Published in final edited form as:

J Trauma Acute Care Surg. 2018 August ; 85(2): 263–270. doi:10.1097/TA.0000000000001944.

Six-month Follow Up of the Injured Trauma Survivor Screen (ITSS): Clinical Implications and Future Directions

Joshua C. Hunt, Ph.D.,

Medical College of Wisconsin, 9200 West Wisconsin Ave., Milwaukee, WI 53226

Samantha A. Chesney, M.S.,

Marquette University

Karen Brasel, M.D., MPH, and

Oregon Health and Science University

Terri A. deRoos-Cassini, Ph.D.

Medical College of Wisconsin

Abstract

Background—The Injured Trauma Survivor Screen (ITSS) has been shown to predict PTSD and depression risk at one-month after traumatic injury. This study explored the ability of the ITSS to predict chronic distress after injury, as well as the impact of combining the ITSS with an additional screening measure.

Method—Patients were enrolled following admission to a Level 1 trauma center. Baseline measurements were collected during initial hospitalization, and follow-up measures were collected an average of 6.5 months after injury. Receiver Operating Characteristic (ROC) curve analyses were run to determine predictive accuracy, controlling for participants who had mental health intervention and for those who experienced additional potentially psychologically traumatic events since their injury event.

Results—Utilizing a cut score of 2, the ITSS PTSD scale had a sensitivity of 85.42%, specificity 67.35%, NPV 91.9% and PPV 51.4%. The Combined PTSD risk group (risk positive on the baseline ITSS and the PTSD Checklist for the DSM-5) had a sensitivity of 72.92%, specificity 81.63%, NPV 88.2% and PPV 61.6%. Also utilizing a cut score of 2, the ITSS Depression scale had a sensitivity of 72.50%, specificity 70.29%, NPV 91.1% and PPV 37.9%.

Conclusions—The 9-item ITSS, which takes approximately five minutes to administer, is a stable screening tool for predicting those most at risk for PTSD and/or depression six-months after

Corresponding Author: 414-805-8641, Fax: 414-805-8641, jhunt@mcw.edu.

Authorship

J.C.H. contributed to the study design, data collection, data analysis, data interpretation, writing, and revision. S.A.C. contributed to data analysis, data interpretation, writing, and revision. K. B. contributed to data interpretation, writing, and revision. T.A.d-C. contributed to the study design, data collection, data analysis, data interpretation, writing, and revision.

Disclosure

The authors declare no conflicts of interest.

The authors have no conflicts of interest to report.

76th Annual Meeting of AAST and Clinical Congress of Acute Care Surgery, September 13–16, 2017, in Baltimore, MD

admission to a Level 1 trauma center following traumatic injury. The Combined PTSD risk group data provide evidence that symptom evaluation by a psychologist can improve specificity. These results further inform the recommendation of the American College of Surgeons Committee on Trauma regarding PTSD and depression screening in trauma centers.

Level of Evidence—Prognostic study, Level III.

Keywords

PTSD; depression; screen; traumatic injury; trauma centers

BACKGROUND

There is mounting support for multidisciplinary and multifactorial approaches to both physical and psychological care of traumatic injury survivors.¹ Where medical care advances have addressed improving survival, attention is also now needed for factors related to a return to function following admission to the hospital for a traumatic injury. A primary contributor to postinjury quality of life is posttraumatic psychological distress.² Specifically, depression rates are reported to vary from 30–40% of trauma survivors,³ and posttraumatic stress disorder (PTSD) rates are 20–30%,⁴ although posttraumatic sequelae are not limited to these two disorders.⁵ This presents a critical challenge for the field as it continues to improve upon how providers may identify and address patient's needs in this domain.

Previous research has shown that while it is difficult to predict posttraumatic psychopathology following a traumatic injury event, both self-report and automated screening measures show significant promise.^{6–9} Underscoring the importance of these measures is the American College of Surgeons – Committee on Trauma's (ACS-CoT) recognition of the need to address mental health concerns and subsequent recommendation to screen for posttraumatic psychological distress following admission for a traumatic injury.¹⁰ Previously published and available online (see supplemental digital content), the Injured Trauma Survivor Screen (ITSS) is a brief self-report measure consisting of nine, yes/no questions, created for and normed on individuals admitted to the trauma service of a Level 1 Trauma Center.⁶ Stepwise logistic regression was used to identify the items that were most predictive of PTSD (sensitivity = 75.00; specificity = 93.94) and a current major depressive episode (sensitivity = 75.00; specificity = 80.8) at one-month post injury.

At the institution in which the ITSS was created, it is currently being administered by the trauma service social workers as a part of routine care. It is the first step in the *Multi-tier Approach to Psychological Intervention after Traumatic injury* ([MAPIT]; Figure 1). If an individual screens positive for either depression or PTSD risk (i.e., a total sum score of 2 or more on either subscale), a *Best Practice* alert is generated in the patient's electronic chart (or electronic medical record). At that point either a physician or an advanced practice provider ([APP] e.g., nurse practitioner or physician's assistant) may check a box to recommend inpatient consultation. Once a consult is placed, the inpatient trauma psychology service is alerted and conducts clinical assessment and intervention as appropriate. The clinical psychologists use a combination of an individual's risk score and clinical interviewing

techniques to determine appropriate dissemination of psychoeducation, psychotherapeutic intervention, or referral to an appropriate provider if necessary.

With regard to outpatient follow-up, it is important to note that there is a great deal of historical scientific evidence for the efficacy and effectiveness of psychotherapy for mental health disorders generally,¹¹ although there is significant current debate about the superiority of any one approach.^{12,13} In fact, psychotherapy for PTSD is a first-line treatment recommendation from the National Center for PTSD.¹⁴ Evidence is also mounting for the implementation of psychotherapy as an early-stage secondary prevention strategy, even in the acute aftermath of traumatic injury.^{15,16} To deliver these services at the institution in which the ITSS was created, there are currently two full-time psychology faculty employed within the Department of Surgery, Division of Critical Care and Acute Care Surgery. Supporting these full-time employees is one, full-time postdoctoral trauma psychology fellow, one rotating (i.e., three days per week) predoctoral psychology resident, and one, part-time (i.e., two days per week) advanced psychology practicum student.

The purpose of the current study was to conduct a six-month follow-up of the ITSS by evaluating sensitivity and specificity to predict six-month PTSD and depression. The analyses presented herein are an extension of the one-month post-injury analyses published by Hunt and colleagues;⁶ therefore, it should be noted that the initial sample (i.e., those who completed assessments during their initial hospitalization) in the current study is identical to that of the previous publication on one-month follow-up data.

In order to evaluate one other aspect of MAPIT, we included a measure of posttraumatic psychological distress in additional ROC curve analyses. The PTSD Checklist for the DSM-5 (PCL-5) is a routine part of our follow-up assessment conducted by psychology. Given that the ITSS questions patients on risk-factors of posttraumatic distress, based on clinical experience, we hypothesized that adding a symptom-based measure to the analyses would likely enhance the sensitivity and/or specificity of PTSD prediction at six-months postinjury. Should this tiered system of psychological care enhance risk prediction for this screening tool, it would inform the development of mental health services for trauma centers attempting to meet the recommendations of the ACS-CoT, as well as inform next steps after a positive screen.

METHOD

Participants and Study Design

The current study sample included adult injured trauma survivors admitted to a Level 1 Trauma Center in the Midwestern U.S. The medical center institutional review board (IRB) approved all measures and procedures prior to study initiation. To create the current sample, measurement data from two prospective longitudinal studies were combined. These studies had identical recruitment procedures, participant sampling population, and criteria for inclusion. Possible participants were a consecutive sample of adults identified via a daily trauma census, who were approached while in hospital for consent. Inclusion criteria included the following: 1) at least 18 years of age; 2) Glasgow Coma Scale 13 upon arrival to the emergency department, and no evidence of moderate or severe brain injury; 3) injury

was not self-inflicted; 4) ability to communicate; 5) English speaking. Participants were not required to have completed a clinical consultation with the inpatient trauma psychology service as a result of a positive screen; involvement in this study was determined independently from involvement in clinical assessment or intervention.

Data were collected for these studies between February 2014 and May 2016. Over that time period there were 2,359 admissions to the trauma service. Using the registry software, a report was run in the electronic medical record using the inclusion criteria for these studies, except for language (i.e., English speaking) as that variable was unavailable in the registry for inquiry. Based on this inquiry, approximately 1,957 admissions would have been viable candidates for participation in this study. All participants ($N = 401$) were enrolled during initial hospitalization and administered the ITSS and the PCL-5 while on the inpatient trauma/critical care service.

The Clinician Administered PTSD Scale for *DSM-5* (CAPS-5), and the Center for Epidemiological Studies Depression Scale, revised version (CESD-R) were administered by graduate and postdoctoral level mental health professionals approximately six-months after injury. Retention between hospitalization and follow-up was 51.9%, yielding a six-month follow-up sample of $N = 208$. Of these participants, six individuals were excluded due to missing data, leaving an analytic sample of $N = 202$. For a subsample ($n = 11$ in one sample; $n = 19$ in the other sample) of the CAPS-5 administrations, a team member who did not complete the live interview listened to an audio recording and double scored the interview, and agreement at the level of diagnosis was 100%.

Difference testing

Several tests were conducted to assess for differences between those who completed the study and those who dropped out. The chi-square test of independence was used for categorical data, the likelihood ratio test was used for nominal data, and the Mann-Whitney U test was used for skewed data.

ROC curve analyses

Receiver Operating Characteristic (ROC) curve analyses were run on two subsamples of the full analytic sample: one sample for the PTSD risk analyses and one sample for the depression risk analysis. For all ROC curve analyses, the prevalence rate used in the developmental sample (i.e., one-month follow-up) was chosen to calculate the NPV and PPV at six-month follow-up. Given that disease prevalence, as it relates to prediction, refers to the probability of a disease being present before an intervention is administered, there is concern for elevated prevalence rates due to exclusionary criteria used in each subsample (i.e., removal of non-symptomatic participants who have received intervention following their injuries; described in detail below).

PTSD risk analyses—The three ROC curve analyses that assessed risk for PTSD (i.e., the ITSS PTSD analysis, the PCL-5 analysis, and the combined PTSD risk analysis) excluded 56 participants who met at least one of the following criteria: 1) they experienced at least one additional, potentially psychologically traumatic event since their injury; and/or 2) they

received mental health intervention since hospitalization and did not meet criteria for DSM-5 PTSD at follow-up. (Note: Those individuals who were in treatment, but remained symptomatic, were not excluded.) This resulted in a final analytic sample for the PTSD analyses of $n = 146$.

The optimal cut score for the ITSS PTSD scale, obtained via the Youden's J index generated by the ROC curve analysis in the developmental sample, was found to be 2. To maintain consistency between the developmental study and the current study, the same cut score was utilized to determine the sensitivity and specificity of the ITSS PTSD scale at six-month follow-up. Participants were coded as PTSD risk negative (0) if their total sum score on a scale was equal to 0 or 1; those having a total sum of 2 or greater were coded as risk positive (1).

A separate ROC curve analysis was run on the PCL-5. Again, the Youden's J index was used to identify an optimal cut-score by which to classify individuals as PTSD risk negative (0) or risk positive (1), according to this symptom measure. This cut score was then utilized to determine the sensitivity and specificity of the PCL-5 at six-month follow-up.

The ITSS PTSD scale and the PCL-5 risk classifications were then merged to form the *combined PTSD risk* categorization. Specifically, those who were coded as PTSD risk positive on *both* the ITSS PTSD scale and the PCL-5 were coded as risk positive (1); those individuals who were PTSD risk negative on one or both of these measures were coded as risk negative (0). Sensitivity and specificity were then determined based on the binary classification of individuals as risk positive or negative.

Depression scale analysis—The ROC curve analysis that assessed risk for depression (i.e., the ITSS Depression analysis) excluded 24 participants who had received mental health intervention since their hospitalization and did not meet criteria for DSM-5 depression diagnosis, resulting in a final analytic sample for the depression risk analysis of $n = 178$. (As with the PTSD sample, those individuals who were in treatment for depression, but remained symptomatic, were not excluded.)

The optimal cut score for the ITSS Depression scale, obtained via the Youden's J index in the developmental sample, was found to be 2. Again, to maintain consistency with the developmental sample, this same cut score was used to determine the sensitivity and specificity of the ITSS Depression scale at six-month follow-up. Participants were coded as depression risk negative (0) if their total sum score was equal to 0 or 1, and those with a total score of 2 or greater were coded as risk positive (1).

Measures

The Injured Trauma Survivor Screen (ITSS)—The 9-item ITSS is a screening tool used to identify risk for the development of PTSD and depression in individuals who have experienced a traumatic injury. A detailed description of ITSS scale development and initial validation can be found in a previous publication.⁶ Four unique items contribute to risk assessment for PTSD and depression independently, and one item applies to risk for both. Items use a yes/no response format to assess pre-, peri-, and post-traumatic risk factors. The

ITSS has been shown to perform well at one-month postinjury to identify those at risk for posttraumatic distress (sensitivity: 75% for PTSD and depression; specificity: 93.9% for PTSD, 95.5% for depression).⁶

PTSD

PCL-5: The PCL-5¹⁷ is a 20-item measure assessing PTSD symptoms as outlined by the *DSM-5*. Respondents are asked to indicate on a scale of 0 (*not at all*) to 5 (*extremely*) how much they have experienced each symptom since their injury (i.e., over the last 6 months). This measure has shown excellent internal consistency, as well as convergent and divergent validity.¹⁷ Internal consistency for the current sample was $\alpha = 0.96$.

CAPS-5: The CAPS-5¹⁸ is a clinical interview that provides symptom scores for frequency, intensity, and severity, as well as an algorithm for PTSD diagnosis. It is widely considered to be the best available diagnostic instrument for PTSD, and has demonstrated strong internal consistency¹⁹, interrater reliability, and diagnostic reliability.²⁰ Internal consistency for total symptom severity in the current sample was $\alpha = 0.95$.

Depression—The CESD-R²¹ is a 20-item assessment of depression symptoms, to which respondents indicate how often they have been bothered by each symptom on a scale of 0 (*not at all/less than 1 day*) to 4 (*nearly every day for 2 weeks*). This measure yields a total severity score, which has shown good internal consistency in a previous study using a large community sample. Internal consistency in the current sample was $\alpha = 0.95$. Additionally, use of a diagnostic algorithm (as outlined by the authors of the CESD-R) for major depressive disorder has shown similar diagnostic rates as large, epidemiological studies of depression.^{22,23} The current study used this diagnostic algorithm to identify those participants who met criteria for a major depressive episode.

RESULTS

Descriptive Statistics and Demographics

Descriptive statistics are presented in Table 1. The analytic sample ($N = 202$) did not differ significantly from those who were lost to follow-up or excluded due to non-completion of measures ($N = 199$) on sex ($\chi^2(1) = 2.15$, $p = 0.143$), race ($LR(5) = 4.74$, $p = 0.449$), or mechanism of injury ($LR(10) = 10.02$, $p = 0.439$). Injury Severity Score (ISS), length of hospital stay, and Intensive Care Unit (ICU) stay data were pulled from the trauma registry. Mann-Whitney U tests were performed to evaluate differences between individuals who completed the study and those who did not. Medians and interquartile ranges are presented. No significant differences were found for ISS [completers = 10 (8 – 14), non-completers = 10.98 (8 – 14); $p = .716$], length of hospital stay [completers = 5 (3 – 8), non-completers = 5 (3 – 6); $p = .253$], or length of ICU stay [completers = 0 (0 – 1), non-completers = 0 (0 – 1); $p = .073$]. Age was significantly different across the two groups ($U = 15,576.50$, $p < 0.001$), such that individuals in the final analytic sample were significantly older (mean age = 42.0 years; $SD = 16.78$) than non-completers (mean age = 35.64 years; $SD = 14.38$).

Average time from injury to the completion of the initial assessments (i.e., during hospitalization) was three days ($SD = 2.40$); completion of the follow-up assessments were, on average, 6.5 months after injury ($SD = 36.44$ days). At the follow-up visit, 29.20% ($n = 59/202$) of participants met criteria for PTSD based on their CAPS-5 assessment and 19.80% ($n = 40/202$) met criteria for a major depressive episode based on their CESD-R assessment. Of those diagnosed with PTSD, over half (55.93%; $n = 33/59$) had comorbid depression, indicating a significant relationship between the two disorders ($\chi^2(1) = 68.51$, $p < 0.001$, $\phi = 0.582$).

There was a significant relationship between race and PTSD diagnosis ($\chi^2(1) = 35.34$, $p < 0.001$, $\phi = 0.418$), as well as race/ethnicity and depression diagnosis ($\chi^2(1) = 20.44$, $p < 0.001$, $\phi = 0.318$). Specifically, individuals of a racial/ethnic minority group were more likely to be diagnosed with PTSD (48.0%; $n = 49/102$ vs. 10.0%; $n = 10/100$) and depression (32.4%; $n = 33/102$ vs. 7.0%; $n = 7/100$) at follow-up. Also, those who experienced an assaultive trauma ($n = 56$) were more likely to be diagnosed with PTSD ($\chi^2(1) = 19.10$, $p < 0.001$, $\phi = 0.308$) and depression ($\chi^2(1) = 18.51$, $p < 0.001$, $\phi = 0.303$). There was no relationship between gender and PTSD ($\chi^2(1) = 0.29$, $p = 0.59$) or depression ($\chi^2(1) = 0.04$, $p = 0.84$) diagnosis.

Of those who met criteria for PTSD, 13.90% ($n = 28/202$) experienced another traumatic event since their injury. Twenty-eight percent ($n = 56/202$) received mental health treatment at some point during the six-month follow-up period. Specifically, 11.9% ($n = 24/202$) received psychotherapy, 8.9% ($n = 18/202$) were taking psychotropic medication, and 6.9% ($n = 14/202$) had both.

ROC Curve Analyses

ROC curve analysis for the ITSS PTSD subscale ($n = 146$) was conducted with 32.88% ($n = 48$) of this sub-sample meeting criteria for DSM-5 PTSD at 6 months. A prevalence rate of 28.7% was used, as that was the rate of PTSD in the one-month sample which yielded a sensitivity of 85.42%, and negative predictive value (NPV) of 91.9%. ROC curve analysis of the PCL-5 administered at baseline was then run on this same sample, yielding a Youden's J index of .16. A final ROC curve analysis was run on the combined PTSD risk group (0 = no risk, only ITSS PTSD risk positive, only PCL-5 risk positive, 1 = both ITSS PTSD risk positive and PCL-5 risk positive). In the final combined PTSD risk group (i.e., 2 on the ITSS PTSD subscale and 16 on the PCL-5), the specificity was 81.63% and positive predictive value was 61.6%. ROC curve analysis for the ITSS Depression subscale ($n = 178$) was then conducted with 22% percent ($n = 40$) of the sub-sample meeting criteria for a major depressive episode, as measured by the CESD-R, and the one-month prevalence rate of 20% was used. All prediction indices for ROC curve analyses are presented in Table 2.

DISCUSSION

This study extended the clinical utility of the ITSS as a first-tier assessment to identify those at risk for PTSD and depression after traumatic injury, rather than relying on measures of acute distress alone. In this sample, the ITSS demonstrated strong sensitivity as a stand-alone screening tool (85.42%, $n = 41/48$) for the development of PTSD six-months post-

hospitalization when it was administered acutely after injury. This was an increase from the one-month sensitivity (75.00%) found in the sample on which the data were normed.⁶ With regard to predicting a major depressive episode six-months postinjury, the sensitivity of the ITSS (72.50%, $n = 29/40$) was comparable to the sensitivity for prediction in the one-month sample (75.00%). For first-tier screeners, higher sensitivity is preferable to specificity, as it implies more false positives, rather than false negatives, and retains the potential for intervention. While symptom measures provide provisional diagnostic information, they tend to be longer and yield lower sensitivity, as was the case in this study. This is due in large part to differing post-injury trajectories of psychological recovery, with many who endorse acute distress no longer meeting diagnostic criteria after an initial period of recovery and vice versa.^{24–26}

Still, addressing specificity is critical for many reasons, including health care costs and the need for efficiency. While the specificity for the ITSS PTSD subscale was not as strong (67.35%, $n = 66/98$), and decreased from the one-month sample (93.94%), this statistic can be increased (81.63%, $n = 80/98$) when combined with a brief, standardized questionnaire of acute stress. In this study, the PCL-5 served as a simple analogue for assessment by a trained mental health professional, although it is only one component of the third tier of MAPIT (Figure 1). A comprehensive psychological follow-up allows for consideration of many other aspects of patients' psychosocial and hospital experiences that can impact their mental health prognosis and inform treatment decisions. A primary example of such an experience is spending time in an ICU. While an ICU stay has been shown to negatively influence posttraumatic injury recovery, the severity of the impact can be ameliorated via psychological follow-up.²⁷ While the specificity of the ITSS for predicting depression (70.29%, $n = 97/138$) was also lower than in the one-month sample (95.50%), unfortunately a symptom-based assessment for depression was not administered during initial hospitalization. Therefore, it is yet unclear whether adding such a measure would improve specificity of the ITSS Depression scale.

Although it is simple to deliver questionnaires to patients, administration and interpretation of mental health assessments, such as the PCL-5, is most credible when completed by trained mental health professionals. Accurate interpretation facilitates the relevant dissemination of psychoeducation and informs appropriate interventions. For example, the National Center for PTSD states that "interpretation of the PCL-5 should be made by a clinician."²⁸ This highlights the utility of having a trained mental health staff member involved with the care of a traumatic injury survivor after initial screening, rather than relying solely on often overburdened medical providers to bolster their training in mental health.

Nevertheless, the ITSS was designed to be administered by any member of a hospital trauma service. At our facility, it is administered by social workers; however, it could also be administered by willing nurses, students, or APPs. Thus, the completion of this screen (and the first and second tiers of MAPIT) requires no additional full-time employees. Consultation and interpretation is then provided in subsequent tiers by an inpatient trauma psychology service. Fourth-tier bedside intervention and outpatient interventions are delivered by the inpatient and outpatient trauma psychology services, respectively. Notably,

the outpatient trauma psychology service is housed within the outpatient surgery clinic, and therefore is also available for brief assessment and intervention to the trauma surgery outpatients who express psychological distress when they present to clinic for follow-up.

Limitations and Future Directions

The limitations of this study include that a subset of this six-month sample is comprised of participants included in the one-month developmental sample; certain exclusion criteria may limit cross-cultural applicability; a measure of early depressive symptoms was not given; the effects of different interventions were simply controlled for by removing those who reported receiving either psychotherapy or pharmacotherapy and no longer met criteria for PTSD or depression; and there was a relatively small sample size, due in part to a retention rate of ~50%. This study cannot be considered a true validation study, limiting the generalizability of this measure as it included participants from the development sample, and there was a significant rate of dropout.

Cross-validation studies are needed to test for validity across trauma center level gradations and in populations demographically different from those on whom the study was created. These studies will also need to include individuals that are non-English speaking. Although the PCL-5 was given at baseline, no equivalent symptom evaluation of depression was completed, and thus a parallel study of improving the ITSS Depression risk prediction with a symptom-based measure could not be done. Additionally, validation studies will need larger sample sizes that follow individuals beyond this six-month timeframe. Future research will enhance prediction models, such as this one, through the use of biomarkers and by including the effect of sociocultural risk factors on the human stress response. Additionally, although further research is needed to reliably predict the benefits of electronic methods of data collection (e.g., smartphone or online survey) on participant retention,²⁹ these methods may be particularly helpful in addressing the attrition of younger individuals and enhance confidence in study conclusions.

The 9-item ITSS (Supplemental Digital Content), which takes approximately 5 minutes to administer, is a stable screening tool for predicting those most at risk for PTSD and/or depression following an acute injury event. The combined PTSD risk group data provide evidence that symptom evaluation by a psychologist would increase the probability of correctly identifying those likely to develop posttraumatic psychopathology. These results help to further inform the recommendation of the ACS-CoT regarding PTSD and depression screening in trauma centers.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funded in part by NIH grant, 1 R21 MH 102838-01 A1

Milwaukee Trauma Outcomes Project team members: Nicholas Schumann, M.S.; Vanessa Simiola, Psy.D.; David Schuh, B.S.; Tim Geier, Ph.D.; and Meredith Halling, M.S.

References

1. Wegener ST, Pollak AN, Frey KP, Hymes RA, Archer KR, Jones CB, Seymour RB, O'Toole RV, Castillo RC, Huang Y, et al. The Trauma Collaborative Care Study (TCCS). *J Orthop Trauma*. 2017; 31:S78–S87. [PubMed: 28323807]
2. Brasel KJ, deRoos-Cassini TA, Bradley CT. Injury severity and quality of life: whose perspective is important? *J Trauma Acute Care*. 2010; 68(2):263–268.
3. Ponsford J, Cameron P, Fitzgerald M, Grant M, Mikocka-Walus A, Schönberger M. Predictors of postconcussive symptoms 3 months after mild traumatic brain injury. *Neuropsychology*. 2012; 26(3):304. [PubMed: 22468823]
4. Zatzick DF, Rivara FP, Nathens AB, Jurkovich GJ, Wang J, Fan MY, Russo J, Salkever DS, MacKenzie EJ. A nationwide US study of post-traumatic stress after hospitalization for physical injury. *Psychol Med*. 2007; 37(10):1469–1480. [PubMed: 17559704]
5. Bryant RA, O'donnell ML, Creamer M, McFarlane AC, Clark CR, Silove D. The psychiatric sequelae of traumatic injury. *Am J Psychiat*. 2010; 167(3):312–320. [PubMed: 20048022]
6. Hunt JC, Sapp M, Walker C, Warren AM, Brasel K, deRoos-Cassini TA. Utility of the injured trauma survivor screen to predict PTSD and depression during hospital admission. *J Trauma Acute Care*. 2017; 82(1):93–101.
7. Russo J, Katon W, Zatzick D. The development of a population-based automated screening procedure for PTSD in acutely injured hospitalized trauma survivors. *Gen Hosp Psychiat*. 2013; 35(5):485–491.
8. Richmond TS, Ruzek J, Ackerson T, Wiebe DJ, Winston F, Kassam-Adams N. Predicting the future development of depression or PTSD after injury. *Gen Hosp Psychiat*. 2011; 33(4):327–335.
9. O'donnell ML, Creamer MC, Parslow R, Elliott P, Holmes AC, Ellen S, Judson R, McFarlane AC, Silove D, Bryant RA. A predictive screening index for posttraumatic stress disorder and depression following traumatic injury. *J Consult Clin Psychol*. 2008; 76(6):923–932. [PubMed: 19045961]
10. Surgeons ACo. [Accessed June, 6, 2017] Resources for optimal care of the injured patient. 2014. <https://www.facs.org/quality%20programs/trauma/vrc/resources>
11. Smith ML, Glass GV. Meta-analysis of psychotherapy outcome studies. *Am Psychol*. 1977; 32(9):752. [PubMed: 921048]
12. Wampold BE, Imel ZE, Laska KM, Benish S, Miller SD, Flückiger C, Del Re AC, Baardseth TP, Budge S. Determining what works in the treatment of PTSD. *Clin Psychol Rev*. 2010; 30(8):923–933. [PubMed: 20638168]
13. Wampold BE, Imel ZE. The great psychotherapy debate: The evidence for what makes psychotherapy work. 2. New York, NY: Routledge; 2015.
14. The Management of Posttraumatic Stress Disorder Work Group. [Accessed July 28, 2017] VA/DoD Clinical practice guideline for the management of posttraumatic stress disorder and acute stress disorder. Jun, 2017 <https://www.healthquality.vagov/guidelines/MH/ptsd/>
15. Rothbaum BO, Kearns MC, Price M, Malcoun E, Davis M, Ressler KJ, Lang D, Houry D. Early intervention may prevent the development of posttraumatic stress disorder: a randomized pilot civilian study with modified prolonged exposure. *Biol Psychiatry*. 2012; 72(11):957–963. [PubMed: 22766415]
16. Rothbaum BO, Kearns MC, Reiser ME, Davis MJ, Kerley MK, Rothbaum MA, Mercer MK, Price M, Houry D, Ressler KJ. Early intervention following trauma may mitigate genetic risk for PTSD in civilians: a pilot prospective emergency department study. *J Clin Psychiatry*. 2014; 75(12):1380–1387. [PubMed: 25188543]
17. Blevins CA, Weathers FW, Davis MT, Witte TK, Domino JL. The Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5): Development and Initial Psychometric Evaluation. *J Trauma Stress*. 2015; 28(6):489–498. [PubMed: 26606250]
18. Weathers FW, Blake DD, Schnurr PP, Kaloupek DG, Marx BP, Keane TM. [Accessed November 10, 2016] The Clinician-Administered PTSD Scale for DSM-5 (CAPS-5). 2013. Interview available from the National Center for PTSD at www.ptsd.va.gov
19. Weathers FW, Ruscio AM, Keane TM. Psychometric properties of nine scoring rules for the Clinician-Administered Posttraumatic Stress Disorder Scale. *Psychol Assess*. 1999; 11(2):124.

20. Blanchard EB, Hickling EJ, Barton KA, Taylor AE, Loos WR, Jones-Alexander J. One-year prospective follow-up of motor vehicle accident victims. *Behav Res Ther.* 1996; 34(10):775–786. [PubMed: 8952120]
21. Eaton WW, Smith C, Ybarra M, Muntaner C, Tien A. Center for Epidemiologic Studies Depression Scale: Review and revision (CESD and CESD-R). 2004.
22. Van Dam NT, Earleywine M. Validation of the Center for Epidemiologic Studies Depression Scale —Revised (CESD-R): Pragmatic depression assessment in the general population. *Psychiatry Res.* 2011; 186(1):128–132. [PubMed: 20843557]
23. Hasin DS, Goodwin RD, Stinson FS, Grant BF. Epidemiology of major depressive disorder: results from the National Epidemiologic Survey on Alcoholism and Related Conditions. *Arch Gen Psychiatry.* 2005; 62(10):1097–1106. [PubMed: 16203955]
24. deRoos-Cassini TA, Mancini AD, Rusch MD, Bonanno GA. Psychopathology and resilience following traumatic injury: a latent growth mixture model analysis. *Rehabil Psychol.* 2010; 55(1): 1–11. [PubMed: 20175629]
25. Bonanno GA, Westphal M, Mancini AD. Resilience to loss and potential trauma. *Annu Rev Clin Psychol.* 2011; 7:511–535. [PubMed: 21091190]
26. Browne AL, Appleton S, Fong K, Wood F, Coll F, de Munck S, Newnham E, Schug SA. A pilot randomized controlled trial of an early multidisciplinary model to prevent disability following traumatic injury. *Disabil Rehabil.* 2013; 35(14):1149–1163. [PubMed: 23083416]
27. Jensen JF, Thomsen T, Overgaard D, Bestle MH, Christensen D, Egerod I. Impact of follow-up consultations for ICU survivors on post-ICU syndrome: a systematic review and meta-analysis. *J Intensive Care Med.* 2015; 41(5):763–775.
28. U.S. Department of Veterans Affairs. [Accessed June 21, 2017] PTSD Checklist for DSM-5 (PCL-5). May 11, 2017 <https://www.ptsd.va.gov/professional/assessment/adult-sr/ptsd-checklist.asp>
29. Lane TS, Armin J, Gordon JS. Online recruitment methods for web-based and mobile health studies: a review of the literature. *J Med Internet Res.* 2015; 17(7)

Figure 1. Multi-tier Approach to Psychological Intervention after Traumatic injury (MAPIT)
Note. PCL-5 = Posttraumatic Stress Disorder Checklist–for *DSM-5*; CESD-R = Center for Epidemiologic Studies Depression Scale–Revised; white = evidence provided for use; grey = emerging evidence; black = further evidence needed

Table 1Descriptive Statistics ($N = 202$)

	M (SD)
Age	41.67 (16.64)
	Percentage
Sex: Male	68.8%
Education	
Less than high school	15.6%
Graduated high school	33.2%
Some college	33.7%
Bachelor's degree	10.1%
Advanced degree	7.5%
Race/Ethnicity *	
White/Caucasian	49.5%
African American/Black	40.6%
Latino/Hispanic	8.9%
Native American	1.0%
Mechanism of Injury	
MVC	31.2%
GSW	16.3%
Fall	15.3%
MCC	11.9%
Stabbing	9.4%
PSV	5.4%
Industrial accident	5.0%
Recreational	3.0%
Blunt assault	1.5%
Other	1.0%

MVC = motor vehicle crash, GSW = gunshot wound, MCC = motor cycle crash, PSV = pedestrian struck by vehicle;

* Participants were asked "How do you describe your race or ethnicity?"

Table 2

Predictive Utility of Screening Tools for Depression and PTSD Risk at 6-months Postinjury

Screening Tool (Cutoff for Positive Risk)	Index	Major depressive episode ¹ at 6 months
ITSS: Depression (≥ 2)	AUC [95% CI]	0.714 [0.642, 0.779]
	Sensitivity	72.50% ($n = 29/40$)
	Specificity	70.29% ($n = 97/138$)
	PPV	37.9%
	NPV	91.1%
PTSD² at 6 months		
ITSS: PTSD (≥ 2)	AUC [95% CI]	0.764 [0.687, 0.830]
	Sensitivity	85.42% ($n = 41/48$)
	Specificity	67.35% ($n = 66/98$)
	PPV	51.4%
	NPV	91.9%
PCL-5 (≥ 16)	AUC [95% CI]	0.802 [0.728, 0.863]
	Sensitivity	77.08% ($n = 37/48$)
	Specificity	77.05% ($n = 74/98$)
	PPV	58.1%
	NPV	89.3%
Combined PTSD Risk Group (i.e., both ITSS PTSD and PCL-5 risk positive)	AUC [95% CI]	0.773 [0.696, 0.838]
	Sensitivity	72.92% ($n = 35/48$)
	Specificity	81.63% ($n = 80/98$)
	PPV	61.6%
	NPV	88.2%

Note.

¹Criteria for a major depressive episode was assessed with the CESD-R.²Criteria for PTSD was assessed with the CAPS-5. AUC = Area under the curve.