OXFORD
UNIVERSITY PRESS

Archives of Clinical Neuropsychology 32 (2017) 491–498

Archives of CLINICAL NEUROPSYCHOLOGY

Cognitive Screening Tests Versus Comprehensive Neuropsychological Test Batteries: A National Academy of Neuropsychology Education Paper†

Tresa M. Roebuck-Spencer[1], Tannahill Glen[2], Antonio E. Puente[3], Robert L. Denney[4,*], Ronald M. Ruff[5], Gayle Hostetter[6], Kevin J. Bianchini[7]

[1]*Jefferson Neurobehavioral Group, Metairie, LA, USA*
[2]*Neuropsychology, Inc., Jacksonville, FL, USA*
[3]*Department of Psychology, University of North Carolina, Wilmington, NC, USA*
[4]*Neuropsychological Associates of Southwest Missouri, Springfield, MO, USA*
[5]*San Francisco Clinical Neurosciences, San Francisco, CA, USA*
[6]*Independent Practice, Honolulu, HI, USA*
[7]*Jefferson Neurobehavioral Group, Metairie, LA, USA*

*Corresponding author at: Neuropsychological Associates of Southwest Missouri, Springfield, MO, USA. *Tel.: (417) 881-1810; fax: 888-728-5456.*
E-mail address: denney@psychologistspringfield.com (R.L. Denney).

Editorial Decision 16 February 2017; Accepted 16 February 2017

Abstract

The American Medical Association Current Procedural Panel developed a new billing code making behavioral health screening a reimbursable healthcare service. The use of computerized testing as a means for cognitive screening and brief cognitive testing is increasing at a rapid rate. The purpose of this education paper is to provide information to clinicians, healthcare administrators, and policy developers about the purpose, strengths, and limitations of cognitive screening tests versus comprehensive neuropsychological evaluations. Screening tests are generally brief and narrow in scope, they can be administered during a routine clinical visit, and they can be helpful for identifying individuals in need of more comprehensive assessment. Some screening tests can also be helpful for monitoring treatment outcomes. Comprehensive neuropsychological assessments are multidimensional in nature and used for purposes such as identifying primary and secondary diagnoses, determining the nature and severity of a person's cognitive difficulties, determining functional limitations, and planning treatment and rehabilitation. Cognitive screening tests are expected to play an increasingly important role in identifying individuals with cognitive impairment and in determining which individuals should be referred for further neuropsychological assessment. However, limitations of existing cognitive screening tests are present and cognitive screening tests should not be used as a replacement for comprehensive neuropsychological testing.

Keywords: Mild cognitive impairment; Assessment; Professional issues; Elderly/Geriatrics/Aging; Childhood neurologic disorders

Introduction

As our population ages, there is a growing important role for cognitive screening tools to detect cognitive impairment that would otherwise go unappreciated. The 2010 Patient Protection and Affordable Care Act identified mental health screening as

†Note: This paper has been written, reviewed, and edited by members of the National Academy of Neuropsychology (NAN) Policy and Planning Committee. The Policy and Planning Committee is charged with writing position papers regarding important issues that affect the profession of neuropsychology and consumers of neuropsychological services. Possible topics for the position papers are suggested by the NAN Board of Directors, members of the NAN Policy and Planning Committee, or individual NAN members. Primary authors are identified and approved by the NAN Policy and Planning Committee. These authors typically are experts on the topic and can come from within or outside the Policy and Planning Committee. Primary authors, Policy and Planning Committee members, and selected outside reviewers provide extensive peer review for all papers. All topics and the final manuscripts submitted by the Policy and Planning Committee are reviewed and approved by the NAN Board of Directors.

doi:10.1093/arclin/acx021 Advance Access publication on 10 March 2017

an essential health benefit. More recently, the American Medical Association Current Procedural Panel developed a new billing code (96127) making behavioral health screening reimbursable (Abraham, 2013). Unexpected and unusually high utilization of the Current Procedural Terminology (CPT) code 96120 (billed for computerized testing) was observed over the past 5 years (Federal Register, 2015). This increased use of computerized testing is believed to be, in large part, a result of using these tools to screen for cognitive impairment. There are misunderstandings regarding what differentiates cognitive screening from a clinical neuropsychological evaluation. The growing use of screening tools and increased development and use of computer-based cognitive assessment instruments has made the importance of this distinction even greater. The purpose of this paper is to provide information to help clinicians, healthcare administrators, and policy developers to better understand the purpose, strengths, and limitations of cognitive screening tests versus comprehensive neuropsychological evaluations.

Rationale for this Education Paper

Considerations for screening for disease and criteria for screening tests were described nearly 50 years ago by Wilson and Jungner in a report commissioned by the World Health Organization in 1968. Screening instruments are now common in medicine, where they are used for early detection of genetic diseases (Andermann & Blancquaert, 2010), medical conditions such as hypertension (U.S. Preventative Services Task Force, 2009), and cardiovascular disease (Jacoby et al., 2015). Their usefulness has been demonstrated in medical decision-making (e.g., resource allocation and treatment; Quinlivan et al., 2015), collecting research data, and improving outcomes (Faruque et al., 2015). In populations at risk for psychiatric disorders, for example, there are screening measures for post-traumatic stress disorder in Veterans (Tiet, Schutte, & Leyva, 2013) and depression in patients with cancer (Walker et al., 2014).

Cognitive screening is common in primary care and community settings (Morley et al., 2015). Some of the most commonly used tests include the Cambridge Cognitive Examination (Huppert, Brayne, Gill, Paykel, & Beardsall, 1995), CogState (Makdissi et al., 2001), MiniCog (Borson, Scanlan, Brush, Vitaliano, & Dokmak, 2000), Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975), Montreal Cognitive Assessment (MoCA) (Nasreddine et al., 2005), Neurobehavioral Cognitive Status Examination (Kiernan, Mueller, Langston, & Van Dyke, 1987), NeuroTrax/BrainCare (Dwolatzky et al., 2003), Six Item Screener (Callahan, Unverzagt, Hui, Perkins, & Henrie, 2002), Rapid Cognitive Screen (Malmstrom et al., 2015), St. Louis University Mental Status (Feliciano et al., 2013), and CNS Vital Signs (Gualtieri & Johnson, 2006). Statistical characteristics and other qualities of those measures are included in reviews by Cullen, O'Neill, Evans, Coen, and Lawlor (2007), Cordell et al. (2013), Zygouris and Tsolaki (2014), and Morley et al. (2015). Cognitive screening measures are sometimes used to identify treatable or reversible causes of cognitive impairment (Morley et al., 2015) or to identify cognitive impairment in at-risk populations, including patients with brain tumors (Raiker et al., 2015), psychiatric disorders (Gierus et al., 2015), traumatic brain injuries (Perry et al., 2015), or mild cognitive impairment (MCI; Morley et al., 2015; Zygouris et al., 2015). In 2001, the American Academy of Neurology (AAN) issued a practice recommendation supporting the use of cognitive screening measures in persons with suspected MCI (Petersen et al., 2001). In 2010, AAN issued practice parameters regarding driving safety, noting the possible usefulness of MMSE scores for identifying patients with dementia who are at risk for unsafe driving (American Academy of Neurology, 2010).

There are several advantages to using screening tools, particularly in a computerized format. The 2003 U.S. Preventative Services Task Force (Boustani et al., 2003) recognized that cognitive testing contributes to higher rates of *detection* of cognitive impairment in older adults (e.g., differentiating dementia from normal cognition) in primary care settings, compared to informal observation alone (Cordell et al., 2013). Screening tests can serve as an impetus for further examination or as a baseline measure to determine change in clinical status over time. Cognitive screening tools typically require relatively limited administration time and less staff training (Cordell et al., 2013). With regard to computerized cognitive screening tests, a 2012 position paper from the American Academy of Clinical Neuropsychology and the National Academy of Neuropsychology suggested that increased use of these tests is likely related to ease of patient and doctor accessibility, automation of interpretive guidelines and cutoffs, and reduced administration time and cost (Bauer et al., 2012). Interestingly, a recent survey of neuropsychologists' use of computerized tests found that these factors contributed more to decisions about test usage as opposed to clinical factors like age, practice setting, or diagnosis (Rabin, Spadaccini, Brodale, Elbulok-Charcape, & Barr, 2014).

Increased development and use of cognitive screening tests might reflect greater media attention to research advancements and increased public awareness of cognitive health and cognitive impairment associated with factors like brain injury (Moser, Schatz, & Lichtenstein, 2015) and dementia (Friedman et al., 2015). Another major factor in the increased use of screening measures was the passage of the 2010 Patient Protection and Affordable Care Act, which identified mental health screening services as essential. The Affordable Care Act (ACA, 2010) specifically requires assessment of cognitive impairment in the Medicare Annual Wellness Visit (Cordell et al., 2013). Not surprisingly, this new policy has resulted in increased utilization

of cognitive testing billing codes by medical doctors and non-psychologist staff/practitioners at a rate that has exceeded several hundred percentage points each year over the last 5 years (Federal Register, 2015). The new policy resulted in the creation of the CPT code 96127: Brief Behavioral Assessment, for reimbursable identification of emotional and behavioral health impairment.

In response to these factors, a statement on Screening and Psychological Assessment was provided by the Working Group on Screening and Assessment (WGSA), a collaboration of the American Psychological Association's Board of Professional Affairs and the Committee for the Advancement of Professional Practice of the American Psychological Association (2014). This statement provides information to aid in distinguishing between psychological screening versus more comprehensive psychological evaluation and assessment.

The current paper builds upon the work of the WGSA and specifically applies those statements and ideas to cognitive screening and neuropsychological evaluations. Such distinction is necessary because despite recommendations noted by the WGSA for appropriate training in use and interpretation of psychological assessment tools, the greatest increase in use of computerized and rapid cognitive screening measures is by non-psychologist physicians and support staff in medical/neurology settings (Puente, 2013). It is felt that these distinctions are of importance to neuropsychologists/psychologists, other medical disciplines who diagnose and treat cognitive impairment, public consumers, and third party payers.

Cognitive Screening Measures

The 2014 WGSA statement differentiates between screening tests or measures and psychological assessment. These statements are equally applicable to cognitive screening and neuropsychological assessment. According to the statement, screening tests: (a) can be used for the early identification of individuals at potentially high risk for a specific condition or disorder; (b) can indicate a need for further evaluation or preliminary intervention; (c) are generally brief and narrow in scope; (d) may be administered as part of a routine clinical visit; (e) may be used to monitor treatment progress, outcome, or change in symptoms over time; (f) may be administered by clinicians, support staff with appropriate training, an electronic device (such as a computer), or self-administered; (g) can be used by support staff who follow an established protocol for scoring with a pre-established cut-off score and guidelines for individuals with positive scores; and (h) are neither definitively diagnostic nor a conclusive indication of a specific condition or disorder.

Limitations of Cognitive Screening Measures

Bauer and colleagues (2012) detailed limitations of computerized neuropsychological assessment devices that may also be applied to screening measures more broadly. Such measures are often marketed to users without neuropsychological or psychometric training. They note that even the technical characteristics of such measures (e.g., software, installation, processing, and other computer-based factors) may affect test administration and reliability. This point highlights the need for user qualifications to include knowledge of psychometrics and relevant technical factors prior to interpretation of test scores acquired from such tests.

Cognitive screening tests are not in and of themselves diagnostic. Instead, they may indicate the likelihood of having a particular condition in comparison to a reference group (Cullen, O'Neill, Evans, Coen, & Lawlor, 2007) and may identify those persons who require more extensive, comprehensive, diagnostic neuropsychological assessment (Morley et al., 2015). Cognitive screening tests should be carefully chosen to maximize detection of persons requiring further investigation although minimizing unnecessary evaluations resulting from false-positive results (Bauer et al., 2012 ; Cullen, O'Neill, Evans, Coen, & Lawlor, 2007). Further, cognitive screening tests should be chosen based on availability of appropriate normative data that take into account demographic factors like age, ethnicity, race, education, and gender (American Academy of Neurology, 2010).

Additionally, important information may be missed when such tests are administered by support staff or when they are self-administered. As noted by Bauer and colleagues (2012), "behavioral indicators of emotional, motivational, or mental status issues that might complicate test interpretation may be inadvertently missed," and critical non-neurologic factors in performance may not be considered, such as premorbid abilities and reading level, adequate attention and motivation, medication effects, and psychiatric status.

Finally, significant limitations exist when screening tools lack adequate classification accuracy. The potential for harm related to false-positive screening test results or over-diagnosis is significant, and psychological distress stemming from false-positive screening results is well documented in medicine (Bond, Garside, & Hyde, 2015; Krantz & Meyers, 2015). Likewise, false negatives or failure to identify cognitive impairment when present may result in missed treatment opportunities and may

place an individual and the community in danger when an individual with impaired cognition engages in activities they may no longer be able to perform (e.g., driving and medication management).

Studies comparing the accuracy of the most commonly used cognitive screening tests (i.e., MMSE and MoCA) highlight these cautions and illustrate that sensitivity of these tools is low. That is, the use of these tests alone will miss a large proportion of individuals with true cognitive impairment. For example, Chan and colleagues (2014) found that 78% of stroke patients deemed cognitively intact by the MoCA, actually demonstrated cognitive impairment in one or more cognitive domains. Further, a high percentage (59%) who scored perfectly on the MoCA was found to be cognitively impaired on comparable neuropsychological assessment. A separate study of patients with brain tumors by Olson and colleagues (2011) also found that the MMSE and MoCA were lacking in sensitivity and missed many individuals with true cognitive impairment. The MMSE was particularly low in sensitivity, detecting only 19% of individuals with cognitive impairment. Sensitivity to detect cognitive impairment was better with the MoCA, but it still only reached 62%. Although the MMSE was highly specific (94%), the MoCA misclassified 44% of individuals as impaired when they were not.

Misclassification is likely further magnified when relying on individual cognitive domains of the MoCA. That is, scores on individual cognitive domains from the MoCA were poor predictors of actual impairment in corresponding areas on comprehensive neuropsychological testing (Moafmashhadi & Koski, 2012). Inaccurate classification of screening measures is likely due to restricted range of scores, ceiling effects, and failure to measure relevant areas of cognitive functioning, such as intellectual functioning, processing speed, and visual memory. The MMSE and the MoCA are highlighted here as exemplars of commonly used cognitive screening measures. A systematic review of the many available cognitive screening measures was beyond the scope of this paper; however, it is likely that similar classification issues arise with other cognitive screening tests.

In summary, screening tests provide information about whether a person might have a diagnosis or a condition; they typically are not, however, sufficient to diagnose a condition or determine the clinical status of a patient. The classification accuracy of a screening test will depend on many factors, and there are limitations when using screening tests alone. Research on the current most commonly used cognitive screening tests highlights that the sensitivity of these measures is lacking and indicates a need to rely on clinical risk factors in addition to screening tests when determining who should be referred for further comprehensive neuropsychological assessment.

Comprehensive Neuropsychological Examination

Comprehensive neuropsychological assessment has well established clinical utility across multiple clinical disorders (Braun et al., 2011) and has been found to be more sensitive to impaired cognitive functioning than other medical tests (e.g., Schmand et al., 2014). Neuropsychological assessment is a good predictor of later functional status (e.g., Green et al., 2008; Hanks et al., 2008; Sherman et al., 2011). It is valued and found to be useful by its stakeholders, including patients, caregivers, and referral sources (e.g., Hilsabeck, Hietpas, & McCoy, 2014; Temple, Carvalho, & Tremont, 2006; Tremont, Westervelt, Javorsky, Podolanczuk, & Stern, 2002; Westervelt, Brown Tremont, Javorsky, & Stern, 2007). Finally, its cost-utility has been well documented with reduced costs and reduced service utilization following neuropsychological evaluation (e.g., Prigatano & Pliskin, 2003; VanKirk, Horner, Turner, Dismuke, & Muzzy, 2013).

The 2014 WGSA statement on screening measures and psychological assessment also provides direction that can be directly applied to neuropsychological assessment. That is, psychological/neuropsychological assessment: (a) provides a more comprehensive clinical picture of an individual; (b) is comprehensive in focusing on the individual's functioning across multiple domains; (c) can aid diagnosis and/or treatment planning in a culturally competent manner; (d) can identify psychological problems and conditions, indicate their severity, and provide treatment recommendations; (e) integrates results from multiple psychological tests, clinical interviews, behavioral observations, clinical record reviews, and collateral information; (f) may include screening measures that are used in conjunction with other information from the assessment, providing a broader context for interpreting the results; (g) may use screening results to determine the choice of instruments for an assessment; and (h) may cover multiple domains of functioning, such as language, memory, visual and verbal problem solving, executive functioning, adaptive functioning, psychological status, capacity for self-care, relevant psychosocial history, and others needed to respond to the referral questions. See Table 1 for summary of distinctions between cognitive screening tests and comprehensive neuropsychological evaluations.

When considering neuropsychological assessment, it is important to note the difference between simple cognitive screening *tests* like the MMSE, and brief focused neuropsychological assessment batteries, such as the Repeatable Battery for the Assessment of Neuropsychological Status (Randolph, Tierney, Mohr, & Chase, 1998). The use of brief focused neuropsychological batteries is not routine and is determined by patient characteristics and referral questions. Brief neuropsychological assessments may be multidimensional or single-domain, and unlike screening tests may be diagnostic in certain cases. Brief

Table 1. Summary of distinctions between cognitive screening tests and comprehensive neuropsychological batteries

	Cognitive Screening Tests	Comprehensive Neuropsychological Batteries
Potential uses	• Early identification of individuals at potential risk for condition or disorder • May indicate need for further evaluation or intervention • May be used to monitor progression of symptoms or response to intervention • Does not provide definitive diagnoses	• Determination of presence and magnitude of impairment • Determination of diagnoses • Determination of functional status, abilities, and capacities • Assistance with medical treatment planning
Administration	• Generally brief (<30 min) • May be administered as part of routine clinical visit • Requires minimal training for administrator or can be self-administered	• Varies but typically several hours • Typically occurs as a separate encounter or appointment • Requires specialized training in administration and interpretation
Domains assessed	• Narrow in scope	• Multidimensional • Provides information about functioning across multiple domains

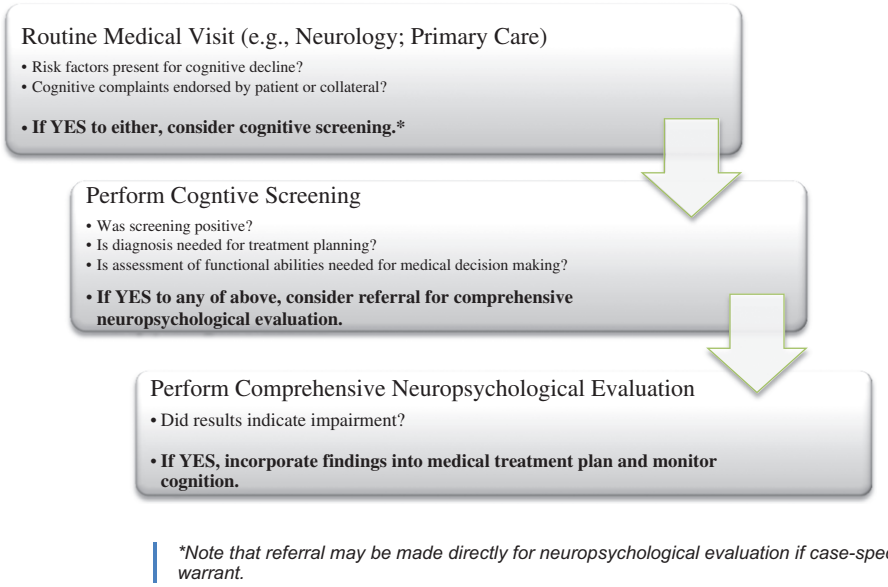

Fig. 1. Proposed practice model for utilization of cognitive screening measures and comprehensive neuropsychological evaluation. *Note that referral may be made directly for neuropsychological evaluation if case-specifics warrant.

focused neuropsychological assessment requires specialized training and expertise in interpretation and more intellectual work product than simply applying a defined cut-off score to a given participant (as is common with individual screening tests).

Further, Bauer and colleagues (2012) elaborate on the distinction between testing and assessment, citing Matarazzo (1990): "testing" is defined as using "cognitive tests to obtain behavioral samples of abilities," in certain domains, although "neuropsychological assessment" is defined as comprehensive evaluation that "integrates test results, with history, symptoms, behavioral observations, physical findings…to yield interpretive statements about the underlying causes of the patient's performance pattern" (p. 6). Larrabee (2014) also details components of neuropsychological assessment in what he termed an ability-focused comprehensive neuropsychological test battery that is based on psychometric qualities of selected tests, performance validity measures, and multiple measures in each domain assessed. In practice, most neuropsychologists use an ability-focused battery that is relevant to referral questions, patient characteristics, and the need to differentiate diagnoses (Sweet, Meyer, Nelson, & Moberg, 2011). Components of such a comprehensive neuropsychological battery are guided by training and clinical decision-making.

A proposed integrative process using cognitive screening tests and comprehensive neuropsychological assessments is presented in Fig. 1. In a practical way, this model illustrates how the routine use of cognitive screening tests might affect care and assist medical providers in determining which patients would benefit from more comprehensive neuropsychological assessment. It is important to note, however, that this model should not be interpreted to mean that screening tests must

always precede referral for comprehensive evaluations. For instance, direct referral for comprehensive neuropsychological assessment may be most prudent when the presence of cognitive impairment is already known or suspected and when further medical decision-making would benefit from diagnostic clarity and/or determination of the pattern and magnitude of cognitive impairment. Further, this model presupposes that screening tests emphasize sensitivity over specificity. In this respect, optimal screening tests should avoid false negative errors, or in other words, should avoid missing true cognitive impairment when it is actually present.

Conclusions

The growth in development and use of cognitive screening tests has the potential to contribute to cost-effective delivery of services, improved healthcare resource allocation, early identification of patients in need of more comprehensive diagnostic evaluation, and improved cognitive outcomes. The greatest recent increase in use of these tests is by medical providers who typically do not have advanced training and experience with cognitive assessment or psychometrics. Thus, education on appropriate selection, use, and interpretation of cognitive screening tests is critical. This is an area of particular expertise for neuropsychologists, and represents an opportunity for the profession to guide others in making these choices. Also, a potential unintended consequence of the new CPT cognitive screening code may be confusion and complication of appropriate reimbursement for administration of cognitive screening tests versus administration and interpretation of neuropsychological screening batteries and comprehensive evaluations. This, too, presents an opportunity for the profession to publicly differentiate between the use of cognitive screening tests versus integrative, diagnostic evaluations performed by clinical neuropsychologists.

Conflict of Interest

Drs. Roebuck-Spencer, Glen, Denney, Hostetter, and Bianchini have no disclosures. Dr. Puente is the current American Psychological Association president. Dr. Ruff receives royalties from four psychological tests, none of which are presented as screening tests.

References

Abraham, M. (2013). *CPT 2014. Current procedural terminology*. Chicago: American Medical Association.

ACA (2010). Compilation of Patient Protection and Affordable Care Act. Retrieved August 18, 2016, from https://www.hhs.gov/sites/default/files/ppacacon.pdf.

American Academy of Neurology (2010). Practice parameter update: evaluation and management of driving risk in dementia. Report of the quality standards subcommittee of the American Academy of Neurology. *Neurology*, *74*, 1–1.

American Psychological Association Ethical Principles of Psychologists and Code of Conduct (2010). Retrieved July 29, 2016, from http://www.apa.org/ethics/code/index.aspx

American Psychological Association Practice Organization. (2014, December). *Distinguishing between screening and assessment for mental and behavioral health problems: A statement from an American Psychological Association Practice Organization work group on screening and psychological assessment*. Retrieved December 1, 2016, from http://www.apapracticecentral.org/reimbursement/billing/assessment-screening.aspx

Andermann, A., & Blancquaert, I. (2010). Genetic screening: A primer for primary care. *Canadian Family Physicians*, *56*, 333–339.

Bauer, R., Iverson, G., Cernich, A., BinderTerm, L., Ruff, R., & Naugle, R. (2012). Computerized neuropsychological assessment devices: Joint position paper of the American Academy of Clinical Neuropsychology and the National Academy of Neuropsychology. *Clinical Neuropsychology*, *26*, 177–96.

Bond, M., Garside, R., & Hyde, C. (2015). A crisis of visibility: The psychological consequences of false positive mammograms: An interview study. *British Journal of Health Psychology*, *20*, 792–806.

Borson, S., Scanlan, J., Brush, M., Vitaliano, P., & Dokmak, A. (2000). The mini-cog: a cognitive 'vital signs' measure for dementia screening in multilingual elderly. *International Journal of Geriatric Psychiatry*, *15*, 1021–7.

Boustani, M., Peterson, B., Harris, R., Lux, L., Krasnov, C., Sutton, S., et al. (2003). *Screening for Dementia*. Rockville, MD: Agency for Healthcare Research and Quality.

Braun, M., Tupper, D., Kaufmann, P., McCrea, M., Postal, K., Westerveld, M., et al. (2011). Neuropsychological assessment: A valuable tool in the diagnosis and management of neurological, neurodevelopmental, medical, and psychiatric disorders. *Cognitive and Behavioral Neurology*, *24*, 107–114.

Callahan, C., Unverzagt, F., Hui, S., Perkins, A., & Henrie, H. (2002). Six-item screener to identify cognitive impairment among potential subjects for clinical research. *Medical Care*, *40*, 771–81.

Chan, E., Khan, S., Oliver, R., Gill, S. K., Werring, D. J., & Cipolotti, L. (2014). Underestimation of cognitive impairments by the Montreal cognitive assessment (MoCA) in an acute stroke unit population. *Journal of the Neurological Sciences*, *343*, 176–179.

Cordell, C., Borson, S., Boustani., M., Chodosh, J., Rueben, D., Verghese, J., et al. (2013). Alzheimer's association recommendations for operationalizing the detection of cognitive impairment during the medicare annual wellness visit in a primary care setting. *Alzheimer's and Dementia*, *9*, 141–50.

Cullen, B., O'Neill, B., Evans, J., Coen, R., & Lawlor, B. (2007). A review of screening tests for cognitive impairment. *Journal of Neurology, Neurosurgery and Psychiatry*, *78*, 790–799.

Dwolatzky, T., Whitehead, V., Doniger, G. M., Simon, E. S., Schweiger, A., Jaffe, D., et al. (2003). Validity of a novel computerized cognitive battery for mild cognitive impairment. *BMC Geriatrics*, *3*, 4.

Faruque, F., Zhang, X., Nichols, E., Bradley, D., Reeves-Darby, R., Reeves-Darby, V., et al. (2015). The impact of preventative screening resource distribution on geographic and population-based disparities in colorectal cancer in Mississippi. *BMC Research Notes*, *8*, 423.

Federal Register (2015). Notice of proposed rulemaking, Medicare physician fee schedule. Potentially Misvalued Codes identified by screen for high expenditures. *Federal Register, 79 (291)*, 67576–577.

Feliciano, L., Horning, S., Klebe, K., Anderson, S., Cornwell, R., & Davis, H. (2013). Utility of the SLUMS as a cognitive screening tool among a nonveteran sample of older adults. *Am J Geriatric Psychiatry*, *21*, 623–630.

Folstein, M., Folstein, S., & McHugh, P. (1975). "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, *12*, 189–98.

Friedman, D., Bekofsky, K., Anderson, L., Bryant, L., Hunter, R., Ivey, S., et al. (2015). Public perceptions about risk and protective factors for cognitive health and impairment: A review of the literature. *International Psychogeriatrics*, *27*, 1263–1275.

Gierus, J., Mosiolek, A., Koweszko, T., Wnukiewicz, P., Kozyra, O., & Szulc, A. (2015). The Montreal cognitive assessment as a preliminary assessment tool in general psychiatry: Validity of MoCA in psychiatric patients. *General Hospital Psychiatry*, *37*, 476–480.

Green, R. E., Colella, B., Hebert, D. A., Bayley, M., Kang, H. S., Till, C., et al. (2008). Prediction of return to productivity after severe traumatic brain injury: investigations of optimal neuropsychological tests and timing of assessment. *Archives of Physical Medicine and Rehabilitation*, *89*, S51–S60.

Gualtieri, C., & Johnson, L. (2006). Reliability and validity of a computerized neurocognitive test battery, CNS vital signs. *Archives of Clinical Neuropsychology*, *21*, 623–643.

Hanks, R. A., Millis, S. R., Ricker, J. H., Giacino, J. T., Nakese-Richardson, R., Frol, A. B., et al. (2008). The predictive validity of a brief inpatient neuropsychologic battery for persons with traumatic brain injury. *Archives of Physical Medicine and Rehabilitation*, *89*, 950–957.

Hilsabeck, R. C., Hietpas, T. L., & McCoy, K. J. M. (2014). Satisfaction o referring providers with neuropsychological services within a Veterans Administration Medical Center. *Archives of Clinical Neuropsychology*, *29*, 131–140.

Huppert, F., Brayne, C., Paykel, E., & Beardsall, L. (1995). CAMCOG: a concise neuropsychological test to assist dementia diagnosis. *British Journal of Clinical Psychology*, *34*, 529–541.

Jacoby, D., Hajj, J., Javaheri, A., deGoma, E., Lin, A., Ahn, A., et al. (2015). Carotid intima-media thickness measurement promises to improve cardiovascular risk evaluation in head and neck cancer patients. *Clinical Cardiology*, *38*, 280–284.

Kiernan, R., Mueller, J., Langston, J., & Van Dyke, C. (1987). The neurobehavioral cognitive status examination: A brief but quantitative approach to cognitive assessment. *Annals of Internal Medicine*, *10*, 481–5.

Krantz, S., & Meyers, G. (2015). Health risks from computed tomographic screening. *Thoracic Surgery Clinics*, *25*, 155–160.

Larrabee, G. (2014). Test validity and performance validity: Considerations in providing a framework for development of an ability-focused neuropsychological test battery. *Archives of Clinical Neuropsychology*, *29*, 695–714.

Makdissi, M., Collie, A., Maruff, P., Darby, D., Bush, A., McCrory, P., et al. (2001). Computerised cognitive assessment of concussed Australian rules footballers. *British Journal of Sports Medicine*, *35*, 354–360.

Malmstrom, T., Voss, V., Cruz-Oliver, D., Cummings-Vaughn, L., Tumosa, N., Grossnerg, G. T., et al. (2015). Rapid cognitive screen (RCS): A point-of-care screening for dementia and mild cognitive impairment. *Journal of Nutrition Health and Aging*, *19*, 741–744.

Matarazzo, J. (1990). Psychological assessment versus psychological testing: Validation from Binet to the school, clinic and courtroom. *American Psychologist*, *45*, 999–1017.

Moafmashhadi, P., & Koski, L. (2012). Limitations for interpreting failure on individual subtests of the Montreal cognitive assessment. *Journal of Geriatric Psychiatry*, *26*, 19–28.

Morley, J., Morris, J., Berg-Weger, M., Borson, S., Carpenter, B., del Campo, N., et al. (2015). Brain health: The importance of recognizing cognitive impairment: An IAGG consensus statement. *Journal of the American Medical Directors Association*, *16*, 731–739.

Moser, R., Schatz, P., & Lichtenstein, J. (2015). The importance of proper administration and interpretation of neuropsychological baseline and postconcussion computerized testing. *Applied Neuropsychology: Child*, *4*, 41–48.

Nasreddine, Z. S., Phillips, N. A., Bedirian, V., Charbonneau, S., Whitehead, V., Collin, I., et al. (2005). The Montreal cognitive assessment, MoCA: A brief screening tool for mild cognitive impairment. *Journal of the American Geriatric Society*, *53*, 695–699.

Olson, R. A., Iverson, G. L., Carolan, H., Parkinson, M., Brooks, B. L., & McKenzie, M. (2011). Prospective comparison of two cognitive screening tests: Diagnostic accuracy and correlation with community integration and quality of life. *Journal of Neurooncology*, *105*, 337–344.

Perry, D., Sturm, V., Peterson, M., Pieper, C., Bullock, T., Boeve, B. F., et al. (2015). Association of traumatic brain injury with subsequent neurological and psychiatric disease: A meta-analysis. *Journal of Neurosurgery*, *124*, 511–526.

Petersen, R., Stevens, J., Ganguli, M., Tangalos, E., Cummings, J., & DeKosky, S. (2001). Practice parameter: early detection of dementia: Mild cognitive impairment (an evidence-based review). Report of the quality standards subcommittee of the American Academy of Neurology. *Neurology*, *56*, 1133–42.

G. P. Prigatano, & N. H. Pliskin (Eds) (2003). *Clinical neuropsychology and cost outcome research: A beginning*. New York, NY: Taylor and Francis.

Puente, A. (2013). Coding, billing and documenting professional psychology services. Retrieved December 1, 2016, from www.psychologycoding.com.

Quinlivan, A., Thakkar, V., Stevens, W., Morrisroe, K., Prior, D., Rabusa, C., et al. (2015). Cost savings with a new screening algorithm for pulmonary arterial hypertension in systemic sclerosis. *Internal Medicine Journal*, *45*, 1134–1140.

Rabin, L., Spadaccini, A., Brodale, D., Grant, K., Elbulok-Charcape, M., & Barr, W. (2014). Utilization rates of computerized tests and test batteries among clinical neuropsychologists in the United States and Canada. *Professional Psychology: Research and Practice*, *45*, 368–377.

Raiker, J., Manning, E., Herrington, B., May, A., Haynes, S., Graves, P., et al. (2015). Brief neurocognitive screening in youth with brain tumors: A preliminary investigation of the Lebby-Asbell neurocognitive screening examination. *Brain Injury*, *29*, 1192–1198.

Randolph, C., Tierney, M., Mohr, E., & Chase, T. (1998). The repeatable battery for the assessment of neuropsychological status: preliminary clinical validity. *Journal of Clinical and Experimental Neuropsychology*, *20*, 310–9.

Schmand, B., Rienstra, A., Tamminga, H., Richard, E., van Gool, W. A., Caan, M. W. A., et al. (2014). Responsiveness of magnetic resonance imaging and neuropsychological assessment in memory clinic patients. *Journal of Alzheimer's Disease*, *40*, 409–418.

Sherman, E. M., Wiebe, S., Fay-McClymont, T. B., Tellez-Zenteno, J., Metcalfe, A., Hernandez-Ronquillo, L., et al. (2011). Neuropsychological outcomes after epilepsy surgery: Systematic review and pooled estimates. *Epilepsia*, *52*, 857–869.

Sweet, J. J., Meyer, D. G., Nelson, N. W., & Moberg, P. J. (2011). The TCN/AACN 2010 "Salary Survey": Professional practices, beliefs, and incomes of U.S. Neuropsychologists. *The Clinical Neuropsychologist*, *25*, 12–61.

Temple, R. O., Carvalho, J., & Tremont, G. (2006). A national survey of physicians' use of and satisfaction with neuropsychological services. *Archives of Clinical Neuropsychology: The Official Journal of The National Academy of Neuropsychologists*, *21*, 371–382.

Tiet, Q., Schutte, K., & Leyva, Y. (2013). Diagnostic accuracy of brief PTSD screening instruments in military veterans. *Journal of Substance Abuse Treatment*, *45*, 134–142.

Tremont, G., Westervelt, H. J., Javorsky, D. J., Podolanczuk, A., & Stern, R. A. (2002). Referring physicians' perceptions of the neuropsychological evaluation: How are we doing? *The Clinical Neuropsychologist*, *16*, 551–554.

U.S. Preventative Services Task Force (2009). Screening for high blood pressure: Reaffirmation recommendation statement. *American Family Physician*, *79*, 1087–1088.

VanKirk, K. K., Horner, M. D., Turner, T. H., Dismuke, C. E., & Muzzy, W. (2013). Hospital service utilization is reduced following neuropsychological evaluation in a sample of US Veterans. *The Clinical Neuropsychologist*, *27*, 750–761.

Walker, J., Hansen, C., Martin, P., Symeonides, S., Ramessur, R., Murray, G., et al. (2014). Prevalence, associations and adequacy of treatment of major depression in patients with cancer: A cross-sectional analysis of routinely collected clinical data. *Lancet Psychiatry*, *1*, 343–350.

Westervelt, H. J., Brown, L. B., Tremont, G., Javorsky, D. J., & Stern, R. A. (2007). Patient and family perceptions of the neuropsychological evaluation: How are we doing? *The Clinical Neuropsychologist*, *21*, 263–273.

Wilson, J., & Jungner, G. (1968). *Principles and practice of screening for disease*. Geneva: World Health Organization.

Zygouris, S., Giakoumis, D., Votis, K., Doumpoulakis, S., Ntovas, K., Segkouli, S., et al. (2015). Can a virtual reality cognitive training application fulfill a dual role? Using the virtual supermarket cognitive training application as a screening tool for mild cognitive impairment. *Journal of Alzheimer's Disease*, *44*, 1333–1337.

Zygouris, S., & Tsolaki, M. (2014). Computerized cognitive testing for older adults: A review. *American Journal of Alzheimer's Disease and Other Dementias*, *30*, 13–28.