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Screening for mental health symptoms following pediatric traumatic injury: A practice management guideline (from the Pediatric Trauma Society, Society of Trauma Nurses, and Center for Pediatric Traumatic Stress)

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Decades of research have documented risk of mental health difficulties, particularly posttraumatic stress symptoms (PTSS), among children with injuries.[1,2] A smaller body of literature indicates risk for depression, which may co-occur with PTSS.[3,4] A previous systematic review suggested that roughly 22% to 42% of youth will experience PTSS in the first month following injury, with 10% to 19% continuing to experience symptoms after 10 months.[1] Importantly, the risk of re-injury, significant impairment in daily functioning, and poor health-related quality of life are associated with symptoms of posttraumatic stress disorder (PTSD), even if full diagnostic criteria are not met.[4–10]

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Given this risk for impairing mental health symptoms, the American College of Surgeons (ACS) updated the standards in the Resources for Optimal Care of the Injured Patients in 2022 to require mental health screening for Level I and Level II Pediatric Trauma Centers.[11] Specifically, trauma centers "must meet the mental health needs of trauma patients by having (1) a protocol to screen patients at high risk for psychological sequelae with subsequent referral to a mental health provider (Level I, Level II) or (2) a process for referral to a mental health provider when required (Level III)." The standard does not define which patients are "at high risk for psychological sequalae." Further guidance on meeting this new requirement was provided in an ACS Best Practices Guidelines document.[12] While this document provides a table of potential screening tools, the list is not based on a rigorous meta-analysis or systematic literature review.

We aimed to conduct a systematic review to develop evidence-based practice management recommendations regarding mental health screening in pediatric patients with injuries employing a modified Grading of Recommendations Assessment, Development and Evaluation (GRADE) methodology. Specifically, guidance is needed regarding which patients, if any, to prioritize for mental health screening and which screening tools accurately and efficiently identify injured pediatric patients at risk for concurrent and/or prospective mental health difficulties.

METHOD

Using a modified GRADE approach for this systematic review, we assembled a group of pediatric trauma experts (pediatric psychologists, social worker, nurses, advance practice providers, trauma surgeons) from the Pediatric Trauma Society (PTS), Society of Trauma Nurses (STN), and the Center for Pediatric Traumatic Stress (CPTS) and collaborated with a GRADE expert. In a consensus conference and using voting to determine outcomes, these experts developed Population, Intervention, Comparator, and Outcomes (PICO) questions (see Supplemental Digital Content, Supplemental materials for AGREE Reporting Checklist for Clinical Practice Guidelines, http://links.lww.com/TA/E312). Relevant outcomes were identified by the working group and then each member

voted independently on outcomes using a scale of 1 to 9. Rounded average scores for each outcome were categorized as critical (7 to 9), important but not critical (4 to 6), or limited importance (1 to 3). Only critically important outcomes were considered in decision making for generating final recommendations.

PICO Question 1: Among pediatric patients (<18 years) with injury (P; excluding child abuse, self-harm), should screening for significant psychological symptoms only occur among those perceived to be at risk (I) versus all patients with injuries (C) in order to identify those with current symptoms and/or risk for later psychological symptoms (O)? **Lay language:** Should only those patients perceived to be at risk for psychological symptoms be screened or should all patients with injury be screened?

PICO Question 2a: Among pediatric patients (<18 years) with injury (P; excluding child abuse, self-harm), do screening tools for identification of those with *concurrent* significant psychological symptoms (I) predict outcomes measured using a reliable and valid assessment of psychological symptoms (e.g., PTSD, depression; C) in an accurate manner (e.g., specific, sensitive; O)? **Lay language:** Which screening tool(s) should be used to identify those at risk for current psychological symptoms?

PICO Question 2b: Among pediatric patients (<18 years) with injury (P; excluding child abuse, self-harm), do screening tools for identification of those with *later* significant psychological symptoms (I) predict outcomes measured using a reliable and valid assessment of psychological symptoms (e.g., PTSD, depression; C) in an accurate manner (e.g., specific, sensitive; O)? **Lay language:** Which screening tool(s) should be used to identify those at risk for later psychological symptoms?

Data Sources and Search Strategy

Following the GRADE approach and led by an expert medical librarian, we conducted a search of PubMed, Scopus, PsychINFO, Emcare, CINAHL, and Cochrane Trials Register databases on 5/8/2023, and repeated this search on 5/8/2024, leading to the addition of one article (see Supplemental Digital Content, Supplemental materials for search terms and strategy, http://links.lww.com/TA/E313). Identified articles were uploaded into Covidence software (Melbourne, Australia). At each review phase (abstract/title, full-text), two reviewers independently applied inclusion/exclusion criteria to each article. All conflicts were discussed among the lead author and at least one other reviewer and consensus was reached.

Study Eligibility

To be included, articles had to meet the following criteria: (1) describe results of a quantitative empirical study in a medical setting (e.g., inpatient, emergency department) of pediatric patients (<18 years) who experienced an unintentional injury; (2) describe use of a screening tool, which does not require administration by a trained mental health professional, to categorize pediatric patients into groups based on risk for current and/or future mental health symptoms and/or report outcomes regarding accuracy of the tool (e.g., sensitivity, specificity); (3) report relations between screening tool results and outcomes of interest, namely child mental health symptoms (acute stress disorder [ASD], PTSD, anxiety, depression, behavioral problems) or child behavioral health service utilization (e.g., psychology consultations). We excluded non-English articles, abstracts, systematic or narrative reviews, meta-analyses, qualitative studies, intervention studies, policy articles, editorials, protocol articles, and consensus documents. We also excluded studies that involved only patients with traumatic brain injuries or focused on child abuse or self-harm, as these are unique populations with distinct outcomes (e.g., changes in cognitive functioning) or correlates (e.g., foster care placement) that complicate prediction of mental health outcomes. Given the focus on child mental health outcomes that are related to exposure to unintentional injury, we also excluded studies that measured exclusively the following mental health outcomes: Attention Deficit/Hyperactivity Disorder, autism, schizophrenia, psychosis, cognitive disorders, intellectual disability, procedural anxiety, and reported solely on parent or caregiver mental health outcomes.

For PICO 1, included articles had to explicitly a) compare outcomes of interest (e.g., utilization of mental health services) across patients for whom a screening tool was and was not used, b) examine outcomes of interest among a targeted subsample of patients for whom a screening tool was used, or c) examine outcomes of interest among those for whom a universal screening approach was taken. For PICO 2, manuscripts had to include measures of accuracy (i.e., sensitivity, specificity) for *concurrent* prediction of mental health symptoms (PICO 2a) or for prediction of *later* mental health symptoms (PICO 2b).

Data Extraction and Methodology

One reviewer (JP) extracted data points from each manuscript and a different reviewer (CY) checked accuracy and completeness of extraction. The two reviewers met to resolve conflicts and consulted with other reviewers as needed.

For PICO 2a and PICO 2b, sensitivity, specificity, positive predictive values (PPV), negative predictive values (NPV), and the area under the receiver operating curve (AUC) were extracted when available.[13] In evaluating screening tool performance to identify children at-risk for mental health symptoms following injury, higher sensitivity and higher NPV are desirable. Tools that optimize the odds of correctly identifying those with mental health symptoms (sensitivity) and optimize the probability that those who screen negatively are truly *not* at risk for mental health symptoms (NPV) will ensure patients with any risk are identified and mental health supports are utilized by those truly in need.[14,15] In this context, the consequences of lower specificity or PPV, i.e., increased odds of incorrectly capturing those not truly at-risk, are minimal in terms of harms to patients and families and cost. Thus, screening tools that show promising sensitivity (≥70%) and NPV (≥70%) and modest specificity (≥50%) and PPV (≥50%) are considered effective.

Recommendation Creation

PICO 1

All reviewers voted independently on the strength of practice management recommendation for PICO 1, considering the quality and depth of the evidence, as well as weighing risks and potential benefits.

PICO 2a and 2b

All authors reviewed an in-depth qualitative synthesis of results for PICO 2a and 2b. Given the lack of a gold standard screening tool for comparison and significant variability across

studies, all authors agreed that meta-analyses for PICO 2a and 2b were not feasible. All authors agreed to a qualitative process to evaluate which screening tools met specific criteria to be recommended for clinical use. These criteria were developed collaboratively by all authors and revised based on individual feedback and group discussion. The Essential Screening Tool Criteria required for recommending tool use and the additional Desirable Criteria are listed in Table 1.

External Review

The PTS Guidelines Committee and the Boards of STN and CPTS conducted an external review of the methods, recommendations, and full manuscript. All endorsed this guideline.

RESULTS

In the initial search 6,228 studies were identified, 377 reached full-text review, and 25 were included in analyses (see Fig. 1).[16–40]

PICO 1: Screen Only Those Perceived to Be at Risk vs. Screen All Patients With Injury

Among the final 25 papers, five offered data regarding who should be screened for mental health difficulties.

Qualitative Synthesis

Two studies compared utilization of psychology consultations for admitted pediatric injury patients who were and were not part of a PTSD screening program.[29,37] One study reported a 40% increase in appropriate referrals to psychology when comparing referrals preimplementation and postimplementation of a universal PTSD screening program.[31] Of those referred, 95% to 96% were diagnosed with ASD and 90% to 92% of these patients were then diagnosed with PTSD. However, over 70% of patients who should have been referred to psychology, based on the screening tool, were not. Many of these missed referrals occurred among young children (<5 years) and children with pain-related issues. In a second study, rates of completed inpatient psychology consultations were significantly higher among those for whom a standardized screening program existed (15.12%; admitted youth ≥8 years) compared with those who were not eligible for this program, i.e., relying on medical provider clinical intuition about whether to refer (0.85%; admitted youth <8 years). Data from both studies suggest that without universal use of a screening tool, patients who could benefit from mental health referrals are missed.

Three articles evaluated predictors of positive PTSD screening results, offering data regarding which pediatric injury populations may be at high risk for PTSD and should be prioritized for screening.[19,21,37] Results across studies conflicted on which factors predicted a positive PTSD screen. For example, race/ethnicity, indicators of socioeconomic status, and high Injury Severity Score (ISS) predicted high rates of positive PTSD screen for some but not other studies. One study found that those who screen positively initially, show higher rates of later positive screens.[29] Taken together, data are limited and inconsistent on which factors predict positive PTSD screening results.

In terms of equity, one study found no differences in screening tool administration across race and insurance type (public vs. private) among those eligible for a standardized screening program.[37] Universal screening may ensure services are matched to needs and improve equitable access to care.

Quantitative Synthesis

While sample sizes varied (range = 31–1153), overall populations were similar, although some studies reported incomplete data (e.g., one did not report patient age, two did not report patient sex, three did not report race or ethnicity). Older samples (7–17 years) were mostly male (66–70%) and White (59–64%; 4–26% African American, 35% Hispanic, <1% Asian). Roughly half of these samples had private health insurance (47–56%) and half had public (31–43%) or no health insurance (10%). In the one study of younger children that reported demographic data, this sample was slightly majority male (55%) and White (58%; 26% African American, 1% Asian) and only 37% had private health insurance (52% public health insurance).

All five studies required that patients were admitted due to injury. Only one study reported injury type. Four studies reported data on injury mechanisms, which included motor vehicle collisions (MVC), falls, sports injury, dog bite, and

TABLE 1. Essential and Desirable Criteria to Recommend a Screening Tool for PICO Questions 2a and 2b

Essential Screening Tool Criteria
1. Screening tool performance has been evaluated with injured children in a medical setting
2. At least one study provides evidence that screening tool detects concurrent psychological distress and/or predicts persistent, ongoing distress
3. Tool is feasible for use in the emergency department or inpatient setting (i.e., time to administer, ease of scoring)*
4. Evidence-based scoring guidelines are provided and include guidance on interpreting the meaning of a positive screen so that healthcare team can take appropriate action (e.g. monitor, assess further, refer for mental health services)
5. No rigorous study/substantial evidence showing that the tool is **not** effective at detecting psychological distress and/or predicts persistent, ongoing distress
Additional Desirable Screening Tool Criteria
1. Multiple studies provide evidence for prediction of concurrent or future/ongoing psychological distress
2. At least one study offers evidence for prediction of broader spectrum of distress—e.g., posttraumatic stress, depression, anxiety, behavioral difficulties, and/or impact on functioning
3. Demonstrated feasibility and utility based on real world use in multiple settings
4. Tool has been evaluated in, and has evidence for good performance with, injured patients similar to those in the target setting (e.g., age, culture, language, injury types and severity)

Note. Criteria developed through discussion and revisions among all authors.
* Based on authors' judgment when formal feasibility data (ie time to administer) was not reported.

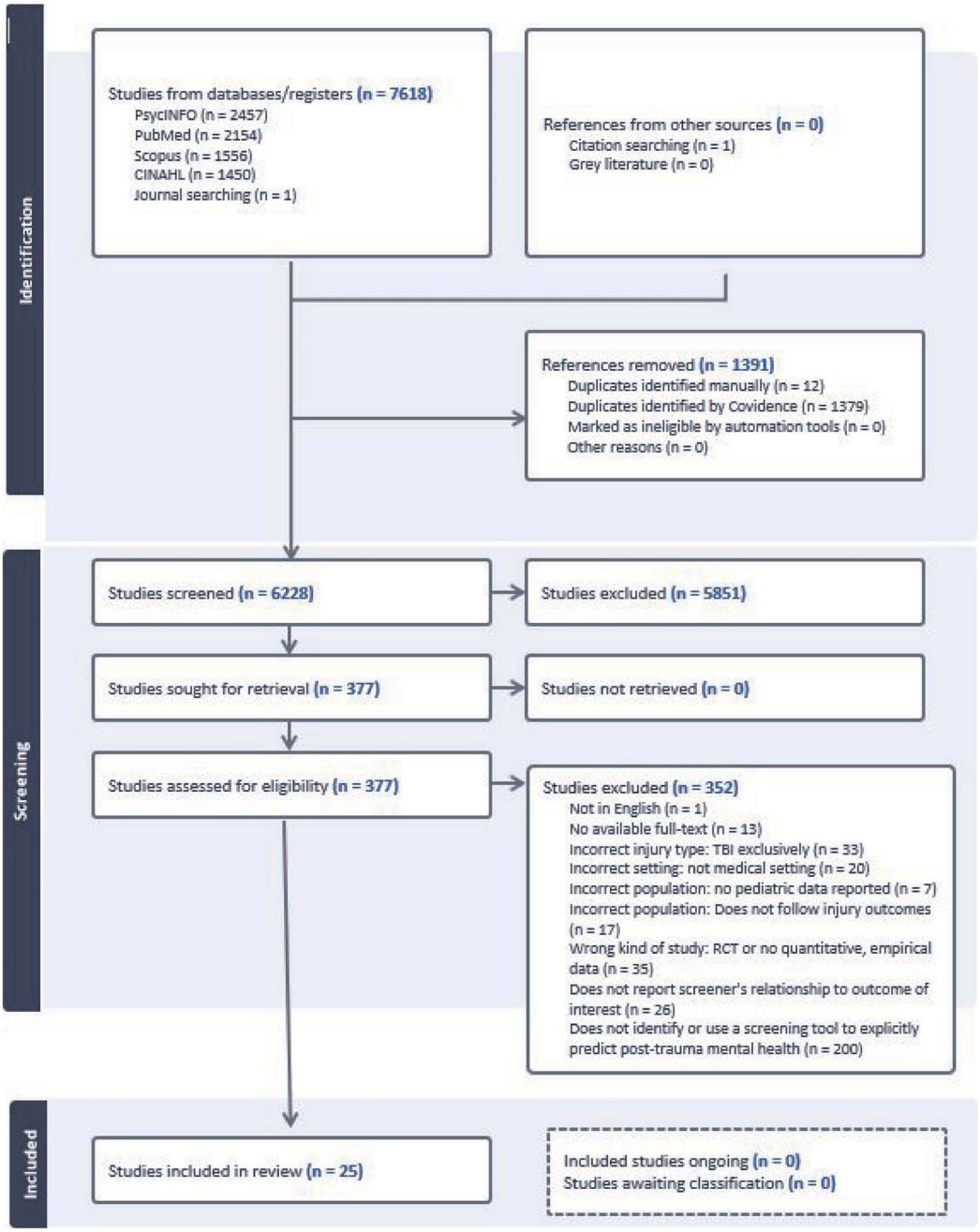

Figure 1. PRISMA Flow Diagram.

gunshot. Most common were MVC (17–40%) and falls (21–33%). Three studies reported ISS: one reported mostly minor ISS (65%) and two provided mean ISS (range = 7–10). One study reported average hospital stay (M_{days} = 2.84–3.15, *SD* = 6.75–7.29).

Three studies conducted screening during the hospital admission[21,31,37] and two administered post-discharge.[19,29] While all studies screened for PTSD, tools varied. One study created an unvalidated tool,[31] two employed the Screening Tool for Early Predictors of PTSD (STEPP),[21,37] one used the Child Trauma Screening Questionnaires (CTSQ; ages 7–18 years) and the Young Child PTSD Screen (YCPS; 2–6 years),[19] and another used only the CTSQ.[29]

Grading the Evidence

Only two studies compared a screening tool protocol to clinical intuition as indicators of need for a psychology consult or other mental health service. Results from both indicate significant risk of under-referral without a universal screening process. Three studies used retrospective data from clinical programs while two described prospective data.[21,29]

Three studies examined predictors of positive screens for PTSD. While such data may indicate populations to prioritize in a screening program, these findings rely on the assumption that the screening tool provides a valid and reliable indicator of PTSD or PTSD risk. Two studies used the STEPP, which has not consistently performed well in prospective prediction of PTSD.[18,24,33,39] One study used a screening tool developed by an interdisciplinary team at the institution which has not yet been validated.[31] All studies examined screening for PTSD only and did not consider other mental health symptoms, such as depression or anxiety. All studies evaluated screening tools among patients who were admitted for injury, but only three studies administered the screening tool during the admission.[21,31,37] Overall, the level of evidence for targeted compared with universal screening was very low due to inconsistency among study findings and unblinded study designs with retrospective components.

Recommendation

We strongly recommend universal mental health screening among pediatric patients with injury to identify those most at-risk for mental health difficulties. Universal screening benefits (e.g., efficient and accurate referrals for care, potential for improved patient functioning and lower patient distress) and high risk of harm in missing pediatric patients experiencing current or future mental health difficulties (e.g., continued or worsening patient distress and functioning) significantly outweigh the extremely minimal risk of harm in universal screening (e.g., potential patient/caregiver discomfort in answering questions).

PICO 2a: Screening Tools for *Concurrent* Significant Psychological Symptoms Predict Outcomes Inaccurately vs. Accurately

Among the included articles, four manuscripts offered data regarding accuracy of screening tools for concurrent mental health concerns.[26,34,36,38] One study from each PICO 2a and 2b have overlapping data.[33,34]

Qualitative Synthesis

All four studies involved screening for concurrent PTSD or ASD, although each employed a different screening tool. Screening tool administration timing varied. Three studies evaluated only one tool and another examined a battery of tools and evaluated the performance of varying combinations of the tools in predicting concurrent PTSD. All four studies used structured clinical interviews, the gold standard, to evaluate PTSD outcomes.

Quantitative Synthesis

Across the four studies, sample sizes (range = 63–479) varied. Average age of patients ranged from 12.35–14.05 years (*SD* = 1.8–3.4 years). All studies reported mostly male (57–70%) samples; only two included race/ethnicity data (56–61% White, 20.1–40% Black/African-American, 38% "other ethnicity"). Only one study included a sample of Spanish-speaking patients.[26]

One study reported types of injuries sustained. All studies described mechanism of injury, most common were MVC (46–64%), assault (22–54%), and sports injuries (22%). No study reported ISS or average length of hospital stay.

BDI + IES + R-CMAS

Although the performance of a battery of screening tools, the Impact of Events Scale (IES, 15-items), Birleson Depression Inventory (BDI, 18 items), and the Revised Children's Manifest Anxiety Scale (R-CMAS, 37 items), showed good sensitivity (n = 170; 85%) and specificity (85%, PPV = 58%), a battery of multiple tests is not feasible. [38]

BDI

The BDI performed poorly in predicting concurrent PTSD (sensitivity = 31%, specificity = 97%; n = 170).[38]

R-CMAS

The R-CMAS performed poorly in predicting concurrent PTSD (sensitivity = 33%, specificity = 93%; n = 170).[38]

IES or Children's Revised Impact of Events

Various versions of the Impact of Events Scale (IES; 15-items, 8-items; six weeks post-injury) with varying cut-off scores showed moderate to good performance (n = 170, n = 63, sensitivity = 67–100%, specificity = 71–92%, PPV = 29–72%, NPV = 98–100%) in predicting concurrent PTSD or PTSS.[36,38]

Child PTSD Symptom Scale

The Child PTSD Symptom Scale (CPSS; 24 items) showed good prediction of concurrent PTSD across multiple samples (n = 185, n = 68; six months post-injury; sensitivity = 84–94%, specificity = 76–83%).[34]

Acute Stress Checklist for Children-Kids (ASC-3, ASC-6, CEA)

Three versions of the Acute Stress Checklist for Children (ASC-Kids; ASC-6 item, ASC-3 item, Spanish version) administered within the first month of injury showed moderate to excellent concurrent prediction of ASD (AUC = 0.76–0.81, sensitivity = 59–73%, specificity = 63–86%, PPV = 39–62%, NPV = 84–88%).[26]

Grading the Evidence

While sensitivity (range = 59–100%) and specificity (range = 63–94%) data are promising and PTSD outcomes were rigorously measured using gold standard structured interviews, few studies contributed data to this PICO question. Only one study examined concurrent screening tool performance within the first weeks of injury.[26] Taken together, the level of evidence is low and due to lack of randomization and no masking of screening tool outcome.

Recommendation

Due to paucity of data, recommendation voting could not be completed. Instead, the work group developed the Essential and Desirable Criteria for a screening tool. The following screening tools were best at identifying concurrent risk of PTSD or PTSS: ASC-Kids (within one month of injury), IES/Children's Revised Impact of Events (CRIES) (6 weeks to 6 months postinjury), CPSS (6-months post-injury; see Table 2).

PICO 2b: Screening Tools for *Later* Significant Psychological Symptoms Predict Outcomes Inaccurately vs. Accurately

Among the included articles, 16 manuscripts offered data regarding accuracy of screening tools in predicting later mental health concerns. Three pairs of studies have overlapping data for PICO 2b. Two pairs are both in PICO 2b[16,17,32,33] and the other included one study each from PICO 2b and 2a.[33,34]

Qualitative Synthesis

There was significant variability across studies in the screening tools examined, outcome measurement approach, and timing of when the screening tool and outcome measures were administered (see Tables 3–5, Supplementary Table).

Fourteen screening tools were evaluated across the 16 included studies, with 12 screening tools measuring child PTSS or risk factors for PTSS, one measuring child depression, and one measuring multiple risk factors for family adjustment (see Table 3). Six studies examined the STEPP. Four studies each evaluated the CTSQ (or equivalent measure) and heart rate. Of the 16 studies, six compared two or more screening tools; the remaining 10 examined one screening tool. Five studies administered the screening tool within 24 hours of the injury (see Table 4).

Nearly all studies measured PTSS or PTSD as an outcome (n = 14). Three studies measured multiple outcomes. Across all 16 studies, 17 different outcome measures were used to assess PTSD (10), depression (3), and anxiety (1), quality of life (1), and broad psychological distress (1; see Table 5). Timing of outcome measurement varied, although 15 of 16 studies measured outcomes between one and six-months post-injury (see Supplemental Digital Content, Table 1, http://links.lww.com/TA/E314).

Quantitative Synthesis

Sample sizes ranged (29–492, $M = 133.38$, $SD = 106.63$, *Median* = 93.5). Twelve out of 16 included patients aged six, seven, or eight years to 16 or 17 years old. Two studies included children under six years.[22,28] Across all 16 studies, most patients were male (range = 54–77%) and White (range = 38–88%). Half of the studies did not report race/ethnicity (n = 8) and only one reported socioeconomic status. Six studies reported percent of Black/African-American patients (range 31–56%); one US study reported on Hispanic ethnicity (6%).[18] One Australian study included Aboriginal and/or Torres Strait Islander (4.3%) and Asian (11.6%) patients.[22]

Most studies involved patients admitted for injury (n = 13) and excluded patients who had suspected abuse or self-inflicted injuries (n = 6), were not able to participate in English (n = 8), had cognitive delays (n = 10), or had traumatic brain injuries (n = 8). Some studies excluded patients who lived far from the hospital (n = 3), were involved with child protective services (n = 2), or were not medically stable within a certain timeframe (n = 2).

Ten studies did not report injury type and one included only patients with burns.[22] Fourteen studies reported injury mechanisms; MVC were frequent reasons for admission (range = 26–72%) across 11 of these 14 studies, and falls were included in seven of these 15 studies (range = 30–47%). Other injury mechanisms included burns, blunt force, gunshot wounds, and dog bites. Of the 11 studies reporting ISS, three reported a median of 5 (range = 1–30), two reported a median of 9 (range = 1–30), and five reported mean ISS (range = 2.10–14). One study reported ISS categorized as minor (78.8%), moderate (17.5%) or severe (3.7%). The burn injury study reported total body surface area burned ($M = 4.28$, $SD = 6.64$). Of the 14 articles involving admitted patients, nine reported mean length of admission (range = 3.4–10.15 days). Three studies reported median lengths of stay at 2 days and another reported 62% with a 1-day stay and 36.5% with 2 to 7 days.

STEPP or adapted versions (STEPP-AUS)

Of the three studies comparing the STEPP to other measures, only one study found that an adapted version of the STEPP (STEPP-AUS) performed best in predicting later PTSD (AUC = 0.73–0.86, $p < 0.01$, sensitivity = 73–89%, specificity = 69%).[33] However, both the original STEPP and the STEPP-AUS had poor internal consistency. Other screening tools, namely the ASC-6 and a combined score on three tools (STEPP, CPSS, Center for Epidemiologic Studies Depression Scale [CES-D]) outperformed the STEPP in the remaining two comparison studies.[24,30]

Across all six studies of the original STEPP, only one (n = 269) showed good prediction of later PTSD (specificity = 48%, sensitivity = 88%, PPV = 25%, NPV = 95%).[40] The remaining five studies showed poor performance of the STEPP,[18,24,30,39] including one study (n = 90) in which the STEPP was no better than chance at identifying later PTSD (AUC = 0.52–0.62, $p = 0.22$–0.88).[33]

CTSQ

The CTSQ outperformed the CRIES in predicting later PTSD (n = 135; sensitivity = 82–85%, specificity = 74–75%, PPV = 23–26%, NPV = 98%) and, when considering sensitivity and NPV, the CTSQ alone (n = 79; sensitivity = 82–85%, NPV = 98%) outperformed the CTSQ combined with heart rate (1 SD > mean for age and sex in the emergency department or 24 hours post-injury) to predict later PTSD.[27,35] In the remaining two studies, the CTSQ was outperformed by other screening tools (adapted version of STEPP, combination of three screening tools) in predicting later PTSS.[24,33] However, these two studies (n = 90; n = 290) used an equivalent but not exact version of the CTSQ and the sensitivity (82–89%; 57%), specificity (31–32%; 91%), NPV (92–96%; 98%), and PPV (12–15%; 20%) of the CTSQ in those studies ranged widely.

ASC-Kids (ASC-6)

In a small study (n = 29) that randomized screening tools within 3 days of the injury, the ASC-6 performed better than the STEPP and the Child Stress Disorders Checklist-Short Form (CSDC-SF) in predicting later PTSD (sensitivity = 100%; specificity = 88%; NPV = 100%, PPV = 50%).[30]

Pediatric Emotional Distress Scale-Early Screener

In a prospective study (2–6 years; n = 87), the Pediatric Emotional Distress Scale-Early Screener (PEDS-ES) alone performed better (sensitivity = 85%; specificity = 63%, PPV = 41%,

TABLE 2. Recommended Screening Tools for Prediction of Psychological Symptoms (PICO 2a And 2b)

	ASC-Kids	CTSQ	CRIES	PEDS-ES	Heart Rate	CPSS	PAT-Burn Population
Screener content	Early child PTS* symptoms	Early child PTS symptoms	Early child PTS symptoms	Early child symptoms	Measured in ED, within 24 h	Early child PTS symptoms	Family level risk factors
Predict concurrent vs. later distress	Both	Later	Both	Later	Later	Both	Later
Language(s)	Eng, Span	Eng	Eng	Eng, Germ	n/a	Eng	Eng
No. items	3- or 6-item	10 items	4 items	21 items	n/a	17 items	Unknown
Child ages	8–17 y	6–16 y	5–17 y	2–6 y	7–17 y	8–17 y	6 months to 16 y
Source of information	Child	Child	Caregiver	Caregiver	EHR	Child	Caregiver
Who can administer	Any staff	Any staff	Any staff		Any staff	Any staff	Any staff
Time to administer	1–2 min	2–3 min	1–2 min	5–7 min	n/a	5–7 min	<10 min, online version
Free for hospitals to use?	Yes	Yes**	Yes	Yes	Yes	Yes	No
Essential Criteria							
1) Screening tool performance has been evaluated with injured children in a medical setting	✔	✔	✔	✔	✔	✔	✔
2) At least one study provides evidence that screening tool detects concurrent psychological distress and/or predicts persistent, ongoing distress	✔	✔	✔	✔	✔	✔	✔
3) Tool is feasible for use in the emergency department or inpatient setting (i.e., time to administer, ease of scoring)†	✔	✔	✔	✔	✔	✔	✔
4) Evidence-based scoring guidelines are provided and include guidance on interpreting the meaning of a positive screen so that healthcare team can take appropriate action (e.g., monitor, assess further, refer for mental health services)	✔	✔	✔	✔	✔	✔	✔
5) No rigorous study/substantial evidence showing that the tool is **not** effective at detecting psychological distress and/or predicts persistent, ongoing distress	✔	✔	✔	✔	✔	✔	✔
Desirable Criteria							
1) Multiple studies provide evidence for prediction of concurrent or future/ongoing psychological distress	✔	✔	✔		✔	✔	
2) Evidence for prediction of BOTH concurrent and future psychological distress.	✔		✔			✔	
3) At least one study offers evidence for prediction of broader spectrum of distress—e.g., posttraumatic stress, depression, anxiety, behavioral difficulties, and/or impact on functioning							✔
4) Demonstrated feasibility and utility based on real world use in multiple settings							
5) Tool has been evaluated in, and has evidence for good performance with, injured patients similar to those in the target setting (e.g., age, culture, language, injury types and severity)							

Note. Criteria developed through discussion and revisions among all authors.
Heart rate ≥ 1 SD or ≥2 SD above mean for sex and age.
*PTS, posttraumatic stress.
**Free to use, but must register to use and report results if used in research.
† Based on authors' judgment (i.e. not hour-long clinical interview) rather than feasibility studies.

TABLE 3. Screening Tools Examined Across Studies Included in PICO 2b

	Screening Tools													
Studies	**STEPP**	**ASC-6**	**CSDC-SF**	**HR**	**CASQ**	**CTSQ**	**CRIES**	**STEPP-AUS**	**CPTCI**	**PEDS-ES**	**5 Qs**	**CPSS**	**CES-D**	**CPTSDI**	**PAT-B**
Winston (2003)	X														
Kassam-Adams (2004)					X										
Kassam-Adams (2005)				X											
Kenardy (2006)						X	X								
De Young (2007)				X											
Bryant* (2007)					X										
Bryant* (2007)				X											
Olsson (2008)				X		X									
Nixon (2010)**†	X					Equiv		X	X						
Kramer (2013)										X	X				
Van Meijel (2015)	X														
Kassam-Adams (2015)	X					Equiv						X	X		
McKinnon† (2016)									X						
Buchanan (2019)	X														
Mazo (2021)	X	X	X												
Hocking (2023)															X

*Overlapping data.
**Overlap with Nixon 2013 in 2a.
†Overlapping data.

NPV = 93%) than the PEDS-ES plus unvalidated 5-item measure of risk factors in predicting later PTSD.[28]

Heart Rate (measured in the emergency department [HRED] or within 24 hours of admission [HR24])

All three studies (n = 101, n = 76, n = 190) employing heart rate found its performance in predicting PTSS as moderate to good (sensitivity = 47–70%, specificity = 53–84%, PPV = 17–53%, NPV = 81–96%).[16,20,23]

CSDC-SF

The CSDC-SF performed more poorly (sensitivity = 67%, specificity = 17%, PPV = 23%, NPV = 50%) than the ASC-6.[30]

TABLE 4. Timing of Screening Tool Administration Across Studies Included in PICO 2B

	Screening Timing					
Studies	**Within 24 Hours**	**Within 1 Week**	**Within 2 Weeks**	**Within 3 Weeks**	**Within 1 Month**	**1–6 Months**
Winston (2003)					X	
Kassam-Adams (2004)					X	
Kassam-Adams (2005)	X					
Kenardy (2006)			X			
De Young (2007)	X					
Bryant (2007)*					X	
Bryant (2007)*	X					
Olsson (2008)	X		X			
Nixon (2010)**†					X	
Kramer (2013)			X			
Van Meijel (2015)		X				
Kassam-Adams (2015)			X			
McKinnon (2016)†						X
Buchanan (2019)	X					
Mazo (2021)					X	
Hocking (2023)				X		

*Overlapping data.
**Overlap with Nixon 2013 in 2a.
†Overlapping data.
Note. "Within 24 hours of injury" groups together studies that administered the screening tool during admission, in the emergency department, at hospital arrival, or within 24 hours of injury or admission. "Within 2 weeks" group together studies that administered the screening tool within 2 weeks of injury or 6–13 days postinjury. "Within 1 month" groups together studies administering a screening tool 3 days to 1 month post-injury, no more than 1-month post-injury, and 6–28 days postinjury.

TABLE 5. Outcome Measures Used Across Studies Included in PICO 2b

	Outcome Measures																
Studies	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Winston (2003)				X	X	X	X										
Kassam-Adams (2004)				X													
Kassam-Adams (2005)				X													
Kenardy (2006)								X									
De Young (2007)								X									
Bryant* (2007)									X								
Bryant* (2007)									X								
Olsson (2008)								X									
Nixon**† (2010)				X			X			X							
Kramer (2013)											X						
Van Meijel (2015)								X				X					
Kassam-Adams (2015)													X	X	X		
McKinnon† (2016)				X				X								X	
Buchanan (2019)	X	X															
Mazo (2021)			X														
Hocking (2023)																	X

*Overlapping data.
**Overlap with Nixon 2013 in 2a.
†Overlapping data.
Note. (1) New mental health diagnosis in EMR, 14 categories: adjustment disorders, anxiety disorders, attention-deficit/hyperactivity disorders (ADHDs), bipolar disorders, disruptive behavior disorders, eating disorders, learning/cognitive disorders, nonbipolar depressive disorders, pervasive developmental disorders, psychotic disorders, sleep disorders, somatoform disorders, substance use disorders, and other disorders, (2) New psychotropic med in EMR. Eight categories: ADHD, anti-anxiety, anticonvulsant, antidepressant, antipsychotic, bipolar, hypnotics/sedatives, and stimulants, (3) Child Report of Posttraumatic Symptoms (CROPS) questionnaire, (4) Clinician-Administered PTSD Scale for Children and Adolescents (CAPS-CA), (5) Child and Adolescent Trauma Survey [CATS], PTSD, Symptom Scale, (6) Multidimensional Anxiety Scale for Children (MASC-10), Short form, (7) Children's Depression Inventory (CDI-S), Short form, (8) Anxiety Disorders Interview Schedule for DSM-IV Child Version, Parent Interview Schedule, (ADIS) PTSD, (9) UCLA PTSD Index for DSM-IV, 19 items encompassing 17 PTSD symptoms (UCLA-PTSD), (10) Affective disorders module of the Schedule for Affective Disorders and Schizophrenia, present and lifetime version (K-SADS), PTSD and Major Depression, (11) German version19 of the PTSD Semi-structured Interview and Observational Record for Infants and Young Children (PTSDSSI), (12) Dutch version of the Children's Revised Impact of Event Scale (CRIES), (13) Child PTSD Symptom Scale (CPSS), (14) Center for Epidemiologic Studies Depression Scale (CES-D), (15) Pediatric Quality of Life Inventory (PQLI), (16) Children's PTSD Inventory (CPTSDI), (17) Strengths & Difficulties Questionnaire (SDQ).

CRIES

The CRIES was outperformed by the CTSQ in predicting later PTSS (sensitivity = 55–69%, specificity = 58%, PPV = 11–15%, NPV = 93–95%).[27]

CPSS

The CPSS, when combined with the CES-D and the STEPP, performed better than any one tool in predicting later PTSD and depression (n = 290).[24] Administered alone, the CPSS performed well in predicting PTSD (sensitivity = 100%, specificity = 82%, PPV = 15%, NPV = 100%) but not depression (sensitivity = 44%, specificity = 82%, PPV = 19%, NPV = 94%).

CES-D

The CES-D, when combined with the CPSS and the STEPP, outperformed any one tool in predicting later PTSD and depression (n = 290).[24] Administered alone, the CES-D showed poor to moderate performance in predicting PTSD and depression (PTSD: sensitivity = 39%, specificity = 94%, PPV = 21%, NPV = 98%; depression: sensitivity = 30%, specificity = 95%, PPV = 27%, NPV = 93%).

Child Acute Stress Reaction Questionnaire

The Child Acute Stress Reaction Questionnaire (CASQ; 48-items) showed moderate performance in predicting PTSD (sensitivity = 40–50%, specificity = 76–80%; PPV-11-24%, NPV = 91–96%), although the length of this tool limits its feasibility.[17,25]

CTPCI

One out of two studies showed The Children's Post-Traumatic Cognitions Inventory (CPTCI) had excellent specificity (82–91%) and sensitivity (81–88%) in predicting later PTSD (n = 535, n = 90).[32,33] However, the authors specifically state that this measure should not be used as a screening tool for PTSD.

Psychosocial Assessment Tool-Burn Population

The Psychosocial Assessment Tool for young children with burn injuries (PAT-B; n = 68) performed well (sensitivity = 71%, specificity = 79%, PPV = 56%, NPV = 88%) in prospectively predicting child psychological outcomes (emotional symptoms, conduct problems).[22]

Grading the Evidence

Results from these 16 studies of largely small samples offer sensitivity, specificity, PPV, and NPV data in predicting PTSD for predominantly White male samples of youth ages 8 to 17 years. Many studies employed prospective approaches and gold standard measurement approaches for outcomes (e.g., structured clinical interviews for PTSD). Few studies described masking those measuring outcomes to the results of the

screening tool(s). Most screening tools are brief measures that can be administered by non-mental health professionals. Few studies offered data on accuracy for screening tools for young children, with the PEDS-Early and PAT-B showing promise for very young patients. Taken together, the level of evidence is very low due to risk of bias, inconsistency, and study designs.

Recommendation

As with PICO 2a, recommendation voting was not done due to the available data. Based on the work group's developed Essential and Desired Criteria, the authors identified the following screening tools as most accurate for prospective risk of PTSD or PTSS: ASC-Kids, CTSQ, CRIES, PEDS-ES, heart rate (HRED, HR24), CPSS, and PAT-Burn (see Table 2).

UTILIZATION IN CLINICAL PRACTICE

Pediatric trauma centers aiming to meet the ACS requirements for mental health screening should work toward screening all injured children. Many (51–64%) pediatric trauma centers report screening pediatric patients with injury, particularly for PTSD. However, many describe prioritizing patients for screening based on factors with inconsistent evidence of indicating increased risk (e.g., ISS).[41]

Pediatric trauma centers should employ screening tools that, at a minimum, meet Essential Criteria for accuracy and feasibility (see Tables 1 and 2). Healthcare professionals (e.g., nurses, physicians, social workers) who complete brief training and consultation from mental health professionals can administer these tools, as determined by individual institution resources and policies.

There are several limitations of this review. The findings indicate the need for additional rigorous research to evaluate and compare the performance of specific screening tools, across a range of pediatric injury populations. All future studies should report demographics of those studied (race/ethnicity, socioeconomic status, primary language) to aid trauma centers in matching results to the populations they serve. This work could inform an update of this guideline. Future research should also consider mental health screening for other family members (e.g., caregivers, siblings).

A recent survey reported concerns about feasibility of integrating screening protocols into practice, particularly given staffing shortages.[42] However, one study at a Level 1 pediatric trauma center documented screening and psychology consultation completion rates close to 70%, suggesting feasibility of universal screening programs.[37] Implementation science can guide trauma centers in developing, initiating, and sustaining screening programs matched to resources (e.g., staffing).[43] This work should include collaboration with mental health professionals, creation of an implementation blueprint, identifying a champion, and tracking data on screening program implementation that includes equity-focused data.[44]

AUTHORSHIP

The first author (J.P.) wrote the original draft of this article. Eleven authors contributed to developing PICO questions, creating inclusion criteria, reviewing of abstracts and full manuscripts for inclusion, and reviewing data extraction results and voting on PICO questions (J.P., M.M., L.R., C.H.A., R.J., M.S., M.B.D., S.W.L., T.N., I.M., N.K.A.). Two authors (J.F., I.M.) served as GRADE experts and guided the methodology, analysis, and voting processes. R.J., medical librarian, conducted the literature search and guided rigorous methodology. J.P. completed all data extraction and C. L.Y. checked and edited results from the data extraction. All authors provided critical revision of the article and approved the final version of this article.

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