Accuracy of Dementia Screening Instruments in Emergency Medicine: A Diagnostic Meta-analysis

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ABSTRACT

Background: Dementia is underrecognized in older adult emergency department (ED) patients, which threatens operational efficiency, diagnostic accuracy, and patient satisfaction. The Society for Academic Emergency Medicine geriatric ED guidelines advocate dementia screening using validated instruments.

Objectives: The objective was to perform a systematic review and meta-analysis of the diagnostic accuracy of sufficiently brief screening instruments for dementia in geriatric ED patients. A secondary objective was to define an evidence-based pretest probability of dementia based on published research and then estimate disease thresholds at which dementia screening is most appropriate. This systematic review was registered with PROSPERO (CRD42017074855).

Methods: PubMed, EMBASE, CINAHL, CENTRAL, DARE, and SCOPUS were searched. Studies in which ED patients ages 65 years or older for dementia were included if sufficient details to reconstruct 2 × 2 tables were reported. QUADAS-2 was used to assess study quality with meta-analysis reported if more than one study evaluated the same instrument against the same reference standard. Outcomes were sensitivity, specificity, and positive and negative likelihood ratios (LR+ and LR–). To identify test and treatment thresholds, we employed the Pauker-Kassirer method.

Results: A total of 1,616 publications were identified, of which 16 underwent full text-review; nine studies were included with a weighted average dementia prevalence of 31% (range, 12%–43%). Eight studies used the Mini Mental Status Examination (MMSE) as the reference standard and the other study used the MMSE in conjunction with a geriatrician's neurocognitive evaluation. Blinding to the index test and/or reference standard was inadequate in four studies. Eight instruments were evaluated in 2,423 patients across four countries in Europe and North America. The Abbreviated Mental Test (AMT-4) most accurately ruled in dementia (LR+ = 7.69 [95% confidence interval {CI} = 3.45–17.10]) while the Brief Alzheimer's Screen most accurately ruled out dementia (LR– = 0.10 [95% CI = 0.02–0.28]). Using estimates of diagnostic accuracy for AMT-4 from this meta-analysis as one trigger for more comprehensive geriatric vulnerability assessments, ED dementia screening benefits patients when the prescreening probability of dementia is between 14 and 36%.

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Conclusions: ED-based diagnostic research for dementia screening is limited to a few studies using an inadequate criterion standard with variable masking of interpreter's access to the index test and the criterion standard. Standardizing the geriatric ED cognitive assessment methods, measures, and nomenclature is necessary to reduce uncertainties about diagnostic accuracy, reliability, and relevance in this acute care setting. The AMT-4 is currently the most accurate ED screening instrument to increase the probability of dementia and the Brief Alzheimer's Screen is the most accurate to decrease the probability of dementia. Dementia screening as one marker of vulnerability to initiate comprehensive geriatric assessment is warranted based on test–treatment threshold calculations.

Cognitive dysfunction in older adults includes mild cognitive impairment, dementia, and delirium in addition to traumatic brain injury, intoxication, and central nervous system infections also encountered in younger populations. Delirium is an acute and reversible disturbance in attention with multiple potential precipitants, while mild cognitive impairment is an early form of Alzheimer's disease with memory and language problems only manifest with formal testing.[1,2] On the other hand, dementia represents a chronic neurodegenerative disease that impairs executive functioning, memory, orientation, and judgment.[1] Total United States expenditures for dementia care in 2010 were estimated at $157 to $215 billion,[3] while globally costs were estimated at $604 billion in 2010 and projected to increase to $1 trillion by 2018.[4] Dementia has the potential to negatively influence effective emergency care. For example, unrecognized dementia is associated with diagnostic inaccuracy as clinicians evaluate a patient's acute complaints and the cause of their symptoms.[5] Dementia is also associated with increased use of the ED,[6] prolonged ED length of stay, increased admission rates,[7] prolonged hospitalizations, incident delirium,[8] fall risk,[9] and higher mortality,[7] as well as subsequent ED returns[10] and hospital readmissions.[11,12] Therefore, older adults with dementia represent a vulnerable ED population that will present with increasing frequency over coming decades. In response, nurse and physician leaders worldwide are increasingly advocating a more dementia friendly ED, which includes multiple strategies such as limiting psychotropic or anxiolytic medications that can worsen confusion or agitation, adapting pain assessment measures to accommodate dementia patients, and ensuring follow-up mechanisms after ED discharge.[13] Whether these strategies or other approaches improve dementia patient outcomes is largely unknown and quite unexplorable until dementia can be accurately identified in ED settings.

Primary care providers often fail to diagnose dementia, so reliance on the past medical history alone during an episode of emergency care can miss over 90% of cases.[14–16] While the traditional emergency medicine process appropriately prioritizes the identification of *acutely* life-threatening illness or injury, dementia is a chronic neurodegenerative process without a cure, and its key symptom (cognitive impairment) is often underrecognized in the ED.[15] Most ED staff worldwide do not screen for cognitive dysfunction, even in the geriatric-specific ED.[17–19] Nonetheless, ascertaining older adults' baseline cognitive status is a core competency for emergency medicine residency graduates,[20] and screening for dementia and delirium are prominent recommendations in the American College of Emergency Physicians-Society for Academic Emergency Medicine geriatric emergency department guidelines.[21]

Efficient dementia screening in ED settings relies on ultrabrief instruments that are simultaneously reliable and accurate, psychometrically valid, acceptable to ailing patients, acknowledged as value-added by health care providers, and available during episodes of care without requiring extra resources or equipment to administer. Although several dementia screening instruments from myriad health settings have been described, no prior systematic review has quantitatively evaluated the diagnostic accuracy of these instruments in the ED.[22] The primary objective of this meta-analysis was to identify and summarize the pooled diagnostic test characteristics (sensitivity, specificity, and likelihood ratios [LRs]) for dementia screening instruments in the ED. A secondary objective was to assess the pretest probability of dementia along with test and treatment thresholds using the Pauker-Kassirer method, based on estimates of sensitivity, specificity, diagnostic risks, and treatment benefits derived from this meta-analysis.[23]

METHODS

Study Design

We conducted a systematic review and meta-analysis of original research studies that reported data on the diagnostic accuracy of dementia in older ED patients. The design and reporting of this systematic review conform to the Preferred Reporting Items for Systematic

Reviews and Meta-Analyses of Diagnostic Test Accuracy Studies.[24] Studies were included if they described adults aged 65 years or older, evaluated in the ED setting with an index test for dementia and compared with an acceptable reference standard for dementia. A priori determinants of acceptable reference standards included the Mini Mental Status Examination (MMSE) or more formal neuropsychological evaluation by qualified individuals (psychiatrist, neurologist, geriatrician) using Diagnostic Statistical Manual of Mental Disorders (DSM-V) criteria. For inclusion, studies had to provide sufficient detail on the dementia screening test and reference standard to construct two-by-two tables. We contacted the authors of potentially appropriate studies if they did not report sufficient detail to reconstruct two-by-two tables. When multiple studies reported diagnostic accuracy on the same or overlapping patient populations (same site, same time period), the publication with the largest sample size was selected for inclusion. We elected to define "disease positive" as an abnormal reference standard using the threshold defined in the original studies, whereas "disease-negative" patients were those with normal results on the reference standard. This systematic review was registered with PROSPERO (CRD42017074855).

Search Strategy

The published literature was searched using strategies created by a medical librarian (SF) for the concepts of emergency department, people 60 and older, screening, dementia and diagnosis. These strategies were established using a combination of standardized terms and key words and were implemented in PubMed Medline 1946–, Embase.com 1947–, EBSCO Cumulative Index for Nursing and Allied Health (CINAHL) 1937–, Wiley Cochrane Central Register of Controlled Trials (CENTRAL), Wiley Database of Abstracts of Reviews of Effects (DARE), Wiley Cochrane Database of Systematic Reviews, and clinicaltrials.gov. All searches were completed in March 2014 and were limited to English using database supplied limits. The search was updated in June 2018. Due to a change in database access, Scopus was used in place of Embase. All previous databases were searched again. All results were exported to EndNote. We used the automatic duplicate finder in EndNote and duplicates were assumed to be accurately identified and removed. Full search strategies are provided in Data Supplement S1 (available as supporting information in the online version of this paper, which is available at http://onlinelibrary.wiley.com/doi/10.1111/acem.13573/full). Two authors (DK, LS) also conducted bibliographic searches of research abstracts presented at scientific meetings published in *Academic Emergency Medicine*, *Annals of Emergency Medicine*, *Canadian Journal of Emergency Medicine*, and *Journal of the American Geriatrics Society*. Data from each study were abstracted by one author (CRC).

Two authors (DE, CRC) independently reviewed the titles and abstracts to identify potentially relevant articles. Additionally, full-text articles' references were reviewed to identify additional studies for potential inclusion. Information abstracted included the study setting, exclusion criteria, enrollment method, screening instrument(s) evaluated, and reference standard employed in addition to two-by-two tables for quantification of diagnostic accuracy and meta-analysis.

Individual Evidence Quality Appraisal

Two authors (JB, MAL) independently used the Quality Assessment Tool for Diagnostic Accuracy Studies (QUADAS-2) for systematic reviews to evaluate the risk of bias for the identified studies.[25] Several a priori conditions were used to evaluate individual study's risk of bias and degree of applicability.

- If the study enrollment occurred anywhere other than an ED (for example, if enrollment included patients in a dementia clinic or on a hospital ward in addition to the ED) then the results were assessed as "low applicability."
- If the same assessor collected elements of both the index test and the reference standard, blinding was considered inadequate.
- Establishing the presence or absence of dementia required the evaluation of an expert in cognitive assessment (generally a geriatrician, neuropsychologist, or neurologist) using DSM-V criteria (or the equivalent of DSM-V for earlier studies). If the MMSE was the sole reference standard, the study was deemed high risk of bias.

QUADAS-2 inter-rater agreement was quantified using a kappa analysis with qualitative descriptors previously described by Byrt.[26] Discrepancies were resolved after review by a third author (CRC).

Data Analysis

One author (CRC) computed meta-analysis estimates when one or more studies evaluated the same

dementia screening test against the same reference standard. No consensus exists about whether a fixed-effects or random-effects model is more appropriate for diagnostic meta-analyses, although some evidence indicates significant between-study heterogeneity in diagnostic studies which implies that a random-effects model is more appropriate.[27] Therefore, we generated combined estimates for diagnostic accuracy using a random-effects model (Meta-DiSc Version 1.4, Hospital Universitario Ramón y Cajal).[28,29] The DerSimonian-Laird random effects model was used to quantify statistical interstudy heterogeneity via the index of inconsistency (I^2), Cochrane's Q, and tau-square.[30,31] Tau represents the estimated standard deviation of underlying effects across studies, while I^2 estimates the proportion of total variability in point estimates attributable to heterogeneity.[32] We also report pooled estimates of dichotomous positive LRs (LR+) and negative LRs (LR–) from the random-effects model. Because of the small number of studies and uncertain interpretation for diagnostic meta-analyses, publication bias was not evaluated.

Test–Treatment Threshold

Universal ED dementia screening is likely not feasible, nor does the United States Preventive Services Task Force support such widespread screening.[33] However, a subset of ED patients with previously unrecognized dementia might benefit from screening using sufficiently accurate instruments. Identifying which patients might benefit and what interventions might benefit them requires methods distinct from diagnostic meta-analysis. We used the Pauker-Kassirer method to estimate thresholds for further dementia testing or referral for dementia treatment. This technique is based on seven variables: false-negative and false-positive rates of the diagnostic test assessed as well as sensitivity and specificity, risk of the diagnostic test, potential risk of treatment in false-positive patients, and benefits of treatment in true-positive cases.[23] Few of these risks or benefits have been formally evaluated in ED settings for dementia screening, so our estimates are arbitrary. Accordingly, we provide an interactive calculator to empower readers to recompute thresholds with different estimates of screening test accuracy or anticipated risks and benefits that may be more acceptable to individual clinician's patient populations and clinical setting (Data Supplement S2, available as supporting information in the online version of this paper, which is available at http://onlinelibrary.wiley.com/doi/10.1111/acem.13573/full).

RESULTS

A total of 1,616 unique citations were identified through a search of PubMed, EMBASE, CINAHL, CENTRAL, and DARE and 1,588 were excluded after review of their title and abstract revealed inapplicability to our inclusion criteria. A total of 16 studies underwent full-text review and nine were included in the current analysis (Figure 1).[16,34–41] The seven excluded studies enrolled duplicate patients,[42–44] provided insufficient details to reconstruct two-by-two tables,[45–47] or did not assess a brief screening instrument.[48] Included studies are detailed in Table 1 and the eight dementia screening instruments are summarized in Data Supplement S3 (available as supporting information in the online version of this paper, which is available at http://onlinelibrary.wiley.com/doi/10.1111/acem.13573/full). Studies were conducted between 2003 and 2016, enrolling a total of 2,423 patients. Four studies occurred in the United States, two in Canada, two in Ireland, and one in Scotland. Enrollment criteria ages ranged from over age 65 to over 75 and all excluded critically ill patients. Non–English-speaking patients were excluded with the exception of Wilding et al.,[39] which also included those speaking French. One study was a randomized trial comparing two different screening instruments,[34] while the other eight studies were prospective cross-sectional, convenience sampling investigations.

QUADAS-2 assessment for risk of bias and applicability demonstrated poor inter-rater agreement for the assessment of predefined thresholds for the index test, real-world administration of the index test, acceptability of the reference standard, sufficient interval between the index test and the reference standard, and uniformity of reference standard testing (Table 2).[26] However, the poor inter-rater reliability observed for the index test applicability, reference standard acceptability, between-test interval, and reference test uniformity reflect the paradox of high agreement and low kappa. Each of those QUADAS-2 questions had agreement in eight of nine studies (agreement = 89%) between reviewers but had two zero cells in the kappa two-by-two table. This paradox is a recognized limitation of kappa as a quantitative measure of inter-rater agreement.[49] This paradox does not explain the low kappa observed for predefined thresholds for the index test since the agreement was only 66% for this assessment, so the low kappa likely reflects our failure to define acceptable index test thresholds before the QUADAS-2 reviews ensued.

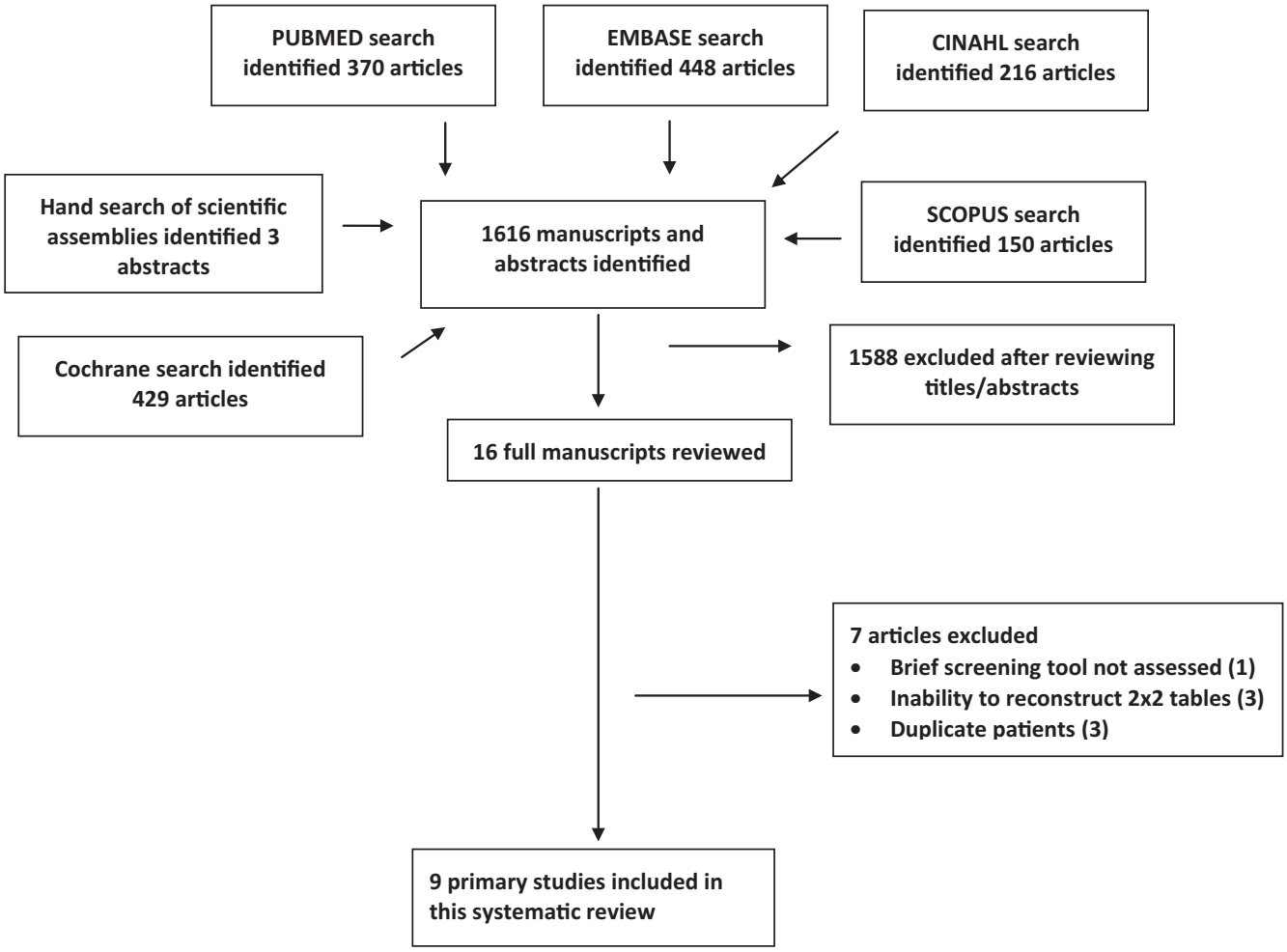

Figure 1. Study selection process.

Blinding to the reference standard for the individual interpreting the index test was uncertain or inadequate in four studies, while blinding to the index test by the reference standard evaluator was inadequate in six studies. The reference standard was the MMSE for all but two studies, but the threshold to differentiate "dementia" from "no dementia" was ≤ 23 in five studies[16,34–37] and ≤ 24 in two studies.[39,41] The other two studies used MMSE in combination with other instruments and assessments as the reference standard for dementia as detailed in Table 1.[38,40] O'Sullivan et al.[40] was the only study to use DSM-V criteria and a formal neurocognitive assessment by a geriatrician. The weighted mean prevalence of dementia was 30.7% and ranged from 12% in Barbic et al.[41] to 43% in Schofield et al.[36] Wilding et al.[39] used trained geriatric nurses to administer the screening test, while all other studies employed research assistants for that task. Only four studies reported adherence to any iteration of the Standard for Reporting Diagnostic Accuracy Studies (STARD) reporting criteria.[50,51]

Screening Instruments

Five instruments were assessed in multiple studies permitting meta-analysis of diagnostic accuracy: Abbreviated Mental Test-4 (AMT-4), caregiver Alzheimer's Disease-8 (cAD8), Ottawa 3DY (O3DY), Short Blessed Test (SBT), and the Six Item Screener (Figure 2). Significant statistical heterogeneity was noted for each measure of diagnostic accuracy for every instrument with the exception of the Six Item Screener LR– and cAD8 LR+ and LR–. The AMT-4 demonstrated the highest pooled LR+ (7.69 [95% confidence interval {CI} = 3.47–17.10]), while the O3DY pooled LR– 0.17 (95% CI 0.05–0.66) and the SBT pooled LR– 0.18 (95% CI = 0.09–0.39) most accurately reduce the probability of dementia. Three instruments were only evaluated in single studies: Animal Fluency,[39] Brief Alzheimer's Screen,[37] and the Mini Cog[34] (Table 3). The Brief Alzheimer's Screen was more accurate than the O3DY and Short Blessed Test to reduce the probability of dementia but requires more time to administer and complex algebraic computations to interpret.

Table 1
Summary of Included Studies

Study	Location	No. Patients	Mean or Median Age (Years)	Exclusion Criteria	Study Design	Dementia Screeners Assessed	Criterion Standard	Prevalence of Outcomes
Barbic 2018[41]	St. Paul's Hospital, Vancouver British Columbia, over 5-month period in 2016	117	82	Age < 75, Canadian Triage Score Level 1, sensory deficits prohibiting communication, acute confusion or hallucinations, non–English speaking, previous diagnosis of dementia, nursing home resident, inability to provide or lack of consent	Prospective cross-sectional, convenience sampling	SBT O3DY	MMSE ≤ 24	MMSE ≤ 24 in 12% O3DY agreed with MMSE in 58%, while SBT did so in 61.5% of cases Kappa for O3DY 0.64 and for SBT 0.63
Carpenter 2011a[37]	Barnes-Jewish Hospital, St. Louis, MO, Jun 2009–Mar 2010	163	78	Age < 65; receipt of antiemetic, benzodiazepine, or narcotic prior to cognitive assessment; non–English speaking; critical illness as judged by emergency physician; inability to provide consent in absence of caregiver to consent	Prospective, cross-sectional, convenience sampling	BAS, SBT, O3DY, cAD8	MMSE ≤ 23	MMSE ≤ 23 in 37% Abnormal cognitive screening noted by O3DY in 66%, BAS in 65%, cAD8 in 55%, and SBT in 43%
Carpenter 2011b[16]	Barnes-Jewish Hospital Emergency Department, St. Louis, MO, Jul 2008–Apr 2009	319	76	Age < 65; receipt of antiemetic, benzodiazepine, or narcotic prior to cognitive assessment; non–English speaking; critical illness as judged by emergency physician; inability to provide consent in absence of caregiver to consent	Prospective, cross-sectional, convenience sampling	SIS, cAD8	MMSE ≤ 23	MMSE ≤ 23 in 35% Review of past medical history noted "dementia" in only 6% of patients
Dyer 2016[47]	Tallaght Hospital Emergency Department, Dublin, Ireland, Jun–Aug 2014	196	78	Age < 65, too unwell, unable or unwilling to consent	Prospective naturalistic study, convenience sampling	AMT-4	Either a positive delirium screen using CAM-ICU or cAD8 ≥ 2 or MMSE ≤ 26 with negative AD8	50% had abnormal result on one or more of the criterion standards (13% CAM-ICU positive delirium, 23.5% abnormal cAD8, 14% MMSE ≤ 26) 74% with abnormal results had no prior formal diagnosis of dementia
O'Sullivan 2017[40]	Mercy University Hospital Emergency Department, Cork, Ireland, Jun–Nov 2015	368	77	Age < 70, intoxicated, poor English skills, medical instability, severe intellectual disability, refusal or inability to consent without family to assent	Prospective, nonconsecutive sampling	SBT	Geriatrician assessment using DSM-V criteria including researcher collected MMSE, DRS-R98, and IQCODE	19.6% of the 368 with SBT screening categorized as dementia by geriatrician assessment 21.7% screened positive for delirium using 4-AT

(Continued)

Table 1 (continued)

Study	Location	No. Patients	Mean or Median Age (Years)	Exclusion Criteria	Study Design	Dementia Screeners Assessed	Criterion Standard	Prevalence of Outcomes
Schofield 2010[36]	Glasgow Royal Infirmary Accident and Emergency Department, Feb–Aug 2007	520	77	Age < 65, nonverbal, learning disability, non–English speaking without interpreter	Prospective, nonconsecutive sampling	AMT4	MMSE ≤ 23	MMSE ≤ 23 in 43% Due to pain or eyesight problems 13.5% of enrolled patients unable to complete the MMSE Mean completion times for AMT4 and MMSE were 4.7 and 11.6 minutes, respectively
Wilber 2005[34]	Akron City Hospital Emergency Department, fall 2003	75 for SIS, 75 for Mini-Cog	75	Age < 65, nonverbal, learning disability, non–English speaking, medically unstable, prescreening medications "that could affect their mental status"	Prospective, randomized cross-sectional convenience sampling	SIS Mini-Cog	MMSE ≤ 23	MMSE ≤ 23 in 24% of SIS group and 21% of Mini-Cog cohort SIS required < 1 minute to complete Mini-Cog clock drawing test alone required a median of 1.5 minutes to complete
Wilber 2008[35]	EDs of Akron City Hospital, Barnes-Jewish Hospital, and Cleveland Clinic, Jan 2006–Jan 2007	352	77	Age < 65, non–English speaking; receipt of opioids, antiemetics, or benzodiazepines prior to cognitive assessment; medically unstable	Prospective, nonconsecutive sampling	SIS	MMSE ≤ 23	MMSE ≤ 23 in 32% Statistically nonsignificant differences in sensitivity and specificity were observed across sites
Wilding 2016[39]	The Ottawa Hospital, Jan–Aug 2010	238	82	Age < 75, medically unstable, preexisting dementia diagnosis, overt cognitive impairment, residence outside Ottawa, non-English or non-French language, hearing or visual impairment	Prospective, nonconsecutive sampling	O3DY Animal Fluency Test	MMSE ≤ 24	MMSE ≤ 24 in 13% MMSE and O3DY agreed in 75.6% MMSE and Animal Fluency Test agreed in 46% using cutoff < 15 and 76% using cutoff < 10

AMT-4 = Abbreviated Mental Test 4; 4-AT = delirium screen; BAS = Brief Alzheimer's Screen; cAD8 = Caregiver Alzheimer's Dementia 8; CAM-ICU = Confusion Assessment Method for the Intensive Care Unit; DRS-R98 = Delirium Rating Scale Revised 98; IQCODE = Informant Questionnaire on Cognitive Decline in the Elderly; MMSE = Mini Mental State Examination; O3DY = Ottawa3DY; SBT = Short Blessed Test; SIS = Six Item Screener; DSM-V = Diagnostic & Statistical Manual of Mental Disorders.

Table 2
Overview of Quality Assessment of Included Studies

Study	Sample	Avoided Inappropriate Exclusions?	Patients and Settings Match Study Question?	Blinded Interpretation of Index Test?	Threshold Predefined?	Acceptable Index Test Application?	Acceptable Reference (Criterion) Standard?	Outcomes Assessed by Blinded Assessor?	Assessed Outcomes Pertinent?	Appropriate Interval Between Index Test and Reference Standard?	Same Reference (Criterioin) Standard for All Patients?	All Patients Analyzed?
Barbic 2018[41]	Nonconsecutive	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes
Carpenter 2011a[37]	Nonconsecutive	Yes	Yes	Uncertain	Yes	Yes	No	No	Yes	Uncertain	Yes	Yes
Carpenter 2011b[16]	Nonconsecutive	Yes	Yes	Uncertain	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Dyer 2016[47]	Nonconsecutive	Yes	Yes	No	Yes	Yes	No	No	No	Uncertain	No	Yes
O'Sullivan 2017[40]	Nonconsecutive	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Schofield 2010[36]	Uncertain	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Uncertain	Yes	Yes
Wilber 2005[34]	Consecutive	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Wilber 2008[35]	Nonconsecutive	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Wilding 2008[39]	Nonconsecutive	Yes	Yes	No	Uncertain	Yes	No	No	Yes	Uncertain	Yes	Yes
Kappa		0.61	1.0	1.0	0.53	0.27	0	0.69	0.61	0	0	1.0

Barbic et al.[41] reported moderate inter-rater reliability for O3DY (κ = 0.64) and for the SBT (κ = 0.63). Carpenter et al.[37] evaluated multiple instruments head to head and observed that the O3DY and Brief Alzheimer's Score categorized more patients with dementia (66 and 65%, respectively) than did the cAD8 (55%) or SBT (43%). In terms of feasibility, Schofield et al.[36] noted that the AMT-4 required a mean of 4.7 minutes to complete compared with 11.6 minutes for the MMSE. Wilber et al.[34] reported that the Six Item Screener is usually completed in less than 1 minute compared with the Mini-Cog requiring a mean of 1.5 minutes to complete. Furthermore, many patients could not complete the Mini-Cog because of pain or intravenous line in their dominant arm or because they did not have their corrective lens in the ED.

The MMSE is inaccurate for identifying mild cognitive impairment and some favor the Montreal Cognitive Assessment (MoCA) instead.[44,52,53] When compared against the MoCA, a "normal" Brief Alzheimer's Screen, SBT, or cAD8 do not accurately reduce the probability of mild cognitive impairment. An abnormal cAD8 and SBT significantly increase the probability of mild cognitive impairment in African Americans in one unpublished urban study in the United States.[42] However, the MoCA categorized 93% of African American patients in this study as mild cognitive impairment compared with 63% of Caucasians, which are both substantially higher than population norms. Health literacy also impacts the diagnostic accuracy of ED dementia screening for some patients. One urban United States study reported the cAD8 is significantly better to rule out dementia for patients with health literacy levels beyond 12th grade than are the Brief Alzheimer's Screen or SBT.[43]

Test–Treatment Threshold

In developing the test–treatment threshold for the older adult with possible newly diagnosed dementia in the ED setting, we were most interested in exploring the scenario of expedited outpatient referral for definitive diagnostic testing that typically requires lengthy neurologic testing followed by advanced neuroimaging and cerebrospinal fluid analysis.[54] Since Alzheimer's disease is the most common dementia subtype and currently has no cure, the hypothetical benefits of diagnosing this disorder include potential disease modifying medications to slow the rate of cognitive decline[55,56] as well as the opportunity for patients to voice end-of-life and other medical care preferences

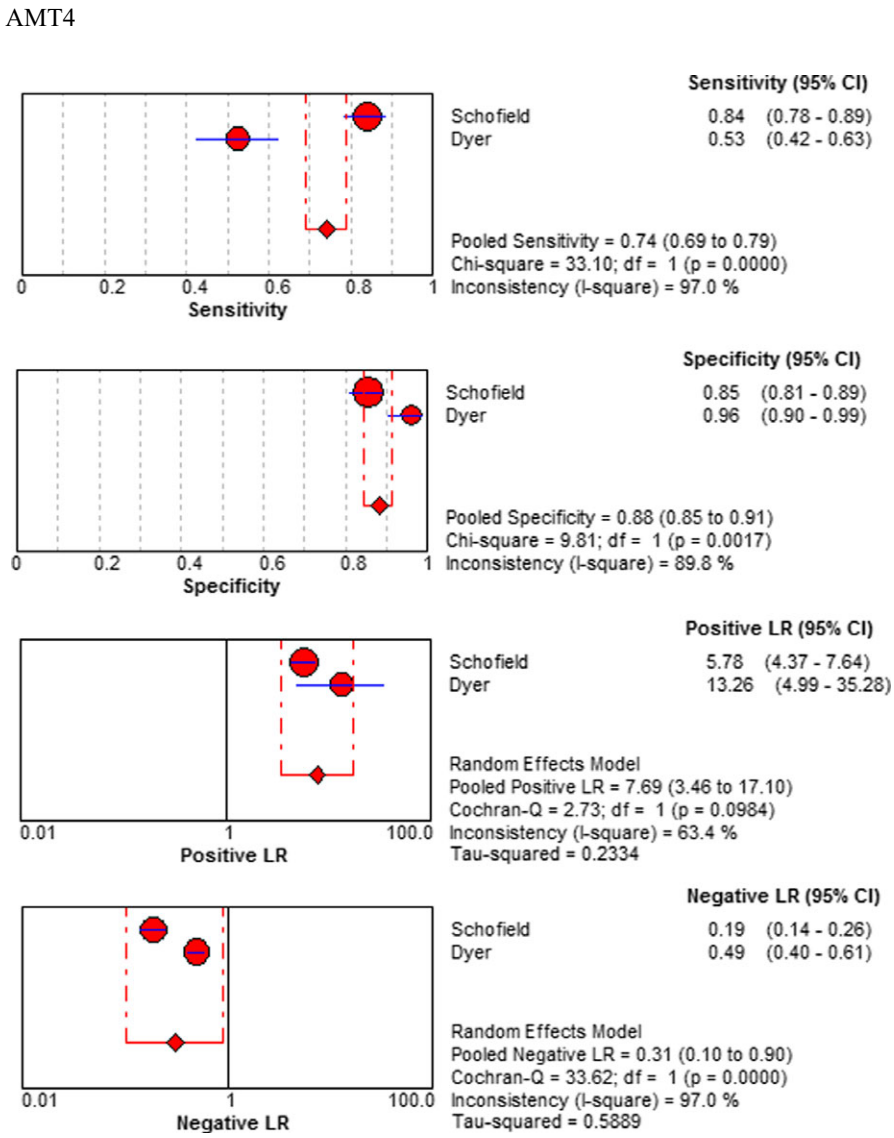

Figure 2. Forest plots of dementia screening instruments.

while still able. We were unable to find any research evidence with which to estimate the benefits or harms of ED dementia screening to guide downstream prescribing of disease modifying medications or goals of care. Another potential benefit is to use cognitive vulnerability identified by abnormal dementia screening as a decision point to initiate comprehensive geriatric assessment (CGA) in the ED or following the ED visit.[57,58]

CGA includes a structured diagnostic and therapeutic approach to identify a frail older person's medical, functional, cognitive, and social capabilities and limitations with the ultimate objective to identify and manage geriatric vulnerabilities within the scope of the patient's goals of care. A multidisciplinary approach to CGA is required and most of this approach will occur outside of the ED via a "frailty unit", specialist ward, or mobile assessment team.[59,60] While a recent Cochrane review exploring CGA for hospitalized patients demonstrates high-quality evidence demonstrating increased likelihood of remaining in home in the next year (16 trials, 6,799 patients) without improving dependence, mortality, or hospital readmissions, these CGA interventions did not occur in the ED.[57] A before/after evaluation exploring the benefits of CGA in the ED demonstrated a significant reduction in hospital admissions for patients over age 65 from 59.5% to 53.0%.[59] For the purposes of our test–treatment analysis, we used this 6.5% absolute risk reduction (59.5–53.0) as our proposed benefit for dementia screening in the ED (BR_x).

The risks of dementia screening include unnecessary angst and additional testing with concomitant

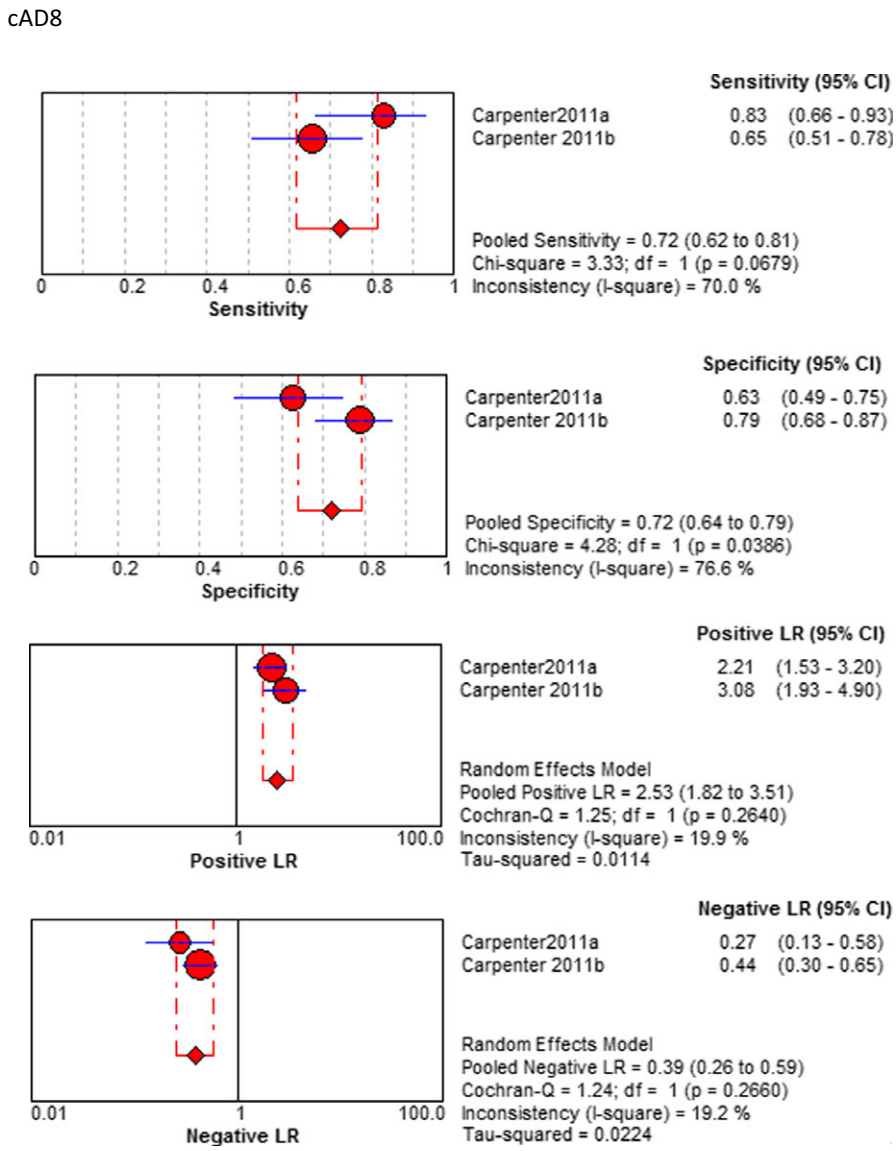

Figure 2. Continued

costs for false-negative results.[61] Another risk is delay to potentially lifesaving interventions for acute illness or injury while dementia screening is performed. No ED studies have quantified this risk, so we estimate a 0.5% cumulative risk of dementia screening in this setting (R_t). The risks of treatment with CGA in patients without dementia (R_{rx}) have not been quantified either in the ED setting[59] or in Cochrane reviews of hospitalized[57] or surgical patients,[58] so we estimate a 2% risk for the test–treatment equation.

The AMT-4 had the highest LR+ and when used in the test–treatment formula with pooled sensitivity 74% ($P_{pos/d}$), probability of a negative result in patients with dementia ($P_{neg/d} = 1 - 0.74 = 0.26$), pooled specificity 88% ($P_{pos/nd}$), and probability of a positive result in patients without dementia ($P_{neg/nd} = 1 - 0.88 = 0.12$), the test threshold is 14.7% and the treatment threshold is 36.5% (Figure 3). Since the weighted mean prevalence of abnormal dementia screening results in ED patients with predominantly previously unrecognized dementia in this meta-analysis is 30.6%, the test–treatment threshold based on these assumptions indicates that the potential harms and benefits of screening geriatric patients for dementia in the ED favor dementia screening. Since the O3DY is a simpler instrument that has been studied in more ED settings and more accurately reduces the probability of dementia than does the AMT-4 (pooled LR = 0.17 vs. 0.31), using the pooled sensitivity and specificity of the O3DY in the test–treatment equation yields a test threshold of 18% and a treatment threshold of 43%, which are not significantly different than the AMT-4 estimate. Test and treatment threshold estimates provide a quantitative context on which to

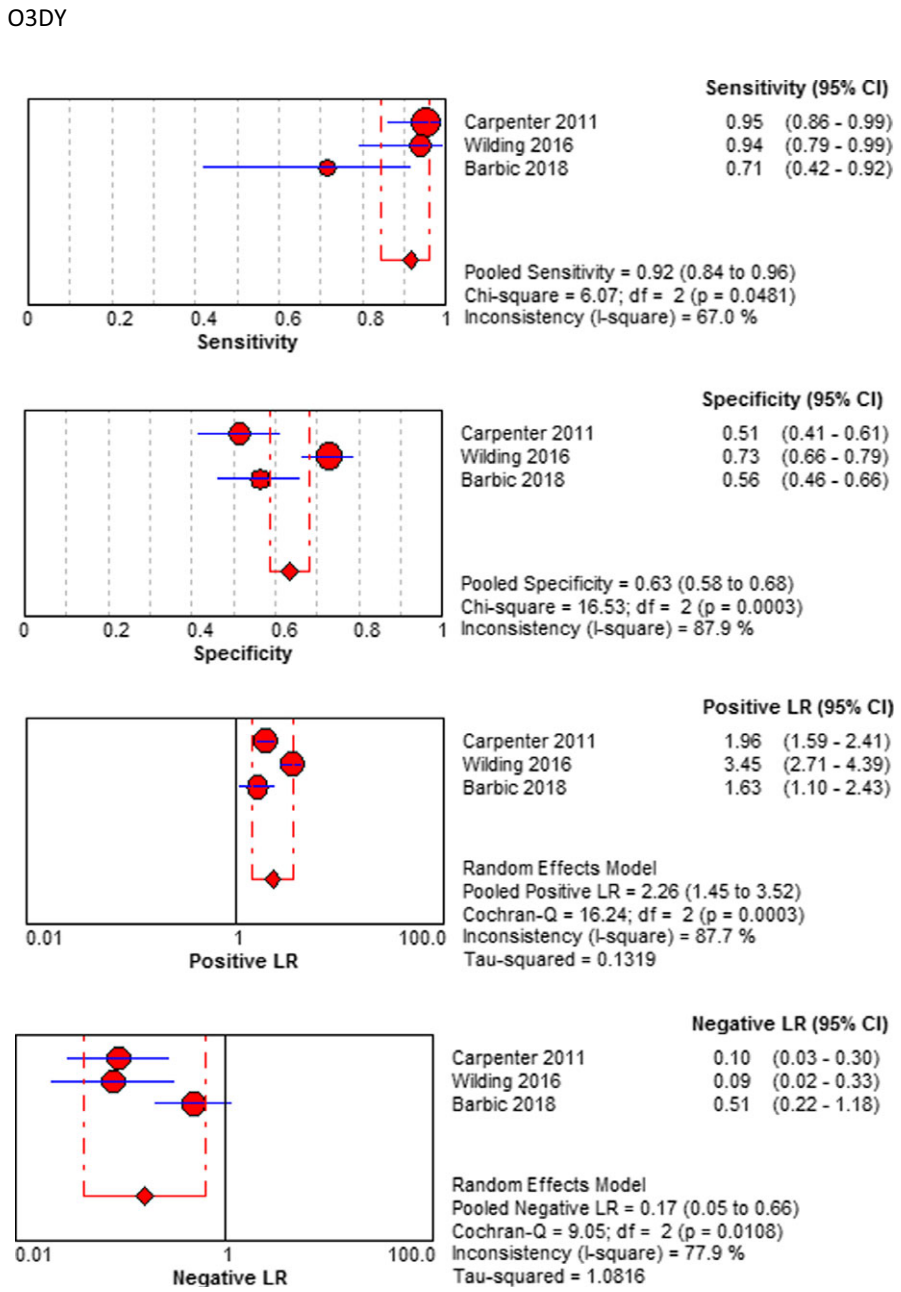

Figure 2. Continued

evaluate the value of process changes that incorporate dementia screening into ED patient care. An Excel file is provided as an online supplement to this manuscript for readers to recalculate these thresholds using alternative estimates of risk, benefit, and diagnostic accuracy as new evidence emerges (Data Supplement S2).

DISCUSSION

This meta-analysis provides ED clinicians with comparative diagnostic accuracy results on which to base emergency medicine dementia screening protocols, while also highlighting research priorities for future investigators. A 2016 Cochrane review quantified the accuracy of the MMSE as a dementia screening instrument for inpatient and primary care settings, noting a sensitivity of 85% and specificity of 90% at thresholds of not more than 24.[62] However, the MMSE is copyright protected and is a time-consuming and cumbersome screening instrument for the fast-paced ED environment.[22,63] The MMSE may yield false positives in lower socioeconomic and limited health literacy populations,[64–66] while exhibiting false negatives in highly educated groups.[64] The issue of wrongly labeling sociodemographic populations such as economically challenged or lower literate or non-English

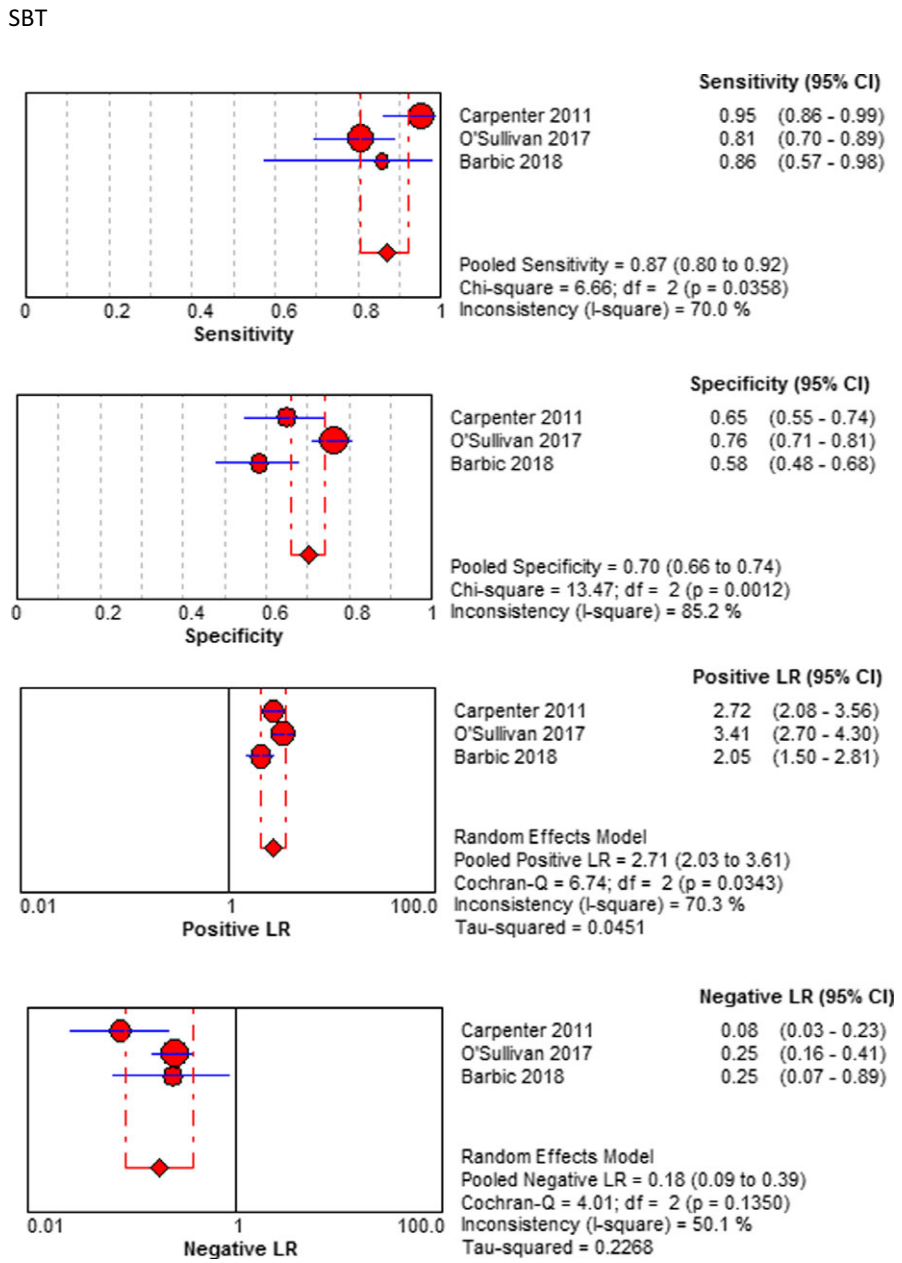

Figure 2. Continued

groups as higher risk for dementia based on the MMSE is particularly problematic since these groups may be disproportionately represented in some EDs. Profiling ethnic and socioeconomic disparities in future ED dementia screening studies is one approach to mitigate this bias, as highlighted at the 2003 *Academic Emergency Medicine* consensus conference.[67] Our meta-analysis adds to the Cochrane review by summarizing the quantity and quality of emergency medicine research to guide clinicians, educators, and guideline developers creating evidence-based protocols to improve health care outcomes for ED patients with dementia and to provide guidance and support to their relatives.

Overcoming skepticism regarding the value of screening in the ED, weighed against the dangers of continual mission creep, is essential as the role of emergency medicine expands. Why should emergency providers screen for dementia if this chronic neurodegenerative process is incurable? Potential motivators include structural and process quality indicators (QIs) for ED dementia patients to reduce practice variability. Structural QIs include local ED policies for management of older persons with recognized dementia that include family/care partners in medical decision making during an episode of care, as well as adaptation of pain assessment approaches in dementia patients.[68,69] Process QIs include tracking the proportion

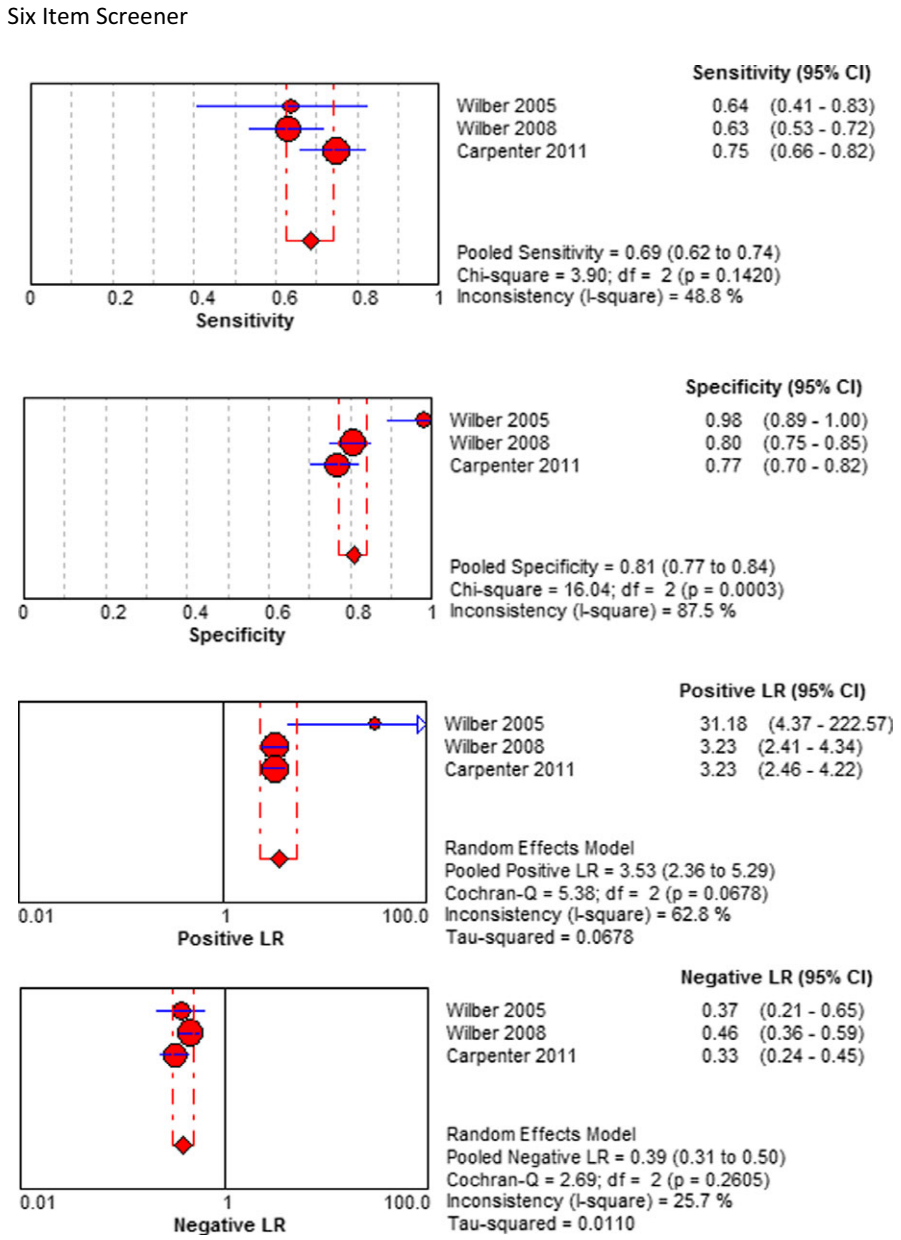

Figure 2. Continued

Table 3
Diagnostic Accuracy of Dementia Instruments from Single Studies

Screening Instrument	Sensitivity, % (95% CI)	Specificity, % (95% CI)	Positive LR (95% CI)	Negative LR (95% CI)
Animal fluency < 10	63 (45–77)	78 (76–81)	2.9 (1.8–4.0)	0.48 (0.28–0.73)
Animal fluency < 15	91 (75–98)	39 (37–40)	1.5 (1.2–1.6)	0.24 (0.06–0.68)
Brief Alzheimer Screen	95 (87–99)	52 (48–55)	2.0 (1.6–2.2)	0.10 (0.02–0.28)
Mini-Cog	75 (51–91)	85 (78–89)	4.9 (2.4–8.3)	0.30 (0.10–0.62)

LR = likelihood ratio.

of older ED patients with documented dementia assessment with Health Insurance Portability and Accountability Act–compliant notification of family to solicit collateral history when dementia is suspected.[70] In addition, multiorganizational guidelines in the United States and Canada advise emergency providers in any adult ED to incorporate and document baseline cognitive function in the initial assessment of all aging adults.[21] Routinely screening older adults for dementia and documenting this assessment using the same validated and psychometrically

$$T_{\text{testing threshold}} = [(P_{pos/nd}) \times (R_{rx})] \div [(P_{pos/nd} \times R_{rx}) + (P_{pos/d} \times B_{rx})] = 14.7\%$$

$$T_{\text{treatment threshold}} = [(P_{neg/nd}) \times (R_{rx}) - R_t] \div [(P_{neg/nd} \times R_{rx}) + (P_{neg/d} \times B_{rx})] = 36.5\%$$

Where assumptions on diagnostic accuracy for dementia are based upon the summary prognostic accuracy estimates of the AMT4 for geriatric adults from Figure 2.

$P_{pos/nd}$ = probability of a positive result in patients without disease = 1-specificity = 1-0.88 = 0.12
$P_{neg/nd}$ = probability of a negative result in patients without disease = specificity = 0.88
R_{rx} = risk of treatment in patients without disease = 0.02
R_t = risk of diagnostic test = 0.005
$P_{pos/d}$ = probability of a positive result in patients with disease = sensitivity = 0.74
$P_{neg/d}$ = probability of a negative result in patients with disease = 1 – sensitivity = 1-0.74= 0.26
B_{rx} = benefit of treatment in patients with disease = 0.065

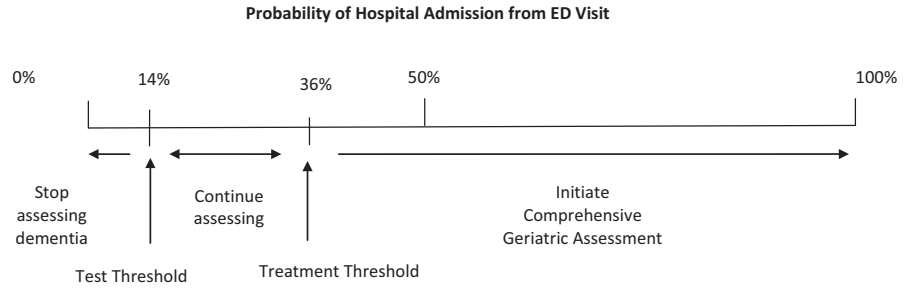

Figure 3. Test–treatment threshold assumptions.

robust instrument would allow downstream providers to rapidly differentiate acute from chronic cognitive dysfunction and contemplate delirium earlier in the ED episode of care. Identifying dementia should not delay access to care. While obtaining consent for time-dependent emergencies is often unnecessary, most ED decisions are not time dependent, and recognizing the presence or absence of dementia is essential for establishing capacity while engaging in shared decision making regarding tests, interventions, and disposition decisions.[71] In addition, dementia severity varies between patients and none of the ED screening instruments evaluates dementia severity or decisional capacity.[72]

Understanding the diagnostic accuracy of ultrabrief dementia screening instruments is also relevant for medical educators. Approximately one-third of senior emergency medicine residents lack confidence in the recognition and management of cognitive disorders, despite the emphasis on assessing for dementia and delirium as a core competency by the American Board of Emergency Medicine in 2010.[20,73] Evidence-based educators should emphasize that not all dementia screening instruments are equally accurate—and that none of them is diagnostic to *rule in* dementia. Box 1 provides a Bayesian example of how one instrument can be used and how to convey the cognitive performance that the instrument does and does not assess for learners.

Implications for Future Research

This review highlights multiple lessons that future investigators can employ to improve the overall quality and reproducibility of ED dementia research. Current labels for dementia screening instruments elicit confusion in communicating across fields and countries. The SBT was originally described in 1983 as the Orientation-Memory-Concentration Test[74] and in the emergency medicine literature has also been called the Quick Confusion Scale[45,75] and the 6-Item Cognitive Impairment Test.[40] Establishing a uniform

Box 1
Applying These Results in the Clinical Setting

A 75-year old community-dwelling female presenting to the ED would have a pretest probability for dementia of 30% based on this systematic review. An abnormal AMT4 (pooled LR+ = 7.69) would increase the probability that this patient has dementia to 77% (95% CI = 60%–88%). The Six Item Screener (pooled LR+ = 3.53) would increase the posttest probability of dementia for this patient to 60% (95% CI = 50%–69%). The Brief Alzheimer's Screen demonstrated the lowest LR– to most accurately reduce the probability of dementia (LR– = 0.10), decreasing the probability in this patient to 4% (95% CI = 0.8%–11%). Clinicians should explain the purpose of ED dementia screening and emphasize the necessity of definitive testing for abnormal results since these are not designed as stand-alone diagnostic tests.

nomenclature or index of synonymous instruments would permit investigators and journal editors to more clearly compare future studies with prior research. In addition, reporting guidelines for dementia diagnostic accuracy studies exist, but none of the studies used them.[50] Only four studies used any version of the general diagnostic STARD reporting guidelines.[51] Adherence to Enhancing the Quality and Transparency of Health Research (EQUATOR) Network reporting guidelines reduces intra- and interspecialty variability in communicating scientific methods, results, and clinical implications within the context of previous knowledge, yet guidelines like STARD are too often neglected in emergency medicine.[76,77]

Other methodologic issues require clarification and likely standardization across dementia studies. Some medications like benzodiazepines, antiemetics, and opioids often cloud individual's sensorium, but only a few dementia studies specifically excluded patients receiving those medications prior to cognitive assessment with the index test or criterion standard. The illness or injury leading to the ED visit may also skew cognitive screening toward "abnormal." In other words, the test–retest cognitive test reproducibility may be suboptimal when comparing cognitive testing in the ED while unwell with the same testing (same instrument) weeks later after recovery.[78] The order of administration of the index test and the reference standard may also skew observed accuracy via recall bias.[79,80] For example, a three-item recall or stating months backward may be performed more easily by patients the second time they are tested. If an index test and reference standard share a similar component such as stating the months of the year backward, the index test could be interpreted as a false negative or false positive depending on the order of administration as was observed in Wilber et al.[35] Additionally, few studies used objective assessments to differentiate delirium from dementia. Although the overall recognition of cognitive dysfunction, whether acute or chronic, is the most important assessment of decisional capacity in aging adults, differentiating dementia and delirium is an important epidemiologic issue and essential for interventions striving to improve outcomes. A variety of instruments exist to identify delirium.[21,81] Few studies explore the ethical concerns surrounding research of potentially cognitively impaired individuals in emergency settings. Although all studies appropriately excluded critically ill or injured patients, ethical guidelines for emergency research recommending subject assent and care partner consent exist and merit elaboration in future ED dementia screening research.[82]

Long-term, multidisciplinary acceptance of ED dementia screening instruments will ultimately require comparison against reference standards respected by a vast array of stakeholders including neurologists, psychologists, and geriatricians. Unfortunately, the chaotic ED is not conducive to time-consuming testing that adheres to DSM-V criteria, nor do most ED research laboratories have the expert personnel required to provide such neuropsychological testing around the clock. Every study in this meta-analysis used the MMSE, which is not an acceptable reference standard. Feasible alternatives to the MMSE include the MoCA[52] and the St. Louis University Mental State examination,[83] although preliminary unpublished ED evaluation in urban U.S. settings indicate over 90% of patients are stratified as abnormal using the MoCA implying a need to adapt population norms for these tests.[42]

As demonstrated in our test–treatment assumptions, quantifiable benefits for ED dementia screening are lacking, although not unimaginable. We estimated benefits at the level of the patient, but caregiver and societal benefits are also conceivable. For example, identification of possible dementia could be linked with assessment of caregiver strain, which when unaddressed has been linked with dissatisfaction on medical care patient surveys.[69,84] Identifying dementia risk could trigger subsequent assessment of caregiver strain via linkage to telephone follow-up,[85] community care coordination programs like "Partners in Dementia Care,"[86] or other initiatives that could simultaneously improve the process and outcomes of care for patients with previously unrecognized dementia. Societal benefits for ED dementia screening include assessment of driving safety for older adults, whereby early recognition might prevent future accidents.[87]

In diagnostics a hierarchy of evidence exists. Quantifying accuracy alone is a lower tier of value than research demonstrating improved outcomes of importance to patients and families.[88] Demonstrating benefits for ED dementia screening may require randomized trials. Such trials should evaluate both beneficial patient-centric outcomes (which are not necessarily traditional mortality or ED returns[89]) and potential adverse consequences of angst, additional medical expenses, and inconvenience for false-positive screening results. In addition, dementia is not a monomorphic disease, but rather exists in spectrums of severity with multiple subtypes. Rarely, dementia is a symptom of a reversible

disease like hypothyroidism or depression.[90] Future ED diagnostic and interventional researchers should begin to stratify dementia by severity. The Clinical Dementia Rating scale exists in the Alzheimer's research community but has never been assessed in ED settings.[91] Instead, ED investigators stratify dementia severity by nonvalidated gradients of worsening MMSE scoring, which is likely skewed by language barriers, literacy levels, and sensory impairments. Finally, implementation researchers should also evaluate the feasibility and accuracy of dementia screening using technology like smart phones and iPads while patients and caregivers await care in waiting rooms or other times of ED delays.[92] The majority of older patients are comfortable with this technology and more automated dementia screening processes not reliant on the nurse or physician personnel would promote knowledge translation.[93]

LIMITATIONS

The ability of this meta-analysis to accurately and reliably delineate the diagnostic role of appropriate ED screening instruments for dementia is limited by the small number of studies available. In addition, these studies used a variety of criteria to establish the diagnosis of dementia. Many of the studies used the same nonclinical personnel to collect the variables for both the screening test being assessed and the reference standard, which increases the possibility of incorporation bias that can skew observed estimates of both sensitivity and specificity upward.[94] Only one study used a reference standard that incorporated DSM criteria and evaluation by an expert in cognitive evaluation. Although clinicians are unlikely to apply DSM criteria to rule in or rule out dementia, diagnostic researchers in ED settings can and should rely on DSM criteria. Unfortunately, no studies evaluated or sufficiently hypothesized about the potential value of ED dementia screening for patients, caregivers, society, or ED operational flow. Therefore, our test–treatment results and discussion derive from arbitrary estimates for risks of dementia screening, as well as non–evidence-based assumptions of intervention potential benefits and harms once dementia is assumed based on ED screening. Acknowledging these arbitrary assumptions, this article includes an interactive Excel file to empower readers to adjust our estimates when higher-quality evidence emerges. Finally, a minority of included studies adhered to the STARD reporting criteria, which is likely associated with the significant heterogeneity observed between the individual studies.[76]

CONCLUSIONS

Despite the frequency and anticipated societal challenges associated with aging population's dementia-related cognitive dysfunction, little diagnostic research exists to guide geriatric ED dementia screening protocols. Existing research is limited by inadequate reference standards. Acknowledging these limitations, the AMT-4 most accurately rules in dementia, while the BAS most accurately rules out dementia. Future ED dementia screening accuracy research should use DSM criteria, standard names for the same instruments, and the same thresholds to enhance the quality of subsequent studies. Based on largely arbitrary assumptions of risk and benefit, our test–treatment threshold calculations indicate that ED dementia screening as a marker of vulnerability to guide initiation of CGA would be beneficial to a subset of geriatric patients.

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Supporting Information

The following supporting information is available in the online version of this paper available at http://onlinelibrary.wiley.com/doi/10.1111/acem.13573/full

Data Supplement S1. Supplemental material.

Data Supplement S2. interactive calculator.

Data Supplement S3. Appendix of ED dementia screening instruments.

Data Supplement S1. Full search strategies.

Prepared by:

Susan A. Fowler, MLIS
Bernard Becker Medical Library
Washington University in St. Louis

Methods section text:

The published literature was searched using strategies created by a medical librarian for the concepts of emergency department, people sixty and older, screening, dementia and diagnosis. These strategies were established using a combination of standardized terms and key words, and were implemented in PubMed Medline 1946-, Embase.com 1947-, EBSCO Cumulative Index for Nursing and Allied Health (CINAHL) 1937-, Wiley Cochrane Central Register of Controlled Trials (CENTRAL), Wiley Database of Abstracts of Reviews of Effects (DARE), Wiley Cochrane Database of Systematic Reviews, and clinicaltrials.gov. All searches were completed in March 2014, and limited to English using database supplied limits. The search was updated in July 2017 and again in June 2018. Due to a change in database access, Scopus was used in place of Embase. All previous databases were searched again. All results were exported to EndNote. We used the automatic duplicate finder in EndNote and duplicates were assumed to be accurately identified and removed for a total of 1098 unique citations. The update run in 2017 retrieved an additional 290 unique citations and in 2018, 73 unique citations. Forty-four trials were located in ClinicalTrials.gov with an additional 17 in the 2017 update and 1 in the 2018 update. Fully reproducible search strategies are provided.

Appendix

PubMed Medline
3/24/2014
Filters activated: English
252 results

7/29/2017
Filters activated: English, 3/01/2014 - 07/31/2017
106 results

6/25/2018
Filters activated: English, 8/01/2017 - 06/25/2018
21 results

("Emergency Treatment"[Mesh] OR "Emergency Medical Services"[Mesh] OR "Emergency Service, Hospital"[Mesh] OR "Crisis Intervention"[Mesh] OR "Critical Care"[Mesh] OR "Critical Care" OR "Crisis Intervention" OR "Crisis Interventions" OR "Critical Incident" OR "Critical Incidents" OR "Trauma Center" OR "Trauma Centers" OR "Trauma Units" OR "Trauma Unit" OR "acute care" OR "acute medical care" OR "prehospital care" OR "prehospital patient care" OR emergency) AND ("Aged"[Mesh] OR "Aged, 80 and over"[Mesh] OR "Frail Elderly"[Mesh] OR "Geriatrics"[Mesh] OR Geriatric* OR "Aged" OR Elder* OR Nonagenarian* OR Octogenarian* OR Centenarian* OR "senior citizen" OR "senior citizens" OR

Data Supplement S1. Full search strategies.

"senium" OR "very old" OR "oldest old" OR "older adult" OR "older adults" OR "older patients" OR "older patient" OR "older people" OR "older adults") AND ("Risk Assessment"[Mesh] OR "Mass Screening"[Mesh] OR "Geriatric Assessment"[Mesh] OR "risk stratification" OR "safety assessment" OR "risk adjustment" OR "risk analysis" OR "screening tool" OR "ISAR"[tiab] OR "TRST"[tiab] OR "prognostic stratification" OR "silver code" OR "screening instruments" OR "screening instrument" OR runciman[tiab] OR Rowland[tiab] OR "Risk Assessments" OR "risk assessment" OR "Risk Appraisal" OR "six item screen") AND ("Dementia"[Mesh] OR Dementia* OR Amentia* OR Alzheimer* OR "Lewy body" OR DNTC[tiab] OR "diffuse neurofibrillary tangles with calcification"[tiab] OR "frontotemporal lobar degeneration" OR FTD[tiab] OR FTLD[tiab] OR "Pick's complex"[tiab] OR "Pick complex"[tiab] OR fvFTD[tiab] OR bvFTD[tiab] OR "primary progressive aphasia" OR "Mesulam syndrome" OR PPA[tiab] OR tvFTD[tiab] OR "progressive nonfluent aphasia" OR "non-fluent progressive aphasia" OR "nonfluent progressive aphasia" OR PNFA[tiab] OR "progressive non-fluent aphasia" OR "AIDS encephalopathy" OR "HIV 1 associated cognitive motor complex" OR "HIV associated cognitive motor complex" OR "HIV associated neurocognitive disorder" OR "HIV encephalopathy" OR "HIV Encephalopathies" OR "Huntington Disease" OR "Huntington chorea" OR "chorea Huntington" OR "chronic progressive chorea" OR "hereditary chorea" OR "Huntington's chorea" OR "Huntington's disease" OR "Kluver Bucy"[tiab] OR "Kluever Bucy"[tiab] OR "Kluver-Bucy" OR "mental deterioration" OR "cognitive deterioration" OR "mental regression" OR "neuronal ceroid lipofuscinosis" OR "amaurotic familial idiocy" OR "amaurotic idiocy" OR "Batten disease" OR "batten mayou disease" OR "familial amaurotic idiocy" OR "neuronal ceroid-lipofuscinoses" OR "neuronal ceroid-lipofuscinosis" OR "neuronal ceroidosis" OR "Pick disease" OR "pick syndrome" OR "prion disease" OR "bovine spongiform encephalopathy" OR "chronic wasting disease" OR "Creutzfeldt Jakob disease" OR "fatal familial insomnia" OR "Gerstmann Straussler Scheinker syndrome" OR "kuru" OR "scrapie" OR "transmissible mink encephalopathy" OR "transmissible neurodegenerative disease" OR "subacute spongiform" OR "transmissible spongiform encephalopathy" OR "pseudodementia" OR "Rett syndrome" OR "rett disease" OR "Retts syndrome" OR senility[tiab] OR "senile confusion" OR "senile psychosis" OR tauopathy[tiab] OR tauopathies[tiab] OR "Kohlschutter-Tonz Syndrome" OR "cognitive impairment" OR "mental status") AND (diagnosis[MeSH] OR diagnosis[Subheading] OR "Prognosis"[Mesh] OR "Signs and Symptoms"[Mesh] OR screen*[tiab] OR diagnosed OR diagnoses OR diagnosis OR diagnosing OR diagnosable* OR diagnostician* OR diagnostic* OR "diagnosings"[tiab] OR "sign"[tiab] OR "signs"[tiab] OR symptom OR symptoms OR symptomatic OR tool* OR "history" OR exam* OR "testing" OR "tests" OR "tested" OR "test" OR find* OR "found"[tiab] OR differential* OR prognosis OR prognoses)

CINAHL

3/24/2017
Filters: English
143 results

7/29/2017
Filters: English, 3/2014 – 7/2017
73 Results

6/25/2018
Filters activated: English, 8/01/2017 - 06/25/2018
19 results

Data Supplement S1. Full search strategies.

(MH “Emergency Treatment+” OR MH “Emergency Medical Services+” OR MH “Emergency Service, Hospital+” OR MH “Crisis Intervention+” OR MH “Critical Care+” OR “Critical Care” OR “Crisis Intervention” OR “Crisis Interventions” OR “Critical Incident” OR “Critical Incidents” OR “Trauma Center” OR “Trauma Centers” OR “Trauma Units” OR “Trauma Unit” OR “acute care” OR “acute medical care” OR “prehospital care” OR “prehospital patient care” OR emergency) AND (MH “Aged+” OR MH “Geriatrics+” OR Geriatric* OR Elder* OR Nonagenarian* OR Octogenarian* OR Centenarian* OR “senior citizen” OR “senior citizens” OR “senium” OR “very old” OR “oldest old” OR “older adult” OR “older adults” OR “older patients” OR “older patient” OR “older people” OR “older adults”) AND (MH “Risk Assessment+” OR MH “Mass Screening+” OR MH "Geriatric Assessment+" OR “risk stratification” OR “safety assessment” OR “risk adjustment” OR “risk analysis” OR “screening tool” OR “ISAR” OR “TRST” OR “prognostic stratification” OR “silver code” OR “screening instruments” OR “screening instrument” OR runciman OR Rowland OR “Risk Assessments” OR “risk assessment” OR “Risk Appraisal” OR “six item screen”) AND (MH “Dementia+” OR Dementia* OR Amentia* OR Alzheimer* OR “Lewy body” OR DNTC OR “diffuse neurofibrillary tangles with calcification” OR “frontotemporal lobar degeneration” OR FTD OR FTLD OR “Pick's complex” OR “Pick complex” OR fvFTD OR bvFTD OR “primary progressive aphasia” OR “Mesulam syndrome” OR PPA OR tvFTD OR “progressive nonfluent aphasia” OR “non-fluent progressive aphasia” OR “nonfluent progressive aphasia” OR PNFA OR “progressive non-fluent aphasia” OR “AIDS encephalopathy” OR “HIV 1 associated cognitive motor complex” OR “HIV associated cognitive motor complex” OR “HIV associated neurocognitive disorder” OR “HIV encephalopathy” OR “HIV Encephalopathies” OR “Huntington Disease” OR “Huntington chorea” OR “chorea Huntington” OR “chronic progressive chorea” OR “hereditary chorea” OR “Huntington's chorea” OR “Huntington's disease” OR “Kluver Bucy” OR “Kluever Bucy” OR “Kluver-Bucy” OR “mental deterioration” OR “cognitive deterioration” OR “mental regression” OR “neuronal ceroid lipofuscinosis” OR “amaurotic familial idiocy” OR “amaurotic idiocy” OR “Batten disease” OR “batten mayou disease” OR “familial amaurotic idiocy” OR “neuronal ceroid-lipofuscinoses” OR “neuronal ceroid-lipofuscinosis” OR “neuronal ceroidosis” OR “Pick disease” OR “pick syndrome” OR “prion disease” OR “bovine spongiform encephalopathy” OR “chronic wasting disease” OR “Creutzfeldt Jakob disease” OR “fatal familial insomnia” OR “Gerstmann Straussler Scheinker syndrome” OR “kuru” OR “scrapie” OR “transmissible mink encephalopathy” OR “transmissible neurodegenerative disease” OR “subacute spongiform” OR “transmissible spongiform encephalopathy” OR “pseudodementia” OR “Rett syndrome” OR “rett disease” OR “Retts syndrome” OR senility OR “senile confusion” OR “senile psychosis” OR tauopathy OR tauopathies OR “Kohlschutter-Tonz Syndrome” OR “cognitive impairment” OR “mental status”) AND (MH “diagnosis+” OR MW DI OR MH “Prognosis+” OR MH “Signs and Symptoms+” OR screen* OR diagnosed OR diagnoses OR diagnosis OR diagnosing OR diagnosable* OR diagnostician* OR diagnostic* OR “diagnosings” OR “sign” OR “signs” OR symptom OR symptoms OR symptomatic OR tool* OR “history” OR exam* OR “testing” OR “tests” OR “tested” OR “test” OR find* OR “found” OR differential* OR prognosis OR prognoses)

<u>Embase</u>
3/24/2014
Filters activated: English
448 results

'emergency ward'/exp OR 'emergency care'/exp OR 'emergency treatment'/exp OR 'emergency health service'/exp OR 'emergency medicine'/exp OR ‘Critical Care’ OR ‘Crisis Intervention’ OR ‘Crisis

Data Supplement S1. Full search strategies.

Interventions' OR 'Critical Incident' OR 'Critical Incidents' OR 'Emergicenters' OR 'Emergicenter' OR 'Hospital Service Emergencies' OR 'Trauma Center' OR 'Trauma Centers' OR 'Trauma Units' OR 'Trauma Unit' OR 'Triage' OR 'Triages' OR 'acute care' OR 'acute medical care' OR 'prehospital care' OR 'prehospital patient care' OR 'emergency ward' OR 'emergency treatment' OR 'emergency therapy' OR 'accident service' OR emergency AND ('aged'/exp OR 'aged hospital patient'/exp OR 'frail elderly'/exp OR 'very elderly'/exp OR 'geriatrics'/exp OR geriatric* OR Aged OR Elder* OR '80 and over' OR 'Oldest Old' OR Nonagenarian* OR Octogenarian* OR Centenarian* OR 'senior citizen' OR 'senium' OR 'very old' OR 'older adult' OR 'older adults' OR 'older patients' OR 'older patient' OR 'older people' OR 'older adults') AND ('screening'/exp OR 'risk assessment'/exp OR 'fall risk assessment'/exp OR 'geriatric assessment'/exp OR 'risk stratification' OR 'safety assessment' OR 'risk adjustment' OR 'risk analysis' OR 'screening tool' OR 'identification of senior at risk' OR 'ISAR' OR 'triage risk stratification tool' OR 'TRST' OR 'prognostic stratification' OR 'silver code' OR 'screening instruments' OR 'screening instrument' OR runciman:ab,ti OR rowland:ab,ti OR 'brief risk identification for geriatric health tool' OR 'emergency admission risk likelihood index' OR EARLI OR 'Risk Assessments' OR 'risk assessment' OR 'Risk Appraisal' OR 'six item screen') AND ('dementia'/exp OR Dementia* OR Amentia* OR Alzheimer* OR CADASIL OR 'cerebral autosomal dominant arteriopathy with subcortical infarct and leukoencephalopathy':ti,ab OR 'cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy':ti,ab OR 'Lewy body' OR DNTC:ti,ab OR 'diffuse neurofibrillary tangles with calcification':ti,ab OR ' frontotemporal lobar degeneration' OR FTD:ti,ab OR FTLD:ti,ab OR 'Picks complex':ti,ab OR 'Pick complex':ti,ab OR fvFTD:ti,ab OR bvFTD:ti,ab OR 'primary progressive aphasia' OR 'Mesulam syndrome' OR PPA:ti,ab OR tvFTD:ti,ab OR 'progressive nonfluent aphasia' OR 'non-fluent progressive aphasia' OR 'nonfluent progressive aphasia' OR PNFA:ti,ab OR 'progressive non-fluent aphasia' OR 'AIDS encephalopathy' OR 'HIV 1 associated cognitive motor complex' OR 'HIV associated cognitive motor complex' OR 'HIV associated neurocognitive disorder' OR 'HIV encephalopathy' OR 'HIV Encephalopathies' OR 'AIDS Encephalopathies' OR 'Huntington Disease' OR 'Huntington chorea' OR 'chorea Huntington' OR 'chorea major' OR 'chronic progressive chorea' OR 'hereditary chorea' OR 'Huntingtons chorea' OR 'Huntingtons disease' OR 'Kluver Bucy':ti,ab OR 'Kluever Bucy':ti,ab OR 'Kluver-Bucy' OR 'Temporal Lobectomy Behavior Syndrome' OR 'mental deterioration' OR 'cognitive deterioration' OR 'mental regression' OR 'neuronal ceroid lipofuscinosis' OR 'amaurotic familial idiocy' OR 'amaurotic idiocy' OR 'Batten disease' OR 'batten mayou degeneration' OR 'batten mayou disease' OR 'batten mayou spielmeyer vogt disease' OR 'batten stengel disease' OR 'familial amaurotic idiocy' OR 'mckusick 20420' OR 'neuronal ceroid-lipofuscinoses' OR 'neuronal ceroid-lipofuscinosis' OR 'neuronal ceroid lipofuscinosis spielmeyer vogt sjogren type' OR 'neuronal ceroidosis' OR 'Pick disease' OR 'pick syndrome' OR 'prion disease' OR 'bovine spongiform encephalopathy' OR 'chronic wasting disease' OR 'Creutzfeldt Jakob disease' OR 'fatal familial insomnia' OR 'Gerstmann Straussler Scheinker syndrome' OR 'kuru' OR 'scrapie' OR 'transmissible mink encephalopathy' OR 'transmissible neurodegenerative disease' OR 'subacute spongiform' OR 'transmissible spongiform encephalopathy' OR 'pseudodementia' OR 'Rett syndrome' OR 'morbus rett' OR 'rett disease' OR 'Retts syndrome' OR senility OR 'senile confusion' OR 'senile psychosis' OR senilitas OR tauopathy OR tauopathies OR 'Kohlschutter-Tonz Syndrome' OR 'cognitive impairment' OR 'mental status') AND ('diagnosis'/exp OR 'physical disease by body function'/exp OR 'prognosis'/exp OR screen* OR diagnosed OR diagnoses OR diagnosis OR diagnosing OR diagnosable* OR diagnostician* OR diagnostic* OR 'diagnosings' OR 'sign' OR 'signs' OR

Data Supplement S1. Full search strategies.

symptom OR symptoms OR symptomatic OR tool* OR 'history' OR exam* OR 'testing' OR 'tests' OR 'tested' OR 'test' OR find* OR 'found' OR differential OR prognosis OR prognoses)

Scopus

7/29/2017

Filters Activated: English, 3/2014 – present

150 Results

6/25/2018

Filters activated: English, 8/01/2017 - 06/25/2018

37 results

TITLE-ABS-KEY("emergency ward" OR "emergency care" OR "emergency treatment" OR "emergency health service" OR "emergency medicine" OR "Critical Care" OR "Crisis Intervention" OR "Crisis Interventions" OR "Critical Incident" OR "Critical Incidents" OR "Emergicenters" OR "Emergicenter" OR "Hospital Service Emergencies" OR "Trauma Center" OR "Trauma Centers" OR "Trauma Units" OR "Trauma Unit" OR "Triage" OR "Triages" OR "acute care" OR "acute medical care" OR "prehospital care" OR "prehospital patient care" OR "emergency ward" OR "emergency treatment" OR "emergency therapy" OR "accident service" OR emergency) AND TITLE-ABS-KEY("aged" OR "aged hospital patient" OR "frail elderly" OR "very elderly" OR "geriatrics" OR geriatric* OR Aged OR Elder* OR "80 and over" OR "Oldest Old" OR Nonagenarian* OR Octogenarian* OR Centenarian* OR "senior citizen" OR "senium" OR "very old" OR "older adult" OR "older adults" OR "older patients" OR "older patient" OR "older people" OR "older adults") AND TITLE-ABS-KEY("screening" OR "risk assessment" OR "fall risk assessment" OR "geriatric assessment" OR "risk stratification" OR "safety assessment" OR "risk adjustment" OR "risk analysis" OR "screening tool" OR "identification of senior at risk" OR "ISAR" OR "triage risk stratification tool" OR "TRST" OR "prognostic stratification" OR "silver code" OR "screening instruments" OR "screening instrument" OR runciman OR rowland OR "brief risk identification for geriatric health tool" OR "emergency admission risk likelihood index" OR EARLI OR "Risk Assessments" OR "risk assessment" OR "Risk Appraisal" OR "six item screen") AND TITLE-ABS-KEY("dementia" OR Dementia* OR Amentia* OR Alzheimer* OR CADASIL OR "cerebral autosomal dominant arteriopathy with subcortical infarct and leukoencephalopathy" OR "cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy" OR "Lewy body" OR DNTC OR "diffuse neurofibrillary tangles with calcification" OR " frontotemporal lobar degeneration" OR FTD OR FTLD OR "Picks complex" OR "Pick complex" OR fvFTD OR bvFTD OR "primary progressive aphasia" OR "Mesulam syndrome" OR PPA OR tvFTD OR "progressive nonfluent aphasia" OR "non-fluent progressive aphasia" OR "nonfluent progressive aphasia" OR PNFA OR "progressive non-fluent aphasia" OR "AIDS encephalopathy" OR "HIV 1 associated cognitive motor complex" OR "HIV associated cognitive motor complex" OR "HIV associated neurocognitive disorder" OR "HIV encephalopathy" OR "HIV Encephalopathies" OR "AIDS Encephalopathies" OR "Huntington Disease" OR "Huntington chorea" OR "chorea Huntington" OR "chorea major" OR "chronic progressive chorea" OR "hereditary chorea" OR "Huntingtons chorea" OR "Huntingtons disease" OR "Kluver Bucy" OR "Kluever Bucy" OR "Kluver-Bucy" OR "Temporal Lobectomy Behavior Syndrome" OR "mental deterioration" OR "cognitive deterioration" OR "mental regression" OR "neuronal ceroid lipofuscinosis" OR "amaurotic familial idiocy" OR

Data Supplement S1. Full search strategies.

"amaurotic idiocy" OR "Batten disease" OR "batten mayou degeneration" OR "batten mayou disease" OR "batten mayou spielmeyer vogt disease" OR "batten stengel disease" OR "familial amaurotic idiocy" OR "mckusick 20420" OR "neuronal ceroid-lipofuscinoses" OR "neuronal ceroid-lipofuscinosis" OR "neuronal ceroid lipofuscinosis spielmeyer vogt sjogren type" OR "neuronal ceroidosis" OR "Pick disease" OR "pick syndrome" OR "prion disease" OR "bovine spongiform encephalopathy" OR "chronic wasting disease" OR "Creutzfeldt Jakob disease" OR "fatal familial insomnia" OR "Gerstmann Straussler Scheinker syndrome" OR "kuru" OR "scrapie" OR "transmissible mink encephalopathy" OR "transmissible neurodegenerative disease" OR "subacute spongiform" OR "transmissible spongiform encephalopathy" OR "pseudodementia" OR "Rett syndrome" OR "morbus rett" OR "rett disease" OR "Retts syndrome" OR senility OR "senile confusion" OR "senile psychosis" OR senilitas OR tauopathy OR tauopathies OR "Kohlschutter-Tonz Syndrome" OR "cognitive impairment" OR "mental status") AND TITLE-ABS-KEY("diagnosis" OR "physical disease by body function" OR "prognosis" OR screen* OR diagnosed OR diagnoses OR diagnosis OR diagnosing OR diagnosable* OR diagnostician* OR diagnostic* OR "diagnosings" OR "sign" OR "signs" OR symptom OR symptoms OR symptomatic OR tool* OR "history" OR exam* OR "testing" OR "tests" OR "tested" OR "test" OR find* OR "found" OR differential OR prognosis OR prognoses)

Cochrane

3/24/2014

Protocols: 3
Reviews: 60
CENTRAL: 274
DARE: 37

7/29/2017

Filters: 2014 - present
CENTRAL: 4
Protocols: 3
Reviews: 48
DARE: 0

6/25/2018

Filters: 8/2017 - present
CENTRAL: 0
Protocols: 0
Reviews: 11
DARE: 0

([mh "Emergency Treatment"] OR [mh "Emergency Medical Services"] OR [mh "Emergency Service, Hospital"] OR [mh "Crisis Intervention"] OR [mh "Critical Care"] OR "Critical Care" OR "Crisis Intervention" OR "Crisis Interventions" OR "Critical Incident" OR "Critical Incidents" OR "Trauma Center" OR "Trauma Centers" OR "Trauma Units" OR "Trauma Unit" OR "acute care" OR "acute medical care" OR "prehospital care" OR "prehospital patient care" OR emergency) AND ([mh "Aged"] OR [mh "Geriatrics"] OR Geriatric* OR Elder* OR Nonagenarian* OR Octogenarian* OR Centenarian* OR "senior

Data Supplement S1. Full search strategies.

citizen" OR "senior citizens" OR "senium" OR "very old" OR "oldest old" OR "older adult" OR "older adults" OR "older patients" OR "older patient" OR "older people" OR "older adults") AND ([mh "Risk Assessment"] OR [mh "Mass Screening"] OR [mh "Geriatric Assessment"] OR "risk stratification" OR "safety assessment" OR "risk adjustment" OR "risk analysis" OR "screening tool" OR "ISAR" OR "TRST" OR "prognostic stratification" OR "silver code" OR "screening instruments" OR "screening instrument" OR runciman OR Rowland OR "Risk Assessments" OR "risk assessment" OR "Risk Appraisal" OR "six item screen") AND (MH "Dementia+" OR Dementia* OR Amentia* OR Alzheimer* OR "Lewy body" OR DNTC OR "diffuse neurofibrillary tangles with calcification" OR "frontotemporal lobar degeneration" OR FTD OR FTLD OR "Pick's complex" OR "Pick complex" OR fvFTD OR bvFTD OR "primary progressive aphasia" OR "Mesulam syndrome" OR PPA OR tvFTD OR "progressive nonfluent aphasia" OR "non-fluent progressive aphasia" OR "nonfluent progressive aphasia" OR PNFA OR "progressive non-fluent aphasia" OR "AIDS encephalopathy" OR "HIV 1 associated cognitive motor complex" OR "HIV associated cognitive motor complex" OR "HIV associated neurocognitive disorder" OR "HIV encephalopathy" OR "HIV Encephalopathies" OR "Huntington Disease" OR "Huntington chorea" OR "chorea Huntington" OR "chronic progressive chorea" OR "hereditary chorea" OR "Huntington's chorea" OR "Huntington's disease" OR "Kluver Bucy" OR "Kluever Bucy" OR "Kluver-Bucy" OR "mental deterioration" OR "cognitive deterioration" OR "mental regression" OR "neuronal ceroid lipofuscinosis" OR "amaurotic familial idiocy" OR "amaurotic idiocy" OR "Batten disease" OR "batten mayou disease" OR "familial amaurotic idiocy" OR "neuronal ceroid-lipofuscinoses" OR "neuronal ceroid-lipofuscinosis" OR "neuronal ceroidosis" OR "Pick disease" OR "pick syndrome" OR "prion disease" OR "bovine spongiform encephalopathy" OR "chronic wasting disease" OR "Creutzfeldt Jakob disease" OR "fatal familial insomnia" OR "Gerstmann Straussler Scheinker syndrome" OR "kuru" OR "scrapie" OR "transmissible mink encephalopathy" OR "transmissible neurodegenerative disease" OR "subacute spongiform" OR "transmissible spongiform encephalopathy" OR "pseudodementia" OR "Rett syndrome" OR "rett disease" OR "Retts syndrome" OR senility OR "senile confusion" OR "senile psychosis" OR tauopathy OR tauopathies OR "Kohlschutter-Tonz Syndrome" OR "cognitive impairment" OR "mental status") AND ([mh "diagnosis"] OR [mh / DI] OR [mh "Prognosis"] OR [mh "Signs and Symptoms"] OR screen* OR diagnosed OR diagnoses OR diagnosis OR diagnosing OR diagnosable* OR diagnostician* OR diagnostic* OR "diagnosings" OR "sign" OR "signs" OR symptom OR symptoms OR symptomatic OR tool* OR "history" OR exam* OR "testing" OR "tests" OR "tested" OR "test" OR find* OR "found" OR differential* OR prognosis OR prognoses)

ClinicalTrials.gov

7/29/2017

17 Studies

6/25/2018

1 Study

Age: Senior 66+
Condition/Disease: dementia
Intervention/Treatment: screen OR screening OR assess OR risk
Outcome Measures: diagnosis OR prognosis

First Received From: 03/01/2014 To 07/31/2017
First Posted From: 8/01/2018 to 06/25/2017

Data Supplement S1. Full search strategies.

OR

Age: Senior 66+
Condition/Disease: dementia
Other Terms: Emergency
Intervention/Treatment: screen OR screening OR assess OR risk
Outcome Measures:

First Received From: 03/01/2014 To 07/31/2017
First Posted From: 8/01/2018 to 06/25/2017

Data Supplement S3

Appendix of ED Dementia Screening Instruments

AD8

If the patient has an accompanying reliable informant, they are asked the following questions.

Has this patient displayed any of the following issues? Remember a "Yes" response indicates that you think there has been **a change in the last several years** caused by thinking and memory (cognitive) problems.

1) Problems with judgment (example, falls for scams, bad financial decisions, buys gifts inappropriate for recipients)?
2) Reduced interest in hobbies/activities?
3) Repeats questions, stories, or statements?
4) Trouble learning how to use a tool, appliance, or gadget (VCR, computer, microwave, remote control)?
5) Forgets correct month or year?
6) Difficulty handling complicated financial affairs (for example, balancing checkbook, income taxes, paying bills)?
7) Difficulty remembering appointments?
8) Consistent problems with thinking and/or memory?

Each affirmative response is one-point. A score of ≥ 2 is considered high-risk for dementia.

Abbreviated Mental Test-4

1) How old are you?
2) What is your birthday?
3) What is the name of this place?
4) What year is this?

Any error is considered high-risk for dementia.

Animal Fluency

Name as many animals as possible in 60 seconds.

Investigators explored both <10 animals named and <15 animals named as high-risk for dementia.

Brief Alzheimer's Screen

Instructions to the patient: I would like to ask you some questions that ask you to use your memory. I am going to name three objects. Please wait until I say all three words, then repeat them. Remember what they are because I am going to ask you to name them again in a few minutes. Please repeat these words for me: APPLE – TABLE – PENNY
(May repeat names 3 times if necessary, repetition not scored)

Did the patient correctly repeat all three words? **YES** **NO**

1) What is the date? (D) **Correct** **Incorrect**
2) Name as many animals as you can in 30-seconds. (A) _____ (number)
3) Spell "world" backwards (S) Number correct
0 **1** **2** **3** **4** **5**
4) Three-item recall (R) Number correct
0 **1** **2** **3**

Brief Alzheimer's Screen = (3.03 x R) + (0.67 x A) = (4.75 x D) + (2.01 x S)

BAS ≤ 26 is consistent with dementia

Mini-Cog

Instructions for the patient: I would like to do some things to test your memory. I am going to name three objects. Please wait until I say all three words, and then repeat them. Remember what they are because I am going to ask you to name them again in a few minutes. Please remember these words for me: APPLE – TABLE – PENNY.

Now, instruct the patient to draw the face of a clock on the back of this paper. After the patient puts the numbers on the clock face, ask him to draw the hands of the clock to read ten minutes after eleven. These instructions may be repeated, but no additional instructions should be given. Give the patient as much time as necessary to complete. The clock is considered normal if all numbers are present in the correct sequence and position, and the hands readably display the requested time.

What are the three objects I asked you to remember?

1. Apple _____ (1)
2. Table _____ (1)
3. Penny _____ (1)

Total Score: _____ **(3)**

High-risk for dementia if score = 0 or if score ≤2 with an abnormal clock.

Ottawa 3DY

1) What day is today? **Correct** **Incorrect**
2) What is the date? **Correct** **Incorrect**
3) Spell “world” backwards

Number correct

0 **1** **2** **3** **4** **5**

4) What year is this? **Correct** **Incorrect**

A single incorrect response on any of these four items is consistent with dementia.

Six Item Screener

Instructions to the patient: I would like to ask you some questions that may ask you to use your memory. I am going to name three objects. Please wait until I say all three words, then repeat them. Remember these words for me: GRASS – PAPER – SHOE. (May repeat names 3 times if necessary, repetition not scored).

1) What year is this?
2) What month is this?
3) What is the day of the week?

After one-minute. What are the three objects that I asked you to remember?

4) [Grass]
5) [Paper]
6) [Shoe]

Each correct response is awarded one-point. Two or more errors is considered high-risk for dementia.

Short Blessed Test*

Instructions to the patient: Now I would like to ask you some questions to check your memory and concentration. Some of them may be easy and some of them may be hard.

		Correct	Incorrect
1)	What year is it now?	**0**	**1**
2)	What month is this?	**0**	**1**

Please repeat this name and address after me:
John Brown, 42 Market Street, Chicago
John Brown, 42 Market Street, Chicago
John Brown, 42 Market Street, Chicago
(underline words repeated correctly in each trial)
Trials to learn _____ (if unable to do in 3 trials = C)

3) Without looking at your watch or clock, tell me what time it is. (If response is vague, prompt for specific response within 1-hour)

Correct **Incorrect**
0 **1**

4) Count aloud backwards from 20 to 1 (mark correctly sequenced numerals – if subject starts counting forward or forgets the task, repeat instructions and score one error)

0 1 2 Errors

20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

5) Say the months of the year in reverse order. If the tester needs to prompt with the last name of the month of the year, one error should be scored – mark correctly sequenced months.

D N O S A JL JN MY AP MR F J **0 1 2 Errors**

6) Repeat the name and address you were asked to remember.

(John Brown, 42 Market Street, Chicago) **0 1 2 3 4 5 Errors**

_____, ____, ___, _____, _____

Item	Errors	Weighting Factor	Final Item Score
1		x 4	
2		x 3	
3		x 3	
4		x 2	
5		x 2	
6		x 2	

Sum Total (range 0-28) =
0-4 = normal cognition
5-9 = questionable impairment
≥ 10 = impairment consistent with dementia

* Also known as Orientation-Memory-Concentration Test, Quick Confusion Scale, and the 6-Item Cognitive Impairment Test.