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Factors associated with completing evidence-based psychotherapy for PTSD among veterans in a national healthcare system

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ABSTRACT

Little is known about predictors of initiation and completion of evidence-based psychotherapy (EBP) for posttraumatic stress disorder (PTSD), with most data coming from small cohort studies and post-hoc analyses of clinical trials. We examined patient and treatment factors associated with initiation and completion of EBP for PTSD in a large longitudinal cohort. We conducted a national, retrospective cohort study of all Iraq and Afghanistan War veterans who had a post-deployment PTSD diagnosis from 10/01–9/15 at a Veterans Health Administration facility and had at least one coded post-deployment psychotherapy visit. We examined utilization of PE and CPT (individual or group) during any 24-week period. We used ordered logistic, logistic, and Cox proportional hazards regressions to examine variables associated with EBP initiation, early termination, and completion, and time to completion. Over a 15-year period, of 265,566 veterans with PTSD, 22.8% initiated an EBP, and only 9.1% completed treatment. Completers did so about three years after their initial mental health visit. Factors positively associated with EBP completion included military sexual trauma, older age, race/ethnicity (i.e., African-American race for PE), combat, and multiple deployments. The VHA has become timelier in delivering EBP for PTSD, and several subgroups are more likely to complete EBP.

1. Introduction

The US Veterans Health Administration (VHA) has implemented two specific posttraumatic stress disorder (PTSD) evidence-based psychotherapy (EBP) protocols, Cognitive Processing Therapy (CPT) and Prolonged Exposure (PE; Karlin et al., 2010; Kussman, 2008). Research trials of CPT and PE have resulted in improved PTSD symptoms among veterans (e.g. Haagen et al., 2015; Monson et al., 2006; Schnurr et al., 2007, 2015; Suris et al., 2013; Voelkel et al., 2015). Cross-sectional studies have estimated that fewer than 13% of all VHA patients undergoing PTSD treatment receive any PE or CPT over a six to twelve-month period (Lu et al., 2016; Shiner et al., 2013; Sripada et al., 2018). A recent 15-year longitudinal cohort study of Iraq and Afghanistan veterans who initiated psychotherapy for PTSD in the VHA showed that 20% ever received any sessions of PE or CPT (Maguen et al., 2018). Additionally, up to half of veterans who start individual EBPs in a clinical setting drop out of treatment (Kehle-Forbes et al., 2016; Miles and Thompson, 2016). While one study found no differences in drop-out rates between CPT and PE (Miles and Thompson, 2016), another found that those receiving PE drop out at higher rates that patients receiving CPT (e.g., 45% vs. 33%; Kehle-Forbes et al., 2016). Available data shows that VA patients initiating EBPs attend about 5 to 9 sessions (Kehle-Forbes et al., 2016; Watts et al., 2014), indicating that some patients may drop out of treatment before completing the full 8–12 session protocol. Despite apparent underuse and low completion rates, there is little research on patient and treatment-factors associated with initiating and completing evidence-based psychotherapy (EBP). Such information could better assist with understanding barriers and facilitators to care, as well as guide outreach and retention efforts.

Few studies have examined patient demographic and prior

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treatment factors associated with outpatient EBP treatment initiation and completion, and these studies have examined care at individual sites. In terms of patient demographics, younger veterans tended to initiate EBPs at lower rates than older veterans and were more likely to drop out of treatment at three sites (Mott et al., 2014a; Jeffreys et al., 2014; Kehle-Forbes et al., 2016), whereas age was not significantly associated with treatment discontinuation at a fourth site (Gros et al., 2013). In terms of prior treatment factors, an active area of debate is whether individuals need prior PTSD psychotherapy before starting EBPs (De Jongh et al., 2016). One site examined this question, and those who delayed EBP initiation were more likely to complete treatment (Mott et al., 2014b). In related qualitative work, patients who completed EBPs reported that prior treatment increased confidence in their ability to participate in EBP (Hundt et al., 2015), and that not feeling ready was a common reason for declining EBP (Hundt et al., 2017a).

Implementing EBPs in the VHA has been an ongoing process with refinements along the way. Given that clinicians were gradually trained to use these treatments over the implementation period (Karlin, 2012; Wagner et al., 2011), examining whether year of treatment has an impact on initiating and completing EBPs is also important. A follow up study at one large site indicated increased use of EBPs in individual clinics over time (e.g., Hundt et al., 2017b). However, year of entry into mental health treatment has never been examined on a national level as a potential predictor of initiation and completion of EBPs. Relatedly, while some individuals receive EBPs in the first year of entering treatment, others can take a longer time to initiate care. Other factors that may impact time to treatment include patient readiness and barriers to care (Zubkoff et al., 2016), as well as systemic barriers (Watts et al., 2014). Among a national sample of Iraq and Afghanistan veterans using VHA care, we found that earlier initiation of any treatment after the last deployment was associated with greater improvement in PTSD symptoms (Maguen et al., 2014). Therefore, beyond the general trend in EBP availability within the VA system, there is a need to examine which patient factors were associated with shorter time to receiving EBPs.

Due to challenges in readily identifying CPT and PE use in the VHA national electronic medical records (Shiner et al., 2012), we recently developed an algorithm to identify EBPs through natural language processing (NLP) of psychotherapy notes (please see Maguen et al., 2018). More specifically, using NLP, we developed machine-learning algorithms to classify note text on a large scale in an observational study of Iraq and Afghanistan veterans with PTSD. PTSD visits were linked to 8.1 million psychotherapy notes, and annotators labeled 3467 randomly-selected psychotherapy notes (kappa = 0.88) to indicate receipt of EBP. Our overall classification accuracy was strong (0.991 for PE; 0.965 for CPT individual, and 0.968 for CPT group), indicating that our algorithm correctly identified instances or CPT and PE in the electronic medical records. Due to robust performance metrics of our algorithm, we were able to use it to identify patients' use of EBPs. While CPT was implemented in the VHA in 2006 and PE in 2007, templated notes for these treatments were not implemented until 2015 and are still underused in clinical practice (Shiner et al., 2018), meaning that a NLP approach continues to be the only viable option for longitudinal analysis of CPT and PE use over the entire EBP implementation period. Our goal was to describe uptake and completion of EBPs as well as facilitators and barriers to receiving EBPs in a national healthcare system. Prior studies have been able to elucidate national use and trends, but this is the first time that examining these barriers and facilitators is possible on a national level across a fifteen-year period. Overall, we were interested in examining three groups-veterans who never received any EBPs, those who dropped out of EBPs, and those who completed at least a minimally-adequate course of EBP treatment. In addition, we examined factors associated with timing of EBP receipt.

2. Methods

2.1. Study population

We identified 308,556 Iraq and Afghanistan war veterans who had a post-deployment PTSD diagnosis from October 2001 to September 2015 at one of 130 VHA facilities. Of those, 265,566 had an initial post-deployment mental health visit and at least one coded psychotherapy visit (with PTSD as the primary or secondary diagnosis) that was linked to a clinical note by June 15th, 2017.

2.2. Data sources

We obtained demographic and military service information from the Iraq and Afghanistan War Veterans Roster and the VA Corporate Data Warehouse (CDW), a national repository of VHA clinical and administrative data. We obtained diagnostic, encounter, and pharmacy data from the CDW.

2.3. Outcome variables

We measured three hierarchal outcomes related to utilization of PE and CPT (individual or group) during any 24-week period (chosen as a conservative estimate): (1) receipt of eight or more sessions of PE or CPT (defined as PE or CPT completion; Cully et al., 2008; Mott et al., 2014a; Spoont et al., 2010); (2) receipt of 1–7 sessions of PE/CPT (defined as early termination); and (3) no PE/CPT treatment. Additionally, we measured time from first mental health visit (defined as index date) to completion of the first full-dose of PE/CPT.

We allowed 24-weeks for the completion of evidence-based psychotherapy and recognize that for some individuals this may represent poor continuity of treatment; however, we wanted to account for the reality of avoidance that manifests in PTSD and did not want to underestimate rates in those receiving these treatments that have significant barriers prohibiting completion in a shorter time frame.

2.4. Independent variables

Using ICD-9 and ICD-10 codes, we identified the following outpatient or inpatient diagnoses in the year before the index date: schizophrenia or other psychotic disorder, bipolar disorder, depression, alcohol abuse and/or dependence, drug abuse and/or dependence, pain conditions, traumatic brain injury, and suicide behavior (ideation and attempts). Comorbidities other than suicide ideation or attempt were defined as 2+ diagnoses at outpatient or 1+ diagnosis at inpatient or fee basis settings before 09/12/2015. We used any suicide codes that were captured in the medical record, given that in our experience, ideation that is strong enough to be captured as a diagnosis is often chronic and warrants inclusion, given that this is a rare event. We did not have any exclusion criteria.

We also included trauma exposure variables available in the medical records including military sexual trauma (MST) as well as serving in a combat zone and number of deployments, which served as a proxy for combat exposure. MST is recorded according to a veteran's response to the following: "While you were in the military: (a) Did you receive uninvited and unwanted sexual attention, such as touching, cornering, pressure for sexual favors, or verbal remarks?; (b) Did someone ever use force or threat of force to have sexual contact with you against your will?"

We examined whether taking certain medications in the year prior to or after index date was associated with PE/CPT outcomes. These medications were based on the VA/DoD PTSD treatment guidelines in place for most of the treatment period (Departments of Veterans Affairs and Defense, 2010) and include nine selective serotonin and serotonin-norepinephrine reuptake inhibitors (SSRIs and SNRIs; Desvenlafaxine, Duloxetine, Venlafaxine, Citalopram, Escitalopram, Fluoxetine,

Fluvoxamine, Paroxetine, and Sertraline), two tricyclic antidepressants (TCAs; Amitriptyline and Imipramine), Mirtazapine, and Prazosin. We did not include Nefazadone and Phenylzine, given that these are very rarely prescribed to patients with PTSD in routine VHA clinical practice (Krystal et al., 2017).

To test temporal effects, we examined the association between the year of the first mental health visit (entry year) and PE/CPT outcomes. We created a categorical variable of calendar years, with combined years of 2001–2005 as the reference category, and combined years of 2015–2017 as the last category, due to small numbers of observations in individual years during these periods.

In addition, we considered the following variables as potential covariates: rurality, service connection, and CPT treatment format received (individual, group, or both).

2.5. Statistical analysis

To assess whether statistically significant differences exist between groups, we used Kruskal Wallis tests or Mann-Whitney tests for continuous variables and Chi-Square or Fisher's Exact tests for categorical variables. We used log rank tests to compare the survival distributions of different groups.

We conducted regression analyses focused on three outcome variables: (1) ordered logistic regressions for the three-category outcome variable: no EBP, early termination, or EBP completers in any 24 weeks during follow-up; (2) binary logistic regressions for EBP completers vs. early terminators; and (3) Cox proportional hazards regressions for time to completion of the first PE/CPT. Due to multicollinearity, education was not included as a predictor in the models. To control for potential confounding, variables that were significant in bivariate analyses ($p < 0.05$) were entered in the models as covariates. In regression analyses, we considered $p < 0.001$ as statistically significant. Analyses were completed using SAS 9.4 (SAS Institute, 2013) and StataMP 15 (StataCorp, 2017).

3. Results

3.1. Evidence-based psychotherapy

Of 265,566 veterans with PTSD receiving mental health care, 24,039 (9.1%) completed an EBP for PTSD, 36,595 (13.8%) were early terminators, and 204,932, (77.2%) received no EBP in any 24 weeks during the study period. More specifically, 5154 (1.9%) completed PE, 12,782 (4.8%) were early terminators, during any 24-week period. Furthermore, 19,067 (7.4%) completed CPT, 29,006 (10.9%) were early terminators, during any 24-week period. Given these differences between PE and CPT receipt, we present results separately for each treatment.

3.2. Prolonged exposure therapy

There were many significant differences between the no PE, early termination, and completion groups in this large dataset (Table 1a). In addition to being older and more educated, those who completed PE were more likely to be African-American, Officers, and National Guard or Reservists. The largest differences between those who initiated PE (completed or terminated early) and those who did not were that initiators were more likely to be married and have multiple deployments, military sexual trauma, medications, and a history of pain, TBI, depression, alcohol abuse or dependence, drug abuse or dependence, and suicide ideation or attempt. In addition, those who initiated PE were more likely to live in an urban area, be service connected, and have served in a combat zone. Table 2a shows factors associated with our hierarchical outcome categories (no PE, early termination, completion) during any 24-week period based on ordered logistic regression. The odds of completing progressively larger numbers of PE treatment sessions were greater for those in their 30s and 40s, African-Americans, married individuals, Reservists, Officers, those serving in a combat zone, those with multiple deployments, those with military sexual trauma, non-smokers or those without schizophrenia or bipolar diagnosis, those with a history of pain, TBI, depression, alcohol abuse or dependence, or suicide ideation or attempt, and those who entered VA mental health treatment after 2005, lived in urban areas, or were service connected.

Using binary logistic regression, we examined an additional factor – the number of non-EBP therapy sessions before the first PE session – on the probability of completing PE among patients who ever received any PE (See Appendix Table 1a). Unlike findings based on the ordered logistic regression model, the year in which a patient initiated mental health care was not associated with completing PE, indicating that VA mental health entry year was related to initiation, but not completion of PE. The binary logistic regression results were otherwise similar to the results for the ordered logistic regression.

Of the 5154 patients who completed PE, the mean duration between the first mental health visit and the completion of PE was 3.25 years (SD = 2.66 years). For the rest of the sample who terminated early or did not receive PE (n = 260,412), the average follow-up time in VA care was 7.13 years (SD = 2.76 years) until the last follow-up date (June 15th, 2017) or death.

Table 3a shows factors associated with shorter time to completion of PE from VA mental health entry, based on a Cox proportional hazards model. Patients completed PE in less time if they were in their 30′s and 40′s, African-American, married individuals (relative to the divorced, separated or single), Reservists, Officers, had multiple deployments, experienced military sexual trauma, took medications, had no diagnosis of schizophrenia, had a history of pain, TBI, depression or suicide ideation or attempt, entered VA mental health care after 2005, were service connected or served in a combat zone. Interestingly, whereas PE completion rates did not improve across years (above), time to PE completion improved steadily and dramatically across years.

3.3. Cognitive processing therapy

There were many significant differences between the no CPT, early termination, and completion groups in this large dataset (Table 1b). In addition to being older and more educated, those who completed CPT were more likely to be African-American, National Guard or Reservists, and Officers. The largest differences between those who initiated CPT (completed or terminated early) and those who did not were that initiators were more likely to be women, or to report military sexual trauma, or to take medication, or have a history of bipolar, psychosis, pain, TBI, depression, alcohol abuse or dependence, drug abuse or dependence, or suicide ideation or attempt. In addition, patients who initiated CPT were more likely to be service connected or have served in a combat zone. Compared to those who terminated early, those who completed eight or more sessions were more likely to receive both individual and group formats of CPT. Table 2b shows factors associated with achievement of our hierarchal outcome categories (no CPT, early termination, or completion) during any 24-week period based on ordered logistic regression. The odds of completing progressively larger number of CPT treatment sessions were greater for people 30 years or older, non-Hispanics, married individuals, Reserve members, Officers, those who did not take medications, or were service connected, served in a combat zone, or received group format or both individual and group formats of CPT, relative to individual CPT.

Using binary logistic regression, we examined an additional factor – the number of non-EBP therapy sessions before the first CPT session – on the probability of completing CPT among patients who ever received

any CPT (See Appendix Table 1b). Unlike findings based on the ordered logistic regression model, the year in which a patient initiated mental health care was not associated with CPT completion except for year 2014, relative to years between 2001 and 2005, indicating that VA mental health entry year was significantly related to initiation, but not completion of CPT. The binary logistic regression results were otherwise similar to the results for ordered logistic regression.

Of the 19,607 patients who completed CPT, the mean duration between the first mental health visit and the completion of CPT was 3.49 years (SD: 2.72). For the rest of the sample (n = 245,959) who did not receive CPT or terminated early, the average follow-up time was 7.13 years (SD: 2.76) until the last follow-up date (June 15th, 2017) or death.

Table 3b shows factors associated with faster time to completion of CPT from VA mental health entry, based on a Cox proportional hazards model. Patients completed CPT in less time if they were 30 years or older, non-Hispanic, married, Reservists, Officers, or entered VA mental health care after 2005, served in a combat zone, or received group format or both individual and group formats of CPT, relative to individual format of CPT. As was the case with PE, though CPT completion rates did not improve across years (above), time to CPT completion improved steadily and dramatically across years.

4. Discussion

Over a 15-year period, 308,556 Iraq and Afghanistan war veterans in VHA care were identified as having PTSD and 265,566 veterans with PTSD received mental health care and at least one coded psychotherapy visit. While 22.8% of those veterans initiated an EBP during this period, only 9.1% completed treatment. Significantly more veterans completed CPT than PE, which may reflect a greater number of providers trained in CPT as well as patient and provider treatment preferences (Hundt et al., 2016; Schumm et al., 2015). Availability of both individual and group modalities of CPT may also account for these differences, allowing for easier delivery and completion. Furthermore, those who completed EBPs did so an average of three years after their initial mental health visit. It is unclear whether this is predominantly due to veterans not being ready for evidence-based PTSD treatment upon initial presentation (Zubkoff et al., 2016; Hundt et al., 2017a), needing initial treatment for comorbid medical, psychiatric, or substance abuse conditions (Shiner et al., 2017), needing immediate care to address suicide or other risk issues (Conner et al., 2014), long wait times in the VA treatment system that may lead patients to receive other psychotherapeutic and pharmacologic modalities before receiving evidence-based treatment (Watts et al., 2014), or some combination of these and other factors.

Understanding factors associated with timing to and completion of EBP treatments can assist with better engagement and retention. We found many demographic, military and clinical factors associated with completing an adequate dose of EBP, and doing so in a timely manner. Many factors were similar across both CPT and PE, but some were unique to each. Interestingly, military sexual trauma was one of the strongest predictors of completing PE as well as timing of PE, and these associations closely approached clinical significance for CPT. While this may seem surprising due to the shame and stigma associated with MST, prior studies have found that those with MST have higher healthcare utilization rates (e.g., 50% higher than those without MST; Brignone et al., 2017) and that 76% of veterans with MST receive MST-related care (Turchik et al., 2012). There may be systemic issues that have facilitated completion and timing of EBPs among those with MST, such as implementation of MST coordinators at each facility who assist with connection to care, and availability of free care to those with documented MST. In addition to MST, combat and number of deployments were also associated with timing and completion of EBPs, which may serve as a proxy for exposure to potentially traumatic experiences. The potential impact of trauma type and severity on completion of EBPs is critical, and although more work is needed in this area, our findings suggest that these factors are important and need to be examined in more granularity in future studies.

Importantly, calendar year of treatment seemed to make somewhat of a difference in whether individuals completed EBPs, and a very significant difference in the time it took to complete EBPs. In fact, year of veterans' first mental health visit was the factor most strongly associated with timely EBP completion. This likely reflects the significant efforts that VHA has invested in hiring and training more clinicians to provide EBPs, providing patient materials that explain and demystify these treatments, and investing in campaigns to destigmatize EBPs by having veterans who have benefited tell their recovery stories. The fact that the VA has become more efficient when delivering EBPs is also encouraging, given that on average, veterans are receiving EBPs over three years after their first mental health visit.

We also found that engaging in other psychotherapy prior to starting EBP was associated with higher completion of EBPs, compared to early termination. While veterans may be at high-risk when presenting to treatment or have comorbid conditions that need to be treated prior to starting EBPs, there is also evidence that individuals with PTSD may need to gain trust in providers or in the overall system prior to engaging in EBPs (e.g., Hundt et al., 2015; Hundt et al., 2017a). It may also be that individuals who are more likely to engage in any psychotherapy are more likely to be open to engagement in EBP for PTSD. Veterans may also have competing interests such as family life, school, or work that prohibit initially committing to EBPs, which require weekly attendance and out of session assignments. This finding is an important one that may hold valuable information on how to increase rates of EBPs. It may be that having a few sessions to prepare individuals for EBPs can be helpful in engagement as well as prevention of drop out from EBPs.

There were also notable race differences that varied by treatment. Most notably, African-American veterans were more likely to complete PE, compared to getting none or some PE (only race difference for PE), and once enrolled in EBPs, more likely to complete PE, compared to early termination. African-Americans also received PE more quickly, compared to Whites. Although we need more studies on race to better understand these findings, it is encouraging to see these results. There is a prior study that found that in one VHA clinic, African–Americans showed significantly more improvement than other ethnicities in PE (Jeffreys et al., 2014), which may help explain some of these findings. This is the first known study that has been able to examine national race and ethnicity EBP differences among multiple groups at this level of granularity due to our large sample size. This is consistent with our prior findings demonstrating different healthcare utilization patterns among veteran racial/ethnic groups (Koo et al., 2015).

We found that the relationship between gender and EBPs was somewhat complex. While women were more likely to receive more CPT sessions compared to men, being female was not associated with completing PE. Unfortunately, most clinical trials of EBPs either include only one gender or have relatively small numbers of participants, rendering appropriately powered gender comparisons challenging. In the one known study that could examine gender differences in PE at one VA specialty clinic, no gender differences were found with respect to PE treatment completion rates (Mouilso et al., 2016). This is generally consistent with other studies examining non-EBP PTSD treatment that is most frequently conducted in civilians. One factor that may be key in better understanding EBP completion and timeliness are patient preferences, yet few studies exist in this area. One study that was conducted predominantly with men found that CPT was preferred over other PTSD therapies, including PE (Schumm et al., 2015). Prior studies have found that matching patients to their preferred treatments is

associated with less likelihood of treatment drop out and demonstrated greater treatment improvements (Swift et al., 2011). Related to patient preferences, having a broader choice of delivery methods may help increase engagement and completion. For example, telehealth or web-based delivery of psychotherapy may assist veterans with busy lives who are trying to balance work and home duties.

Not surprisingly, younger age was associated with lower likelihood of EBP completion, more drop out, and slower time to receipt of EBPs. This is consistent with several studies that have found younger veterans to be less likely to engage in care (Jeffreys et al., 2014; Kehle-Forbes et al., 2016). We have previously found that both younger age and longer time to care were associated with less PTSD symptom improvement (Maguen et al., 2014).

There were several clinical factors that impacted completion and timeliness of care. Comorbid conditions including pain, TBI, depression, alcohol or drug abuse or dependence, and suicide ideation or attempt were associated with receiving more PE sessions and timelier PE; however, they were not associated with receiving more CPT sessions or timelier CPT. In addition, having a schizophrenia diagnosis was negatively associated with receiving more sessions of both PE, and negatively associated with timelier PE. More studies are needed to best understand how to best triage individuals with comorbid mental health disorders in a EBP clinical setting, and who benefits most from which treatment. Existing studies have studied provider perceptions yet there is little clinical guidance based on research. Taking medication in the year before or after index date was associated with timelier PE but not CPT. To best facilitate clinical care, future studies should examine how medications may differentially facilitate engagement in CPT and PE.

Although suicidal behavior can be conceptualized on a continuum, and it is important for clinicians to make clinical judgements based on all risk factors evaluated as a whole, prior studies have found that CPT can reduce suicidal ideation among active duty military personnel (Bryan et al., 2016; Gradus et al., 2013). Interestingly, Gradus et al. found that while both EBPs reduced suicidal ideation, CPT was slightly more effective, despite a small magnitude of difference. In patients with TBI, several studies have now shown that EBPs can be conducted effectively with these patients, although timing of treatment may be slower. One study also found that while both EBPs impact PTSD symptoms in those with TBI, veterans completing PE had greater symptom reduction than those completing CPT (Ragsdale et al., 2016). However, others argue that combining EBPs with cognitive rehabilitation may be key, and current trials are underway to test this hypothesis (Jak et al., 2015). In terms of drug dependence, while no known studies have examined CPT in a drug dependent population, one trial using PE combined with concurrent treatment of substance use found reductions in PTSD symptoms (Mills et al., 2012). Finally, although there is some evidence that individuals with severe mental illness (e.g., bipolar disorder and schizophrenia) may benefit from trauma-focused treatments like PE (Grubaugh et al., 2016), completion rates and drop out have not been examined in larger samples; furthermore, clinicians may have concerns about using CPT or PE in those with thought disorder symptoms.

There were several additional findings that deserve further exploration. Not surprisingly, being service connected, and having served in a combat zone were associated with receiving more sessions of PE and CPT. Those in urban areas were more likely to receive more sessions of PE than those in rural areas, and those with group or both individual and group formats of CPT were more likely to receive more sessions of CPT, relative to those receiving individual CPT. Being service connected, and having served in a combat zone were also associated with receiving timelier PE. Having served in a combat zone was associated with receiving timelier CPT, together with group format or both individual and group formats of CPT, relative to individual CPT.

There are several limitations of our study that should be noted. First, this study was conducted with Iraq and Afghanistan War veterans and may not generalize to veterans of all eras. Second, despite the robust performance of our NLP algorithm (see Maguen et al., 2018), it is important to note that EBP cases may have been missed or misidentified. Related, CPT or PE received through non-VA care or Vet Centers would not be captured in the electronic medical record. Third, although mental health diagnoses were made by medical professionals in the patient's medical records (e.g., two or more instances of outpatient diagnoses, which optimizes positive predictive validity; Frayne et al., 2010 and Gravely et al., 2011), diagnoses were not confirmed with gold standard assessment tools; furthermore, there is always the possibility of over or under-diagnosis based on issues such as overreporting due to secondary gain or underreporting due to stigma associated with PTSD (or other mental health disorders that may impact the results). Fourth, we were not able to include several variables that may also be associated with our outcomes such as income and region of treatment. Fifth, although we focused on PTSD concordant medications for this study, future studies may want to examine augmenting medications for PTSD (e.g., antipsychotics) or those that are used to reduce anxiety symptoms, but not recommended (e.g., benzodiazepines). An important are for future investigation is including provider-level predictors that may impact receipt of evidence-based psychotherapies. For example, providers may have beliefs about patient readiness, be reluctant to administer these treatments, or may not be trained in these treatment modalities. All of these variables may impact receipt and completion of these psychotherapies.

We found that while 22.8% Iraq and Afghanistan veterans with PTSD receiving psychotherapy in the VHA initiated EBP during the study period, only 9.1% completed treatment, and those who completed EBPs did so an average of three years after their initial mental health visit. Furthermore, significantly more veterans completed CPT than PE, and there were a number of factors that were associated with completion of EBPs, including history of MST, older age, gender, race/ethnicity, multiple deployments, and comorbid conditions including pain, TBI, depression, suicide ideation or attempt. Psychotherapy sessions prior to first EBP were associated with EBP completion, compared to early termination. Finally, year of engagement in mental health was most strongly associated with timing of care, with those engaging in later years receiving more timely care. This demonstrates that the VHA has made strides in proving timely EBPs due to several programs and initiatives. Future efforts can continue to focus on how to ensure that engaged veterans stay in treatment and complete an adequate dose of EBPs, with efforts targeted at retaining veterans who are most at risk. Future research can also use comparative effectiveness research on a larger scale to advance our understanding of group differences in EBP improvement, given that clinical trials have not had enough power to look at these differences. Some of these differences may account for some of the differential engagement and completion results, which will be important to elucidate in future studies.

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Appendix

Table 1a
Patient characteristics by PE status (N = 265,566).

	No PE (n = 247,630, 93.3%)	1–7 PE Sessions (n = 12,782, 4.8%)	8+ PE Sessions (n = 5154, 1.9%)	P
Baseline age	32.0 (8.6)	32.0 (8.3)	33.6 (8.9)	<0.001
Baseline age categories				<0.001
<30	133,820 (54.0%)	6714 (52.5%)	2307 (44.8%)	
30–39	65,605 (26.5%)	3621 (28.3%)	1516 (29.4%)	
40–49	37,767 (15.3%)	1999 (15.6%)	1063 (20.6%)	
50–59	9507 (3.8%)	412 (3.2%)	245 (4.8%)	
60–69	928 (0.4%)	36 (0.3%)	23 (0.5%)	
70+	3 (0%)	0 (0%)	0 (0%)	
Gender				0.918
Male	221,398 (89.4%)	11,401 (89.2%)	4606 (89.4%)	
Female	26,227 (10.6%)	1381 (10.8%)	548 (10.6%)	
Missing	5 (0%)	0(0%)	0(0%)	
Race				<0.001
White	176,405 (71.2%)	9086 (71.1%)	3480 (67.5%)	
Black or African American	42,037 (17.0%)	2175 (17.0%)	1092 (21.2%)	
American Indian or Alaska Native	2942 (1.2%)	169 (1.3%)	59 (1.1%)	
Asian	3958 (1.6%)	212 (1.7%)	94 (1.8%)	
Native Hawaiian or Other Pacific Islander	2946 (1.2%)	166 (1.3%)	56 (1.1%)	
Multi-races	2988 (1.2%)	152 (1.2%)	69 (1.3%)	
Missing	16,354 (6.6%)	822 (6.4%)	304 (5.9%)	
Ethnicity				<0.001
Hispanic or Latino	30,325 (12.3%)	1725 (13.5%)	686 (13.3%)	
Not Hispanic or Latino	205,317 (82.9%)	10,544 (82.5%)	4256 (82.6%)	
Other	8028 (3.2%)	330 (2.6%)	144 (2.8%)	
Missing	3960 (1.6%)	183 (1.4%)	68 (1.3%)	
Marital status				<0.001
Married	121,414 (49.0%)	6654 (52.1%)	2766 (53.7%)	
Never married	63,257 (25.5%)	2935 (23.0%)	1190 (23.1%)	
Divorced/separated/single	57,767 (23.3%)	2950 (23.1%)	1095 (21.3%)	
Widow/Widower/widowed	745 (0.3%)	28 (0.2%)	19 (0.4%)	
Missing	4447 (1.8%)	215 (1.7%)	84 (1.6%)	
Rurality				<0.001
Highly rural	2404 (1.0%)	131 (1.0%)	43 (0.8%)	
Rural	77,683 (31.4%)	3856 (30.2%)	1490 (28.9%)	
Urban	166,747 (67.3%)	8763 (68.6%)	3611 (70.1%)	
Missing	796 (0.3%)	32 (0.3%)	10 (0.2%)	
Education				<0.001
<HS diploma	3434 (1.4%)	145 (1.1%)	58 (1.1%)	
HS diploma	207,813 (83.9%)	10,686 (83.6%)	4128 (80.1%)	
Some college	18,684 (7.6%)	997 (7.8%)	451 (8.8%)	
Baccalaureate	11,625 (4.7%)	666 (5.2%)	343 (6.7%)	
Post Baccalaureate	2957 (1.2%)	155 (1.2%)	110 (2.1%)	
Unknown	3117 (1.3%)	133 (1.0%)	64 (1.2%)	
Service branch				0.026
Air Force	13,612 (5.5%)	718 (5.6%)	302 (5.9%)	
Army	175,803 (71.0%)	9082 (71.1%)	3633 (70.5%)	
Coast Guard	140 (0.1%)	6 (0.1%)	0 (0%)	
Marine	41,335 (16.7%)	2198 (17.2%)	844 (16.4%)	
Navy	16,740 (6.8%)	778 (6.1%)	375 (7.3%)	
Component				<0.001
Active Duty	165,576 (66.9%)	8558 (67.0%)	3202 (62.1%)	
Guard	52,599 (21.2%)	2639 (20.7%)	1173 (22.8%)	
Reserve	29,455 (11.9%)	1585 (12.4%)	779 (15.1%)	
Rank				<0.001
Enlisted	238,580 (96.4%)	12,252 (95.9%)	4878 (94.6%)	
Officer	7726 (3.1%)	471 (3.7%)	252 (4.9%)	
Warrant	1324 (0.5%)	59 (0.5%)	24 (0.5%)	
Number of deployments				<0.001
Single deployment	136,303 (55.0%)	6723 (52.6%)	2645 (51.3%)	
Multiple deployments	110,431 (44.6%)	6017 (47.1%)	2493 (48.4%)	
Missing	896 (0.4%)	42 (0.3%)	16 (0.3%)	
Served in a combat zone				<0.001
No	110,777 (44.7%)	5689 (44.5%)	2126 (41.3%)	
Yes	63,244 (25.5%)	3425 (26.8%)	1549 (30.1%)	
Missing	73,609 (29.7%)	3668 (28.7%)	1479 (28.7%)	
Military sexual trauma	15,917 (6.4%)	963 (7.5%)	422 (8.2%)	<0.001
Service connected				<0.001
No	17,240 (7.0%)	468 (3.7%)	122 (2.4%)	
Yes	230,389 (93.0%)	12,314 (96.3%)	5032 (97.6%)	

(*continued on next page*)

Table 1a (*continued*)

	No PE (n = 247,630, 93.3%)	1–7 PE Sessions (n = 12,782, 4.8%)	8+ PE Sessions (n = 5154, 1.9%)	P
Missing	1 (0%)	0 (0%)	0 (0%)	
Smoking in yr before index date	24,159 (9.8%)	1092 (8.5%)	417 (8.1%)	<0.001
Medication	160,215 (64.7%)	8658 (67.7%)	3570 (69.3%)	<0.001
# Comorbidities	2.5 (1.8)	2.9 (1.9)	2.8 (1.9)	<0.001
Comorbidities				
Schizophrenia	3627 (1.5%)	125 (1.0%)	39 (0.8%)	<0.001
Bipolar	32,250 (13.0%)	1760 (13.8%)	654 (12.7%)	0.037
Psychosis	7479 (3.0%)	384 (3.0%)	131 (2.5%)	0.138
Pain	184,021 (74.3%)	10,420 (81.5%)	4310 (83.6%)	<0.001
TBI	36,647 (14.8%)	2766 (21.6%)	1161 (22.5%)	<0.001
Depression	156,713 (63.3%)	9197 (72.0%)	3670 (71.2%)	<0.001
Alcohol abuse	55,164 (22.3%)	3409 (26.7%)	1308 (25.4%)	<0.001
Alcohol dependence	41,545 (16.8%)	2623 (20.5%)	1017 (19.7%)	<0.001
Drug abuse	34,731 (14.0%)	2042 (16.0%)	792 (15.4%)	<0.001
Drug dependence	28,052 (11.3%)	1681 (13.2%)	641 (12.4%)	<0.001
Suicide ideation or attempt	28,605 (11.6%)	2084 (16.3%)	760 (14.8%)	<0.001
# Other therapies before 1st PE	N/A	12.1 (21.5)	13.8 (24.2)	<0.001
# Other therapies before 1st PE, excluding those with no therapy	N/A	(n = 11,141) 13.8 (22.5)	(n = 4528) 15.8 (25.2)	<0.001

Note: P-values for continuous variables are based on Kruskal Wallis test or Mann-Whitney Test, and p-values for categorical variables are based on Chi-Square or Fisher's Exact test.

Medication: Took any of 13 PTSD medications in the one year before or after index date.

Comorbidities other than suicide ideation or attempt were defined as 2+ diagnoses at outpatient or 1+ diagnosis at inpatient or fee basis settings before 09/12/2015 (the last date for PTSD diagnosis for this cohort); suicide ideation or attempt was defined as any diagnosis at any setting before 09/12/2015.

Table 1b

Patient characteristics by CPT status in any 24-weeks during follow-up (N = 265,566).

	No CPT (n = 216,953, 81.7%%)	1–7 CPT Sessions (n = 29,006, 10.9%)	8+ CPT Sessions (n = 19,607, 7.4%)	P
Baseline age	32.0 (8.5)	32.0 (8.3)	33.5 (9.1)	<0.001
Baseline age categories				<0.001
<30	118,339 (54.6%)	15,354 (52.9%)	9148 (46.7%)	
30–39	57,088 (26.3%)	8144 (28.1%)	5510 (28.1%)	
40–49	32,532 (15.0%)	4456 (15.4%)	3841 (19.6%)	
50–59	8176 (3.8%)	982 (3.4%)	1006 (5.1%)	
60–69	816 (0.4%)	70 (0.2%)	101 (0.5%)	
70+	2 (0%)	0 (0%)	1 (0%)	
Gender				<0.001
Male	195,075 (89.9%)	25,354 (87.4%)	16,976 (86.6%)	
Female	21,875 (10.1%)	3652 (12.6%)	2629 (13.4%)	
Missing	3 (0%)	0 (0%)	2 (0%)	
Race				<0.001
White	154,267 (71.1%)	20,921 (72.1%)	13,783 (70.3%)	
Black or African American	36,727 (16.9%)	4843 (16.7%)	3734 (19.0%)	
American Indian or Alaska Native	2490 (1.2%)	386 (1.3%)	294 (1.5%)	
Asian	3553 (1.6%)	396 (1.4%)	315 (1.6%)	
Native Hawaiian or Other Pacific Islander	2532 (1.2%)	394 (1.4%)	242 (1.2%)	
Multi-races	2583 (1.2%)	376 (1.3%)	250 (1.3%)	
Missing	14,801 (6.8%)	1690 (5.8%)	989 (5.0%)	
Ethnicity				<0.001
Hispanic or Latino	26,666 (12.3%)	3778 (13.0%)	2292 (11.7%)	
Not Hispanic or Latino	179,679 (82.8%)	23,971 (82.6%)	16,467 (84.0%)	
Other	7082 (3.3%)	857 (3.0%)	563 (2.9%)	
Missing	3526 (1.6%)	400 (1.4%)	285 (1.5%)	
Marital status				<0.001
Married	106,420 (49.1%)	14,474 (49.9%)	9940 (50.7%)	
Never married	55,733 (25.7%)	6940 (23.9%)	4709 (24.0%)	
Divorced/separated/single	50,197 (23.1%)	7026 (24.2%)	4589 (23.4%)	
Widow/Widower/widowed	642 (0.3%)	92 (0.3%)	58 (0.3%)	
Missing	3961 (1.83%)	474 (1.6%)	311 (1.6%)	
Rurality				<0.001
Highly rural	2042 (0.9%)	317 (1.1%)	219 (1.1%)	
Rural	67,527 (31.1%)	9312 (32.1%)	6190 (31.6%)	
Urban	146,693 (67.6%)	19,280 (66.5%)	13,148 (67.1%)	
Missing	691 (0.3%)	97 (0.3%)	50 (0.3%)	
Education				<0.001
<HS diploma	3059 (1.4%)	362 (1.3%)	216 (1.1%)	
HS diploma	182,649 (84.2%)	24,302 (83.8%)	15,676 (80.0%)	
Some college	16,108 (7.4%)	2262 (7.8%)	1762 (9.0%)	
Baccalaureate	9893 (4.6%)	1405 (4.8%)	1336 (6.8%)	

(*continued on next page*)

Table 1b (*continued*)

	No CPT (n = 216,953, 81.7%%)	1–7 CPT Sessions (n = 29,006, 10.9%)	8+ CPT Sessions (n = 19,607, 7.4%)	*P*
Post Baccalaureate	2540 (1.2%)	321 (1.1%)	361 (1.8%)	
Unknown	2704 (1.3%)	354 (1.2%)	256 (1.3%)	
Service branch				<0.001
Air Force	11,818 (5.5%)	1580 (5.5%)	1234 (6.3%)	
Army	153,728 (70.9%)	20,737 (71.5%)	14,053 (71.7%)	
Coast Guard	129 (0.1%)	11 (0.04%)	6 (0.03%)	
Marine	36,658 (16.9%)	4743 (16.4%)	2976 (15.2%)	
Navy	14,620 (6.7%)	1935 (6.7%)	1338 (6.8%)	
Component				<0.001
Active Duty	145,732 (67.2%)	19,260 (66.4%)	12,344 (63.0%)	
Guard	45,567 (21.0%)	6285 (21.7%)	4559 (23.3%)	
Reserve	25,654 (11.8%)	3461 (11.9%)	2704 (13.8%)	
Rank				<0.001
Enlisted	209,204 (96.4%)	27,956 (96.4%)	18,550 (94.6%)	
Officer	6594 (3.0%)	911 (3.1%)	944 (4.8%)	
Warrant	1155 (0.5%)	139 (0.5%)	113 (0.6%)	
Number of deployments				<0.001
Single deployment	119,614 (55.1%)	15,702 (54.1%)	10,355 (52.8%)	
Multiple deployments	96,582 (44.5%)	13,198 (45.5%)	9161 (46.7%)	
Missing	757 (0.4%)	106 (0.4%)	91 (0.5%)	
Served in a combat zone				<0.001
No	96,927 (44.7%)	12,976 (44.7%)	8689 (44.3%)	
Yes	55,339 (25.5%)	7534 (26.0%)	5345 (27.3%)	
Missing	64,687 (29.8%)	8496 (29.3%)	5573 (28.4%)	
Military sexual trauma	12,750 (5.9%)	2543 (8.8%)	2009 (10.3%)	<0.001
Service connected				<0.001
No	16,193 (7.5%)	1126 (3.9%)	511 (2.6%)	
Yes	200,759 (92.5%)	27,880 (96.1%)	19,096 (97.4%)	
Missing	1 (0%)	0 (0%)	0 (0%)	
CPT format ever received				<0.001
Individual only	N/A	19,956 (68.8%)	9294 (47.4%)	
Group only	N/A	6409 (22.1%)	3818 (19.5%)	
Both individual and group	N/A	2618 (9.0%)	6495 (33.1%)	
Missing	N/A	23 (0.1%)	0 (0%)	
Smoking yr before index date	21,319 (9.8%)	2710 (9.3%)	1639 (8.4%)	<0.001
Medication	139,601 (64.4%)	19,542 (67.4%)	13,300 (67.8%)	<0.001
# Comorbidities	2.4 (1.8)	2.9 (2.0)	3.2 (2.1)	<0.001
Comorbidities				
Schizophrenia	3148 (1.5%)	366 (1.3%)	277 (1.4%)	0.038
Bipolar	26,749 (12.3%)	4561 (15.7%)	3354 (17.1%)	<0.001
Psychosis	6245 (2.9%)	996 (3.4%)	753 (3.8%)	<0.001
Pain	159,145 (73.4%)	23,443 (80.8%)	16,163 (82.4%)	<0.001
TBI	30,899 (14.2%)	5663 (19.5%)	4012 (20.5%)	<0.001
Depression	134,134 (61.8%)	20,727 (71.5%)	14,719 (75.1%)	<0.001
Alcohol abuse	45,929 (21.2%)	7920 (27.3%)	6032 (30.8%)	<0.001
Alcohol dependence	33,600 (15.5%)	6357 (21.9%)	5228 (26.7%)	<0.001
Drug abuse	28,149 (13.0%)	5288 (18.2%)	4128 (21.1%)	<0.001
Drug dependence	22,482 (10.4%)	4354 (15.0%)	3538 (18.0%)	<0.001
Suicide ideation or attempt	22,842 (10.5%)	4779 (16.5%)	3828 (19.5%)	<0.001
# Other therapies before 1st CPT	N/A	10.8 (20.5)	12.7 (20.6)	<0.001
# Other therapies before 1st CPT, excluding those with no therapy	N/A	(n = 23,965) 13.1 (21.9)	(n = 16,701) 14.9 (21.6)	<0.001

Note: P-values for continuous variables are based on Kruskal Wallis test or Mann-Whitney test, and p-values for categorical variables are based on Chi-Square or Fisher's Exact test.

Medication: Took any of 13 PTSD medications in the year before or after index date.

Comorbidities other than suicide ideation or attempt were defined as 2+ diagnoses at outpatient or 1+ diagnosis at inpatient or fee basis settings before 09/12/2015 (the last date for PTSD diagnosis for this cohort); suicide ideation or attempt was defined as any diagnosis at any setting before 09/12/2015.

Table 2a

Ordered logistic regression predicting likelihood of No PE sessions, Partial dose (1–7 sessions), and Full dose (8+ sessions) by patient characteristics.

	Odds ratio (95% CI)	*P*
Baseline age category		
<30	Ref	
30–39	1.11 (1.06–1.15)	<0.001
40–49	1.10 (1.05–1.16)	<0.001
50–59	0.93 (0.85–1.01)	0.097
60+*	0.89 (0.68–1.17)	0.412
Gender		
Male	Ref	
Female	0.93 (0.88–0.99)	0.017

(*continued on next page*)

Table 2a (*continued*)

	Odds ratio (95% CI)	*P*
Race		
White	Ref	
Black /African American	1.09 (1.04–1.13)	<0.001
American Indian or Alaska Native	1.06 (0.92–1.21)	0.441
Asian	1.10 (0.97–1.24)	0.130
Native Hawaiian or Other Pacific Islander	1.03 (0.89–1.18)	0.685
Multi-races	1.02 (0.88–1.17)	0.828
Missing	1.02 (0.95–1.09)	0.553
Ethnicity		
Hispanic or Latino	Ref	
Not Hispanic or Latino	0.93 (0.89–0.98)	0.005
Other	0.78 (0.70–0.87)	<0.001
Missing	0.83 (0.72–0.95)	0.007
Marital status		
Married	Ref	
Never married	0.89 (0.85–0.92)	<0.001
Divorced/separated/single	0.88 (0.84–0.91)	<0.001
Widow/Widower/widowed	0.80 (0.59–1.07)	0.133
Missing	0.99 (0.87–1.12)	0.896
Service branch		
Air force	Ref	
Army	0.96 (0.90–1.03)	0.249
Coast Guard	0.56 (0.25–1.28)	0.173
Marine	1.03 (0.95–1.11)	0.524
Navy	0.90 (0.82–0.98)	0.016
Component		
Active Duty (regular)	Ref	
Guard	1.05 (1.01–1.09)	0.027
Reserve	1.16 (1.11–1.22)	<0.001
Rank		
Enlisted	Ref	
Officer	1.31 (1.21–1.42)	<0.001
Warrant	0.86 (0.69–1.08)	0.204
Number of deployments		
Single deployment	Ref	
Multiple deployments	1.11 (1.07–1.14)	<0.001
Missing	0.90 (0.68–1.18)	0.458
Military sexual trauma	1.26 (1.18–1.35)	<0.001
Smoking	0.86 (0.82–0.91)	<0.001
Medication	1.06 (1.02–1.09)	0.001
Schizophrenia	0.54 (0.46–0.63)	<0.001
Bipolar	0.90 (0.86–0.95)	<0.001
Pain	1.37 (1.31–1.42)	<0.001
TBI	1.45 (1.40–1.51)	<0.001
Depression	1.31 (1.27–1.36)	<0.001
Alcohol abuse	1.12 (1.07–1.17)	<0.001
Alcohol dependence	1.12 (1.07–1.17)	<0.001
Drug abuse	0.98 (0.93–1.04)	0.500
Drug dependence	1.01 (0.95–1.07)	0.728
Suicide ideation or attempt	1.28 (1.22–1.34)	<0.001
Year of 1st mental health visit		
2001–2005	Ref	
2006	1.17 (1.07–1.27)	<0.001
2007	1.15 (1.07–1.25)	<0.001
2008	1.29 (1.19–1.39)	<0.001
2009	1.35 (1.25–1.45)	<0.001
2010	1.31 (1.21–1.41)	<0.001
2011	1.24 (1.15–1.34)	<0.001
2012	1.28 (1.18–1.38)	<0.001
2013	1.28 (1.18–1.38)	<0.001
2014	1.27 (1.17–1.39)	<0.001
2015–2017	1.31 (1.12–1.52)	<0.001
Rurality		
Urban	Ref	
Rural	0.93 (0.90–0.96)	<0.001
Highly rural	0.97 (0.83–1.13)	0.694
Missing	0.67 (0.49–0.92)	0.013
Service connected		
No	Ref	
Yes	1.82 (1.67–1.98)	<0.001
Served in a combat zone		
No	Ref	
Yes	1.14 (1.10–1.18)	<0.001

(*continued on next page*)

Table 2b
Ordered logistic regression predicting likelihood of No CPT sessions, Partial dose (1–7 sessions), and Full dose (8+ sessions) by patient characteristics.

	Odds ratio (95% CI)	P
Baseline age category		
<30	Ref	
30–39	1.11 (1.06–1.16)	<0.001
40–49	1.35 (1.27–1.43)	<0.001
50–59	1.58 (1.42–1.75)	<0.001
60+	2.14 (1.55–2.95)	<0.001
Gender		
Male	Ref	
Female	1.04 (0.96–1.12)	0.351
Race		
White	Ref	
Black /African American	1.02 (0.97–1.08)	0.456
American Indian or Alaska Native	1.06 (0.90–1.25)	0.457
Asian	1.11 (0.95–1.30)	0.206
Native Hawaiian or Other Pacific Islander	0.90 (0.76–1.08)	0.266
Multi-races	0.95 (0.80–1.13)	0.568
Missing	0.94 (0.86–1.03)	0.182
Ethnicity		
Hispanic or Latino	Ref	
Not Hispanic or Latino	1.15 (1.08–1.22)	<0.001
Other	1.07 (0.94–1.22)	0.294
Missing	1.13 (0.95–1.35)	0.167
Marital status		
Married	Ref	
Never married	1.05 (1.00–1.11)	0.045
Divorced/separated/single	0.91 (0.87–0.96)	<0.001
Widow/Widower/widowed	0.73 (0.51–1.04)	0.079
Missing	0.94 (0.80–1.11)	0.483
Service branch		
Air force	Ref	
Army	0.92 (0.85–1.00)	0.063
Coast Guard	0.67 (0.23–1.95)	0.468
Marine	0.97 (0.88–1.07)	0.550
Navy	0.93 (0.83–1.03)	0.171
Component		
Active Duty (regular)	Ref	
Guard	1.08 (1.03–1.14)	0.003
Reserve	1.14 (1.08–1.22)	<0.001
Rank		
Enlisted	Ref	
Officer	1.43 (1.29–1.58)	<0.001
Warrant	1.02 (0.79–1.34)	0.856
Number of deployments		
Single deployment	Ref	
Multiple deployments	1.03 (0.99–1.08)	0.090
Missing	1.20 (0.89–1.62)	0.227
Military sexual trauma	1.15 (1.06–1.25)	0.001
Smoking	0.91 (0.85–0.97)	0.005
Medication	0.93 (0.89–0.97)	<0.001
Schizophrenia	1.04 (0.87–1.25)	0.659
Bipolar	0.96 (0.91–1.02)	0.153
Psychosis	0.95 (0.85–1.07)	0.401
Pain	1.00 (0.95–1.05)	0.977
TBI	1.03 (0.98–1.08)	0.266
Depression	1.06 (1.02–1.12)	0.008
Alcohol abuse	1.03 (0.98–1.09)	0.233
Alcohol dependence	1.10 (1.04–1.16)	0.001
Drug abuse	0.97 (0.90–1.03)	0.324
Drug dependence	1.04 (0.96–1.11)	0.340
Suicide ideation or attempt	1.03 (0.97–1.09)	0.388
Year of 1st mental health visit		
2001–2005	Ref	
2006	0.95 (0.86–1.05)	0.308
2007	0.92 (0.84–1.01)	0.089
2008	0.95 (0.87–1.04)	0.293
2009	1.00 (0.91–1.10)	0.999
2010	1.01 (0.92–1.11)	0.807
2011	1.06 (0.97–1.17)	0.203
2012	1.08 (0.98–1.19)	0.105
2013	1.09 (0.99–1.20)	0.085
2014	1.21 (1.08–1.34)	0.001
2015–2017	1.14 (0.94–1.38)	0.187
Rurality		

(*continued on next page*)

Table 2b (*continued*)

	Odds ratio (95% CI)	P
Urban	Ref	
Rural	0.99 (0.95–1.03)	0.632
Highly rural	0.94 (0.78–1.13)	0.503
Missing	0.70 (0.48–1.02)	0.066
Service connected		
No	Ref	
Yes	1.32 (1.18–1.48)	< 0.001
Served in a combat zone		
No	Ref	
Yes	1.10 (1.05–1.15)	< 0.001
missing	1.01 (0.96–1.06)	0.715
CPT format ever received		
Individual	Ref	
Group	1.25 (1.19–1.32)	< 0.001
Both individual and group	5.30 (5.02–5.59)	< 0.001

Table 3a
Cox proportional hazards regression for completion of first PE.

	Hazard Ratio (95% CI)	*P*
Baseline age category		
< 30	Ref	
30–39	1.26 (1.18–1.35)	< 0.001
40–49	1.43 (1.31–1.55)	< 0.001
50–59	1.29 (1.11–1.48)	0.001
60 +	1.31 (0.86–1.48)	0.205
Gender		
Male	Ref	
Female	0.84 (0.75–0.94)	0.002
Race		
White	Ref	
Black or African American	1.24 (1.15–1.33)	< 0.001
American Indian or Alaska Native	0.99 (0.77–1.29)	0.961
Asian	1.16 (0.94–1.42)	0.172
Native Hawaiian or Other Pacific Islander	0.92 (0.71–1.20)	0.549
Multi-races	1.14 (0.90–1.45)	0.286
Missing	0.98 (0.87–1.11)	0.786
Ethnicity		
Hispanic or Latino	Ref	
Not Hispanic or Latino	0.93 (0.85–1.01)	0.083
Other	0.83 (0.69–1.00)	0.050
Missing	0.76 (0.59–0.99)	0.038
Marital status		
Married	Ref	
Never married	0.97 (0.90–1.04)	0.399
Divorced/separated/single	0.85 (0.79–0.91)	< 0.001
Widow/Widower/widowed	1.04 (0.66–1.63)	0.869
Missing	0.94 (0.75–1.18)	0.589
Service branch		
Air force	Ref	
Army	0.94 (0.84–1.06)	0.332
Coast Guard	-*	-*
Marine	1.06 (0.93–1.22)	0.382
Navy	1.01 (0.86–1.17)	0.948
Component		
Active Duty (regular)	Ref	
Guard	1.12 (1.04–1.21)	0.002
Reserve	1.27 (1.17–1.38)	< 0.001
Rank		
Enlisted	Ref	
Officer	1.39 (1.22–1.59)	< 0.001
Warrant	0.77 (0.51–1.15)	0.195
Number of deployments		
Single deployment	Ref	
Multiple deployments	1.13 (1.07–1.19)	< 0.001
Missing	0.78 (0.48–1.28)	0.329
Military sexual trauma	1.39 (1.24–1.57)	< 0.001
Smoking	0.85 (0.76–0.94)	0.001
Medication	1.13 (1.06–1.20)	< 0.001
Schizophrenia	0.53 (0.38–0.74)	< 0.001

(*continued on next page*)

Table 3a (*continued*)

	Hazard Ratio (95% CI)	*P*
Bipolar	0.89 (0.82–0.97)	0.009
Psychosis	0.81 (0.68–0.98)	0.029
Pain	1.43 (1.33–1.55)	<0.001
TBI	1.50 (1.40–1.60)	<0.001
Depression	1.22 (1.14–1.30)	<0.001
Alcohol abuse	1.09 (1.02–1.17)	0.018
Alcohol dependence	1.12 (1.03–1.21)	0.005
Suicide ideation or attempt	1.21 (1.11–1.32)	<0.001
Year of 1st mental health visit		
2001–2005	Ref	
2006	1.41 (1.21–1.64)	<0.001
2007	1.43 (1.23–1.65)	<0.001
2008	1.77 (1.54–2.05)	<0.001
2009	2.08 (1.80–2.40)	<0.001
2010	2.34 (2.02–2.70)	<0.001
2011	2.38 (2.06–2.76)	<0.001
2012	2.83 (2.44–3.28)	<0.001
2013	2.88 (2.46–3.36)	<0.001
2014	4.25 (3.60–5.01)	<0.001
2015–2017	6.08 (4.70–7.88)	<0.001
Rurality		
Urban	Ref	
Rural	0.91 (0.85–0.97)	0.003
Highly rural	0.85 (0.63–1.14)	0.277
Missing	0.56 (0.30–1.04)	0.068
Service connected		
No	Ref	
Yes	2.35 (1.96–2.81)	<0.001
Served in a combat zone		
No	Ref	
Yes	1.26 (1.18–1.35)	<0.001
missing	1.05 (0.98–1.13)	0.130

* Coast guard group had no observation of outcome (full-dose PE), so no estimate of HR.

Table 3b
Cox proportional hazards regression for completion of first CPT.

	Hazard Ratio (95% CI)	*P*
Baseline age category		
<30	Ref	
30–39	1.11 (1.07–1.15)	<0.001
40–49	1.29 (1.23–1.35)	<0.001
50–59	1.45 (1.35–1.56)	<0.001
60+	1.92 (1.57–2.34)	<0.001
Gender		
Male	Ref	
Female	1.03 (0.98–1.09)	0.272
Race		
White	Ref	
Black or African American	0.99 (0.95–1.03)	0.625
American Indian or Alaska Native	1.06 (0.95–1.19)	0.304
Asian	1.07 (0.95–1.19)	0.273
Native Hawaiian or Other Pacific Islander	0.93 (0.82–1.06)	0.304
Multi-races	0.94 (0.83–1.06)	0.309
Missing	0.97 (0.90–1.03)	0.325
Ethnicity		
Hispanic or Latino	Ref	
Not Hispanic or Latino	1.13 (1.08–1.18)	<0.001
Other	1.08 (0.98–1.19)	0.131
Missing	1.14 (1.00–1.29)	0.045
Marital status		
Married	Ref	
Never married	1.04 (1.00–1.08)	0.028
Divorced/separated/single	0.93 (0.90–0.96)	<0.001
Widow/Widower/widowed	0.72 (0.56–0.93)	0.013
Missing	0.99 (0.88–1.12)	0.915
Service branch		
Air force	Ref	
Army	0.94 (0.89–1.00)	0.060

(*continued on next page*)

Table 3b (*continued*)

	Hazard Ratio (95% CI)	*P*
Coast Guard	0.83 (0.37–1.86)	0.652
Marine	0.99 (0.92–1.06)	0.691
Navy	0.96 (0.89–1.04)	0.311
Component		
Active Duty (regular)	Ref	
Guard	1.05 (1.01–1.09)	0.009
Reserve	1.09 (1.04–1.14)	<0.001
Rank		
Enlisted	Ref	
Officer	1.32 (1.23–1.41)	<0.001
Warrant	1.01 (0.83–1.22)	0.940
Number of deployments		
Single deployment	Ref	
Multiple deployments	1.02 (0.99–1.05)	0.122
Missing	1.21 (0.98–1.49)	0.077
Military sexual trauma	1.09 (1.03–1.16)	0.003
Smoking	0.93 (0.88–0.98)	0.006
Medication	0.99 (0.96–1.02)	0.551
Schizophrenia	1.01 (0.89–1.14)	0.898
Bipolar	0.98 (0.94–1.02)	0.395
Psychosis	0.98 (0.91–1.06)	0.608
Pain	1.00 (0.96–1.04)	0.859
TBI	1.03 (0.99–1.07)	0.096
Depression	1.05 (1.01–1.09)	0.007
Alcohol abuse	1.02 (0.98–1.06)	0.283
Alcohol dependence	1.06 (1.02–1.11)	0.005
Drug abuse	0.97 (0.92–1.02)	0.204
Drug dependence	1.02 (0.97–1.07)	0.538
Suicide ideation or attempt	1.02 (0.98–1.06)	0.363
Year of 1st mental health visit		
2001–2005	Ref	
2006	1.20 (1.11–1.29)	<0.001
2007	1.38 (1.28–1.48)	<0.001
2008	1.68 (1.56–1.80)	<0.001
2009	2.09 (1.95–2.25)	<0.001
2010	2.51 (2.33–2.70)	<0.001
2011	3.15 (2.92–3.39)	<0.001
2012	3.94 (3.65–4.24)	<0.001
2013	4.99 (4.62–5.40)	<0.001
2014	7.30 (6.69–7.95)	<0.001
2015–2017	9.62 (8.30–11.16)	<0.001
Rurality		
Urban	Ref	
Rural	0.99 (0.96–1.03)	0.704
Highly rural	0.97 (0.85–1.11)	0.683
Missing	0.80 (0.60–1.07)	0.133
Service connected		
No	Ref	
Yes	1.15 (1.06–1.26)	0.002
Served in a combat zone		
No	Ref	
Yes	1.06 (1.03–1.10)	<0.001
missing	1.01 (0.97–1.04)	0.690
CPT format ever received		
Individual	Ref	
Group	1.21 (1.16–1.25)	<0.001
Both individual and group	3.07 (2.97–3.17)	<0.001

Table 1a
Logistic regression (comparing PE completers and early terminators).

	Odds ratio (95% CI)	*P*
Baseline age category		
<30	Ref	
30–39	1.20 (1.10–1.30)	<0.001
40–49	1.45 (1.31–1.61)	<0.001
50–59	1.57 (1.31–1.88)	<0.001
60+	1.69 (0.99–2.89)	0.055
Gender		
Male	Ref	
Female	0.87 (0.76–0.99)	0.038

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Table 1a (*continued*)

	Odds ratio (95% CI)	*P*
Race		
White	Ref	
Black /African American	1.20 (1.10–1.31)	<0.001
American Indian or Alaska Native	0.91 (0.67–1.23)	0.546
Asian	1.08 (0.84–1.38)	0.561
Native Hawaiian or Other Pacific Islander	0.85 (0.63–1.16)	0.317
Multi-races	1.14 (0.86–1.53)	0.364
Missing	0.94 (0.81–1.09)	0.423
Ethnicity		
Hispanic or Latino	Ref	
Not Hispanic or Latino	0.98 (0.89–1.09)	0.769
Other	1.08 (0.86–1.35)	0.528
Missing	0.86 (0.64–1.17)	0.345
Marital status		
Married	Ref	
Never married	1.11 (1.02–1.21)	0.019
Divorced/separated/single	0.92 (0.85–1.00)	0.060
Widow/Widower/widowed	1.48 (0.82–2.68)	0.197
Missing	0.90 (0.68–1.18)	0.441
Service branch		
Air Force	Ref	
Army	0.97 (0.84–1.12)	0.670
Coast Guard	(no observation)	–
Marine	1.06 (0.90–1.25)	0.496
Navy	1.16 (0.96–1.40)	0.123
Component		
Active Duty	Ref	
Guard	1.11 (1.01–1.21)	0.023
Reserve	1.18 (1.07–1.31)	0.001
Rank		
Enlisted	Ref	
Officer	1.16 (0.98–1.36)	0.084
Warrant	0.86 (0.53–1.39)	0.540
Number of deployments		
Single deployment	Ref	
Multiple deployments	1.05 (0.98–1.12)	0.160
Missing	0.84 (0.47–1.53)	0.576
Military sexual trauma	1.19 (1.02–1.38)	0.023
Smoking	0.97 (0.86–1.10)	0.673
Medication	1.09 (1.01–1.17)	0.021
Schizophrenia	0.81 (0.56–1.17)	0.263
Bipolar	0.94 (0.84–1.04)	0.208
Pain	1.11 (1.01–1.22)	0.024
TBI	1.07 (0.99–1.16)	0.089
Depression	0.91 (0.84–0.98)	0.014
Alcohol abuse	0.96 (0.88–1.05)	0.330
Alcohol dependence	0.98 (0.88–1.05)	0.631
Drug abuse	1.08 (0.96–1.23)	0.195
Drug dependence	1.00 (0.88–1.15)	0.948
Suicide ideation or attempt	0.90 (0.81–1.00)	0.053
# Other therapies before 1st PE	1.00 (1.00–1.01)	<0.001
Year of 1st mental health visit		
2001–2005	Ref	
2006	1.15 (0.96–1.37)	0.133
2007	1.05 (0.89–1.25)	0.538
2008	1.07 (0.90–1.25)	0.447
2009	1.06 (0.90–1.25)	0.452
2010	1.12 (0.95–1.32)	0.165
2011	1.06 (0.90–1.25)	0.502
2012	1.06 (0.90–1.26)	0.474
2013	0.87 (0.73–1.04)	0.118
2014	1.15 (0.95–1.39)	0.158
2015–2017	1.32 (0.96–1.80)	0.083
Rurality		
Urban	Ref	
Rural	0.95 (0.88–1.02)	0.172
Highly rural	0.84 (0.59–1.19)	0.322
Missing	0.73 (0.35–1.51)	0.399
Service connected		
No	Ref	
Yes	1.47 (1.20–1.81)	<0.001
Served in a combat zone		
No	Ref	
Yes	1.19 (1.09–1.29)	<0.001
Missing	1.08 (1.00–1.17)	0.050

Table 1b
Logistic regression (comparing CPT completers and early terminators).

	Odd ratio (95% CI)	*P*
Baseline age category		
<30	Ref	
30–39	1.11 (1.05–1.16)	<0.001
40–49	1.34 (1.26–1.42)	<0.001
50–59	1.56 (1.41–1.73)	<0.001
60+	2.11 (1.53–2.92)	<0.001
Gender		
Male	Ref	
Female	1.03 (0.96–1.11)	0.382
Race		
White	Ref	
Black /African American	1.02 (0.97–1.08)	0.404
American Indian or Alaska Native	1.07 (0.90–1.25)	0.449
Asian	1.11 (0.95–1.30)	0.195
Native Hawaiian or Other Pacific Islander	0.90 (0.76–1.08)	0.259
Multi-races	0.94 (0.79–1.12)	0.501
Missing	0.94 (0.86–1.03)	0.172
Ethnicity		
Hispanic or Latino	Ref	
Not Hispanic or Latino	1.15 (1.08–1.22)	<0.001
Other	1.07 (0.94–1.22)	0.305
Missing	1.13 (0.95–1.34)	0.174
Marital status		
Married	Ref	
Never married	1.05 (1.00–1.11)	0.047
Divorced/separated/single	0.91 (0.87–0.96)	<0.001
Widow/Widower/widowed	0.73 (0.51–1.04)	0.078
Missing	0.95 (0.80–1.11)	0.505
Service branch		
Air Force	Ref	
Army	0.92 (0.84–1.00)	0.050
Coast Guard	0.66 (0.23–1.92)	0.448
Marine	0.97 (0.88–1.07)	0.535
Navy	0.93 (0.83–1.03)	0.163
Component		
Active Duty	Ref	
Guard	1.08 (1.03–1.14)	0.003
Reserve	1.14 (1.07–1.22)	<0.001
Rank		
Enlisted	Ref	
Officer	1.43 (1.29–1.58)	<0.001
Warrant	1.01 (0.78–1.32)	0.929
Number of deployments		
Single deployment	Ref	
Multiple deployments	1.03 (0.99–1.08)	0.091
Missing	1.21 (0.89–1.62)	0.220
Military sexual trauma	1.15 (1.06–1.25)	0.001
Smoking	0.91 (0.85–0.97)	0.007
Medication	0.92 (0.88–0.96)	<0.001
Schizophrenia	1.02 (0.85–1.22)	0.828
Bipolar	0.96 (0.90–1.01)	0.121
Psychosis	0.94 (0.84–1.06)	0.311
Pain	1.00 (0.95–1.05)	0.892
TBI	1.03 (0.98–1.08)	0.315
Depression	1.06 (1.01–1.11)	0.010
Alcohol abuse	1.03 (0.98–1.08)	0.292
Alcohol dependence	1.09 (1.03–1.16)	0.003
Drug abuse	0.96 (0.90–1.03)	0.232
Drug dependence	1.03 (0.96–1.11)	0.358
Suicide ideation or attempt	1.02 (0.96–1.08)	0.542
# Other therapies before 1st CPT	1.00 (1.00–1.01)	<0.001
Year of 1st mental health visit		
2001–2005	Ref	
2006	0.96 (0.87–1.06)	0.433
2007	0.94 (0.85–1.03)	0.201
2008	0.97 (0.89–1.07)	0.580
2009	1.02 (0.93–1.13)	0.609
2010	1.04 (0.95–1.15)	0.396
2011	1.10 (1.00–1.21)	0.056
2012	1.11 (1.01–1.23)	0.025
2013	1.13 (1.02–1.24)	0.019
2014	1.25 (1.12–1.39)	<0.001
2015–2017	1.18 (0.97–1.43)	0.096

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Table 1b (*continued*)

	Odd ratio (95% CI)	*P*
Rurality		
Urban	Ref	
Rural	0.99 (0.95–1.03)	0.672
Highly rural	0.94 (0.78–1.13)	0.526
Missing	0.68 (0.47–1.00)	0.048
Service connected		
No	Ref	
Yes	1.32 (1.18–1.47)	<0.001
Served in a combat zone		
No	Ref	
Yes	1.10 (1.05–1.15)	<0.001
missing	1.01 (0.96–1.06)	0.743
CPT format ever received		
Individual	Ref	
Group	1.25 (1.19–1.31)	<0.001
Both individual and group	5.29 (5.01–5.58)	<0.001

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2019.02.027.

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