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Screening and Treating Hospitalized Trauma Survivors for PTSD and Depression

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Abstract

Traumatic injury affects over 2.6 million U.S. adults annually and elevates risk for a number of negative health consequences. This includes substantial psychological harm, the most prominent being posttraumatic stress disorder (PTSD), with approximately 21% of traumatic injury survivors developing the disorder within the first year after injury. PTSD is associated with deficits in physical recovery, social functioning, and quality of life. Depression is diagnosed in approximately

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6% in the year after injury and is also a predictor of poor quality of life. The American College of Surgeons Committee on Trauma suggests screening for and treatment of PTSD and depression, reflecting a growing awareness of the critical need to address patients' mental health needs after trauma. While some trauma centers have implemented screening and treatment or referral for treatment programs, the majority are evaluating how to best address this recommendation and no standard approach for screening and treatment currently exists. Further, guidelines are not yet available with respect to resources that may be used to effectively screen and treat these disorders in trauma survivors, as well as who is going to bear the costs. The purpose of this review is: 1) to evaluate the current state of the literature regarding evidence-based screens for PTSD and depression in the hospitalized trauma patient, and 2) summarize the literature to date regarding the treatments that have empirical support in treating PTSD and depression acutely after injury. This review also includes structural and funding information regarding existing post-injury mental health programs. Screening of injured patients and timely intervention to prevent or treat PTSD and depression could substantially improve health outcomes and improve quality of life for this high-risk population.

Keywords

Posttraumatic stress disorder (PTSD); Depression; Screening; Early Intervention

Long term quality of life in the trauma survivor population

Each year approximately 2.6 million civilians in the United States (U.S.) are involved in a single incident traumatic experience (e.g., motor vehicle crashes, falls, gunshot wounds) resulting in injuries requiring care at a designated trauma center.[1] Although traumatic injury is a leading cause of death in the U.S., medical advancements have increased survivorship over the years,[2-4] shifting focus from mortality to health-related quality of life (HRQoL) in traumatic injury populations. Broadly, HRQoL is a multidimensional construct describing subjective perceptions of physical and mental health as well as their correlates, including functional status, health risks, social support, and socioeconomic status.[5] Pursuant to this shift in focus toward HRQoL, there has been overwhelming evidence detailing HRQoL impairment following traumatic injury. Specifically, Holbrook and colleagues utilized a large prospective epidemiologic design to characterize the HRQoL and functional outcomes after trauma in adults.[6] Researchers noted "prolonged and profound" functional impairment after trauma, with most patients (i.e., 80%) continuing to detail poorer HRQoL when compared to healthy population norms at 18-month follow-up. These findings mirror other investigations, [7-9] with one study observing HRQoL impairment up to 15 years after severe injury.[10]

Research demonstrates HRQoL after traumatic injury is highly related to and influenced by posttraumatic psychological distress.[11] General health, work status, and recovery satisfaction are largely dependent on mental health outcomes twelve months after injury, even after adjusting for baseline status, injury severity, and physical recovery.[12] Psychiatric and substance use disorders frequently occur among patients hospitalized for injury, particularly posttraumatic stress disorder (PTSD).[13] Approximately one in four individuals develop chronic PTSD following physical trauma.[8,14] It is important to note although the focus is on

PTSD, the disorder develops over time and cannot be diagnosed before 30 days posttrauma. Significant PTSD-like symptoms within 30 days posttrauma are referred to as Acute Stress Disorder (ASD). Because ASD does not accurately predict PTSD,[15] the disorder of focus here is PTSD, particularly given its chronic and debilitating nature within the context of morbidity of trauma patients. In fact, a diagnosis of PTSD is one of the strongest correlates of poor post-injury HRQoL, especially when compared to trauma-exposed individuals without PTSD.[7]

Adding to recovery complexity and often comorbid with PTSD, depression is another response to traumatic injury. Holbrook and colleagues reported 60% of patients met criteria for depression at discharge, abating to 31% six months posttrauma.[16] Examining two other representative datasets, depression in injury survivors was reported to be 27% at six months and 6.6% at twelve months post-injury.[14] Although depression is distinct from PTSD, the two often co-occur, with some depression rates as high as 32% in individuals with PTSD one-year post injury.[17] As with PTSD, depression following physical trauma is associated with long-term impairment across numerous functional outcomes.[4] Specifically, research suggests depression is linked with significant impairments in physical and mental health, loss of major activity and work, as well as barriers to engagement in activities of daily living.[4] Though beyond the scope of this review, myriad psychiatric disorders beyond PTSD and depression can emerge in following traumatic injury.[18]

American College of Surgeons – Committee on Trauma recommendation

Given the significant contribution of psychological distress to morbidity of traumatically injured patients, efforts are underway within the U.S. to conduct hospital screening to determine patients at risk of PTSD and depression. Underlining the importance of this process, the American College of Surgeons Committee on Trauma (ACS-COT) suggests PTSD and depression risk screening for hospitalized trauma patients as a part of rehabilitative trauma center care.[19] As with other psychological concerns now requiring screening and intervention (e.g., alcohol use), there is potential for PTSD and depression recommendations to become requirements for major trauma centers.

Screens for the hospitalized injured population

Several measures have been designed and validated to evaluate the risk for developing PTSD and depression in adult traumatic injury populations. Screening typically involves either acute symptom-based measures used for a provisional diagnosis (e.g., PTSD Checklist 5 [PCL-5] described below) or a compilation of pre-, peri-, and posttraumatic risk factors. Though many screening tools have been validated for non-injured populations, this review includes only screens developed, validated, and/or suggested for use in hospitalized traumatic injury populations.

Currently, the ACS-COT suggests use of the PCL-5 to screen for PTSD.[19-22] The PCL-5, a 20-item Likert-type self-report questionnaire, requires patients to answer questions assessing symptoms from the four PTSD symptom clusters posited by the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5).[23] The PCL-5 was developed and

evaluated using trauma-exposed college students,[24] with further validation efforts in military veteran populations with PTSD.[25] The PCL-5 has a recommended cut-score of 33 for provisional diagnosis (range 0–80) one-month post-injury. The PCL-5's intent is to screen for probable current diagnosis, but it is not validated as a screen to be administered in the acute aftermath of trauma to predict future diagnostic risk. The PCL-5 may perform best in hospital trauma environments after a risk screen is administered, perhaps as a next step to assess symptoms and assist in treatment decisions,[26] or in rehabilitation settings to assess for probable diagnosis of PTSD when time since trauma is greater. A recent article of trauma patients 6 months postinjury suggests a PCL-5 cutoff score of greater than 30 is likely to indicate probable PTSD diagnosis.[27] Finally, it is important to note rating-scale measures in general tend to overestimate PTSD prevalence in population-based studies, so if used in the appropriate timeframe (i.e., greater than 30 days post-injury), it should be used as a marker of distress along with a referral to a mental health provider for definitive diagnosis.[28]

Screening trauma patients for the presence of depression requires a different set of probing questions. The Patient Health Questionnaire 9 (PHQ-9) is currently recommended in the ACS-COT resource manual as a screener for depression. This screen is a 9-item Likert-type self-report questionnaire assessing the nine *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV) depression criteria from "0" (not at all) to "3" (nearly every day). Although this measure has not been validated in hospitalized trauma patients, the psychometric properties of this scale have been well-validated across numerous contexts, including primary care, medical outpatients, and specialist medical services,[21] including medical and surgical inpatients.[29] The self-reporting PHQ-9 compares very well to clinician-administered instruments assessing major depression.[30] The most consistently reported and recommended PHQ-9 cut-score is 10 (range 0–27) to indicate significant depression requiring intervention or monitoring.[31] Alternatively, some suggest using a diagnostic algorithm (i.e., five or more symptoms "more than half the days" in the past two weeks, with one being depressed mood/anhedonia) with a cut-score of 10.[32]

How best to screen for depression and acute posttraumatic stress requires personnel and resources, which may not be available in many trauma centers. Trauma centers with limited mental health providers or overburdened social workers may find it difficult to administer a 20-item PTSD screen and a 9-item depression screen to all hospitalized trauma patients. In one report, physicians noted time constraint as the most frequently encountered barrier in assessment of emotional functioning and PTSD risk screening in trauma populations.[33] To address these concerns, several research groups have attempted to develop simpler in-person and automated predictive screens for PTSD in injured survivors. Review of these screens is outlined below and summarized in Table 1.

In-person risk screening

In a study of patients admitted to Level I trauma centers in Australia, O'Donnell and colleagues examined pre-, peri-, and posttrauma variables to develop a predictive screen for PTSD and depression. [34] The Posttraumatic Adjustment Scale (PAS) screen, with 10 Likert-style items, predicted PTSD based on all items with a cutoff score of 16 [sensitivity, 0.82; specificity, 0.84; Positive Predictive Value (PPV), 0.27; Negative Predictive Value (NPV),

0.98] and depressed on five items with a cutoff score of 4 (sensitivity, 0.72; specificity, 0.75; PPV, 0.30; NPV, 0.91). Further, the screen was cross-validated on another sample with identical inclusion/exclusion criteria and maintained adequate validity. That said, the study population represented a small proportion of patients admitted to the trauma service (i.e., 4,432 screened, 404 completed 12-month follow-up). Additionally, the study included a relatively limited number of assaultive traumas (i.e., 5%) when compared to general U.S. trauma center rates (i.e., 10.89%), creating external validity concerns. [35] Although the screen is short, responses have a 5-point Likert scale (0 = "Not at all," 4 = "Totally"), increasing administration time as well as potential for less standardization and greater variability in interpretation and subsequent response, where manufactured Likert categories may not reflect the more sophisticated, continuous, and subjective experience of traumatic injury. [36,37]

Richmond and colleagues studied injured patients selected randomly from the emergency department (ED) of a hospital in a large U.S. city to develop and assess use of a predictive screen for PTSD and depression. [38] Beginning with 42 yes/no items, researchers examined likely predictors of post-injury PTSD and/or depression to develop a predictive screen, including prior trauma, depression history, subjective response to injury, acute symptomology, and acute physiological arousal (i.e., heart rate, pain, injury severity). The final measure included 8 items predicting PTSD (sensitivity = 1.00, specificity = 0.66) and depression (sensitivity = 0.81, specificity = 0.71). In addition to being brief, this screen was administered to participants one to two weeks post-injury using numerous delivery formats, where some completed the measure in hospital and others completed it via telephone post-discharge. These alternatives might make screening simpler, but to date this screen has not been validated on strictly hospitalized samples.[39] Also raising external validity concerns, only 2% of the sample developed PTSD, lower compared to epidemiological studies (i.e., approximately 21% twelve months post-injury).

Given limitations of these existing screens for hospitalized trauma survivors, a brief screen for PTSD and depression risk was developed in individuals admitted to a hospital's trauma service. Using methodology like Richmond and colleagues,[38] a comprehensive risk factor review was undertaken followed by generation of a 48-item pool.[40] This was administered to participants experiencing assaultive (~25%) and non-assaultive injuries an average of four days post-injury; logistic regression then reduced the item pool to the most predictive items. A product of this protocol, the *Injured Trauma Survivor Screen* (ITSS), is a 9-item measure containing five items screening for PTSD and five items screening for depression, with one overlapping item, and a score of ≥2 indicating a positive screen for PTSD and depression, separately.[39]

Like Richmond and colleagues' screen, administration of the ITSS is relatively short with a yes/no response format. At the institution where it was created, the screen is part of routine care, administered by social workers. Although the ITSS relies on in-person assessment and requires more resources compared to automated screens, it may provide greater diagnostic specificity. Additionally, where symptom-based screens assess symptoms in the last thirty days (e.g. PCL), this screen captures risk within a shorter timeframe post-trauma. The ITSS has adequate sensitivity and specificity at one- and six-months: 1-Month: sensitivity (PTSD

= 0.75, depression = 0.75), specificity (PTSD = 0.94, depression = 0.96), NPV (PTSD = 0.90, depression = 0.801), and PPV (PTSD = 0.83, depression = 0.94). [39] Six month ROC curve analysis for the ITSS PTSD and depression risk screen retained a high level of sensitivity and specificity.[26] Validation in other samples is underway to further assess performance of this screen as an American Association for the Surgery of Trauma multi-institutional trial.

Adding to screening efforts, Carlson and colleagues examined data from a prospective study on risk factors for maladaptive recovery to develop a screen predicting posttraumatic symptoms two months post-injury. [41] The authors developed an elaborate analysis resulting in a predictive performance of 9 factors. A positive classification of 5+ factors has a sensitivity of 0.89 and a specificity of 0.78 in predicting PTSD. Additionally, a set of 4 prospectively-assessed brief risk factor measures with a positive classification of 2+ factors had a sensitivity of 0.86 and a specificity of 0.72. Although this investigation has numerous strengths, like item selection based on total measure scores (versus relationship to predicted outcome) with different response types for each question, investigators identified the limitation that the highly predictive risk factor of posttrauma life stress was measured retrospectively, at the same time as the outcome measure. Further, approximately half of the sample consisted of non-injured individuals with loved ones treated for injuries, changing generalizability parameters. Finally, although this screen detects PTSD risk, it does not include a depression assessment.

Another risk measure for PTSD and depression post-injury is the peritraumatic distress inventory (PDI),[42] a 13-item self-report measure with Likert-type responses assessing physiological and emotional responses during and shortly after traumatic events.[43] This is important, as peritrauma responses are linked with greater fear conditioning during trauma, and therefore greater PTSD risk. Another advantage of the PDI is its availability in languages including English, French, Japanese, Dutch, Malay, and Persian, demonstrating strong validity and reliability within each language.[44-47] Bunnell and colleagues expanded on the PDI psychometrics by identifying optimal cut-scores determining PTSD and depression risk separately post-injury. With adequate sensitivity and specificity (0.71 and 0.73, respectively) at 1-month post-injury, a cut-score of 23 was optimal for predicting clinically elevated PTSD symptoms,[42] and a cut-score of 21 (sensitivity = 0.70, specificity = 0.69) for elevated depression symptoms.[48] There are advantages for using this measure to assess risk, including less questions assessing for PTSD and depression risk. In the above-cited study, the PDI was administered to patients 30 days post-injury to assess for current diagnostic risk, suggesting need for additional studies to evaluate the PDI as a more proximal risk screen, potentially within days to weeks post-injury. Additionally, given the nature of peri-trauma questions, this screen might perform better closer to injury, such as in the ED for those not hospitalized.

These screening tools require either patient self-reporting or trauma center personnel administering an interview. As such, they are limited to patient response and the resources necessary to administer in-person testing, both of which might limit wide-spread utility. It would be advantageous to harvest the electronic health record (EHR) to better identify at-risk patients.

Automated Screening

Russo and colleagues developed an automated PTSD screen for hospitalized patients that abstracts risk information from the EHR system, effectively eliminating person-time required for an in-person screen.[28, 49] This is significant, as personnel effort required for screen administration are minimal beyond what information is entered already clinically. Data abstracted from the EHR as screen items include gender/sex, race, insurance status, ICU visit, previous hospitalizations, intentionality, tobacco use, blood alcohol content or previous substance use disorder, and premorbid PTSD and other psychiatric diagnoses. The benefit of this screener is the ability to cost-effectively screen every trauma patient, resulting in high population impact. Despite these benefits, this screen assumes all data are included in the EHR, which is often not the case. For example, only 30% of patients in the Russo study had prior admissions to the hospital, diminishing predictive utility of recurrent admissions as well as the ability to incorporate premorbid diagnoses into the model.

Other forms of automated screening may be feasible in trauma centers but have not undergone sufficient evaluation. Other researchers in one southeastern trauma center integrated a text-messaging platform into their service, allowing daily tracking of psychological recovery using global distress measures.[50-51] Such systems engage patients in symptom monitoring and may assist in identifying patients in need of mental health intervention. However, more validation work is needed to establish these tools as predictive instruments. Furthermore, although 98% of the U.S. adult population has mobile phone access, patients may not have consistent engagement with these systems.

Summary of screens for PTSD and depression post-injury

Screening literature for PTSD and depression post-injury is still developing, yet it is crucial to integrate mental and behavioral health care into trauma centers. Advances in statistical techniques have in part led the field to begin utilizing machine learning-based approaches to better forecast PTSD trajectories post-injury.[53] As numerous variables may hold predictive information, analysis and integration of these variables simultaneously is necessary to increase utilization of personalized medicine.

Although no screen included in this review is perfect, trauma centers implementing the ACS-COT screening recommendation must consider their existing resources and patient flow when deciding upon a screen. The automated screen by Russo and colleagues is attractive, particularly for trauma centers where adding a short screen to social work or nursing responsibilities is not significantly challenging. Unfortunately, this screen relies on EHR data entry and if not present, variables are assumed to be “no,” increasing likelihood of false negatives. The four abovementioned in-person screens are relatively short, although the PAS involves Likert-type responses, potentially increasing administration time.

Trauma centers may want to determine which screen to use based on who will be administering it and how positive screens are managed. For example, if a trauma center has a mental health consult option, screening with the ITSS and placing a consult is ideal. However, for programs planning to screen in outpatient settings or closer to discharge

without the possibility of referring to mental health inpatient providers, implementing a screen validated outside the hospital environment, such as the Richmond et al. screen, may be best. The discharge process can then involve referral to outpatient mental health services.

Inevitably ethical concerns related to documentation and notification of risk arise when considering multidisciplinary integrated care. As healthcare moves toward an integrated model, with mental health professionals practicing as part of multidisciplinary inpatient and outpatient teams, assessment of psychological distress has increased. Protection of patient information and wellbeing remains vital, with various ethical implications affecting health care systems. Although there is potential for patient distress upon learning of risk status, it is unethical to ignore potential risk for maladjustment. For example, development of PTSD has been linked to increased HRQoL impairment,[7] and depression as a mortality risk factor has been shown to be akin in strength to smoking.[54] Given the importance of identifying at-risk patients regarding psychological distress, reasonable safeguards can act to mitigate likelihood of patient harm. Specifically, assignment of role-based user privileges is a significant component of medical record security.[55] Further, the American College of Preventive Medicine emphasizes that in addition to patient and provider education regarding screen interpretation and proper notification of and discussion about screen results, proper follow-up and assessment can reduce risk of deleterious screening outcomes, such as stigmatizing labels, gratuitous testing, and inappropriate treatment.[56] Continued focus on and exploration of ethical and privacy concerns is critical in developing screening programs ensuring the benefits are accentuated while reducing potential for harm.[57]

Evidence-based interventions

Screening is beneficial when there are adequate secondary prevention strategies and treatments ameliorating likelihood or severity of distress post-injury. As noted above, screening efforts have utilized pre-, peri-, and post-trauma risk factors to predict deleterious outcomes. Prevention efforts based on risk factors and subsequent intervention efforts have been assessed for effectiveness. Over the past 20 years numerous interventions have been employed to mitigate risk for PTSD, depression, substance abuse, and other psychosocial stressors, such as chronic pain following traumatic injury. Below, these treatment paradigms are categorized into stepped care models and disorder specific approaches. Additionally, telehealth considerations are presented.

Disorder Specific Approaches.

Disorder specific interventions, like Prolonged Exposure (PE) for PTSD or Behavioral Activation (BA) for depression, have been evaluated and provide a better controlled environment for evaluating outcome. As such, these studies screen for PTSD or depression risk, and then suggest treatment based on symptom presentation. For example, modified PE provided to patients with a traumatic injury who screened positive for PTSD risk in the ED has been evaluated.[58] This treatment is based on extensive PE literature suggesting efficacy for PE in treating PTSD. This modified PE takes a brief early intervention approach, targeting symptoms prior to PTSD diagnosis based on evidence-based intervention for chronic PTSD. Initial treatment sessions occurred bedside in the ED and then one- and two-

weeks at outpatient follow-up, totaling three sessions, so to mitigate risk for PTSD by one-month post-injury. Results found early, modified PE is effective at reducing PTSD symptom severity by one-month, the point at which PTSD diagnosis is made. Similarly, Wagner and colleagues utilized BA as an early intervention for depression and PTSD,[59] finding those who received BA improved in mood and physical functioning compared to treatment as usual. Although study results are promising, replication efforts are needed that include an evaluation of the number of sessions needed in inpatient settings for there to be significant benefit in reducing symptoms and chronic distress.

A recent meta-analysis of 12 intervention trials examined the effectiveness and efficacy of early treatments rendered within the first three months post-injury in preventing or mitigating occurrence and severity of PTSD, depression, and anxiety post-injury.[60] All sessions were psychologist-led, and treatment often consisted of four to six sessions, with opportunity for further assistance and intervention as needed. The meta-analysis determined interventions occurring in the first four weeks incorporating CBT and PE yielded the largest effects on PTSD, depression, and anxiety. Education-focused treatment had little effect on symptoms.

Stepped Collaborative Care Models.

Stepped collaborative care has been investigated to determine effectiveness of reducing PTSD, depression, and substance use symptoms following traumatic injury. A series of trials suggest effectiveness of these models in reducing PTSD symptoms and improving functional impairment six to twelve months post-injury.[60-63] In general, this approach improves clinical outcomes by collaboratively identifying patient-specific priorities with treatment planning around these specific needs. Related to the traumatic injury population, stepped collaborative care models can include case management post-injury, with collaborative interventions if needed, like cognitive behavioral therapy (CBT) and/or pharmacotherapy. Collaborative care intervention teams can include front-line trauma center social work or nursing providers as well as MD and PhD level psychiatrist and psychologist consultants.

O'Donnell and colleagues examined the impact of a stepped early psychological intervention on patients admitted to two Level I trauma services in Australia.[64] Using the PAS in addition to administration of the PCL and Hospital Anxiety and Depression Scale (HADS) at four-weeks post-injury, participants were assigned to high and low risk groups. The high-risk group was then randomly assigned to treatment as usual (n = 22) or early intervention (n = 24, 75% completed treatment). Utilizing a flexible treatment approach with a CBT focus, intent-to-treat analyses revealed those treated reported larger gains when compared to the treatment as usual group. A series of stepped collaborative care intervention trials have demonstrated the effectiveness of this intervention approach in reducing early PTSD-like symptoms. The above-referenced meta-analysis suggests although early CBT interventions may have greater isolated treatment effects, stepped collaborative care models may have the greatest overall population impact of any current early trauma center-based intervention.[60] An effectiveness-implementation hybrid randomized trial of stepped collaborative care is currently ongoing at 25 US Level I trauma centers.[65]

Multitier Approach to Psychological Intervention after Traumatic-injury (MAPIT).

At the institution where the ITSS was developed, as well as several other institutions throughout the U.S., psychological care is integrated into routine medical care received by patients admitted to trauma and other relevant services (e.g., orthopedics). Integration constitutes an important first step in de-stigmatizing and normalizing mental healthcare as a routine part of recovery from a potentially life-altering traumatic injury. The MAPIT model consists of four tiers: 1) Screening, (currently done via the ITSS) is entered into a flowsheet in patient EHR; 2) generation of a "best practice alert" in patient EHR, which for amenable patients, allows providers to generate a consultation request in their chart; 3) consultation and further evaluation by the inpatient trauma psychology team, a step that can increase specificity in diagnostic prediction; 4) psychoeducation and inpatient intervention as appropriate, and for those who are interested or in need, a referral to outpatient trauma psychology which is housed in the outpatient trauma surgery clinic.[26] Certainly, this integration requires institutional support for psychology staff, and adoption and implementation of each aspect of this model will vary. Additional research is necessary to validate the model; however, evidence for many aspects of it have been discussed herein.

Telehealth care's role in improving access to care for injured patients.

Another option to consider is telehealth. Ruggiero and colleagues have implemented a technology-enhanced, stepped care intervention, the Trauma/Telehealth Resilience and Recovery Program (TRRP), in three trauma centers in South Carolina. The intervention consists of: (1) in-hospital education; (2) symptom self-monitoring via automated text-messaging system; (3) mental health telephone screen 30-days post-discharge; and (4) telehealth-based assessment and best practice mental health services. Patients with positive 30-day screens for PTSD or depression are offered several options: face-to-face treatment, local referrals, and home-based telemental health. Over 70% of patients indicate a preference for home-based telemental health. The availability of telehealth-based care is particularly critical to this population because many have poor mobility in the early stages of recovery due to injuries, and a meaningful minority of patients, particularly those living in rural settings, may not reside in close geographic proximity to a trauma center providing best practice treatment for PTSD and depression. Non-inferiority trials have shown home-based telemental health services for PTSD and depression are non-inferior to office-based treatment.[66-69]

Summary of posttraumatic mental health service delivery models.

One significant distinction is the notion of screening immediately versus screening in days and weeks after discharge. Trauma centers can go about this in multiple ways. One way taken at institutions listed in Table 2 is screening immediately using face-to-face brief, early intervention sessions with hospitalized patients before discharge and follow-up outpatient psychological care as needed. Another way is to provide basic education while waiting to screen until later, such as in the first post-discharge follow-up visit and then offering referrals or telehealth treatment immediately after a positive screen. From a population impact perspective, screening for risk in the hospital likely has the greatest effect. If a screen is administered when the patient is still in the hospital, completion of those screens will

inherently be greater than waiting until a follow-up visit or trying to reach patients over the phone post discharge when loss to follow-up occurs. However, in programs where follow-up rates are high and known risk factor prevalence is low (i.e., previous psychiatric history, low rates of penetrating trauma), a wait to screen approach might improve capture of those with more chronic distress while also more efficiently utilizing resources.

Costs and Cost-Effectiveness of Trauma Center-Based Interventions

Prior investigation has assessed the costs of trauma center-based care delivery.[70,71] A series of investigations have now assessed the potential cost-effectiveness and cost savings derived from brief alcohol screening and intervention delivered from trauma centers.[72,73] Although posttraumatic stress disorder has been the subject of cost-analyses,[74] literature review revealed few investigations assessing costs or cost-effectiveness of PTSD screening and intervention in the trauma center context.

Program funding and creative solutions

Although clinical and research efforts regarding the screening and treatment of traumatically injured patients have advanced over the years, “best practice” guidelines have yet to be established. There are a handful of trauma centers utilizing formal collaborative or integrated services for mental and behavioral health care of trauma patients. Developing a screening and intervention program along with hiring staff to facilitate the program requires an investment of resources. Authors on this manuscript have implemented mental and behavioral health programs for trauma patients. Examples of these services and associated factors, including billable services and revenue are presented in Table 2. Despite differences between programs, each utilizes a screening process translating to inpatient psychological care and outpatient post-discharge treatment as needed. As these programs have yet to be robustly evaluated, they do not rise to the level of “best practice;” however, it is hoped they serve as foundations on which to develop a codified set of guidelines for integration of psychological care following traumatic injury.

If trauma programs do not have resources or patient volume to justify an inpatient posttrauma mental health program, other models of care could be utilized. For example, Topitzes and colleagues are testing a Trauma Screening and Brief Intervention and Referral to Treatment (T-SBIRT) for patients presenting to medical clinics. [75] In this model, trauma history is assessed and if symptoms are found, referral to treatment in the community is made. A model including screening and treatment referral could easily be adapted within a trauma inpatient unit. This could include risk screening (possibly by social workers or nursing), symptom assessment, and treatment referrals as needed. This is predicated on the idea the trauma center has developed relationships with community providers using best practices with expertise in trauma-related disorders and treatment. For example, a randomized controlled trial using a screen and brief treatment approach in the hospital with those at risk for PTSD revealed no difference in PTSD outcome compared to controls.[76] The authors cited difficulty with access to community mental health provider access as a major barrier to continued psychological recovery and suggest a strong link between trauma centers and community mental health professionals to continue treatment.

Additionally, consideration of multiple clinical and other roles in which mental health providers are used can also support funding. Warren and colleagues describe three different Level I trauma centers where psychologists not only provide direct inpatient and outpatient clinical care but also engage in related activities, including psychological support for families of patients, support for treatment team members to reduce burnout, and trauma research activities and injury prevention efforts.[77] Of the posttraumatic mental health programs in Table 2, two charge for services that include inpatient and outpatient care for those with continued distress, increasing areas for possible revenue.

In summary, there is an increasing focus on mental health needs of trauma patients in trauma centers across the U.S., with the intent to improve poor morbidity. In fact, the ACS-COT recently convened a meeting of experts to inform measurement of patient reported outcomes, including physical and cognitive functioning, mental health, and quality of life, suggesting national interest in addressing trauma as a chronic disease. Different screening modalities exist depending upon the needs and resources available for individual trauma centers, and it is likely different trauma centers will develop different types and levels of care depending upon patient-specific needs and center resources. Although intervention research suggests early treatment outperforms treatment as usual or no treatment, continued research focus on evidenced-based interventions for this population is needed to inform best practice guidelines.

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Table 1.

Summary of screens available for PTSD and/or Depression in hospitalized trauma patients

	Sensitivity/Specificity*	Benefits	Limitations
In-person screens			
Symptom screens			
PTSD Checklist for DSM-5 (PCL5) *20 items; Likert scale (0 - 4)*	Not documented in this population	• Well established measure that examines specific symptoms of PTSD • Previous iterations of the screen are well validated across multiple populations	• Diagnostic tool not designed to predict PTSD • Not predictive of depression • No validation study for a cut-off in the hospitalized injured population
Posttraumatic Adjustment Screen (PAS) *10 items; Likert scale (0 - 4)*	12 months post injury: PTSD = .82/.84 Depression = .72/.75	• Created for and normed on the traumatic injury population • Cross validated via subsample	• Non-U.S. sample with minimal assaultive trauma • Likert scale more cumbersome
Peritraumatic Distress Inventory (PDI) *13 items; Likert scale (0 - 4)*	1 month post injury: PTSD = .71/.73 Depression = .70/.69	• Available in multiple languages • Recent analysis with the traumatic injury population • Cut-scores for depression and PTSD	• Administered 1 month after injury to predict 1 month distress • Likert scale more cumbersome
Risk factor screens			
Predictive screening tool for depression and PTSD after injury *8 items; Yes/No response*	Not documented	• Simple Yes/No response format	• Created for and normed on Emergency Department population • No known validation study
Inured Trauma Survivor Screen (ITSS) *9 items (5 for PTSD risk, 5 for depression risk, with 1 overlapping item); Yes/No response*	One-month post injury: PTSD = .75/.94 (≥2) Depression = .75/.95 (≥2) Six-month post injury PTSD = .85/.67 (≥2) Depression = .73/.70 (≥2)	• Created for and normed on the traumatic injury population • Simple Yes/No response format	• No known validation study+
Automated screens			
Automated EMR screen *10 items collected from electronic medical record*	One-month post injury: PTSD = .70/.40 (>3) Six months post injury: PTSD = .81/.38 (>3) 12 months post injury: PTSD = .84/.36 (>3)	• Created for and normed on the traumatic injury population • Cross validated via validation sample • Optimizes population level impact	• Information may not be available in EMR • Not predictive of depression

Note.

*Refers to the sensitivity and specificity of the measure in the traumatic service population;

+AAST multi-institutional validation study underway.

Table 2.

Examples regarding funding of current posttraumatic mental and behavioral health programs in trauma centers

Institution Type	Trauma Level	Department[A]	Number of admissions	Pediatric/ Adult/Both	Type and number of mental health staff	Source of funding	Operating Margin[B]
A. Academic Medical Center	I	Surgery/Division of Trauma & Acute Care Surgery	2,600+	Adult	2 full time psychology faculty, 1 postdoctoral fellow, 1 psychology resident[C]	Clinical dollars from psychology faculty and fellow billing for inpatient and outpatient care, internal and external research grants	Revenue neutral considering patient billing and grant research funding for faculty effort
B. Private not for profit hospital	I	Surgery/Division of Trauma, Critical Care & Acute Care Surgery	2,500+	Adult	1 primary psychologist for clinical coverage and 1 primary trauma research psychologist, 2 psychologists who provide coverage for primary psychologist, 1 psychiatrist and 1psychiatric nurse practitioner	Psychologists and psychiatrist inpatient and outpatient billing, internal and external grants to support research	Patient billing does not cover all costs, trauma research dollars help offset cost of both primary psychologist, primary research psychologist and trauma research team members
C. Academic Medical Center &County Hospital	I	Trauma Services Department (Hospital-based)	2,400+	Adult	1full time psychologist, 2 full time licensed counselors, and 1 full time child life specialist/ survivor network coordinator	Trauma Services' cost center's operational budget funds the trauma psychosocial program managed by the Trauma Psychologist	Revenue generation for trauma services includes trauma activation response, procedures, and screening processes. Average cost to margin over the past three years is 27%.
D. Academic medical center	I	Surgery/Division of Acute Care Surgery	2,500+ 2300+Adult 175+ Peds.	Both	2 full time psychology Faculty, 1 postdoctoral fellow, 1 predoctoral practicum student	Clinical revenue from Psychology faculty billing for inpatient care, internal and external research grants	Revenue generating considering patient billing and grant research funding for faculty effort
E. Academic Medical Center – Telehealth Resilience and Recovery Program	I	Surgery, Pediatrics, Nursing, Psychiatry	1900+ Adult 150+ Peds	Both	Part-time licensed professional counselor, 2 part-time clinical psychology postdoctoral fellows, 3 part-time clinical interns (MS/ PhD)	MUSC Center for Telehealth funding, Duke Endowment funding, clinical revenue from billing for face-to-face services	Patient billing does not cover all costs, partly because home-based telemental health is only a billable service under some (but a growing number of) insurance policies. Grant research funding for faculty effort.

Note.

[A] Department = where the personnel are employed;

[B] Operating Margin for covering salary, fringe, and benefits for personnel within the program;

[C] Psychology resident is a part of an institution wide health psychology residency and is funded through the hospital and therefore not calculated.