

NEUROPSYCHOLOGICAL TESTING UNDER THE MEDICAL BENEFIT

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INSTRUCTIONS FOR USE

This Medical Policy provides assistance in interpreting UnitedHealthcare benefit plans. When deciding coverage, the enrollee specific document must be referenced. The terms of an enrollee's document (e.g., Certificate of Coverage (COC) or Summary Plan Description (SPD) and Medicaid State Contracts) may differ greatly from the standard benefit plans upon which this Medical Policy is based. In the event of a conflict, the enrollee's specific benefit document supersedes this Medical Policy. All reviewers must first identify enrollee eligibility, any federal or state regulatory requirements and the enrollee specific plan benefit coverage prior to use of this Medical Policy. Other Policies and Coverage Determination Guidelines may apply. UnitedHealthcare reserves the right, in its sole discretion, to modify its Policies and Guidelines as necessary. This Medical Policy is provided for informational purposes. It does not constitute medical advice.

UnitedHealthcare may also use tools developed by third parties, such as the MCG™ Care Guidelines, to assist us in administering health benefits. The MCG™ Care Guidelines are intended to be used in connection with the independent professional medical judgment of a qualified health care provider and do not constitute the practice of medicine or medical advice.

BENEFIT CONSIDERATIONS

Some benefit documents within UnitedHealthcare exclude neuropsychological testing for some or all indications. The exclusions section of the enrollee-specific benefit document must be consulted in order to determine benefit coverage for neuropsychological testing.

Neuropsychological testing for attention-deficit/hyperactivity disorder (ADHD) is a medical benefit service when medically referred and related or secondary to a known/suspected organic-medical condition resulting from brain injury or disease process (e.g., concussion, intractable seizure disorder, cancer treatment effects). Neuropsychological testing for ADHD is a mental health benefit service when representing a developmental condition not due to specific brain injury or disease process, where there are suspected organic functional impairments.

The scope of the criteria for attention-deficit/hyperactivity disorders and developmental disorders or significant developmental delays is applicable only to neuropsychological testing that is covered by the medical benefit.

Essential Health Benefits for Individual and Small Group:

For plan years beginning on or after January 1, 2014, the Affordable Care Act of 2010 (ACA) requires fully insured non-grandfathered individual and small group plans (inside and outside of Exchanges) to provide coverage for ten categories of Essential Health Benefits (“EHBs”). Large group plans (both self-funded and fully insured), and small group ASO plans, are not subject to the requirement to offer coverage for EHBs. However, if such plans choose to provide coverage for benefits which are deemed EHBs (such as maternity benefits), the ACA requires all dollar limits on those benefits to be removed on all Grandfathered and Non-Grandfathered plans. The determination of which benefits constitute EHBs is made on a state by state basis. As such, when using this guideline, it is important to refer to the enrollee’s specific plan document to determine benefit coverage.

COVERAGE RATIONALE

Neuropsychological testing is proven and medically necessary for the evaluation of patients with the following conditions when the result of testing will influence clinical decision making:

1. Attention-deficit/hyperactivity disorder (ADHD) when all of the following are present:
 - Specific neurocognitive behavioral deficits related to ADHD need to be evaluated and
 - Testing has been recommended by a physician and is related or secondary to a known or suspected organic-medical condition resulting from brain injury or disease process (e.g., concussion, intractable seizure disorder, cancer treatment effects, genetic disorders, inborn errors of metabolism)

The scope of these criteria is applicable only to neuropsychological testing that is covered by the medical benefit. These criteria do not apply to evaluate or determine educational interventions.

2. Confirmed space-occupying brain lesion including the following:
 - Brain abscess
 - Brain tumors
 - Arteriovenous malformations within the brain
3. Dementia or symptoms of dementia such as memory impairment or memory loss (including extrapyramidal disorders such as Parkinson’s disease) that is associated with a new onset or progressive memory loss and a decline in at least one of the following cognitive domains (DSM-5):
 - complex attention
 - executive function
 - learning and memory
 - language
 - perceptual-motor
 - social cognition
4. Demyelinating disorders including multiple sclerosis
5. Intellectual disability or intellectual developmental disorder when all of the following are present:
 - The intellectual disability or intellectual developmental disorder is associated with a known or suspected medical cause (e.g., traumatic brain injury, in utero toxin exposure, early seizure disorder, sickle cell disease, genetic disorders) and

- The intellectual disability or intellectual developmental disorder meets all of the following criteria (DSM-5):
 - Deficits in intellectual function, such as reasoning, problem solving, planning, abstract thinking, judgment, academic learning, and learning from experience, confirmed by both clinical assessment and individualized, standardized intelligence testing
 - Deficits in adaptive functioning that result in failure to meet developmental and sociocultural standards for personal independence and social responsibility. Without ongoing support, the adaptive deficits limit functioning in one or more activities of daily life, such as communication, social participation, and independent living across multiple environments, such as home, school, work and community
 - Onset of intellectual and adaptive deficits during the developmental period

The scope of these criteria is applicable only to neuropsychological testing that is covered by the medical benefit. These criteria do not apply to evaluate or determine educational interventions.
6. Encephalopathy including acquired immunodeficiency syndrome (AIDS) encephalopathy, human immunodeficiency virus (HIV) encephalopathy, hepatic encephalopathy, Lyme disease encephalopathy including neuroborreliosis, Wernicke's encephalopathy and systemic lupus erythematosus (SLE) encephalopathy.
 7. Neurotoxin exposure with at least one of the following:
 - Demonstrated serum levels of neurotoxins
 - Individual with documented significant prenatal alcohol, drug, or toxin exposure
 8. Seizure disorder including patients with epilepsy and patients being considered for epilepsy surgery
 9. Stroke or more than one transient ischemic attack
 10. Traumatic brain injury (TBI): TBI is defined as a bump, blow, or jolt to the head or a penetrating head injury that disrupts the normal function of the brain.(Centers for Disease Control and Prevention). See the following Web site for more information: <http://www.cdc.gov/TraumaticBrainInjury/index.html>. Accessed April 2014.

Baseline neuropsychological testing in asymptomatic persons to manage potential sport-related concussions is unproven and not medically necessary.

There is insufficient evidence to indicate that the use of baseline neuropsychological testing in athletes or other individuals alters risk from concussion. There is insufficient evidence that baseline tests influence physician decision-making or outcomes of treatment of concussion.

Computerized neuropsychological testing such as ImPACT™, CogState Sport®, or HeadMinder® is unproven and not medically necessary when used alone for evaluating concussions.

Computerized neuropsychological testing should be used in conjunction with a standard non-computerized neuropsychological evaluation to evaluate concussions. The evidence is insufficient to establish the validity and reliability of computerized tests to evaluate concussions when used in isolation. Prospective controlled trials are needed to demonstrate the clinical utility of these tests to detect impairment following concussion when used alone.

Neuropsychological testing is unproven and not medically necessary for the following diagnoses alone without other proven conditions as noted above:

- Headaches including migraine headache
- History of myocardial infarction

- Intermittent explosive disorder

There is insufficient clinical evidence to demonstrate that the use of neuropsychological testing for patients with myocardial infarction, migraine or other headaches or intermittent explosive disorder without associated cognitive disorders can be used effectively for clinical decision making to improve patient management of those conditions.

The Mindstreams® Cognitive Health Assessment is unproven and not medically necessary for diagnosing dementia or mild cognitive impairment.

Available clinical trials have failed to document a beneficial effect of Mindstreams computerized cognitive testing on long-term clinical outcomes. The evidence is insufficient to establish the validity of Mindstreams computerized cognitive testing compared with traditional tests for the assessment of dementia and cognitive impairment.

APPLICABLE CODES

The Current Procedural Terminology (CPT®) codes and Healthcare Common Procedure Coding System (HCPCS) codes listed in this policy are for reference purposes only. Listing of a service code in this policy does not imply that the service described by this code is a covered or non-covered health service. Coverage is determined by the enrollee specific benefit document and applicable laws that may require coverage for a specific service. The inclusion of a code does not imply any right to reimbursement or guarantee claims payment. Other policies and coverage determination guidelines may apply. This list of codes may not be all inclusive.

CPT® Code	Description
96116	Neurobehavioral status exam (clinical assessment of thinking, reasoning and judgment, e.g., acquired knowledge, attention, language, memory, planning and problem solving, and visual spatial abilities), per hour of the psychologist's or physician's time, both face-to-face time with the patient and time interpreting test results and preparing the report
96118	Neuropsychological testing (e.g., Halstead-Reitan Neuropsychological Battery, Wechsler Memory Scales and Wisconsin Card Sorting Test), per hour of the psychologist's or physician's time, both face-to-face time administering tests to the patient and time interpreting these test results and preparing the report
96119	Neuropsychological testing (e.g., Halstead-Reitan Neuropsychological Battery, Wechsler Memory Scales and Wisconsin Card Sorting Test), with qualified health care professional interpretation and report, administered by technician, per hour of technician time, face-to-face
96120	Neuropsychological testing (e.g., Wisconsin Card Sorting Test), administered by a computer, with qualified health care professional interpretation and report

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DESCRIPTION OF SERVICES

Neuropsychological testing is a set of formal procedures utilizing diagnostic tests specifically focused on identifying the presence of brain damage, injury or dysfunction and any associated functional deficits. Measurement of deficits cannot be based on single test results and should always be assessed in the context of the medical and neurological examination.

Neuropsychological testing is customarily associated with neurological diagnoses rather than behavioral health diagnoses.

Neuropsychological tests are administered in a variety of contexts including paper-and-pencil, computers, and visual aids. Following an initial clinical interview with a neuropsychologist, tests are strategically selected to identify specific deficits and preserved abilities. Standardized tests are then administered by a trained technician or neuropsychologist. Some tests offer multiple forms making them useful for repeated administration to the same patient, thereby minimizing practice effects. In light of the numerous procedures available for assessment of different neurocognitive functions, test selection is based on familiarity of the examiner with certain tests, availability of appropriate normative data, ability of the patient to participate in testing (e.g., quadriplegic or hemiplegic patients may not be able to participate in psychomotor testing), and validity of particular procedures for the specific function being measured. For developmental disorders, neuropsychological tests are useful as part of a complete clinical decision making process and do not unilaterally make the diagnosis of autism spectrum disorder (Zwaigenbaum, 2009).

Neuropsychological tests include but are not limited to the following: Boston Diagnostic Aphasia Examination (BDAE), Conners' Continuous Performance Test (CCPT), Controlled Oral Word Association Test (COWAT), Delis-Kaplan Test Battery, Freedom from Distractibility Index (FFDI) from the Wechsler Intelligence Scales, Gordon Diagnostic System (GDS), Halstead-Reitan Neuropsychological Battery, Rey Auditory Verbal Learning Test (RAVLT), Rey-Osterreith Complex Figure Test, Stroop Color and Word Test, Test of Variables of Attention (TOVA), Trail Making Tests, Wechsler Adult Intelligence Scale-Revised (WAIS-III/IV), Wide Range Assessment of Memory and Learning (WRAML), and Wisconsin Card Sorting Test (WCST). At times, neurocognitive measures are supplemented by emotional functioning and personality testing and include but are not limited to the following: Minnesota Multiphasic Personality Inventory-2 (MMPI-2)/Minnesota Multiphasic Personality Inventory-A (MMPI-A), Personality Assessment Inventory (PAI), Geriatric Rating Scale, Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI), and Rorschach Inkblot Method.

Computerized testing for dementia and cognitive impairment including the Mindstreams® Cognitive Health Assessment (NeuroTrax® Corp.) uses computer-based assessments in an attempt to identify cognitive impairment in the elderly. The software programs give patients various stimuli or puzzles to solve using a mouse or a keypad. The Mindstreams system automatically generates a report that details the patient's performance in the standard cognitive domains, or areas, e.g., memory, attention, executive function, visual spatial perception, verbal skills, motor planning, and information processing.

Computerized neuropsychological tests are widely used as part of the overall medical management of concussion to monitor recovery. Most computer-based cognitive assessment tools are designed to detect the speed and accuracy of attention, memory, and thinking ability. Currently available computerized tests include ImPACT (Immediate Post-Concussion Assessment and Cognitive Testing, ImPACT Applications, Inc.), ANAM (Automated Neuropsychological Assessment Metrics, the United States Army Medical Department), CogState Sport (Axon Sports, Ltd.), and HeadMinder (Headminder, Inc.). These tests are being investigated for baseline testing of asymptomatic persons and managing concussions once they occur.

Neuropsychological testing is typically conducted or supervised by a licensed psychologist with training and expertise in the types of tests/assessment being requested and is able to interpret testing data in accordance with the American Psychological Association standards of practice. Tests may be administered and scored by an appropriately trained psychometrist or psychometrician under the supervision of a licensed psychologist (or other qualifying service provider). However, test interpretation and report writing must be done by the licensed psychologist or other provider of care, and all reports must be signed by the psychologist or other provider of care. The licensed psychologist must have face-to-face contact with the patient being tested, at a minimum at both an initial intake interview visit and at the testing feedback visit.

During administration, the provider monitors ensure that the patient is giving sufficient effort and attention to completing the test battery to ensure that a valid and reliable measure is obtained.

While neuropsychological testing is usually done by or under the supervision of a specially trained psychologist, it may also be provided by a certified neuro-behavioral psychiatrist (with certification in neurology through the American Board of Psychiatry and Neurology, or accreditation in behavioral neurology and neuropsychiatry through the American Neuropsychiatric Association) when the following criteria are met:

- The provider has professional training and expertise in the types of tests/assessment being requested; and
- The provider can conduct test administration, scoring, and interpretation in accordance with currently prevailing national professional and ethical standards regarding provision of neuropsychological testing service.

CLINICAL EVIDENCE

Attention Deficit Hyperactivity Disorder (ADHD)

Thaler et al. (2010) compared patterns of attention, learning, and memory impairment on the Test of Memory and Learning (TOMAL) between 80 children with ADHD and 80 normal comparisons who were matched for age and gender. Results demonstrated that children with ADHD performed significantly worse than matched controls on the Attention/Concentration Index and the Sequential Recall Index. ROC analysis indicated that these two indices had good classification accuracy. Significant correlation between the TOMAL Index scores and tests of intelligence and visuomotor integration supported the convergent and discriminant validity of the test. According to the investigators, these results provide support for the validity of the TOMAL in assessing neurocognitive deficits in children with ADHD.

Bechtel et al. (2012) evaluated whether boys with epilepsy-related ADHD and developmental ADHD share a common behavioral, pharmaco-responsive, and neurofunctional pathophysiology. Seventeen boys with diagnosed combined epilepsy/ADHD, 15 boys with developmental ADHD, and 15 healthy controls (aged 8-14 years) performed on working memory tasks (N-back) while brain activation was recorded using functional magnetic resonance imaging. On a behavioral level, boys with epilepsy-related ADHD as well as those with developmental ADHD performed similarly poorly on tasks with high cognitive load when compared to healthy controls. On the functional level, both patient groups showed similar reductions of activation in all relevant parts of the functional network of working memory when compared to controls. The study data showed strong similarities between epilepsy-related and developmental ADHD on the behavioral, pharmaco-responsive, and neural level, favoring the view that ADHD with and without epilepsy shares a common underlying neurobehavioral pathophysiology.

The clinical evidence was reviewed in May 2014 with no additional information identified that would change the conclusion.

Dementia, Possible Dementia, Memory Loss, and Memory Impairment

For memory impairment or dementia screening, a single test of global measures of function or a measure of cognitive function is usually administered along with a test of behavioral or emotional symptoms. In addition to brief screening tests, for some patients, comprehensive neuropsychological testing may be indicated to confirm a diagnosis, evaluate effects of treatment, and assist in designing rehabilitative or intervention strategies for the patient. Standardized test batteries are too long for most patients with dementia; specialized dementia batteries or an individualized test battery is usually more appropriate.

A definitive diagnosis of Alzheimer's disease is based on the presence of memory deficits along with deficits in at least one other aspect of cognition, and in some cases is made on neuropsychological test results alone (Talwalker, 1996). Impairment in primary (short-term) memory alone is not a useful diagnostic marker for Alzheimer's disease in the early stages. Tests

of delayed recall (long-term memory) and retrieval of facts of common knowledge have been shown to be the most useful measures to distinguish normal aging and early Alzheimer's disease. Dementia due to Alzheimer's disease can be distinguished from dementia due to vascular disease by differences in pattern of memory impairment and the progressive nature of Alzheimer's disease. Careful interpretation of test results, taken in conjunction with medical findings, allows differentiation of Alzheimer's disease from normal memory loss due to aging, and from vascular dementia.

Carthey-Goulart et al. (2012) compared the performance of groups with semantic dementia (SD) (n=27) and progressive nonfluent aphasia (PNFA) (n=16) with comparable ages, education, disease duration, and severity of dementia as measured by the Clinical Dementia Rating Scale on a comprehensive neuropsychological battery. The authors found that neuropsychological tests that examine verbal and nonverbal semantic associations, verbal working memory, and phonological processing are the most helpful for distinguishing between PNFA and SD.

Madureira et al. (2010) determined the extent to which the performance in neuropsychological tests would be able to predict the clinical diagnosis of dementia. The LADIS (Leukoaraiosis and Disability) is a prospective study that evaluates the impact of white matter changes (WMC) on the transition of independent elderly to disability. The subjects were evaluated at baseline and yearly during 3 years with a comprehensive clinical, functional and neuropsychological protocol. At each visit, dementia was classified according to clinical criteria. The performance in the neuropsychological batteries was compared according to the clinical diagnosis of dementia. From the initially enrolled 639 subjects, 480 were evaluated at year 3. Dementia was diagnosed in 90 participants. The demented subjects had worse performance in almost all the baseline cognitive tests. Using receiver operating characteristic curves, the investigators found that the Vascular Dementia Assessment Scale (VADAS) battery had higher sensitivity and specificity rates to identify dementia compared with the Mini-Mental State Examination (MMSE) and Alzheimer's Disease Assessment Scale. Worse performances on baseline MMSE were predictors of dementia. The investigators concluded that performance on the MMSE and the VADAS battery were important predictors of dementia at a 3-year period.

Pseudodementia, a dementia of "nonorganic" etiology, is due to profound depression and can be difficult to differentiate from true dementia. The Geriatric Depression Scale is commonly used for evaluating depression in elderly people. Prospective studies have shown increased accuracy in differentiating pseudodementia from true dementia with repeated testing 12-18 months later (Yousef, 1998). This is a vital distinction to make, as organic dementia is often progressive and is usually not reversible, while dementia associated with depression may reverse or resolve with treatment.

The clinical evidence was reviewed in May 2014 with no additional information identified that would change the conclusion.

Developmental Disorders

In general, empirical data, rather than evidence from prospective studies with long-term follow-up, support the use of neuropsychological testing for developmental disorders in infants and children. For the Test of Infant Motor Performance, there is evidence from a longitudinal study with subjects stratified by postconceptional age, medical risk, and race or ethnicity that this test has predictive validity for identifying infants at risk for poor developmental outcome (Campbell, 1995).

In a national cohort of extremely low birth weight (ELBW) children, neuropsychological test profiles were assessed in 4 groups defined according to a neurological examination at 5 years of age: normal neuromotor status (N = 56), motor coordination problems (N = 32), multiple subtle neuromotor signs including both motor coordination problems and deviant reflexes (N = 20), and spastic diplegia (N = 12). The neurocognitive assessment included a test of intelligence, the Wechsler Primary and Preschool Scale of Intelligence-Revised (WPPSI-R) and 14 subtests of attention and executive functions, verbal functions, manual motor functions, visuocstructional

functions and verbal learning. The children with normal neuromotor status performed within the average range; children with motor coordination problems had widespread impairment; and children with spastic diplegia and children with multiple minor neuromotor signs had uneven test profiles with stronger verbal results but weaknesses in attention and executive functions, and in manual motor and visuoconstructional tasks. According to the investigators, very early gestation children with neuromotor signs, including motor coordination problems, are at risk for neurocognitive impairment, in spite of average intelligence. More impaired children have more irregular test profiles. Follow-up and neuropsychological assessments of very preterm children with minor neuromotor signs are therefore indicated (Korkman, 2008).

Hartman et al. (2010) examined the motor skills and executive functions in school-age children with borderline and mild intellectual disabilities (ID). Sixty-one children aged between 7 and 12 years diagnosed with borderline ID (33 boys and 28 girls; $71 < IQ < 79$) and 36 age peers with mild ID (24 boys and 12 girls; $54 < IQ < 70$) were assessed. Their abilities were compared with those of 97 age- and gender-matched typically developing children. Qualitative motor skills, i.e. locomotor ability and object control, were evaluated with the Test of Gross Motor Development (TGMD-2). Executive functioning (EF), in terms of planning ability, strategic decision-making and problem solving, was gauged with the Tower of London (TOL) task. Compared with the reference group, the full ID cohort scored significantly lower on all assessments. According to the investigators, the study results support the notion that besides being impaired in qualitative motor skills, intellectually challenged children are also impaired in higher-order executive functions. The authors conclude that deficits in the two domains are interrelated, so early interventions boosting their motor and cognitive development are recommended.

In the Cooperative Study of Sickle Cell Disease, Wang et al. (2001) compared the results of serial neuropsychologic testing in 373 children with sickle cell disease with the results of serial magnetic resonance imaging (MRI) examinations, particularly to evaluate neuropsychologic function in the absence of overt stroke. Twenty-seven patients had overt strokes and 62 had silent infarcts. Patients with hemoglobin SS and silent infarcts had significantly lower scores for math and reading achievement, Full-Scale IQ, Verbal IQ, and Performance IQ, when compared with those with normal MRI findings. In children with hemoglobin SS and normal MRI findings, the scores for Verbal IQ, math achievement, and coding (a subscale of Performance IQ) declined with increasing age. The investigators concluded that school-aged children with sickle cell disease had compromised neuropsychologic function in the presence of silent infarcts. In addition, they had declines in performance in certain areas of function over time. Therapeutic interventions that prevent or lessen cognitive impairment are needed before school entry for children with sickle cell disease.

The clinical evidence was reviewed in May 2014 with no additional information identified that would change the conclusion.

Traumatic Brain Injury

Longitudinal and case controlled studies along with numerous case reports support the use of neuropsychological tests to assess the severity of injury and the prognosis for patients with closed head trauma, to monitor progression, and to provide measures of outcome for determining degree of recovery (Baum, 2008; Kalmar, 2008; Greve, 2008). Sufficient scientific evidence from a variety of sources exists to prove the efficacy of neuropsychological testing in the immediate and long-term evaluation of brain-injured patients (Williams, 2013; Boake, 2001; Atchison, 2004).

The clinical evidence was reviewed in May 2014 with no additional information identified that would change the conclusion.

Other Disorders

Neuropsychological testing may have a role in the clinical management of the following medical disorders:

- brain lesions including abscesses, tumors, and arteriovenous malformations in the brain (Iuvone, 2011; Krupp, 2009; Visani, 2006)
- demyelinating disease including multiple sclerosis (Benedict, 2006; Caceres, 2011; Glanz, 2012)
- encephalopathy (Poh, 2012; Martin, 2006; Skinner, 2009; Stewart 2010)
- epilepsy and seizure disorders (Austin, 2010; Potter, 2009; Jackson, 2012)
- neurotoxin exposure (Rohlman, 2005; Lasio-Baker, 2004)
- stroke (Wiberg, 2012)

The clinical evidence was reviewed in May 2014 with no additional information identified that would change the conclusion.

Computerized Neuropsychological Testing for Concussion

Echemendia et al. (2013) critically reviewed the literature from the past 12 years regarding key issues in sports-related neuropsychological assessment of concussion. Based on the review of the literature, the authors concluded that traditional and computerized neuropsychological tests are useful in the evaluation and management of concussion. Brief cognitive evaluation tools are not substitutes for formal neuropsychological assessment. According to the authors, there is insufficient evidence to recommend the widespread routine use of baseline neuropsychological testing.

Broglio et al. (2007a) examined the test-retest reliability of 3 commercially available computer-based neurocognitive assessments using clinically relevant time frames in 118 healthy student volunteers. The participants completed the ImPACT, Concussion Sentinel, and Headminder Concussion Resolution Index tests on 3 days: baseline, day 45, and day 50. Each participant also completed the Green Memory and Concentration Test to evaluate effort. Intraclass correlation coefficients were calculated for all output scores generated by each computer program as an estimate of test-retest reliability. All participants demonstrated high levels of effort on all days of testing, according to Memory and Concentration Test interpretive guidelines. The investigators concluded that computer-based concussion evaluations did not provide stable measures of cognitive functioning in healthy adults and that inconsistent performance on concussion assessments may lead clinicians to inaccurate determinations of cognitive function. According to the authors, clinicians should be cautious in interpreting findings of concussion assessments and should use a multifaceted approach.

In a cohort study, Lau et al. (2011) quantified the prognostic ability of computerized neurocognitive testing in combination with symptoms during the subacute recovery phase from sports-related concussion. A total of 108 male high school football athletes completed a computer-based neurocognitive test battery (ImPACT) within 2.23 days of injury and were followed until returned to play as set by international guidelines. Athletes were grouped into protracted recovery (>14 days; n = 50) or short-recovery (≤14 days; n = 58). Multiple discriminant function analyses revealed that the combination of 4 symptom clusters and 4 neurocognitive composite scores had the highest sensitivity (65.22%), specificity (80.36%), positive predictive value (73.17%), and negative predictive value (73.80%) in predicting protracted recovery. The investigators concluded that the use of computerized neurocognitive testing in conjunction with symptom clusters results improves sensitivity, specificity, positive predictive value, and negative predictive value of predicting protracted recovery compared with each used alone. There is also a net increase in sensitivity of 24.41% when using neurocognitive testing and symptom clusters together compared with using total symptoms on Post-Concussion Symptom Scale alone.

Elbin et al. (2011) investigated the 1-year test-retest reliability of the ImPACT online version in a sample of high school athletes. A total of 369 varsity high school athletes completed 2 mandatory preseason baseline cognitive assessments approximately 1 year apart as required by their respective athletics program. No diagnosed concussion occurred between assessments. Intraclass correlation coefficients (ICCs) for ImPACT online indicated that motor processing speed (.85) was the most stable composite score, followed by reaction time (.76), visual memory

(.70), and verbal memory (.62). Unbiased estimates of reliability were consistent with ICCs: motor processing speed (.85), reaction time (.76), visual memory (.71), and verbal memory (.62). The authors concluded that the online ImpACT baseline is a stable measure of neurocognitive performance across a 1-year time period for high school athletes. This was an uncontrolled case series and this limits the validity of the study.

Schatz et al. (2006) evaluated the diagnostic utility of the composite scores of Immediate Post-Concussion Assessment and Cognitive Testing (ImpACT) and Post Concussion Symptom Scale scores (PCSS). Recently concussed high school athletes (n=72) were tested within 72 hours of sustaining a concussion, and data were compared to non-concussed high school athletes with no history of concussion (n=66). A discriminant function analyses was conducted to measure the ability of the five ImpACT composite scores, as well as the PCSS to classify concussion status. One discriminant function was identified that consisted of the Visual Memory, Processing Speed, and Impulse Control composite scores PCSS, which correctly classified 85.5% of the cases. Approximately 82% of participants in the concussion group and 89% of participants in the control group were correctly classified. Using these data, the sensitivity of ImpACT was 81.9%, and the specificity was 89.4%. The investigators concluded that as part of a formal concussion management program, ImpACT is a useful tool for the assessment of the neurocognitive and neurobehavioral sequelae of concussion, and can also provide post-injury cognitive and symptom data that can assist a practitioner in making safer return to play decisions. According to the investigators, when used appropriately, by a trained neuropsychologist and in conjunction with a thorough clinical interview, the utility of ImpACT is likely to be further enhanced. This was a retrospective study, and this limits its validity.

Broglio et al. (2007) investigated the sensitivity of concussion-related symptoms, a postural control evaluation, and neurocognitive functioning in concussed collegiate athletes. From 1998 to 2005, all high-risk athletes completed a baseline concussion-assessment battery that consisted of a self-reported symptom inventory, a postural control evaluation, and a neurocognitive assessment. Postconcussion assessments were administered within 24 hours of injury to 75 athletes who had physician-diagnosed concussion. Individual tests and the complete battery were evaluated for sensitivity to concussion. The computerized Immediate Post-Concussion Assessment and Cognitive Testing and HeadMinder Concussion Resolution Index (neurocognitive tests) were the most sensitive to concussion (79.2 and 78.6%, respectively). These tests were followed by self-reported symptoms (68.0%), the postural control evaluation (61.9%), and a brief pencil-and-paper assessment of neurocognitive function (43.5%). When the complete battery was assessed, sensitivity exceeded 90%. According to investigators, currently recommended concussion-assessment batteries accurately identified decrements in one or more areas in most of the athletes with concussion. These findings support previous recommendations that sports-related concussion should be approached through a multifaceted assessment with components focusing on distinct aspects of the athlete's function.

Randolph et al. (2005) assessed the criteria that should be met in order to establish the utility of neuropsychological (NP) instruments as a tool in the management of sport-related concussion and to review the degree to which existing tests have met these criteria. The authors completed a comprehensive literature review of MEDLINE and PsychLit from 1990 to 2004, including all prospective, controlled studies of NP testing in sport-related concussion. The data synthesis indicated that the effects of concussion on NP test performance are so subtle even during the acute phase of injury (1-3 days postinjury) that they often fail to reach statistical significance in group studies. Thus, this method may lack utility in individual decision making because of a lack of sensitivity. In addition, most of these tests fail to meet other psychometric criteria (e.g., adequate reliability) necessary for this purpose. Finally, it is unclear that NP testing can detect impairment in players once concussion-related symptoms (e.g., headache) have resolved. Because no current guideline for the management of sport-related concussion allows a symptomatic player to return to sport, the utility of NP testing remains questionable. The authors concluded that despite the theoretic rationale for the use of NP testing in the management of sport-related concussion, no NP tests have met the necessary criteria to support a clinical

application at this time. Additional research is necessary to establish the utility of these tests before they can be considered part of a routine standard of care, and concussion recovery should be monitored via the standard clinical examination and subjective symptom checklists until NP testing or other methods are proven effective for this purpose.

Maerlender et al. (2010) compared scores on the ImPACT battery to a comprehensive battery of traditional neuropsychological measures and several experimental measures used in the assessment of sports-related concussion in 54 healthy male athletes. Convergent validity was demonstrated for four of the five ImPACT domain scores. Two cognitive domains often compromised as a result of mild TBI were not directly identified by the ImPACT battery: sustained attention and auditory working memory. Affective symptoms correlated with performance on measures of attention and working memory. In this healthy sample the correlations between the domains covered by ImPACT and the neuropsychological battery supports ImPACT as a useful screening tool for assessing many of the cognitive factors related to mild traumatic brain injury. However, the narrow construct structure of ImPACT would limit interpretation, particularly with regard to the important functions of working memory and response accuracy. This may make ImPACT testing difficult to interpret for the untrained professional. According to the investigators, the study suggests that other sources of data such as a traditional neuropsychological testing including verbal memory, visual memory, and working memory need to be considered when identifying and managing concussions.

In a consensus statement, the 4th International Conference on Concussion in Sport states that the use of neuropsychological testing contributes significant information in concussion assessment. No specific recommendations are made regarding computerized neuropsychological testing. The statement does not advocate the use of neuropsychological testing alone in determining the presence of concussion or in the concussion management process. The consensus statement suggests that baseline neuropsychological testing may be useful in interpreting the test but is not required as a mandatory component due to insufficient evidence to support recommending routine use of baseline testing (McCrorry et al., 2013).

Baseline Neuropsychological Testing for Concussion

In a study conducted by Schmidt et al. (2012), 1,060 collegiate student-athletes completed baseline testing as part of an ongoing clinical program. Gender-specific normative means were obtained from a subset of 673 athletes with no history of self-reported concussion, learning disabilities, or attention deficit disorders. Concussions were later diagnosed in 258 athletes who had completed baseline testing. Athletes completed a computerized neurocognitive test (Automated Neuropsychological Assessment Metrics), postural control assessment, and a 15-item graded symptom checklist at baseline and again following injury. Two post-concussion difference scores were computed for each outcome measure: (1) Baseline comparison = post-concussion score - individualized baseline score; and (2) Normative comparison = post-concussion score - normative mean. Athletes were considered impaired if post-concussion difference exceeded the reliable change parameters. The baseline comparison method identified 2.6 times more impairments than the normative comparison method for Simple Reaction Time-Test 1. The normative comparison method identified 7.6 times more impairments than the baseline comparison method for Mathematic Processing. No other disagreements were observed for postural control or symptom severity. The authors concluded that when using these concussion assessment tools, clinicians may consider using normative data in lieu of individualized baseline measures. This may be especially useful to clinicians with limited resources and an inability to capture baselines on all athletes.

Brown et al. (2007) investigated factors, such as sex, SAT score, alertness, and sport, and their effects on baseline neuropsychological test scores. The study population comprised 327 National Collegiate Athletic Association Division I athletes from 12 men's and women's sports. The investigators concluded that the performance on computerized neuropsychological tests may be affected by a number of factors, including sex, SAT scores, alertness at the time of testing, and the athlete's sport. According to the investigators, in order to avoid making clinical

misinterpretations, clinicians should acknowledge that individual baselines vary over time and should account for this variation. The clinical utility of baseline testing in clinical decision-making was not addressed.

Hunt et al. (2007) examined effort in an athletic population to determine if poor effort effects baseline neuropsychological test performance. High school athletes (n=199) were administered a brief neuropsychological test battery, which included the Dot Counting Test (DCT) and the Rey 15-Item Test with recognition trial. One-way analyses of variance were used to compare groups with adequate and poor effort test performance. Most athletes (N=177; 89%) exerted adequate effort while a number of athletes (N=22; 11%) exerted poor effort on the DCT. Statistically significant differences existed between effort groups on several of the neuropsychological tests. The investigators concluded that poor effort was observed in the athletic population during baseline testing and athletes with poor effort displayed statistically significant differences in performance on neuropsychological tests. Adding an effort test to baseline examinations may improve post-concussion test score interpretations. The clinical utility of baseline testing in clinical decision-making was not addressed.

Randolph (2011) reviewed the risks associated with sport-related concussion, and the clinical validity and reliability data for the most commonly used baseline test, the ImPACT program. The authors found no published prospective controlled study of the current version of ImPACT that would allow a determination to be made as to whether ImPACT is capable of detecting impairment in a significant percentage of athletes once they are symptom free. According to the authors, the bulk of the evidence suggests that ImPACT is not particularly sensitive to the effects of concussion, particularly once subjective symptoms have resolved. The poor sensitivity and low reliability of this test is associated with a high false negative rate (i.e., classifying a player's neurocognitive status as normal, when in fact, it is not). The use of baseline neuropsychological testing, therefore, is not likely to diminish risk. The clinical utility of baseline testing in clinical decision-making was not addressed.

The clinical evidence was reviewed in May 2014 with no additional information identified that would change the conclusion.

Mindstreams® Cognitive Health Assessment

Dwolatzky et al. (2010) examined the validity of the Mindstreams battery designed specifically for evaluating those with moderate cognitive impairment. One hundred and seventy participants over the age of 60 years performed the computerized battery in addition to standard clinical evaluation. Staging was according to the Clinical Dementia Rating Scale (CDR) on the basis of clinical data but independent of computerized cognitive testing results, thus serving as the gold standard for evaluating the discriminant validity of the computerized measures. Seven participants received a global Clinical Dementia Rating (CDR) score of 0 (not impaired), 76 were staged as CDR 0.5 (very mildly impaired), 58 as CDR 1 (mildly impaired), 26 as CDR 2 (moderately impaired), and 3 as CDR 3 (severely impaired). Mindstreams Global Score performance was significantly different across CDR groups, reflecting poorer overall battery performance for those with greater impairment. This was also true for the domain summary scores, with Executive Function and Memory distinguishing best between CDR 0.5 and 1, and Orientation best differentiating among CDR 1 and 2. The investigators concluded that the Mindstreams battery for moderate impairment differentiates among varying degrees of cognitive impairment in older adults, providing detailed and distinct cognitive profiles. Limitations of this study include lack of a control group and small sample size.

Achiron et al. (2007) compared the Mindstreams test battery with the Neuropsychological Screening Battery for Multiple Sclerosis (NSBMS), which is considered the reference standard for cognitive screening in MS, in patients with MS (n=58) and in a control group of healthy volunteers (n=71) who were matched for age, education, gender, handedness, and computer use. The 71 controls were randomly selected from 410 individuals who were used to establish normative values for the Mindstreams system. Five of the 7 index scores (memory, executive function,

attention, information processing, and motor skills) significantly discriminated MS patients from controls, while visuo-spatial and verbal-function indexes did not. However, the NSBMS system was not assessed in a similar manner; only correlation coefficients of the Mindstreams index scores and NSBMS system outcomes were presented. As with the study by Ritsner et al. (2006), all of the correlations were statistically significant, but the magnitude of the correlation coefficients indicates only moderate correlation at best. This study, therefore, demonstrates the capability of the Mindstreams system to differentiate MS patients from healthy volunteers across 5 of 7 cognitive domains, but the data are insufficient to establish the equivalence of the Mindstreams system to the standard of care or to demonstrate a benefit of Mindstreams assessment on clinical outcomes.

Elstein et al. (2005) compared the Mindstreams battery with a battery of 18 standard neuropsychological tests that were administered by a psychologist to patients with type 1 Gaucher disease. In patients with Gaucher disease, Mindstreams detected no cognitive decline among miglustat-treated patients compared with those treated with enzyme replacement therapy or untreated patients. In contrast, 5 of 18 traditional tests found differences in cognitive functioning for the miglustat-treated patients. This study does not support equivalence of the Mindstreams battery to traditional neuropsychological testing in this patient group. The results are inconclusive due to several study limitations, including the incomplete testing of subjects with the Mindstreams battery, group inequalities, technical failures with some of the traditional tests, and the overall uncertainty regarding cognitive impairments in this group.

Overall, the available evidence is insufficient to establish the validity of Mindstreams computerized cognitive testing compared with traditional tests for the assessment of cognitive impairment.

The clinical evidence was reviewed in May 2014 with no additional information identified that would change the conclusion.

Intermittent Explosive Disorder

There are no clear underlying medical issues associated with intermittent explosive disorder, nor are there published clinical trials that support the use of neuropsychological testing for this disorder. According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), published by the American Psychiatric Association, the following criteria must be met in order for a patient to be diagnosed with intermittent explosive disorder:

1. Recurrent behavioral outbursts that represent a failure to control aggressive impulses as manifested by one of the following:
 - a. Verbal aggression (e.g., temper tantrums, tirades, verbal arguments or fights) or physical aggression towards property, animals, or other individuals, occurring, on average, twice weekly for a period of three months. The physical aggression does not result in damage or destruction of property and does not result in physical injury to animals or other individuals.
 - b. Three behavioral outbursts involving damage or destruction of property and/or physical assault with physical injury against animals or other individuals occurring within a 12-month period.
2. The magnitude of aggressiveness expressed during the recurrent outbursts is grossly out of proportion to the provocation or any precipitating psychosocial stressors.
3. The recurrent aggressive outbursts are not premeditated (i.e. are impulsive) and are not committed to achieve some tangible objective (e.g., money, power, intimidation).
4. The recurrent aggressive outbursts cause either marked distress in the individual or impairment in occupational or interpersonal functioning, or are associated with financial or legal consequences.
5. Chronological age is at least 6 years (or equivalent developmental level).
6. The recurrent aggressive outbursts are not better explained by another mental disorder and are not attributable to another medical condition or to physiological effects of a substance.

Headaches Including Migraine

Literature addressing the neuropsychological consequences of migraine headaches is not conclusive. Studies on the relationship between migraine and cognitive functioning have demonstrated conflicting results. Some studies show a detrimental effect of migraine on cognitive skills (Calandre, 2002). Other studies have shown no difference in cognitive skills for patients with migraine headaches (Gaist, 2005; Pearson, 2006).

Dresler et al. (2012) evaluated three neuropsychological tests (Trail Making Test (TMT), Go/Nogo Task and Stroop Task) that were completed by four headache patient samples (chronic CH, episodic CH in the active or inactive period, and migraine patients) and compared to healthy controls. Analyses revealed that patients with chronic and active episodic CH appeared particularly impaired in tests relying more on intact executive functioning (EF) than on basal cognitive processes. Within the CH groups performance decreased linearly with increasing severity. The authors stated that impaired EF could also result from medication and sleep disturbances due to active CH. The authors went on to say that because decreased performance was also present outside the attacks it may hint at generally altered brain function, but does not necessarily reflect clinically relevant behavior.

Mongini et al. (2005) evaluated whether neuropsychological tests demonstrate a frontal lobe dysfunction in patients with chronic migraine. The Gambling Task (GT), the Tower of Hanoi-3 (TOH-3) and the Object Alternation Test (OAT) were administered to 23 female patients previously treated for chronic migraine and to 23 healthy women who were similar to the patients in age and educational level, and the mean test scores of the two groups were compared. The patient group scored significantly higher than the controls on the TOH-3 and, especially, the OAT. In the patients, no significant relationship was found between the neuropsychological test scores and those for the Minnesota Multiple Personality Inventory (MMPI), the Spielberg State-Trait Anxiety Inventory (STAI), and the Beck Depression Inventory (BDI). The investigators concluded that the data suggest a relationship between chronic headache and dorsolateral function (as tested by the TOH-3) and orbitofrontal function (as tested by the OAT). The decision-making function related to ventromedial prefrontal cortex (tested by the GT) did not show a statistically significant difference between patients and controls. These neuropsychological findings seem to be partly independent of the patient's psychological traits and psychiatric disorders. This study was limited by as small sample size.

There is insufficient clinical evidence to conclude that the use of neuropsychological testing for patients with migraine headaches without associated cognitive disorders can be used effectively for clinical decision making to improve management of this condition. No published clinical trials were found that support the use of neuropsychological testing for clinical decision making to improve management for patients with other types of headaches who did not have associated cognitive disorders.

The clinical evidence was reviewed in May 2014 with no additional information identified that would change the conclusion.

History of Myocardial Infarction

Literature addressing the neuropsychological consequences of myocardial infarction is not conclusive. Studies on the relationship between myocardial infarction and cognitive functioning have demonstrated conflicting results. Some studies show a detrimental effect of myocardial infarction on cognitive skills (Sauve, 2009; Almeida, 2008). Other studies have shown no difference in cognitive skills for patients with myocardial infarctions (Ahto, 1999, Grubb, 2000).

Moser et al. (1999) examined neuropsychological functioning among a sample of cardiac rehabilitation (CR) patients. Using neuropsychological instruments, patients were compared in a CR program to age-matched outpatient control subjects who had no known history of cardiac or neurologic disease. Cardiac rehabilitation patients were then divided into dichotomous subgroups

based on whether they had undergone coronary artery bypass grafting, had experienced a myocardial infarction, had hypertension, or had impaired ejection fraction. Neuropsychological functioning was examined relative to each of these factors. Cardiac rehabilitation patients had poorer neuropsychological test performance than did control subjects, with subtle relative deficits on measures of response generation, memory, and verbal abstraction, and particularly verbal fluency. Low ejection fraction, hypertension, and prior coronary artery bypass graft were associated with greater relative neuropsychological impairments. Although CR patients were not grossly neuropsychologically impaired as a group, it appears highly likely that many within a given program exhibit some degree of neuropsychological dysfunction. According to the investigators, including neuropsychological screening as part of pre-CR testing would help to identify such patients. Further prospective clinical trials are necessary to confirm that neuropsychological testing is beneficial for patients who have experienced a myocardial infarction.

Neuropsychological data were gathered from 46 healthy controls, 42 cardiac patients referred for percutaneous coronary intervention (PCI), and 43 cardiac patients referred for coronary artery bypass grafting (CABG). Fourteen cognitive function tests were utilized at baseline and at three time points after surgery (3 weeks, 4 months, 1 year). No clear pattern of group differences or change at follow-up emerged. A greater percentage of CABG patients than controls worsened in seven tests (three at 1 year), but a greater percentage of PCI patients than controls also worsened in seven tests (three at 1 year). Generalized estimating equations showed only two tests (Wechsler Adult Intelligence Scale, Third Edition, Digit Symbol, and Hopkins Verbal Learning Test, Revised, Total Recall) to be significantly different between groups from baseline to 1 year. Compared with healthy controls, more PCI patients than CABG patients worsened in the former of those two tests, whereas more PCI and CABG patients improved on the latter. The investigators concluded that current CABG procedure does not appear to create cognitive decline (Sweet, 2008).

There is insufficient clinical evidence to conclude that the use of neuropsychological testing for patients with myocardial infarction without associated cognitive disorders can be used effectively for clinical decision making to improve management of this condition.

The clinical evidence was reviewed in May 2014 with no additional information identified that would change the conclusion.

Professional Societies

American Academy of Neurology (AAN): In an evidence-based guideline update for the evaluation and management of concussion in sports, the AAN states that it is likely that neuropsychological testing of memory performance, reaction time, and speed of cognitive processing, regardless of whether administered by paper-and-pencil or computerized method, is useful in identifying the presence of concussion (sensitivity 71%–88% of athletes with concussion). This is based on evidence from 1 Class II study and multiple Class III studies. The AAN also states that both types of testing (paper-and-pencil or computerized) generally require a neuropsychologist for accurate interpretation, although the tests may be administered by a non-neuropsychologist. According to AAN, there is insufficient evidence to support conclusions about the use of neuropsychological testing in identifying concussion in preadolescent age groups. The AAN goes on to say that inexperienced licensed health care providers (LHCPs) should be instructed in the proper administration of standardized validated sideline assessment tools. This instruction should emphasize that these tools are only an adjunct to the evaluation of the athlete with suspected concussion and cannot be used alone to diagnose concussion (Level B – probably effective). The AAN further states that LHCPs caring for athletes might utilize individual baseline scores on concussion assessment tools, especially in younger athletes, those with prior concussions, or those with preexisting learning disabilities/attention deficit/hyperactivity disorder, as doing so fosters better interpretation of postinjury scores (Level C - Possibly effective) (Giza 2013).

In a 2010 position statement on sports concussion, the AAN made the following recommendations:

- Any athlete who is suspected to have suffered a concussion, regardless of severity, is to be removed immediately from participation in a game or practice.
- A licensed health care professional, such as a neurologist, whose scope of practice includes proper training in the evaluation and management of concussion, must clear the youth athlete before he or she can return to play. This includes sports recognized by high school athletic associations as well as youth and recreational leagues run by other entities.

The AAN published a report regarding neuropsychological testing of adults. This report indicates that neuropsychological testing is most useful for management planning in patients with suspected dementia, multiple sclerosis, Parkinson's disease, traumatic brain injury, stroke, and HIV encephalopathy. It is also useful for detecting deficits in patients with particularly high premorbid intelligence levels in which bedside-type clinical testing may be insensitive to mild alterations. Neuropsychological testing also has an important role in evaluating patients undergoing epilepsy surgery (Cummings, 1996).

The Quality Standards Subcommittee of the AAN published an evidence-based review for the early detection of dementia. (Petersen, 2001) The recommendations state that neuropsychological batteries are useful to identify patients with dementia, particularly when administered to an increased-risk population (i.e., those with cognitive impairment).

A practice parameter for the screening and diagnosis of autism developed by the American Academy of Neurology and the Child Neurology Society indicates that neuropsychological, behavioral, and academic assessments should be performed as needed, in addition to the cognitive assessment, to include social skills and relationships, educational functioning, problematic behaviors, learning style, motivation and reinforcement, sensory functioning, and self-regulation for the diagnosis of autism (Filipek, 2000). The guideline was reaffirmed by the developer on October 18, 2003, July 28, 2006, and most recently on July 10, 2010.

In a practice parameter update on the evaluation and management of driving risk in dementia, the AAN states that there is insufficient evidence to recommend neuropsychological testing to predict driving capability among patients with dementia (Iverson et al. 2010).

In a practice parameter update on the care of the patient with amyotrophic lateral sclerosis (ALS), the AAN states that the domain of cognitive and behavioral impairment in ALS is a rapidly evolving field and there is little consensus regarding diagnostic criteria and assessment methods. Screening tests of executive function may be considered to detect cognitive impairment in patients with ALS prior to confirmation with formal neuropsychological evaluation (Level C) (Miller et al. (2009).

American Psychological Association (APA): The American Psychological Association published updated guidelines for the evaluation of dementia and age-related cognitive change. The guidelines include the following information regarding neuropsychological testing for this condition (American Psychological Association, 2012):

- Neuropsychological evaluation and cognitive testing remain among the most effective differential diagnostic methods in discriminating pathophysiological dementia from age-related cognitive decline, cognitive difficulties that are depression-related, and other related disorders. Even after reliable biological markers have been discovered, neuropsychological evaluation and cognitive testing will still be necessary to determine the onset of dementia, the functional expression of the disease process, the rate of decline, the functional capacities of the individual, and hopefully, response to therapies.
- Comprehensive neuropsychological evaluations for dementia and cognitive change include tests of multiple cognitive domains, typically including memory, attention, perceptual and motor skills, language, visuospatial abilities, reasoning, and executive

functions. Measures of mood and personality may be relevant in many cases. Psychologists are encouraged to refer to current compendia resources and the clinical research literature in selecting assessment instruments. Psychologists are encouraged to use standardized, reliable, and valid tests.

- Technology assisted assessments (e.g., computer administered cognitive batteries, tele-health visits) are rapidly advancing but appropriate psychometric properties and normative data are nascent. These technologies may have significant advantages for older persons with limited mobility or health-care access, but may also disadvantage older persons with limited experience and expertise interacting with technology.

American Psychiatric Association: The American Psychiatric Association published practice guidelines for the psychiatric evaluation of adults. The following statements were made in the guidelines regarding neuropsychological testing (American Psychiatric Association, 2006):

- The testing has a broad range of application, but the decision to order neuropsychological testing for an individual patient remains a matter of clinical judgment.
- The testing may be requested when cognitive deficits are suspected or there is a need to grade for severity or progression of deficits over time.
- The testing can be helpful in distinguishing between cognitive disorders and malingering or factitious disorders. When patients present later in life with the new onset of psychosis or mood disorder accompanied by cognitive deficits, neuropsychological testing may also be helpful in distinguishing dementia from other psychiatric syndromes.

In its guidelines on the treatment of AD and other dementias, the American Psychiatric Association states the following: A variety of research definitions for mild cognitive impairment are in place, but there is no consensus on the optimal definition. The most widely accepted definition requires the following:

- Subjective cognitive complaints,
 - Evidence of objective deficits in cognitive function based on age- and education-adjusted norms on standardized neuropsychological tests,
 - Intact daily functioning,
 - Evidence of cognitive decline from a prior level, and
 - Evidence of not meeting the criteria for dementia.
- (American Psychiatric Association, 2007)

American Academy of Pediatrics (AAP): A joint statement for learning disabilities, dyslexia, and vision from the American Academy of Pediatrics, Section on Ophthalmology, Council on Children with Disabilities; American Academy of Ophthalmology; American Association for Pediatric Ophthalmology and Strabismus; and the American Association of Certified Orthoptists states that children who exhibit signs of learning disabilities should be referred for educational, psychological, neuropsychological, and/or medical diagnostic assessments (AAP, 2009).

In a policy statement on sport-related concussion in children and adolescents, the AAP states that neuropsychological testing can be helpful to provide objective data to athletes and their families after a concussion. Neuropsychological testing is one tool in the complete management of a sport-related concussion and alone does not make a diagnosis or determine when return to play is appropriate. According to the AAP, testing is performed by using one of several computerized neuropsychological tests including ANAM (Automated Neuropsychological Assessment Metrics), CogState, HeadMinder, and ImPACT or through pencil-and paper testing administered by a neuropsychologist. Each of the computerized tests has published data on test-retest reliability, and all have demonstrated deficits in concussed athletes compared with their baseline assessments. One critique of the computerized tests is that the vast majority of studies have been conducted by the developers of the tests, which raises some concern for bias, because some independent study results have suggested slightly less reliable results. More rigorous pencil-and-paper testing conducted formally by a neuropsychologist is also an option, although test-retest reliability has been questioned. If an athlete is suffering from postconcussive

symptoms over several months or has had multiple concussions, formal assessment by a neuropsychologist may be beneficial, specifically to identify areas for which the athlete may need academic accommodations (AAP, 2010).

American Academy of Child and Adolescent Psychiatry (AACAP): Practice parameters from the American Academy of Child and Adolescent Psychiatry (Volkmar et al. 2014) state that neuropsychological correlates of autism spectrum disorder include impairments in executive functioning (e.g., simultaneously engaging in multiple tasks) (Ozonoff et al. 1991), weak central coherence (integrating information into meaningful wholes) (Happé and Frith 2006), and deficits in theory-of-mind tasks (taking the perspective of another person) (Baron-Cohen et al. 1985). The AACAP has published practice parameters for the assessment and treatment of children and adolescents with ADHD. The AACAP indicates that neuropsychological testing is not required as part of a routine assessment for ADHD, but may be indicated by the findings of the standard psychological assessment (Pliszka, et al., 2007).

International Society for Hepatic Encephalopathy and Nitrogen Metabolism (ISHEN): A guideline prepared by the Commission on Neuropsychological Assessment of Hepatic Encephalopathy appointed by the ISHEN states that neuropsychological testing is an established methodology for quantifying cognitive impairment due to various forms of encephalopathy, including low-grade or minimal hepatic encephalopathy (Randolph, 2009).

National Academy of Neuropsychology (NAN): In a policy for the evaluation of childhood learning disorders, the NAN states that when comprehensive information about a child's brain-related strengths and weaknesses is necessary to understand potential sources of the problem and implications for functioning, a neuropsychological evaluation is most often the best choice (Silver, 2006).

In a position paper on the diagnosis and management of sports-related concussion, the NAN states that neuropsychological evaluation is recommended for the diagnosis, treatment, and management of sports-related concussion at all levels of play (Moser, 2007).

American Academy of Clinical Neuropsychology (AACN) and National Academy of Neuropsychology (NAN): A joint position paper of the AACN and NAN sets forth their position on appropriate standards and conventions for computerized neuropsychological assessment devices (CNADs). The authors state that CNADs are subject to, and should meet, the same standards for the development and use of educational, psychological, and neuropsychological tests (American Psychological Association, 1999) as are applied to examiner-administered tests. The authors also state that those employing CNADs have the education, training, and experience necessary to interpret their results in a manner that will best meet the needs of the patients they serve (Bauer 2012).

American Medical Society for Sports Medicine: In a position statement for concussion in sport the American Medical Society for Sports Medicine provided an evidence-based, best practices summary to assist physicians with the evaluation and management of sports concussion (Harmon et al. 2013). The following statements were made regarding neuropsychological (NP) testing:

- NP tests are an objective measure of brain-behavior relationships and are more sensitive for subtle cognitive impairment than clinical exam. Most concussions can be managed appropriately without the use of NP testing.
- Computerized neuropsychological (CNP) testing should be interpreted by healthcare professionals trained and familiar with the type of test and the individual test limitations, including a knowledgeable assessment of the reliable change index, baseline variability and false-positive and false-negative rates.
- Paper and pencil NP tests can be more comprehensive, test different domains and assess for other conditions which may masquerade as or complicate assessment of concussion.

- NP testing should be used only as part of a comprehensive concussion management strategy and should not be used in isolation.
- The ideal timing, frequency and type of NP testing have not been determined. In some cases, properly administered and interpreted NP testing provides an added value to assess cognitive function and recovery in the management of sports concussions.
- It is unknown if use of NP testing in the management of sports concussion helps prevent recurrent concussion, catastrophic injury or long-term complications.
- Comprehensive NP evaluation is helpful in the post-concussion management of athletes with persistent symptoms or complicated courses.

U.S. FOOD AND DRUG ADMINISTRATION (FDA)

NeuroTrax Corp., the manufacturer of Mindstreams, submitted a 510k premarket notification to the FDA on March 9, 2007, however, the FDA determined that the Mindstreams device was not substantially equivalent to other devices and declined the application in a letter dated December 21, 2007, which explained that the FDA considered the device to be Class III device. NeuroTrax Corp. appealed this decision on April 10, 2008, but the FDA maintained its earlier decision and notified the company of such on December 4, 2008. On March 15, 2012, the FDA sent a warning letter to NeuroTrax Corp. stating that the Mindstreams device was being marketed in the United States without FDA marketing clearance or approval. NeuroTrax Corp. was required to cease marketing in the United States within 15 days of receipt of the warning letter. See the following Web site for more information:

<http://www.fda.gov/ICECI/EnforcementActions/WarningLetters/2012/ucm296778.htm> Accessed April 2014.

CENTERS FOR MEDICARE AND MEDICAID SERVICES (CMS)

Medicare does not have a National Coverage Determination (NCD) for neuropsychological testing. Local Coverage Determinations (LCDs) do exist. Refer to the LCDs for [Home Health Speech-Language Pathology](#), [Medicine: Partial Hospitalization Programs](#), [Outpatient Physical and Occupational Therapy Services](#), [Outpatient Psychiatry and Psychology Services](#), [Outpatient Speech Language Pathology](#), [Partial Hospitalization Programs \(PHPs\) – Psychiatric](#), [Psychiatric Codes](#), [Psychiatric Partial Hospitalization Program](#), [Psychiatric Partial Hospitalization Program \(PHP\)](#), [Psychiatric Partial Hospitalization Programs](#), [Psychiatry and Psychology Services](#), [Psychological and Neuropsychological Testing](#) and [Therapy and Rehabilitation Services](#). (Accessed May 30, 2014)

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POLICY HISTORY/REVISION INFORMATION

Date	Action/Description
10/01/2014	<ul style="list-style-type: none"> • Reorganized policy content • Updated benefit considerations; added language for <i>Essential Health Benefits for Individual and Small Group</i> plans to indicate: <ul style="list-style-type: none"> ○ For plan years beginning on or after January 1, 2014, the Affordable Care Act of 2010 (ACA) requires fully insured non-grandfathered individual and small group plans (inside and outside of Exchanges) to provide coverage for ten categories of Essential Health Benefits (“EHBs”) ○ Large group plans (both self-funded and fully insured), and small group ASO plans, are not subject to the requirement to offer coverage for EHBs; however, if such plans choose to provide coverage for benefits which are deemed EHBs (such as maternity benefits), the ACA requires all dollar limits on those benefits to be removed on all Grandfathered and Non-Grandfathered plans ○ The determination of which benefits constitute EHBs is made on a state by state basis; as such, when using this guideline, it is important to refer to the enrollee’s specific plan document to determine benefit coverage • Revised coverage rationale: <ul style="list-style-type: none"> ○ Added language to indicate if service is “medically necessary” or “not medically necessary” to applicable proven/unproven statement ○ Updated list of proven indications in accordance with the American Psychiatric Association's <i>Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)</i> updates (replacing language specific to <i>DSM-4</i>); modified language for the following conditions: <ul style="list-style-type: none"> ▪ Dementia or symptoms of dementia such as memory impairment or memory loss ▪ Intellectual disability or intellectual developmental disorder ○ Updated description of traumatic brain injury (TBI) to indicate TBI is defined as a bump, blow, or jolt to the head or a penetrating head injury that disrupts the normal function of the brain • Updated supporting information to reflect the most current clinical evidence, CMS information and references • Archived previous policy version 2013T0152K