

# Validation of Caregiver-Centered Delirium Detection Tools: A Systematic Review

(Caregiver-Centered Delirium Detection Tools)

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## **Abstract**

**Objectives:** To summarize the validity of caregiver-centered delirium detection tools in hospitalized adults and assess associated patient and caregiver outcomes.

**Design:** Systematic review

**Setting:** We searched MEDLINE, EMBASE, PsycINFO, CINAHL, Scopus from inception to May 15, 2017

**Participants:** Hospitalized adults

**Intervention:** Caregiver-centered delirium detection tools

**Measurements:** We drafted a protocol from Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Two reviewers independently completed abstract and full-text review, data extraction, and quality assessment. We summarized findings using descriptive statistics including mean, median, standard deviation, range, frequencies (percent), and Cohen's Kappa ( $\kappa$ ). Included studies reported on the validity of caregiver-centered delirium detection tools or associated patient and caregiver outcomes, and were cohort or cross-sectional in design.

**Results:** We reviewed 6056 titles and abstracts, included six articles, and identified six caregiver-centered tools. All tools were designed to be used in several minutes or less, and had 11 items or fewer. Three tools were caregiver-*administered* (completed independently by caregivers): Family Confusion Assessment Method (FAM-CAM), Informant Assessment of Geriatric Delirium (I-AGeD), and Sour Seven. Three tools were caregiver-*informed* (administered by a healthcare

professional using caregiver input): Single Question in Delirium (SQiD), Single Screening Question Delirium (SSQ-Delirium), and the Stressful Caregiving Response to Experiences of Dying (SCARED). Caregiver-administered tools had higher psychometric properties [FAM-CAM sensitivity 75% (95% confidence interval CI, 35-95%), specificity 91% (95% CI, 74-97%); Sour Seven positive predictive value, PPV 89.5%, negative predictive value, NPV 90%] than caregiver-informed tools [SQiD: sensitivity 80% (95% CI, 28.3-99.5%), specificity 71% (95% CI, 58.77-99.8%), SSQ-Delirium sensitivity 79.6%, specificity 56.1%].

**Conclusions:** Delirium detection is essential for appropriate delirium management.

Caregiver-centered delirium detection tools are promising to improve delirium detection and associated patient and caregiver outcomes. Comparative studies utilizing larger sample sizes and multiple centers are required to determine validity and reliability characteristics.

**Key Words:** delirium; caregiver; family; hospital; screening

## **Introduction**

Delirium is an acute confusional state characterized by fluctuating course, attention deficits, and cognitive disturbances.<sup>1</sup> Delirium is common in hospital settings, affecting over 20% of patients, and may lead to longer hospital stays and mechanical ventilation, long-term cognitive impairment, physical disability, and death.<sup>2-5</sup> Delirium is also distressing to caregivers (i.e. family or friends involved in patient care), potentially increasing the risk of adverse psychological outcomes, including major depressive disorder, generalized anxiety disorder, and posttraumatic stress disorder.<sup>6</sup>

In many hospitals, healthcare professionals (e.g. nurses and clinicians) screen for delirium using validated healthcare professional-administered delirium detection tools, such as the Confusion Assessment Method (CAM).<sup>7</sup> Despite routine screening, over 60% of delirium cases remain undetected in general hospital settings.<sup>8</sup> If delirium remains undetected, then it cannot be managed appropriately, further increasing the risk of adverse patient and caregiver outcomes.<sup>9</sup>

Using caregiver-centered delirium detection tools, caregivers may be able to identify symptoms of delirium more readily than a healthcare professional who is unfamiliar with the patient.<sup>10</sup> Delirium can often be missed by intermittent screening due to the fluctuating course of delirium, causing many cases of delirium to remain undetected.<sup>11</sup> Using caregiver-centered tools, caregivers can independently screen for delirium throughout the patient's hospital stay and notify healthcare professionals accordingly, potentially leading to earlier and more frequent diagnoses.

Engaging caregivers in delirium detection may also decrease caregiver distress and adverse psychological outcomes. Multiple high-impact guidelines and studies in palliative care and community settings have demonstrated that caregiver involvement in patient care is recommended to improve patient and caregiver outcomes.<sup>12-15</sup> For instance, symptoms of anxiety and depression decreased in caregivers who witnessed cardiopulmonary resuscitation and received information on end-of-life care.<sup>16, 17</sup> Additionally, a community-based study suggested that involving caregivers in delirium detection improves caregiver satisfaction with patient care.<sup>18</sup>

Caregiver-centered delirium detection tools exist, and have been studied in various hospital settings. Caregiver-centered tools may be caregiver-*administered* (i.e. administered independently by caregivers), or caregiver-*informed* (i.e. administered by healthcare professionals but informed by caregiver input). Understanding the properties of these tools is crucial to improve delirium detection, yet there have been no reviews summarizing the validity of caregiver-centered delirium detection tools in hospital settings. Using systematic review methodology, this study will summarize and compare caregiver-centered delirium detection tools in hospitalized adults and evaluate associated patient and caregiver outcomes.

## **Methods**

### **Search, Registration, and Information Sources**

We drafted the study protocol (available from <https://prism.ucalgary.ca/handle/1880/52090>) *a priori* according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines<sup>19</sup> and registered the systematic review on the International Prospective Register of Systematic Reviews (PROSPERO) (registration ID: CRD42017067107).<sup>20</sup> We searched PROSPERO and the Cochrane Database of Systematic Reviews<sup>21</sup> for related systematic reviews to ensure study originality. The search strategy was finalized after independent consultation and review with two medical librarians. The search was conducted in the following online bibliographic databases: MEDLINE, EMBASE, PsycINFO, CINAHL, and Scopus, from inception to May 15, 2017, with no restrictions. To identify additional studies, we searched the reference lists of included full-text articles and relevant reviews.

### **Eligibility Criteria**

We included studies that fulfilled the following four criteria: 1) original/primary peer-reviewed research, 2) observational study design (e.g. cohort study, cross-sectional study), 3) conducted in adult patients ( $\geq 18$  years old) in any hospital setting, and 4) reported on the validity of caregiver-centered delirium detection tools. We also identified associated outcomes in patients (e.g. length of hospital stay, duration of mechanical ventilation, long-term cognitive impairment, death) and caregivers (e.g. anxiety, depression). Caregiver was defined as any family member or friend who is directly involved in patient care. Hospital was defined as any inpatient facility that provides primary medical care. Caregiver-centered delirium detection tools were defined as any delirium measurement tools that involved the caregiver's assessment of delirium symptoms.

### **Study Selection**

Two of three reviewers (BR, KK, DD) completed title and abstract screening independently, and in duplicate. If either reviewer indicated a study to be included, it was reviewed in full-text. Two reviewers (BR, KK) completed full-text screening independently, and in duplicate using the standardized eligibility criteria. At this stage, both reviewers agreed on inclusion and reasons for exclusion. Disagreements were resolved by discussion or the involvement of a third reviewer (DD or KF). Reviewers translated all non-English manuscripts using Google Translate.<sup>22</sup>

### **Data Extraction**

Two reviewers (BR, KK) extracted data independently, and in duplicate from included studies using a standardized electronic data form developed and piloted by study authors. Data elements extracted included: study information (e.g. author, publication year, study design),

patient and caregiver demographics (e.g. age, sex, education), index and reference tool used, delirium prevalence, psychometric properties [e.g. sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) and 95% confidence intervals when reported], patient outcomes, and caregiver outcomes.

### **Study Quality**

Two reviewers assessed methodological quality of included studies independently, and in duplicate using Quality of Diagnostic Accuracy Studies 2 (QUADAS-2), a tool designed to evaluate the quality of diagnostic accuracy studies.<sup>23</sup> QUADAS-2 was used to assess bias and concerns regarding applicability using signaling questions in four domains: 1) patient selection, 2) index test, 3) reference standard, and 4) flow and timing. Risk of bias was "low" if all signaling questions in the domain were answered "yes". Risk of bias was "high" if any signaling questions in the domain were answered "no". Risk of bias was "unclear" if half or more of the signaling questions did not have sufficient information to make a judgment. Concern of applicability was "low" if the domain matched the review question. Concern of applicability was "high" if the domain did not match the review question. Concern of applicability was "unclear" if insufficient data were reported to make a judgment.

### **Data Synthesis and Analysis**

We summarized findings using descriptive statistics including mean, median, standard deviation (SD), range, frequencies (percent), and Cohen's Kappa ( $\kappa$ ). A meta-analysis was not conducted due to clinical heterogeneity between study outcomes.

## **Results**

### **Methodological Quality**

Table 1 presents the methodological quality evaluated using QUADAS-2.<sup>23</sup> All studies had an overall "unclear" or "low" risk of bias and concern of applicability; all studies were of acceptable quality to include in the systematic review.

### **Study Selection and Characteristics**

The search strategy yielded 10,290 citations; 19 additional citations were found by reviewing reference lists of included studies (Figure 1). After duplicates were removed, reviewers screened titles and abstracts of 6,076 unique citations; 5,892 citations did not meet inclusion criteria. Reviewers assessed 184 articles in full-text and six studies were included in the final systematic review.<sup>6, 10, 24-27</sup>

Dates of publication ranged from 2007 to 2016. Studies were conducted in the United States (n = 1), Canada (n = 1), Portugal (n = 1), the Netherlands (n = 1), the United Kingdom (n = 1), and Australia (n = 1). Study designs included cross-sectional (n = 2), and prospective cohort (n = 4). The mean ( $\pm$  SD) number of participating patient-caregiver dyads in each study was 98.3 ( $\pm$  69.4) (range: 21-200).

### **Caregiver-*Informed* Delirium Detection Tools**

Three of the included articles evaluated caregiver-informed delirium detection tools, including the Stressful Caregiving Response to Experiences of Dying (SCARED),<sup>6</sup> Single Question in Delirium (SQiD),<sup>24</sup> and Single Screening Question-Delirium (SSQ-Delirium).<sup>27</sup>

#### **SCARED**

The SCARED is a 10-item tool that evaluates potentially distressing events witnessed by caregivers during terminal illness, including observing a patient in a state of confusion or



delirium.<sup>28</sup> The SCARED scores feelings of fear and helplessness, and frequency of distressing events on a 4-point Likert scale.<sup>28</sup>

In a multi-center cross-sectional study in palliative care settings, caregiver-perceived delirium was suggested if the caregiver reported seeing the patient confused or delirious at least once per week in the previous month.<sup>6</sup> Nineteen percent of patients had caregiver-perceived delirium.<sup>6</sup> The Short Portable Mental Status Questionnaire (SPMSQ) conducted by a research assistant was used as a reference of cognitive function for the SCARED.<sup>6</sup> The SPMSQ is a scalar measure of cognition ranging from 0 to 10; 0 indicates severe cognitive impairment and 10 indicates normal cognition.<sup>29</sup> Although the SPMSQ does not directly measure delirium, scores below eight are correlated with higher rates of delirium.<sup>30</sup> Patients with caregiver-perceived delirium on the SCARED were more likely to have a SPMSQ score indicative of mild cognitive dysfunction than patients without caregiver perceived delirium (15.6% versus 0.7%;  $p < 0.001$ ).<sup>6</sup>

The study also evaluated the relationship between caregiver-perceived delirium and caregiver psychological outcomes, including major depressive disorder, generalized anxiety disorder (GAD), and posttraumatic stress disorder.<sup>6</sup> The Structured Clinical Interview for the DSM-IV (SCID Axis I modules) was used to measure psychological outcomes in caregivers.<sup>31, 32</sup> Caregivers of patients with caregiver-perceived delirium were 12 times more likely to have GAD symptomology than caregivers of patients without caregiver-perceived delirium, [odds ratio, OR = 12.12 (95% CI, 2.26-65.18;  $p < 0.01$ )].<sup>6</sup>

**SQID**

The SQiD is a delirium detection tool that consists of one question: “Do you feel that [patient's name] has been more confused lately?”<sup>24</sup> Delirium is suggested if the caregiver’s answer indicates any decline in the patient’s cognition.<sup>24</sup>

A single-center validation study in an inpatient oncology unit evaluated the psychometric properties of the SQiD.<sup>24</sup> The reference standard was a psychiatric interview conducted by trained physicians using DSM-IV criteria.<sup>33</sup> DSM-IV criteria yields a dichotomous delirium diagnosis (yes/no) by evaluating features of delirium, including altered attention, consciousness, cognition, and fluctuating course.<sup>30</sup> The reference standard identified five cases of delirium in the sample of 19 patients.<sup>24, 33</sup> The SQiD identified eight cases of delirium in the sample of 19 patients.<sup>24</sup> The sensitivity and specificity of the SQiD were 80% (95% CI, 28.3-99.5%) and 71% (95% CI, 41.9-91.6%), respectively.<sup>24</sup> The PPV of the SQiD was 50% (95% CI, 15.7-84.3%) and the NPV was 91% (95% CI, 58.7-99.8%).<sup>24</sup> The SQiD demonstrated a significant inter-tool correlation to the reference standard, with a  $\kappa$  of 0.431 ( $p = 0.023$ ).<sup>24</sup>

### **SSQ-Delirium**

The SSQ-Delirium is a delirium detection tool that consists of one question: “how has your relative/friend's memory changed with his/her current illness?”<sup>27</sup> Caregiver answers are scored on a five-point Likert scale ranging from 1 (much improved) to 5 (much worse).<sup>27</sup> Scores of 4 (a bit worse) to 5 (much worse) suggest delirium.<sup>27</sup>

A single-center validation study conducted in an acute geriatric ward evaluated psychometric properties of the SSQ-Delirium.<sup>27</sup> The CAM conducted by a trained senior medical student was used as a reference standard for delirium diagnosis (Table 2).<sup>27</sup> The CAM is a 4-item measure of delirium yielding a dichotomous diagnosis (yes/no) by evaluating features of

delirium based off of the DSM-III-R criteria.<sup>27,34</sup> The sensitivity and specificity of the SSQ-Delirium were 79.6% and 56.1%, respectively.<sup>27</sup> The PPV of the SSQ-Delirium was 28.6% and the NPV was 91.4%.<sup>27</sup>

### **Caregiver-Administered Delirium Detection Tools:**

Three included articles evaluated three caregiver-*administered* delirium detection tools: the Family Confusion Assessment Method (FAM-CAM),<sup>10</sup> Informant Assessment of Geriatric Delirium (I-AGeD),<sup>25</sup> and Sour Seven.<sup>26</sup>

#### **I-AGeD**

The I-AGeD is a 10-item questionnaire used to detect symptoms of delirium based on DSM-IV criteria.<sup>25, 33</sup> A multi-center cross-sectional study was conducted to evaluate the validity of the I-AGeD in geriatric ward settings. The reference standard was a psychiatric interview conducted by a geriatric resident physician using the DSM-IV criteria.<sup>25, 33</sup> Patients with delirium had a significantly higher mean  $\pm$ SD I-AGeD score ( $6.03 \pm 2.7$ ) than non-delirious patients ( $3.58 \pm 2.9$ ,  $p < 0.001$ ).<sup>25</sup> With a cut-off score for delirium of 4 or greater, the sensitivity of the I-AGeD was 77.4% and the specificity was 63.2%.<sup>25</sup> In a subgroup without dementia and a cut-off score for delirium of 4 or greater, the sensitivity of the I-AGeD was 100% and the specificity was 65.2%.<sup>25</sup> Against the CAM, the sensitivity of the I-AGeD was 81.5% and the specificity was 64.3%.<sup>25</sup>

#### **FAM-CAM**

The FAM-CAM is an 11-item delirium detection questionnaire that evaluates four distinct features of delirium: acute onset and fluctuating course, inattention, disorganized thinking, and altered level of consciousness.<sup>35</sup>

A single-center validation study in an intermediate care unit (i.e. a medical unit for medically stable patients who are too unstable to use traditional long-term care facilities) evaluated the validity of the European Portuguese version of the FAM-CAM with a high level of comprehensibility and conceptual equivalence to the English version.<sup>10</sup> The reference standard was a psychiatric interview conducted by a psychiatrist using DSM-IV-TR criteria.<sup>33</sup> The sensitivity and specificity of the FAM-CAM were 75% (95% CI, 35-95%) and 91% (95% CI, 74-97%), respectively.<sup>10</sup> The PPV of the FAM-CAM was 67% (95% CI, 31-91%) and the NPV was 93% (95% CI, 77-99%).<sup>10</sup> There was statistically significant agreement between the FAM-CAM and the DSM-IV-TR, with a  $\kappa$  of 0.6 (95% CI, 0.4-1.0).<sup>10</sup>

### **Sour Seven**

The Sour Seven is a 7-item weighted questionnaire totalling a maximum score of 18.<sup>26</sup> The items evaluate features of delirium including altered awareness and attention, fluctuation, disordered thinking and behaviour, impaired eating or drinking, and difficulty in mobility.<sup>26</sup>

A single-center study validated the Sour Seven for use by untrained (i.e. with no formal review of the tool) caregivers and nurses in general medical and surgical hospital units.<sup>26</sup> The reference standard was a psychiatric interview conducted by a geriatric psychiatrist using on DSM-IV criteria.<sup>33</sup> A score of 4 was used to indicate "possible delirium", and a score of 9 to indicate delirium.<sup>26</sup> With a cut-off score for delirium of 4, the Sour Seven had a PPV of 89.5% and an NPV of 90.0%.<sup>26</sup> With a cut-off score for delirium of 9, the Sour Seven had a PPV of 100.0% and an NPV of 74.1%.<sup>26</sup> There were no significant differences in delirium ratings on questionnaires completed by nurses versus caregivers.<sup>26</sup>

### **Discussion**

The systematic search of the literature identified six caregiver-centered delirium detection tools.<sup>6, 10, 24-27</sup> All included studies had acceptable methodological quality to include the systematic review. Caregiver-informed tools, including the SQiD and SSQ-Delirium may be highly feasible for use in hospitals because they require no training and consist of one item each. Future research should evaluate the use of these tools in hospital settings where patients are likely to remain for a short period of time (i.e. less than 24 hours), such as emergency departments (EDs). Delirium screening is often not prioritized in EDs, leading to decreased detection upon admission.<sup>36-39</sup> For instance, studies have demonstrated that delirium often remains undetected in EDs due to the lack of structured psychiatric interviews, incomplete documentation of cognitive impairment in medical records, and insufficient psychiatric referrals.<sup>36, 37, 40</sup> These tools require no training, therefore any healthcare professional could administer the SQiD or SSQ-Delirium to quickly screen for delirium. Overall, these tools may improve delirium detection in EDs leading to increased documentation of cognitive impairment and further screening or psychiatric referral, but further validation is required.

The SCARED is a caregiver-informed tool that evaluates caregiver responses to experiences in palliative care, rather than directly detecting delirium. As such, the SCARED may be useful to evaluate the frequency and extent of caregiver distress caused by delirium, but may not be feasible for delirium detection in hospitals. Using the SCARED, Buss *et al.* demonstrated an important correlation between caregiver-perceived delirium and increased symptoms of GAD in caregivers, highlighting the need for research evaluating how the use of caregiver-centered delirium detection tools can help reduce psychiatric outcomes.

Caregiver-administered delirium detection tools, including the FAM-CAM, I-AGeD, and Sour Seven require minimal effort from the care team and no preliminary training. Using these tools, caregivers can independently detect symptoms of delirium and notify healthcare professionals accordingly. Studies using the original English version of the FAM-CAM were not included in this review due to being conducted in a community-based setting<sup>17</sup> with an interventional study design.<sup>35</sup> Similar to the Portuguese FAM-CAM, the English FAM-CAM consists of 11 items that evaluate four distinct features of delirium: acute onset and fluctuating course, inattention, disorganized thinking, and altered level of consciousness.<sup>35</sup> Future research should evaluate the use of caregiver-administered tools in hospital settings where patients are likely to remain for longer periods of time (i.e. more than 24 hours), such as ICUs, palliative care units, and other hospital wards. These settings demonstrate high delirium prevalence according to healthcare professional-administered tools, with 45-87% of ICU patients, 13-42% of palliative care patients, and over 20% of general ward patients experiencing delirium during their stay.<sup>41, 42</sup> Allowing caregivers to continuously screen for symptoms of delirium during patient hospital stays may reduce cases of delirium that remain undetected by intermittent screening. Caregiver-administered tools also may be particularly useful due to high caregiver presence in these settings. For instance, in a study evaluating ICU patients who stayed longer than two days, over 96% of patients were visited by family or friends.<sup>15</sup> The median visitation time was 11.5 hours (IQR = 6.3-17).<sup>15</sup> Additionally, in settings where the patient is sedated or functionally limited (e.g. ICU) delirium detection can be difficult for healthcare professionals who are unfamiliar with the patient.<sup>11</sup> Using these tools, caregivers may be able to detect symptoms of delirium where healthcare professionals may not. For instance, Bull *et al.*

demonstrated that caregivers using the FAM-CAM observed excessive drowsiness that healthcare professionals did not.<sup>43</sup>

Based on the literature, it is possible that these tools may reduce adverse caregiver psychological outcomes; however, more research is required. Though none of the included studies evaluated the effects that caregiver-centered tools had on caregiver psychological outcomes, literature in community settings suggests that caregivers are highly satisfied with the use of caregiver-centered tools. For instance, 62% of caregivers reported that use of the FAM-CAM increased their confidence in their caregiving abilities.<sup>18</sup>

### **Strengths & Limitations**

This study has several qualities that strengthen its conclusions. This study followed rigorous, published protocol (according to PRISMA standards) to ensure transparency and quality.<sup>19</sup> No restrictions were placed on the search to ensure all relevant studies were appropriately included. This study provides an up-to-date summarization of caregiver-centered delirium detection tools, and is the first to summarize the use of caregiver-centered delirium detection tools in hospital settings only; past studies have included outpatient settings.<sup>44</sup> This review focused on hospitalized patients because they have a higher risk of developing delirium than patients in long-term care and community medical facilities.<sup>45</sup> We aimed to reduce clinical heterogeneity by focusing solely on hospitalized populations because the pathophysiology of delirium is inherently heterogeneous and clinical outcomes differ between hospital and community settings.

The strength of the conclusions of this study may be limited by several factors, highlighting the need for comparative studies to yield robust evidence on operating

characteristics with respect to reference standard, setting, population, and timing. First, reference standards between studies differed. Some reference standards, such as the CAM demonstrated lower psychometric properties than the gold standard, a psychiatric interview using DSM-5 criteria. Differing reference standards decreases the relevance of comparison between index tools. For instance, Martins *et al.* found that the sensitivity of the FAM-CAM varied based on the reference standard that was used (DSM-V or CAM); thus using psychometrically different reference tools may change validation outcomes.<sup>10</sup> Second, the definition of hospital was very broad resulting in the inclusion of varied hospital settings, which could not be corrected for using systematic review methodology. Different hospital settings pose unique diagnostic challenges (e.g. mechanically ventilated patients in ICU, high prevalence of dementia in geriatric units), therefore tools may have different psychometric properties and operating characteristics in varying populations and clinical settings. Third, there was significant clinical heterogeneity in study outcomes impairing direct comparison of operating characteristics. Only four studies reported sensitivity and specificity and only two reported PPV and NPV, making it difficult to directly compare the validity of the tools. Lastly, the quality of included studies varied and was not always optimal. Although no studies had clear violations in any QUADAS-2 categories, many did not provide sufficient information to make an informed judgment.

## **Conclusions**

Delirium detection is essential to appropriately manage delirium. Caregiver-centered delirium detection tools may feasibly improve the timeliness and frequency of delirium detection. Overall, caregiver-centered delirium detection tools engage caregivers to improve



delirium detection and potentially reduce adverse patient and caregiver outcomes associated with unmanaged delirium. Further studies are needed to evaluate the validity and reliability of these tools in different hospital settings (using the same reference standard) where they may be most useful. Additional research with these tools should involve larger sample sizes and multiple centers to further explore their validity, and increase generalizability and impact. No risks associated with these tools have been reported; further research and knowledge translation studies should monitor potential adverse effects on patients and families and healthcare provider perceptions of their use in patient care.

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**Conflicts of Interest:** The developer of the CAM-ICU (EWE) did not perform the evidence analysis and had no input into the outcome of this review. The authors (BR, KK, DD, EWE, JED, HTS, and KMF) do not have any conflicts of interest relevant to this manuscript.

**Author Contributions:** BR, KK, EWE, JED, HTS and KMF designed the study; BR, KK and DD extracted the data; BR, KK, HTS, JED, and KMF interpreted the data; EWE, JED and HTS provided expert consult; BR and KK drafted the manuscript; all authors critically revised successive versions of the manuscript and approved the final version for submission.

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Table 1: Characteristics of Included Studies

| <i>Study</i>                 | <i>Year</i> | <i>Location</i> | <i>Hospital Setting</i> | <i>Mean Patient Age, n (±SD)</i> | <i>Dyads*, n</i> | <i>Caregiver-Centered Tool Used</i> |
|------------------------------|-------------|-----------------|-------------------------|----------------------------------|------------------|-------------------------------------|
| Buss <i>et al.</i>           | 2007        | United States   | Oncology, palliative    |                                  | 200              | SCARED                              |
| Hendry <i>et al.</i>         | 2015        | United Kingdom  | Acute, geriatric        | 80.9                             | 70               | SSQ-Delirium                        |
| Martins <i>et al.</i>        | 2014        | Portugal        | Intermediate care*      |                                  | 40               | FAM-CAM                             |
| Rhodus-Meester <i>et al.</i> | 2013        | The Netherlands | Geriatric               | 86.4 (±8.0)                      | 88               | I-AGeD                              |
| Sands <i>et al.</i>          | 2010        | Australia       | Oncology, palliative    | 53.2                             | 21               | SQID                                |
| Shulman <i>et al.</i>        | 2016        | Canada          | Medical, surgical       | 81.3 (±8.9)                      | 80               | Sour Seven                          |

Abbreviations:

FAM-CAM= Family Confusion Assessment Method; SCARED= Stressful Caregiving Responses to Experiences of Dying; SSQ-Delirium= Single Screening Question Delirium; I-AGeD= Informant Assessment of Geriatric Delirium; SQiD= Single Question in Delirium

\*Intermediate care: a medical unit for medically stable patients who are too unstable to use traditional long-term care facilities

\*Dyad: a patient and caregiver

Table 2: Validation Outcomes of Included Tools

| <i>Index Tool</i>   | <i>Caregiver-administered or -informed</i> | <i>Reference Standard</i> | <i>Sensitivity % (95% CI, %)</i> | <i>Specificity % (95% CI, %)</i> | <i>PPV % (95% CI, %)</i>                        | <i>NPV % (95% CI, %)</i>                       | <i>Inter-Tool Correlation <math>\kappa</math>, (p-value)</i> |
|---------------------|--|---------------------------|----------------------------------|----------------------------------|---|--|--|
| <i>I-AGeD</i>       | Administered                               | CAM                       | 80                               | 64                               | 50%   | -  | -  |
| <i>FAM-CAM</i>      | Administered                               | DSM-IV-TR                 | 75 (35-95)                       | 91 (74-97)                       | 67 (31-91)                                      | 93 (77-99)                                     | 0.6, 95% CI  |
|                     |  | CAM                       | 86 (42-99)                       | 91 (74-97)                       | 67 (31-91)                                      | 97 (81-99)                                     | 0.3-0.9 with DSM-IV-TR; 0.7, 95% CI 0.4-1 with CAM           |
| <i>Sour Seven</i>   | Administered                               | DSM-5                     | -                                | -                                | 89.5 (cut-off score 4)<br>100 (cut-off score 9) | 90 (cut-off score 4)<br>74.1 (cut-off score 9) | -  |
| <i>SCARED</i>       | Informed                                   | SPMSQ                     | -                                | -                                | -   | -  | -  |
| <i>SQiD</i>         | Informed                                   | CAM                       | 80 (28.4-99.5)                   | 71 (41.9-91.6)                   | 50 (15.7-84.3)                                  | 91 (58.7-99.8)                                 | 0.43 (0.023) with DSM-IV                                     |
| <i>SSQ-Delirium</i> | Informed                                   | CAM                       | 76.9                             | 56.1                             | 28.6  | 91.4   | -  |

Abbreviations:

CI- confidence interval; I-AGeD- Informant Assessment of Geriatric Delirium; FAM-CAM- Family Confusion Assessment Method; SCARED- Stressful Caregiving Responses to Experiences of Dying; SQiD- Single Question in Delirium; SSQ-Delirium- Single Screening Question Delirium; CAM- Confusion Assessment Method; DSM-IV-TR- Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision; SPMSQ- Short Portable Mental Status Questionnaire; DSM-5- Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition

Table 3. QUADAS-2 Quality Assessment of Included Studies

| <i>Study Author</i>          | <i>Risk of Bias</i>      |                   |                           |                        | <i>Applicability Concerns</i> |                   |                           | <i>Overall</i> |
|------------------------------|--------------------------|-------------------|---------------------------|------------------------|-------------------------------|-------------------|---------------------------|----------------|
|                              | <i>Patient Selection</i> | <i>Index Test</i> | <i>Reference Standard</i> | <i>Flow and Timing</i> | <i>Patient Selection</i>      | <i>Index Test</i> | <i>Reference Standard</i> |                |
| <i>Buss et al.</i>           | ±                        | ±                 | ±                         | +                      | +                             | ±                 | +                         | ±              |
| <i>Hendry et al.</i>         | +                        | ±                 | +                         | +                      | +                             | ±                 | ±                         | +              |
| <i>Martins et al.</i>        | ±                        | ±                 | +                         | +                      | ±                             | ±                 | +                         | ±              |
| <i>Rhodus-Meester et al.</i> | ±                        | +                 | +                         | +                      | +                             | +                 | +                         | +              |
| <i>Sands et al.</i>          | +                        | +                 | +                         | +                      | +                             | +                 | +                         | +              |
| <i>Shulman et al.</i>        | ±                        | ±                 | +                         | +                      | +                             | +                 | +                         | +              |

All questions in each domain were answered with “yes” (+), “no” (-), or “unclear” (±). The overall risk of bias was rated as “low” (+), “high” (-), or “unclear” (±).

Figure 1: PRISMA Study Flow Diagram

