

# A Systematic Review of Instruments to Identify Mental Health and Substance Use Problems Among Children in the Emergency Department

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## ABSTRACT

**Objective:** Specialized instruments to screen and diagnose mental health problems in children and adolescents are not yet standard components of clinical assessments in emergency departments (EDs). We conducted a systematic review to investigate the psychometric properties, accuracy, and performance metrics of instruments used in the ED to identify pediatric mental health and substance use problems.

**Methods:** We searched seven electronic databases and the gray literature for psychometric validation studies, diagnostic studies, and cohort studies that assessed any instrument to screen for or diagnose mental illness, emotional or behavioral problems, or substance use disorders. Studies had to include children and adolescents with mental health presentations or positive screens for substance use. Two reviewers independently screened studies for relevance and quality. Diagnostic study quality was assessed with the four QUADAS-2 domains. Psychometric study quality was assessed with published criteria for instrument reliability, validity, and usability. We present a descriptive analysis of the reported psychometric properties and diagnostic performance of instruments for each study.

**Results:** Of the 4,832 references screened, 14 met inclusion criteria. Included studies evaluate 18 instruments for identifying suicide risk (six studies), alcohol use disorders (six studies), mood disorders (one study), and ED decision making (need for assessment, admission; one study). Nine studies include a psychometric focus but quality varies, with no studies fully meeting criteria for reliability, validity, and usability. Seven studies examine diagnostic performance of an instrument, but no study has a low risk of bias for all QUADAS-2 domains. The HEADS-ED instrument has good inter-rater reliability ( $r = 0.785$ ) for identifying general mental health problems and modest evidence for ruling in patients requiring hospital admission (positive likelihood ratio [LR+] = 6.30). Internal consistency (reliability) varies for instruments to screen for suicide risk ( $\alpha = 0.46$ – $0.97$ ), and no instruments have both high sensitivity and high specificity. The Ask Suicide-Screening Questions (ASQ) is highly sensitive (98%) and has strong evidence for ruling out risk (negative likelihood ratio [LR–] = 0.04). Among screening instruments for alcohol use disorders, internal consistency is high for the consumption subscale of the Alcohol Use Disorders Identification Test ( $\alpha = 0.83$ – $0.88$ ) and the Adolescent Drinking Index ( $\alpha = 0.92$ ). Both instruments also had sound internal validity. Diagnostically, a two-item instrument based on DSM-IV criteria is the most accurate in identifying patients

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with a disorder (area under the curve = 0.89) and has modest evidence for ruling in and out risk (LR+ = 8.80, LR- = 0.13).

**Conclusions:** From available evidence, we recommend that ED clinicians use 1) the HEADS-ED to rule in ED admission among pediatric patients with visits for mental health care, 2) the ASQ to rule out suicide risk among pediatric patients with any visit type, and 3) the DSM-IV two-item instrument to rule in/rule out alcohol use disorders among pediatric patients currently using alcohol. These instruments require minimal to no training or time commitment. We also recommend that clinicians become familiar with each instrument's psychometric properties to understand the quality of the evidence base. In this review, however, we identify methodologic limitations in the evidence base. To develop a robust evidence base, additional research is necessary.

Mental health care visits by children and adolescents to general and pediatric emergency departments (EDs) have increased significantly over the past 10 years in the United States.<sup>1,2</sup> These children and adolescents may or may not have been previously diagnosed with a mental disorder or problem.<sup>3</sup> Using specialized instruments to identify mental health problems among children and adolescents during ED care is supported by the American Academy of Pediatrics (AAP) and the Committee on Pediatric Emergency Medicine.<sup>3</sup> However, we do not know whether such instruments are a standard component of clinical assessments by ED clinicians in general and pediatric EDs. Research suggests that using instruments to identify mental health problems among pediatric ED patients is not widespread<sup>4–6</sup> even if the ED visit is mental health related.<sup>6</sup>

Two setting-related barriers to using specialized instrument in screening for mental health problems are absence of validated instruments and time limitations.<sup>6</sup> ED physicians and nurses also raise professional concerns about their lack of knowledge, lack of training, and high discomfort with mental health care.<sup>6,7</sup> In 2011, the AAP recognized several instruments, including those for assessing suicide risk, as addressing both setting-related barriers and professional concerns.<sup>3</sup> These instruments are evidence-based, have sound psychometric and/or diagnostic properties, and can be rapidly deployed at the bedside and by nonspecialists. More recently, several other instruments have been evaluated with pediatric mental health patients to identify concerns related to mental health during an ED visit (e.g., Cappelli et al.,<sup>8</sup> Gipson et al.<sup>9</sup>).

This systematic review has two objectives: 1) to evaluate the psychometric properties and accuracy of instruments intended for children and adolescents who present to the ED with a mental health concern and 2) to provide a more definitive knowledge base on the performance metrics of available instruments

while considering whether the instruments can address setting-related barriers and professional concerns.

## METHODS

### Study Design

A protocol for the review was developed and registered with PROSPERO (Registration # CRD42016033708). Reporting of the review adheres to the PRISMA statement checklist.<sup>10</sup> Funding for the review was provided by the Emergency Strategic Clinical Network of Alberta Health Services (Alberta, Canada). In-kind support of research librarian services was provided by the Alberta SPOR SUPPORT Unit, Knowledge Translation platform. These funding organizations had no involvement in any aspect of the conduct, analysis, and manuscript preparation of this review.

### Search Strategy

A research librarian developed the search strategies for the following databases: MEDLINE, Embase, CENTRAL, EBM Reviews (Cochrane Database of Systematic Reviews, Health Technology Assessment Database and Database of Abstracts of Reviews of Effects), PsycINFO, CINAHL, Social Services Abstracts, and ProQuest Theses and Dissertations. Restrictions were language (English) and date (2000–2015, including literature published up to October 1–14, 2015). The gray literature was searched using Google Scholar, Health Services Research Projects in Progress, Health Services/Sciences Research Resources, and Health Services/Technology Assessment Texts. Reference lists of relevant reviews were searched as well. Clinical trials were searched using www.clinicaltrials.gov. Also searched were conference proceedings of the past two years (2014 and 2015) from the American College of Emergency Physicians, Canadian Association of Emergency Physicians, and Emergency Medicine Academy. Data Supplement S1 (available as supporting

information in the online version of this paper) provides the search terms developed for the MEDLINE database.

### Criteria for Considering Studies for This Review

This review aimed to include a broad range of mental health instruments that have been evaluated with pediatric mental health patients in the ED. Studies that recruited both nonpsychiatric and psychiatric patients were included because the study instrument was still used with mental health patients. Mental health instruments were defined as any instruments that could identify mental illness, emotional or behavioral disorders, substance use problems (substance use disorders or harmful/hazardous use; problems that have been associated with mental disorders<sup>11</sup>), or suicide risk. To be included in the review, a study had to evaluate an instrument with children and adolescents (6–18 years) presenting to an ED with a mental health concern (psychiatric) and/or recent substance use. Studies of young adult and pediatric mental health patients were included if the mean age of the entire group was <20 years. Eligible study designs included psychometric, diagnostic, and cohort studies. Diagnostic studies compared an instrument to a reference standard, but a comparator was not required for psychometric studies to be included in this review. The primary outcomes of interest were 1) instrument validity and reliability for psychometric studies and 2) positive and negative likelihood ratios (LR+ and LR–, respectively) for diagnostic and cohort studies. Secondary outcomes of interest were 1) factor solution or factor loading (if factor solution was not available) and model fit for psychometric studies and 2) area under the curve for diagnostic and cohort studies.

### Screening for Eligibility

References were organized and screened using EndNote X7.2.1. Two reviewers (AS, SWK) independently screened title and abstract for the first 100 articles in the EndNote library and then calculated inter-rater agreement with the kappa statistic.<sup>12</sup> Once a sufficiently high kappa was reached ( $\geq 0.8$ ), the remaining references in the library were divided in two and each reviewer screened one half using title and abstract. Two reviewers (AS, SWK) independently reviewed the full text of studies that were identified as potentially relevant using our predetermined inclusion and exclusion criteria. Any discrepancies were discussed

between the reviewers and taken to a third party (ASN) if no agreement could be reached.

### Data Abstraction

Data were extracted using a standardized form that assessed study characteristics (e.g., language of publication, country), characteristics of the study population, study setting, instrument description and reference standard (diagnostic studies only), and results. Data were extracted by one reviewer (SWK) and reviewed for completeness and accuracy by another reviewer (AS). Discrepancies were resolved by discussion or by contacting corresponding authors of included studies.

### Quality Assessment

Methodologic quality for all studies was assessed independently by two reviewers (SWK, AS). Disagreements were resolved by consensus or by involving a third reviewer (ASN) as required. The quality of instrument development reported in psychometric studies (appropriateness of analytic techniques and psychometric statistics) was assessed using a modified version of an evaluation tool for early childhood social-emotional screening and assessment measures (developed by Gokierto et al.).<sup>13</sup> That tool includes criteria to assess instrument reliability, validity, and usability, with each category being assessed on multiple factors (see Data Supplement S2, available as supporting information in the online version of this paper). We modified the tool by excluding criteria that were not relevant to psychometric studies (e.g., sensitivity and specificity) or that were not relevant to an ED-based instrument (e.g., size of the early childhood standardization sample). Each study was evaluated on the psychometric evidence provided (e.g., no evidence provided, criterion not met, criterion met). When a study did not fully meet a criterion, the overall study quality was downgraded (see Data Supplement S2).

The methodologic quality and applicability of diagnostic studies was assessed using QUADAS-2.<sup>14</sup> The QUADAS-2 reports on four domains: patient selection, index test, reference standard, and flow (of patients through the study) and timing (of the index test and reference standard). Signaling questions for each domain were answered to indicate whether a study had a low, high, or unclear risk of bias. If all signaling questions in a domain were answered “yes,” then risk of bias was judged as low. If any signaling question in a domain was answered “no,” the study was flagged as having a potential for bias. If any

signaling question in a domain was answered “unclear” due to insufficient information, risk of bias was judged as unclear. Assessing applicability for each QUADAS-2 domain involved determining whether the study matched the objective of the systematic review. Applicability was judged as high (a match between study and review), low (no match), or unclear (insufficient evidence to determine a match).

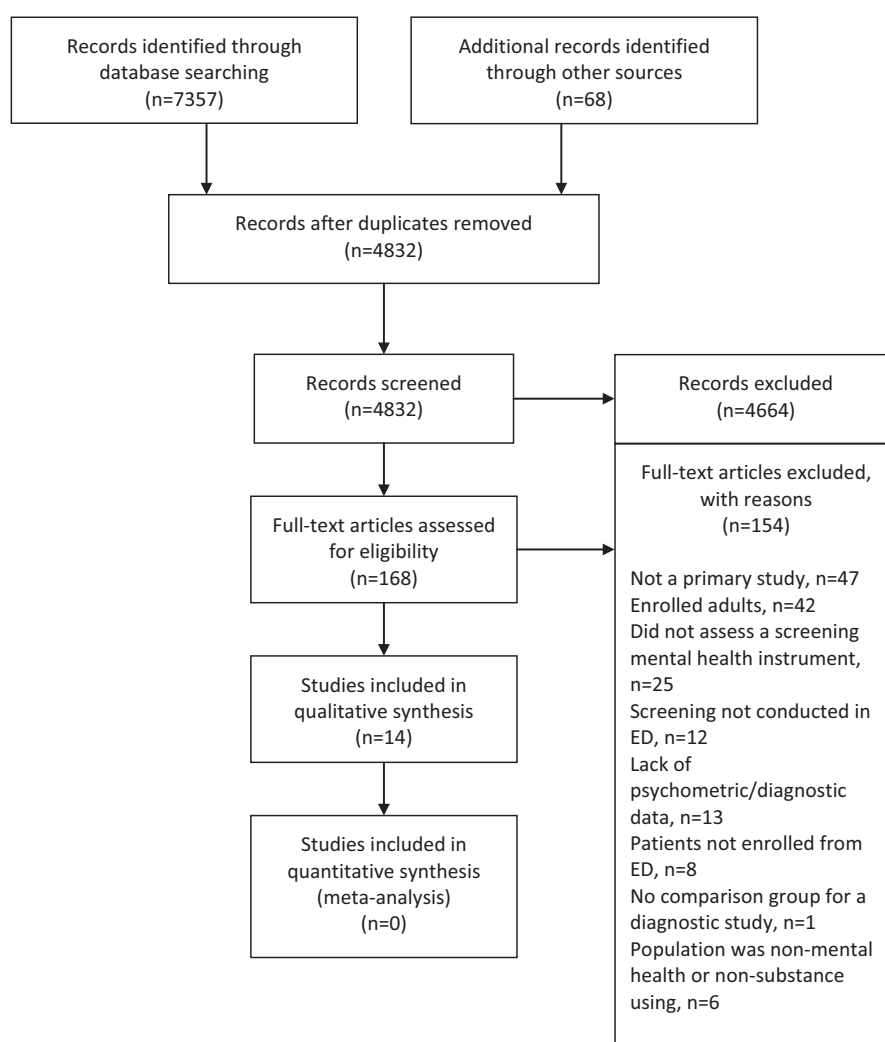
## Data Analysis

Evidence tables were developed to describe the studies, including information on study design, methodologic quality, study population and setting, sample size, instruments, and comparators. Psychometric outcome data were extracted from studies to determine each instrument’s psychometric properties and compare them against set criteria (see Data Supplement S2).

Diagnostic data were extracted from articles to assess the sensitivity and specificity of each instrument. LR+

and LR– likelihood ratios were extracted to provide estimates of how instrument cut scores change the odds of a diagnosis. If sensitivity and specificity data were provided but LR+ and LR– were not, we calculated  $LR+ = \text{sensitivity} / (1 - \text{specificity})$  and  $LR- = (1 - \text{sensitivity}) / \text{specificity}$ . LR+ expresses the strength of evidence available to “rule in” a diagnosis, whereas LR– indicates whether a diagnosis could be “ruled out.” General guidelines for interpreting LR+ values to rule in a disorder are >10, strong evidence; 5 to 10, modest evidence; 2 to 5, weak evidence; and 0.5 to 2, no significant change in the likelihood of a disorder. General guidelines for interpreting LR– values to rule out a disorder are 0.2 to 0.5, weak evidence; 0.1 to 0.2, modest evidence; and <0.1, strong evidence.<sup>15</sup> In this review we aimed to identify diagnostic instruments with large LR+ and small LR– values.

We examined area under the receiver operating characteristic curve to determine instrument accuracy. We used general guidelines for interpreting the values:



**Figure 1.** Selection of studies.

0.90–1 (excellent accuracy), 0.80–0.90 (good accuracy), 0.70–0.80 (fair accuracy), 0.60–0.70 (poor accuracy), and 0.50–0.60 (fail).<sup>16</sup>

We were unable to assess for publication bias due to the small numbers of studies for any given instrument. Heterogeneity in patient populations, clinical instruments, and outcome reporting limited our ability to conduct a meta-analysis. Instead, we conducted a descriptive analysis of the psychometric and diagnostic results of each study.

## RESULTS

### Literature Search and Selection

Our search strategy identified 7,425 citations, with 4,832 citations remaining after removing duplicates. Of these, 168 were considered potentially relevant based on their title and abstract (Figure 1). Full-text review identified 14 studies that met inclusion criteria; 10 provided psychometric data and seven provided diagnostic data.

### Description of Included Studies

Table 1 presents 18 instruments that were evaluated in the 14 included studies. Instruments for identifying alcohol use disorders<sup>17–22</sup> and suicide risk<sup>9,23–28</sup> were assessed in six and seven studies, respectively, making these two clinical focuses the most common conditions assessed. Characteristics of included studies, stratified by clinical focus, are presented in Table 2. Three studies<sup>19,21,26</sup> report early findings of later published studies.<sup>18,20,25</sup>

### Study Quality

Details on the quality of the studies that assess instrument psychometrics are provided in Data Supplement S3 (available as supporting information in the online version of this paper). Data Supplement S4 (available as supporting information in the online version of this paper) provides details on the quality of the studies that report diagnostic evaluations.

### General Screening

One study presents a psychometric and diagnostic assessment of an instrument for general use.<sup>8</sup> The instrument, the HEADS-ED, meets criteria for content and predictive validity and partially meets the criterion for convergent/concurrent validity. The criterion for inter-rater reliability is partially met. The instrument

**Table 1**

Clinical Instruments Used in the Studies for the Identification of Mental Health and Alcohol Use Problems Among Children in the ED

|                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| General screening<br>HEADS-ED                                                                                                                                                     | Home, Education, Activities/Peers, Drug/Alcohol, Suicidality, Emotions/Behavior, Discharge Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Suicide risk<br>ASQ<br>C-SSRS<br><br>RSQ<br>Composite: SIQ-JR, AUDIT-C, RADS-2                                                                                                    | Ask Suicide-Screening Questions<br>Columbia-Suicide Severity Rating Scale<br>Risk of Suicide Questionnaire<br>Suicide Ideation Questionnaire for patients aged 13 or 14 years, Alcohol Use Disorders Identification Test–Consumption subscale, Reynolds Adolescent Depression Scale                                                                                                                                                                                                                                                                                                                                   |
| SQS<br>TQS                                                                                                                                                                        | Single-Question Screen<br>Two-Question Screen                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Alcohol use disorders<br>ADI<br>AUDIT<br><br>AUDIT-C<br><br>CAGE<br><br>CRAFTT<br><br>DSM-IV two-item scale<br><br>FAST<br>RAFFT<br>RAPS4-QF/RAPS-QF<br><br>RUFT-Cut<br><br>TWEAK | Adolescent Drinking Index<br>Alcohol Use Disorders Identification Test<br>Alcohol Use Disorders Identification Test–Consumption subscale<br>Cut down, Annoyed, Guilty, Eye-opener<br>Car, Relax, Alone, Forget, Friends, Trouble<br>(1) Alcohol abuse (drinking in hazardous situations);<br>(2) Alcohol dependence<br>Fast Alcohol Screening Test<br>Relax, Alone, Friends, Family, Trouble<br>Remorse, Amnesia/blackouts, Perform, Starter/eye-opener, Quantity, Frequency<br>Riding with a drinking driver, Unable to stop, Family/Friends, Trouble, Cut down<br>Tolerance, Worried, Eye-opener, Amnesia, Kut-down |

requires minimal training in assessment and interpretation. The QUADAS-2 assessment shows a low risk of bias for the approach to patient selection and for flow and timing in the diagnostic study of the HEADS-ED. In the study, the risk of bias is unclear for how the index test and reference standard were used.<sup>8</sup>

### Suicide Risk

Four studies provide psychometric data on three instruments that assess for risk of suicide: C-SSRS,<sup>9</sup> RSQ,<sup>25,26</sup> and a composite of several instruments (SIQ-JR, AUDIT-C, RADS-2).<sup>28</sup> The C-SSRS meets criteria for content validity and internal consistency and partially meets the criterion for predictive validity. No evidence is provided for other forms of reliability and validity. The C-SSRS has an administration time of less than 15 minutes and requires minimal training in assessment and interpretation. The RSQ meets the

**Table 2**  
Overview of Included Studies

| Author, Year, Country                                                          | Study Design (Enrollment)        | Participants: Inclusion and Exclusion Criteria                                                                                                                                                                                                                                                                                                                        | Instrument                         | Clinical Usability                             |                         |
|--------------------------------------------------------------------------------|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------------------------------|-------------------------|
|                                                                                |                                  |                                                                                                                                                                                                                                                                                                                                                                       |                                    | Administrator During the Study                 | Time to Complete        |
| <i>Assessment of General Mental Health Status and Well-being</i>               |                                  |                                                                                                                                                                                                                                                                                                                                                                       |                                    |                                                |                         |
| Cappelli et al., 2012, <sup>8</sup> Canada                                     | Prospective cohort (consecutive) | <i>Inclusion:</i> Patients aged < 18 y with a mental health concern.<br><i>Exclusion:</i> Patients with a need for immediate medical or surgical care.                                                                                                                                                                                                                | HEADS-ED                           | Crisis intervention worker, research assistant | Varies                  |
| <i>Assessment of Suicide Risk</i>                                              |                                  |                                                                                                                                                                                                                                                                                                                                                                       |                                    |                                                |                         |
| Gipson et al., 2015, <sup>9</sup> US                                           | Prospective cohort (convenience) | <i>Inclusion:</i> Patients aged 13–17 y seeking emergency psychiatric services.<br><i>Exclusion:</i> None stated.                                                                                                                                                                                                                                                     | C-SSRS                             | Social worker, physician                       | Range = 1–2 to 5–10 min |
| Horowitz et al., 2012, <sup>24</sup> US                                        | Prospective cohort (convenience) | <i>Inclusion:</i> Patients aged 10–21 y with either medical/surgical or psychiatric concerns.<br><i>Exclusion:</i> Patients with any disorder preventing an ability to comprehend questions or relay answers, triage level 1 suggesting physiologic instability, or parent/guardian unavailable or did not speak English.                                             | ASQ                                | Research assistant                             | <2 min                  |
| Folse and Hahn, 2009, <sup>25</sup> US<br>Folse et al., 2006, <sup>26</sup> US | Prospective cohort (convenience) | <i>Inclusion:</i> Patients aged > 12 y who were seeking psychiatric or nonpsychiatric care, who were medically stable and could understand English.<br><i>Exclusion:</i> Patients for whom privacy conditions supported a discussion without risk of being overheard by others in the ED.                                                                             | RSQ                                | Registered nurse                               | 90 s                    |
| Horowitz et al., 2001, <sup>27</sup> US                                        | Prospective cohort (consecutive) | <i>Inclusion:</i> Patients aged < 18 y seeking emergency care primarily for psychiatric reasons.<br><i>Exclusion:</i> Patients with impairments that would prevent completion of the assessment tools or missing data on the tool or criterion standard assessments.                                                                                                  | RSQ                                | Triage nurse                                   | <2 min                  |
| King et al., 2009, <sup>28</sup> US                                            | Prospective cohort (convenience) | <i>Inclusion:</i> Patients aged 13–17 y seeking pediatric or psychiatric emergency services.<br><i>Exclusion:</i> Patients with severe cognitive impairment, abnormal vital signs, or parent/guardian unavailable or did not speak English.                                                                                                                           | Composite: SIQ-JR, AUDIT-C, RADS-2 | Self-report                                    | 5–10 min                |
| Rutman et al., 2008, <sup>23</sup> US                                          | Prospective cohort (convenience) | <i>Inclusion:</i> Patients aged 12–17 y with injury, illness, and/or psychiatric concerns.<br><i>Exclusion:</i> Patients with critical illness or injury, developmental delay, or intoxication or if patient or parent/guardian did not speak English.                                                                                                                | SQS<br>TQS                         | Research assistant, study physician            | <1 min                  |
| <i>Assessment of Alcohol Use Disorders</i>                                     |                                  |                                                                                                                                                                                                                                                                                                                                                                       |                                    |                                                |                         |
| Hernandez et al., 2014, <sup>17</sup> US                                       | Prospective cohort (convenience) | <i>Inclusion:</i> Patients aged 13–17 y who reported consuming alcohol within 6 h of their ED admission, had a positive blood alcohol test or breathalyzer reading, and/or scored four or above on the AUDIT.<br><i>Exclusion:</i> Patients who were suicidal, in police custody, requiring hospitalization, or whose medical care interrupted the screening process. | ADI                                | Self-report                                    | <5 min                  |
| (Continued)                                                                    |                                  |                                                                                                                                                                                                                                                                                                                                                                       |                                    |                                                |                         |

(Continued)

Table 2 (continued)

| Author, Year, Country                                                                                                                                                                                                        | Study Design (Enrollment)           | Participants: Inclusion and Exclusion Criteria                                                                                                                                                                                                                                                                                                                                                                                                                                      | Instrument                                                     | Clinical Usability             |                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|--------------------------------|------------------|
|                                                                                                                                                                                                                              |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                | Administrator During the Study | Time to Complete |
| Kelly et al., 2009, <sup>18</sup> US                                                                                                                                                                                         | Prospective cohort (nonconsecutive) | <i>Inclusion:</i> Patients aged 18–20 y, who received medical clearance, currently used alcohol. Adolescents could be alcohol positive at the time of ED presentation.<br><i>Exclusion:</i> Patients with a Glasgow Coma Score < 15, not accompanied by a parent/guardian if < 18 y, admitted due to suspected child abuse or neglect, unable to read and complete a self-report questionnaire, or intoxicated and not oriented to time and place/able to provide informed consent. | AUDIT-C, CRAFFT, RAPS4-QF, FAST, RUFT-Cut, DSM-IV 2-item scale | Self-report                    | 1–5 min*         |
| Kelly et al., 2004, <sup>19</sup> US                                                                                                                                                                                         |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | AUDIT, CAGE, CRAFFT, RAPS-QF, RUFT-Cut                         |                                |                  |
| Kelly et al., 2002, <sup>20</sup> US<br>Kelly and Donovan, 2001, <sup>21</sup> US                                                                                                                                            | Prospective cohort (nonconsecutive) | <i>Inclusion:</i> Patients aged 12–20 y with no serious head injury, not seriously ill or critically injured, accompanied by a parent or legal guardian if < 18 y, able to read and complete a self-report questionnaire, who currently used alcohol and properly completed the questionnaire (e.g., provided usable data). Adolescents could be alcohol positive at the time of ED presentation.<br><i>Exclusion:</i> Patients too ill or critically injured to approach.          | AUDIT, TWEAK, CAGE<br>AUDIT                                    | Self-report                    | 1–2 min†         |
| Bastiaens et al., 2000, <sup>22</sup> US                                                                                                                                                                                     | Prospective cohort (consecutive)    | <i>Inclusion:</i> Patients aged 13–18 y referred for psychiatric assessment.<br><i>Exclusion:</i> Patients who presented by themselves or who did not have a parental figure who had lived with them for at least 6 mo.                                                                                                                                                                                                                                                             | RAFFT                                                          | Triage nurse                   | <2 min           |
| *Five minutes for CRAFFT; 2 minutes for AUDIT/AUDIT-C/ DSM-IV 2-item scale; 1 minute for RAPS4-QF/FAST/RUFT-Cut, DSM-IV 2-item scale; <1 minute for CAGE.<br>†2 minutes for AUDIT; <2 minutes for TWEAK; <1 minute for CAGE. |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                |                                |                  |

criterion for content validity, partially meets the criterion for criterion validity, and does not meet the criterion for internal consistency. No evidence is provided for other forms of reliability and validity. The RSQ has an administration time of less than 15 minutes and requires no training. The composite tool meets criteria for content and concurrent validity and for internal consistency. No evidence is provided for other forms of reliability and validity. The composite tool has an administration time of less than 15 minutes and requires minimal training in assessment and interpretation.

Three studies evaluated the diagnostic properties of four instruments: the ASQ,<sup>24</sup> RSQ,<sup>27</sup> SQS,<sup>23</sup> and TQS.<sup>23</sup> The ASQ shows a high risk of bias for methods of patient selection, an unclear risk of bias for how the index test and reference standard were used in the diagnostic evaluation and a low risk of bias for

flow and timing of instrument delivery. The RSQ shows a low risk of bias for all four domains: methods of patient selection, how the index test and reference standard were used in the diagnostic evaluation, and flow and timing of instrument delivery. The SQS and TQS show a high risk of bias for methods of patient selection, a low risk of bias for use of the index and reference standard, and a low risk of bias for flow and timing.

### Alcohol Use Disorders

Five studies report on the psychometric properties of 11 different instruments to assess for alcohol use disorders: the ADI, AUDIT, AUDIT-C, CAGE, CRAFFT, RAPS4-QF/RAPS-QF, FAST, RUFT-Cut, TWEAK, and a DSM-IV two-item scale. The criterion for content validity is met by all instruments, and the criterion for construct validity is achieved for the ADI

and AUDIT.<sup>17,21</sup> The criterion for internal consistency is partially met for all 11 instruments.<sup>17–21</sup> The criterion for criterion validity is met for the ADI and partially met for the AUDIT.<sup>17,20</sup> One study evaluates concurrent validity of the AUDIT, TWEAK, and CAGE, with the instruments partially meeting the criterion.<sup>20</sup> All the instruments have an administration time of less than 15 minutes and require limited to no training.

Three studies evaluate the diagnostic properties of nine of the 11 instruments.<sup>18,19,22</sup> One study<sup>22</sup> considered risk of bias low for methods of patient selection and two studies<sup>18,19</sup> considered the risk high. All three studies consider the risk of bias high for the index test or its conduct or interpretation. All studies consider the risk of bias low for the reference standard, its conduct, or its interpretation. Risk of bias for flow and timing is considered low<sup>22</sup> or unclear.<sup>18,19</sup>

## Reliability and Validity of Instruments

The reliability and validity of instruments for use in the ED are presented in Table 3.

## General Screening

The HEADS-ED is a reliable instrument when used by multiple ED clinicians ( $r = 0.785$ ), with reliability of the instrument's seven domains ranging from  $r = 0.57$  (Emotions and behaviors domain) to  $r = 0.90$  (Drugs and alcohol domain). The instrument has also been shown to predict which pediatric mental health patients are in need of a full psychiatric assessment and admission to hospital.<sup>8</sup>

## Suicide Risk

The C-SSRS is a reliable instrument ( $\alpha = 0.81$  for the five-item intensity scale) with the ability to predict: 1) ED revisits for suicide attempts by adolescents who seek emergency mental health care (intensity scale score; odds ratio [OR] = 1.09; 95% confidence interval [CI] = 1.01–1.17) and 2) ED revisits for mental health care by adolescents who report suicidal ideation during their index ED visit (OR, 1.09; 95% CI = 1.00–1.19).<sup>9</sup>

The RSQ has been studied with adolescent patients in mental health ED visits, but psychometric properties largely reflect data from patients in nonpsychiatric visits.<sup>25,26</sup> Two studies found modest reliability ( $\alpha = 0.64$  and  $\alpha = 0.65$ ) for the two-item RSQ rather than the four-item version. Correlations of RSQ items with psychiatric and suicide-related diagnoses vary. Question 1 (“Are you here because you tried to hurt yourself?”) has

the strongest correlations with psychiatric ( $r = 0.87$  and  $r = 0.76$ ) and suicide-related ( $r = 0.72$  and  $r = 1.00$ ) diagnoses.<sup>25,26</sup> The composite instrument of suicide, alcohol, and mood-related questions has excellent reliability, ranging from 0.89 to 0.97. Adolescents who screen at elevated risk of suicide using the composite instrument score higher on hopelessness than psychiatrically hospitalized adolescents.<sup>28</sup>

## Alcohol Use Disorders

The AUDIT and its consumption subscale, the AUDIT-C, are the most extensively studied instruments.<sup>18–21</sup> The reliability of the full instrument is excellent ( $\alpha = 0.83$ – $0.88$ ) as is reliability for the subscale ( $\alpha = 0.81$ ). The full instrument has validity in distinguishing between adolescents with hazardous and non-hazardous drinking ( $p < 0.001$ ); breathalyzer-positive and breathalyzer-negative adolescents ( $p < 0.02$ ); and age, sex, and racial differences in alcohol consumption (all statistically significant). The underlying factor structure of the AUDIT is also sound (construct validity).

The 24-item ADI also demonstrates excellent reliability ( $\alpha = 0.92$ ).<sup>17</sup> Its underlying factor structure is sound, and it can distinguish between various alcohol and other drug use outcomes.<sup>17</sup> Modest reliability has been reported for other alcohol use disorder instruments: the CAGE, TWEAK, CRAFFT, RAPS4-QF, FAST, DSM-IV two-item, and RUFT-Cut. The TWEAK and CAGE are able to distinguish between adolescents with hazardous and nonhazardous drinking ( $p < 0.001$  and  $p < 0.05$ , respectively).<sup>20</sup> The TWEAK has also been shown to distinguish age-related drinking differences.<sup>20</sup>

## Diagnostic Accuracy of Instruments

Our findings on the accuracy of mental health instruments for use in the ED are presented in Table 4.

## General Screening

If used as part of a general mental health evaluation, the HEADS-ED has good accuracy in identifying pediatric mental health patients who require hospital admission (area under the curve = 0.82).<sup>8</sup> Risk of admission is sixfold more likely if patients receive a HEADS-ED score  $> 7$  and a suicidal risk score of 2 (range = 0 to 2).

## Suicide Risk

In the three studies that examine suicide risk instruments in pediatric psychiatric patients,<sup>23,24,27</sup> none of

**Table 3**  
Overview of Psychometric Studies That Evaluated Instruments to Identify Mental Health Problems and Alcohol Use Disorders Among Patients Presenting with Mental Health or Alcohol-Related Concerns

| Author                                            | Instrument<br>(No. Items or<br>Domains) | Participants                   |                          | Findings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                    |
|---------------------------------------------------|-----------------------------------------|--------------------------------|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                   |                                         | Sample, <i>n</i><br>(% Female) | Age (y),<br>Range (Mean) | Validity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Reliability                                                                                                                                                                                                                                        |
| General Screening<br>Cappelli et al. <sup>8</sup> | HEADS-ED<br>(7 domains)                 | 313 (58.1)                     | 4–17<br>(14.3)           | <p>Concurrent validity (correlation with CANS-MH 3.0 items), range</p> <ul style="list-style-type: none"> <li><math>r = 0.32\text{--}0.89</math></li> </ul> <p>Concurrent validity (correlation with CDI items), range</p> <ul style="list-style-type: none"> <li><math>r = 0.17\text{--}0.43</math></li> </ul> <p>Predictive validity</p> <ul style="list-style-type: none"> <li>Predictive of consultation for a full psychiatric assessment and subsequent admission to inpatient care, mean difference in scores for those referred for consultation vs. not (<math>p &lt; 0.000</math>) and those admitted vs. discharged (<math>p &lt; 0.000</math>).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p>Inter-rater reliability</p> <ul style="list-style-type: none"> <li><math>r = 0.785</math></li> </ul> <p>Single-item reliability, HEADS-ED items, range</p> <ul style="list-style-type: none"> <li><math>r = 0.57\text{--}0.90</math></li> </ul> |
|                                                   | C-SSRS<br>(3 subscales)                 | 178 (55.6)                     | 13–17<br>(15.25)         | <p>Predictive validity of intensity scale score</p> <ul style="list-style-type: none"> <li>Not predictive of a return psychiatric emergency visit, but predictive of a suicide attempt at return psychiatric emergency visit (OR = 1.09; 95% CI = 1.01–1.17); among subgroup of adolescents who reported suicidal ideation at visit, predictive of return psychiatric emergency visit (OR = 1.09; 95% CI = 1.00–1.19), but not of a suicide attempt at return visit.</li> </ul> <p>Predictive validity of intensity scale items</p> <ul style="list-style-type: none"> <li>The duration item (how long suicidal thoughts last) was the only item-level predictor of return psychiatric emergency visits (OR = 1.67; 95% CI = 1.16–2.42) and suicide attempt at return visit (OR = 1.80; 95% CI = 1.06–3.04).</li> </ul> <p>Predictive validity of severity scale score</p> <ul style="list-style-type: none"> <li>Not predictive of a return psychiatric emergency visit or a suicide attempt at return psychiatric emergency visit. Score categorization (intent vs. no intent) did not predict a return psychiatric emergency visit or a suicide attempt at return visit.</li> </ul> | <p>Internal consistency reliability</p> <ul style="list-style-type: none"> <li>5-item intensity scale, <math>\alpha = 0.81</math></li> <li>1-item severity and behavior scales, NA</li> </ul>                                                      |

(Continued)

Table 3 (continued)

| Author                       | Instrument<br>(No. Items or<br>Domains)                                     | Participants                   |                                   | Findings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                       |
|------------------------------|-----------------------------------------------------------------------------|--------------------------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                              |                                                                             | Sample, <i>n</i><br>(% Female) | Age ( <i>y</i> ),<br>Range (Mean) | Validity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Reliability                                                                                                                                                                                                           |
| Folse and Hahn <sup>25</sup> | RSQ<br>(4 items)                                                            | 59* (61.0)                     | 12–24<br>(19.3)                   | <p>Criterion validity (criterion: positive/negative screens significantly correlate with presence/absence of postevaluation diagnoses indicating imminent suicide risk)</p> <ul style="list-style-type: none"> <li>A positive screen for question 1 of the RSQ was correlated with a postevaluation primary diagnosis (<math>r = 0.87</math>) and suicide-related diagnosis (<math>r = 0.72</math>; <math>p &lt; 0.01</math>).</li> <li>A positive screen for question 2 of the RSQ was correlated with postevaluation primary diagnosis (<math>r = 0.49</math>) and suicide diagnosis (<math>r = 0.57</math>; <math>p &lt; 0.01</math>).</li> <li>Questions 3 and 4 of the RSQ did not contribute to validity.</li> </ul> <p>Criterion validity (criterion: positive/negative screens significantly correlate with presence/absence of postevaluation diagnoses indicating imminent suicide risk)</p> <ul style="list-style-type: none"> <li>A positive screen for question 1 of the RSQ was correlated with a psychiatric-related discharge diagnosis (<math>r = 0.76</math>) and suicide-related discharge diagnosis (<math>r = 1.00</math>; <math>p &lt; 0.01</math>).</li> <li>A positive screen for question 2 of the RSQ was correlated with a psychiatric-related discharge diagnosis (<math>r = 0.34</math>) and suicide diagnosis (<math>r = 0.48</math>; <math>p &lt; 0.01</math>).</li> <li>A positive screen for question 3 of the RSQ was correlated with a psychiatric-related discharge diagnosis (<math>r = 0.28</math>; <math>p &lt; 0.05</math>).</li> <li>Question 4 of the RSQ did not contribute to validity.</li> </ul> <p>Concurrent validity (difference between total scores, mean <math>\pm</math> SD)</p> <ul style="list-style-type: none"> <li>Adolescents who screened positive for elevated suicide risk with the composite instrument had results on the BHS<sup>†</sup> (<math>11.7 \pm 5.3</math>) comparable to or higher than those previously reported for psychiatrically hospitalized adolescents (<math>6.9 \pm 4.9</math>).</li> </ul> | <p>Internal consistency reliability</p> <ul style="list-style-type: none"> <li>4-item instrument, <math>\alpha = 0.46</math></li> <li>2-item instrument (questions 1 and 2), <math>\alpha = 0.64</math></li> </ul>    |
| Folse et al. <sup>26</sup>   |                                                                             | 39 <sup>†</sup> (71.8)         | 12–24<br>(18)                     | <p>Criterion validity (criterion: positive/negative screens significantly correlate with presence/absence of postevaluation diagnoses indicating imminent suicide risk)</p> <ul style="list-style-type: none"> <li>A positive screen for question 1 of the RSQ was correlated with a psychiatric-related discharge diagnosis (<math>r = 0.76</math>) and suicide-related discharge diagnosis (<math>r = 1.00</math>; <math>p &lt; 0.01</math>).</li> <li>A positive screen for question 2 of the RSQ was correlated with a psychiatric-related discharge diagnosis (<math>r = 0.34</math>) and suicide diagnosis (<math>r = 0.48</math>; <math>p &lt; 0.01</math>).</li> <li>A positive screen for question 3 of the RSQ was correlated with a psychiatric-related discharge diagnosis (<math>r = 0.28</math>; <math>p &lt; 0.05</math>).</li> <li>Question 4 of the RSQ did not contribute to validity.</li> </ul> <p>Concurrent validity (difference between total scores, mean <math>\pm</math> SD)</p> <ul style="list-style-type: none"> <li>Adolescents who screened positive for elevated suicide risk with the composite instrument had results on the BHS<sup>†</sup> (<math>11.7 \pm 5.3</math>) comparable to or higher than those previously reported for psychiatrically hospitalized adolescents (<math>6.9 \pm 4.9</math>).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p>Internal consistency reliability</p> <ul style="list-style-type: none"> <li>4-item instrument, <math>\alpha = 0.63</math></li> <li>2-item instrument (questions 1 and 2), <math>\alpha = 0.65</math></li> </ul>    |
| King et al. <sup>28</sup>    | Composite: SIO-JR<br>(15 items), AUDIT-C<br>(3 items), RADS-2<br>(30 items) | 298 (50.3)                     | 13–17 (15.02)                     | <p>Criterion validity (criterion: positive/negative screens significantly correlate with presence/absence of postevaluation diagnoses indicating imminent suicide risk)</p> <ul style="list-style-type: none"> <li>A positive screen for question 1 of the RSQ was correlated with a psychiatric-related discharge diagnosis (<math>r = 0.76</math>) and suicide-related discharge diagnosis (<math>r = 1.00</math>; <math>p &lt; 0.01</math>).</li> <li>A positive screen for question 2 of the RSQ was correlated with a psychiatric-related discharge diagnosis (<math>r = 0.34</math>) and suicide diagnosis (<math>r = 0.48</math>; <math>p &lt; 0.01</math>).</li> <li>A positive screen for question 3 of the RSQ was correlated with a psychiatric-related discharge diagnosis (<math>r = 0.28</math>; <math>p &lt; 0.05</math>).</li> <li>Question 4 of the RSQ did not contribute to validity.</li> </ul> <p>Concurrent validity (difference between total scores, mean <math>\pm</math> SD)</p> <ul style="list-style-type: none"> <li>Adolescents who screened positive for elevated suicide risk with the composite instrument had results on the BHS<sup>†</sup> (<math>11.7 \pm 5.3</math>) comparable to or higher than those previously reported for psychiatrically hospitalized adolescents (<math>6.9 \pm 4.9</math>).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p>Internal consistency reliability</p> <ul style="list-style-type: none"> <li>SIO-JR, <math>\alpha = 0.97</math></li> <li>AUDIT-C, <math>\alpha = 0.89</math></li> <li>RADS-2, <math>\alpha = 0.95</math></li> </ul> |

(Continued)

Table 3 (continued)

| Author                                                  | Instrument<br>(No. Items or<br>Domains)                                                                                  | Participants                   |                                   | Findings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|--------------------------------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                         |                                                                                                                          | Sample, <i>n</i><br>(% Female) | Age ( <i>y</i> ),<br>Range (Mean) | Validity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Reliability                                                                                                                                                                                                                                                                                                                                                |
| Alcohol Use Disorders<br>Hernandez et al. <sup>17</sup> | ADI<br>(24 items)                                                                                                        | 740 (41.5)                     | 13–17 (15.26)                     | Construct validity, model fit<br><ul style="list-style-type: none"> <li>24-item, 4-factor model<sup>§</sup>: RMSEA = 0.090, CFI = 0.812, TLI = 0.789</li> <li>8-item, 4-factor model<sup>§</sup>: RMSEA = 0.050, CFI = 0.984, TLI = 0.967</li> <li>8-item, 4-factor model of adolescents who had a negative alcohol screen: RMSEA = 0.079, CFI = 0.968, TLI = 0.936</li> <li>8-item, 4-factor model of adolescents who had a positive alcohol screen: RMSEA = 0.024, CFI = 0.994, TLI = 0.987</li> </ul> Criterion validity (criterion: the association between 24-item ADI and 8-item ADI and alcohol-related/substance use outcomes, $\beta$ ) <ul style="list-style-type: none"> <li>Hangover (0.02 vs. 0.17, <math>p &lt; 0.001</math>)</li> <li>Alcohol withdrawal (0.27 vs. 0.30, <math>p &lt; 0.001</math>)</li> <li>Positive alcohol screen (0.20 vs. 0.21, <math>p &lt; 0.001</math>)</li> <li>Cigarette use (0.18 vs. 0.16, <math>p &lt; 0.001</math>)</li> <li>Cocaine use (0.28 vs. 0.25, <math>p &lt; 0.01</math>)</li> <li>Other substance use (0.27 vs. 0.25, <math>p &lt; 0.001</math>)</li> </ul> NR | Internal consistency reliability <ul style="list-style-type: none"> <li>24-item scale, <math>\alpha = 0.92</math></li> <li>8-item adapted scale, <math>\alpha = 0.79</math></li> </ul>                                                                                                                                                                     |
| Kelly et al. <sup>18</sup>                              | AUDIT-C (3 items),<br>CRAFT (6 items),<br>RAPS4-QF (6 items),<br>FAST (3 items), RUFT-Cut (5 items), DSM-IV 2-item scale | 181 (43)                       | 18–20 (NR)                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Internal consistency reliability <ul style="list-style-type: none"> <li>AUDIT-C, <math>\alpha = 0.81</math></li> <li>RAPS4-QF, <math>\alpha = 0.68</math></li> <li>FAST, <math>\alpha = 0.64</math></li> <li>RUFT-Cut, <math>\alpha = 0.64</math></li> <li>CRAFT, <math>\alpha = 0.61</math></li> <li>DSM-IV 2-item, <math>\alpha = 0.41</math></li> </ul> |
| Kelly et al. <sup>19</sup>                              | AUDIT (10 items),<br>CAGE (4 items),<br>CRAFT (6 items),<br>RAPS-QF (6 items),<br>RUFT-Cut (5 items)                     | 93 (45)                        | 18–20 (19.0)                      | NR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Internal consistency reliability <ul style="list-style-type: none"> <li>AUDIT, <math>\alpha = 0.83</math></li> <li>RAPS4-QF, <math>\alpha = 0.63</math></li> <li>CAGE, <math>\alpha = 0.56</math></li> <li>CRAFT, <math>\alpha = 0.65</math></li> <li>RUFT-Cut, <math>\alpha = 0.64</math></li> </ul>                                                      |

(Continued)

Table 3 (continued)

| Author                     | Instrument<br>(No. Items or<br>Domains)                 | Participants                   |                          | Findings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                  |
|----------------------------|---------------------------------------------------------|--------------------------------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                            |                                                         | Sample, <i>n</i><br>(% Female) | Age (y),<br>Range (Mean) | Validity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Reliability                                                                                                                                                                                                      |
| Kelly et al. <sup>20</sup> | AUDIT (10 items),<br>TWEAK (5 items),<br>CAGE (4 items) | 103 (46.6)                     | 12–20 (17.5)             | <p>Concurrent validity (correlation between total scores)</p> <ul style="list-style-type: none"> <li>AUDIT and TWEAK (<math>r = 0.83</math>, <math>p &lt; 0.001</math>)</li> <li>AUDIT and CAGE (<math>r = 0.43</math>, <math>p &lt; 0.001</math>)</li> <li>TWEAK and CAGE (<math>r = 0.53</math>, <math>p &lt; 0.001</math>)</li> </ul> <p>Criterion validity (criterion: hazardous vs. nonhazardous drinking, mean score <math>\pm</math> SD)</p> <ul style="list-style-type: none"> <li>AUDIT (<math>15.9 \pm 7.3</math> vs. <math>4.3 \pm 3.2</math>, <math>p &lt; 0.001</math>)</li> <li>9-item AUDIT (<math>14.3 \pm 6.4</math> vs. <math>3.8 \pm 2.8</math>, <math>p &lt; 0.001</math>)</li> <li>TWEAK (<math>3.93 \pm 1.5</math> vs. <math>1.93 \pm 1.3</math>, <math>p &lt; 0.001</math>)</li> <li>CAGE (<math>1.1 \pm 1.3</math> vs. <math>0.56 \pm 0.85</math>, <math>p &lt; 0.05</math>)</li> </ul> <p>Criterion validity (criterion: breathalyzer-positive adolescents vs. breathalyzer-negative adolescents, mean <math>\pm</math> SD)</p> <ul style="list-style-type: none"> <li>AUDIT (<math>15.6 \pm 9.6</math> vs. <math>6.8 \pm 6.2</math>, <math>p &lt; 0.02</math>)</li> <li>TWEAK and CAGE (NS) Construct validity (group differences for alcohol use, mean <math>\pm</math> SD)</li> </ul> <p>Age (<math>&lt;17.5</math> y vs. <math>&gt;17.5</math> y)</p> <ul style="list-style-type: none"> <li>AUDIT (<math>5.02 \pm 4.9</math> vs. <math>10.39 \pm 8.0</math>, <math>p &lt; 0.001</math>)</li> <li>TWEAK (<math>2.23 \pm 1.5</math> vs. <math>3.10 \pm 1.8</math>, <math>p &lt; 0.04</math>)</li> <li>CAGE (NS)</li> </ul> <p>Gender (male vs. female)</p> <ul style="list-style-type: none"> <li>TWEAK (<math>3.9 \pm 1.5</math> vs. <math>2.1 \pm 1.8</math>, <math>p &lt; 0.009</math>)</li> <li>AUDIT and CAGE (NS)</li> </ul> <p>Race/ethnicity (Caucasian vs. African American adolescents)</p> <ul style="list-style-type: none"> <li>AUDIT (<math>8.56 \pm 7.6</math> vs. <math>5.07 \pm 3.9</math>, <math>p &lt; 0.02</math>)</li> <li>TWEAK and CAGE (NS)</li> </ul> <p>Construct validity, model fit</p> <ul style="list-style-type: none"> <li>9-item, 1-factor model: RMSEA = 0.21, CFI = 0.80, NNFI = 0.76, GFI = 0.75</li> <li>10-item, 3-factor model<sup>**</sup>: RMSEA = 0.04, CFI = 0.99, NNFI = 0.98, GFI = 0.95</li> <li>9-item, 2-factor model<sup>**</sup>: RMSEA = 0.04, CFI = 0.99, NNFI = 0.98, GFI = 0.94</li> </ul> | <p>Internal consistency reliability</p> <ul style="list-style-type: none"> <li>AUDIT, <math>\alpha = 0.88</math></li> <li>TWEAK, <math>\alpha = 0.50</math></li> <li>CAGE, <math>\alpha = 0.66</math></li> </ul> |
| Kelly et al. <sup>21</sup> | AUDIT (10 items)                                        |                                |                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p>Internal consistency reliability</p> <ul style="list-style-type: none"> <li>Total scale, <math>\alpha = 0.86</math></li> </ul>                                                                                |

CANS-MH 3.0 = Child and Adolescent Needs and Strengths–Mental Health instrument, version 3.0; CDI = Children's Depression Inventory; CFI = Comparative Fit Index; NA = not applicable; NR = not reported; NS = not statistically significant; RMSEA = root mean square error of approximation; TLI = Tucker Lewis index.

\*61.5% of the adolescent sample presented with nonpsychiatric complaints.

†62.1% of the adolescent sample presented with nonpsychiatric complaints.

‡Beck Hopeless Scale scores have shown predictive validity for suicide attempts in adolescents.<sup>29</sup>

§Goodness-of-fit statistics for first-order confirmatory factor analysis.

||Modified version.

\*Item for hazardous drinking removed to see if differences were inflated.

\*\*Analysis allowed for correlated error variances.

**Table 4**  
Overview of Diagnostic Studies That Evaluated Instruments to Identify Mental Health Problems and Alcohol Use Disorders

| Participants                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                         | Findings                 |             |                                                                    |                         |                         |                      |      |      |          |      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------------|--------------------------|-------------|--------------------------------------------------------------------|-------------------------|-------------------------|----------------------|------|------|----------|------|
| Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Instrument         | Sample, n<br>(% Female) | Age (y), Range<br>(Mean) | Reference   | Recommended Score/<br>Cut-score (Score<br>Range)                   | Sensitivity<br>(95% CI) | Specificity<br>(95% CI) | Predictive<br>Values |      | LRs  | Accuracy |      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                    |                         |                          |             |                                                                    |                         |                         | +                    | -    | +    | -        |      |
| <b>General Screening</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                    |                         |                          |             |                                                                    |                         |                         |                      |      |      |          |      |
| Cappelli<br>et al. <sup>8</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | HEADS-ED           | 313 (58.1)**            | 4–17 (14.3)              | CANS-MH     | HEADS-ED score > 7<br>(0–14) and suicidal<br>risk score of 2 (0–2) | 0.82 (NR)               | 0.87 (NR)               | NR                   | NR   | 6.30 | 0.21     | 0.82 |
| <b>Suicide Risk</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                    |                         |                          |             |                                                                    |                         |                         |                      |      |      |          |      |
| Horowitz<br>et al. <sup>24</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ASQ                | 180 (58.3)**            | 10–21 (14.4)             | SIQ/SIQ-JR* | A positive response to<br>at least 1/4 of the<br>items             | 0.98 (91.7–99.7)        | 0.66 (55.2–75.0)        | 71.3                 | 96.9 | 2.8  | 0.04     | 0.83 |
| Horowitz<br>et al. <sup>27</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | RSQ                | 144 (54)**              | 10–21 (13.6)             | SIQ/SIQ-JR* | A positive response to<br>at least 1/4 of the<br>items             | 0.98 (NR)               | 0.37 (NR)               | 55                   | 97   | 1.56 | 0.05     | 0.87 |
| Rutman<br>et al. <sup>23</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | SQS                | 212 <sup>†</sup> (50.0) | 12–17 (14.7)             | CES-D       | A positive response to<br>the 1 item                               | 0.56 (50%–63%)          | 0.93 (90%–96%)          | 83                   | 78   | 8.0  | 0.47     | NR   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | TQS                |                         |                          |             | A positive response to<br>at least 1/2 of the<br>items             | 0.78 (73%–84%)          | 0.82 (77%–87%)          | 72                   | 87   | 4.3  | 0.27     | NR   |
| <b>Alcohol Use Disorders</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                         |                          |             |                                                                    |                         |                         |                      |      |      |          |      |
| Kelly et al. <sup>18</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | AUDIT-C            | 181 <sup>‡</sup> (43)   | 18–20 (NR)               | DSM-IV AUD  | Cut-score = 6 <sup>§</sup> (0–12)                                  | 0.74 (NR)               | 0.77 (NR)               | NR                   | NR   | 3.22 | 0.34     | 0.83 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | CRAFT              |                         |                          |             | Cut-score = 3 (0–6)                                                | 0.69 (NR)               | 0.73 (NR)               | NR                   | NR   | 2.56 | 0.42     | 0.79 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | RAPS4-QF           |                         |                          |             | Cut-score = 3 (0–6)                                                | 0.79 (NR)               | 0.72 (NR)               | NR                   | NR   | 2.82 | 0.29     | 0.80 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | FAST <sup>  </sup> |                         |                          |             | Cut-score = 3 (0–16)                                               | 0.83 (NR)               | 0.73 (NR)               | NR                   | NR   | 3.07 | 0.23     | 0.83 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | RUFT-Cut           |                         |                          |             | Cut-score = 3 (0–11)                                               | 0.80 (NR)               | 0.68 (NR)               | NR                   | NR   | 2.50 | 0.29     | 0.81 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | DSM-IV<br>2-item   |                         |                          |             | Cut-score = 1 (0–2)                                                | 0.88 (NR)               | 0.90 (NR)               | NR                   | NR   | 8.80 | 0.13     | 0.89 |
| Kelly et al. <sup>19</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | AUDIT              | 93 <sup>‡</sup> (45)    | 18–20 (19.0)             | DSM-IV AUD  | Cut-score = 10 (0–40)                                              | 0.82 (NR)               | 0.78 (NR)               | 71                   | 88   | 3.73 | 0.23     | 0.85 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | CAGE               |                         |                          |             | Cut-score = 1 (0–4)                                                | 0.66 (NR)               | 0.58 (NR)               | 52                   | 71   | 1.57 | 0.59     | 0.68 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | CRAFT              |                         |                          |             | Cut-score = 3 (0–6)                                                | 0.82 (NR)               | 0.67 (NR)               | 63                   | 84   | 2.48 | 0.27     | 0.79 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | RAPS-QF            |                         |                          |             | Cut-score = 3 (0–6)                                                | 0.82 (NR)               | 0.54 (NR)               | 55                   | 81   | 1.78 | 0.33     | 0.76 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | RUFT-Cut           |                         |                          |             | Cut-score = 3 (0–11)                                               | 0.82 (NR)               | 0.78 (NR)               | NR                   | NR   | 3.73 | 0.23     | 0.84 |
| Bastiaens<br>et al. <sup>22</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | RAFFT              | 226 (45)                | 13–18 (15.4)             | DSM-IV SUD  | 2 positive answers                                                 | 0.89 (NR)               | 0.69 (NR)               | NR                   | NR   | 2.87 | 0.16     | NR   |
| AUD = alcohol use disorder diagnosis; CANS-MH = Child and Adolescent Needs and Strengths-Mental Health instrument; CD = cannabis diagnosis; CDI = children's depression inventory; CES-D = Center for Epidemiological Studies Depression Scale; DSM = Diagnostic and Statistical Manual of Mental Disorders; LR = likelihood ratio; NA = not applicable; NR = not reported; SUD = substance use disorder diagnosis.<br>*For adolescents < 14 years old.<br>  Modified version.<br>§Cut-point of 6 recommended for females.<br>†Percentage of patients with psychiatric ED visits not reported.<br>‡Percentage of patients who were alcohol positive at the time of study enrollment not reported.<br>**pediatric psychiatric population |                    |                         |                          |             |                                                                    |                         |                         |                      |      |      |          |      |

the instruments demonstrate both high sensitivity and specificity. Instruments that are more sensitive are less specific (ASQ, RSQ), and those that are more specific are less sensitive (SQS, TQS). The ASQ and RSQ provide strong evidence to rule out risk. In terms of ruling in risk, an adolescent with a positive response to at least one of the four ASQ items has an almost threefold higher risk for suicide ( $LR+ = 2.8$ ).<sup>24</sup>

## Alcohol Use Disorders

Diagnostic accuracy ranges widely among the 12 instruments evaluated with adolescent ED patients. Most effective for detecting an alcohol use disorder (area under the curve = 0.89) was using two diagnostic items based on DSM-IV criteria ("In the past year, have you sometimes been under the influence of alcohol in situations where you could have caused an accident or gotten hurt?" and "Have there often been times when you had a lot more to drink than you intended to have?").<sup>18</sup> Adolescents who answer yes to at least one of the two items are eightfold more likely to be diagnosed with a disorder ( $LR+ = 8.80$ ), but evidence for ruling out a disorder with these items is modest ( $LR- = 0.13$ ).<sup>18</sup>

## DISCUSSION

Using specialized instruments to screen and diagnose mental health problems among children who present to the ED is supported by the AAP and the Committee on Pediatric Emergency Medicine.<sup>3</sup> However, actual use of evidence-based, mental health screening practices among ED physicians has been documented at less than 10%.<sup>6</sup> Physician screening can benefit children who present to the ED with mental health and/or substance use concerns but have yet to receive a diagnosis. Such screening can inform consultation with mental health professionals and in-house assessments by them. If mental health resources are not available in the ED, physician screening becomes an integral step in comprehensive discharge planning and referral to mental health services for more detailed psychiatric assessment. For children who present with known mental health and/or substance use concerns, physicians can use instruments to identify immediate risks (e.g., risk of suicide) and guide disposition decision making. This systematic review identifies three instruments, the HEADS-ED, the ASQ, and the DSM-IV, as evidence-based screening options for ED physicians. These instruments require minimal

(HEADS-ED) to no training (ASQ, DSM-IV two-item instrument) before use.

Using the recommended cut scores, the HEADS-ED provides reasonable sensitivity and specificity for the ED setting. The instrument will detect 82% of pediatric mental health patients requiring admission (18% who require admission will go undetected) and will correctly report 87% of patients who do not need admission (13% who do not require admission will be identified as needing admission).

Recent research has found screening for suicide risk to be acceptable to clinicians, parents, and pediatric patients.<sup>30</sup> The ASQ provides strong evidence to rule out risk and is a highly sensitive instrument for detecting risk of suicide in our population of interest, pediatric psychiatric patients (98% sensitivity and 66% specificity), as well as general pediatric ED population (97% sensitivity and 88% specificity). While ASQ instrument specificity is modest in our population of interest, pediatric psychiatric patients, high sensitivity is most essential in evaluating risk of suicide. The false-positive rate of 34% in a pediatric psychiatric patient population and 12% in a general pediatric patient population may be best addressed by ED physicians regarding the instrument as an initial screen. Patients who screen positive (whether true or false positive) should be assessed further for risk of suicide. Whether this subsequent assessment is conducted by a mental health professional or by a physician may depend on the resources available in the ED at the time of the visit. Any decision to not screen a child because of concerns over a potential false-positive result, or discomfort with what clinical decisions should follow screening outcomes, should be tempered by the potential benefit of identifying a child in need. One-third of young people with suicidal ideation will go on to develop a plan, and of these young people, approximately 60% will attempt suicide.<sup>31</sup>

Pediatric patients who answer yes to at least one of the two items on the DSM-IV instrument are at eightfold greater risk of having an alcohol use disorder (modest evidence to rule in a disorder). The instrument also provides ED physicians with good sensitivity and specificity. It will detect 88% of patients with a disorder (12% with a disorder will go undetected) and will correctly report 90% of patients who do not have a disorder (10% who do not have a disorder will be identified as having one). The DSM-IV instrument can be used by physicians as an initial screen with patients whose presenting complaints or history indicate the need for

assessment. Children who screen positive could be discharged with a recommendation to follow up with more specialized addictions services for assessment and potential treatment. This approach can reduce the potential impact on ED patient flow and resources.

The different diagnostic approaches and varied findings in this review suggest that the field of ED-based mental health instrumentation requires maturation and refinement. Additional research must address methodologic limitations identified in this review. This will develop a robust evidence base for the instruments identified as psychometrically and diagnostically sound. Part of this research must define minimally acceptable thresholds for instrument sensitivity/specificity and LRs to rule in and rule out disorders. In the ED, instruments that have maximum sensitivity and specificity and strong evidence to rule in/rule out disorders are most desirable. Easy-to-use instruments with those characteristics, and with minimum training requirements and implementation time, can provide ED physicians and other ED clinicians with critical information rapidly. Such information is valuable in guiding further assessment, consultation, and discharge planning.

## LIMITATIONS

Our findings in this review have several limitations. First, some psychometric studies that we included lacked evidence or reporting on reliability and validity. We were therefore unable to comprehensively evaluate inter-rater and test-retest reliability or convergent/concurrent and construct validity of the screening instruments. Second, the diagnostic studies commonly enrolled a convenience sample of patients and did not use a prespecified threshold for the index test. This creates potential for bias in patient selection or interpretation of the index test, which could have influenced the screening results. Future studies should avoid using the tool to decide on outcomes (independence). Third, methodologic heterogeneity among the studies was significant, specifically in the screening instruments used. Instruments such as the HEADS-ED were assessed in only one study and therefore tests of the reliability, validity, and diagnostic accuracy of many of these instruments have not been replicated. Further, the limited number of trials available for each instrument prevented us from assessing the risk of publication bias. Finally, as with any systematic review, selection bias is possible. Although we conducted an

extensive search of the electronic and gray literature, the search was limited by language (English only) and date of publication (2000–2015). Without these restrictions, our search might have identified some additional studies.

## CONCLUSION

Reliable, valid, and accurate instruments are available for use in pediatric mental health visits to the ED. However, these instruments need a more robust evidence base through additional research that addresses the methodologic and psychometric limitations we identify in this review. From available evidence, we recommend that emergency care clinicians use the HEADS-ED to rule in ED admission among children with visits for mental health care, the ASQ to rule out suicide risk among children with any visit type, and DSM-IV two-item instrument to rule in/rule out alcohol use disorders among children who currently use alcohol. We also recommend that clinicians familiarize themselves with instrument validity and reliability, and the evidence base for this information, to understand current instrument strengths and limitations. With this understanding, clinicians can make best use of these valuable instruments in assessing child and adolescent mental health during ED visits.

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## Supporting Information

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The following supporting information is available in the online version of this paper:

**Data Supplement S1.** Search strategy developed for Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R).

**Data Supplement S2.** Modified quality criteria from Gokiart et al.<sup>13</sup>

**Data Supplement S3.** The quality of instruments reported in psychometric studies using quality criteria from Gokiart et al.<sup>13</sup>

**Data Supplement S4.** Quality assessment of diagnostic studies using the QUADAS-2.