

# Behavioral Health Screening and Follow-Up Services in Pediatric Trauma Centers Across the United States

Leigh E. Ridings,<sup>1,\*</sup> PhD, Hannah C. Espeleta,<sup>1</sup> PhD, Nicole Litvitskiy,<sup>1</sup> BS, Kristen Higgins,<sup>1</sup> MA, Olivia Bravoco,<sup>1</sup> BS, Tatiana M. Davidson,<sup>1</sup> PhD, Christian J. Streck,<sup>2</sup> MD, FACS, Nancy Kassam-Adams,<sup>3,4</sup> PhD, and Kenneth J. Ruggiero,<sup>1</sup> PhD

<sup>1</sup>College of Nursing, Medical University of South Carolina, USA

<sup>2</sup>Department of Surgery, College of Medicine, Medical University of South Carolina, USA

<sup>3</sup>Center for Injury Research & Prevention, Children's Hospital of Philadelphia, USA

<sup>4</sup>University of Pennsylvania Perelman School of Medicine, USA

\*All correspondence concerning this article should be addressed to Leigh E. Ridings, PhD, College of Nursing, Medical University of South Carolina, 99 Jonathan Lucas Street, Charleston, SC 29425, USA. E-mail: ridingle@musc.edu

## Abstract

**Objective:** Over 120,000 U.S. children are hospitalized for traumatic injury annually, a major risk factor for behavioral health problems such as acute/posttraumatic stress disorder (PTSD) and depression. Pediatric trauma centers (PTCs) are well positioned to address the recent mandate by the American College of Surgeons Committee on Trauma to screen and refer for behavioral health symptoms. However, most PTCs do not provide screening or intervention, or use varying approaches. The objective of this mixed-methods study was to assess PTCs' availability of behavioral health resources and identify barriers and facilitators to service implementation following pediatric traumatic injury (PTI).

**Methods:** Survey data were collected from 83 Level I (75%) and Level II (25%) PTC program managers and coordinators across 36 states. Semistructured, qualitative interviews with participants ( $N=24$ ) assessed the feasibility of implementing behavioral health education, screening, and treatment for PTI patients and caregivers.

**Results:** Roughly half of centers provide behavioral health screening, predominantly administered by nurses for acute stress/PTSD. Themes from qualitative interviews suggest that (1) service provision varies by behavioral health condition, resource, delivery method, and provider; (2) centers are enthusiastic about service implementation including screening, inpatient brief interventions, and follow-up assessment; but (3) require training and lack staff, time, and funding to implement services.

**Conclusions:** Sustainable, scalable, evidence-based service models are needed to assess behavioral health symptoms after PTI. Leadership investment is needed for successful implementation. Technology-enhanced, stepped-care approaches seem feasible and acceptable to PTCs to ensure the availability of personalized care while addressing barriers to sustainability.

**Keywords:** accidents and injuries; dissemination and implementation science; posttraumatic stress and trauma; psychosocial intervention; qualitative methods.

## Introduction

Each year more than 120,000 children in the United States incur injuries so severe that they require hospitalization (National Center for Injury Prevention and Control, 2021). Pediatric traumatic injury (PTI) is a major public health concern associated with annual individual and societal costs of more than \$58 billion (Centers for Disease Control and Prevention, 2020). Between 20% and 40% of these children develop significant emotional and behavioral health needs, including acute or posttraumatic stress disorder (PTSD) and depression, which adversely affect quality of life, physical recovery, family routines, and academic functioning (Landolt et al., 2009; Zatzick et al., 2008). Pediatric trauma centers are uniquely positioned to address children's and caregivers' emotional and behavioral recovery and need sustainable models of care to accelerate clinical improvement after pediatric injury.

Trauma center leaders widely recognize post-injury emotional and behavioral health as a top national priority. The American

College of Surgeons Committee on Trauma (ACS COT) recently mandated that trauma centers implement behavioral health screening and referral for injured patients at high risk for psychological sequelae (American College of Surgeons, 2022). A recent survey determined that only 28% of trauma centers provide routine screening for PTSD (Bulger et al., 2022), highlighting the lack of preparedness many centers may experience in response to the ACS COT mandate. Other research has similarly found that few pediatric trauma centers implement acute stress or PTSD assessment (28%–36%) or education (18%–20%) after pediatric injury (Guess et al., 2019), with even fewer protocols offered for caregivers and follow-up services or referrals (Ridings et al., 2022).

It is critical to identify dissemination and implementation strategies to support effective, cost-efficient, scalable mental health service models that are acceptable and feasible in trauma centers. Collaborative stepped-care models (i.e., service models that combine medical and behavioral health care to provide effective, least resource-intensive treatment to patients who need it) may be particularly well suited to the

needs of pediatric trauma patients (McCarty et al., 2016). This is because (1) they are designed to guide resource allocation efficiently in light of evidence that the majority of patients do not develop PTSD or depression (Kahana et al., 2006; Zatzick et al., 2007) and (2) pediatric trauma patients are diverse with regard to age, race, ethnicity, sex, and injury mechanism (e.g., motor vehicle collisions, firearm, serious falls) and require equitable care that can be tailored to their unique needs. Technology, in combination with stepped-care models, also has the potential to reduce costs and overcome implementation barriers that may vary based on infrastructure, patient volume, organizational climate, and local/regional policy. Technology-enhanced, behavioral health screening, education, and treatment referral services can be integrated at various levels of service depending on trauma centers' unique needs and workflow.

Behavioral health screening and education after PTI allow for early symptom identification and long-term risk reduction to promote access to behavioral health services and save millions of dollars in healthcare costs and lost work expenses. This is particularly important for injured children, as they are unlikely to access services without significant support from caregivers and/or trauma center resources, resulting in potential negative behavioral health and chronic disease consequences in adulthood. However, resource prioritization, existing technology integration, and collaborative care implementation barriers and facilitators in pediatric trauma centers remain unknown. We previously reported on survey results from pediatric trauma center leaders assessing center characteristics and describing the landscape of existing behavioral health screening, education, and treatment referrals (Ridings et al., 2022). The current study expands on these analyses, includes qualitative interview results with providers assessing service implementation barriers and facilitators, and integrates these findings to make recommendations for improved practice after PTI.

## Methods

### Procedure

This study was approved by our Institutional Review Board. Participants were trauma program managers, coordinators, directors, or injury prevention coordinators at U.S. Level I and II trauma centers serving children at the time of the study. Participants were identified via a pediatric trauma center listserv, an ACS list of verified trauma centers, and a web-based searches and were first recruited via email and/or phone to complete a quantitative survey. Participants received a detailed description of the study and survey link and provided consent before initiating the online survey. Participants received a \$20 digital gift code for completing the survey. All participants who completed the survey were asked about interest in completing a subsequent qualitative interview; interested participants indicated willingness to be contacted later and provided their email addresses separately from their survey responses. A purposive sample of participants based on trauma center level, location, and trauma registry who completed the quantitative survey was invited to complete a phone-based semistructured, qualitative interview to bolster quantitative findings. Interviews were audio-recorded and conducted by two doctoral- (L. R. Ridings) and bachelor's-level (O. Bravoco) researchers trained in the conduct of

qualitative interviewing. Participants received an additional \$30 digital gift code for completing interviews.

### Survey and Interview Development

The quantitative survey (Ridings et al., 2022) was developed by the principal investigator (L. E. Ridings) and refined by study staff (K. J. Ruggiero, C. J. Streck) to assess (1) characteristics of respondents and trauma centers; (2) behavioral health resource availability and decision-making (factors determining screening, education, and treatment prioritization); and (3) common barriers and facilitators to implementing behavioral health services at their sites (e.g., infrastructure that supports or impedes behavioral health service implementation). A semistructured, qualitative interview guide was developed by the principal investigator (L. E. Ridings) to complement the quantitative survey assessing (1) existing protocols addressing behavioral health screening, education, and/or treatment referrals after PTI, (2) ideas for behavioral health services developed for and tailored to their pediatric trauma population, and (3) unique barriers and facilitators to implementing these services at their sites. Quantitative survey items assessing barriers and facilitators and qualitative interview questions are included in [Supplementary Material](#).

### Data Analysis

#### Quantitative Analysis

Descriptive analyses, including frequencies, were conducted to examine respondent and trauma center characteristics including Level I or II status, state accreditation and ACS verification, and population served (children only vs. children and adults). We utilized descriptive analyses to examine current trauma center practices in mental health screening, education, and treatment as well as barriers and facilitators to implementing these services in trauma centers. Finally, chi-square tests of independence were utilized to compare barriers and facilitators based on trauma center characteristics listed above.

#### Qualitative Analysis

Qualitative interviews were transcribed by a third-party professional transcriptionist. A thematic analysis was conducted independently by two trained, bachelor's- and master's-level coders based on recommendations by Bradley and colleagues (2007). Coders employed an integrated method of coding such that a deductive approach was utilized to develop and organize the codebook based on existing hypotheses and an inductive approach was utilized to create new codes based on concepts that emerged from ongoing review of transcriptions. The codebook was adapted with each interview based on emerging themes. Both coders used a spreadsheet-based codebook to code all interviews separately and compare codes to assess reliability. The principal investigator provided oversight and resolved any discrepancies prior to establishing final themes. Coders followed an iterative coding approach to identify and refine thematic categories and prevent coder bias until thematic saturation was met. Qualitative themes endorsed by at least 50% of participants are reported in the *Results*, with few exceptions when themes are particularly unique and/or distinctively inform the next steps of this line of work.

#### Data Availability

The data underlying this article cannot be shared publicly due to the privacy of individuals who participated in the study.

The data will be shared on reasonable request to the corresponding author.

## Results

### Quantitative Results

#### Trauma Center Characteristics and Behavioral Health Practices

Trauma centers participating in the survey included 83 Level I (75%) and Level II (25%) centers across 36 states. Surveys were completed by trauma program leaders, with 96% identifying as trauma program managers, coordinators, or medical directors. Fifty-one percent of centers reported serving children and adult patients, while 49% serve children only. Respondents indicated that their center is accredited by their state (86%) and ACS-verified (90%). Less than half (46%) screened for child behavioral health concerns post-injury, and even fewer (18%) screened caregivers or family members. Mental health education was provided to child patients in about 63% of trauma center respondents, with education for caregivers and family members occurring in approximately 47% of centers. Finally, 64% of participants reported providing mental health treatment or referrals for treatment to child patients and their family members. See [Table I](#) for descriptives of participating trauma center characteristics, mental health resources, and mental health practices. Further results illustrating trauma center providers' beliefs about addressing child

and family behavioral health are published elsewhere ([Ridings et al., 2022](#)).

#### Barriers to Implementing Behavioral Health Resources

Trauma center respondents endorsed several barriers to implementing behavioral health screening, education, and service referral practices for pediatric patients and their family members including (1) lack of funding (70%), (2) inadequate staff (66%), (3) time constraints (55%), (4) limited awareness of the behavioral health concerns for this population (40%), and (5) trauma center leadership not recognizing behavioral health concerns as a priority (30%; see [Table II](#)). Compared to sites that were not state-accredited, sites that were accredited were more likely to report the fifth barrier, leadership not recognizing behavioral health concerns as a priority (Fischer's exact test,  $p = .015$ ). Additionally, the fourth barrier, limited awareness of behavioral health problems, was more likely to be endorsed by sites with a psychologist on staff (Likelihood ratio = 10.58,  $p = .032$ ) compared to a psychiatrist on staff, both professionals on staff, or neither on staff. Barriers 1–3 did not significantly differ across other trauma center characteristics including Level I or Level II centers, population served (e.g., children only vs. children and adults), or size of annual trauma registry.

#### Facilitators to Implementing Behavioral Health Resources

Trauma center respondents also endorsed several facilitators to implementing behavioral health services including (1) established

**Table I.** Trauma Center and Participant Characteristics for Quantitative Survey (N = 83)

Trauma Center Characteristics	N (%)	Participant Demographics	N (%)
Level I	61 (74)	Occupational role	
Level II	21 (25)	Trauma program manager	60 (72)
State accredited	71 (86)	Trauma program coordinator	16 (19)
ACS verification	75 (90)	Trauma medical director	4 (5)
Annual trauma registries		Pediatric injury prevention coordinator	1 (1)
<500	8 (10)	Other	2 (2)
500–1,000	21 (25)	Length of employment	
1,000–2,500	33 (40)	<6 months	4 (5)
2,500–5,000	19 (23)	6 months to 1 year	6 (7)
5,000+	2 (2)	1–3 years	25 (30)
Population served		4–5 years	15 (18)
Children only	41 (49)	6 years or more	33 (40)
Children and adults	42 (51)	Length of employment at any trauma center	
Percentage of pediatric patients that are top-tier activations		1–3 years	4 (5)
<10%	37 (45)	4–5 years	4 (5)
10%–25%	39 (47)	6 years or more	74 (89)
25%–50%	4 (5)	Highest degree earned	
75%–99%	1 (1)	Associates degree	5 (6)
Mental health resources available		Bachelor's degree	20 (24)
Psychologist	16 (19)	Master's degree	48 (58)
Psychiatrist	10 (12)	PhD or equivalent	4 (5)
Both psychologist and psychiatrist	52 (63)	MD or equivalent	5 (5)
Neither psychologist or psychiatrist	2 (2)	Highest degree field	
Unknown	2 (2)	Business	5 (6)
Existing MH practices		Health Leadership/Administration	6 (7)
MH screening for child patients	38 (46)	Nursing	63 (76)
MH screening for caregivers or family members	15 (18)	Medicine	4 (5)
MH education for child patients	52 (63)	Public Health	1 (1)
MH education for caregivers or family members	39 (47)	Social Work	1 (1)
MH treatment/referrals for child patients and family members	53 (64)		

Note. MH = mental health.

**Table II.** Frequencies of Barriers and Facilitators to Implementing Behavioral Health Protocols from the Quantitative Survey

	%
<b>Barriers</b>	
Financial resources, funding to implement these programs	70
Inadequate staff needed to complete screen	68
Limited time to implement these programs	55
Limited awareness of mental health problems with this population	40
Not recognized as a priority by leadership	30
Other (e.g., family willingness to accept care, no formal screening tools, no place to refer in the community)	11
<b>Facilitators</b>	
Connections with community mental health clinics for referrals	55
Availability of internal mental health clinics for consults/referrals	43
Recognition from leadership that this is a priority	40
Availability of appropriate staff to implement these programs	39
Initiatives in place to address pediatric mental health needs after injury	33
Financial resources to implement these programs	19
Other (e.g., automatic referral processes to social work, care coordination program implemented, in patient behavioral health department, multidisciplinary teams)	5

connections with community mental health clinics for patient referrals (55%), (2) available internal mental health professionals for consultation or referrals (43%), (3) recognition from leadership that behavioral health is a priority (40%), (4) identified staff to implement services (39%), and (5) current initiatives in place to address behavioral health needs after injury (33%). Facilitators did not significantly differ across Level I or Level II centers, state-accreditation status, population served (e.g., children only vs. children and adults), size of annual trauma registry, or mental health professionals on staff (e.g., psychologist alone, psychiatrist alone, both psychologist and psychiatrist, neither).

### Qualitative Results

Qualitative semistructured interviews with 24 trauma center leaders addressed behavioral health resources and their implementation of behavioral health resources for traumatically injured children and their caregivers. See Table III for a summary of center characteristics for interviewees. Table IV presents themes related to trauma centers': (1) existing behavioral health services (screening, education, and treatment); (2) suggestions for behavioral health services (screening, education, and treatment); and (3) Perceived barriers and facilitators to implementing behavioral health services. The remainder of this section summarizes the most common themes, subthemes, and representative quotes associated with these three major areas.

### Major Theme 1: Variation in Existing Behavioral Health Services

**Theme 1a. Behavioral health screening procedures vary by provider, patient population, and delivery method.** Of those centers (46%) with an existing behavioral health screening protocol, most noted that screens were conducted with children (compared to caregivers or other family members) by nurses. Responses varied when asked which patients were

most typically screened; most centers focus screening on injured adolescents, while fewer screen all injured pediatric patients regardless of age or admission status. Protocols to address positive screening results widely varied; about half submit psychology consults and fewer make referrals to community organizations or use in-house resources (e.g., specialty clinics).

**Theme 1b. Wide variation in the extent and type of behavioral health education or treatment exists.** Some centers reported providing psychoeducation for patients following pediatric injury, most commonly delivered via handouts (e.g., pamphlets) or face-to-face discussion; no center delivered education via technology (e.g., websites, apps, etc.). Educational content varied from site to site and was mostly provided by social work for all pediatric trauma patients. Centers offer behavioral health treatment either on-site or via community referrals for mood- or acute stress/PTSD-related concerns. Treatment referrals are most commonly requested by providers expressing patient behavioral health concerns and rarely occur based on significant scores on behavioral health screens. A small number of centers have protocols to provide follow-up assessments (e.g., behavioral health screens, general "check-ins," etc.) with patients in the weeks following discharge. When asked about providing follow-up services to patients, one participant communicated:

*I think it's a good idea in theory. I think it'll be hard to identify [who requires services]. I think, yeah, I think if maybe it was identified by the social worker or somebody at high risk, that would be great. But I don't know the feasibility of doing that for every single trauma patient.*

### Major Theme 2: Perceived Importance and Need for Behavioral Health Services

**Theme 2a. Behavioral health screening for patients and caregivers was viewed as important.** When asked about ideas for behavioral health screening, participants identified the importance of screening caregivers of pediatric injury patients. They also noted that screening should be offered to admitted trauma patients or all injured patients regardless of admission or activation status. Acute stress/PTSD or depression was most commonly identified as behavioral health needs that should be screened by social worker or nursing staff. When asked how patients' screening results might be addressed, suggestions included scheduling outpatient follow-up services or submitting in-house psychology consults.

**Theme 2b. Pediatric injury patients should receive psychoeducation following injury.** Participants felt that patients should receive psychoeducation about common psychiatric reactions and self-care following injury, and that information about community behavioral health resources should be included. When asked who should receive this psychoeducation, there was some variation in response, but many felt that all patients and their caregivers should be included. Suggestions for psychoeducation delivery methods included handouts/pamphlets, provider-patient conversations, or web/app-based resources by nursing or social work.

**Theme 2c. Treatment referrals should be offered to patients with significant behavioral health screens.** Participants thought patients with clinically significant scores on behavioral health screens should receive either onsite behavioral

**Table III.** Trauma Center and Participant Characteristics for the Qualitative Interviews

Trauma Center Characteristics	N (%)	Participant Demographics	N (%)
Level I	13 (54)	Occupational role	
Level II	10 (42)	Trauma program manager	17 (71)
State accredited	21 (88)	Trauma program coordinator	5 (21)
ACS verification	22 (92)	Trauma medical director	2 (8)
Annual trauma registries		Length of employment	
<500	2 (8)	<6 months	1 (4)
500–1,000	9 (38)	6 months to 1 year	2 (8)
1,000–2,500	8 (33)	1–3 years	7 (29)
2,500–5,000	4 (17)	4–5 years	5 (21)
5,000+	1 (4)	6 years or more	9 (38)
Population served		Length of employment at any trauma center	
Children only	12 (50)	1–3 years	1 (4)
Children and adults	12 (50)	4–5 years	2 (8)
Percentage of pediatric patients that are top-tier activations		6 years or more	20 (83)
<10%	10 (42)	Highest degree earned	
10%–25%	13 (54)	Associates degree	3 (13)
75%–99%	1 (4)	Bachelor's degree	9 (38)
MH resources available		Master's degree	8 (33)
Psychologist	3 (12)	PhD or equivalent	1 (4)
Psychiatrist	5 (21)	MD or equivalent	2 (8)
Both psychologist and psychiatrist	16 (67)	Highest degree field	
Existing MH practices		Business	2 (8)
MH screening for child patients	9 (38)	Health leadership	1 (4)
MH screening for caregivers or family members	4 (17)	Nursing	18 (75)
MH education for child patients	11 (46)	Medicine	2 (8)
MH education for caregivers or family members	7 (29)		
MH treatment/referrals for child patients and family members	14 (58)		

Note. MH = mental health.

**Table IV.** Themes from Trauma Center Staff Interviews

Core Theme	Sub Theme
Variation in Existing Behavioral Health Services	1a. Behavioral health screening procedures vary by provider, patient population, and delivery method. 1b. Wide variation in the extent and type of behavioral health education or treatment exists.
Perceived Importance and Need for Behavioral Health Services	2a. Behavioral health screening for patients and caregivers was viewed as important. 2b. Pediatric injury patients should receive psychoeducation following injury. 2c. Treatment referrals should be offered to patients with significant behavioral health screens. 2d. Trauma center staff desire follow-up services with patients post-discharge to assess behavioral health recovery.
Perceived barriers and facilitators to implementing behavioral health services	3a. Staff want to provide screening and education and cite infrastructure changes needed. 3b. Interventions to reduce the risk of problematic psychosocial sequelae are desired in hospital, but staff are lacking. 3c. Some barriers exist to implementing behavioral health treatment or referrals after injury.

health services or community referrals, depending on available treatment options at their centers. Psychiatrists and/or psychologists were the most commonly identified treatment providers.

**Theme 2d. Trauma center staff desire follow-up services with patients post-discharge to assess behavioral health recovery.** Almost all participants noted that providers should follow up with patients following discharge, most commonly via telephone or text or email to provide formal behavioral health screening, referrals, or general needs assessments. One participant reported:

*I feel that would be a benefit definitely, and you know, I do this, you know, care coordination thing now, but even with patients that I mean I work in that program with, I think anybody that, you know, screens higher, you know,*

*would benefit from a call as well. So you know just to make sure all of our kids, we're meeting the needs of all of them.*

Responses were varied regarding who should receive follow-up assessments—some saw this as important only for those with significant in-hospital screens and some noted the importance of including both patients and their caregivers.

### Major Theme 3: Perceived Barriers and Facilitators to Implementing Behavioral Health Services

**Theme 3a. Staff want to provide screening and education and cite infrastructure changes needed.** No respondent indicated disinterest in providing behavioral health screens at their centers. Of those who hoped to implement screening protocols, about half said it would be feasible within their existing

infrastructure. Consistent with survey results, implementation barriers cited included a lack of staff, resources, and/or time to conduct screenings. An additional barrier identified in qualitative interviews was missing opportunities to screen patients before discharge. In addition to facilitators reported in the survey (i.e., existing behavioral health requirements and leadership support), additional implementation facilitators included having trauma providers on staff with behavioral health education/awareness and access to brief screening tools. Participants cited some infrastructure/workflow changes needed to implement screening protocols including standardizing a protocol with questionnaires embedded in patients' electronic medical records and strengthening staff support during evenings and weekends. As described above, participants saw benefits in offering patients psychoeducation after injury, but several noted that providers would require significant training and education prior to implementation.

**Theme 3b. Interventions to reduce the risk of problematic psychosocial sequelae are desired in hospital, but staff are lacking.** Over 70% of participants were interested in implementing a brief, in-hospital intervention to reduce risk of acute stress disorder, PTSD, and/or depression symptom development. While some reported that this model would be feasible to implement in their centers, many noted implementation barriers including lack of staff or time to provide the intervention. Some participants saw potential in these interventions to generate additional revenue for their centers. Some centers would require hiring new staff to implement these brief interventions, while a few felt they could use existing inpatient consultation services to meet this need. For example, in reference to brief in-hospital interventions, one person said:

*That would be awesome. I think [the patients] would feel supported and I think that, for those folks, that would have a trickle effect on their outcomes just because [patients] sometimes are very defensive, and I think it would be almost their mini cheerleading team to get them from point A to point B during a very difficult time.*

**Theme 3c. Some barriers exist to implementing behavioral health treatment or referrals after injury.** When asked about the feasibility of implementing behavioral health treatment in their trauma centers, participants identified barriers such as reduced patient treatment access (e.g., transportation or physical mobility challenges, lacking insurance) and lack of community behavioral health resources or relationships with community resources. One participant stated:

*First, there's a ton of barriers in the urban setting, you know, they truly are not feeding their kids three meals a day . . . and they don't have the resources for that. So, you know, when you're looking at Maslow's hierarchy of needs. . . Because people aren't going to listen to those things that have higher level if they can't get their basic needs met.*

## Discussion

We conducted a national mixed-methods study with pediatric trauma center managers and leaders to assess existing resources; perceptions of screening, education, and treatment as well as barriers and facilitators to implementing protocols; and

ideas for practical ways to address behavioral health screening and prevention and intervention in their respective trauma centers. The ACS Committee on Trauma (ACS COT) now mandates that trauma centers screen and refer patients for behavioral health services after traumatic injury ([American College of Surgeons, 2022](#)); however, no clear roadmap exists to address this directive. Our data highlight inconsistency across trauma centers and wide variability regarding behavioral health screening procedures (i.e., what is being done?), populations served (i.e., who receives services?), follow-up services (i.e., what is done with screening results?), and treatment referrals (i.e., do those who need intensive treatment receive it?). Approximately half or fewer participating trauma centers address behavioral health in some way, but this leaves tens of thousands of children without guidance about whether, when, and how to access services to address challenges such as PTSD, acute stress disorder, and/or depression. Pediatric trauma centers need evidence-based guidelines to assist in creating a vision and implementation strategy to launch a cost-effective, sustainable, and feasible program in adherence with ACS COT recommendations.

Whereas half or fewer centers provide behavioral health services, themes emerging from qualitative interviews suggest that most center staff value the implementation of screening, education, follow-up assessments, and/or treatment referrals to address patient and caregiver psychosocial needs. Participants noted the importance of screening both children and their caregivers for acute stress disorder and/or PTSD after pediatric injury, even though only half currently screen for child behavioral health symptoms and far fewer assess caregivers' behavioral health needs. Similarly, few centers reported providing follow-up services post-discharge (e.g., general "check-ins," formal assessments, outpatient services); yet providers were enthusiastic about the idea of adopting this protocol in their centers via telephone or text or email. It is important to note that while most patients are admitted to these centers for treatment after unintentional injury, a smaller percentage are admitted for treatment after intentional injury (e.g., self-inflicted injury, child maltreatment); however, most sites have established protocols to connect these families with individualized services to better meet their needs. Trauma centers rated factors such as child maltreatment, injury severity, and trauma mechanism as important to prioritize for mental health screening ([Ridings et al., 2022](#)). Standardizing behavioral health screening for traumatically injured children, regardless of mechanism or severity, would prepare trauma centers to address the ACS COT guidelines and triage to specialty clinics or follow-up services more effectively.

Despite centers' enthusiasm to provide behavioral health services, several barriers were identified by centers to implement these services. One unique finding in this study is that the barrier, limited awareness of behavioral health problems, was more likely to be endorsed by sites with a psychologist on staff compared to those staffed with only a psychiatrist, both professionals, or neither. While additional research is needed to contextualize this finding, it is possible that since psychologists at trauma centers serve unique roles compared to psychologists in more general mental health or outpatient settings, there may be less awareness of behavioral health problems that would typically be assessed and treated in a more traditional mental health setting. For example, psychologists in inpatient trauma settings are often consulted to

provide brief coping skills to patients undergoing serious or painful medical procedures, to provide crisis management and safety planning for patients with suicidal ideation or self-harm, and/or to promote health-related behaviors for patients prior to discharge. Awareness may be less focused on more commonly observed behavioral health problems, such as anxiety, depression, and PTSD, and more on crisis or acute challenges patients face after traumatic injury.

Our data also emphasize inadequate funding, personnel, and time as consistently identified barriers that many centers face. Technology-assisted tools may provide sustainable solutions to these barriers in the form of automated behavioral health screens (e.g., app- or SMS-based screens), educational videos viewed in-hospital depicting common emotional and behavioral reactions by developmental age, apps or websites designed to accelerate emotional recovery for parents and children post-injury (Marsac et al., 2013, 2015) SMS-facilitated symptom monitoring (Bunnell et al., 2019; Davidson et al., 2017; Price et al., 2014), chatbot- or SMS-generated follow-up assessments 1–3 months following discharge, and telehealth-delivered, evidence-based behavioral health interventions provided by staff psychologists, psychiatrists, social workers, or via community agency connections to reduce persisting trauma-related symptoms (Ridings et al., 2019). Digital health solutions have the potential to reduce demands on staff time while addressing patients' behavioral health needs in a way that is cost-effective and acceptable to pediatric patients, their caregivers, and trauma centers. While text- or phone-based mental health screens may not provide billable options for pediatric trauma centers, rates in the U.S. charge less than \$0.008 per text message, for example, to send and receive texts under 160 characters, offering centers with a low-cost, low-burden solution to follow-up assessments post-discharge. Additionally, since the COVID-19 pandemic, guidelines for telemedicine have become more flexible, allowing physicians, physician assistants, and advanced practice nurse practitioners to bill CPT codes for online digital management services via a secure platform (Nicoletti, 2023). Calls to address barriers to the provision and reimbursement of digital health services are widespread and have the potential to generate action for the expansion of mental health service options for trauma centers and other healthcare settings (Graham et al., 2021; Mohr et al., 2021). It is noteworthy that among the center staff interviewed, none reported the current use of technology to deliver behavioral health screening, education, or interventions. Technology integration may facilitate service access and uptake for injured children and their caregivers while addressing many of the barriers cited.

### Stepped-Care Models May Help to Reduce Cost and Resource Barriers

In addition to leveraging technology to overcome implementation barriers, stepped-care clinical models also offer solutions to provide the least resource-intensive interventions to patients and their caregivers with varying levels of risk for developing behavioral health challenges (McCarty et al., 2016). The use of stepped-care approaches may be more feasible for hospitals to implement while also supporting the need to deliver personalized care. While screening is recommended as a universal approach (completed with all patients hospitalized for injury), screening results ideally should drive the structure, timing, and intensity of subsequent behavioral

health services. For example, stepped models can take the form of (1) standardized acute stress screenings for all hospitalized patients to identify those at high risk for intervention; (2) individualized education and intervention for patients at highest risk of developing symptoms and functional impairment to enhance patient awareness and service engagement; (3) patient symptom self-tracking following hospital discharge to promote awareness of behavioral health recovery; (4) follow-up behavioral health assessment one to 3 months post-injury; and (5) referral to trauma-informed behavioral health treatment for patients who develop acute stress disorder, PTSD, or depression. While stepped-care models are appealing to trauma centers, many lack appropriate connections or guidelines needed to develop and implement these models. Effective stepped service models are often rooted in cognitive and behavioral principles and require partnerships between interdisciplinary teams (e.g., trauma, surgery, nursing, psychology, psychiatry, social work) to provide evidence-based early intervention or secondary prevention strategies to injured children and their caregivers (Price et al., 2014; Roberts et al., 2010; Rothbaum et al., 2012). Several stepped-care approaches have shown promise and established feasibility (Hunt et al., 2018; Ridings et al., 2019; Rothbaum et al., 2014; Ruggiero et al., 2020; Zatzick et al., 2011, 2013).

Participants in the current study reported several aspects of their existing workflow and infrastructure that could facilitate the implementation of these service components. While inadequate staff and time were cited as service implementation barriers, 99% of centers implement an SBIRT protocol within their centers, with most of them administered by nurses or social workers (Ridings et al., 2022). Nursing or social work staff could be trained to provide inpatient behavioral health education, screening, and/or brief intervention at the time of the SBIRT protocol. Alternatively, though our data do not indicate their percentage of dedicated effort to the trauma service, 63% of centers had both psychologists and psychiatrists on staff (Ridings et al., 2022) and may be able to leverage their support to conduct these services. With more than 70% of respondents reporting interest in the implementation of brief, in-hospital interventions to reduce distress and prevent mental health symptom development, psychologists and/or psychiatrists could lead these 15- to 45-min interventions with the potential for billing and service reimbursement. Centers could determine whether health and behavior assessment and intervention codes, for example, could be reported for these inpatient services and identify appropriate providers to conduct them accordingly. Advanced practice providers, social workers, and/or interns may also be utilized to assist with service delivery at each step. More than half of interviewees reported connections with community organizations; these partnerships can be promoted to enhance access to services for symptomatic patients who may not otherwise receive behavioral health care.

Behavioral health service implementation has the potential to reduce healthcare disparities for patients and caregivers who need treatment while also generating added revenue for pediatric trauma centers. Investment and engagement from pediatric trauma center directors and leaders are critical to the successful implementation of behavioral health screening protocols. Additional time, training, and education for leadership regarding the benefits of early screening and follow-up assessment for both patients and trauma centers may be required throughout the planning and implementation phases.

Mental healthcare providers on the trauma staff, such as pediatric psychologists, nurse practitioners, psychiatrists and/or psychiatry residents, are uniquely positioned to provide these trainings in-house to trauma centers interested in implementing these services. Ongoing training and education may be required to promote uptake and sustainment of these services over time with potential increased motivation from sites seeking ACS accreditation or reaccreditation. Embedding mental health-focused presentations and check-ins into existing interdisciplinary trauma team meetings (e.g., major trauma committee meetings, pediatric acute care staff meetings) may strengthen implementation outcomes and sustainability.

### Limitations and Future Directions

This study is not without its limitations. While this study presents data on the current state of pediatric mental health screening, education, and treatment in 83 trauma centers across 36 states, its findings are limited to the current practice within the United States and therefore may not be generalizable to other countries addressing mental health after traumatic injury. Issues related to pediatric psychology should be identified and addressed internationally, though they are prioritized to varying degrees in different countries. Future research could assess and compare mental health service provision and policies outside of the United States that may impact relevant factors such as dedicated funds to mental health in trauma care settings, technology integration capability, particularly in rural countries, and availability of mental health providers to deliver these services in both inpatient and outpatient or community service settings. Further, insurance reimbursement for mental health services is a frequently evolving issue that requires additional research, leadership support, and advocacy to promote the sustainability of these critical services for families after pediatric trauma. An additional consideration is that the results of analyses comparing state-accredited sites with non-accredited sites should be interpreted with caution, as only 14% of sites were not state-accredited. More research is needed with comparable cell sizes to replicate these results. Additionally, the current study is unique in its description of mental health service facilitators and barriers from the perspective of pediatric trauma center leaders. However, other key stakeholder input, such as caregivers and children and providers (e.g., nursing, psychiatry, psychology, social work) is not highlighted and is important to integrate as a next step. One additional limitation is that the generalizability of the study's findings to all U.S. pediatric trauma centers is uncertain. It is possible that sites with more capacity to address mental health were more likely to participate in this study, despite the study staff's multiple contact attempts to recruit centers of varying sizes, resources, and locations. Finally, additional research is needed to test the effectiveness and implementation feasibility of technology tools to screen and deliver mental health resources. Specifically, technology resource availability, cost, and implementation strategies should be systematically evaluated for trauma centers and other pediatric healthcare settings interested in technology integration.

### Conclusions

The current study used a mixed-methods design to assess existing behavioral health services embedded in pediatric

trauma centers and to identify barriers and facilitators to implementing services to address behavioral health needs. It appears that current behavioral health service provision varies in the type of service offered, trauma population served, and provider, with half or fewer of centers screening for acute stress disorder and/or PTSD symptoms. Pediatric trauma center leaders value the importance of screening, educating, and treating patients and their caregivers after pediatric injury. However, barriers such as inadequate staff, funding, and time impede their ability to implement services. Existing workflow factors, such as established connections with community mental health clinics, internal mental health staff, and prioritization by leadership, may facilitate the adoption of technology and stepped-care models to reduce provider burden and meet patients' needs in a cost-effective, sustainable way.

### Supplementary Data

Supplementary data can be found at: <https://academic.oup.com/jpepsy>.

### Acknowledgments

The authors wish to acknowledge Hannah Sebald for her contributions to participant recruitment for this study. The authors also wish to acknowledge the U.S. trauma center leaders and managers for their tireless efforts caring for traumatically injured children and for dedicating their time to participate in this study.

### Funding

This work was supported by funding from the Medical University of South Carolina (MUSC) Technology Applications Center for Healthful Lifestyles pilot initiative. Dr. Ridings is supported by the National Institute of Child Health and Human Development (K23HD098325). Drs. Davidson and Ruggiero were supported by awards from The Duke Endowment (6657-SP) and National Institute of Child Health and Human Development (R01 HD102336). Dr. Ruggiero was supported by the SmartState South Carolina Centers of Economic Excellence.

### Conflicts of interest

None declared.

### Author Contributions

Leigh E. Ridings (Conceptualization [lead], Formal analysis [supporting], Funding acquisition [lead], Investigation [lead], Methodology [lead], Project administration [lead]), Hannah C. Espeleta (Formal analysis [lead], Writing—original draft [lead], Writing—review & editing [equal]), Nicole Litvitskiy (Formal analysis [lead], Project administration [supporting], Writing—review & editing [supporting]), Kristen Higgins (Formal analysis [lead], Project administration [supporting], Writing—review & editing [supporting]), Olivia Bravoco (Conceptualization [supporting], Investigation [supporting], Methodology [supporting]), Tatiana M. Davidson (Conceptualization [supporting], Methodology [supporting], Writing—original draft [supporting], Writing—review & editing [supporting]), Christian J. Streck (Conceptualization

[supporting], Data curation [supporting], Methodology [supporting], Project administration [supporting], Resources [supporting], Writing—review & editing [supporting]), Nancy Kassam-Adams (Validation [supporting], Visualization [supporting], Writing—review & editing [supporting]), and Kenneth J. Ruggiero (Conceptualization [supporting], Funding acquisition [supporting], Methodology [supporting], Resources [supporting], Supervision [supporting], Validation [supporting], Visualization [supporting], Writing—review & editing [lead]).

## References

- American College of Surgeons. (2022). *Resources for Optimal Care of the Injured Patient (2022 Standards)*. ACS. <https://www.facs.org/quality-programs/trauma/quality/verification-review-and-consultation-program/standards/2022-resources-repository/access/>
- Bradley, E. H., Curry, L. A., & Devers, K. J. (2007). Qualitative data analysis for health services research: Developing taxonomy, themes, and theory. *Health Services Research, 42*, 1758–1772. <https://doi.org/10.1111/j.1475-6773.2006.00684.x>
- Bulger, E. M., Johnson, P., Parker, L., Moloney, K. E., Roberts, M. K., Vaziri, N., Seo, S., Nehra, D., Thomas, P., & Zatzick, D. (2022). Nationwide Survey of Trauma Center Screening and Intervention Practices for Posttraumatic Stress Disorder, Firearm Violence, Mental Health, and Substance Use Disorders. *Journal of the American College of Surgeons, 234*, 274–287. <https://doi.org/10.1097/XCS.000000000000064>
- Bunnell, B. E., Davidson, T. M., Winkelmann, J. R., Maples-Keller, J. L., Ridings, L. E., Dahne, J., Fakhry, S. M., & Ruggiero, K. J. (2019). Implementation and utility of an automated text messaging system to facilitate symptom self-monitoring and identify risk for posttraumatic stress disorder and depression in trauma center patients. *Telemedicine Journal and e-Health: The Official Journal of the American Telemedicine Association, 25*, 1198–1206.
- Centers for Disease Control and Prevention. (2023). *WISQARS Cost of Injury*. <https://www.cdc.gov/injury/wisqars/>
- Davidson, T. M., Bunnell, B. E., & Ruggiero, K. J. (2017). An automated text-messaging system to monitor emotional recovery after pediatric injury: Pilot feasibility study. *Psychiatric Services (Washington, D.C.), 68*, 859–860. <https://doi.org/10.1176/appi.ps.201600515>
- Graham, A. K., Weissman, R. S., & Mohr, D. C. (2021). Resolving key barriers to advancing mental health equity in rural communities using digital mental health interventions. *JAMA Health Forum, 2*, e211149. <https://doi.org/10.1001/jamahealthforum.2021.1149>
- Guess, K. E., Fifolt, M., Adams, R. C., Ford, E. W., & McCormick, L. C. (2019). Life after trauma: A survey of level 1 trauma centers regarding posttraumatic stress disorder and acute stress disorder. *Journal of Trauma Nursing: The Official Journal of the Society of Trauma Nurses, 26*, 223–233. <https://doi.org/10.1097/jtn.0000000000000451>
- Hunt, J. C., Chesney, S. A., Brasel, K., & deRoon-Cassini, T. A. (2018). Six-month follow-up of the injured trauma survivor screen: Clinical implications and future directions. *The Journal of Trauma and Acute Care Surgery, 85*, 263–270. <https://doi.org/10.1097/ta.0000000000001944>
- Kahana, S. Y., Feeny, N. C., Youngstrom, E. A., & Drotar, D. (2006). Posttraumatic stress in youth experiencing illnesses and injuries: An exploratory meta-analysis. *Traumatology, 12*, 148–161. <https://doi.org/10.1177/1534765606294562>
- Landolt, M. A., Vollrath, M. E., Gnehm, H. E., & Sennhauser, F. H. (2009). Post-traumatic stress impacts on quality of life in children after road traffic accidents: Prospective study. *Australian & New Zealand Journal of Psychiatry, 43*, 746–753. <https://doi.org/10.1080/00048670903001919>
- Marsac, M. L., Hildenbrand, A. K., Kohser, K. L., Winston, F. K., Li, Y., & Kassam-Adams, N. (2013). Preventing posttraumatic stress following pediatric injury: A randomized controlled trial of a web-based psycho-educational intervention for parents. *Journal of Pediatric Psychology, 38*, 1101–1111.
- Marsac, M. L., Winston, F. K., Hildenbrand, A. K., Kohser, K. L., March, S., Kenardy, J., & Kassam-Adams, N. (2015). Systematic, theoretically grounded development and feasibility testing of an innovative, preventive web-based game for children exposed to acute trauma. *Clinical Practice in Pediatric Psychology, 3*, 12–24. <https://doi.org/10.1037/cpp0000080>
- McCarty, C. A., Zatzick, D., Stein, E., Wang, J., Hilt, R., & Rivara, F. P., for the Seattle Sports Concussion Research Collaborative (2016). Collaborative care for adolescents with persistent postconcussive symptoms: A randomized trial. *Pediatrics, 138*, e20160459. <https://doi.org/10.1542/peds.2016-0459>
- Mohr, D. C., Azocar, F., Bertagnolli, A., Choudhury, T., Chrisp, P., Frank, R., Harbin, H., Histon, T., Kaysen, D., Nebeker, C., Richards, D., Schueller, S. M., Titov, N., Torous, J., & Areán, P. A. Banbury Forum on Digital Mental Health. (2021). Banbury Forum Consensus Statement on the path forward for digital mental health treatment. *Psychiatric Services, 72*, 677–683. <https://doi.org/10.1176/appi.ps.202000561>
- National Center for Injury Prevention and Control. (2021). February 9. *Nonfatal Data*. Nonfatal Injury Data. <https://www.cdc.gov/injury/wisqars/nonfatal.html>
- Nicoletti, B. (2023). *CPT® Codes (99421-99423)—and Payment for—Online Digital Evaluation and Management (E/M) Services*. CodingIntel. <https://codingintel.com/cpt-codes-online-digital-evaluation-and-management-services/>
- Price, M., Ruggiero, K. J., Ferguson, P. L., Patel, S. K., Treiber, F., Couillard, D., & Fakhry, S. M. (2014). A feasibility pilot study on the use of text messages to track PTSD symptoms after a traumatic injury. *General Hospital Psychiatry, 36*, 249–254. <https://doi.org/10.1016/j.genhosppsych.2014.02.004>
- Ridings, L. E., Anton, M. T., Winkelmann, J., Davidson, T. M., Wray, L., Streck, C. J., & Ruggiero, K. J. (2019). Trauma resilience and recovery program: Addressing mental health in pediatric trauma centers. *Journal of Pediatric Psychology, 44*, 1046–1056. <https://doi.org/10.1093/jpepsy/jsz053>
- Ridings, L. E., Espeleta, H. C., Streck, C. J., Davidson, T. M., Litvitskiy, N., Bravoco, O., Kassam-Adams, N., & Ruggiero, K. J. (2022). Assessing service quality and access in trauma centers through behavioral health screening, education, and treatment after pediatric injury. *Journal of Pediatric Surgery, 57*, 632–636. <https://doi.org/10.1016/j.jpedsurg.2022.01.014>
- Roberts, J. C., deRoon-Cassini, T. A., & Brasel, K. J. (2010). Posttraumatic stress disorder: A primer for trauma surgeons. *The Journal of Trauma, 69*, 231–237. <https://doi.org/10.1097/ta.0b013e3181e16e2a>
- Rothbaum, B. O., Kearns, M. C., Price, M., Malcoun, E., Davis, M., Ressler, K. J., Lang, D., & Houry, D. (2012). Early intervention may prevent the development of posttraumatic stress disorder: A randomized pilot civilian study with modified prolonged exposure. *Biological Psychiatry, 72*, 957–963. <https://doi.org/10.1016/j.biopsych.2012.06.002>
- Rothbaum, B. O., Kearns, M. C., Reiser, E., Davis, J. S., Kerley, K. A., Rothbaum, A. O., Mercer, K. B., Price, M., Houry, D., & Ressler, K. J. (2014). Early intervention following trauma may mitigate genetic risk for PTSD in civilians. *The Journal of Clinical Psychiatry, 75*, 1380–1387. <https://doi.org/10.4088/jcp.13m08715>
- Ruggiero, K. J., Davidson, T. M., Anton, M. T., Bunnell, B., Winkelmann, J., Ridings, L. E., Bravoco, O., Crookes, B., McElligott, J., & Fakhry, S. M. (2020). Patient engagement in a technology-enhanced, stepped-care intervention to address the mental health needs of Trauma Center patients. *Journal of the American College of Surgeons, 231*, 223–230. <https://doi.org/10.1016/j.jamcollsurg.2020.03.037>

- Zatzick, D. F., Jurkovich, G. J., Fan, M.-Y., Grossman, D., Russo, J., Katon, W., & Rivara, F. P. (2008). Association between posttraumatic stress and depressive symptoms and functional outcomes in adolescents followed up longitudinally after injury hospitalization. *Archives of Pediatrics & Adolescent Medicine*, *162*, 642–648. <https://doi.org/10.1001/archpedi.162.7.642>
- Zatzick, D. F., Rivara, F. P., Nathens, A. B., Jurkovich, G. J., Wang, J., Fan, M.-Y., Russo, J., Salkever, D. S., & Mackenzie, E. J. (2007). A nationwide US study of post-traumatic stress after hospitalization for physical injury. *Psychological Medicine*, *37*, 1469–1480. <https://doi.org/10.1017/s0033291707000943>
- Zatzick, D., Jurkovich, G., Rivara, F. P., Russo, J., Wagner, A., Wang, J., Dunn, C., Lord, S. P., Petrie, M., O'connor, S. S., & Katon, W. (2013). A randomized stepped care intervention trial targeting post-traumatic stress disorder for surgically hospitalized injury survivors. *Annals of Surgery*, *257*(3), 390–399. <https://doi.org/10.1097/sla.0b013e31826bc313>
- Zatzick, D., Rivara, F., Jurkovich, G., Russo, J., Trusz, S. G., Wang, J., Wagner, A., Stephens, K., Dunn, C., Uehara, E., Petrie, M., Engel, C., Davydow, D., & Katon, W. (2011). Enhancing the population impact of collaborative care interventions: Mixed method development and implementation of stepped care targeting posttraumatic stress disorder and related comorbidities after acute trauma. *General Hospital Psychiatry*, *33*(2), 123–134. <https://doi.org/10.1016/j.genhosppsy.2011.01.001>