Screening for Delirium in the Emergency Department: A Systematic Review

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Older adults who visit emergency departments (EDs) often experience delirium, but it is infrequently recognized. A systematic review was therefore conducted to identify what delirium screening tools have been used in ED-based epidemiologic studies of delirium, whether there is a validated set of screening instruments to identify delirium among older adults in the ED or prehospital environments, and an ideal schedule during an older adult's visit to perform a delirium evaluation. MEDLINE/EMBASE, Cochrane, PsycINFO, and CINAHL databases were searched from inception through February 2013 for original, English-language research articles reporting on the assessment of older adults' mental status for delirium. Twenty-two articles met all study inclusion criteria. Overall, 7 screening instruments were identified, though only 1 has undergone initial validation for use in the ED environment and a second instrument is currently undergoing such validation. Minimal information was identified to suggest the ideal scheduling of a delirium assessment process to maximize the recognition of this condition in the ED. Study results indicate that several delirium screening tools have been used in investigations in the ED, though validation of these instruments for this particular environment has been minimal to date. The ideal interval(s) during which a delirium screening process should take place has yet to be determined. Research will be needed both to validate delirium screening instruments to be used for investigation and clinical care in the ED and to define the ideal timing and form of the delirium assessment process for older adults. [Ann Emerg Med. 2014;63:551-560.]

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INTRODUCTION

Background

Delirium is a syndrome of acute change in mental status accompanied by inattention and marked by a fluctuating course.[1] The condition is estimated to occur in 11% to 42% of hospitalizations,[2] is believed to add between $38 billion and $152 billion to health care expenditures annually in the United States,[3] and is a common complication of the care of acutely ill older adults. Delirium causes distress to caregivers and places patients at higher risk for institutionalization, readmission to the hospital, and death.[4,5] Because patients discharged home from the emergency department (ED) with unidentified delirium have 6-month mortality rates almost 3-fold greater (30.8% versus 11.8%) than their counterparts in whom delirium is detected,[6] unrecognized delirium in the acute care setting presents a major health challenge to older adults.

Importance

On average, delirium has been estimated to be present in approximately 7% to 10% of older ED visitors during their ED stay[7-9] but often goes undetected. Studies consistently show that emergency providers identify delirious patients in only 16% to 35% of cases.[7,8,10,11] Consequently, the Society for Academic Emergency Medicine's Geriatric Task Force has called for mental status screening to be a standard component of the evaluation of every senior in the ED.[12] Members of the Geriatric Task Force have also articulated a need for further investigation into delirium assessment,[13] including the identification of an optimal screening tool and window during which patient evaluations should be performed.[14]

Goals of This Investigation

During the last several decades, several screening instruments have been developed to identify delirious patients in a variety of venues for either research, clinical care, or both.[15,16] The ED, however, represents a unique environment with intense time demands on providers and high volumes of patients that can make caring for older adults more challenging[17] and where it will be necessary as a result to separately evaluate screening instruments for delirium.[14] Therefore, in this systematic review, we sought to answer the following questions: what delirium assessment tools have been used in epidemiologic studies of delirium in the ED and out-of-hospital environment, is there a set of validated screening instruments that should be used to identify delirium among elderly ED patients, and is there evidence for when delirium screening

Editor's Capsule Summary

What is already known on this topic

Although delirium is estimated to be present in 7% to 10% of older patients in the emergency department (ED), it frequently goes undetected.

What question this study addressed

What is the evidence that delirium screening instruments are feasible and valid in the ED and when should they be used?

What this study adds to our knowledge

Data about delirium screening are scarce.

How this is relevant to clinical practice

Despite there being a need to identify delirium in ED geriatric patients, there are no validated instruments and there is a paucity of data on this topic.

should be performed during the course of a patient's ED encounter?

MATERIALS AND METHODS

We conducted a search through February 2013 of MEDLINE/EMBASE from 1946, the Cochrane Library from inception, the PsycINFO database from 1941, and the CINAHL database from 1965. Search terms included the words "delirium" or "acute confusional state" AND "emergency," "emergency room," or "emergency department." We limited the results of the CINAHL and PsycINFO searches to those articles that were peer reviewed. The reference lists of included articles were reviewed by 2 people (M.A.L., a geriatrician, and F.C.M., an emergency physician) to ascertain any further potential studies for inclusion. Additional articles were identified from our own libraries. We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines[18] for the conduct and reporting of systematic reviews and meta-analyses, whenever possible.

Selection of Participants

Using the PICOT framework[19] (Table 1), we established study selection criteria before conducting any database searches. This approach required us to name the population, intervention, comparison groups, outcomes, and time frame for articles that would be potentially included in our review. There was no preferred study design type. In brief, articles in English studying the prospective evaluation of patients aged 65 years and older for delirium in the ED or out-of-hospital environments and describing the test characteristics of delirium assessment instruments were eligible. A study member (M.A.L.) reviewed and assessed each title and each abstract evaluated in this article, whereas articles submitted for full review were evaluated by 2 reviewers (M.A.L. and F.C.M.). At title review, articles were excluded if they were clearly not relevant. Articles and abstracts were excluded at later stages from this review for the following reasons: the article did not meet predetermined inclusion criteria, the evaluation of delirium did not occur in the ED or out-of-hospital environment, the article was not in English, or the presented abstract was from a scientific meeting presentation and was not published as a separate, peer-reviewed article.

Table 1. PICOT criteria and search strategy.

Criterion	Search strategy
Population of interest	Aged 65 y or above and in the ED or out-of-hospital (ie, EMS) environment
Intervention of interest	Inclusion: Assessment of mental status for delirium Exclusion: Evaluation takes place outside of ED/out-of-hospital environment or assessment deals with patients who are delirious as a result of illicit drug consumption or ethanol intake/withdrawal
Comparison	No comparison group specified or required
Outcomes	Any outcome considered that quantifies delirium presence or development
Time frame	Intervention/assessment performed at any point in the course of the patient's ED stay or in the out-of-hospital environment (under care by EMS)

PICOT, Population, intervention, comparison groups, outcomes, and time frame.

Data Collection and Processing

Two reviewers (M.A.L. and F.C.M.) abstracted data from each eligible study submitted for full review to a standardized collection instrument, recording study type, population, intervention, comparison group, and results. Additional information was collected about study methodology and whether the study reported on the validation, timing, or application of a delirium screening instrument. Original study authors were contacted, whenever needed, to clarify study details. The 2 reviewers resolved any differences of opinion about which articles to include in the final review, details of data extraction, and quality reviews among themselves through discussion; no residual disagreements required external adjudication.

Each study was independently assessed by the 2 reviewers with the Grading of Recommendations Assessment, Development and Evaluation approach.[20] Within this framework, articles were determined to provide "grade I"–level evidence if they reported data from a randomized, placebo-controlled trial with allocation concealment; "grade II"–level evidence if they reported data from a randomized, placebo-controlled trial without adequate allocation concealment; "grade III"–level evidence if they presented data from an observational study; and "grade IV"–level evidence if they presented data from a case series or case report. Additionally, among the validation studies, the 2 reviewers independently assessed for bias in reporting of diagnostic test results, using the Quality Assessment of Diagnostic Accuracy Studies tool[21] as recommended in the

Standards for the Reporting of Diagnostic Accuracy statement.[22] Among the validation studies, the 2 reviewers also independently determined quality ratings according to the following criteria described by Wei et al[23]: "adequacy of the reference standard rating (ie, comprehensive assessment for delirium), blinded assessment (ie, no shared information between CAM [Confusion Assessment Method] rater and reference standard), close proximity of assessments between CAM rater and the reference standard assessment (≤8 hours), inclusion of false-positive challenges (eg, dementia, depression, and other psychiatric conditions), and inclusion of false-negative challenges (eg, patients with normal mental status, without psychiatric conditions)." According to this methodology, we assigned 1 point for each met criterion, whereas we allowed one-half point for each partially met criterion. Criteria scores were then combined for each validation study. Any disagreements on scoring were discussed between reviewers until consensus on final criteria scores was achieved.

RESULTS

In our initial search of the databases, we identified 2,666 titles (Figure). In this process, we found that the same titles emerged from different sources, suggesting saturation of all available articles. After full review, 22 articles ultimately met all of the inclusion criteria and were included in this systematic review. All of these articles described studies that provided information that addressed the use of screening instruments for delirium identification within the ED, whereas 3 of these articles simultaneously provided information about the optimal timing of a delirium screening process in the ED. Among the articles providing information about the identification of delirium in the ED, 2 were validation studies of a screening instrument in the ED, whereas 20 were application studies of screening tools.

Among the reviewed articles, delirium was identified among ED patients with 7 different instruments: the CAM,[24] the Confusion Assessment Method–ICU (CAM-ICU),[25] the Confusion Assessment Method–Emergency Department (CAM-ED),[23] the Organic Brain Syndrome Scale,[26] the Diagnostic and Statistical Manual criteria, the Delirium Rating Scale,[27] and the NEECHAM Confusion Scale.[28] The CAM was the most frequently used instrument (11 studies), whereas the CAM-ICU was the second most commonly used (6 studies). The CAM requires raters to assess 9 delirium elements and takes approximately 5 minutes to complete. The CAM-ICU is an adaptation of the CAM that includes nonverbal items, requires assessment of 4 cardinal features of delirium, and has been validated in the ICU population. The CAM-ED is another adaptation of the CAM and adds attention tasks to the original CAM instrument. The Organic Brain Syndrome Scale consists of 2 subscales with 15 questions and 39 clinical items. The Delirium Rating Scale requires the completion of a 10-item scale based on all information available to the rater. The NEECHAM Confusion Scale consists of 3 subscales and assesses patients on their cognitive status, observed behavior and performance at tasks, and their "vital status."

The CAM has been used extensively in the ED literature to identify older adults with delirium (Table 2). In these applications, the tool has been used to establish the prevalence of delirium among seniors,[5,8,9] to identify the proportion of older adults with delirium who arrive by EMS,[29] to assess documentation rates for delirium and the effect of delirium screening on those rates,[9,10] to determine whether routine mental status screening can identify delirium early in an ED visit,[30] and to identify the long-term sequelae of delirium.[6,31]

In these studies using the CAM, investigators reported delirium prevalence rates in the ED among elderly adults ranging from 0.6% to 24%. In the case of the study[29] that reported a delirium prevalence rate of 0.6%, the authors noted that this number may be "artificially low" and raised the possibility that other screening tools, such as the CAM-ICU, may be more appropriate for the ED environment.

In a series of studies, Han et al[11,32-35] investigated the prevalence, associated characteristics, and consequences of delirium in the ED among older adults with the second most frequently used screening instrument, the CAM-ICU. In a separate study, Carpenter et al[36] evaluated the performance of a battery of screening tests to detect cognitive impairment among seniors, including an assessment for delirium with the CAM-ICU. A validation of the CAM-ICU for use in the ED among older adults was not presented in any of these investigations. In their studies, Han et al[11,32-35] reported delirium prevalence rates between 8.3% and 37.9% among selected subsets of older ED visitors. By comparison, Carpenter et al[36] found that 5.5% of their ED study population experienced delirium.

In one study,[7] a separate group of investigators used a third instrument, the CAM-ED, to establish the prevalence of delirium among older adults in the ED and to assess the sensitivity of an emergency physician's documentation of the condition. With the CAM-ED, 10% of patients were judged to have delirium or "probable" delirium. A validation of this instrument, however, was not presented in this original study, nor was one identified in this systematic review.

Finally, in a Turkish study, investigators used the evaluation by an emergency medicine resident and neurologist applying the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (*DSM-IV*) criteria to investigate the clinical characteristics of older (≥65 years) and younger (≤65 years) adults with delirium.[37] No data were provided in this article to calculate a delirium prevalence rate, though delirium was found in equal numbers of patients between the 2 groups, with 21 cases among older adults and 22 cases among younger adults.

In 4 articles, delirium screening tools were used to identify patients for further study, but not to evaluate either delirium screening test performance or delirium prevalence rates. In the first article,[38] as part of their efforts to identify prospectively those factors that extend hospital length of stay, investigators screened older adults in the ED for delirium, using the Delirium Rating Scale. Though a prevalence rate of delirium in the ED was not presented, the authors demonstrated a connection between

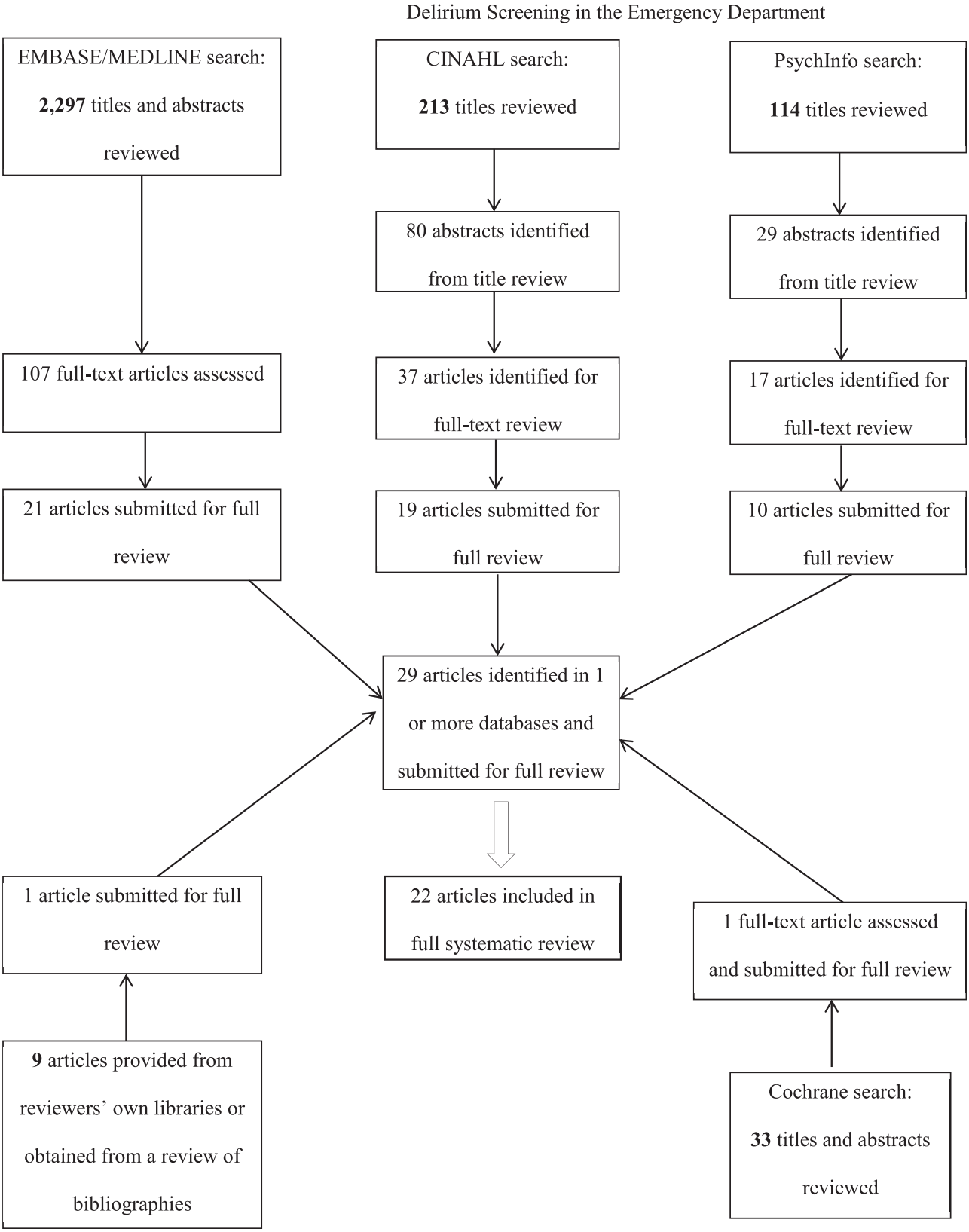

Figure. Search results and selection of studies for systematic review.

Table 2. Application studies of delirium screening instruments.

Instrument	Study	Publication Date	Country	Use	Finding
Prospective identification of delirium					
CAM	Elie et al	2000	Canada	Establish prevalence of delirium in ED. CAM administered by research psychiatrist.	Delirium prevalence 9.6% (95% CI 6.9%–12.4%)
	Hare et al	2008	Australia	Evaluate whether routine mental status screening can identify delirium early in an ED visit. CAM administered by research nurse.	Nurse-led assessment of cognition is feasible; delirium was present in 3 of 28 patients (10.7%)
	Hustey and Meldon	2002	United States	Establish prevalence and documentation rate of delirium in ED. CAM administered by research assistants.	10% of patients were delirious (95% CI 7%–14%); 17% had cognitive impairment noted (95% CI 9%–27%)
	Hustey et al	2003	United States	Assess documentation rates for delirium and effect of delirium screening on its recognition. CAM assessment performed by research assistant.	7% of patients were delirious (95% CI 4%–11%); 16% of delirious patients were recognized (95% CI 3%–40%); screening changed management plans in no cases
	Kakuma et al	2003	Canada	Establish whether prevalent delirium is risk factor for mortality. CAM assessment performed by research assistant.	Patients discharged from ED with delirium undetected have higher mortality
	Naughton et al	1995	United States	Determine prevalence of delirium in ED. CAM assessment performed by research assistant.	24% of patients >70 y were delirious
	Shah et al	2011	United States	Establish rate of delirium and other cognitive impairment among older adults arriving by EMS. CAM assessment performed by study staff.	0.6% of patients were found to be delirious
	Vida et al	2006	Canada	Establish relationship between delirium and later ADLs, basic ADLs, IADLs. CAM assessment performed by research assistant.	Delirium alone is not a predictor of poorer functional outcome
CAM-ICU	Carpenter et al	2011	United States	Identify delirious patients during evaluation of several other cognitive screening instruments. CAM-ICU assessment performed by research assistant.	5.5% of patients had delirium
	Han et al	2009	United States	Establish recognition, risk factors, and subtypes of delirium. CAM-ICU assessment performed by research assistant.	8.3% of patients were delirious; delirium was missed in 76% of cases
	Han et al	2009	United States	Evaluate whether nursing home patients are at greater risk for delirium in the ED. CAM-ICU assessment performed by research assistant.	37.9% of nursing home patients were delirious vs 5.7% of non–nursing home patients
	Han et al	2010	United States	Evaluate whether delirium is an independent predictor of death within 6 mo. CAM-ICU assessment performed by research assistant.	17.2% of patients were delirious; delirium is an independent predictor of 6-mo mortality
	Han et al	2011	United States	Assess whether delirium is predictor of hospital length of stay. CAM-ICU assessment performed by research assistant.	17% of patients were delirious; delirium is an independent predictor of hospital length of stay
	Han et al	2011	United States	Analyze the effect of delirium on accuracy of chief complaint and understanding of discharge instructions. CAM-ICU assessment performed by research assistant.	Patients with delirium superimposed on dementia had less accurate chief complaints and understood their discharge instructions less frequently
CAM-ED	Lewis et al	1995	United States	Evaluate the sensitivity of a conventional assessment for detecting delirium. CAM-ED assessment performed by research assistant.	10% of patients had delirium or probable delirium; 17% of cases were identified by emergency physicians' records
DSM-IV criteria	Duran and Aygün	2012	Turkey	Classify delirium according to its cause in older and younger adult populations. DSM criteria applied by emergency resident and neurologist.	Metabolic disorders were the most common cause of delirium in the 21 older adults and 22 younger adults with delirium.

Table 2. Continued.

Delirium identification used to identify patients for further study					
Instrument	**Study**	**Publication Date**	**Country**	**Study Aim**	**Notes**
OBS Scale	Bjorkelund et al	2010	Sweden	Evaluate whether a multifactorial program can reduce delirium among elderly hip fracture patients. OBS performed by research investigator.	Patients with delirium at admission excluded from study
NEECHAM	Milisen et al	2001	Belgium	Test the effect of nurse-led program for delirium on patient outcomes. NEECHAM performed by nurses.	Screening of patients for delirium occurred in ED
Delirium Rating Scale	Saravay et al	2004	United States	Identify cause of extended length of stay in elderly hospitalized patients. Unclear who administered DRS.	Delirium identified at admission in the ED is associated with greater length of stay
CAM	Shapiro et al	2001	United States	To assess functional decline for older adults after minor traumatic injury. Unclear who administered CAM.	Patients with delirium were excluded from the study

ADLs, activities of daily living; *IADLs*, instrumental activities of daily living; *OBS*, Organic Brain Syndrome Scale.

delirium in the ED, clinical and behavioral complications during a patient's hospitalization, and longer hospital length of stay.

In a second study,[39] investigators from Scandinavia identified delirium among patients admitted with hip fracture from the ED, using the Organic Brain Syndrome scale. No specific numbers for delirium identification with the scale in the ED were presented. In a similar manner, investigators from Belgium used the NEECHAM Confusion Scale to identify delirium among older adults who had experienced a hip fracture.[40] In this study, the primary nurse screened for delirium with the NEECHAM Confusion Scale, whereas the CAM was used to confirm the diagnosis of delirium. The proportion of cases of delirium that were identified within the ED, however, was not presented.

One final study[41] used the CAM to exclude older adults with delirium who presented with trauma to a US ED. The study investigated functional decline after minor injury in older adults but did not present data on the number of adults who were excluded from the study or who were identified with delirium.

The studies analyzed in this systematic review were of heterogenous design. The studies were judged to provide level III evidence according to the Grading of Recommendations Assessment, Development and Evaluation criteria.

The studies identified in this review reported delirium rates ranging between 0.6% in the general population of older adults treated in one ED[29] to 37.9% among nursing home patients treated in another ED.[34] Delirium, however, was most frequently reported as occurring in 7% to 10% of older adults assessed in the ED.[7-11,25] In the studies in which provider recognition of delirium was assessed, providers identified between 16% and 17%[7,10] and 35%[8] of cases of delirium in older adults.

Though 7 tools were identified in this review, only 1 instrument, the CAM, was validated in a population of seniors visiting the ED, first in a Canadian study and later in a Brazilian study (Table 3). In the Canadian study (21 patients considered delirious of 110 screened),[42] the investigators first compared the results of CAMs performed by lay interviewers to geriatricians' CAM results. Then, the investigators further compared the geriatrician's CAM to his or her evaluation of the patient, using the *Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised* (*DSM-III-R*) and *DSM-IV* criteria, as well as with his or her clinical judgment of whether delirium was present. Using the geriatrician's CAM as the reference standard, the sensitivity and specificity, respectively, of a lay interviewer's CAM assessment were 0.86 and 1.00. κ Statistics were reported for the agreement of the geriatrician's CAM with the *DSM-III-R* (0.86; 95% confidence interval [CI] 0.43 to 1.12), *DSM-IV* (0.97; 95% CI 0.78 to 1.16), and clinical impression (0.94; 95% CI 0.76 to 1.13).

In the Brazilian study (17 patients considered delirious of 100 screened),[43] the results of the Portuguese-language version of the CAM administered by a geriatrician were compared with the results of an independent evaluation by a psychiatrist, who applied the *DSM-IV* criteria within 2 hours of the geriatrician's assessment. In this analysis, the CAM displayed a sensitivity of 0.94 and specificity of 0.96. In a second analysis, the

Table 3. Validation studies of delirium screening instruments.

Instrument	Study	Publication Date	Country	Performance Characteristics	Quality Rating*
CAM	Monette et al	2001	Canada	κ Scores for reliability between CAM and *DSM-III-R* (0.86; 95% CI 0.43–1.12), *DSM-IV* (0.97; 95% CI 0.78–1.16), and clinical impression (0.94; 95% CI 0.76–1.13). CAM performed by geriatrician and lay interviewer.	4.5 of 5 quality points
CAM (Portuguese)	Fabbri et al	2008	Brazil	CAM displayed a sensitivity of 0.94 and specificity of 0.96 compared with a psychiatrist's evaluation with the *DSM-IV* criteria. CAM was administered by a geriatrician.	2.5 of 5 quality points

*Quality points assigned according to methodology of Wei et al[23]: 1 point each for "adequacy of the reference standard, blinded assessment, close proximity of assessments between CAM rater and the reference standard assessment, inclusion of false-positive challenges, and inclusion of false-negative challenges."

investigators sought to establish the interobserver reliability of the CAM by comparing a subset of evaluations by the geriatrician with a second clinician's evaluation performed concurrently. Among the 24 patients evaluated in this manner, the geriatrician and clinician agreed in their delirium assessments in 22 of 24 cases, yielding a κ score of 0.70.

Because of the small number of validation studies, the differences in study designs, and the potential differences between these 2 ED environments, we did not calculate pooled sensitivity and specificity statistics for the CAM. In our analysis, we found the studies' validation procedures to be of heterogeneous quality, with the Canadian study earning 4.5 validation quality points and the Brazilian study earning 2.5 validation quality points (out of 5 maximum). These 2 studies were determined to constitute grade III evidence, applying the Grading of Recommendations Assessment, Development and Evaluation methodology, and each had 10 of 14 positive responses to the questions used in the Quality Assessment of Diagnostic Accuracy Studies assessment tool (Appendix E1, available online at http://www.annemergmed.com).

Three studies provided information to assess the optimal screening interval(s) during which a delirium screening process might be timed. In a pair of studies, Han et al[11,34] evaluated patients for delirium at arrival and then 3 hours later, using the CAM-ICU. In the first of these studies, 32 of 341 patients (9.4%) who sought care in the ED had positive CAM-ICU assessments initially, whereas 6 of 90 patients (6.7%) who underwent an assessment at 3 hours were subsequently found to have newly identified delirium.[30] In the second study,[11] 21 of 376 older adults (6.9%) initially had a positive CAM-ICU test result. Among the 82 (27.1%) patients who then underwent a second assessment with the CAM-ICU at 3 hours, an additional 4 patients (4.9%) were newly found to be delirious.

The third study used a different design to evaluate the effect of mental status screening on the care plans for delirious older adults in the ED.[10] Though the study did not use serial evaluations of patients for delirium as the previous studies had, it did provide information on the effect of the disclosure of delirium screening results to emergency physicians at the end of a visit. During the investigation, the research team assessed for delirium at enrollment in the ED but did not share these assessments with the patients' emergency physicians until after a disposition and care plan had been developed. Following this protocol, the authors found that ED providers recognized delirium in only 3 of 19 (16%) patients identified by CAM testing, but that when the results of the investigators' delirium testing were shared with providers, none of the original management or discharge plans were changed. Following through on their original management plans, the emergency providers discharged home 5 of the 19 patients who were discovered to be delirious by the research team. This finding suggests that delirium screening results may need to be provided earlier in the ED stay to affect provider behavior.

LIMITATIONS

Our study may be limited by its search strategy, its inclusion of articles printed only in English, and publication bias. Additionally, our review was conducted without the involvement of a research librarian, though a member of our research team has conducted previous systematic reviews. To limit these potential biases, we hand-searched reference lists for potential additional articles and searched multiple scientific databases. Our review deviated from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines as applied to systematic reviews in that we did not register our systematic review and have not placed a copy of our review protocol online, though our methods are described in this article. Finally, the reports identified in this systematic review provide details on the efficacy of these screening tools' use during clinical investigations, though their effectiveness and performance characteristics in daily clinical use have yet to be demonstrated.

DISCUSSION

This review provides a comprehensive outline of the use of delirium screening instruments in studies conducted in EDs and the out-of-hospital environment, both nationally and internationally, during the last several decades. Furthermore,

it identifies those screening tools that have been used in epidemiologic studies of delirium, those delirium screening instruments that have been validated for use in the ED, and the body of evidence that exists to support when a delirium screening process should be conducted during the course of an older adult's ED visit. Our review identifies that there is a lack of delirium assessment tools that have been validated for use in the ED and a paucity of evidence to guide practitioners on the optimal timing of a delirium screening assessment, despite a call by geriatric emergency medicine experts more than 10 years ago for brief delirium assessments to be developed for the ED and for further research to be conducted in this area.[13]

From this review, it is clear that older adults in the ED are frequently delirious and also that emergency providers' recognition of delirium has not appeared to improve much despite an increase in literature on the topic. It is possible, though not proven, that delirium frequently goes unrecognized among older adults in the ED in part because of the lack of a validated and brief instrument for delirium identification there, as well as a lack of recognition among providers of the potential consequences of a missed delirium diagnosis. As this review highlights, there are dangers associated with undetected delirium. Initial evidence shows that older adults who are discharged from the ED with their delirium unidentified are at greater risk of death in the next 6 months than those patients whose delirium is recognized[6] and that delirium is an independent predictor of death among older adults seeking care in the ED.[35] These findings, demonstrating a link between delirium and mortality, are consistent with results observed in other populations of individuals affected by delirium in the hospital setting.[44,45] Consequently, this systematic review underscores opportunities to improve the quality and organization of ED and out-of-hospital care that is provided to older adults with delirium.

A variety of tools have been used to identify delirium among older adults in ED research studies, though to date only 1, the CAM, has undergone initial validation, albeit in relatively small study populations and in studies that did not strictly follow the Standards for the Reporting of Diagnostic Accuracy criteria. Indeed, the CAM is extensively used and has gained wide acceptance in the research community for use in multiple clinical venues,[23] though it is unclear how frequently it is used in clinical practice within the ED. More recently, it has been argued by some that the CAM-ICU may be the preferred standard for delirium identification in the ED,[36] though the CAM-ICU's validation in the ED is still ongoing.[46] Given its ease of use and its short length, the CAM-ICU may indeed be well suited for use by ED providers.[46] However, in light of recent evidence suggesting that the CAM-ICU may not perform as well as expected outside of the ICU setting,[47] we believe the separate validation of the CAM-ICU for use in the ED is necessary.

Beyond the CAM and the CAM-ICU, other promising delirium assessments exist, including the Delirium Diagnostic Tool–Provisional and the Single Question in Delirium. These instruments were investigated in patients with traumatic brain injury and in hospitalized patients, respectively,[48,49] and may deserve evaluation in the ED, given their brevity and performance characteristics in initial studies. More recently, other delirium assessment tools, including the Emergency Department Delirium Triage Screen and the Brief Confusion Assessment Method, have been presented at scientific conferences,[50,51] though their assessments have not been published yet, to our knowledge, in peer-reviewed journal article formats. Beyond these, a randomized controlled trial from Australia will evaluate new criteria for the diagnosis of delirium against the CAM among patients receiving care in an ED.[52] Criteria that may aid in the refinement of delirium assessment tools have been described in the literature[53] and may be useful during the development of new delirium screening tools for the ED and out-of-hospital environments.

Even with a validated screening instrument, the performance of delirium assessment may still be influenced by timing considerations, including when the syndrome is most readily detected and when the results are most useful to emergency providers. By definition, delirium is a condition that is marked by fluctuations in mental status over time. In the majority of studies evaluated in this review, investigators assessed patients' mental status at one time only. In 2 studies, though, a set of investigators made repeated patient observations to demonstrate that a small but significant proportion of adults who were not initially identified as delirious were found to be so when testing was repeated 3 hours later. These findings suggest a potential benefit to screening for delirium at multiple points during the course of a patient's ED visit to maximize the syndrome's identification. However, inadequate evidence exists to define the ideal schedule for conducting the repeated testing. The optimal frequency and manner of delirium testing will ultimately need to be established, of course, with sensitivity to time, personnel, and resource allocation considerations of the busy ED environment. New research should seek to identify the critical junctures in care when delirium testing could be performed to improve its recognition. If delirium is detected, there are a variety of interventions that have been developed and applied in other areas of the hospital, including the Delirium Room and the Hospital Elder Life Program, that in concept might be adapted to the ED environment and affect patient-oriented outcomes.[54-56]

The timing of any delirium assessment should also take into account when its results might be most useful to the clinician. The findings of Hustey et al[10] suggest that emergency physicians are not influenced in their management decisions by the results of standardized cognitive testing for delirium if that testing is shared after a patient's disposition and plan of care have been determined. It remains possible, yet untested, that standardized delirium assessments that are shared with providers earlier in the course of an ED visit will positively influence patient management and outcomes. Research will be needed to answer this question conclusively.

In summary, the recognition of delirium by providers appears to be central to the management and provision of appropriate care to affected older adults in the ED. Two delirium screening

tools have been identified as being most frequently used in the literature, though only 1 tool, the CAM instrument, has undergone initial validation for use in the ED environment. Minimal evidence exists to suggest the optimal timing of delirium assessment(s) to maximize its identification, though repeated delirium testing appears necessary. To move the field of delirium identification and management forward within the ED, we believe a series of concrete steps will be needed. As identified by others, a brief tool for delirium screening that has been appropriately validated in the ED will likely be needed, as well as further education of emergency professionals about the importance of delirium recognition. In particular, delirium identification has been identified by emergency medicine and geriatric educators as a potential core competency for graduating emergency medicine residents.[57] However, given that practice change requires more than just education[58] and occurs most effectively when multifaceted strategies are used,[59] the adoption of an improved system of care for the management of potentially delirious patients may be needed. Multicomponent, proactive systems of care that work to mitigate the impact of delirium on patient's health and health care use have been shown to be effective in other areas of the hospital outside of the ED.[54,60] Future research on the identification and management of delirium in the ED should build on the important work conducted to date in this field and should potentially occur under the purview of a national body that may promote coordinated efforts with validated patient-oriented outcome instruments across a variety of sites. Patients who are at high risk of poor outcomes from the sequelae of delirium, including seniors and other vulnerable adults, should be targeted for study within this research program.

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Appendix E1.

Quality Assessment of Diagnostic Accuracy Studies tool results

Study: Fabrri, 2008

Item	Reviewer 1 Response (M.A.L.)	Reviewer 2 Response (F.C.M.)	Final Response After Discussion
Was the spectrum of patients representative of the patients who will receive the test in practice?	Yes	Yes	Yes
Were selection criteria clearly described?	Yes	Yes	Yes
Is the reference standard likely to correctly classify the target condition?	Yes	Yes	Yes
Is the period between reference standard and index test short enough to be reasonably sure that the target condition did not change between the 2 tests?	Yes	Yes	Yes
Did the whole sample or a random selection of the sample receive verification using a reference standard of diagnosis?	Yes	Yes	Yes
Did patients receive the same reference standard regardless of the index test result?	Yes	Yes	Yes
Was the reference standard independent of the index test (ie, the index test did not form part of the reference standard)?	Yes	Yes	Yes
Was the execution of the index test described in sufficient detail to permit replication of the test?	Yes	Yes	Yes
Was the execution of the reference standard described in sufficient detail to permit its replication?	Yes	Yes	Yes
Were the index test results interpreted without knowledge of the results of the reference standard?	Yes	Unclear	Unclear
Were the reference standard results interpreted without knowledge of the results of the index test?	Yes	Unclear	Unclear
Were the same clinical data available when test results were interpreted as would be available when the test is used in practice?	Yes	Yes	Yes
Were uninterpretable/intermediate test results reported?	Unclear	Unclear	Unclear
Were withdrawals from the study explained?	Yes	Unclear	Unclear
Calculated κ score	0.32		

Quality Assessment of Diagnostic Accuracy Studies tool results.

Study: Monette, 2001

Item	Reviewer 1 Response (M.A.L.)	Reviewer 2 Response (F.C.M.)	Final Response After Discussion
Was the spectrum of patients representative of the patients who will receive the test in practice?	Yes	Yes	Yes
Were selection criteria clearly described?	Yes	Yes	Yes
Is the reference standard likely to correctly classify the target condition?	Yes	Unclear	Yes
Is the period between reference standard and index test short enough to be reasonably sure that the target condition did not change between the 2 tests?	Yes	Yes	Yes
Did the whole sample or a random selection of the sample receive verification using a reference standard of diagnosis?	Yes	No	No
Did patients receive the same reference standard regardless of the index test result?	Yes	No	No
Was the reference standard independent of the index test (ie, the index test did not form part of the reference standard)?	Yes	Yes	Yes

Appendix E1. Continued.

Quality Assessment of Diagnostic Accuracy Studies tool results.

Study: Monette, 2001

Item	Reviewer 1 Response (M.A.L.)	Reviewer 2 Response (F.C.M.)	Final Response After Discussion
Was the execution of the index test described in sufficient detail to permit replication of the test?	Yes	Yes	Yes
Was the execution of the reference standard described in sufficient detail to permit its replication?	Yes	Yes	Yes
Were the index test results interpreted without knowledge of the results of the reference standard?	Yes	Unclear	Yes
Were the reference standard results interpreted without knowledge of the results of the index test?	Yes	Unclear	Yes
Were the same clinical data available when test results were interpreted as would be available when the test is used in practice?	Yes	Yes	Yes
Were uninterpretable/intermediate test results reported?	Unclear	Unclear	Unclear
Were withdrawals from the study explained?	Yes	No	No
Calculated κ score	0.17		