Medical Coverage Policy

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Neuropsychological Testing

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Overview

This Coverage Policy addresses neuropsychological testing used to assess neurocognitive effects of various disorders and aid in clinical decision-making.

Coverage Policy

Coverage of neuropsychological testing varies across plans as does coverage for services for or in connection with an injury or illness arising out of, or in the course of, any employment for wage or profit.

A number of states have coverage mandates that require regulated benefit plans to cover services related to an autism spectrum disorder (ASD) or pervasive developmental disorder (PDD). For example, New York law requires regulated benefit plans to provide coverage for the screening, diagnosis and treatment of ASD/PDD.

Neuropsychological testing is considered medically necessary when the information obtained will be used for clinical decision-making and there are symptoms indicative of a significant decline in cognitive or behavioral functioning.

and a reasonable suspicion of ANY of the following:

- autism spectrum disorder
- brain tumor
- cerebral anoxic or hypoxic episode
- central nervous system (CNS) infection with presence of neurocognitive problems (e.g., herpes encephalitis, human immunodeficiency virus [HIV] infection, Lyme disease with CNS neurological involvement)
- dementia (e.g., Alzheimer's disease, vascular dementia, Lewy body dementia)
- demyelinating disease (e.g., multiple sclerosis)
- epilepsy and seizure disorders
- exposure to agents known to be associated with cerebral dysfunction (e.g., lead poisoning, intrathecal methotrexate, cranial irradiation)
- extrapyramidal disease (e.g., Parkinson's, Huntington's Disease)
- postconcussion syndrome
- stroke or cerebral vascular injury (e.g., brain aneurysm, subdural hematoma)
- traumatic brain injury
- concussion (mild traumatic brain injury) and mild cognitive impairment (neurocognitive disorder) when those diagnoses are associated with a change in mental status, there is also a suspicion of an underlying central nervous system condition and standard treatment has failed

Neuropsychological testing is considered to be not medically necessary when used primarily for:

- educational or vocational assessment or training
- improving academic performance
- baseline assessment of function
- monitoring of chronic conditions when there is no significant new change in behavior, mental state or cognition
- screening purposes

Computerized neuropsychological testing for any indication that does not require a physician, psychologist, or licensed mental health professional to provide interpretation and preparation of a report is considered experimental, investigational or unproven.

General Background

Neuropsychological testing consists of the administration of a series of standardized assessments designed to objectively measure cognitive function. Neuropsychological testing is indicated when notable behavioral and/or cognitive changes have been associated with a history of moderate to severe head trauma or organic brain disease. This testing provides the basis for the conclusions regarding the neurocognitive effects of various medical disorders and aids in diagnosis. Making an assessment of preserved and compromised cognitive functions can also help to predict the effects of remediation. The testing results assist the clinician determine the scope and severity of cognitive impairments through a comparison of patient responses to established normative test values. The results of the testing may assist the clinician in developing a program or plan of care that is specific to the patient's needs, and determine appropriate adjustments to the patient's treatment.

Neuropsychological testing should be delayed until reversible medical or metabolic conditions that are adversely affecting the central nervous system (CNS) are corrected, when possible. Formal neuropsychological testing should also be delayed until any acute changes have stabilized following trauma, infections, or metabolic or vascular insults to the CNS.

Neuropsychological testing should only be performed by practitioners who are appropriately trained in administering and interpreting these tests.

The components of neuropsychological assessment include all of the following:

- assessment of higher cortical functions, which includes thought process and organization, reasoning and judgment
- assessment of attention, language, memory and problem-solving
- obtaining a developmental history, the history of medical disease, trauma and psychiatric illness, and the history of the person's cognitive decline and/or premorbid level of function

Neuropsychological tests and measures used for clinical purposes must meet standards for psychometric adequacy. These standards include (American Academy of Clinical Neuropsychology [AACN], 2007):

- acceptable levels of reliability
- demonstrated validity in relation to other tests and/or to brain status, including evidence that the test or measure assesses the process, ability, or trait it purports to assess
- normative standards that allow the clinician to evaluate the patient's scores in relation to relevant patient characteristics, such as age, gender, and socio-demographic or cultural/linguistic background

Neuropsychological testing differs from psychological testing in that neuropsychological testing measures higher cerebral functioning, which focuses on cognitive skills and abilities (i.e., language, memory and problem-solving), whereas psychological testing is designed to provide information about a patient's personality and emotional functioning.

Computerized Neuropsychological Testing: Computerized neuropsychological testing is also referred to as automated or computer-based testing. This type of testing has been developed over the last 20 years (Schatz and Browndyke, 2002) as an alternative, or adjunct to, traditionally administered testing methods. There are features in computer-based testing that are absent in the traditional form of neuropsychological testing, including: timing of response latencies, automated analysis of response patterns, transfer of results to a database for further analysis, and the ease with which normative data can be collated or compared to existing databases (Schatz and Browndyke, 2002). Limitations to computer-based testing include, but may not be limited to: unfamiliarity with the equipment by the patient and the potential for inaccurate timing procedures. Some of the tests are a translation of existing standardized tests into a computerized administration (e.g., Wisconsin Card Sorting Test™) while others include the development of tests and test batteries of tests unique to the computer application (Wild, et al., 2008).

Many of the computer based tests were developed to evaluate the presence of mild cognitive impairment or for sports-related concussion. Some of the tests have been adapted for testing in the pediatric populations, including assessment for attention-deficit/hyperactivity disorder (ADHD) (Luciana, 2003). These tests are also used in the research setting.

Many computerized tests do not require a professional to interpret or to complete a report. The computer program provides an automatically generated report. The test may not involve a visit or evaluation by a neuropsychologist and may be administered by a non-skilled or unlicensed individual.

Examples of computerized testing include, but are not limited to:

- Mindstreams® Cognitive Health Assessment (NeuroTrax, Newark, NJ): This product is intended to provide an objective measurement of cognitive function parameters. An Assessment Report is available within seconds after testing, and contains a complete accounting of performance in the cognitive domains of memory, attention, executive function, visual spatial perception, verbal skills, motor planning, and information processing speed.
- BrainCare (NeuroTrax, Newark NJ) is the current version of the original MindStreams product. BrainCare is a cloud-based software application that includes tests, reports and data-driven recommendations.
- Cambridge Neuropsychological Testing Automated Battery (CANTAB®) (Cambridge Cognition Ltd, Cambridge, UK): This test is a non-linguistic and culturally blind and can be administered by a trained assistant. This test includes specialized batteries that deal with specific conditions including: CANTAB Alzheimer's, CANTAB ADHD, and CANTAB's Core Cognition battery.

- CNS Vital signs® (CNS Vital Signs LLC, Chapel Hill, NC): This test batteries for five domains: memory (verbal and visual recognition), psychomotor speed (i.e., finger tapping, symbol digit coding), reaction time, cognitive flexibility (shifting attention, Stroop paradigm), and complex attention. The program can be completed in 25-30 minutes, does not require an attendant to be present and the program will produce a report.
- Computer-Administered Neuropsychological Screen for Mild Cognitive Impairment (CANS-MCI®) (Screen, Inc. Seattle, WA): This test was developed as a screening instrument for detection of mild cognitive impairment. Tests include assessment of language, memory and executive function.
- Cognivue test (Cognivue, Inc., Victor, NY). This is a computerized cognitive test that is intended for early detection of dementia signs. It is self-adminstered in ten minutes.

Neuropsychological Testing in the Educational Setting
Neuropsychological testing is also used in educational settings to provide information regarding educational planning and determine appropriate classroom placement (Stebbins, 2007). The testing may be used to identify specific learning disabilities and developmental disabilities.

Neuropsychological Testing
Migraines
The published literature regarding the clinical utility of neuropsychological testing for patients with headaches and migraines is not conclusive. It has been suggested that there may be cognitive impairment with migraines, but studies have not been conclusive (O'Bryant, et al., 2006; Baars, et al., 2010).There is insufficient clinical evidence that demonstrates that neuropsychological testing is useful in clinical decision making or will improve management of these conditions.

Mild Cognitive Impairment (MCI)
Mild cognitive impairment (MCI) is a stage between normal cognitive changes that may occur with age and more serious symptoms that indicate dementia. Symptoms of MCI can include problems with thinking, judgment, memory, and language, but the loss doesn't significantly interfere with the ability to handle everyday activities. Symptoms of MCI include mild memory loss; difficulty with planning or organization; trouble finding words; frequently losing or misplacing things; and forgetting names, conversations, and events. An individual with MCI may be at greater risk of eventually developing Alzheimer's or another type of dementia, particularly if the degree of memory impairment is significant, but MCI does not always progress to dementia. Symptoms may remain stable for several years, and even improve over time in some people (National Institute of Neurological Disorders and Stroke [NINDS], 2020).

Epidemiological data suggests that certain risk factors for dementia are more common in Blacks and Hispanics than whites, such as hypertension, coronary artery disease, and stroke, which may account for some of the racial disparities observed in Alzheimer's disease. There is little consensus, however, on the cause for observed disparities in prevalence (U.S. Preventive Services Task Force [USPSTF], 2020). It has also been noted that dementia prevalence varies by gender, affecting more women than men. While previous research suggested that higher rates of dementia prevalence in women were related largely to women's longer life expectancy, newer research suggests that differences in genetic factors and education levels may contribute to disparate prevalence rates by gender as well (USPSTF, 2020).

Chronic Fatigue Syndrome
Chronic fatigue syndrome (CFS) can be a disabling illness characterized by persistent fatigue and associated myalgias, tender lymph nodes, arthralgias, chills, feverish feelings and postexertional malaise. Diagnosis of this syndrome is by exclusion with no definitive laboratory test or physical findings. Evaluation for this condition should include a detailed medical history, complete physical examination, including a mental status examination and a standard series of urine and blood laboratory tests to identify other possible causes of illness. The medical necessity for the use of neuropsychological testing in the assessment and/or management of chronic fatigue syndrome is not supported in the medical literature.

Baseline Assessment
A recent area of development for neuropsychological testing, in particular computerized testing, is baseline assessment, which is when the testing is performed in the in the absence of signs and/or symptoms for purposes

of a later comparison. A use for baseline testing that is becoming prevalent is in the assessment and management of sports-related concussion (Schatz and Browndyke, 2002). In some contact sports, an athletic program may perform a baseline assessment of an individual's cognitive performance at the beginning of the season for purposes of later comparison in the event of an injury. When these tests are performed prior to injury, or in the absence of signs and/or symptoms, this use would not be considered medically necessary.

Concussion
A mild or minor traumatic brain injury (TBI) is a temporary and brief interruption of neurologic function after head trauma, and may involve a loss of consciousness. A concussion is a type of minor TBI usually caused by acceleration-deceleration or rotational injury to a freely mobile head, and is frequently associated with contact sports. Almost all-patients with minor TBI will have rapid and complete symptom resolution; with no long-term sequelae. The majority (80–90%) of concussions resolve in a short (7–10 day) period, although the recovery time frame may be longer in children and adolescents (McCrory, et al., 2013).

The diagnosis of acute concussion involves the assessment of a range of domains, including clinical symptoms, physical signs, behavior, balance, sleep, and cognition, along with a detailed concussion history (McCrory, et al., 2009). The cornerstone of concussion management is physical and cognitive rest until symptoms resolve and then a graded program of exertion prior to medical clearance and return to play (when associated with sports injury). The majority of patients will recover spontaneously over several days (McCrory, et al., 2009). The individual should be completely symptom free at rest and with physical exertion (e.g., sprints, non-contact aerobic activity) and cognitive exertion (e.g., studying, schoolwork) prior to return to sports or recreational activities (CDC, 2019).

Past history of concussions is among the risk factors that can lead to a protracted period of recovery. The number and date(s) of prior concussions and the duration of symptoms for each injury should be assessed. The effects of multiple mild TBIs may be cumulative, especially if there is minimal duration of time between injuries and less biomechanical force results in subsequent mild traumatic brain injury (CDC, 2019).

Neuropsychological testing is increasingly being used in the area of sport-related concussion to assist in return to play decisions (McCrory, et al., 2009).The question as to whether or not routine testing is associated with improved clinical outcomes is unclear (Kirkwood, et al., 2009). A review of the evidence for the clinical utility of a computerized test, ImPACT, reveals insufficient support to suggest that use of the test is associated with modified risk. The report concluded that “for evaluating and advising concussed athletes when to return to play, ImPACT test results should not be the determining factor (Mayers, et al., 2012).

The effects of multiple mild TBIs may be cumulative. Risk factors for protracted recovery or cumulative impact include past history of concussion, time to recovery, successive concussions with limited time in between insults, and the degree of biomechanical force associated with the trauma (CDC, 2019). Therefore, a thorough clinical review that includes the number and date(s) of prior concussions is essential to a good assessment.

Neuropsychological testing may be medically necessary when the concussion is associated with a change in mental status, there is also a suspicion of an underlying central nervous system condition and standard treatment has failed.

Postconcussion Syndrome: A small percentage of patients may report persistent symptoms (e.g., headache, sensory sensitivity, memory or concentration difficulties, irritability, sleep disturbance, depression) for extended periods after trauma. These symptoms are referred to as postconcussion or postconcussive syndrome (Heegaard and Biros, 2014). The postconcussion syndrome (PCS) is a common sequelae of traumatic brain injury (TBI), and it is a symptom complex that includes headache, dizziness, neuropsychiatric symptoms, and cognitive impairment. PCS is most often described in the setting of mild TBI, but it may also occur after moderate and severe TBI, and similar symptoms are described after whiplash injuries as well. Loss of consciousness does not have to occur for PCS to develop. (Evans, [UpToDate], 2021). Patients with persistence of symptoms may need referral for neuropsychological testing (Rossetti, et al., 2014).

Computerized neuropsychological test batteries for concussion: Additional computerized neuropsychological test batteries are used in management of concussions to facilitate decisions about safe

return to play, work or school. These tests generally take about 15-25 minutes to complete. An example of computerized testing used in evaluation of concussion include is the ImPACT (Immediate Post-Concussion Assessment and Cognitive Testing) (ImPACT Applications, Inc., Pittsburgh, PA). According to the vendor website the test can be administered by an athletic trainer, school nurse, athletic director, team coach, team doctor, or anyone trained to administer baseline testing. It takes approximately 20 minutes and a clinical report is provided by the program.

Literature Review—Computerized Neuropsychological Testing for Concussion: Although neuropsychological testing appears to be used in the assessment of sport-related concussion, the scientific literature is not conclusive regarding the clinical utility of this testing for evaluation and management of concussion. The published literature generally addresses the use of computerized testing for the assessment of sport-related concussion in the areas of baseline assessment and return-to-play decisions. The studies focus on a specific population and it is difficult to generalize the results to other populations.

Ivins et al. (2019) conducted a study to assess agreement between four brief computerized neurocognitive assessment tools (CNTs), ANAM, CogState, CNS Vital Signs, and ImPACT, by comparing rates of low scores. The study included four hundred and six US Army service members (SMs) with (n = 167) and without (n = 239) acute mild traumatic brain injury who completed two randomly assigned CNTs with order of administration also randomly assigned. A base rate analysis for each CNT was conducted to determine the proportions of SMs in the control and mTBI groups who had various numbers of scores that were 1.0+, 1.5+, and 2.0+ standard deviations below the normative mean. These results were used to identify a hierarchy of low score levels ranging from poorest to least poor performance. Then there was a comparison between the agreement between every low score level from each CNT pair administered to the SMs. More SMs in the mTBI group had low scores on all CNTs than SMs in the control group. As performance worsened, the association with mTBI became stronger for all CNTs. Most if not all SMs who performed at the worst level on any given CNT also had low scores on the other CNTs they completed but not necessarily at an equally low level. Limitations of the study included that there were relatively small numbers of SMs in each CNT pair who performed at the poorest levels; all of the possible psychometric differences that may have contributed to differences in agreement levels between the CNTs, could not be explored; and the study used data from military service members and the findings may not be generalizable to other populations CNTs are used to assess, especially high school and college athletes. The authors concluded that these results suggest that all of the CNTs examined are broadly similar but still retain some psychometric differences that need to be better understood. The authors note that the findings represent a starting point for future research on the CNTs rather than any definitive statement about the clinical utility or superiority of any of the CNTs we examined and future investigation is necessary to determine what aspects of these CNTs may be responsible for imperfect agreement, and what CNTs seem to better predict post-mTBI symptoms and recovery trajectory.

Broglio et al. (2018) reported on a study to evaluate the test-retest reliability of commonly implemented and emerging concussion assessment tools across a large nationally representative sample of student-athletes. The study included participants (n = 4874) from the Concussion Assessment, Research, and Education Consortium who completed annual baseline assessments on two or three occasions. Each assessment included measures of self-reported concussion symptoms, motor control, brief and extended neurocognitive function, reaction time, oculomotor/oculovestibular function, and quality of life. Consistency between years 1 and 2 and 1 and 3 were estimated using intraclass correlation coefficients or Kappa and effect sizes (Cohen's d). Clinical interpretation guidelines were also generated using confidence intervals to account for non-normally distributed data. The results noted that reliability for the self-reported concussion symptoms, motor control, and brief and extended neurocognitive assessments from year one to two ranged from 0.30 to 0.72 while effect sizes ranged from 0.01 to 0.28 (i.e., small). The reliability for these same measures ranged from 0.34 to 0.66 for the year 1-3 interval with effect sizes ranging from 0.05 to 0.42 (i.e., small to less than medium). The year 1-2 reliability for the reaction time, oculomotor/oculovestibular function, and quality-of-life measures ranged from 0.28 to 0.74 with effect sizes from 0.01 to 0.38 (i.e., small to less than medium effects). The authors concluded that the investigation noted less than optimal reliability for most common and emerging concussion assessment tools and they noted that despite this finding, their use is still necessitated by the absence of a gold standard diagnostic measure, with the ultimate goal of developing more refined and sound tools for clinical use.

Davis, et al (2017) reported on a systematic review to evaluate the evidence regarding the management of sport-related concussion (SRC) in children and adolescents. The eight subquestions included the effects of age on symptoms and outcome, normal and prolonged duration, the role of computerized neuropsychological tests (CNTs), the role of rest, and strategies for return to school and return to sport (RTSp). Studies were included if they were original research on SRC in children aged 5 years to 18 years, and excluded if they were review articles, or did not focus on childhood SRC. Twenty-three articles addressed the question of: Is CNT accurate for diagnosing and assessing recovery of SRC concussion in children? Regarding CNT, the review concluded that the widespread routine use of baseline CNT is not recommended.

Farnsworth et al. (2017) analyzed reliability data for computerized neurocognitive tests (CNTs) using meta-analysis and examine moderating factors that may influence reliability. Studies were included if they met all of the following criteria: used a test-retest design, involved at least one CNT, provided sufficient statistical data to allow for effect-size calculation, and were published in English. The review included eighteen studies involving 2674 participants. Intraclass correlation coefficients were extracted to calculate effect sizes and determine overall reliability. The Fisher Z transformation adjusted for sampling error associated with averaging correlations. Moderator analyses were conducted to evaluate the effects of the length of the test-retest interval, intraclass correlation coefficient model selection, participant demographics, and study design on reliability. Heterogeneity was evaluated using the Cochran Q statistic. The results included that the proportion of acceptable outcomes was greatest for the Axon Sports CogState Test (75%) and lowest for the ImPACT (25%). Moderator analyses indicated that the type of intraclass correlation coefficient model used significantly influenced effect-size estimates, accounting for 17% of the variation in reliability. The authors concluded that the Axon Sports CogState Test, which has a higher proportion of acceptable outcomes and shorter test duration relative to other CNTs, may be a reliable option; however, future studies are needed to compare the diagnostic accuracy of these instruments.

Gaudet et al. (2017) reported on a systematic review of existing research that investigated the prevalence of invalid baseline results and the effectiveness of Immediate Post-Concussion and Cognitive Testing (ImPACT) embedded invalidity indicators in detecting suspect effort. The study included 17 studies that included prevalence rates of invalid performances or examined the effectiveness of ImPACT's invalidity indicators. The inclusion criteria included a minimum sample of at least 20 participants; included an original data-set; the study was relational, experimental, or quasi-experimental; the use of ImPACT for cognitive screening; and, the study included the rate of invalid performances generated for the study sample, even if not the primary focus of the study. Of these studies, 12 included prevalence rates of invalid baseline results; and across this group of studies (after removing an outlier), the weighted prevalence rate of invalid baseline results was 6%. Four of the 17 studies examined the effectiveness of ImPACT's embedded invalidity indicators. ImPACT's embedded invalidity indicators correctly identified suboptimal effort in approximately 80% of individuals instructed to perform poorly and avoid detection ('coached') or instructed to perform poorly ('naïve'). The authors concluded that the findings raise a number of issues pertaining to the use of ImPACT including that invalid performance incidence may increase with large group versus individual administration, use in nonclinical settings, and among those with Attention Deficit-Hyperactivity Disorder or learning disability. The authors note that although ImPACT's embedded invalidity indicators detect invalid performance at a rate of 6% on average, known group validity studies suggest that these measures miss invalid performance approximately 20% of the time when individuals purposefully underperform. Limitation of the studies included the small sample size.

Hang et al. (2015) reported on a prospective cohort study to determine if computerized neurocognitive testing (Immediate Post-Concussion Assessment and Cognitive Testing [ImPACT]) in the emergency department (ED) can be used as a prognostic tool to detect young athletes at risk of having protracted concussive symptoms. The study included 109 subjects 11 to 18 years who presented to an ED less than 24 hours after sustaining a sports-related concussion. ImPACT was administered in the ED, and categorization of performance was done with score of "poor" if the athlete had 3 (of 4) or greater low domain scores. Participants completed the Post-Concussion Symptom Scale (PCSS) in the ED and at one and two weeks after injury. Athletes were symptomatic if their PCSS score was more than six in males and more than eight in females. Results indicated that 60% and 36% remained symptomatic at 1 and 2 weeks after injury, respectively. "Poor" ImPACT performance was not found to be particularly useful in predicting athletes with protracted symptoms (at 1 week: positive predictive value, 70.8%; negative predictive value, 43.5%; at 2 weeks: positive predictive value, 47.8%; negative predictive value, 68.9%). In bivariate analysis, a higher ED PCSS score was associated with protracted symptoms (at 1

week: odds ratio, 1.1 [confidence interval, 1.0-1.1]; at 2 weeks: odds ratio, 1.0 [confidence interval, 1.0-1.1]). The authors concluded that computerized neurocognitive testing in the ED has limited usefulness in predicting protracted symptoms and further research is necessary.

The American Academy of Clinical Neuropsychology (AACN) and the National Academy of Neuropsychology (NAN) published joint position paper on appropriate standards and conventions for computerized neuropsychological assessment devices (CNADs) (Bauer, et al., 2012). The paper includes the following statements regarding CNADs:

- CNADs are subject to, and should meet, the same standards for the development and use of educational, psychological, and neuropsychological tests as are applied to examiner-administered tests.
- Developers of CNADs are expected to provide a clear definition of the intended end-user population, including a description of the competencies and skills necessary for effective and accurate use of the device and the data it provides.
- Test developers should provide users with sufficient technical information to insure that the local installation of a CNAD will produce data that can be accurately compared with that which exists in the test's normative database.
- CNADs are subject to the same standards and conventions of psychometric test development, including descriptions of reliability, validity, and clinical utility (accuracy and diagnostic validity), as are examiner-based measures.
- Professionals select scoring and interpretation services (including automated services) on the basis of evidence of the validity of the program and procedures as well as on other appropriate considerations
- Professionals retain responsibility for the appropriate application, interpretation, and use of assessment instruments, whether they score and interpret such tests themselves or use automated or other services.

Echemendia et al. (2013) reported on a critical review the literature from the past 12 years regarding the key issues in sports-related neuropsychological assessment. The review found that based on review of the literature, 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. The authors note that there is insufficient evidence to recommend the widespread routine use of baseline neuropsychological testing.

Resch et al. (2013) conducted a cross-sectional cohort study of 91 healthy subjects to document test-retest reliability for the ImPACT neuropsychological test battery using two different clinically relevant time intervals. Both groups completed ImPACT forms 1, 2, and 3, which were delivered sequentially either at: one week intervals for group one (n=46) or at baseline, day 45, and day 50 for group two (n=45). Group two also completed the Green Word Memory Test (WMT) as a measure of effort. Intraclass correlation coefficients (ICCs) were calculated for the composite scores of ImPACT between time points. Repeated-measures analysis of variance was used to evaluate changes in ImPACT and WMT results over time. The ICC values for group one ranged from 0.261–0.878 for the four ImPACT composite scores. The ICC values for group two ranged from 0.374–0.756. In group one, ImPACT classified 37.0% and 46.0% of healthy participants as impaired at time points two and three, respectively. In group two, ImPACT classified 22.2% and 28.9% of healthy participants as impaired at time points two and three respectively. ImPACT misclassified 22% to 46% of healthy college-aged adult sample as impaired on one or more indices at one or both time points after baseline testing. The authors note that ImPACT had varying test-retest reliability on several metrics using different time frames for reassessment. This study included healthy subjects, rather than those with a head injury, and did not address clinical utility.

Thomas et al. (2011) performed a prospective non-controlled study using sixty subjects, aged 11-17, who presented to the emergency department (ED) immediately after a head injury. The study was designed to answer two questions: 1) is there a correlation between performance on a computer-based neurocognitive assessment (ImPACT) performed within 12 hours of head injury, and repeat assessments performed at least once, from three to ten days later; and 2) was the computerized test more sensitive to the identification of concussion severity when compared to two standard clinical grading scales. Post-concussive symptoms, outcomes, and complications were assessed via telephone follow-up for all subjects. Sixty patients completed phone follow-up and only 36 patients (60%), however, completed follow-up testing. The median follow-up testing interval was six days post-injury. Traditional concussion grading was reported to not correlate with

neurocognitive deficits detected in the ED or at follow-up. The neurocognitive domains of verbal memory, processing speed, and reaction time, on the other hand, were reported to show a correlation, though a statistical threshold for certainty or a statistical correlation was not reported. At two weeks post-injury, 23 patients (41%) had not returned to normal activity. At six weeks, six patients (10%) still had not returned to normal activity. No correlation with return to normal activity was reported. The authors concluded that immediate computerized neuropsychological assessment in the ED can predict neurocognitive deficits seen in follow-up. They further postulated that this information may be used to individualize treatment decisions. Limitations of the study included the small sample size, lack of control group, lack of power to identify a correlation between three days post injury, lack of power to perform a subgroup analysis, incomplete statistical reporting, and lack of comparison to the traditional validated and normed clinical neuropsychological test assessment. The study did not allow, nor draw, conclusions regarding the clinical utility of the intervention.

Lau et al. (2011) conducted a prospective, cohort study (n=108) to evaluate the correlation between performance on computerized neurocognitive testing (ImPACT) in combination with clinical symptoms, with recovery from sports-relate concussion. Male, high-school, football athletes completed a computer-based neurocognitive test battery within 2.23 days of injury and were followed until returned to play, using international guidelines. Athletes were grouped into protracted recovery (>14days; n=50) or short-recovery (≤14 days; n=58). Separate discriminant function analyses were performed using total symptom score on Post-Concussion Symptom Scale (PCSS), symptom clusters (migraine, cognitive, sleep, neuropsychiatric), and Immediate Post-concussion Assessment and Cognitive Testing neurocognitive scores (verbal memory, visual memory, reaction time, processing speed). Multiple discriminant function analyses revealed that the combination of four symptom clusters and four 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. Discriminant function analyses of total symptoms on the Post-Concussion Symptom Scale alone had a sensitivity of 40.81%; specificity, 79.31%; positive predictive value, 62.50%; and negative predictive value, 61.33%. The four symptom clusters alone discriminant function analyses had a sensitivity of 46.94%; specificity, 77.20%; positive predictive value, 63.90%; and negative predictive value, 62.86%. Discriminant function analyses of the four computerized neurocognitive scores alone had a sensitivity of 53.20%; specificity, 75.44%; positive predictive value, 64.10%; and negative predictive value, 66.15%. The authors concluded that the use of computerized neurocognitive testing in conjunction with symptom clusters results improves sensitivity, specificity, positive predictive value, and negative predictive value for predicting protracted recovery compared with each used alone. Although the study appears to indicate that the use neuropsychological testing along with symptom assessment may assist in predicting recovery, the results are not robust and do not indicate that this testing should be used for this purpose. The test was not designed to, and did not, address clinical utility.

Maerlander et al. (2010) conducted a study that compared scores across three test batteries in 54 healthy male athletes. The three batteries included the ImPACT test, traditional neuropsychological tests, and several experimental measures used in the assessment of sports-related concussion. The findings concluded that convergent validity was demonstrated for four of the five ImPACT domain scores. However, two cognitive domains, sustained attention and auditory working memory, often compromised as a result of mild TBI did not show convergent validity. Affective symptoms correlated with performance on measures of attention and working memory. The authors concluded that 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 some of the cognitive factors related to mild TBI. They recommended, however, that other sources of data should be considered when identifying and managing concussions. Limitations of the study included its focus on reportedly healthy subjects, rather than those with a head injury, and small sample size. Further the study was not designed to, and did not, address clinical utility.

Broglio et al. (2007) utilized a repeated measures design in 118 healthy student volunteers to examine the test-retest reliability of three commercially available computer-based neurocognitive assessments using clinically relevant time frames. The participants completed the ImPACT, Concussion Sentinel, and Headminder Concussion Resolution Index tests on three 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. Findings included: the intraclass correlation coefficient estimates from baseline to day 45 assessments ranged from .15 to .39 on the ImPACT, .23 to .65 on the Concussion Sentinel, and .15 to .66 on the Concussion Resolution Index.

The intraclass correlation coefficient estimates from the day 45 to day 50 assessments ranged from .39 to .61 on the ImPACT, .39 to .66 on the Concussion Sentinel, and .03 to .66 on the Concussion Resolution Index. Three contemporary computer-based concussion assessment programs evidenced low to moderate test-retest reliability coefficients. It was noted that that the findings do not appear to be due to suboptimal effort or other factors related to poor test performance, since persons identified by individual programs as having poor baseline data were excluded from the analyses. The authors note that until the psychometric properties of these tests can be clarified, clinicians should use a battery of evaluative measures when assessing concussion. Findings from multiple assessment techniques, such as self-reported symptoms, postural control, and neurocognitive performance, should be incorporated into a concussion assessment protocol. The authors concluded that the neurocognitive evaluation should continue to be part of a multifaceted concussion assessment program, with priority given to those scores showing the highest reliability. Limitations of the study included the lack of comparison to standardized and normed tests, its focus on reportedly healthy subjects, rather than those with a head injury, and small sample size. In addition, the study was not designed to, and did not, address clinical utility.

Wild et al. (2008) conducted a systematic review of the status of computerized cognitive testing to detect cognitive decline in the aging population. Due to the heterogeneity across selected studies and test batteries, a quantitative meta-analysis was not possible. The study included review of 11 test batteries that were either developed to screen for cognitive decline in the elderly or have been applied to that indication. In all cases, published research was found that described psychometric properties of these tests. In slightly more than half the tests, normative data for elderly subjects were rated as less than adequate as a result of either small sample size or lack of data specific to older adults in a larger sample. It was noted that reliability data was typically presented in some form, although only three test batteries met the highest rating achieved by describing more than one type of reliability. Few of the batteries are fully self-administered—the tests ranged widely in the amount of interaction required of an examiner. One of the potential advantages of computerized tests is the flexibility in terms of immediate adjustment of performance levels.

Repeat Testing
Repeat testing may be medically indicated when there is a significant change in behavior or medical condition and will affect treatment planning. Repeat testing for monitoring of a condition is not considered medically necessary unless it will impact clinical decision-making or level of care planning.

Neuropsychological Testing for Other Conditions
Neuropsychological testing is of limited value in any of the following conditions:

- When the patient has a substance abuse background and either of the following conditions apply:
  - The patient continues to use to an extent that would render test results inaccurate.
  - The patient is not yet 10 or more days post-detoxification.
- When the patient is on certain daily medications (e.g., mood-altering substances or beta-blockers) that may confound interpretation of results, and the drug effects have not been ruled out

There are situations when routine screening of individuals is performed, such as for the purpose of early detection of changes in cognition. The use of neuropsychological testing for screening purposes, in the absence of signs and symptoms, would be considered not medically necessary.

Professional Societies/Organizations—Concussion
American Academy of Neurology (AAN): The AAN published updated evidence-based guidelines for evaluation and management of concussion in sports (Giza, et al., 2013). The guidelines are endorsed by the National Football League Players Association, the Child Neurology Society, the National Association of Emergency Medical Service Physicians, the National Association of School Psychologists, the National Athletic Trainers Association, and the Neurocritical Care Society. The guidelines include the following recommendations:

Regarding the question of diagnostic tools that are useful in identifying athletes suspected of having sustained concussion:

- The reference standard by which these tools were compared was a clinician-diagnosed concussion (by physician or certified athletic trainer). It was noted that none of these tools is intended to “rule out”

concussion or to be a substitute for more thorough medical, neurologic, or neuropsychological evaluations.

- Regarding neuropsychological testing the guidelines note that, “Instruments for neuropsychological testing are divided into 2 types on the basis of their method of administration: paper-and-pencil and computer. Both types generally require a neuropsychologist for accurate interpretation, although they may be administered by a non-neuropsychologist. 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) (one Class II study; multiple Class III studies). There is insufficient evidence to support conclusions about the use of neuropsychological testing in identifying concussion in preadolescent age groups.”

Recommendations related to assessment, diagnosis, and management of suspected concussion; and recommendations for management of diagnosed concussion (including acute management, return-to-play, and retirement):

- Regarding return-to-play (RTP) and concussion resolution: Clinical licensed health care providers (LHCPs) might use supplemental information, such as neurocognitive testing or other tools, to assist in determining concussion resolution. This may include but is not limited to resolution of symptoms as determined by standardized checklists and return to age-matched normative values or an individual’s preinjury baseline performance on validated neurocognitive testing (Level C).
- Regarding retirement from play after multiple concussions:
  - LHCPs might refer professional athletes with a history of multiple concussions and subjective persistent neurobehavioral impairments for neurologic and neuropsychological assessment (Level C).
  - LCHPs caring for amateur athletes with a history of multiple concussions and subjective persistent neurobehavioral impairments might use formal neurologic/cognitive assessment to help guide retirement-from-play decisions (Level C).

Level C: Possibly effective, ineffective, or harmful (or possibly useful/predictive or not useful/predictive) for the given condition in the specified population. (Level C rating requires at least one Class II study or two consistent Class III studies.)

American Academy of Orthopaedic Surgeons (AAOS): the AAOS published a consensus statement regarding concussion (mild traumatic brain injury) and the team physician (2005/2011). Regarding neuropsychological (NP) testing, the guidelines include:

- It is essential that the team physician understand:
  - NP testing is recommended as an aid to clinical decision-making but not a requirement for concussion management.
  - NP testing is one component of the evaluation process and should not be used as a stand-alone tool to diagnose, manage or make return-to-play decisions in concussion.
- It is desirable that the team physician understand:
  - The indications and limitations of neuropsychological testing.
  - Post-injury neuropsychological test data are more useful if compared to the athlete’s pre-injury baseline.
  - It is unclear what type and content of test data are most valid and valuable.
  - Value of NP testing is enhanced when used as part of a multi-faceted assessment and treatment program.

American Academy of Pediatrics (AAP): The AAP published an updated clinical report regarding sport-related concussion (SRC) in children and adolescents (Halstead, et al., 2018). The report includes the following regarding neurocognitive testing: “Neurocognitive testing after an SRC is only 1 tool that may be used in assessing an athlete for recovery and should not be used as a sole determining factor to determine when return to play is appropriate. Testing should be performed and conducted by providers who have been trained in the proper administration and interpretation of the tests.”

American Medical Society for Sports Medicine (AMSSM): the AMSSM published a position statement regarding concussion in sport (Harmon, et al., 2013). The statement is endorsed by the National Trainers' Athletic Association and the American College of Sports Medicine.

Recommendations for diagnosis of concussion include:

- Concussion remains a clinical diagnosis ideally made by a healthcare provider familiar with the athlete and knowledgeable in the recognition and evaluation of concussion.
- Graded symptom checklists provide an objective tool for assessing a variety of symptoms related to concussions, while also tracking the severity of those symptoms over serial evaluations.
- Standardized assessment tools provide a helpful structure for the evaluation of concussion, although limited validation of these assessment tools is available.

Recommendations for sideline evaluation and management of concussion include (Strength of recommendation C*):

- Any athlete suspected of having a concussion should be stopped from playing and assessed by a licensed healthcare provider trained in the evaluation and management of concussions.
- Recognition and initial assessment of a concussion should be guided by a symptoms checklist, cognitive evaluation (including orientation, past and immediate memory, new learning and concentration), balance tests and further neurological physical examination.
- While standardized sideline tests are a useful framework for examination, the sensitivity, specificity, validity and reliability of these tests among different age groups, cultural groups and settings is largely undefined. Their practical usefulness with or without an individual baseline test is also largely unknown.
- Balance disturbance is a specific indicator of a concussion, but not very sensitive. Balance testing on the sideline may be substantially different than baseline tests because of differences in shoe/cleat-type or surface, use of ankle tape or braces, or the presence of other lower extremity injury.
- There is no same day return-to-play for an athlete diagnosed with a concussion.
- Athletes suspected or diagnosed with a concussion should be monitored for deteriorating physical or mental status.

Recommendations regarding neuropsychological testing include (Strength of recommendation C*):

- Neuropsychological (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.

*Strength-of-recommendation taxonomy
Strength of recommendation and basis for recommendation:
A: Consistent, good-quality patient-oriented evidence
B: Inconsistent or limited-quality patient-oriented evidence
C: Consensus, disease-oriented evidence, usual practice, expert opinion or case series for studies of diagnosis, treatment, prevention or screening

The 4th International Conference on Concussion in Sport: A consensus statement on concussion in sport was published by this conference (McCrory, et al., 2013). The guidelines include:

- The majority (80–90%) of concussions resolve in a short (7–10 day) period, although the recovery time frame may be longer in children and adolescents
- The cornerstone of concussion management is physical and cognitive rest until the acute symptoms resolve and then a graded program of exertion prior to medical clearance and return to play.

Regarding neuropsychological assessment, the guidelines include the following:

- The application of neuropsychological (NP) testing in concussion has been shown to be of clinical value and contributes significant information in concussion evaluation
- NP assessment should not be the sole basis of management decisions. It should be seen as an aid to the clinical decision-making process in conjunction with a range of assessments of different clinical domains and investigational results.
- Formal NP testing is not required for all athletes, however when this is considered necessary then it should ideally be performed by a trained neuropsychologist
- NP testing may be used to assist return to play decisions and is typically performed when an athlete is clinically asymptomatic, however NP assessment may add important information in the early stages following injury
- There may be particular situations where testing is performed early to assist in determining aspects of management e.g., return to school in a pediatric athlete. This is usually best determined in consultation with a trained neuropsychologist
- Baseline NP testing was considered by the panel and was not felt to be required as a mandatory aspect of every assessment, however may be helpful or add useful information to the overall interpretation of these tests. At present, there is insufficient evidence to recommend the widespread routine use of baseline neuropsychological testing.

These are consensus guidelines and it is not clear whether these conclusions are based on a methodologically rigorous systematic evaluation of the published evidence. The guidelines do not address the incremental clinical value of neuropsychological testing on health outcomes compared to the information that is available from clinical assessment. The guidelines do not address the clinical utility of testing once the symptoms have resolved. The clinical value that is referred to in the guidelines is related to sport concussion and return-to-play. The guidelines do not appear to demonstrate the clinical validity of neuropsychological testing for the evaluation of concussion.

Professional Societies/Organizations—Other Conditions

American Academy of Child and Adolescent Psychiatry (AACAP): The AACAP published practice parameters for the assessment and treatment of children and adolescents with ADHD (Pliszka, et al., 2007). Regarding neuropsychological testing the parameters note that this testing is not required as part of a routine assessment for ADHD, but may be indicated by the findings of the standard psychological assessment.

American Academy of Neurology (AAN): The Guideline Development, Dissemination, and Implementation Subcommittee of the American Academy of Neurology published updated guidelines for mild cognitive impairment. The guidelines include the recommendations (Petersen, et al., 2018):

- For patients for whom screening or assessing for MCI is appropriate, clinicians should use validated assessment tools to assess for cognitive impairment.
- For patients who test positive for MCI, clinicians should perform a more formal clinical assessment for diagnosis of MCI.

The rationale for the recommendation notes that when screening or assessing for MCI, validated assessment tools should be used. Various instruments have acceptable diagnostic accuracy for detecting MCI, with no instrument being superior to another. Because brief cognitive assessment instruments are usually calibrated to maximize sensitivity rather than specificity, patients who test positive for MCI should then have further assessment (e.g., more indepth cognitive testing, such as neuropsychological testing with interpretation based on appropriate normative data) to formally assess for this diagnosis. Diagnosis of MCI is based ultimately on a clinical evaluation determining cognitive function and functional status and not solely on a specific test score.

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; 2019).

American Psychiatric Association: This organization published practice guidelines for treatment of patients with Alzheimer's disease and other dementias (American Psychiatric Association, 2007). The guidelines note that:

- Neuropsychological testing may help in deciding whether a patient with subtle or atypical symptoms actually has dementia as well as in more thoroughly characterizing an unusual symptom picture.
- Testing may help to characterize the extent of cognitive impairment, to distinguish among the types of dementias, and to establish baseline cognitive function.
- Testing may also help identify strengths and weaknesses that could guide expectations for the patient, direct interventions to improve overall function, assist with communication, and inform capacity determinations.

The guidelines notes that mild cognitive impairment is a term used to represent a variety of mild cognitive syndromes manifested by a modest but detectable decline in cognitive function in the setting of largely intact functional status (American Psychiatric Association, 2007). There are a variety of research definitions for mild cognitive impairment, 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
- evidence of not meeting the criteria for dementia

American Psychological Association: This organization published updated guidelines for the evaluation of dementia and age-related cognitive change (American Psychological Association, 2021). The guidelines include the following regarding neuropsychological testing for this condition:

Psychologists are aware that standardized psychological and neuropsychological tests are important tools in the assessment of dementia and age-related cognitive change.

National Institute on Aging-Alzheimer's Association: These organizations published criteria for the symptomatic predementia phase of Alzheimer’s disease (AD), referred to in the criteria as mild cognitive impairment due to AD. The workgroup developed the following two sets of criteria. One is for core clinical criteria that can be used by healthcare providers without access to advanced imaging techniques or cerebrospinal fluid analysis. The second critieria is research criteria that could be used in clinical research settings, including clinical trials. The second set of criteria incorporate the use of biomarkers based on imaging and cerebrospinal fluid measures. The final set of criteria for mild cognitive impairment due to AD has four levels of certainty, depending on the presence and nature of the biomarker findings. The authors note that considerable work is needed to validate the criteria that use biomarkers and to standardize biomarker analysis for use in community settings.

U.S. Preventive Services Task Force (USPSTF): The USPSTF published a statement regarding screening for cognitive impairment in older adults. The statement concludes that the current evidence is insufficient to assess the balance of benefits and harms of screening for cognitive impairment in older adults. (USPTF, 2020).

Use Outside of the US
European Federation of Neurological Societies (EFNS)
The EFNS published guidelines for the diagnosis and management of Alzheimer's disease (Hort, et al., 2010). The guidelines note that, “Quantitative neuropsychological testing should be made in patients with questionable or very early Alzheimer's disease (AD)” (Level B).

Level B rating: (established as probably useful/predictive or not useful/predictive) requires at least one convincing class II study or overwhelming class III evidence.

The EFNS published clinical guidelines Clinical Management of Amyotrophic Lateral Sclerosis (MALS) (2012). Included in the recommendation is, "Those with evidence of early language deficits should undergo full neuropsychological testing (GCPP*)".

> * GCPP: Where there was lack of evidence but consensus was clear, opinion stated as Good Clinical Practice Points

The EFNS published recommendations for the diagnosis of Parkinson's disease (PD) (Berardelli, et al., 2013). The recommendations include, "Neuropsychological testing, functional and structural neuroimaging investigations should be primarily performed to exclude other causes of Parkinsonism in patients with suspected PD (Level A)".
Level A: effective
Note: A Level A or B recommendation does not mean that this test should be employed in all patients of a certain group, but simply means that the test has good diagnostic accuracy. It is for the physician to decide whether or not to use it in the given patient.

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 Institute for Health and Clinical Excellence (NICE) (United Kingdom [UK]): NICE published clinical guidelines for diagnosis and management of the epilepsies in adults and children (2021). Regarding neuropsychological assessment, the guidelines note that:

- Neuropsychological assessment should be considered in children, young people and adults in whom it is important to evaluate learning disabilities and cognitive dysfunction, particularly in regard to language and memory.
- Referral for a neuropsychological assessment is indicated:
  - when a child, young person or adult with epilepsy is having educational or occupational difficulties
  - when an MRI has identified abnormalities in cognitively important brain regions
  - when a child, young person or adult complains of memory or other cognitive deficits and/or cognitive decline

NICE published updated guidelines for dementia (2018). Regarding neuropsychological testing, the guidelines note:
Consider neuropsychological testing if it is unclear:
- whether the person has cognitive impairment or
- whether their cognitive impairment is caused by dementia or
- what the correct subtype diagnosis is

Use Outside of the US
No relevant information.

Medicare Coverage Determinations

	Contractor	Policy Name/Number	Revision Effective Date
NCD		No National Coverage Determination found	
LCD	CGS Administrators, LLC	Outpatient Psychiatry and Psychology Services (L34353)	5/27/2021

LCD	Wisconsin Physicians Service Insurance Corporation	Psychological and Neuropsychological Testing (L34646)	10/31/2020
LCD	First Coast Service Options, Inc.	Psychological and Neuropsychological Tests (L34520)	7/1/2020
LCD	National Government Services, Inc.	Psychiatry and Psychology Services (L33632)	11/28/2019

Note: Please review the current Medicare Policy for the most up-to-date information.

Coding/Billing Information

Note: 1) This list of codes may not be all-inclusive.
2) Deleted codes and codes which are not effective at the time the service is rendered may not be eligible for reimbursement.

Considered Medically Necessary when criteria in the applicable policy statements listed above are met:

CPT®* Codes	**Description**
96116	Neurobehavioral status exam (clinical assessment of thinking, reasoning and judgment, [eg, acquired knowledge, attention, language, memory, planning and problem solving, and visual spatial abilities]), by physician or other qualified health care professional, both face-to-face time with the patient and time interpreting test results and preparing the report; first hour
96121	Neurobehavioral status exam (clinical assessment of thinking, reasoning and judgment, [eg, acquired knowledge, attention, language, memory, planning and problem solving, and visual spatial abilities]), by physician or other qualified health care professional, both face-to-face time with the patient and time interpreting test results and preparing the report; each additional hour (List separately in addition to code for primary procedure)
96132	Neuropsychological testing evaluation services by physician or other qualified health care professional, including integration of patient data, interpretation of standardized test results and clinical data, clinical decision making, treatment planning and report, and interactive feedback to the patient, family member(s) or caregiver(s), when performed; first hour
96133	Neuropsychological testing evaluation services by physician or other qualified health care professional, including integration of patient data, interpretation of standardized test results and clinical data, clinical decision making, treatment planning and report, and interactive feedback to the patient, family member(s) or caregiver(s), when performed; each additional hour (List separately in addition to code for primary procedure)
96136†	Psychological or neuropsychological test administration and scoring by physician or other qualified health care professional, two or more tests, any method; first 30 minutes
96137†	Psychological or neuropsychological test administration and scoring by physician or other qualified health care professional, two or more tests, any method; each additional 30 minutes (List separately in addition to code for primary procedure)
96138†	Psychological or neuropsychological test administration and scoring by technician, two or more tests, any method; first 30 minutes
96139†	Psychological or neuropsychological test administration and scoring by technician, two or more tests, any method; each additional 30 minutes (List separately in addition to code for primary procedure)

†**Note: Covered when medically necessary and when used to report neuropsychological test administration and scoring**

ICD-10-CM Diagnosis Codes	Description
A17.82	Tuberculosis meningoencephalitis
A17.83	Tuberculosis neuritis
A39.81	Meningococcal encephalitis
A44.0-A44.9	Bartonellosis
A50.42	Late congenital syphilitic encephalitis
A52.14	Late syphilitic encephalitis
A68.0-A68.9	Relapsing fevers
A69.20	Lyme disease, unspecified
A69.21	Meningitis due to Lyme disease
A69.22	Other neurologic disorders in Lyme disease
A75.0-A75.9	Typhus fever
A77.0-A77.9	Spotted fever (tick-borne rickettsioses)
A78	Q fever
A79.0 – A79.9	Other rickettsioses
A81.00-A81.9	Atypical virus infections of the central nervous system
A83.0-A83.9	Mosquito-borne viral encephalitis
A84.0-A84.9	Tick-borne viral encephalitis
A85.0-A85.8	Other viral encephalitis, not elsewhere classified
A86	Unspecified viral encephalitis
A88.0	Enteroviral exanthematous fever [Boston exanthem]
A88.8	Other specified viral infections of central nervous system
A89	Unspecified viral infection of central nervous system
A92.31	West Nile virus infection with encephalitis
B00.4	Herpesviral encephalitis
B06.01	Rubella encephalitis
B20	Human immunodeficiency virus [HIV] disease
B26.2	Mumps encephalitis
B50.0-B50.9	Plasmodium falciparum malaria
B51.0-B51.9	Plasmodium vivax malaria
B52.0-B52.9	Plasmodium malariae malaria
B53.0-B53.8	Other specified malaria
B54	Unspecified malaria
B55.0-B55.9	Leishmaniasis
B56.0-B56.9	African trypanosomiasis
B57.0	Acute Chagas' disease with heart involvement
B57.1	Acute Chagas' disease without heart involvement

ICD-10-CM Diagnosis Codes	Description
B57.2	Chagas' disease (chronic) with heart involvement
B57.40-B57.49	Chagas' disease (chronic) with nervous system involvement
B58.2	Toxoplasma meningoencephalitis
B60.00-B60.09	Babesiosis
B60.8	Other specified protozoal diseases
B64	Unspecified protozoal disease
B90.0	Sequelae of central nervous system tuberculosis
B91	Sequelae of poliomyelitis
B94.1	Sequelae of viral encephalitis
C70.0-C70.9	Malignant neoplasm of meninges
C71.0-C71.9	Malignant neoplasm of brain
C72.0-C72.9	Malignant neoplasm of spinal cord, cranial nerves and other parts of central nervous system
C79.31	Secondary malignant neoplasm of brain
C79.32	Secondary malignant neoplasm of cerebral meninges
D33.0-D33.9	Benign neoplasm of brain and other parts of central nervous system
D42.0	Neoplasm of uncertain behavior of cerebral meninges
D43.0-D43.9	Neoplasm of uncertain behavior of brain and central nervous system
D49.6	Neoplasm of unspecified behavior of brain
F01.50-F01.51	Vascular dementia
F02.80-F02.81	Dementia in other diseases classified elsewhere
F03.90-F03.91	Unspecified dementia
F04	Amnestic disorder due to known physiological condition
F05	Delirium due to known physiological condition
F06.0-F06.8	Other mental disorders due to known physiological condition
F07.81	Postconcussional syndrome
F07.89	Other personality and behavioral disorders due to known physiological condition
F07.9	Unspecified personality and behavioral disorder due to known physiological condition
F09	Unspecified mental disorder due to known physiological condition
F10.10-F10.99	Alcohol related disorders
F11.10-F11.99	Opioid related disorders
F13.10-F13.99	Sedative, hypnotic or anxiolytic related disorders
F14.10-F14.99	Cocaine related disorders
F15.10-F15.99	Other stimulant related disorders
F16.10-F16.99	Hallucinogen related disorders

ICD-10-CM Diagnosis Codes	Description
F18.10-F18.99	Inhalant related disorders
F20.0-F20.9	Schizophrenia
F21	Schizotypal disorder
F22	Delusional disorders
F23	Brief psychotic disorder
F24	Shared psychotic disorder
F25.0-F25.9	Schizoaffective disorders
F28	Other psychotic disorder not due to a substance or known physiological condition
F29	Unspecified psychosis not due to a substance or known physiological condition
F30.10-F30.9	Manic episode
F31.0-F31.9	Bipolar disorder
F32.0-F32.9	Major depressive disorder, single episode
F32.A	Depression, unspecified (Code effective 10/01/2021)
F33.0-F33.9	Major depressive disorder, recurrent
F34.0-F34.9	Persistent mood [affective] disorders
F39	Unspecified mood [affective] disorder
F40.00-F40.9	Phobic anxiety disorders
F41.0-F41.9	Other anxiety disorders
F42.2-F42.9	Obsessive-compulsive disorder
F43.0-F43.9	Reaction to severe stress, and adjustment disorders
F44.0	Dissociative amnesia
F44.1	Dissociative fugue
F44.2	Dissociative stupor
F44.4	Conversion disorder with motor symptom or deficit
F44.5	Conversion disorder with seizures or convulsions
F44.6	Conversion disorder with sensory symptom or deficit
F44.7	Conversion disorder with mixed symptom presentation
F45.41	Pain disorder exclusively related to psychological factors
F45.42	Pain disorder with related psychological factors
F53.0-F53.1	Mental and behavioral disorders associated with the puerperium, not elsewhere classified
F54	Psychological and behavioral factors associated with disorders or diseases classified elsewhere
F64.0-F64.9	Gender identity disorders
F68.10-F68.13	Factitious disorder imposed on self
F68.A	Factitious disorder imposed on another
F70-F79	Intellectual disabilities

ICD-10-CM Diagnosis Codes	Description
F80.0-F80.9	Specific developmental disorders of speech and language
F81.0-F81.9	Specific developmental disorders of scholastic skills
F82	Specific developmental disorder of motor function
F84.0-F84.9	Pervasive developmental disorders
F88	Other disorders of psychological development
F89	Unspecified disorder of psychological development
F90.0-F90.9	Attention-deficit hyperactivity disorders
F91.0-F91.9	Conduct disorders
F93.0-F93.9	Emotional disorders with onset specific to childhood
F94.0-F94.9	Disorders of social functioning with onset specific to childhood and adolescence
F95.0-F95.9	Tic disorder
F98.8	Other specified behavioral and emotional disorders with onset usually occurring in childhood and adolescence
F98.9	Unspecified behavioral and emotional disorders with onset usually occurring in childhood and adolescence
G00.0-G09	Bacterial meningitis, not elsewhere classified
G10	Huntington's disease
G13.8	Systemic atrophy primarily affecting central nervous system in other diseases classified elsewhere
G14	Postpolio syndrome
G20	Parkinson's disease
G21.11	Neuroleptic induced parkinsonism
G21.19	Other drug induced secondary parkinsonism
G21.2	Secondary parkinsonism due to other external agents
G21.3	Postencephalitic parkinsonism
G21.4	Vascular parkinsonism
G21.8	Other secondary parkinsonism
G21.9	Secondary parkinsonism, unspecified
G23.0-G23.9	Other degenerative diseases of basal ganglia
G25.5	Other chorea
G30.0-G30.9	Alzheimer's disease
G31.01-G31.09	Frontotemporal dementia
G31.1	Senile degeneration of brain, not elsewhere classified
G31.2	Degeneration of nervous system due to alcohol
G31.83	Dementia with Lewy bodies
G31.84	Mild cognitive impairment, so stated
G31.85	Corticobasal degeneration
G31.89	Other specified degenerative diseases of nervous system
G31.9	Degenerative disease of nervous system, unspecified
G35	Multiple sclerosis

ICD-10-CM Diagnosis Codes	Description
G36.1	Acute and subacute hemorrhagic leukoencephalitis [Hurst]
G36.8	Other specified acute disseminated demyelination
G36.9	Acute disseminated demyelination, unspecified
G37.0	Diffuse sclerosis of central nervous system
G37.1	Central demyelination of corpus callosum
G37.2	Central pontine myelinolysis
G37.4	Subacute necrotizing myelitis of central nervous system
G37.8	Other specified demyelinating diseases of central nervous system
G37.9	Demyelinating disease of central nervous system, unspecified
G40.001-G40.019	Localization-related (focal) (partial) idiopathic epilepsy and epileptic syndromes with seizures of localized onset
G40.101-G40.119	Localization-related (focal) (partial) symptomatic epilepsy and epileptic syndromes with simple partial seizures
G40.201-G40.219	Localization-related (focal) (partial) symptomatic epilepsy and epileptic syndromes with complex partial seizures
G40.301-G40.319	Generalized idiopathic epilepsy and epileptic syndromes
G40.A01-G40.A19	Absence epileptic syndrome
G40.B01-G40.B19	Juvenile myoclonic epilepsy[impulsive petit mal]
G40.401-G40.419	Other generalized epilepsy and epileptic syndromes
G40.501-G40.509	Epileptic seizures related to external causes
G40.801-G40.804	Other epilepsy
G40.811-G40.814	Lennox-Gastaut syndrome
G40.821-G40.824	Epileptic spasms
G40.833-G40.834	Dravet syndrome
G40.89	Other seizures
G40.901-G40.919	Epilepsy, unspecified
G91.0	Communicating hydrocephalus
G91.1	Obstructive hydrocephalus
G91.3	Post-traumatic hydrocephalus, unspecified
G91.4	Hydrocephalus in diseases classified elsewhere
G91.8	Other hydrocephalus
G91.9	Hydrocephalus, unspecified
G92	Toxic encephalopathy (Code invalid effective 09/30/2021)
G92.00	Immune effector cell-associated neurotoxicity syndrome, grade unspecified (Code effective 10/01/2021)
G92.01	Immune effector cell-associated neurotoxicity syndrome, grade 1(Code effective 10/01/2021)
G92.02	Immune effector cell-associated neurotoxicity syndrome, grade 2 (Code effective 10/01/2021)
G92.03	Immune effector cell-associated neurotoxicity syndrome, grade 3 (Code effective 10/01/2021)
G92.04	Immune effector cell-associated neurotoxicity syndrome, grade 4 (Code effective 10/01/2021)
G92.05	Immune effector cell-associated neurotoxicity syndrome, grade 5 (Code effective 10/01/2021)
G92.8	Other toxic encephalopathy (Code effective 10/01/2021)

ICD-10-CM Diagnosis Codes	Description
G92.9	Unspecified toxic encephalopathy (Code effective 10/01/2021)
G93.1	Anoxic brain damage, not elsewhere classified
G93.40	Encephalopathy, unspecified
G93.49	Other encephalopathy
G93.7	Reye's syndrome
G94	Other disorders of brain in diseases classified elsewhere
G96.9	Disorder of central nervous system, unspecified
G97.2	Intracranial hypotension following ventricular shunting
G97.31-G97.32	Intraoperative hemorrhage and hematoma of a nervous system organ or structure complicating a procedure
G97.81	Other intraoperative complications of nervous system
G97.82	Other postprocedural complications and disorders of nervous system
I60.00-I60.9	Nontraumatic subarachnoid hemorrhage
I61.0-I61.9	Nontraumatic intracerebral hemorrhage
I62.00-I62.9	Nontraumatic subdural hemorrhage
I63.00-I63.9	Cerebral infarction
I67.3	Progressive vascular leukoencephalopathy
I69.010-I69.019	Cognitive deficits following nontraumatic subarachnoid hemorrhage
I69.110-I69.119	Cognitive deficits following nontraumatic intracerebral hemorrhage
I69.210-I69.219	Cognitive deficits following other nontraumatic intracranial hemorrhage
I69.310-I69.319	Cognitive deficits following cerebral infarction
I69.810-I69.819	Cognitive deficits following other cerebrovascular disease
I69.910-I69.919	Cognitive deficits following unspecified cerebrovascular disease
I97.810-I97.811	Intraoperative cerebrovascular infarction
I97.820-I97.821	Postprocedural cerebrovascular infarction
Q04.9	Congenital malformation of brain, unspecified
Q06.9	Congenital malformation of spinal cord, unspecified
Q07.9	Congenital malformation of nervous system, unspecified
Q28.2	Arteriovenous malformation of cerebral vessels
Q28.3	Other malformations of cerebral vessels
R09.01	Asphyxia
R09.02	Hypoxemia
R41.1	Anterograde amnesia
R41.2	Retrograde amnesia
R41.3	Other amnesia
R48.0	Dyslexia and alexia
R56.1	Post traumatic seizures
R56.9	Unspecified convulsions
S06.0X0A	Concussion without loss of consciousness, initial encounter
S06.0X0D	Concussion without loss of consciousness, subsequent encounter

ICD-10-CM Diagnosis Codes	Description
S06.0X0S	Concussion without loss of consciousness, sequela
S06.0X1A	Concussion with loss of consciousness of 30 minutes or less, initial encounter
S06.0X1D	Concussion with loss of consciousness of 30 minutes or less, subsequent encounter
S06.0X1S	Concussion with loss of consciousness of 30 minutes or less, sequela
S06.0X9A	Concussion with loss of consciousness of unspecified duration, initial encounter
S06.0X9D	Concussion with loss of consciousness of unspecified duration, subsequent encounter
S06.0X9S	Concussion with loss of consciousness of unspecified duration, sequela
S06.1X0S	Traumatic cerebral edema without loss of consciousness, sequela
S06.1X1S	Traumatic cerebral edema with loss of consciousness of 30 minutes or less, sequela
S06.1X2S	Traumatic cerebral edema with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.1X3S	Traumatic cerebral edema with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.1X4S	Traumatic cerebral edema with loss of consciousness of 6 hours to 24 hours, sequela
S06.1X5S	Traumatic cerebral edema with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.1X6S	Traumatic cerebral edema with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.1X9S	Traumatic cerebral edema with loss of consciousness of unspecified duration, sequela
S06.2X0S	Diffuse traumatic brain injury without loss of consciousness, sequela
S06.2X1S	Diffuse traumatic brain injury with loss of consciousness of 30 minutes or less, sequela
S06.2X2S	Diffuse traumatic brain injury with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.2X3S	Diffuse traumatic brain injury with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.2X4S	Diffuse traumatic brain injury with loss of consciousness of 6 hours to 24 hours, sequela
S06.2X5S	Diffuse traumatic brain injury with loss of consciousness greater than 24 hours with return to pre-existing conscious levels, sequela
S06.2X6S	Diffuse traumatic brain injury with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.2X9S	Diffuse traumatic brain injury with loss of consciousness of unspecified duration, sequela
S06.300S	Unspecified focal traumatic brain injury without loss of consciousness, sequela
S06.301S	Unspecified focal traumatic brain injury with loss of consciousness of 30 minutes or less, sequela
S06.302S	Unspecified focal traumatic brain injury with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.303S	Unspecified focal traumatic brain injury with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.304S	Unspecified focal traumatic brain injury with loss of consciousness of 6 hours to 24 hours, sequela
S06.305S	Unspecified focal traumatic brain injury with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.306S	Unspecified focal traumatic brain injury with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.309S	Unspecified focal traumatic brain injury with loss of consciousness of unspecified duration, sequela
S06.310S	Contusion and laceration of right cerebrum without loss of consciousness, sequela
S06.311S	Contusion and laceration of right cerebrum with loss of consciousness of 30 minutes or less, sequela
S06.312S	Contusion and laceration of right cerebrum with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.313S	Contusion and laceration of right cerebrum with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela

ICD-10-CM Diagnosis Codes	Description
S06.314S	Contusion and laceration of right cerebrum with loss of consciousness of 6 hours to 24 hours, sequela
S06.315S	Contusion and laceration of right cerebrum with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.316S	Contusion and laceration of right cerebrum with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.319S	Contusion and laceration of right cerebrum with loss of consciousness of unspecified duration, sequela
S06.320S	Contusion and laceration of left cerebrum without loss of consciousness, sequela
S06.321S	Contusion and laceration of left cerebrum with loss of consciousness of 30 minutes or less, sequela
S06.322S	Contusion and laceration of left cerebrum with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.323S	Contusion and laceration of left cerebrum with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.324S	Contusion and laceration of left cerebrum with loss of consciousness of 6 hours to 24 hours, sequela
S06.325S	Contusion and laceration of left cerebrum with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.326S	Contusion and laceration of left cerebrum with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.329S	Contusion and laceration of left cerebrum with loss of consciousness of unspecified duration, sequel
S06.330S	Contusion and laceration of cerebrum, unspecified, without loss of consciousness, sequela
S06.331S	Contusion and laceration of cerebrum unspecified with loss of consciousness of 30 minutes or less, sequela
S06.332S	Contusion and laceration of cerebrum unspecified with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.333S	Contusion and laceration of cerebrum unspecified with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.334S	Contusion and laceration of cerebrum unspecified with loss of consciousness of 6 hours to 24 hours, sequela
S06.335S	Contusion and laceration of cerebrum unspecified with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.336S	Contusion and laceration of cerebrum, unspecified, with loss of consciousness greater than 24 hours without return to pre-existing consciousness level with patient surviving, sequela
S06.339S	Contusion and laceration of cerebrum, unspecified, with loss of consciousness of unspecified duration, sequela
S06.340S	Traumatic hemorrhage of right cerebrum without loss of consciousness, sequela
S06.341S	Traumatic hemorrhage of right cerebrum with loss of consciousness of 30 minutes or less, sequela
S06.342S	Traumatic hemorrhage of right cerebrum with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.343S	Traumatic hemorrhage of right cerebrum with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.344S	Traumatic hemorrhage of right cerebrum with loss of consciousness of 6 hours to 24 hours, sequela
S06.345S	Traumatic hemorrhage of right cerebrum with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.346S	Traumatic hemorrhage of right cerebrum with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela

ICD-10-CM Diagnosis Codes	Description
S06.349S	Traumatic hemorrhage of right cerebrum with loss of consciousness of unspecified duration, sequela
S06.350S	Traumatic hemorrhage of left cerebrum without loss of consciousness, sequela
S06.351S	Traumatic hemorrhage of left cerebrum with loss of consciousness of 30 minutes or less, sequela
S06.352S	Traumatic hemorrhage of left cerebrum with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.353S	Traumatic hemorrhage of left cerebrum with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.354S	Traumatic hemorrhage of left cerebrum with loss of consciousness of 6 hours to 24 hours, sequela
S06.355S	Traumatic hemorrhage of left cerebrum with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.356S	Traumatic hemorrhage of left cerebrum with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.359S	Traumatic hemorrhage of left cerebrum with loss of consciousness of unspecified duration, sequela
S06.360S	Traumatic hemorrhage of cerebrum, unspecified, without loss of consciousness, sequela
S06.361S	Traumatic hemorrhage of cerebrum, unspecified with loss of consciousness of 30 minutes or less, sequela
S06.362S	Traumatic hemorrhage of cerebrum, unspecified with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.363S	Traumatic hemorrhage of cerebrum, unspecified with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.364S	Traumatic hemorrhage of cerebrum, unspecified with loss of consciousness of 6 hours to 24 hours, sequela
S06.365S	Traumatic hemorrhage of cerebrum, unspecified with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.366S	Traumatic hemorrhage of cerebrum, unspecified with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.369S	Traumatic hemorrhage of cerebrum, unspecified with loss of consciousness of unspecified duration, sequela
S06.370S	Contusion, laceration, and hemorrhage of cerebellum without loss of consciousness, sequela
S06.371S	Contusion, laceration and hemorrhage of cerebellum with loss of consciousness of 30 minutes or less, sequela
S06.372S	Contusion, laceration and hemorrhage of cerebellum with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.373S	Contusion, laceration and hemorrhage of cerebellum with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.374S	Contusion, laceration and hemorrhage of cerebellum with loss of consciousness of 6 hours to 24 hours, sequela
S06.375S	Contusion, laceration and hemorrhage of cerebellum with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.376S	Contusion, laceration and hemorrhage of cerebellum with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.379S	Contusion, laceration and hemorrhage of cerebellum with loss of consciousness of unspecified duration, sequela
S06.380S	Contusion, laceration, and hemorrhage of brainstem without loss of consciousness, sequela
S06.381S	Contusion, laceration and hemorrhage of brainstem with loss of consciousness of 30 minutes or less, sequela
S06.382S	Contusion, laceration and hemorrhage of brainstem with loss of consciousness of 31 minutes to 59 minutes, sequela

ICD-10-CM Diagnosis Codes	Description
S06.383S	Contusion, laceration and hemorrhage of brainstem with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.384S	Contusion, laceration and hemorrhage of brainstem with loss of consciousness of 6 hours to 24 hours, sequela
S06.385S	Contusion, laceration and hemorrhage of brainstem with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.386S	Contusion, laceration and hemorrhage of brainstem with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.389S	Contusion, laceration and hemorrhage of brainstem with loss of consciousness of unspecified duration, sequela
S06.4X0S	Epidural hemorrhage without loss of consciousness, sequela
S06.4X1S	Epidural hemorrhage with loss of consciousness of 30 minutes or less, sequela
S06.4X2S	Epidural hemorrhage with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.4X3S	Epidural hemorrhage with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.4X4S	Epidural hemorrhage with loss of consciousness of 6 hours to 24 hours, sequela
S06.4X5S	Epidural hemorrhage with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.4X6S	Epidural hemorrhage with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.4X9S	Epidural hemorrhage with loss of consciousness of unspecified duration, sequela
S06.5X0S	Traumatic subdural hemorrhage without loss of consciousness, sequela
S06.5X1S	Traumatic subdural hemorrhage with loss of consciousness of 30 minutes or less, sequela
S06.5X2S	Traumatic subdural hemorrhage with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.5X3S	Traumatic subdural hemorrhage with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.5X4S	Traumatic subdural hemorrhage with loss of consciousness of 6 hours to 24 hours, sequela
S06.5X5S	Traumatic subdural hemorrhage with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.5X6S	Traumatic subdural hemorrhage with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.5X9S	Traumatic subdural hemorrhage with loss of consciousness of unspecified duration, sequela
S06.6X0S	Traumatic subarachnoid hemorrhage without loss of consciousness, sequela
S06.6X1S	Traumatic subarachnoid hemorrhage with loss of consciousness of 30 minutes or less, sequela
S06.6X2S	Traumatic subarachnoid hemorrhage with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.6X3S	Traumatic subarachnoid hemorrhage with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.6X4S	Traumatic subarachnoid hemorrhage with loss of consciousness of 6 hours to 24 hours, sequela
S06.6X5S	Traumatic subarachnoid hemorrhage with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.6X6S	Traumatic subarachnoid hemorrhage with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.6X9S	Traumatic subarachnoid hemorrhage with loss of consciousness of unspecified duration, sequela
S06.810S	Injury of right internal carotid artery, intracranial portion, not elsewhere classified without loss of consciousness, sequela
S06.811S	Injury of right internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness of 30 minutes or less, sequela

ICD-10-CM Diagnosis Codes	Description
S06.812S	Injury of right internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.813S	Injury of right internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.814S	Injury of right internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness of 6 hours to 24 hours, sequela
S06.815S	Injury of right internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.816S	Injury of right internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.819S	Injury of right internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness of unspecified duration, sequela
S06.820S	Injury of left internal carotid artery, intracranial portion, not elsewhere classified without loss of consciousness, sequela
S06.821S	Injury of left internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness of 30 minutes or less, sequela
S06.822S	Injury of left internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.823S	Injury of left internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.824S	Injury of left internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness of 6 hours to 24 hours, sequela
S06.825S	Injury of left internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.826S	Injury of left internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.829S	Injury of left internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness of unspecified duration, sequela
S06.890S	Other specified intracranial injury without loss of consciousness, sequela
S06.891S	Other specified intracranial injury with loss of consciousness of 30 minutes or less, sequela
S06.892S	Other specified intracranial injury with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.893S	Other specified intracranial injury with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.894S	Other specified intracranial injury with loss of consciousness of 6 hours to 24 hours, sequela
S06.895S	Other specified intracranial injury with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.896S	Other specified intracranial injury with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.899S	Other specified intracranial injury with loss of consciousness of unspecified duration, sequela
S06.9X0S	Unspecified intracranial injury without loss of consciousness, sequela
S06.9X1S	Unspecified intracranial injury with loss of consciousness of 30 minutes or less, sequela
S06.9X2S	Unspecified intracranial injury with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.9X3S	Unspecified intracranial injury with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.9X4S	Unspecified intracranial injury with loss of consciousness of 6 hours to 24 hours, sequela
S06.9X5S	Unspecified intracranial injury with loss of consciousness greater than 24 hours with return to pre-existing consciousness level, sequela
S06.9X6S	Unspecified intracranial injury with loss of consciousness greater than 24 hours without return to pre-existing consciousness level with patient surviving, sequela

ICD-10-CM Diagnosis Codes	Description
S06.9X9s	Unspecified intracranial injury with loss of consciousness of unspecified duration, sequela
S06.A0XS	Traumatic brain compression without herniation, sequela (Code effective 10/01/2021)
S06.A1XS	Traumatic brain compression with herniation, sequela (Code effective 10/01/2021)
T66.XXXS	Radiation sickness, unspecified, sequela

Considered educational in nature/not medically necessary:

ICD-10-CM Diagnosis Codes	Description
	All other codes

References

1. Albert MS, DeKosky ST, Dickson D, Dubois B, Feldman HH, Fox NC, et al. The diagnosis of mild cognitive impairment due to Alzheimer's disease: recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. Alzheimers Dement. 2011 May;7(3):270-9.

2. American Academy of Clinical Neuropsychology. American Academy of Clinical Neuropsychology (AACN) practice guidelines for neuropsychological assessment and consultation. Clin Neuropsychol. 2007 Mar;21(2):209-31. Accessed June 28, 2021. Available at URL address: https://theaacn.org/position-papers-and-policies/

3. American Academy of Neurology. Position statement on sports concussion. AAN Policy 2013-8. March 2013; updated 2020. Accessed June 28, 2021. Available at URL address: https://www.aan.com/policy-and-guidelines/policy/position-statements/sports-concussion/

4. American Academy of Orthopaedic Surgeons (AAOS). Concussion (Mild Traumatic Brain Injury) and the Team Physician: A Consensus Statement. September 2005; Revised September 2011. Accessed June 28, 2021. Available at URL address: https://aaos.org/globalassets/about/bylaws-library/information-statements/1029-concussion-mild-traumatic-brain-injury-and-the-team-physician---a-consensus-statement.pdf

5. American Psychiatric Association. Practice guideline. Treatment of Patients With Alzheimer's Disease and Other Dementias, Second Edition. Oct 2007. Accessed June 28, 2021. Available at URL address: https://www.psychiatry.org/psychiatrists/practice/clinical-practice-guidelines

6. American Psychological Association. APA guidelines for the Evaluation of Dementia and Age-related Cognitive Changes. Feb 2021. Accessed June 28, 2021. Available at URL address: https://www.apa.org/practice/guidelines/guidelines-dementia-age-related-cognitive-change.pdf

7. Baars MA, van Boxtel MP, Jolles J. Migraine does not affect cognitive decline: results from the Maastricht aging study. Headache. 2010 Feb;50(2):176-84.

8. Bauer RM, Iverson GL, Cernich AN, Binder LM, Ruff RM, Naugle RI. Computerized neuropsychological assessment devices: joint position paper of the American academy of clinical neuropsychology and the national academy of neuropsychology. Arch Clin Neuropsychol. 2012 May;27(3):362-73.

9. Berardelli A, Wenning GK, Antonini A, Berg D, Bloem BR, Bonifati V, et al. EFNS/MDS-ES/ENS [corrected] recommendations for the diagnosis of Parkinson's disease. Eur J Neurol. 2013 Jan;20(1):16-34.

10. Heegaard WE, Biros MH. Head injury. In: Marx JA, ed. Rosen's Emergency Medicine: Concepts and Clinical Practice. 8th ed. Philadelphia, Pa: Mosby, an imprint of Elsevier; 2014.

11. Broglio SP, Ferrara MS, Macciocchi SN, Baumgartner TA, Elliott R. Test-retest reliability of computerized concussion assessment programs. J Athl Train. 2007 Oct-Dec;42(4):509-14.

12. Broglio SP, Macciocchi SN, Ferrara MS. Sensitivity of the concussion assessment battery. Neurosurgery. 2007 Jun;60(6):1050-7; discussion 1057-8.

13. Broglio SP, Cantu RC, Gioia GA, Guskiewicz KM, Kutcher J, Palm M, et al.; National Athletic Trainer's Association. National Athletic Trainers' Association position statement: management of sport concussion. J Athl Train. 2014 Mar-Apr;49(2):245-65.

14. Broglio SP, Katz BP, Zhao S, McCrea M, McAllister T; CARE Consortium Investigators. Test-Retest Reliability and Interpretation of Common Concussion Assessment Tools: Findings from the NCAA-DoD CARE Consortium. Sports Med. 2018 May;48(5):1255-1268. doi: 10.1007/s40279-017-0813-0. Erratum in: Sports Med. 2018 Mar 26;:.

15. Cahn-Hidalgo D, Estes PW, Benabou R. Validity, reliability, and psychometric properties of a computerized, cognitive assessment test (Cognivue®). World J Psychiatry. 2020 Jan 19;10(1):1-11.

16. Cambridge Cognition Ltd, CANTAB® [product information]. Accessed June 28, 2021. Available at URL address: cambridgecognition.com/cantab/technology/

17. Center for Disease Control and Prevention (CDC). Heads Up Facts for Physicians About Mild Traumatic Brain Injury (MTBI). Page last reviewed: July 28, 2020. Accessed June 28, 2021. Available at URL address: http://www.cdc.gov/headsup/providers/index.html

18. Center for Disease Control and Prevention (CDC). Myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS). Information for healthcare professionals. Page last reviewed: may , 2021. Accessed June 9, 2020. Available at URL address: http://www.cdc.gov/cfs/hcp.html

19. Centers for Medicare and Medicaid Services (CMS). Local Coverage Determinations (LCDs) alphabetical index. Accessed June 29, 2021. Available at URL address: https://www.cms.gov/medicare-coverage-database/indexes/lcd-alphabetical-index.aspx

20. Centers for Medicare and Medicaid Services (CMS). National Coverage Determinations (NCDs) alphabetical index. June 29, 2021. Available at URL address: https://www.cms.gov/medicare-coverage-database/indexes/ncd-alphabetical-index.aspx.

21. Cheng Y, Wu W, Wang J, Feng W, Wu X, Li C. Reliability and validity of the Repeatable Battery for the Assessment of Neuropsychological Status in community-dwelling elderly. Arch Med Sci. 2011 Oct;7(5):850-7.

22. Chin AL, Negash S, Hamilton R. Diversity and disparity in dementia: the impact of ethnoracial differences in Alzheimer disease. Alzheimer Dis Assoc Disord. 2011 Jul-Sep;25(3):187-95.

23. CNS Vital Signs LLC. CNS Vital signs. Accessed June 28, 2021. Available at URL address: https://www.cnsvs.com/

24. Cognivue, Inc. Cognivue test [product information]. Accessed June 28, 2021. Available at URL address: https://www.cognivue.com/

25. Davis GA, Anderson V, Babl FE, Gioia GA, Giza CC, Meehan W, et al. What is the difference in concussion management in children as compared with adults? A systematic review. Br J Sports Med. 2017 Jun;51(12):949-957.

26. Echemendia RJ, Iverson GL, McCrea M, Macciocchi SN, Gioia GA, Putukian M, et al. Advances in neuropsychological assessment of sport-related concussion. Br J Sports Med. 2013 Apr;47(5):294-8.

27. Echemendia RJ, Iverson GL, McCrea M, Broshek DK, Gioia GA, Sautter SW, et al. Role of neuropsychologists in the evaluation and management of sport-related concussion: an inter-organization position statement. Clin Neuropsychol. 2011 Nov;25(8):1289-94.

28. EFNS Task Force on Diagnosis and Management of Amyotrophic Lateral Sclerosis:, Andersen PM, Abrahams S, Borasio GD, de Carvalho M, Chio A, Van Damme P, et al.. EFNS guidelines on the clinical management of amyotrophic lateral sclerosis (MALS)--revised report of an EFNS task force. Eur J Neurol. 2012 Mar;19(3):360-75.

29. Elbin RJ, Schatz P, Covassin T. One-year test-retest reliability of the online version of ImPACT in high school athletes. Am J Sports Med. 2011 Nov;39(11):2319-24.

30. Evans RW. Postconcussion syndrome. In: UpToDate, Post TW (Ed), UpToDate, Waltham, MA. Last updated: Apr 09, 2021 (Accessed on June 29, 2021).

31. Farnsworth JL 2nd, Dargo L, Ragan BG, Kang M. Reliability of Computerized Neurocognitive Tests for Concussion Assessment: A Meta-Analysis. J Athl Train. 2017 Sep;52(9):826-833.

32. Filipek PA, Accardo PJ, Ashwal S, Baranek GT, Cook EH Jr, Dawson G, et al. Practice parameter: screening and diagnosis of autism: report of the Quality Standards Subcommittee of the American Academy of Neurology and the Child Neurology Society. Neurology. 2000 Aug 22;55(4):468-79. (guideline reaffirmed by the developer October 18, 2003, July 28, 2006, July 10, 2010, August 9, 2014). Accessed June 29, 2021. Available at URL address: https://www.aan.com/Guidelines/Home/GuidelineDetail/33

33. Gaudet CE, Weyandt LL. Immediate Post-Concussion and Cognitive Testing (ImPACT): a systematic review of the prevalence and assessment of invalid performance. Clin Neuropsychol. 2017 Jan;31(1):43-58.

34. Giza CC, Kutcher JS, Ashwal S, Barth J, Getchius TS, Gioia GA, et al. Summary of evidence-based guideline update: Evaluation and management of concussion in sports: Report of the Guideline Development Subcommittee of the American Academy of Neurology. Neurology. 2013 Mar 18. [Epub ahead of print]

35. Halstead ME, Walter KD, Moffatt K; COUNCIL ON SPORTS MEDICINE AND FITNESS. Sport-Related Concussion in Children and Adolescents. Pediatrics. 2018 Dec;142(6). pii: e20183074.

36. Hang B, Babcock L, Hornung R, Ho M, Pomerantz WJ. Can Computerized Neuropsychological Testing in the Emergency Department Predict Recovery for Young Athletes With Concussions? Pediatr Emerg Care. 2015 Oct;31(10):688-93.

37. Harmon KG, Drezner JA, Gammons M, Guskiewicz KM, Halstead M, Herring SA, et al. American Medical Society for Sports Medicine position statement: concussion in sport. Br J Sports Med. 2013 Jan;47(1):15-26.

38. Hort J, O'Brien JT, Gainotti G, Pirttila T, Popescu BO, Rektorova I, et al.; EFNS Scientist Panel on Dementia. EFNS guidelines for the diagnosis and management of Alzheimer's disease. Eur J Neurol. 2010 Oct;17(10):1236-48.

39. ImPACT (Immediate Post-Concussion Assessment and Cognitive Testing) ImPACT Applications, Inc. Accessed June 29, 2021. Available at URL address: https://impacttest.com/

40. Iverson DJ, Gronseth GS, Reger MA, Classen S, Dubinsky RM, Rizzo M; Quality Standards Subcomittee of the American Academy of Neurology. Practice parameter update: evaluation and management of driving risk in dementia: report of the Quality Standards Subcommittee of the American Academy of Neurology. Neurology.2010 Apr 20;74(16):1316-24. (Reaffirmed on July 13, 2013, January 23, 2016, and January 26, 2019)

41. Ivins BJ, Arrieux JP, Schwab KA, Haran FJ, Cole WR. Using Rates of Low Scores to Assess Agreement between Brief Computerized Neuropsychological Assessment Batteries: A Clinically-based Approach for Psychometric Comparisons. Arch Clin Neuropsychol. 2019;34(8):1392-1408.

42. Kirkwood MW, Randolph C, Yeates KO. Returning pediatric athletes to play after concussion: the evidence (or lack thereof) behind baseline neuropsychological testing. Acta Paediatr. 2009 Sep;98(9):1409-11.

43. Kirkwood MW, Yeates KO, Taylor HG, Randolph C, McCrea M, Anderson VA. Management of pediatric mild traumatic brain injury: a neuropsychological review from injury through recovery. Clin Neuropsychol. 2008 Sep;22(5):769-800.

44. Lau BC, Collins MW, Lovell MR. Sensitivity and specificity of subacute computerized neurocognitive testing and symptom evaluation in predicting outcomes after sports-related concussion. Am J Sports Med. 2011 Jun;39(6):1209-16.

45. Lau BC, Collins MW, Lovell MR. Cutoff scores in neurocognitive testing and symptom clusters that predict protracted recovery from concussions in high school athletes. Neurosurgery. 2012 Feb;70(2):371-9; discussion 379.

46. Luciana M. Practitioner review: computerized assessment of neuropsychological function in children: clinical and research applications of the Cambridge Neuropsychological Testing Automated Battery (CANTAB). J Child Psychol Psychiatry. 2003 Jul;44(5):649-63.

47. Maerlender A, Flashman L, Kessler A, Kumbhani S, Greenwald R, Tosteson T, et al. Examination of the construct validity of ImPACT™ computerized test, traditional, and experimental neuropsychological measures. Clin Neuropsychol. 2010 Nov;24(8):1309-25.

48. Mayers LB, Redick TS. Clinical utility of ImPACT assessment for postconcussion return-to-play counseling: psychometric issues. J Clin Exp Neuropsychol. 2012;34(3):235-42. Epub 2011 Dec 13.

49. McCrory P, Meeuwisse W, Johnston K, Dvorak J, Aubry M, Molloy M, Cantu R. Consensus statement on Concussion in Sport 3rd International Conference on Concussion in Sport held in Zurich, November 2008. Clin J Sport Med. 2009 May;19(3):185-200.

50. McCrory P, Meeuwisse W, Aubry M, Cantu B, Dvořák J, Echemendia R, et al. Consensus statement on Concussion in Sport - The 4th International Conference on Concussion in Sport held in Zurich, November 2012. Phys Ther Sport. 2013 May;14(2):e1-e13.

51. McGrath N, Eloi J. The Role of Neuropsychology in the Evaluation of Concussion. Semin Pediatr Neurol. 2019 Jul;30:83-95.

52. Meehan WP 3rd, d'Hemecourt P, Collins CL, Taylor AM, Comstock RD. Computerized neurocognitive testing for the management of sport-related concussions. Pediatrics. 2012 Jan;129(1):38-44. Epub 2011 Nov 30.

53. Mendez MF. Mental status scales to evaluate cognition. In: UpToDate, Post TW (Ed), UpToDate, Waltham, MA. Last updated: April 16, 2019 (Accessed on June 29, 2021).

54. National Institute for Health and Clinical Excellence (NICE). The epilepsies: the diagnosis and management of the epilepsies in adults and children in primary and secondary care. London (UK): National Institute for Health and Clinical Excellence (NICE); 2012 Jan. (updated May 2021) (Clinical guideline; no. 137). Accessed June 29, 2021. Available at URL address: https://www.nice.org.uk/guidance/cg137

55. National Institute for Health and Clinical Excellence (NICE). Dementia: assessment, management and support for people living with dementia and their carers. NICE guideline [NG97] Published date: June 2018. Accessed June 29, 2021. Available at URL address: https://www.nice.org.uk/guidance/ng97

56. National Institute of Neurological Disorders and Stroke (NINDS). Dementia: Hope Through Research. Date last modified: 6/7/2021. Accessed June 29, 2021. Available at URL address: https://www.ninds.nih.gov/Disorders/Patient-Caregiver-Education/Hope-Through-Research/Dementia-Hope-Through-Research

57. National Institute of Neurological Disorders and Stroke (NINDS). Traumatic Brain Injury Information page. Date last modified: 3/27/2019. Accessed June 29, 2021. Available at URL address: https://www.ninds.nih.gov/Disorders/All-Disorders/Traumatic-Brain-Injury-Information-Page

58. NeuroTrax website, BrainCare [product information]. Accessed June 29, 2021. Available at URL address: https://www.neurotrax.com/

59. O'Bryant SE, Marcus DA, Rains JC, Penzien DB. Neuropsychology of migraine: present status and future directions. Expert Rev Neurother. 2005 May;5(3):363-70.

60. O'Bryant SE, Marcus DA, Rains JC, Penzien DB. The neuropsychology of recurrent headache. Headache. 2006 Oct;46(9):1364-76.

61. Patnode CD, Perdue LA, Rossom RC, Rushkin MC, Redmond N, Thomas RG, Lin JS. Screening for Cognitive Impairment in Older Adults: An Evidence Update for the U.S. Preventive Services Task Force [Internet]. Rockville (MD): Agency for Healthcare Research and Quality (US); 2020 Feb. Report No.: 19-05257-EF-1. PMID: 32129963.

62. Petersen RC, Lopez O, Armstrong MJ, Getchius TSD, Ganguli M, Gloss D, et al. Practice guideline update summary: Mild cognitive impairment: Report of the Guideline Development, Dissemination, and Implementation Subcommittee of the American Academy of Neurology. Neurology. 2018 Jan 16;90(3):126-135.

63. Pliszka S; AACAP Work Group on Quality Issues. Practice parameter for the assessment and treatment of children and adolescents with attention-deficit/hyperactivity disorder. J Am Acad Child Adolesc Psychiatry. 2007 Jul;46(7):894-921. Accessed June 29, 2021. Available at URL address: https://www.aacap.org/aacap/resources_for_primary_care/practice_parameters_and_resource_centers/practice_parameters.aspx

64. Randolph C, Hilsabeck R, Kato A, Kharbanda P, Li YY, Mapelli D, et al.; International Society for Hepatic Encephalopathy and Nitrogen Metabolism (ISHEN). Neuropsychological assessment of hepatic encephalopathy: ISHEN practice guidelines. Liver Int. 2009 May;29(5):629-35.

65. Resch J, Driscoll A, McCaffrey N, Brown C, Ferrara MS, Macciocchi S, et al. ImPact Test-Retest Reliability: Reliably Unreliable? J Athl Train. 2013 May 31. [Epub ahead of print]

66. Rossetti HC, Barth JT, Broshek DT, Freeman JR. Concussion and Brain Injury. In: Miller MD, Thompson SR, Delee & Drez's Orthopaedic Sports Medicine. 4th Ed. Philadelphia: Saunders, an imprint of Elsevier Inc; 2014.

67. Schatz P, Pardini JE, Lovell MR, Collins MW, Podell K. Sensitivity and specificity of the ImPACT Test Battery for concussion in athletes. Arch Clin Neuropsychol. 2006 Jan;21(1):91-9.

68. Schatz P, Browndyke J. Applications of computer-based neuropsychological assessment. J Head Trauma Rehabil. 2002 Oct;17(5):395-410.

69. Schatz P, Moser RS, Solomon GS, Ott SD, Karpf R. Prevalence of invalid computerized baseline neurocognitive test results in high school and collegiate athletes. J Athl Train. 2012;47(3):289-96.

70. Schatz P. Long-term test-retest reliability of baseline cognitive assessments using ImPACT. Am J Sports Med. 2010 Jan;38(1):47-53.

71. Schroeder RW, Martin PK, Walling A. Neuropsychological Evaluations in Adults. Am Fam Physician. 2019 Jan 15;99(2):101-108. PMID: 30633479.

72. Screen, Inc., Computer-Administered Neuropsychological Screen for Mild Cognitive Impairment CANS-MCI [product information]. Accessed June 29, 2021. Available at URL address: https://screen-inc.com/

73. Shiekh SI, Cadogan SL, Lin LY, Mathur R, Smeeth L, Warren-Gash C. Ethnic Differences in Dementia Risk: A Systematic Review and Meta-Analysis. J Alzheimers Dis. 2021;80(1):337-355.

74. Sorbi S, Hort J, Erkinjuntti T, Fladby T, Gainotti G, Gurvit H, et al.; EFNS Scientist Panel on Dementia and Cognitive Neurology. EFNS-ENS Guidelines on the diagnosis and management of disorders associated with dementia. Eur J Neurol. 2012 Sep;19(9):1159-79.

75. Stebbins GT. Neuropsychological testing. In: Goetz C. Textbook of clinical neurology. 3rd ed. Chicago, IL: W.B. Saunders Company; 2007. ch 27.

76. Thomas DG, Collins MW, Saladino RA, Frank V, Raab J, Zuckerbraun NS. Identifying neurocognitive deficits in adolescents following concussion. Acad Emerg Med. 2011 Mar;18(3):246-54.

77. U.S. Preventive Services Task Force (USPSTF). Recommendation for Screening for Cognitive Impairment in Older Adults. 2020. Accessed June 29, 2021. Available at URL address: https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/cognitive-impairment-in-older-adults-screening

78. Volkmar F, Siegel M, Woodbury-Smith M, King B, McCracken J, American Academy of Child and Adolescent Psychiatry (AACAP) Committee on Quality Issues (CQI). Practice Parameter for the assessment and treatment of children and adolescents with autism spectrum disorder. J Am Acad Child Adolesc Psychiatry. 2014 Feb;53(2):237-57.

79. Wild K, Howieson D, Webbe F, Seelye A, Kaye J. Status of computerized cognitive testing in aging: a systematic review. Alzheimers Dement. 2008 Nov;4(6):428-37.