NEUROPHYSIOLOGIC TESTING

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Related Policies: None

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COVERAGE RATIONALE

Electromyography (EMG)

Surface electromyography (SEMG) is unproven.

There is limited and insufficient evidence to support the use of SEMG. Studies varied considerably in SEMG instrumentation, SEMG protocol, and diagnostic algorithm. Depending on the study’s SEMG approach, diagnostic performance ranged from poor to fair. Further research is needed to standardize SEMG approaches and diagnostic algorithms, increase diagnostic performance, and to assess the role of SEMG in clinical practice.

Macroelectromyography (macro-EMG) testing is unproven.

There is limited and insufficient evidence to support the use of macro-EMG. Additional studies are needed to establish how this test improves diagnostic capabilities and physician decision-making.

Nerve Conduction Studies

Nerve conduction studies with or without late responses (e.g., F-wave and H-reflex tests) are proven for the evaluation of the following suspected or known disorders only when performed in conjunction with needle electromyography except in limited circumstances*:
Peripheral nerve entrapment syndromes
Generalized neuropathies
Hereditary, metabolic, or degenerative polyneuropathy
Plexopathy (acquired disorder in tissue along nerves that causes motor and sensory dysfunction)
Neuromuscular junction disorders
Myopathies
Motor neuron disease
Spine disorder with nerve root impingement symptoms
Cervical, thoracic, and/or lumbosacral radiculopathy
Guidance for botulinum toxin injection for spasmodic dysphonia or segmental dystonia when it is difficult to isolate affected muscles
Traumatic nerve lesions

*Nerve conduction studies are proven when performed without needle electromyography in patients on anticoagulants, patients who have lymphedema or patients who are being evaluated for carpal tunnel syndrome.

The American Association of Neuromuscular and Electrodiagnostic Medicine (AANEM) states that it is in the best interest of patients, in the majority of situations, for the needle EMG and the NCS examination to be conducted and interpreted at the same time (AANEM, Proper Performance and Interpretation of Electrodiagnostic Studies, 2006).

Nerve conduction studies are unproven for all conditions other than those listed above as proven.
There is limited and insufficient evidence to conclude that nerve conduction studies are beneficial for health outcomes in patients with disorders other than those listed above as proven.

Non-invasive automatic or portable nerve conduction monitoring systems that test only distal motor latencies and conduction velocities, such as NC-stat, Brevio, or NervePace are unproven for the purpose of electrodiagnostic testing.
Studies of these devices are primarily small case series comparing portable with conventional nerve conduction studies in the same patient. Studies that did use controls did not always report the patients’ conditions. Large, robust randomized, controlled studies are needed to prove the safety and efficacy of this technology.

Physiologic Recording of Tremor
Physiologic recording of tremor using accelerometers and gyroscopes such as Kinesia™ or Tremorometer™ is unproven.
There is insufficient evidence and too few studies to conclude that these devices improve therapeutic responses for the purpose of decreasing tremor in patients with tremor. Well-designed controlled studies are needed to determine the usefulness of these devices.

Quantitative Sensory Testing
Quantitative sensory testing, including monofilament testing, pressure-specified sensory testing, computer assisted sensory examinations, and current perception threshold (CPT) testing for the diagnosis and evaluation of nervous system disorders is unproven.
Definitive conclusions for current perception threshold (CPT) testing cannot be drawn due to evidence that is inconsistent. Furthermore, in the absence of other testing, CPT tests do not include sensory nerve conduction amplitudes or other critical data to reach conclusions on diagnoses. Further research is needed to validate the clinical utility of pressure-specified sensory testing.
BACKGROUND

Neurophysiologic studies are used to evaluate patients with suspected or known central and peripheral nervous system disorders. This policy includes information on the following tests:

**Electromyography (EMG)**

EMG measures muscle response to electrical or nerve stimulation. The test is used to evaluate the function of individual nerves and muscles and has various applications in sports, ergonomics, rehabilitation, orthopedics, psychology, and neurology. Two main types of EMG exist: needle EMG (NEMG) and surface EMG (SEMG). Surface electromyography (EMG) is a diagnostic technique in which electrodes are placed on the skin and used to measure the electrical activity of the underlying muscle in response to electrical or nerve stimulation. The surface electromyography (SEMG) recordings, also referred to as the electromyogram, differ among patients and healthy persons and can potentially be used to detect impairments in nerve and/or muscle function. Paraspinal EMG is a type of surface EMG that is used to evaluate back pain. Needle electromyography requires insertion of needles through the patient's skin and is helpful in determining whether muscle weakness results from an injury or a disorder in the nerves that control the muscles, the neuromuscular junction or the muscle itself. NEMG, in combination with nerve conduction studies (NCSs), is the gold standard methodology for assessing the neurophysiologic characteristics of neuromuscular diseases. The term EMG is often used to encompass nerve conduction studies which measure the action potentials that result from peripheral nerve stimulation. Nerve conduction studies (NCS), also referred to as nerve conduction velocity (NCV) studies, aid in evaluating a differential diagnosis and complements the EMG studies. Performed in combination, EMG and NCS testing is usually conducted several weeks after an initial injury; however, in some cases NCS and EMG may prove useful immediately after nerve injury. There is no established standard regarding timing of testing (AANEM Recommended policy for electrodiagnostic medicine, 2011).

Macroelectromyography (macro-EMG) is an electrodiagnostic technique that is used to assess the size of the entire motor unit. It is performed by inserting a special type of needle into the muscle being studied.

**Nerve Conduction Studies (NCSs)**

NCSs also referred to as nerve conduction velocity studies (NCV), are performed to assess the integrity or abnormality of the peripheral nervous system. In these tests the nerve is stimulated by a mild electrical stimulus applied to the nerve through the skin at one or more points along the nerve. Recording of the electrical nerve's response to stimulation s is done by surface electrodes placed over a muscle innervated by the nerve being stimulated (motor conduction study) or skin area (sensory conduction study). The results are compared to normal values. NCS are routinely performed in conjunction with NEMG. (AANEM, Proper Performance and Interpretation of Electrodiagnostic Studies, 2006)

Another type of NCS is late response testing (F wave and H-reflex testing). Late response studies are complementary to NCV and are performed during the same patient evaluation. In some cases, the late response may be the only abnormality (AANEM Recommended policy for electrodiagnostic medicine, 2011). The F-wave is a late response evoked by maximal stimulation during a motor nerve conduction study. The H-reflex is the electrophysiological component of the ankle reflex. The H-reflex is obtained from the calf muscle after stimulation of the posterior tibial nerve. In S-1 radiculopathy, the H-reflex is often absent or prolonged in latency. The H-reflex may also be recorded from other sites such as the quadriceps in the leg following femoral nerve stimulation and the flexor carpi radialis in the arm with median nerve stimulation.

The NC-stat is a non-invasive, automatic, portable nerve conduction monitoring system used for electrodiagnostic testing at the point of care setting. Other devices used for non-invasive nerve conduction measurement include the Brevio and NervePace (the NervePace is no longer in production). A distinguishing feature of these devices is that they test distal motor latencies.
response amplitudes and conduction velocities but do not produce real time wave forms.

**Physiologic Recording of Tremor**

Physiologic recording of tremors using accelerometers and gyroscopes includes the use of devices such as Kinesia or Tremormeter. Kinesia integrates accelerometers and gyroscopes in a compact patient-worn unit to capture kinematic movement disorder features. The Tremormeter is a physiologic recording system using accelerometers that generates precision tremor frequency and amplitude information. TremReport™ is a utility for generating comprehensive reports from tremor records and written interpretations. The current standard in evaluating Parkinson’s disease (PD) tremor is the Unified Parkinson’s Disease Rating Scale (UPDRS), a qualitative ranking system typically completed during an office visit.

**Quantitative Sensory Testing (QST)**

QST is a testing method for objective assessments of peripheral sensory functions. QST usually evaluates the response to one particular stimulus, such as vibration, touch-pressure, heat or cold, and these tests are used to provide information about the function of specific types of nerve fibers. This type of testing includes monofilament stimuli like the Weinstein-Semmes filaments and computer assisted sensory examinations like the CASE IV, the Medoc systems, and the Vibratron or Biothesiometer. These tests have been used to detect and quantitate sensory deficits in diabetic ulcers and diabetic neuropathy in population bases studies and in drug treatment trials.

Two types of QST which use electrical current for stimulation of sensory axons are available. One is the current perception threshold (CPT) instrument (also called sensory nerve conduction threshold [sNCT] testing) and the other is the voltage actuated sensory nerve conduction threshold (V-sNCT) tests.

The pressure-specified sensory testing is another type of QST instrument and is used to assess nerve function by quantifying the sensory thresholds of skin by using with light quantifiable static, or moving cutaneous pressure stimuli. The NK Pressure-Specified Sensory Device is a pressure-specified sensory testing device that measures sensation using two rounded prongs that are pressed against the skin. The pressure of the stimuli is measured along with the patient's response to the stimulus. The term *sensory nerve conduction threshold* (sNCT) tests should not be confused with the term *motor and sensory nerve conduction studies* (NCS), the latter type of tests include measurement of conduction velocity, onset latency and amplitude.

**Performance and Supervision of Testing**

The American Association of Neuromuscular and Electrodiagnostic Medicine recommends that only physicians such as neurologists or physiatrists, specially trained in electrodiagnostic medicine should perform needle EMG examinations since these tests are simultaneously performed and interpreted (AANEM Recommended policy for electrodiagnostic medicine, 2011).

Nerve conduction studies should be performed by a trained physician or a trained individual under direct supervision of a physician. Direct supervision indicates that the physician is in close physical proximity to the electrodiagnostic laboratory while testing is being done and is immediately available to provide assistance and direction (AANEM Recommended policy for electrodiagnostic medicine 2011).

Collection of the clinical and electrophysiologic data should be entirely under the supervision of the electrodiagnostic (EDX) physician. The physician may collect all of the data directly from the patient or may delegate collection of some data to a specifically trained technologist. Data collection may also be delegated to a physician in a residency training program related to neuroscience or physical medicine and rehabilitation or fellowship related to electrodiagnostic and/or neuromuscular medicine. In the case of NCSs and somatosensory evoked potential (SEP) testing, the EDX physician may be absent from the room when the procedure is performed but should be immediately available. Once the physician has determined the preliminary differential diagnosis on the basis of the patient’s history and examination, a technologist may perform the
NCS and/or SEP tests selected by the physician. The physician should be alerted immediately during the testing if any results appear to be unusual or unexpected, so that there is opportunity to reassess the differential diagnosis and develop alternative testing strategies. The patient should remain in the room until the supervising EDX physician has reviewed NCS and diagnostic SEP results. SEPs are also frequently performed for preoperative baselines or prognosis after nerve trauma; those results can be reviewed by the physician at a later time (AANEM, Technologists Conducting Nerve Conduction Studies and Somatosensory Evoked Potential Studies Independently to be Reviewed by a Physician at a Later Time, 2009).

**CLINICAL EVIDENCE**

**Surface Electromyography (SEMG)**

**SEMG used for Chronic Back Pain**

In a meta-analysis, Geisser et al. (2005) evaluated diagnostic performance of SEMG for low back pain among 44 studies that were published during the years 1988 to 2002. The mean sensitivity and specificity was 39.6% and 90.8% for static SEMG, 88.8% and 81.3% for dynamic SEMG, and 84.4% and 89.8% for static SEMG during isometric exertion, respectively. While SEMG could differentiate between patients with low back pain and healthy persons, effect sizes were small to moderate and sensitivity and specificity were poor to fair for all types of SEMG and varied considerably among studies.

Enomoto et al. (2012) evaluated low back pain and alignment of the lumbar spine in the patients with lumbar kyphosis or canal stenosis. The study included kyphosis patients who were 60 years of age or older, age-matched lumbar spinal canal stenosis patients and healthy volunteers. Muscular activity at the L1-2 and L4-5 intervertebral areas was recorded by surface EMG in the resting standing position and also with a weight load held in the standing position. The study indicated constant activity of paravertebral muscles and the susceptibility to muscle fatigue in patients with lumbar kyphosis. According to the authors, the quantification of muscle activity by surface EMG may show the pathology of lumbar kyphosis, and the decrease of muscle activity in the standing position may be a potentially useful index for guiding treatment. However, it is not clear how this information will affect patient management.

Ritvanen et al. (2007) compared the dynamic surface electromyographic (SEMG) activities of back muscles and pain before and after traditional bone setting and physical therapy in 61 patients. The study failed to show a significant association between experienced low back pain and SEMG parameters.

The current evidence suggests that while SEMG measurements differ among patients and healthy persons, the diagnostic performance is not sufficient to recommend SEMG as a diagnostic tool in the evaluation of back pain. There is no information as to how its use would affect patient outcomes. More research is required to standardize SEMG approaches and to assess their diagnostic value in clinical.

**SEMG used for Other Conditions**

Archer et al. (2013) evaluated if measurement of SEMG activity during swallowing would distinguish between preserved and disordered swallow function in Duchenne muscular dystrophy (DMD). This comparative study investigated the peak, duration, and relative timing of muscle activity during swallowing. The study included three groups of participants: nine DMD patients with dysphagia, six DMD patients with preserved swallow function, and 12 healthy controls. Dysphagic DMD participants produced significantly higher normalized peak amplitude measurements than the healthy control group for masseter (61.77 vs. 5.07) and orbicularis oris muscles (71.87 vs. 26.22). Intra-subject variability for masseter peak amplitude was significantly greater for dysphagic DMD participants than the other groups. Different characteristic SEMG waveforms were observed for the three groups. According to the authors, SEMG provides useful physiological information for the evaluation of swallowing in DMD patients, justifying further study. Further research is needed to determine the clinical relevance of these findings.
Manfredini et al. (2011) assessed the diagnostic accuracy of commercially available surface electromyography (sEMG) and kinesiography (KG) devices for myofascial pain of jaw muscles. Thirty-six consecutive patients with diagnostic criteria for temporomandibular disorders (TMD) axis I diagnosis of myofascial pain and an age- and sex-matched group of 36 TMD-free asymptomatic subjects underwent sEMG and KG assessments. Receiver operating characteristics curve analysis showed that for most outcomes, sEMG and KG measures did not reach acceptable levels of sensitivity and specificity, with a 30·6-88·9% percentage of false-positive results. According to the authors, clinicians should not use sEMG and KG devices as diagnostic tools for individual patients who might have myofascial pain in the jaw muscles. Whether intended as a stand-alone measurement or as an adjunct to making clinical decisions, such instruments do not meet the standard of reliability and validity required for such usage.

Gironell et al. (2004) evaluated SEMG for the initial diagnosis of essential tremor in 300 patients who present for the first time with postural tremor of the hands as the predominant symptom. SEMG detected essential tremor in this patient group with 98% sensitivity and 82% specificity, and achieved a positive predictive value of 95% and negative predictive value of 91%. This result suggests SEMG may be an appropriate diagnostic tool for the initial evaluation of essential tremor in symptomatic patients; however, the impact on patient management and outcomes must be evaluated before SEMG can be recommended for the routine evaluation of essential tremor.

There is insufficient evidence in the scientific literature to permit conclusions regarding the clinical utility of surface electromyography. Clinical trials have not demonstrated that surface electromyography is comparable to conventional technologies such as needle electromyography or nerve conduction studies for the evaluation of neuromuscular disorders or other conditions.

Professional Societies

American Academy of Neurology (AAN): The AAN considers the use of SEMG as unacceptable for the diagnosis of neuromuscular disease and low back pain. However, SEMG is an acceptable modality for kinesiologic analysis of movement disorders; for differentiating types of tremors, myoclonus, and dystonia; for evaluating gait and posture disturbances; and for evaluating psychophysical measures of reaction and movement time (based on Class III data - evidence provided by expert opinion, nonrandomized historical controls, or observation(s) from case series) (Pullman et al., 2000).

American Association of Neuromuscular and Electrodiagnostic Medicine (AANEM): According to an AANEM practice topic titled, Use of Surface Electromyography in the Diagnosis and Study of Neuromuscular Disorders, the data are insufficient to determine the clinical utility of surface electromyography (sEMG) for distinguishing between neuropathic and myopathic conditions or for detecting the more specific neuromuscular conditions of post-poliomyelitis syndrome, pathologic fasciculations, acquired demyelinating peripheral neuropathy, amyotrophic lateral sclerosis, myotonic dystrophy, and hypokalemic periodic paralysis (level U - data inadequate or conflicting). The AANEM states that on the basis of two class III studies, sEMG may be useful to detect the presence of neuromuscular disease (level C: possibly effective, ineffective, or harmful for the given condition in the specified population. Level C rating requires at least one class II study or two consistent class III studies) (Meekins, 2008).

Macrolelectromyography (Macro-EMG) Testing

The clinical evidence was reviewed on June 17, 2013 with no additional information identified that would change the unproven conclusion for macrolelectromyography.

A small number of studies have evaluated the use of macro-EMG. Lange et al. (1989) used quantitative motor unit potential analysis, single-fiber electromyography, and macrolelectromyography (macro-EMG) to determine if these techniques could identify weakening muscles. They classified 18 previously affected muscles according to strength from 12 patients...
who had had poliomyelitis 18 to 50 years earlier and concluded that low-amplitude macro-EMG signals may be useful in the identification of muscles weakened by postpolio muscular atrophy.

Sartucci et al. (2011) assessed changes in Motor Units (MU) and extent of MU loss using macro-electromyography (macro-EMG) and Motor Unit Number Estimation (MUNE) in 61 Amyotrophic Lateral Sclerosis (ALS) patients. Macro-EMG increased and fiber density decreased after 8 months of tracking the disease course. The authors concluded that combined use of macro-EMG and MUNE techniques in ALS patients allows the tracking of changes in muscle MU features and number in face of progressive anterior horn cells death over time during disease’s evolution. However, it is not clear how this information will affect patient management.

There is insufficient evidence to conclude that macro-EMG is beneficial for patients with neuromuscular disorders.

**Nerve Conduction Studies (NCS)**

The use of nerve conduction studies including F-wave and H-reflex tests for the diagnosis of early stage polyneuropathies and proximal nerve lesions is confirmed in several reviews and studies (Maccabee et al., 2011; Kostera-Pruszczczyk et al., 2004; Trujillo-Hernandez et al., 2005; Bal et al., 2006; Kocer et al., 2005; Mesrati and Vecchierini, 2004).

Nerve conduction studies are indicated for the following conditions: peripheral nerve entrapment (Calfee, 2012; Kwon, 2008; Sheu, 2006); generalized neuropathies (Derr, 2009, Dyck, 2010, De Sousa, 2009 polyneuropathies (Emeryk-Szajewska, 1998, Torvin Moller, 2009); plexopathy (Mullins, 2007); neuromuscular junction disorders (Meriggioli, 2005); myopathies including polymyositis, dermatomyositis, and congenital myopathies (Wang, 2010); motor neuron disease (Hammad, 2007); spine disorders and radiculopathy (Alrawi, 2007; Haig, 2006); and guidance for botulinum toxin injection for spasmodic dysphonia or segmental dystonia, when it is difficult to isolate affected muscles (Molloy, 2002).

Balbierz et al. (1998) investigated whether needle evaluation added any important clinical information to normal nerve conduction studies in the evaluation of carpal tunnel syndromes in a retrospective review. The investigators determined whether needle examination was abnormal when nerve conduction studies were normal. In patients in whom only carpal tunnel syndrome was suspected, normal nerve conduction studies predicted that EMG would be normal 89.8% of the time. Testing based on a larger sample size might increase the predictive value. According to the investigators, there may be a subpopulation of patients referred for carpal tunnel syndrome who may be adequately evaluated by nerve conduction studies alone.

Wee (2002) evaluated if needle EMG examination of the thenar muscles could provide useful information in addition to the nerve conduction (NC) studies. Electrophysiologic procedures performed on 84 patients (103 hands) consistent with carpal tunnel syndrome (CTS) were reviewed. The median thenar motor NC data were matched with the needle EMG findings in the abductor pollicis brevis (APB) muscle. The severity of the needle EMG findings in the APB muscle correlated well with the severity of the motor NC data. As the thenar compound muscle action potential amplitude decreased and the degree of nerve conduction slowing and block across the wrist increased, there was a corresponding increase in the number of enlarged motor units and decrease in the recruitment pattern in the needle EMG findings. According to the investigators, needle EMG examination confined to the thenar muscles in CTS does not provide any further information when the NC data had already established this diagnosis, and it should not be performed routinely.

Shon et al. (2011) used a nationally representative sample of Medicare beneficiaries with diabetes who used electrodiagnostic services (most commonly nerve conduction studies and EMG) to examine whether specialists and non-specialists were different in the rates of identifying common neuromuscular conditions. Specialists (neurologists and physiatrists) performed 62% of electrodiagnostic consultations; non-specialist physicians and non-physicians performed 31% and
After adjusting for age, race/ethnicity, diabetes severity, and comorbidities, specialists were 1.26-9 times more likely than non-physicians to diagnose polynuropathy, lumbosacral radiculopathy, cervical radiculopathy, carpal tunnel syndrome, and ulnar neuropathy. Almost 80% of electrodiagnostic studies performed by specialists included electromyography testing; fewer than 13% by non-specialists did. The authors concluded that inadequate use of electromyography and fewer specific diagnoses suggest that many non-specialists perform insufficiently comprehensive electrodiagnostic studies.

Point of Care Nerve Conduction Tests
The results of preliminary studies for automatic or portable nerve conduction monitoring systems are promising; however, the studies are primarily small case series comparing portable with conventional nerve conduction studies in the same patient (Kong et al., 2006; Fisher, 2008; Perkins, 2008; Fisher, 2005; Guyette and Wilgis, 2004; Armstrong, 2008).

Bourke et al. (2011) investigated the use of a clinic-based, handheld, non-invasive electrophysiological device (NC-stat®) in 71 patients with suspected carpal tunnel syndrome. These patients were compared to a similar cohort of 71 age-matched patients in whom formal nerve conduction studies were performed at a local neurophysiology unit. Outcome measures were time from presentation to carpal tunnel decompression, the cost of each pathway and the practicalities of using the device in a busy hand unit. According to the authors, the NC-stat® proved to be a successful device when compared with referring patients out for more formal nerve conduction studies, shortening the time from presentation to surgery from 198 days to 102 days. These findings need confirmation in a larger study.

A retrospective, non-comparative study involving 1,190 patients who underwent point-of-service NCS (using NC-stat) for the evaluation of carpal tunnel syndrome concluded that point-of-service NCS generated relevant diagnostic outcomes (Megerian et al., 2007).

Katz (2006) conducted a study to establish a normal data set for median nerve studies in industrial workers using NC-stat technology. Sixteen hundred ninety-five persons applying for employment at a single heavy industry plant without symptoms of carpal tunnel syndrome (CTS) were studied. Based on the results of the study, the investigators concluded that NC-stat technology using distal motor latency (DML) appears to be no more sensitive or specific than a traditionally performed DML for the diagnosis of carpal tunnel syndrome (CTS). Until sensory studies using NC-stat technology are better defined, this technology cannot be recommended for screening or diagnosis of CTS in an industrial population.

Tan et al. (2012) assessed the clinical impact of replacing standard neurophysiologic testing with a hand-held device (Mediracer) for diagnosis of carpal tunnel syndrome (CTS). One hundred patients (200 hands) with suspected CTS were studied by blinded assessors [Hand-therapist (HT1) and Consultant Neurophysiologist] using the Mediracer, followed by standard neurophysiologic testing. To simulate testing by personnel without neurological training, Mediracer recordings were analyzed separately by an assessor who had not seen the patients (HT2). Correlation of the CTS grades was 0.94 for the results obtained by HT1, and 0.87 for HT2. The sensitivity and specificity of the Mediracer was 0.85 and 0.9, respectively, by HT1, and 0.84 and 0.89 for HT2. Nine patients had conditions other than CTS, and 35 patients were judged to require further investigation. The authors concluded that the Mediracer should only be used in patients with typical CTS symptoms and signs and no muscle wasting who have had careful neurological assessment. These findings need confirmation in a larger randomized controlled trial.

Schmidt et al. (2011) compared the specificity and sensitivity of a hand-held nerve conduction study (NCS) device for the detection of lumbosacral radiculopathy (LSR) with standard electrodiagnostic study (EDX). Fifty patients referred to a tertiary referral electromyography (EMG) laboratory for testing of predominantly unilateral leg symptoms (weakness, sensory complaints, and/or pain) were included in the investigation. Twenty-five normal "control" subjects
were later recruited to calculate the specificity of the automated protocol. All patients underwent standard EDX and automated testing. Raw NCS data were comparable for both techniques; however, computer-generated interpretations delivered by the automated device showed high sensitivity with low specificity (i.e., many false positives) in both symptomatic patients and normal controls. The authors concluded that the automated device accurately recorded raw data, but the interpretations provided were overly sensitive and lacked the specificity necessary for a screening or diagnostic examination.

**Professional Societies**

*American Association of Neuromuscular and Electrodiagnostic Medicine (AANEM):* The AANEM recommends that a typical examination performed for nerve conduction studies include: development of a differential diagnosis based upon appropriate history and physical, the NCV study (recording and studying of electrical responses from peripheral nerves or muscles) and the completion of indicated needle EMG studies to evaluate the differential diagnosis and to complement the nerve conduction study. The minimum standards for NCV testing are as follows:

- The testing is medically indicated.
- It is performed using equipment that provides assessment of all parameters of the recorded signals (equipment designed for screening purposes is not acceptable).
- The test is performed by a physician, or by a trained technician under the direct supervision of a physician.
- The EMG must be performed by a trained physician.
- One physician supervises and performs all components of the exam.

*(AANEM Recommended policy for electrodiagnostic medicine, 2011)*

A task force of the AANEM (Charles Cho et al. 2010) evaluated the evidence and made recommendations regarding the use of electrodiagnostic (EDX) testing of patients with suspected lumbosacral radiculopathy. The task force concluded the following:

- In patients with suspected lumbosacral radiculopathy, the following EDX studies probably aid the clinical diagnosis:
  - Peripheral limb EMG (Class II evidence, Level B (probably effective) recommendation).
  - Paraspinal mapping (PM) with needle EMG in lumbar radiculopathy (Class II evidence, Level B recommendation).
  - H-reflex in S1 radiculopathy (Class II and III evidence, Level C (possibly effective) recommendation).

- Evidence suggests a low sensitivity of peroneal and posterior tibial F-waves (Class II and III evidence, Level C recommendation).

- There is inadequate evidence to reach a conclusion on the utility of the following EDX studies:
  - Dermatomal/segmental somatosensory evoked potentials (SEP) of the L5 or S1 dermatomes (Class III evidence, Level C recommendation).
  - Paraspinal mapping (PM) with needle EMG in sacral radiculopathy (one small Class II study, Level U (data inadequate or conflicting).
  - Motor evoked potential (MEP) with root stimulation in making an independent diagnosis of lumbosacral radiculopathy (Class III evidence, Level U).

The position statement of the AANEM regarding the performance and interpretation of electrodiagnostic studies states that the performance of or interpretation of NCS separately from the needle EMG component of the testing should clearly be the exception. Nerve conduction studies performed independent of needle EMG may only provide a portion of the information needed to diagnose muscle, nerve root, and most nerve disorders. When the NCS is used on its own without integrating needle EMG findings or when an individual relies solely on a review of NCS data, the results can be misleading and important diagnoses may be missed (AANEM, Proper performance and interpretation of electrodiagnostic studies, 2006).
A 2002 practice parameter for electrodiagnostic studies in carpal tunnel syndrome developed by the AANEM, American Academy of Neurology, and the American Academy of Physical Medicine and Rehabilitation, lists NCS as a standard diagnostic test for carpal tunnel syndrome and NEMG as an optional test for diagnosing carpal tunnel syndrome (Jablecki et al., 2002).

A 2005 AANEM practice guideline for usefulness of electrodiagnostic techniques in the evaluation of suspected tarsal tunnel syndrome recommends NCS for confirming the presence of tarsal tunnel syndrome. The guideline states that the utility of needle EMG in the assessment of tarsal tunnel syndrome is unclear (Patel et al., 2005).

A 2005 AANEM practice parameter for utility of electrodiagnostic techniques in evaluating patients with suspected peroneal neuropathy states that NCSs are possibly useful to make or confirm the diagnosis of suspected peroneal neuropathy. The guideline indicates that the data are insufficient to determine the role of needle EMG in making the diagnosis of peroneal neuropathy (Marciniak et al., 2005).

A 1999 practice parameter for electrodiagnostic studies in ulnar neuropathy at the elbow by the AANEM, American Academy of Neurology, and American Academy of Physical Medicine and Rehabilitation, states that ulnar sensory and motor NCSs should be performed with surface stimulation and recordings for patients with suspected ulnar neuropathy at the elbow. The guideline also states that depending on the results of NCSs, needle EMG may be indicated (AANEM practice parameter for electrodiagnostic studies in ulnar neuropathy at the elbow: summary statement, 1999).

In a policy for electrodiagnostic medicine, the AANEM recommends that a typical EMG examination includes all of the following: development of a differential diagnosis based upon appropriate history and physical, completion of indicated nerve conduction studies (recording and studying of electrical responses from peripheral nerves or muscles), and the completion of indicated needle EMG studies for selected muscles. The needle EMG studies are interpreted in real time as they are being performed. In addition, the AANEM recommends only one attending physician perform and supervise all components of the electrodiagnostic testing and that the testing occur on the same day. Reporting NCS and EMG results into separate reports is inappropriate and would be an exception to clinical practice (AANEM Recommended Policy for Electrodiagnostic Medicine, 2011).

Based on the literature, the AANEM's position is that there are no contraindications to EMG in patients with lymphedema. However, the AANEM believes that reasonable caution should be taken in performing needle examinations in lymphedematous regions to avoid complications. Clinical judgment should be used in deciding whether the risk of complication is greater than the value of the information to be obtained from the EMG (AANEM, Needle EMG in certain uncommon clinical contexts, 2005).

According to the AANEM, nerve conduction studies may be performed without needle electromyography in patients on anticoagulants, patients who have lymphedema, or patients who are being evaluated for carpal tunnel syndrome. (AANEM, Needle EMG in certain uncommon clinical contexts, 2005; AANEM Recommended Policy for Electrodiagnostic Medicine, 2011; Jablecki et al., 2002)

According to a literature review prepared for the AANEM, the Nervepace Digital Electroneurometer (NDE) is experimental and is not an effective substitute for standard electrodiagnostic studies in clinical evaluation of patients with suspected carpal tunnel syndrome (David, 2003).

According to a model policy for needle electromyography and nerve conduction studies developed by AANEM, electrodiagnostic testing is indicated for the following:
• Focal neuropathies, entrapment neuropathies, or compressive lesions/syndromes such as carpal tunnel syndrome, ulnar neuropathies, or root lesions, for localization
• Traumatic nerve lesions, for diagnosis and prognosis
• Diagnosis or confirmation of suspected generalized neuropathies, such as diabetic, uremic, metabolic, or immune
• Repetitive nerve stimulation in diagnosis of neuromuscular junction disorders such as myasthenia gravis, myasthenic syndrome
• Symptom-based presentations such as “pain in limb,” weakness, disturbance in skin sensation or “paraesthesia” when appropriate pre-test evaluations are inconclusive and the clinical assessment unequivocally supports the need for the study
• Radiculopathy-cervical, lumbosacral
• Polyneuropathy-metabolic, degenerative, hereditary
• Plexopathy-idiopathic, trauma, infiltration
• Myopathy-including polymyositis and dermatomyositis, myotonic, and congenital myopathies
• Precise muscle location for injections such as botulinum toxin, phenol, etc.

(American Association of Neuromuscular and Electrodiagnostic Medicine Model Policy for Needle Electromyography and Nerve Conduction Studies 2012)

Physiologic Recording of Tremor
Scanlon et al. (2013) investigated the properties of oscillatory movement, at rest and in posture, in both the upper and lower limbs of Parkinson’s disease (PD) patients with clinically undetectable to modest rest/postural tremor and healthy controls. PD patients (N=16) and controls (N=8) were examined clinically by a movement disorders specialist and oscillatory movements in all four extremities by using a portable biaxial accelerometer. While tremor intensity and frequency did not differ between groups, the intraindividual variability of rest and postural tremor frequency in the dexterity-dominant lower limb was lower in people with PD than in healthy adults. Additionally, rest tremor frequency was discrepant between upper and lower limbs in PD. According to the authors, this introduces the possibility that minute variations in lower limb movements, which are imperceptible upon clinical exam, can be used to differentiate a diseased sample from a healthy one. More research is needed to evaluate the validity and clinical utility of tremor measurement.

Mostile et al. (2010) evaluated whether scores on the Essential Tremor Rating Assessment Scale (TETRAS) correlate with quantitative assessments using the Kinesia (CleveMed) system in 20 patients with essential tremor (ET). TETRAS clinical scores significantly correlated with predicted Kinesia quantitative variables for postural and kinetic tremor. The investigators concluded that the Kinesia system may have a utility in quantitative assessments of ET when combined with standard clinical assessment. However, the impact of the Kinesia system on patient management has yet been adequately examined.

Caligiuri and Tripp (2004) evaluated a hand-held device (Tremorometer) for quantifying tremor in the upper extremity. Results from 242 subjects with tremor showed significant effects of limb posture on tremor frequency detected by the device which could not be revealed using traditional observer severity ratings. Subjects with tremor associated with idiopathic Parkinson’s disease were distinguished from patients with drug-induced parkinsonian tremor with 83% accuracy. These and other findings on instrument validity demonstrate that tremor assessment can be performed using standard quantitative procedures which overcome many of the limitations inherent in subjective observer ratings. These findings have not been translated into clinical practice demonstrating improved outcomes.

There is insufficient evidence and too few studies to conclude that accelerometers are beneficial for health outcomes in patients with tremor. Well-designed controlled studies are needed to determine the usefulness of these devices.
Quantitative Sensory Testing
Several nonrandomized controlled trials, all of which pertain to the current perception threshold (CPT) test and voltage nerve conduction threshold tests were identified. (Loseth, 2009; House, 2009; Scherens, 2009; Kim et al., 2008; Aird et al., 2006; Matsutomo et al., 2005; Nishimura et al., 2004; Toda et al., 2004; Kudoh et al., 2003; Nishimura et al., 2003; Tseng, 2003) In these studies, patient groups generally have higher CPT values than healthy controls. Nishimura et al. (2003) found that current threshold perception testing had a specificity of 74% and a sensitivity of 73% for the diagnosis of carpal tunnel syndrome. No randomized controlled trials or comparison studies are available for pressure-specified sensory devices for evaluating nerve function (ECRI, Pressure-specified Sensory Device for Evaluating Nerve Function, 2012).

Suokas et al. (2012) systematically reviewed the use of quantitative sensory testing (QST) in pain characterization in osteoarthritis (OA). Of 20 studies comparing people with OA and healthy controls, seven provided sufficient information for meta-analysis. Compared with controls, people with OA had lower pressure pain thresholds (PPTs) both at the affected joint and at remote sites. The authors concluded that QST of PPTs demonstrated good ability to differentiate between people with OA and healthy controls. The authors stated that more research is needed to determine the clinical utility of QST.

Dros et al. (2009) conducted a systematic review of studies in which the accuracy of monofilament testing was evaluated to detect peripheral neuropathy of any cause using nerve conduction as reference standard. Methodological quality was assessed using the Quality Assessment of Diagnostic Accuracy Studies (QUADAS) tool. The investigators identified 54 potentially eligible studies, of which 3 were finally selected for data synthesis. All studies were limited to patients with diabetes mellitus and showed limitations according to the QUADAS tool. Sensitivity ranged from 41% to 93% and specificity ranged from 68% to 100%. Because of the heterogeneous nature of the studies, a meta-analysis could not be accomplished. According to the investigators, despite the frequent use of monofilament testing, little can be said about the test accuracy for detecting neuropathy in feet without visible ulcers. Optimal test application and defining a threshold should have priority in evaluating monofilament testing, as this test is advocated in many clinical guidelines. Accordingly, the investigators do not recommend the sole use of monofilament testing to diagnose peripheral neuropathy.

Feng et al. (2009) conducted a systematic review is to evaluate current evidence in the literature on the efficacy of Semmes Weinstein monofilament examination (SWME) in diagnosing diabetic peripheral neuropathy (DPN). Thirty articles were selected, involving 8365 patients. There was great variation in both the reference test and the methodology of SWME. However, current literature suggests that nerve conduction study (NCS) is the gold standard for diagnosing DPN. Four studies were identified which directly compared SWME with NCS and encompassed 1065 patients with, and 52 patients without diabetes mellitus. SWME had a sensitivity ranging from 57% to 93%, specificity ranging from 75% to 100%, positive predictive value (PPV) ranging from 84% to 100%, and negative predictive value (NPV) ranging from 36% to 94%. The authors concluded that there is great variation in the current literature regarding the diagnostic value of SWME as a result of different methodologies. To maximize the diagnostic value of SWME, a three site test involving the plantar aspects of the great toe, the third metatarsal, and the fifth metatarsals should be used.

Park et al. (2011) compared postsurgical neurosensory alteration and recovery patterns among different nerve fiber types and orthognathic surgeries by measuring current perception thresholds (CPTs). CPTs of 186 patients who underwent various orthognathic surgeries were measured assessing 3 different nerve fiber types before surgery and at 3, 6, and 12 months after surgery. CPTs were highest at 3 months postsurgery and gradually returned to presurgical levels until 12 months postsurgery in most cases. According to the authors, CPTs may be useful for evaluating the patient's severity and recovery of nerve damage after surgery. This study does not establish how current perception thresholds affect therapeutic outcome.
Loseth et al. (2010) evaluated possible differences in distal polyneuropathy (PN) characteristics and degree of abnormalities for various small and large fiber parameters in diabetes type 1 (DM1) and type 2 (DM2). Sixty-six DM1 and 57 DM2 patients with or without PN symptoms were included. Nerve conduction studies (NCS), quantitative sensory testing (QST) and quantification of intraepidermal nerve fibres (IENFs) were performed. Z-scores were calculated from reference materials. In both groups, 42% had abnormal NCS classification, 42% (DM1) and 39% (DM2) abnormal QST, as well as 40% (DM1) and 32% (DM2) abnormal IENF density. In multivariate analysis, some NCS and QST Z-scores were more abnormal in DM2. Symptom scoring correlated better with NCS and QST parameters in DM1. The investigators concluded that the differences could be referred to disease duration, glycaemic control and possibly patient age. The various parameters from NCS, QST and IENF analysis contribute differently in the assessment of polyneuropathy. These findings have not been translated into clinical practice demonstrating improved outcomes.

Mythili et al. (2010) evaluated the discriminative power of the Diabetic Neuropathy Examination Score (DNE), 10-g Semmes-Weinstein Monofilament Examination (SWME) and Quantitative Sensory Testing by Vibration Perception Threshold (VPT) in the diagnosis of diabetic polyneuropathy and sought an optimal screening method in 100 consecutive patients with Type 2 diabetes. Sensitivity and specificity for the DNE, SWME and VPT were calculated, taking NCS as gold standard. Seventy one of 100 subjects had evidence of neuropathy confirmed by nerve conduction studies, while 29 did not have neuropathy. The DNE score gave a sensitivity of 83% and a specificity of 79%. The sensitivity of SWME was 98.5% and specificity was 55%. Vibration Perception Thresholds yielded a sensitivity of 86% and a specificity of 76%. The investigators concluded that a simple neurological examination score is as good as Vibration Perception threshold in evaluation of polyneuropathy in a diabetic clinic.

**Professional Societies**

**American Academy of Neurology (AAN):** In a 2003 report (reaffirmed in 2008), the AAN noted quantitative sensory testing (QST) is a potentially useful tool for measuring sensory impairment for clinical and research studies. However, QST results should not be used as a sole method for diagnosis of pathology. The authors identified no adequately powered class I studies demonstrating the effectiveness of QST in evaluating any particular disorder. Lesser quality studies indicated that QST may be useful in identifying small or large fiber sensory abnormalities in some clinical conditions. The AAN indicated QST poses technical challenges in the methodology of testing, reproducibility, and psychophysical factors which limit the objectivity of testing results. The recommendations for use of QST include:

- Based on Class II evidence, QST measuring vibration and thermal perception thresholds is probably an effective tool in the documentation of sensory abnormalities in patients with diabetic neuropathy (Level B recommendation).
- Based on several Class II studies, QST is probably useful in documenting changes in sensory thresholds in longitudinal evaluation of patients with diabetic neuropathy (Level B recommendation).
- Although there is data to suggest that QST abnormalities may be detectable in the absence of clinical evidence of neuropathy in diabetic patients, there is no credible prospective evidence that patients with these abnormalities will ultimately go on to develop clinical neuropathy. Thus, whether QST is useful in preclinical neuropathy detection is unproven (Level U recommendation - current knowledge is conflicting, unproven, or inadequate) (Shy et al., 2003).

In a practice topic for the evaluation of distal symmetric polyneuropathy, Definition for Clinical Research, the American Academy of Neurology, American Association of Neuromuscular and Electrodiagnostic Medicine, and American Academy of Physical Medicine and Rehabilitation state that the sensitivities and specificities of quantitative sensory testing (QST) varied widely among studies. These psychophysical tests have greater inherent variability, making their results more difficult to standardize and reproduce. Reproducibility of QST varied from poor to excellent. The
practice parameter indicated that there is too much inconsistency among the studies describing the accuracy of QST for its incorporation into the case definition (England, 2009).

**American Association of Electrodiagnostic Medicine (AAEM):** In 2004, AAEM reviewed the technical aspects and reproducibility of different methods to determine threshold for light touch-pressure, vibration, thermal, and pain stimuli. Clinical uses and limitations of QST were also reviewed. The report found that the results of QST are highly dependent on methodology and the full cooperation of the subject. QST has been shown to be reasonably reproducible over a period of days or weeks in normal subjects. The use of QST in research and patient care should be limited to instruments and their corresponding methodologies that have been shown to be reproducible. Literature data do not allow conclusions regarding the relative merits of individual QST instruments (Chong and Cros, 2004). AAEM concluded the following:

- QST is a reliable psychophysical test of large- and small-fiber sensory modalities.
- QST tests the integrity of the entire sensory axis from receptors to brain. Abnormalities do not localize dysfunction to the central or peripheral nervous system, or any particular location along the peripheral nervous system.
- QST is highly dependent on the full cooperation of the patient and may be falsely abnormal if the patient is biased toward an abnormal result or is cognitively impaired. No algorithm can reliably distinguish between psychogenic and organic abnormality.
- QST has been shown to be reasonably reproducible over a period of days or weeks in normal subjects. Since longitudinal QST studies of patients in drug trials are usually done over a period of several months to a few years, reproducibility studies on the placebo-controlled group should be included.
- The reproducibility of thermal thresholds may not be as good as that of vibration threshold.
- For individual patients, more studies are needed to determine the maximum allowable difference between two QSTs that can be attributed to experimental error.
- Different commercially available QST instruments have different specifications (thermode size, stimulus characteristics), testing protocols, algorithms, and normal values. Only QST instruments and their corresponding methodologies that have been shown to be reproducible should be used for research and patient care.
- The results of QST can only be interpreted properly if machine calibration and testing protocol are strictly followed.
- The published evidence does not allow a conclusion to be made regarding whether any QST instrument is better than another.

According to a model policy for needle electromyography and nerve conduction studies developed by American Association of Neuromuscular and Electrodiagnostic Medicine (AANEM), the current perception threshold/sensory nerve conduction threshold test (sNCT) is investigational (American Association of Neuromuscular and Electrodiagnostic Medicine Model Policy for Needle Electromyography and Nerve Conduction Studies 2012).

**The American Academy of Orthopaedic Surgeons (AAOS):** The AAOS 2010 Clinical Practice Guideline on the diagnosis of carpal tunnel syndrome states that the physician should not routinely evaluate patients suspected of having carpal tunnel syndrome with new technology such as pressure specified sensorimotor devices (PSSD).

**Academy of Ambulatory Foot and Ankle Surgery:** In 2009, the Academy of Ambulatory Foot and Ankle Surgery reviewed its guideline on intermetatarsal neuroma and reaffirmed that the current perceptual threshold (Neurometer CPT test) may be used as indicated.

**American College of Foot and Ankle Surgeons:** In 2010, the American College of Foot and Ankle Surgeons revised a clinical practice guideline for the diagnosis and treatment of heel pain, which states that diagnostic studies [for heel pain] may include electromyography (EMG), nerve
conduction velocity (NCV) test, magnetic resonance imaging (MRI), and the pressure-specified sensory device test.

The International Association for the Study of Pain: The International Association for the Study of Pain published guidelines for the assessment of patients with neuropathic pain. According to the guideline, clinical examination, including accurate sensory examination, is the basis of neuropathic pain diagnosis. For more accurate sensory profiling, quantitative sensory testing is recommended for selected cases in clinic, including the diagnosis of small fiber neuropathies and for research purposes. The association states that QST can be used in clinic along with bedside testing, but it cannot allow for estimation of the level of the lesion within the neuraxis. The relevance of QST to predict therapeutic outcome has yet to be established in prospective studies (Haanpaa et al. 2011).

U.S. FOOD AND DRUG ADMINISTRATION (FDA)

Electromyography (EMG)

Quantitative Sensory Testing and Nerve Conduction Studies
Devices used for current perception threshold and sensory nerve conduction threshold testing are classified under product codes LLN and GWF. Note that there are numerous 510(k) marketing clearances for these codes and that not all of these clearances are for devices indicated for nerve threshold testing. Neurosensory testing systems such as the NK Pressure-Specified Sensory Device (PSSD) are regulated by the FDA as Class II devices. The PSSD was approved via the FDA 510(k) process (K934368) on August 11, 1994. See the following Web site for more information: (use product codes LLN or GWF) http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfPMN/pmn.cfm. Accessed June 2013.


Point of care nerve conduction devices are classified under the product code JXE. See the following Web site for more information: http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfPMN/pmncfm. Accessed June 2013.

The NC-stat System received initial FDA 510(k) approval on October 2, 1998 for measurement of neuromuscular signals that are useful in diagnosing and evaluating systemic and entrapment neuropathies. It was approved as an adjunct to, and not a replacement for, conventional electrodagnostic measurements. Four subsequent 510(k) approvals have been issued for this device, the most recent one being issued in July 2006. See the following Web site for more information: http://www.accessdata.fda.gov/cdrh_docs/pdf6/K060584.pdf. Accessed June 2013. The intended use for this device remained essentially unchanged in all approvals issued.

Accelerometers
Kinesia (Cleveland Medical Devices Inc.) received FDA approval in April 2007 to be used for monitoring physical motion and muscle activity to quantify kinematics of movement disorder symptoms such as tremor and assess activity in any instance where quantifiable analysis of motion and muscle activity is desired. Kinesia, a quantitative motor assessment system, is a compact wireless system that uses accelerometers and gyroscopes to monitor three-dimensional motion. The device is worn on the wrist and finger of the patient and can be used to monitor...

**Additional Products**

**Electromyography (EMG):** A number of EMG devices are available that are too numerous to mention here. Surface EMG devices include but are not limited to the following: Spinoscope (Spinex Corp.)

**Quantitative Sensory Testing and Nerve Conduction Studies:** Testing devices include but are not limited to the following: Medi-Dx 7000TM Single-Electrode Sensory Nerve Conduction Threshold Device (NDA Inc, Laguna Beach, CA), Neurometer® CPT Electrodiagnostic Neurostimulator (Neurotron Inc, Baltimore, MD), NC-stat System (NeuroMetrix, Inc.), Brevio (NeuMed, Inc.), NervePace (Neurotron, Inc.); Neural-Scan, formally known as Medi-Dx 7000® (Neuro-Diagnostic Associates); Nk Pressure-Specified Sensory Device (Nk Biotechnical Engineering); Vibration Perception Threshold (VPT) Meter® (Xilas Medical Inc.); Medi-Dx 7000 (Neuro-Diagnostic Assoc. (NDA) Inc.); CASE™ IV System: Computer Aided Sensory Evaluator (WR Medical Electronics Co.); Neurometer® (Neurotron Inc.); Vibriometer™ (Somedic AB, Sweden); Thermal sensitivity tester (Sensortek, Inc., Clifton, NJ); Axon-II™ NCSs System™

**CENTERS FOR MEDICARE AND MEDICAID SERVICES (CMS)**

Medicare does not have a National Coverage Determination (NCD) for Neurophysiologic Studies including, surface electromyography, macro electromyography, and nerve conduction studies. However, Local Coverage Determinations (LCDs) do exist. Refer to the LCDs for Electromyography and Nerve Conduction Studies, Medicine: Nerve Conduction Studies (NCS) and Electromyography (EMG), Nerve Conduction Studies (NCS)/Electromyography (EMG), Nerve Conduction Studies and Electromyography, Nervous System Studies - Autonomic Function, Nerve Conduction and Electromyography, Neuromuscular Electrodiagnostic Testing, Neuromuscular Junction Testing and Somatosensory Testing.

Dynamic surface electromyography is mentioned in the LCD’s for: Gait Analysis and Comprehensive Motion Analysis Studies

Medicare does not have a National Coverage Determination (NCD) for Quantitative sensory testing (QST). However, Local Coverage Determinations do exist. Refer to the LCDs for Services That Are Not Reasonable and Necessary, Non-Covered Services, Non-Covered Services, Non-Covered Category III CPT Codes and Category III CPT Codes.

(Accessed August 9, 2013)

**APPLICABLE CODES**

The codes listed in this policy are for reference purposes only. Listing of a service or device code in this policy does not imply that the service described by this code is a covered or non-covered health service. Coverage is determined by the benefit document. This list of codes may not be all inclusive.

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<thead>
<tr>
<th>CPT® Code (Proven)</th>
<th>Description</th>
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<tr>
<td>95860</td>
<td>Needle electromyography; one extremity with or without related paraspinal areas</td>
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<td>95861</td>
<td>Needle electromyography; 2 extremities with or without related paraspinal areas</td>
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<td>CPT® Code (Proven)</td>
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<td>95863</td>
<td>Needle electromyography; 3 extremities with or without related paraspinal areas</td>
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<td>95865</td>
<td>Needle electromyography; larynx</td>
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<td>95866</td>
<td>Needle electromyography; hemidiaphragm</td>
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<td>95867</td>
<td>Needle electromyography; cranial nerve supplied muscle(s), unilateral</td>
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<td>95868</td>
<td>Needle electromyography; cranial nerve supplied muscles, bilateral</td>
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<td>95869</td>
<td>Needle electromyography; thoracic paraspinal muscles (excluding T1 or T12)</td>
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<td>Needle electromyography; limited study of muscles in one extremity or non-limb (axial) muscles (unilateral or bilateral), other than thoracic paraspinal, cranial nerve supplied muscles, or sphincters</td>
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<td>95872</td>
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<td>Nerve conduction studies; 13 or more studies</td>
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<td>Quantitative sensory testing (QST), testing and interpretation per extremity; using vibration stimuli to assess large diameter fiber sensation</td>
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<td>0108T</td>
<td>Quantitative sensory testing (QST), testing and interpretation per extremity; using cooling stimuli to assess small nerve fiber sensation and hyperalgesia</td>
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<td>0109T</td>
<td>Quantitative sensory testing (QST), testing and interpretation per extremity; using heat-pain stimuli to assess small nerve fiber sensation and hyperalgesia</td>
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<td>0110T</td>
<td>Quantitative sensory testing (QST), testing and interpretation per extremity; using other stimuli to assess sensation</td>
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<td>0199T</td>
<td>Physiologic recording of tremor using accelerometer(s) and gyroscope(s), (including frequency and amplitude) including interpretation and report</td>
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<td>95905</td>
<td>Motor and/or sensory nerve conduction, using preconfigured electrode array(s), amplitude and latency/velocity study, each limb, includes F-wave study when performed, with interpretation and report</td>
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<td>Dynamic surface electromyography, during walking or other functional activities, 1-12 muscles</td>
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<td>96003</td>
<td>Dynamic fine wire electromyography, during walking or other functional activities, 1 muscle</td>
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<td>96004</td>
<td>Review and interpretation by physician or other qualified health care professional of comprehensive computer-based motion analysis, dynamic plantar pressure measurements, dynamic surface electromyography during walking or other functional activities, and dynamic fine wire electromyography, with written report</td>
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<td>Unlisted neurological or neuromuscular diagnostic procedure</td>
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<td>Surface electromyography (emg)</td>
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**Coding Clarification**

**ICD-9 Codes**

See the attached document for a list of allowable ICD-9 diagnosis codes.

![Neurophysiologic Testing ICD9 Codes](image)

**ICD-10 Codes (Preview Draft)**

In preparation for the transition from ICD-9 to ICD-10 medical coding on **October 1, 2015**

A sample listing of the ICD-10 CM and/or ICD-10 PCS codes associated with this policy has been provided below for your reference. This list of codes may not be all inclusive and will be updated to reflect any applicable revisions to the ICD-10 code set and/or clinical guidelines outlined in this policy.

*The effective date for ICD-10 code set implementation is subject to change.*

![Neurophysiologic Testing ICD10 Dx coc](image)

**REFERENCES**


POLICY HISTORY/REVISION INFORMATION

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<th>Action/Description</th>
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<td>05/01/2014</td>
<td>Updated list of applicable ICD-9 diagnosis codes; removed invalid code 787.6</td>
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<td>   Changed tentative effective date of ICD-10 code set implementation from “10/01/14” to “10/01/15”</td>
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