Cognitive Screening Tools

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As the US population ages, the need grows for clinicians in all settings to be familiar with currently available cognitive screening tools. These tools, though not diagnostic, are useful in the early recognition of cognitive changes and of possible underlying dementia. No single cognitive screening tool is appropriate for use in all settings or with all populations. The components, scoring, and interpretation of the more commonly used cognitive screening tools are described here, with their respective benefits and limitations.
A s our elderly population continues to grow, the issues of screening for cognitive impairment and early detection of dementia are becoming increasingly important. Cognitive impairment, particularly in individuals who live alone, contributes to loss of independence, decreased quality of life, and increased health care costs. There are serious and costly implications of unrecognized dementia, including delayed treatment of reversible conditions, medication noncompliance for comorbid conditions, inaccurate and unreliable reporting by patients, safety concerns, potential catastrophes, and increased risk for victimization.

Clinicians in all settings can expect to care for increasing numbers of older adults—many with various degrees of cognitive difficulties. Such problems, especially if undetected, can significantly impact the ongoing management of both acute and chronic medical problems. In primary care settings, it has been reported, between 50% and 65% of patients found to have cognitive deficits meeting the criteria for dementia did not have a diagnosis of dementia noted in their medical record.

The annual wellness examination provided for under the Patient Protection and Affordable Care Act (PPACA) for Medicare beneficiaries is required to include an assessment of cognitive function, but the Centers for Medicare and Medicaid (CMS) have not, to date, recommended any specific screening instrument; examiners are expected to base their assessment on observation and reports from the patient and other informants.

WHY DO TESTING?
The purpose of cognitive screening tests is to aid the clinician in early detection of cognitive change as a first step toward accurate diagnosis—a process that requires further assessment. Such changes may herald the beginning of a dementia, such as Alzheimer’s disease, or may indicate a decreased risk for delirium, such as in the postoperative setting, or functional decline with accompanying safety concerns. Early identification of cognitive changes provides an opportunity for case finding, crisis avoidance, and identification of patients for earlier intervention and management, including a discussion of goals with the patient, and assurance that advance directives are complete and accurate. It is well documented that dementia remains underrecognized and may indeed be the “silent epidemic” of this century. Current estimates are that the incidence of new cases of Alzheimer’s disease will double by 2050. Additionally, improvement in stroke survival rates means that there will likely be increases in vascular and poststroke dementia, as one-third of stroke patients have been found to develop a progressive dementia.

The early detection of cognitive change offers benefits for both patients and providers. If early detection leads to a diagnosis of dementia (regardless of etiology), this can provide an explanation to patients and families regarding recent changes in function, mood, and behavior. A diagnosis of progressive dementia (eg, Alzheimer’s disease, Lewy body disease, frontotemporal dementia) provides an opportunity for early medication management, review and simplification of ongoing chronic disease management, and prevention of problems commonly associated with mismanagement. More importantly, early diagnosis of dementia enables patients to be more involved in planning for their own future care needs, such as execution of advance directives.

Cognitive screening may also help in identification of the at-risk driver or those who should undergo further assessment for fitness to drive.

WHO SHOULD BE SCREENED?
There is no clear consensus on who should undergo cognitive screening or how frequently it should be carried out. Screening should be targeted at individuals who are at greatest risk for either progressive dementia or delirium. Advancing age is a known risk factor for dementia, but there is no agreement on a specific age at which to initiate cognitive screening. In patients older than 80, there is a 25% to 50% prevalence of dementia, thus suggesting that cognitive screening should be initiated before this age. Furthermore, clinicians who provide medical care for patients of advanced age must be increasingly attentive to the possible presence of cognitive decline. Individuals with subjective memory complaints and those with a history of depression have been identified as being at high risk for dementia.

This usually occurs when a family member or another individual close to the patient (eg, employer, friend) becomes concerned about changes in the patient’s thinking, behavior, or function. Additionally, older individuals who have recently undergone surgery or been hospitalized are a population at high risk for acute cognitive changes and should be considered candidates for mental status screening.

Another population for whom cognitive screening may be appropriate is patients with certain medical conditions known to be associated with dementia, as well as any older person with unexplained functional decline. Examples of conditions associated with cognitive decline include

<table>
<thead>
<tr>
<th>Screening tool</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mini–Mental State Exam (MMSE)</td>
<td>69% – 91%</td>
<td>87% – 99%</td>
</tr>
<tr>
<td>Modified Mini–Mental State Exam (3MS)</td>
<td>83% – 94%</td>
<td>85% – 90%</td>
</tr>
<tr>
<td>Mini-Cog</td>
<td>76% – 99%</td>
<td>89% – 93%</td>
</tr>
<tr>
<td>Montreal Cognitive Assessment (MoCA)</td>
<td>100%</td>
<td>87%</td>
</tr>
<tr>
<td>Saint Louis University Mental Status (SLUMS)</td>
<td>92% – 95%</td>
<td>76% – 81%</td>
</tr>
<tr>
<td>General Practitioner Assessment of Cognition (GPCOG)</td>
<td>82%</td>
<td>83%</td>
</tr>
<tr>
<td>Memory Impairment Screen (MIS)</td>
<td>80%</td>
<td>96%</td>
</tr>
<tr>
<td>Clock Drawing Test</td>
<td>88%</td>
<td>71%</td>
</tr>
</tbody>
</table>


Cognitive changes may herald early dementia (eg, Alzheimer’s disease) or functional decline, or reveal an increased risk for delirium.

> PRIMARY POINT

Cognitive changes may herald early dementia (eg, Alzheimer’s disease) or functional decline, or reveal an increased risk for delirium.
Parkinson's disease, a history of stroke, and diabetes mellitus.\textsuperscript{21-22}

Most patients with memory difficulties and other cognitive problems do not report these complaints to their medical provider, and it is unrealistic to expect them to do so. Often it is a family member or a coworker who becomes aware of a problem and voices these concerns to the provider; however, the provider should not rely on this to ensure early detection.

Clinicians must be pro-active and maintain a high index of suspicion for cognitive difficulties, especially when treating adults older than 70 or 75. Becoming familiar with a variety of tools and using one or more regularly to determine whether an individual does or does not have cognitive changes that might warrant further assessment should be a routine part of care.

**WHICH TEST TO USE?**

There is no single, ideal cognitive screening tool that can be recommended for use in every clinical setting. However, the ideal tool would have high sensitivity (i.e., the proportion of those with impairment correctly classified as impaired), high specificity (the proportion of those who are unimpaired correctly identified as not having cognitive problems; see Table 1, page 13), and a high positive predictive value (proportion identified by screening as impaired who really have cognitive impairment). Additionally, such a tool should be easy to administer and score, and should take a minimum amount of time to conduct in our time-pressed clinical environment.

Many of the currently available cognitive screening tests overemphasize memory to the neglect of other areas of cognitive function, such as executive function, language, and praxis, which can be impacted in patients with various conditions.\textsuperscript{30} One review of cognitive screening tests suggests that a comprehensive screening instrument should include six core neuropsychologic domains that are most commonly affected in the early stages of different dementias: executive function, abstract reasoning, attention/working memory, new verbal learning and recall, expressive language, and visuospatial construction.\textsuperscript{24}

**LIMITATIONS OF CURRENT SCREENING TESTS**

Cognitive screening does involve some risk, and every tool has known limitations. A significant barrier can be the administration time required, possibly ranging from five to 20 minutes. There is a potential for false-positive results, and there can be distress and stigma associated with a diagnosis of dementia, for both patients and families.

The majority of cognitive screening tests were developed and validated using cohorts of English-speaking patients. When used in other populations, such as those with English as a second (or third) language, or when used in translation, the results may not be valid. Similarly, many tests have an inherent educational bias, presuming attainment of an eighth-grade level or higher—again calling results into question when the test is conducted in people with less formal education. Further, most of the currently available tools are insensitive to small changes, as they were designed for screening, not to detect changes in a patient over time.

Screening tests may have a ceiling effect, that is, they may be insensitive to changes among patients with high intelligence or high levels of education premorbidity. Some tests may also have a floor effect, lacking the ability to assess for change in patients below a certain level of education or intelligence. The summary scores of these tests have cut-offs for normal and may allow broad-range classification of levels of impairment as mild, moderate, or severe; this is not very useful in distinguishing different patterns of cognitive loss.

**COGNITIVE SCREENING TOOLS**

A variety of tools are available for bedside/clinical assessment of cognition (see Table 2). Their administration can be learned without difficulty, and they can be conducted with relative ease to provide insight into a patient's cognitive abilities and deficits.

**Mini-Mental State Exam**

The most commonly used cognitive screening tool is the Folstein Mini-Mental State Exam (MMSE).\textsuperscript{30} With administration taking about 15 minutes, the MMSE includes assessment of attention, orientation, registration, recall/short-term memory, language, and visuospatial construction. Clinicians will find

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**TABLE 2**

<table>
<thead>
<tr>
<th>Name of instrument</th>
<th>Items</th>
<th>Maximum score</th>
<th>Time to administer</th>
<th>Cognitive functions assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mini-Mental State Exam (MMSE)</td>
<td>19</td>
<td>30</td>
<td>10 min</td>
<td>Orientation, registration, attention and calculation; short-term verbal recall; naming; repetition; three-step command; reading; writing; visuospatial</td>
</tr>
<tr>
<td>Modified Mini-Mental State (3MS)</td>
<td>15</td>
<td>100</td>
<td>15 min</td>
<td>Orientation; registration; attention and calculation; short-term verbal recall; delayed recall; category fluency, executive function, naming; repetition; 3-step command; reading; writing; visuospatial</td>
</tr>
<tr>
<td>Clock Drawing Test</td>
<td>1</td>
<td>4 - 10</td>
<td>3 min</td>
<td>Visuospatial, executive function</td>
</tr>
<tr>
<td>Mini-Cog</td>
<td>2</td>
<td>5</td>
<td>3 - 5 min</td>
<td>Visuospatial, executive functioning, short-term recall; includes clock drawing</td>
</tr>
<tr>
<td>Montreal Cognitive Assessment (MoCA)</td>
<td>12</td>
<td>30</td>
<td>10 min</td>
<td>Visuospatial/executive functioning, naming, attention, repetition, verbal fluency, abstraction, short-term verbal recall, orientation; includes clock drawing</td>
</tr>
<tr>
<td>Saint Louis University Mental Status (SLUMS)</td>
<td>11</td>
<td>30</td>
<td>7 min</td>
<td>Orientation, verbal recall, calculation, naming, attention, executive function; includes clock drawing</td>
</tr>
</tbody>
</table>

this tool most useful in assessing the individual with suspected early dementia and to follow progression through the early and middle stages of cognitive decline in those with Alzheimer's disease and related dementia disorders.

The maximum score is 30 points, with impairment suspected in subjects whose score is 25 or lower. The MMSE is highly dependent on verbal memory, and it does not include any tests of executive function; performance can be influenced by education and cultural background. A formula has been developed that takes age and education into account, allowing for correction of the score (see Table 3).43 The MMSE is currently a proprietary document requiring payment for its use.

The Modified Mini-Mental State Exam (3MS)44 expands upon the MMSE with the addition of items that address remote memory, delayed recall, list generation, and judgment and reasoning. With a maximum score of 100 points, it allows for partially correct responses to be scored. For example, on verbal recall, cues and choices are provided, with subsequent correct answers awarded partial points (i.e., 1 or 2 points out of a 3-point maximum score per recall item). Cognitive impairment is defined by a score of 85 points or less. The 3MS may be more sensitive in identification of early dementia than is the MMSE. The 3MS's expanded item scoring may be helpful in differentiating between some of the clinical dementia subtypes, such as Alzheimer's versus vascular dementia.36

**Clock Drawing Test**
The Clock Drawing Test (CDT) is perhaps the simplest test to administer.32,33 The patient is given a blank sheet of paper and asked to draw a large circle, then to write numbers inside the circle so that it resembles a face of a clock. Once this is completed, the patient is instructed to "draw the hands on the clock to read ten past eleven."

There are multiple scoring systems for the CDT,32,33 with points given for accuracy of placement of the numbers and the size and position of the hands. Lower scores generally indicate greater impairment. The advantages of the CDT are that it is not very threatening, it is very sensitive to changes in early Alzheimer's disease, and its administration requires little training.29 It has also been shown to be highly predictive of driver safety.30

The CDT is most appropriate for screening in busy practices and other settings (e.g., health fairs) where further evaluation can be relied upon to identify any false-positive test results.

**Mini-Cog Test**
The Mini-Cog Test (with instructions available at http://geriatrics.uthscsa.edu/tools/MINI_Cog.pdf) includes the clock-drawing task and a three-word recall, with a simple scoring algorithm.35 Ability to recall all three words, or to recall one or two words with normal results on the clock test, represents a negative screening result for dementia. Conversely, an inability to recall any of the three words, or inability to recall only one or two words with an abnormal clock test, is considered a positive screen for dementia. The Mini-Cog is a good tool for identification of early dementia, but not useful for following changes in individuals identified with cognitive impairment.

The Mini-Cog has been shown to have sensitivity and specificity similar to those of the MMSE, but it is much briefer and easier to administer. It is also less prone to language or ethnic bias, making it appropriate for patients with a wide variety of backgrounds and educational levels, and it translates easily for use in other languages.32,39

### TABLE 3
**Formula Correction for MMSE (MMSE Adjusted, or MMSAdj)**

MMSAdj = Raw MMSE - [0.471 x (education - 12)] + [0.131 x (age - 70)]

*Example:* A 78-year-old patient with 9 years of education scores 21/30 on MMSE.

<table>
<thead>
<tr>
<th>MMSAdj</th>
<th>= 21 - [0.471 x (9 - 12)] + [0.131 x (78 - 70)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>= 21 - [0.471 x (-3)] + [0.131 x (8)]</td>
<td></td>
</tr>
<tr>
<td>= 21 - (-1.413) + (1.048)</td>
<td></td>
</tr>
<tr>
<td>= 21 + 1.413 + 1.048</td>
<td></td>
</tr>
<tr>
<td>= 23.461</td>
<td></td>
</tr>
</tbody>
</table>


**Montreal Cognitive Assessment**
The Montreal Cognitive Assessment (MoCA) was originally designed as a brief screening instrument for mild cognitive impairment.36 It is a single-page, 30-point test, available in multiple languages (with several versions in some languages) at www.mocatest.org. The MoCA includes assessment of short-term memory, visuospatial ability, executive function, attention, concentration, working memory, language, and orientation. A score of 25 or lower is considered subnormal.

By design, the MoCA is useful for detecting subtle deficits that may be missed in patients who are highly educated, who score within the normal range on MMSE (≥ 25), or who have prominent executive dysfunction. The test has been shown to have excellent sensitivity in identification of early/mild cognitive changes and high test-retest reliability, and it is considered an excellent screening tool for detection of cognitive impairment in a busy clinical setting.36

**Saint Louis University Mental Status**
The Saint Louis University Mental Status (SLUMS) has also been shown to have better sensitivity than the MMSE for early cognitive changes.28 This 11-item tool, with a maximum score of 30 points, includes assessment of seven cognitive domains: orientation, recall, attention, calculation, fluency, language, and visuospatial construction. The five-item delayed recall in the SLUMS has been shown to be an excellent discriminator of those with normal cognition versus mild cognitive change. It is available for general use with no fee; currently, it is widely used by the Veterans Administration system.41

**General Practitioner Assessment of Cognition**
The General Practitioner Assessment of Cognition (GPCOG)27 is a unique two-part tool that includes questions for the patient and for someone who knows the patient well ("informant"). The patient items include memory/recall, orientation, and visuospatial tasks. The six informant questions ask about recall, language, and functional abilities. The GPCOG has been shown to have sensitivity and specificity similar to those of the MMSE; as its name indicates, it is designed and best suited for screening in a family medicine or general internal medicine practice.

**Memory Impairment Screen**
The Memory Impairment Screen (MIS)28 uses a four-item mem-
<table>
<thead>
<tr>
<th>Clinical Dementia Rating Stages</th>
<th>Memory</th>
<th>Orientation</th>
<th>Judgment and problem solving</th>
<th>Community affairs</th>
<th>Home and hobbies</th>
<th>Personal care</th>
</tr>
</thead>
<tbody>
<tr>
<td>None 0*</td>
<td>Little to no memory loss; slight, inconsistent forgetfulness</td>
<td>Fully oriented</td>
<td>Solves everyday problems, handles business/financial affairs well; judgment good in relation to past performance</td>
<td>Independent function at usual level in work, shopping, volunteering, social groups</td>
<td>Home life, hobbies, intellectual interests well maintained</td>
<td>Fully capable of self-care</td>
</tr>
<tr>
<td>Questionable dementia 0.5*</td>
<td>Consistent; slight (&quot;benign&quot;) forgetfulness, partial recollection of events</td>
<td>Fully oriented except for slight difficulty with time relationships</td>
<td>Slight impairment in solving problems, similarities, and differences</td>
<td>Slight impairment in these activities</td>
<td>Slight impairment in home life, hobbies, intellectual interests</td>
<td>Fully capable of self-care</td>
</tr>
<tr>
<td>Mild dementia 1*</td>
<td>Moderate memory loss, more marked with recent events; defect interferes with everyday activities</td>
<td>Moderate difficulty with time relationships; oriented for space at examination, may have geographic disorientation elsewhere</td>
<td>Moderate difficulty in handling problems, similarities, and differences; social judgment usually impaired</td>
<td>Unable to function independently at these activities but may be engaged in some; appears normal to casual inspection</td>
<td>Mild but definite functional impairment at home; abandons more difficult chores, as well as hobbies and previous interests</td>
<td>Needs prompting</td>
</tr>
<tr>
<td>Moderate dementia 2*</td>
<td>Severe memory loss; only well-learned material retained; new material rapidly lost</td>
<td>Severe difficulty with time relationships; usually disoriented to time, often to place</td>
<td>Severe impairment in handling problems, similarities, and differences; social judgment usually impaired</td>
<td>No pretense at independent function outside the home; appears well enough to be accompanied to functions outside the home</td>
<td>Only simple chores preserved; very restricted interests, poorly maintained</td>
<td>Requires assistance in dressing, hygiene, maintaining personal effects</td>
</tr>
<tr>
<td>Severe dementia 3*</td>
<td>Severe memory loss; only fragments remain</td>
<td>Orientation to person only</td>
<td>Unable to make judgments or solve problems</td>
<td>No pretense of independent function outside the home; appears too ill to be taken to functions outside the home</td>
<td>No significant function in the home</td>
<td>Requires much help with personal care; frequent incontinence</td>
</tr>
<tr>
<td>Profound dementia 4*</td>
<td>Even fragments of memory generally lost; memory testing made difficult by unintelligible or irrelevant speech</td>
<td>Occasionally responds to own name</td>
<td>Unable to follow even simple instructions or commands</td>
<td>Unable to participate meaningfully in any social setting</td>
<td>Unable to participate meaningfully in any hobby or home activity</td>
<td>May attempt to dress or feed self; nonambulatory without assistance; mostly incontinent</td>
</tr>
<tr>
<td>Terminal dementia 5*</td>
<td>No meaningful memory function; often uncomprehending or obtunded</td>
<td>No recognition of self</td>
<td>Unaware of problems, no comprehension of surroundings</td>
<td>Completely unable to engage in any activity</td>
<td>Completely unable to engage in any activity</td>
<td>Needs to be fed; is bedridden, incontinent</td>
</tr>
</tbody>
</table>

* Numbers represent patient scores on the Clinical Dementia Rating.

ory recall with simple scoring of 0 to 8, based on the formula: 2x (the number recalled spontaneously) + (the number recalled with cuing). It takes less than five minutes to administer, making it a useful tool to screen for suspected memory problems in a busy setting, such as an emergency room. However, the sole reliance on memory, without screening for any other areas of cognition (especially executive function or visuospatial copying), significantly limits the usefulness of the MIS as a general cognitive screening tool.

**Telephone Interview for Cognitive Status**

The cognitive screening instruments described thus far were all designed to be administered in person in a medical setting (office, clinic, or hospital). The 11-item Telephone Interview for Cognitive Status (TICS) was developed as a brief (taking less than 10 minutes) standardized test of cognitive function, specifically suited for situations in which in-person screening is not possible (eg, for patients who are unable to appear in person for clinical follow-up).42-44 The modified TICS (TICS-M), which includes 13 items, has been shown to have less of a ceiling effect than the MMSE.45 It has also been shown to be a cost-effective screening tool for mild cognitive impairment.46

**ASSOCIATED CLINICAL INSTRUMENTS**

The Clinical Dementia Rating (CDR) scale is a useful tool for staging cognitive decline, regardless of the patient’s diagnosis.47 It uses a 0 to 5 rating system in which 0 is considered normal and 5 represents profound impairment.48

<table>
<thead>
<tr>
<th>Screening tool</th>
<th>Preclinical</th>
<th>Mild/early</th>
<th>Moderate/middle</th>
<th>Severe/late</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mini-Mental State Exam (MMSE)</td>
<td>26 – 30</td>
<td>19 – 25</td>
<td>10 – 18</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>Modified Mini-Mental State Exam (3MS)</td>
<td>92 – 100</td>
<td>80 – 91</td>
<td>61 – 79</td>
<td>&lt; 61</td>
</tr>
<tr>
<td>Montreal Cognitive Assessment (MoCA)</td>
<td>22 – 26</td>
<td>16 – 21</td>
<td>5 – 15</td>
<td>&lt; 5</td>
</tr>
<tr>
<td>Clinical Dementia Rating (CDR)</td>
<td>0.5</td>
<td>1.0</td>
<td>2.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>


TABLE 5

Comparison of Cognitive Screening Tool Scores by Impairment Level/Stage

**REFERENCES**


19. Avidan MS, Evers AS. Review of clinical evidence for persistent cognitive decline or inci-

**RADIOLOGY REVIEW**

 continuation from page 8

**ANSWER**

The radiograph demonstrates lateral dislocation of the patella, with no evidence of an acute fracture of any surrounding bones. The patella was easily reduced in the emergency department, and the patient was placed in a knee immobilizer. Orthopedic consultation was obtained.

**Clinician Reviews**

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