BlueCross BlueShield of Alabama

Name of Policy:

Neuromuscular and Electrodiagnostic Testing (EDX): Nerve Conduction Studies (NCS) and Electromyography (EMG) Studies

Policy #: 228
Category: Medicine

Latest Review Date: July 2018
Policy Grade: A

Background/Definitions:

As a general rule, benefits are payable under Blue Cross and Blue Shield of Alabama health plans only in cases of medical necessity and only if services or supplies are not investigational, provided the customer group contracts have such coverage.

The following Association Technology Evaluation Criteria must be met for a service/supply to be considered for coverage:

1. *The technology must have final approval from the appropriate government regulatory bodies;*
2. *The scientific evidence must permit conclusions concerning the effect of the technology on health outcomes;*
3. *The technology must improve the net health outcome;*
4. *The technology must be as beneficial as any established alternatives;*
5. *The improvement must be attainable outside the investigational setting.*

Medical Necessity means that health care services (e.g., procedures, treatments, supplies, devices, equipment, facilities or drugs) that a physician, exercising prudent clinical judgment, would provide to a patient for the purpose of preventing, evaluating, diagnosing or treating an illness, injury or disease or its symptoms, and that are:

1. *In accordance with generally accepted standards of medical practice; and*
2. *Clinically appropriate in terms of type, frequency, extent, site and duration and considered effective for the patient's illness, injury or disease; and*
3. *Not primarily for the convenience of the patient, physician or other health care provider; and*
4. *Not more costly than an alternative service or sequence of services at least as likely to produce equivalent therapeutic or diagnostic results as to the diagnosis or treatment of that patient's illness, injury or disease.*

Description of Procedure or Service:

Electromyography (EMG) and nerve conduction studies (NCS), also collectively known as electrodiagnostic assessment, are intended to evaluate the electrical functioning of muscles and peripheral nerves. These tests are used as diagnostic aids for the evaluation of myopathy and peripheral neuropathy by identifying, localizing, and characterizing electrical abnormalities in the skeletal muscles and peripheral nerves.

The NCS is performed by an eligible provider (e.g., physician, physical therapist or chiropractor) or by a trained allied health professional under direct supervision of an eligible provider trained in electrodiagnostic medicine. The American Association of Neuromuscular and Electrodiagnostic Medicine (AANEM) states, "NCSs should be either (a) performed directly by physician or (b) performed by a trained individual under the direct supervision of a physician. Direct supervision means that the physician is in close physical proximity to the EDX laboratory while testing is underway, is immediately available to provide the trained individual with assistance and direction, and is responsible for selecting the appropriate NCSs to be performed".

Electrodiagnostic Assessment

Electromyography (EMG) and nerve conduction study (NCS) have been used for several decades as adjuncts to the clinical examination in the evaluation of myopathy and peripheral neuropathy. The intent of these tests is to evaluate the integrity and electrical function of muscles and peripheral nerves. They are performed when there is a clinical suspicion for a myopathic or neuropathic process and when clinical examination and standard laboratory testing is unable to make a definitive diagnosis.

Test results do not generally provide a specific diagnosis. Rather, they provide additional information that assists physicians in characterizing a clinical syndrome. EMG/NCS may be useful when there is no clear etiology when symptoms are severe or rapidly progressing, or when symptoms are atypical (e.g., asymmetrical, acute onset, or appearing to be autonomic).

According to the American Association of Neuromuscular and Electrodiagnostic Medicine, electrodiagnostic assessment has the following goals:

- Identify normal and abnormal nerve, muscle, motor or sensory neuron, and neuromuscular junction (NMJ) functioning
- Localize region(s) of abnormal function
- Define the type of abnormal function
- Determine the distribution of abnormalities
- Determine the severity of abnormalities
- Estimate the date of a specific nerve injury
- Estimate the duration of the disease
- Determine the progression of abnormalities or of recovery from abnormal function
- Aid in diagnosis and prognosis of disease
- Aid in selecting treatment options
- Aid in following response to treatment by providing objective evidence of change in NM function
- Localize correct locations for injections of intramuscular agents

Components of the electrodiagnostic exam may include needle EMG, NCS, repetitive nerve stimulation study, somatosensory evoked potentials, and blink reflexes.

Electromyography

Needle EMG

An EMG needle electrode is inserted into selected muscles, chosen by the examining physician depending on the differential diagnosis and other information available at the time of exam. The response of the muscle to electrical stimulation is recorded. There are 3 components evaluated: observation at rest, action potential with minimal voluntary contraction, and action potential with maximum contraction.

Single fiber EMG

In this technique, a needle electrode records the response of a single muscle fiber. This test can evaluate "jitter," which is defined as the variability in time between activation of the nerve and generation of the muscle action potential. Single fiber EMG can also be used to measure fiber density, which is defined as the mean number of muscle fibers for 1 motor unit.

Nerve Conduction Study

Both motor and sensory nerve conduction are assessed. For motor conduction, electrical stimuli are delivered along various points on the nerve and the electrical response is recorded from the appropriate muscle. For sensory conduction, electrical stimuli are delivered to 1 point on the nerve and the response recorded at a distal point on the nerve. Parameters recorded include velocity, amplitude, latency, and configuration.

Late Wave Responses

Late waves are a complement to the basic NCS study and evaluate the functioning of the proximal segment of peripheral nerves, such as the nerve root and the anterior horn cells. There are 2 types of late responses, the H-reflex and the F wave.

The H-reflex is elicited by stimulating the posterior tibial nerve and measuring the response in the gastrocnemius muscle. It is analogous to the ankle reflex and can be prolonged by a radiculopathy at S1 or by a peripheral neuropathy.

The F wave is assessed by supramaximal stimulation of the distal nerve and can be used to estimate the conduction velocity in the proximal portion of the nerve. This will provide information on the presence of proximal nerve abnormalities, such as radiculopathy or plexopathy.

Repetitive Nerve Stimulation

Repetitive nerve stimulation studies are intended to evaluate the integrity and function of the NMJ. The test involves stimulating a nerve repetitively at variable rates and recording the response of the corresponding muscle(s). Disorders of the NMJ will show a diminished muscular response to repetitive stimulation.

Somatosensory Evoked Potentials

Somatosensory evoked potentials evaluate nerve conduction in various sensory fibers of both the peripheral and central nervous system and are used to test the integrity and function of these nerve pathways. They are typically used to assess nerve conduction in the spinal cord and other central pathways that cannot be assessed by standard NCS.

Blink Reflexes

The blink reflexes, which are analogs of the corneal reflex, are evaluated by stimulating the orbicularis orbis muscle at the lower eyelid. They are used to localize lesions in the fifth or seventh cranial nerves.

Differential Diagnosis

The specific components of an individual test are not standardized. Rather, a differential diagnosis is developed by the treating physician, and/or the clinician performing the test, and the specific components of the exam are determined by the disorders that are being considered in the differential. In addition, the differential diagnosis may be modified during the exam to reflect initial findings, and this may also influence the specific components that are included in the final analysis.

Policy:

Nerve conduction velocity (NCV) studies meet Blue Cross and Blue Shield of Alabama's medical criteria for coverage **when conducted and interpreted at the same time as a needle electromyography (NEMG)** test for ANY of the following indications:

- Localization of focal neuropathies or compressive lesions/syndrome, including but not limited to Any of the following:
    - Carpal tunnel
    - Cubital tunnel syndrome
    - Tarsal tunnel syndrome
    - Peroneal nerve compression
    - Thoracic outlet syndrome
- Diagnosis and prognosis of traumatic nerve lesions or other nerve trauma;
- Diagnosis or confirmation of suspected generalized neuropathies, including but not limited to **ANY** of the following:
    - Metabolic and nutritional (diabetic, uremic, amyloidosis, hypothyroidism, immune, vitamin B12 or thiamine deficiency)
    - Toxic neuropathy (e.g., vincristine, amiodarone)
    - Hereditary polyneuropathy (e.g., Charcot-Marie Tooth disease)
    - Infectious neuropathy (e.g., HIV, Lyme disease, Leprosy
    - Demyelinating neuropathy (e.g., Guillain-Barre syndrome)
    - Idiopathic peripheral neuropathy
- Motor neuronopathy conditions (e.g., amyotrophic lateral sclerosis [ALS or Lou Gehrig's disease]):
    - Up to 4 motor nerves and 2 sensory nerves may be studied
    - Needle EMG of up to 4 extremities (or limbs and facial or tongue muscles) is often necessary to document widespread denervation and to exclude a myopathy.

    - One repetitive motor nerve stimulation study may be indicated to exclude a disorder affecting neuromuscular transmission;
- Diagnosis of neuromuscular junction disorders (e.g., myasthenia gravis/myasthenic syndrome) or other neuromuscular conditions (e.g., fasciculation [muscle twitching]) using repetitive nerve stimulation:
    - Repetitive NCSs should be performed in at least 2 nerves and SFEMG in up to 2 muscles,
    - If any of the above tests are abnormal, up to 2 motor and 2 sensory NCSs may be performed to exclude neuropathies that can be associated with abnormal neuromuscular transmission;
    - At least 1 motor and 1 sensory NCS should be performed in a clinically involved limb, preferable in the distribution of a nerve studied with repetitive stimulation or SFEMG;
    - At least 1 distal and 1 proximal muscle should be studied by a needle EMG examination;
        - At least 1 of the muscles should be clinically involved and both muscles should be in clinically involved limbs;
- Differential diagnosis of symptom-based complaints suggesting nerve root, peripheral nerve, muscle, or neuromuscular junction involvement, when pre-test evaluations are inconclusive and clinical assessment supports the need for the study, such as for any of the following:
    - Muscle weakness
    - Muscle atrophy
    - Muscle fasciculation
    - Myokymia
    - Myotonia
    - Loss of dexterity
    - Spasticity
    - Hyper-reflexia
    - Sensory deficits
    - Diplopia
    - Ptosis
    - Swallowing dysfunction
    - Dysarthria
    - Impaired bowel motility
- Follow-up treatment of diabetic peripheral neuropathy, tested once every 24 months;
- Disorders of peripheral nervous system;
- Radiculopathy:
    - H reflexes and F waves may be necessary to support a diagnosis of root dysfunction.
    - Minimal evaluation includes 1 motor and 1 sensor NCS and a needle EMG examination of the involved limb
        - Testing can include up to 3 motor NCSs (in cases of an abnormal motor NCS, the same nerve in the contralateral limb and another motor nerve in the ipsilateral limb can be studied) and 2 sensory NCSs

        - Bilateral studies are often necessary to exclude a central disc herniation with bilateral radiculopathies or spinal stenosis or to differentiate between radiculopathy and plexopathy, polyneuropathy, or mononeuropathy.
    - To differentiate brachial plexopathy from cervical radiculopathy, all major sensory and motor nerves (radial, median, ulnar, and medial and lateral antebrachial cutaneous sensory; radial, median ulnar and possibly axillary and musculocutaneous motor) and a needle EMG examination in both upper extremities may need to be studied
    - To differentiate lumbosacral radiculopathy from lumbar plexopathy, it may be necessary to study all major sensory and motor nerves (superficial peroneal and sural sensory; peroneal and posterior tibial motor) and perform a needle EMG examination in both lower extremities;

- Myopathy:
    - A needle EMG examination of 2 limbs is indicated.
    - To exclude polyneuropathy or neuronopathy, 2 motor and 2 sensory NCSs are indicated.
    - To exclude a disorder of neuromuscular transmission, 2 repetitive motor nerve stimulation studies may be needed;
- Myositis;
- Nerve root compression;
- Neuritis;
- Plexopathy;
- Spinal cord injury;
- Polyneuropathy/mononeuropathy multiplex:
    - To distinguish the nature of the polyneuropathy (axonal or demyelinating, diffuse or multifocal) it may be necessary to study 4 motor and 4 sensory nerves, consisting of 2 motor and 2 sensory NCS in 1 leg, 1 motor and 1 sensory NCS in the opposite leg and 1 motor and 1 NCS in 1 arm.
    - At least 2 limbs should be studied by a needle EMG.

Nerve conduction velocity (NCV) studies when performed alone meet Blue Cross and Blue Shield of Alabama's medical criteria for coverage for **ANY** of the above indications, in **ANY** of the following clinical presentations:

- As a follow-up study of a neuromuscular structure that has undergone previous electrodiagnostic evaluation
- Current use of an anticoagulant
- Presence of lymphedema
- Carpal tunnel syndrome (unilateral, bilateral):
    - For patients with suspected carpal tunnel syndrome (CTS), the following recommendations were made and endorsed by the American Academy of Neurology (AAN), the American Academy of Physical Medicine and Rehabilitation, and the American Association of Neuromuscular & Electrodiagnostic Medicine (AANEM):
        - Perform a median sensory NCS across the wrist with a conduction distance of 13 to 14 cm. If the result is abnormal, do a comparison of the

result of the median sensory NCS to the result of a sensory NCS of one other adjacent sensory nerve in the symptomatic limb.

- If the initial median sensory NCS across the wrist has a conduction distance > 8 cm and the result is normal, do one of the following additional studies:
- Comparison of median sensory or mixed nerve conduction across the wrist over a short (7-8 cm) conduction distance with ulnar sensory nerve conduction across the wrist over the same short (7-8 cm) conduction distance; OR
- Comparison of median sensory conduction across the wrist with radial or ulnar sensory conduction across the wrist in the same limb; OR

- Comparison of median sensory or mixed nerve conduction through the carpal tunnel to sensory or mixed NCS of proximal (forearm) or distal (digit) segments of the median nerve in the same limb.
- Motor conduction studies of the median nerve recording from the muscle and of one other nerve in the symptomatic limb to include measurement of distal latency.
- NCS may be done pre-op a maximum number of times as listed in the Table 1 chart. NSC may be indicated one time post op, to provide reassessment concerning possible failure of surgery

- Post-surgical repair of CTS, to assess possible failure of treatment, tested one time.

Nerve conduction studies (NCS) do not meet Blue Cross and Blue Shield of Alabama's medical criteria for the following indications:

- The F-wave study for carpal tunnel syndrome.
- NCS as screening tests for polyneuropathy of diabetes or end-stage renal disease.
- NCS for the sole purpose of monitoring disease intensity or treatment effectiveness for polyneuropathy of diabetes or end-stage renal disease.
- NCS using portable automated point-of-care hand-held devices. Examples of these nerve conduction testing devices include, but are not limited to, NC-Stat by NeuroMetrix®, Neurometer® and Brevio® NCS-Monitor. See Policy #304 for additional information regarding Automated Point-of-Care Nerve Conduction Tests.
- NCS done by mobile neurodiagnostic labs.
- NCS done by technicians alone, not under direct supervision of a trained eligible provider.
    - Direct supervision in the office setting means the **eligible provider must be present in the office suite and immediately available and able to provide assistance and direction throughout the time the service is performed**. Direct supervision does not mean that the eligible provider must be present in the same room with his or her aide.
- NCS performed without needle EMG at the same time is considered **not medically necessary** except the limited clinical situations listed above.

NEUROMUSCULAR JUNCTION TESTING

Neuromuscular junction testing meets Blue Cross and Blue Shield of Alabama's medical criteria for coverage for **ANY** of the following indications:

- Myopathy
- Motor neuropathy (e.g., ALS)
- Botulinum toxicity
- Myasthenia Gravis
- Lambert Eaton myasthenic syndrome
- The presence of ANY of the following:
    - Diplopia
    - Dysphagia
    - Fatigue/weakness that progresses with repetitive activity

Neuromuscular Junction testing does not meet Blue Cross and Blue Shield of Alabama's medical criteria for ANY other indication.

According to 2018 CPT® instructions:
"Waveforms must be reviewed on site in real time, and the technique (stimulus site, recording site, ground site, filter settings) must be adjusted, as appropriate, as the test proceeds in order to minimize artifact, and to minimize the chance of unintended stimulation of adjacent nerves and the unintended recording from adjacent muscles or nerves. Reports must be prepared on site by the examiner, and consist of the work product of the interpretation of numerous test results, using well-established techniques to assess the amplitude, latency, and configuration of waveforms elicited by stimulation at each site of each nerve tested. This includes the calculation of nerve conduction velocities, sometimes including specialized F-wave indices, along with comparison to normal values, summarization of clinical and electrodiagnostic data, and physician or other qualified health care professional interpretation."

The following definitions apply for billing codes **95905-95913**:

> The use of the term "**onsite**" indicates that the summary of the patient's history and physical examination, execution of all of the appropriate nerve conduction studies and EMG examinations, analysis of the EDX data, and determination of the diagnoses for the patient are all performed in the same location which is most commonly the EDX laboratory. "Onsite" would preclude the use of telemetry or other technologies to allow the EDX data to be transmitted and interpreted at a location different from where the EDX study is performed.
>
> The use of the term "**real time**" with regard to nerve conduction studies indicates that information from the history and physical examinations are integrated*, the specific and tailored EDX study is performed, and the analysis of the waveforms are all done at the same time and while the patient is present in the EDX laboratory (whether that be in an office, a hospital, or a medical clinic). An EDX study performed in "real time" is more sensitive and accurate since it allows the specific NCS and EMG tests performed to be modified as dictated by the results as they arise and it allows the physician to perform

additional NCS or EMG studies, if necessary, after preliminary review and before the patient leaves the EDX laboratory.

*Integration in the context of EDX studies describes how attributes of the history and physical examinations are used to design a specific grouping of nerve conduction studies and a specific selection of muscles to be evaluated during the needle EMG examination for each patient. The EDX examination is therefore tailored to each patient.

Frequency of Testing

Services performed for excessive frequency do not meet Blue Cross and Blue of Alabama's medical criteria for coverage. Frequency is considered excessive when services are performed more frequently than generally accepted by AANEM.

The AANEM lists these recommendations concerning a reasonable maximum number of NCV studies per diagnostic category needed for a physician to render a diagnosis:

Table 1:

Maximum Number of Studies					
	Needle Electromyography	**Nerve Conduction Studies**		**Other Electromyographic Studies**	
Indication	**Number of Services (Tests)**	**Motor NCS with and/or without F wave**	**Sensory NCS**	**H-Reflex**	**Neuromuscular Junction Testing (Repetitive Stimulation)**
Carpal Tunnel (unilateral)	1	3	4	0	0
Carpal Tunnel (bilateral)	2	4	6	0	0
Radiculopathy	2	3	2	2	0
Mononeuropathy	1	3	3	2	0
Polyneuropathy/ Mononeuropathy Multiplex	3	4	4	2	0
Myopathy	2	2	2	0	2
Motor Neuronopathy (e.g., ALS)	4	4	2	0	2
Plexopathy	2	4	6	2	0
Neuromuscular Junction	2	2	2	0	3
Tarsal Tunnel Syndrome (unilateral)	1	4	4	0	0
Tarsal Tunnel Syndrome (bilateral)	2	5	6	0	0
Weakness, Fatigue, Cramps, or Twitching (focal)	2	3	4	0	2
Weakness, Fatigue, Cramps, or Twitching (general)	4	4	4	0	2
Pain, Numbness, or Tingling (unilateral)	1	3	4	2	0
Pain, Numbness, or Tingling (bilateral)	2	4	6	2	0

These limits will not apply if the patient requires evaluation by more than one EDX consultant (i.e., a second opinion or an expert opinion at a tertiary care center) in a given year or if the patient requires evaluation for a second diagnosis in a given year.

Surface EMG testing does not meet Blue Cross and Blue Shield of Alabama's medical criteria for coverage.

See Policy #066 Quantitative Sensory Testing (QST)
See Policy #304 Automated Point-of-Care Nerve Conduction Tests
See Policy #306 Intraoperative Neurophysiologic Monitoring
See Policy #362 Paraspinal Surface Electromyography (SEMG) to Evaluate and Monitor Back Pain

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Blue Cross and Blue Shield of Alabama does not approve or deny procedures, services, testing, or equipment for our members. Our decisions concern coverage only. The decision of whether or not to have a certain test, treatment or procedure is one made between the physician and his/her patient. Blue Cross and Blue Shield of Alabama administers benefits based on the members' contract and corporate medical policies. Physicians should always exercise their best medical judgment in providing the care they feel is most appropriate for their patients. Needed care should not be delayed or refused because of a coverage determination.

Key Points:

This evidence review has been updated regularly with searches of the MEDLINE database. The most recent literature review was performed through April 09, 2018.

Evidence reviews assess whether a medical test is clinically useful. A useful test provides information to make a clinical management decision that improves the net health outcome. That is, the balance of benefits and harms is better when the test is used to manage the condition than when another test or no test is used to manage the condition.

The first step in assessing a medical test is to formulate the clinical context and purpose of the test. The test must be technically reliable, clinically valid, and clinically useful for that purpose. Evidence reviews assess the evidence on whether a test is clinically valid and clinically useful. Technical reliability is outside the scope of these reviews, and credible information on technical reliability is available from other sources.

Suspected Peripheral Neuropathy or Myopathy

Clinical Context and Test Purpose

The question addressed in this evidence review is: Does electrodiagnostic testing improve health outcomes in patients who have suspected peripheral neuropathy or myopathy without a definitive diagnosis based on history, physical exam, and imaging studies.

The following PICOTS were used to select literature to inform this review.

Patients

The relevant populations of interest are individuals who have suspected peripheral neuropathy or myopathy. These fall into the broad categories of compressive neuropathies, nerve root compression, traumatic nerve injuries, generalized and focal neuropathies/myopathies, plexopathies, motoneuron disease, and neuromuscular junction disorders.

Interventions
Electrodiagnostic assessment, consisting of electromyography (EMG), nerve conduction studies (NCS), and related measures, to evaluate the integrity and electrical function of muscles and peripheral nerves.

Comparators
The relevant comparators of interest are standard clinical diagnostic tools and practices currently being used to inform decisions on the diagnosis of suspected peripheral neuropathy or myopathy: history, physical exam, and imaging studies when appropriate.

Outcomes
The clinical utility would be supported by a reduction in pain or other symptoms and improvement in functional measures and quality of life measures specific to the condition. Alternatively, evidence of clinical utility may be derived from a chain of evidence linking improvement in diagnostic accuracy with improvements in treatment guided by a correct diagnosis.

Beneficial outcomes include aiding in the diagnosis of disease and guiding treatment that result in a reduction in symptoms such as pain, numbness, or tingling, and improvements in functional outcomes of muscle strength and quality of life measures.

If patients are diagnosed with peripheral neuropathies or myopathies based on inaccurate EMG or NCS results, unnecessary treatment may be initiated when watchful waiting may be the more appropriate management approach.

Timing
Electrodiagnostic tests are typically performed following clinical evaluation to confirm a diagnosis or provide additional information for a differential diagnosis.

Setting
The tests should be performed in a dedicated electrodiagnostic laboratory using equipment that provides assessment of all parameters of the recorded signals. A NCS should be performed by a physician or by a trained technician under the direct supervision of a physician.

Technically Reliable
Assessment of technical reliability focuses on specific tests and operators and requires review of unpublished and often proprietary information. Review of specific tests, operators, and unpublished data are outside the scope of this evidence review, and alternative sources exist. This evidence review focuses on the clinical validity and clinical utility.

Clinically Valid
A test must detect the presence or absence of a condition, the risk of developing a condition in the future, or treatment response (beneficial or adverse).

In general, EMG and NCS are considered the criterion standards for establishing abnormalities of the electrical system of nerves and muscles, and hence there is a lack of a true reference standard.

Below are examples of representative literature on clinical validity.

Carpal Tunnel Syndrome

Systematic Reviews

A 2004 systematic review of the literature on the diagnosis of carpal tunnel syndrome (CTS) was performed by the American Academy of Orthopaedic Surgeons in support of their guideline development process. There were a total of 35 studies identified with useful data on diagnostic accuracy. There were no prospective studies identified that enrolled a population of patients similar to that seen in clinical practice. The following description of the evidence base was made:

> "The systematic literature review of primary studies indicated that published articles did not employ a consistent reference standard, few studies evaluated the same diagnostic test, and most studies enrolled only a few patients. In addition, the majority of primary studies used a case-control design, which is subject to spectrum bias, thus artificially inflating the sensitivity and specificity of the evaluated tests. Because of the diversity and suboptimal design of published studies, no one test could be identified as a "gold standard" for carpal tunnel syndrome diagnosis."

As a result of the poor quality of evidence, the review concluded that the sensitivity and specificity of electrodiagnostic assessment for CTS is unknown. Evidence-based recommendations could not be developed, and all recommendations were therefore rated at a level V, which is expert opinion.

Observational Studies

Two studies identified calculated the sensitivity and specificity of EMG and NCS. One study used Carpal Tunnel Syndrome-6 (CTS-6) test results as a comparator and the other used mean values of normal controls as comparators.

In 2014, Fowler et al evaluated the diagnostic accuracy of neurodiagnostic studies and ultrasound for CTS, using validated clinical diagnostic criteria as the reference standard. Eighty-five consecutive patients with upper extremity symptoms were referred for evaluation over a three month period at one clinic. All patients completed electrodiagnostic assessment, ultrasound examination, and a validated clinical diagnostic tool (CTS-6 score). The electrodiagnostic exam was considered positive when there was a distal motor latency of ≥4.2msec or a distal sensory latency of ≥3.2msec. There were 55 patients who were positive for CTS on the CTS-6 clinical score.

Chang et al (2006) examined the sensitivity and specificity of various motor and sensory NCS parameters in 280 consecutive patients (360 hands) with suspected CTS and 150 normal controls (see Table 2). In the 360 hands with suspected CTS, 328 (91%) had at least 1 electrodiagnostic abnormality and 9% had normal exams. For individual NCS measures, the sensitivity ranged from 73% to 87% and the specificity ranged from 97% to 99% (see Table 3). Among the 150

controls, NCS readings were mostly within the normal range, with a few sensory and motor findings falling in the abnormal range.

Table 2. Summary of Nonrandomized Study Characteristics for Carpal Tunnel Syndrome

Study	Study Type	Country	Dates	Participants	Blinding	Testing
Fowler et al (2014)	Cross-sectional	U.S.	NR	• Consecutive patients referred to an upper-extremity practice for EMG testing • CTS-6 positive: 55 • CTS-6 negative: 30	EMG technician blinded to CTS-6 results	All patients underwent: (1) CTS-6, (2) ultrasound, and (3) electrodiagnostic testing
Chang et al (2006)	Cross-sectional	Taiwan	NR	• Consecutive patients presenting with ≥1 of the following: numbness, paresthesia, nocturnal awakening, weakness, or pain • CTS patients: 280 • Volunteer controls: 150	EMG technicians blinded to clinical information and diagnosis	All patients underwent the following EMG/NCS testing: motor DL, W-P MCV, sensory DL (D1), sensory DL (D2), sensory DL (D4), W-P SCV (D2), W-P SCT (D2), M-R and M-U

CTS-6: Carpal Tunnel Syndrome-6; D1: thumb; D2: index finger; D4: ring finger; DL: distal latency; EMG: electromyography; M-R: median-radial sensory latency difference; M-U: median-ulnar sensory latency difference; NCS: nerve conduction studies; NR: not reported; W-P MCV: wrist-palm motor conduction velocity; W-P SCT: wrist-palm sensory conduction time; W-P SCV: wrist-palm sensory conduction velocity.

Table 3. Summary of Nonrandomized Study Results for Carpal Tunnel Syndrome

Study	Sensitivity (95% CI), %		Specificity (95% CI), %		PPV (95% CI), %		NPV (95% CI), %	
	US[a]	**EMG[a]**	**US[a]**	**EMG[a]**	**US[a]**	**EMG[a]**	**US[a]**	**EMG[a]**
Fowler et al (2014)	89 (77 to 95)	89 (77 to 95)	90 (72 to 97)	80 (61 to 92)	94 (83 to 98)	89 (71 to 95)	82 (64 to 92)	80 (61 to 92)
Chang et al (2006)								
Motor DL[b]	65.0		99.3		NR		NR	
SDL (D1)[b]	80.3		98.7		NR		NR	
SDL (D2)[b]	72.5		99.3		NR		NR	
SDL (D4)[b]	76.7		100		NR		NR	
W-P MCV[b]	81.7		100		NR		NR	
W-P SCV[b]	73.6		100		NR		NR	
W-P SCT[b]	80.8		100		NR		NR	
M-R[b]	86.7		98.7		NR		NR	
M-U[b]	87.2		96.7		NR		NR	

CI: confidence interval; D1: thumb; D2: index finger; D4: ring finger; DL: distal latency; EMG: electromyography; M-R: median-radial sensory latency difference; M-U: median-ulnar sensory latency difference; NPV: negative predictive value; NR: not reported; PPV: positive predictive value; SDL: sensory distal latency; US: ultrasound; W-P MCV: wrist-palm motor conduction velocity; W-P SCT: wrist-palm sensory conduction time; W-P SCV: wrist-palm sensory conduction velocity.
a Compared with Carpal Tunnel Syndrome-6 test results
b Compared with mean values of normal controls +/- 2.5 standard deviations.

Two studies calculated correlations between EMG and NCS with other measures rather than calculating sensitivity and sensitivity. Homan et al (1999) evaluated the association among clinical symptoms, physical exam, and electrodiagnostic studies in 824 individuals with suspected work-related CTS from 6 job facilities. A total of 449 individuals had at least 1 positive finding on any exam. Of these, only 3% had positive findings on all 3 domains

(symptoms, physical exam, NCS). Overall, there was poor agreement across the 3 measures (κ range, 0-0.18). Tulipan et al (2017) retrospectively studied 50 patients presenting for CTS treatment. Patients completed the Disabilities of the Arm, Shoulder, and Hand questionnaire and the 12-Item Short-Form Health Survey. There were no significant correlations between Disabilities of the Arm, Shoulder, and Hand questionnaire and the 12-Item Short-Form Health Survey scores with median motor or sensory latency measures.

Lumbar Radiculopathy
The North American Spine Society published evidence-based guidelines on the diagnosis and treatment of lumbar radiculopathy in 2012. A systematic review of the literature was performed to identify studies of diagnostic accuracy, one of which was electrodiagnostic testing. For the diagnosis of lumbar radiculopathy, the guidelines reviewed 5 studies on diagnostic accuracy, two of which also included a control group of normal individuals. Sensitivities for various EMG and NCS parameters ranged from 17% to 65%. In the two studies that included a normal control group, specificity for EMG abnormalities was 100% and 87%.

After the North American Spine Society publication, Mondelli et al (2013) evaluated EMG findings in patients with lumbosacral radiculopathy and herniated disc. The diagnosis of radiculopathy due to herniated disc was based on a combination of clinical symptoms and magnetic resonance imaging results. A total of 108 consecutive patients with monoradiculopathy at L4, L5, or S1 were enrolled from 4 electrodiagnostic laboratories. At least 1 EMG abnormality was recorded in 42% of patients, with the most common being a delay in the F wave minimum latency. EMG abnormalities could be predicted on multivariate regression by the presence of clinical symptoms, including muscle weakness, abnormal reflexes, and the presence of paresthesias.

Peroneal Neuropathy
The Association of Neuromuscular & Electrodiagnostic Medicine (AANEM) published an evidence review (2005) in support of practice parameters on the utility of electrodiagnostic testing for patients with suspected peroneal neuropathy. Reviewers performed a systematic review of the literature through July 2003 on the utility of EMG/NCS. Eleven studies met inclusion criteria, four of which were prospective. Eight studies described the use of motor NCS, 8 described the use of sensory NCS, and 5 described the use of needle EMG. Strength of evidence assessments considered the studies to be class III or IV level of evidence. The strongest study design (n=4 studies) used a cohort of patients with clinically diagnosed peroneal neuropathy and reported the sensitivity of EMG/NCS. Sensitivity rates for EMG/NCS varied widely by the type of measure, and the specific area tested, ranging from 19% to 91%. Specificity was not reported. Reviewers concluded that certain NCS parameters were useful for diagnosing peroneal neuropathy and proposed a specific testing strategy to maximize sensitivity. EMG was not found to be useful for confirming the diagnosis of peroneal neuropathy but was helpful in excluding alternative diagnoses.

Pediatric Myopathy
Evidence was identified comparing the accuracy of EMG and NCS with muscle biopsy in children with suspected myopathy. The intent of this line of research is to evaluate whether a diagnosis can be made with certainty using clinical exam plus EMG or NCS, thereby avoiding muscle biopsy.

Rabie et al (2007) evaluated the diagnostic accuracy of EMG compared with muscle biopsy in children with neuropathies or myopathies. The authors retrospectively identified 27 children between the ages of 6 days to 16 years who had EMG studies, a muscle biopsy, and a final diagnosis assigned by the treating physician(s). Final diagnoses were congenital myopathy (five patients), nonspecific myopathy (six patients), congenital myasthenic syndrome (three patients), juvenile myasthenia gravis (one patient), arthrogryposis multiplex congenital (two patients), hereditary motor and sensory neuropathy (one patient), bilateral peroneal neuropathies (one patient), and normal (eight patients). In general, the sensitivity of EMG for detecting abnormalities implied by the final diagnosis was low. For example, the sensitivity of EMG for detecting myopathic motor unit potentials in any myopathy was 47% (7/15), and the sensitivity for congenital myopathies was 40% (2/5). The sensitivity was especially low for patients younger than two years of age compared with older children, but this comparison is limited by very low numbers of patients in each group.

Ghosh et al (2014) performed a retrospective chart review of 227 patients who received EMG studies between the years of 2009-2013. There were 72 patients (32%) who also received muscle biopsy, and these 72 patients constituted the study group. The criterion standard was myopathy confirmed either by muscle biopsy or genetic testing. The overall sensitivity of EMG was 91%, with the most commonly missed diagnosis being metabolic myopathy. The overall specificity was 67%, which is lower than most other reports of specificity, raises the question of whether the sensitivity of muscle biopsy is lower than expected, thus resulting in EMG results that are true positives being classified as false positives.

Section Summary Clinically Valid

EMG/NCS is generally considered to be a specific, but not a sensitive test. However, the evidence on diagnostic accuracy of EMG/NCS is poor, in part because of the lack of a true reference standard. In the scattered evidence that was identified, sensitivity was often less than 50%, and specificity was most commonly in the range of 80% to 100%. Because of the small quantity and poor quality of the evidence, precise estimates of sensitivity and specificity for specific disorders cannot be made.

Clinically Useful

A test is clinically useful if the use of the results informs management decisions that improve the net health outcome of care. The net health outcome can be improved if patients receive correct therapy, or more effective therapy, or avoid unnecessary therapy, or avoid unnecessary testing.

To determine the clinical utility of EMG and NCS, studies need to evaluate the use of EMG and NCS testing to guide treatment decisions and then report health outcomes following the treatments. No studies of this type were identified.

Chain of Evidence

Indirect evidence on clinical utility rests on clinical validity. If the evidence is insufficient to demonstrate test performance, no inferences can be made about clinical utility.

The lack of high-quality evidence on the clinical utility of EMG/NCS is reflected by the lack of evidence-based guidelines. Most existing guidelines rely on expert consensus. This section

reviews guidelines from three organizations will be examined here, focusing on the methods of the development process, and the rigor of evidence review. The three organizations are the American Association of Neuromuscular and Neurodiagnostic Medicine (AANEM), American Academy of Neurology (AAN), and American Academy of Orthopaedic Surgeons (AAOS) (CTS only). The subsequent section on "Practice Guidelines and Position Statements" summarizes the recommendations of the guidelines.

In 1999, AANEM published a document titled "Recommended Policy for Electrodiagnostic Medicine". This document is a Position Statement based on consensus of experts in the field. A consensus conference was held in which 43 experts in the field of electrodiagnostic medicine were invited. No information was given regarding the selection process for these individuals, but it was noted that they were either neurologists or physiatrists who represented a diversity of practice types and locations.

AAOS published clinical practice guidelines on the diagnosis and treatment of carpal tunnel syndrome in 2007. The following statement was made regarding the methodology of these guidelines:

> The AAOS Carpal Tunnel Syndrome (CTS) Guideline Work Group systematically reviewed the available literature, evaluated the level of evidence found in that literature, and subsequently wrote the following recommendations based on a rigorous, standardized consensus process.
>
> Multiple iterations of written review were conducted by the participating Work Group, AAOS Guidelines Oversight Committee, AAOS Evidence-based Practice Committee, and the AAOS Council on Research, Quality Assessment, and Technology prior to final approval by the AAOS Board of Directors.

Consensus on guideline recommendations was conducted using a modification of the nominal group technique.

AAN published a position statement on electrodiagnostic assessment in 2004. According to AAN, "A position statement is a concise explanation of AAN's position on a certain issue that includes background information and the rationale behind the Academy's position. The position statement, generally not exceeding 1,000 words, is in-depth and must reference all supporting evidence." The AAN document on EMG did not contain any description of literature review, nor were there references accompanying the recommendations.

Section Summary Clinically Useful

Existing guidelines from prominent major specialty societies in electrodiagnostic medicine consist primarily of expert consensus. For guidelines based on an evidence review, such as the AAOS guidelines, the evidence was not sufficient to make evidence-based recommendations. All 3 societies have included general recommendations on the utility of electrodiagnostic testing as an adjunct to clinical diagnosis for myopathic and neuropathic disorders. Guidelines supporting these recommendations do not offer detailed indications for patient testing by diagnosis.

Summary of Evidence

For individuals with suspected peripheral neuropathy or myopathy who receive electrodiagnostic assessment including EMG and NCS, the evidence includes small observational studies on a few diagnoses, such as CTS, radiculopathy, and myopathy. Relevant outcomes are test accuracy, symptoms, functional outcomes, and quality of life. Because electrodiagnostic assessment is considered the criterion standard for evaluating the electrical function of peripheral nerves and muscles, there is no true alternative reference standard against which the sensitivity and specificity of particular EMG/NCS abnormalities for particular clinical disorders can be calculated. Different studies have used different reference standards, such as EMG/NCS measures of healthy individuals or clinical examination results. In general, these tests are considered more specific than sensitive and normal results do not rule out the disease. The limited evidence has shown a wide range of sensitivities, which are often less than 50%. The specificity is expected to be considerably higher, but the data are insufficient to provide precise estimates of either sensitivity or specificity.

Practice Guidelines and Position Statements

American Association of Neuromuscular and Electrodiagnostic Medicine (AANEM)

The American Association of Neuromuscular & Electrodiagnostic Medicine (AANEM) has published several position statements on recommended coverage policy for electromyography (EMG) and nerve conduction study (NCS). The first, initially published in 1999, was updated in 2004. The second was published in 2010. Needle EMG and NCS testing was recommended for the following indications:

- 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 "paresthesia" when appropriate pretest 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.

This document also listed situations that were considered investigational.

AANEM published practice parameters on the utility of EMG/NCS for the diagnosis of peroneal neuropathy in 2005. This evidence-based review focused on whether EMG/NCS are useful in diagnosing peroneal neuropathy and/or in determining prognosis. Table 4 lists recommendations AANEM deemed "possibly useful, to make or confirm" a diagnosis.

Table 4. Guidelines on Diagnosis of Peroneal Neuropathy

Recommendation	LOR	COE

Motor NCSs of the peroneal nerve recording from the AT and EDB muscles	C	III
Orthodromic and antidromic superficial peroneal sensory NCS	C	III
At least one additional normal motor and sensory NCS in the same limb, to assure that the peroneal neuropathy is isolated, and not part of a more widespread local or systemic neuropathy		
Data are insufficient to determine the role of needle EMG in making the diagnosis of peroneal neuropathy However, abnormalities on needle examination outside of the distribution of the peroneal nerve should suggest alternative diagnoses	U	IV Expert
In patients with confirmed peroneal neuropathy, EDX studies are possibly useful in providing prognostic information, with regards to recovery of function	C	III/IV

AT: anterior tibialis; COE: class of evidence; EDB: extensor digitorum brevis; EDX: electrodiagnostic; EMG: electromyography; LOR: level of recommendation; NCS: nerve conduction study.

A 2003 consensus statement on diagnosing multifocal motor neuropathy from AANEM has stated:

> "Multifocal motor neuropathy is a diagnosis that is based on recognition of a characteristic pattern of clinical symptoms, clinical signs, and electrodiagnostic findings. The fundamental electrodiagnostic finding is partial conduction block of motor axons."

A 2004 AANEM approved a position statement, endorsed by the American Academy of Neurology and the American Academy of Physical Medicine & Rehabilitation, on diagnostic electromyography included the following:

- "Clinical needle electromyography (EMG) is an invasive medical procedure during which the physician inserts an electrode into a patient's muscles to diagnose the cause of muscle weakness. Needle EMG allows physicians to distinguish a wide range of conditions, from carpal tunnel syndrome to ALS (Lou Gehrig disease).
- Needle EMG is also an integral component of the neurological examination that cannot be separated from the physician's evaluation of the patient. The test is dynamic and depends upon the visual, tactile, and audio observations of the examiner. There is no way for physicians to independently verify the accuracy of reports performed by non-physicians.
- Misdiagnosis can mean delayed or inappropriate treatment (including surgery) and diminished quality of life. Because needle EMG is strictly diagnostic, the procedure clearly and exclusively falls within the practice of medicine."

AANEM (2018) published a policy statement on the use of EMG for distal symmetric polyneuropathy. The statement described 5 situations in which EMG would be beneficial for patients with distal symmetric polyneuropathy: "1) determining primary and alternative diagnoses; 2) determining severity, duration, and prognosis of disease; 3) evaluating risk of associated problems; 4) determining the effect of medications; and 5) evaluating the effect of toxic exposures."

American Academy of Orthopaedic Surgeons

The American Academy of Orthopaedic Surgeons (2007) issued guidelines on the diagnosis of carpel tunnel syndrome. Table 5 lists recommendations made.

Table 5. Guidelines on Diagnosis of Carpal Tunnel Syndrome

No.	Recommendation	LOR	GOE
3.1a	"The physician may obtain electrodiagnostic tests to differentiate among diagnoses."	V	C

3.1b	"The physician may obtain electrodiagnostic tests in the presence of thenar atrophy and/or persistent numbness."	V	C
3.1c	"The physician should obtain electrodiagnostic tests if clinical and/or provocative tests are positive and surgical management is being considered."	II/III	B
3.2	"If the physician orders electrodiagnostic tests, the testing protocol should follow the AAN/AANEM/AAPMR guidelines for diagnosis of CTS."	IV/V	C

AANEM: American Association of Neuromuscular & Electrodiagnostic Medicine; AAOS: American Academy of Orthopaedic Surgeons; AAPM&R: American Academy of Physical Medicine and Rehabilitation; CTS: carpal tunnel syndrome; GOE: grade of evidence; LOR: level of recommendation (II/III: "fair evidence"; IV/V: "poor quality evidence; V: "expert consensus").

North American Spine Society

The North American Spine Society published guidelines on the diagnosis and treatment of lumbar disc herniation in 2012. This document made the following statement about the use of EMG/NCS for diagnosis of lumbar disc herniation:

> "Electromyography, nerve conduction studies and F-waves are suggested to have limited utility in the diagnosis of lumbar disc herniation with radiculopathy. H-reflexes can be helpful in the diagnosis of an S1 radiculopathy, though are not specific to the diagnosis of lumbar disc herniation. (Grade of Recommendation: B)"

The AANEM has issued a policy statement with these minimum standards:

1. The tests should be medically indicated.
2. The tests should be performed using equipment that provides assessment of all parameters of the recorded signals. Equipment designed for "screening purposes" is not acceptable.
3. The NCS should be performed by a physician or by a trained technician under the direct supervision of a physician:

> *Blue Cross and Blue Shield of Alabama defines direct supervision as: Direct supervision in the office setting means the physician must be present in the office suite and immediately available and able to provide assistance and direction throughout the time the service is performed. Direct supervision does not mean that the physician must be present in the same room with his or her aide*. AANEM provides specific recommendations for reporting needle EMG and NCV results. According to the AANEM, the recommendation for documentation of nerve conduction and EMG testing should include (but are not limited to) a description of the patient's clinical problem (demographics, reason for referral), the electrodiagnostic tests performed (techniques, distances, lab reference values, and temperature monitoring), all relevant data derived from these tests (nerves/muscles tested, numerical values for latencies and action potential), and the diagnostic interpretation of the data, including limitations. Complete NCV test measurements should also include amplitude measurements, normal reference values and criteria for abnormalities (AANEM, 2005).

In a position statement published by the AANEM regarding the performance and interpretation of electrodiagnostic studies (AANEM, 2006), the AANEM states:

> "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. Moreover, individuals who interpret NCV data without patient interaction or who rely on studies that have delayed interpretation, who have interpretation made off-site, and who interpret results without complementary information obtained from EMG studies are not meeting the standards outlined in the AANEM policy recommendations."

Except in limited clinical situations, performing nerve conduction studies (NCS) together with needle electromyography (NEMG) is required to diagnose peripheral nervous system disorders. According to the AANEM circumstances under which NCS and EMG should not be performed together include, but are not limited to, limited follow-up studies of neuromuscular structures that have undergone previous electrodiagnostic evaluation, the current use of anticoagulants, or the presence of lymphedema. In addition, the AANEM indicates that for suspected carpal tunnel syndrome, the extent of the needle EMG examination depends on the results of the NCSs and the differential diagnosis considered for the individual patient (AANEM, 2004). The AANEM (2010) does not support screening testing, monitoring disease intensity, or monitoring of treatment efficacy for polyneuropathy of diabetes or polyneuropathy of end stage renal disease (ESRD). NEMG is also not recommended for any of the following:

- testing of intrinsic foot muscles in the diagnosis of proximal lesions;
- definitive diagnostic conclusion from paraspinal EMG in regions bearing scars of previous surgeries, such as previous laminectomy;
- pattern setting limited limb muscle examinations without paraspinal muscle testing for diagnosis of radiculopathy;
- needle EMG testing performed shortly after trauma.

The American Board of Electrodiagnostic Medicine is an independent credentialing body in electrodiagnostic medicine. Its goal is to enhance the quality of patient care through a voluntary certification process.

Electrodiagnostic studies may also be rendered by a Licensed Physical Therapist who is currently listed on the American Physical Therapy Association website as a **Board Certified Clinical Electrophysiologic Certified Specialist** per the American Board of Physical Therapy Specialist. In Alabama, appropriately qualified Physical Therapists can perform EMG studies and provide physical therapy interpretations, but not make medical diagnoses based on the results of testing.

The American Academy of Orthopaedic Surgeons (AAOS) issued a 2007 clinical guideline on the diagnosis of carpel tunnel syndrome. The guideline makes the following recommendations:

- *Recommendation 3.1a.* The physician may obtain electrodiagnostic tests to differentiate among diagnoses. (Level V, Grade C)
- *Recommendation 3.1b.* The physician may obtain electrodiagnostic tests in the presence of thenar atrophy and/or persistent numbness (Level V, Grade C).
- *Recommendation 3.1c.* The physician should obtain electrodiagnostic tests if clinical and/or provocative tests are positive and surgical management is being considered (Level II and III, Grade B)

- *Recommendation 3.2.* If the physician orders electrodiagnostic tests, the testing protocol should follow the AAN/AANEM/AAPMR guidelines for diagnosis of CTS (Level IV and V, Grade C).

A consensus statement on diagnosing multifocal motor neuropathy from AANEM states:

> "Multifocal motor neuropathy is a diagnosis that is based on recognition of a characteristic pattern of clinical symptoms, clinical signs, and electrodiagnostic findings. The fundamental electrodiagnostic finding is partial conduction block of motor axons."

An online information page on electrodiagnostic testing from AAOS, OrthoInfo, 2007 provides the following information:

> An EMG records and analyzes the electrical activity in your muscles. It is used to learn more about the functioning of nerves in the arms and legs. When a normal muscle is at rest, it is electrically silent.
>
> NCS are often done along with the EMG to determine if a nerve is functioning normally. The doctor conducting the test will tape wires (electrodes) to the skin in various places along the nerve pathway. Then the doctor stimulates the nerve with an electric current. As the current travels down the nerve pathway, the electrodes placed along the way capture the signal and time how fast the signal is traveling. In healthy nerves, electrical signals can travel at up to 120 miles per hour. If the nerve is damaged, however, the signal will be slower and weaker. By stimulating the nerve at various places, the doctor can determine the specific site of the injury. Nerve conduction studies also may be used during treatment to test the progress being made.
>
> The accuracy of electrodiagnostic tests depends on the skill of the person conducting the test and the precision of the equipment used. Generally, these tests can accurately determine injuries to the nerves or nerve roots as well as diseases of the nerves and muscles. In some conditions, however, it may take several weeks for changes to become apparent. Additionally, the tests cannot determine the existence or extent of pain. A person may still feel pain or exhibit symptoms even though electrodiagnostic tests show that the nerves are functioning normally. In these cases, your orthopaedist will recommend a course of treatment for you.

U.S. Preventive Services Task Force Recommendations
Not applicable.

Key Words:

Electrodiagnostic medicine, nerve conduction studies (NCS), nerve conduction velocity studies, motor nerve conduction studies, sensory nerve conduction studies, mixed nerve conduction studies, needle electromyography (EMG), late responses, H-reflex studies, F-wave studies single-fiber electromyography (SFEMG), NC-stat System, NC-Stat by NeuroMetrix®, Neurometer® and Brevio® NCS-Monitor., EPAD™, CERSR® Electromyography System,

Approved by Governing Bodies:

Electromyography (EMG) and nerve conduction study (NCS) measure nerve and muscle function and may be indicated when evaluating limb pain, weakness related to possible spinal nerve compression or other neurologic injury or disorder. There are a number of electromyographic devices that have received marketing clearance by the U.S. Food and Drug Administration (FDA). Several devices are listed in Table 1.

Table 1. Electromyographic Devices Approved by FDA

Device	Manufacturer	FDA Clearance	510 (k) No.	FDA Product Code
EPAD™	SafeOp Surgical	2014	K132616	GWF
CERSR® Electromyography System	SpineMatrix	2011	K110048	IKN
Physical Monitoring Registration Unit-S (PMRU-S)	Oktx	2013	K123902	IKN
MyoVision 3G Wirefree™ System	Precision Biometrics	2013	K123399	IKN
NuVasive® NV M5 System	NuVasiv	2011	K112718	ETN
Neuro Omega™ System	Alpha Omega Engineering	2013	K123796	GZL
CareFusion Nicolet® EDX	CareFusion 209	2012	K120979	GWF
Sierra Summit, Sierra Scent	Cadwell Industries	2017	K162383	IKN, GWF

Benefit Application:

Coverage is subject to member's specific benefits. Group specific policy will supersede this policy when applicable.
ITS: Home Policy provisions apply
FEP contracts: Special benefit consideration may apply. Refer to member's benefit plan. FEP does not consider investigational if FDA approved and will be reviewed for medical necessity.

Current Coding:

Codes 95907-95913 describe one or more nerve conduction studies.

- For the purposes of coding, a single conduction study is defined as a sensory conduction test, a motor conduction test with or without an F wave test, or an H-reflex test.
- Each type of study (sensory, motor with or without F wave, H-reflex) for each nerve includes all orthodromic and antidromic impulses associated with that nerve and

constitutes a distinct study when determining the number of studies in each grouping (e.g., 1-2, or 3-4 nerve conduction studies).

- Each type of nerve conduction study is counted only once when multiple sites on the same nerve are stimulated or recorded. The numbers of these separate tests should be added to determine which code to use.

CPT codes:

51785	Needle electromyography (EMG) studies of anal or urethral sphincter, any technique
95860	Needle electromyography; one extremity, with or without related paraspinal areas
95861	Needle electromyography; two extremities, with or without related paraspinal areas
95863	Needle electromyography; three extremities, with or without related paraspinal areas
95864	Needle electromyography; four extremities, with or without related paraspinal areas
95865	Needle electromyography; larynx
95866	Needle electromyography; hemidiaphragm
95867	Needle electromyography; cranial nerve supplied muscle(s), unilateral
95868	Needle electromyography; cranial nerve supplied muscles; bilateral
95869	Needle electromyography; thoracic paraspinal muscles (excluding T1
95870	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
95872	Needle electromyography using single fiber electrode, with quantitative measurement of jitter, blocking and/or fiber density, any/all sites of each muscle studied
95885	Needle electromyography, each extremity, with related paraspinal areas, when performed, done with nerve conduction, amplitude and latency/velocity study; limited (list separately in addition to code for primary procedure)
95886	; complete, five or more muscles studied, innervated by three or more nerves or four or more spinal levels (list separately in addition to code for primary procedure)
95887	Needle electromyography, non-extremity (cranial nerve supplied or axial) muscle(s) done with nerve conduction, amplitude and latency/velocity study (list separately in addition to code for primary procedure)
95907	Nerve conduction studies; 1-2 studies
95908	Nerve conduction studies; 3-4 studies
95909	Nerve conduction studies; 5-6 studies
95910	Nerve conduction studies; 7-8 studies
95911	Nerve conduction studies; 9-10 studies
95912	Nerve conduction studies; 11-12 studies

95913 Nerve conduction studies; 13 or more studies

95937 Neuromuscular junction testing (repetitive stimulation, paired stimuli), each nerve, and 1 method

HCPCS code: **S3900** Surface electromyography (EMG)

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Policy History:

Medical Policy Group, June 2005 **(2)**
Medical Policy Group, November 2005 **(2)**
Medical Policy Administration Committee, November 2005
Available for comment December 1, 2005-January 14, 2006
Medical Policy Group, April 2007 **(2)**
Medical Policy Administration Committee, April 2007
Medical Policy Group, April 2008 **(2)**
Medical Policy Administration Committee, April 2008
Available for comment April 4-May 18, 2008
Medical Policy Group, April 2008 **(2)**
Medical Policy Administration Committee May 2008
Available for comment May 3-June 16, 2008
Medical Policy Group, June 2008 **(2)**

Medical Policy Administration Committee, July 2008
Available for comment June 17-July 31, 2008
Medical Policy Group, June 2009 **(2)**
Medical Policy Group, July 2009 **(2)**
Medical Policy Group, August 2009 **(2)**
Medical Policy Administration Committee, August 2009
Available for comment August 10-September 23, 2009
Medical Policy Group, January 2010 **(2)**
Medical Policy Administration Committee, January 2010
Available for comment January 26-March 11, 2010
Medical Policy Group, December 2011 **(3):** Added new 2012 Codes – 95885, 95886, 95887
Medical Policy Group, November 2012: Added new 2013 Codes 95907, 95908, 95909, 95910, 95911, 95912, & 95913 effective January 1, 2013; Deleted Codes 95900, 95903, 95904, 95934, & 95936 effective January 1, 2013.
Medical Policy Group, January 2013 **(2):** 2013 CPT® coding instructions added re: on site, real time review of wave forms by the examiner and interpretation by qualified physician or other qualified health care professional added.
Medical Policy Administration Committee, February 2013
Medical Policy Group, May 2014 **(5):** Added policy statement for coverage of NCV and EMG concurrently and coverage of NCV alone; Also added coverage information for neuromuscular junction testing; Key Points, CPT Codes, and References updated to support Policy Statements.
Medical Policy Administration Committee, May 2014
Available for comment May 22 through July 5, 2014
Medical Policy Group, July 2014 **(5):** Updated Description, Policy statement, Key Points and References; Added information that Physical Therapist who are currently listed on the American Physical Therapy Association website as a Board Certified Clinical Electrophysiologic Certified Specialist per the ABPTS can perform electrodiagnostic studies; Added definition of "onsite" and "real-time" and reference to support, Also added under neuromuscular junction for at least two nerves to be tested.
Medical Policy Administration Committee, July 2014.
Available for comment July 12 through August 25, 2014
Medical Policy Group, September 2014 **(5):** Updated Description and Policy Statement by removing physician and replacing with eligible provider (e.g., physician, physical therapist, or chiropractor); Removed specific information about physical therapist. No change to policy statement.
Medical Policy Group, August 2015 **(6):** Updates to Description, Key Points, Approved by Governing Bodies and References; no change to policy statement.
Medical Policy Panel, July 2017
Medical Policy Group, July 2017 **(6)**: Updates to Description, Key Points, Governing Bodies, Key Words and Practice Guidelines. No change to policy statement.
Medical Policy Panel, June 2018
Medical Policy Group, July 2018 **(6)**: Updates to Key Points, Governing Bodies, Practice Guidelines and References. No change to policy statement.

hereof. Physicians and other providers are solely responsible for all aspects of medical care and treatment, including the type, quality, and levels of care and treatment.

This policy is intended to be used for adjudication of claims (including pre-admission certification, pre-determinations, and pre-procedure review)in Blue Cross and Blue Shield's administration of plans contracts.