal, K. H., Bertenthal, D., Miner, C. R., Sen, S., & Marmar, C. (2007). Bringing the war back home: Mental health disorders among 103 788 US veterans returning from Iraq and Afghanistan seen at Department of

Veterans Affairs facilities. *Archives of Internal Medicine, 167,* 476–482. doi:10.1001/archinte.167.5.476

Shear, M. K., Greeno, C., Kang, J., Ludewig, D., Frank, E., Swartz, H. A., & Hanekamp, M. (2000). Diagnosis of nonpsychotic patients in community clinics. *American Journal of Psychiatry, 157,* 581–587. doi:10.1176/appi.ajp.157.4.581

Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Amorim, P., Janavs, J., Weiller, E., . . . Dunbar, G. C. (1998). The Mini-International Neuropsychiatric Interview (M.I.N.I.): The development and validation of a structured diagnostic psychiatric interview for *DSM–IV* and ICD-10. *Journal of Clinical Psychiatry, 59,* 22–33.

Spitzer, R. L., Kroenke, K., & Williams, J. B. (1999). Validation and utility of a self-report version of PRIME-MD: The PHQ primary care study. *Journal of the American Medical Association, 282,* 1737–1744. doi:10.1001/jama.282.18.1737

Szeto, H. C., Coleman, R. K., Gholami, P., Hoffman, B. B., & Goldstein, M. K. (2002). Accuracy of computerized outpatient diagnoses in a Veterans Affairs general medicine clinic. *American Journal of Managed Care, 8,* 37–43.

Trinh, N-H. T., Youn, S. J., Sousa, J., Regan, S., Bedoya, C. A., Chang, T. E., . . . Yeung, A. (2011). Using electronic medical records to determine the diagnosis of clinical depression. *International Journal of Medical Informatics, 80,* 533–540. doi:10.1016/j.ijmedinf.2011.03.014

Trivedi, A. N., Matula, S., Miake-Lye, I., Glassman, P. A., Shekelle, P., & Asch, S. (2011). Systematic review: Comparison of the quality of medical care in Veterans Affairs and non-Veterans Affairs settings. *Medical Care, 49,* 76–88. doi:10.1097/MLR.0b013e3181f53575

U.S. Department of Veterans Affairs. (2013). *Million Veteran Program: A partnership with veterans, 2013*. Retrieved from http://www.research.va.gov/mvp/

Weathers, F. W., Litz, B. T., Herman, D. S., Huska, J. A, & Keane, T. M. (1993, October). *The PTSD Checklist (PCL): Reliability, validity, and diagnostic utility*. Paper presented at the Annual Meeting of the International Society for Traumatic Stress Studies, San Antonio, Texas.

Wilde, E. A., Bigler, E. D., Pedroza, C., & Ryser, D. K. (2006). Posttraumatic amnesia predicts long-term cerebral atrophy in traumatic brain injury. *Brain Injury, 20,* 695–699. doi:10.1080/02699050600744079

Wright, A., Maloney, F. L., & Feblowitz, J. C. (2011). Clinician attitudes toward and use of electronic problem lists: A thematic analysis. *BMC Medical Informatics and Decision Making, 11,* Article 36. doi:10.1186/1472-6947-11-36

Yuan, Y. (2011). Multiple imputation using SAS software. *Journal of Statistical Software, 45,* 1–25.

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Correction to Holowka et al. (2014)

In the article, "PTSD Diagnostic Validity in Veterans Affairs Electronic Records of Iraq and Afghanistan Veterans," by Darren W. Holowka, Brian P. Marx, Margaret A. Gates, Heather J. Litman, Gayatri Ranganathan, Raymond C. Rosen, and Terence M. Keane (*Journal of Consulting and Clinical Psychology*, Advance online publication. April 14, 2014. http://dx.doi.org/10.1037/a0036347), the sentence in the 7th paragraph of the Results section "False negatives had significantly lower IPF scores (OR = 0.79; 95% CI [0.64, 0.97] per one-unit increase in grand mean score), fewer Cluster C symptoms (OR = 0.69; 95% CI [0.62, 0.77]), and a higher number of Cluster D symptoms (OR = 1.34; 95% CI [1.14, 1.58]) for lifetime PTSD, compared with true positives and negatives." should read "False **positives** had significantly lower IPF scores . . . "

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