Horizon BCBSNJ
Uniform Medical Policy Manual

Section:	Medicine
Policy Number:	082
Effective Date:	10/15/2019
Original Policy Date:	09/23/2014
Last Review Date:	08/13/2019
Date Published to Web:	07/12/2019

Subject:
Electromyography and Nerve Conduction Studies

Description:

IMPORTANT NOTE:

The purpose of this policy is to provide general information applicable to the administration of health benefits that Horizon Blue Cross Blue Shield of New Jersey and Horizon Healthcare of New Jersey, Inc. (collectively "Horizon BC contract benefits differ from the medical policy, the contract prevails. Although a service, supply or procedure may be medically necessary, it may be subject to limitations and/or exclusions under a member's benefit plan. If a service, proceeds to obtain the service, supply or procedure, the member may be responsible for the cost. Decisions regarding treatment and treatment plans are the responsibility of the physician. This policy is not intended to direct the course and it does not replace a physician's independent professional clinical judgment or duty to exercise special knowledge and skill in the treatment of Horizon BCBSNJ members. Horizon BCBSNJ is not responsible for, does not provide, care. The physician remains responsible for the quality and type of health care services provided to a Horizon BCBSNJ member.

Horizon BCBSNJ medical policies do not constitute medical advice, authorization, certification, approval, explanation of benefits, offer of coverage, contract or guarantee of payment.

Electromyography (EMG) and nerve conduction studies (NCS), also collectively known as an electrodiagnostic assessment, evaluate the electrical functioning of muscles and peripheral nerv evaluation of myopathy and peripheral neuropathy by identifying, localizing, and characterizing electrical abnormalities in the skeletal muscles and peripheral nerves.

Populations	Interventions	Comparators	Outcomes
Individuals: • With suspected peripheral neuropathy or myopathy	**Interventions of interest are:** • Electrodiagnostic assessment including electromyography and nerve conduction studies	**Comparators of interest are:** • Clinical diagnostic workup without electrodiagnostic testing	**Relevant outcomes include:** • Test accuracy • Symptoms • Functional outcomes • Quality of life

BACKGROUND

Electrodiagnostic Assessment

Electromyography (EMG) and nerve conduction study (NCS) are used as adjuncts to clinical evaluation of myopathy and peripheral neuropathy.[1,]These tests intend to evaluate the integrity a peripheral nerves. They are performed when there is clinical suspicion for a myopathic or neuropathic process and when clinical examination and standard laboratory testing cannot make a d

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 v symptoms are severe or rapidly progressing, or when symptoms are atypical (eg, asymmetrical, acute onset, or appearing to be autonomic).

According to the American Association of Neuromuscular & Electrodiagnostic Medicine (1999), electrodiagnostic assessment has the following goals[2,]:

1. "Identify normal and abnormal nerve, muscle, motor or sensory neuron, and NMJ [neuromuscular junction] functioning.

2. Localize region(s) of abnormal function.

3. Define the type of abnormal function.

4. Determine the distribution of abnormalities.

5. Determine the severity of abnormalities.

6. Estimate the date of a specific nerve injury.

7. Estimate the duration of the disease.

8. Determine the progression of abnormalities or recovery from abnormal function.

9. Aid in diagnosis and prognosis of the disease.

10. Aid in selecting treatment options.

11. Aid in following response to treatment by providing objective evidence of change in NM [neuromuscular] function.

12. 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 during the exam.[2,] The stimulation is recorded. Three components are evaluated: observation at rest, action potential with minimal voluntary contraction, and action potential with maximum contraction.[3,]

Single Fiber EMG

In single fiber EMG, a needle electrode records the response of a single muscle fiber. This test can evaluate "jitter," which is defined as the variability in the time between activation of the ne potential. Single fiber EMG can also measure fiber density, which is defined as the mean number of muscle fibers for one motor unit.

Nerve Conduction Study

In NCS, both motor and sensory nerve conduction are assessed. For motor conduction, electrical stimuli are deliveredalong various points on the nerve, and the electrical response is recorded conduction, electrical stimuli are delivered to one point on the nerve and the response recorded at a distal point on the nerve. Parameters recorded include velocity, amplitude, latency, and co

Late Wave Responses

Late waves are a complement to the basic NCS and evaluate the functioning of the proximal segment of peripheral nerves, such as the nerve root and the anterior horn cells. There are two ty 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 radiculo

The F wave is assessed by supramaximal stimulation of the distal nerve and can help estimate the conduction velocity in the proximal portion of the nerve.[3,]This will provide information on abnormalities, such as radiculopathy or plexopathy.

Repetitive Nerve Stimulation

Repetitive nerve stimulation studies evaluate the integrity and function of the neuromuscular junction. The test involves stimulating a nerve repetitively at variable rates and recording the res muscle(s).[3,] Disorders of the neuromuscular junction 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 test the integrity and function of these nerve path 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 oculi muscle at the lower eyelid. They are used to localize lesions in the fifth or sevent

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 spe determined by the disorders being considered in the differential. Also, the differential diagnosis may be modified during the exam to reflect initial findings, and this may also influence the sp analysis.[2,]

Regulatory Status

EMG/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 disorde 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
NuVasive® NVM5 System	NuVasive	2011	K112718	ETN
CERSR® Electromyography System	SpineMatrix	2011	K110048	IKN
CareFusion Nicolet® EDX	CareFusion 209	2012	K120979	GWF
Physical Monitoring Registration Unit-S (PMRU-S)	Oktx	2013	K123902	IKN
MyoVision 3G Wirefree™ System	Precision Biometrics	2013	K123399	IKN
Neuro Omega™ System	Alpha Omega Engineering	2013	K123796	GZL
EPAD™	SafeOp Surgical	2014	K132616	GWF
Sierra Summit, Sierra Ascent	Cadwell Industries	2017	K162383	IKN, GWF

FDA: Food and Drug Administration.

Regulatory Status

- Paraspinal Surface Electromyography (SEMG) to Evaluate and Monitor Back Pain (Policy #020 in the Medicine Section)
- Automated Point-of-Care Nerve Conduction Tests (Policy #044 in the Medicine Section)

Policy:

(NOTE: For Medicare Advantage, please refer to the Medicare Coverage Section below for coverage guidance.)

1. Electrodiagnostic assessment, consisting of electromyography, nerve conduction study, and related measures, is considered ***medically necessary*** as an adjunct to history, physical exam, an criteria are met:

- ☐ Signs and symptoms of peripheral neuropathy and/or myopathy are present; AND
- ☐ Definitive diagnosis cannot be made by physical exam and imaging studies alone; AND
- ☐ Work-up for one or more of the following categories of disease is indicated:

(NOTE: The following list gives specific diagnoses, according to categories of testing, for which electromyography (EMG) and nerve conduction study (NCS) generally provides excluding the diagnosis, above that provided by clinical examination and imaging. The list includes the most common diagnoses for testing, but it is not exhaustive. There may al EMG/NCS provides useful diagnostic information.)

- ☐ Compressive neuropathies

- o Carpal tunnel syndrome
- o Ulnar nerve entrapment
- o Thoracic outlet syndrome
- o Tarsal tunnel syndrome
- o Other peripheral nerve entrapments

- Nerve root compression (when physical exam and magnetic resonance imaging are inconclusive)
  - o Cervical nerve root compression
  - o Thoracic nerve root compression
  - o Lumbosacral nerve root compression
- Traumatic nerve injuries
- Generalized and focal polyneuropathies
  - o Diabetic neuropathy
  - o Uremic neuropathy
  - o Alcohol-related neuropathy
  - o Hereditary neuropathies
    - Charcot-Marie Tooth
    - Other hereditary neuropathies
  - o Demyelinating polyneuropathies
    - Guillain Barre syndrome (acute)
    - Chronic idiopathic demyelinating polyneuropathy
- Generalized myopathies
  - o Polymyositis
  - o Dermatomyositis
  - o Muscular dystrophies
- Plexopathies
  - o Cervical plexopathy
  - o Brachial plexopathy
  - o Lumbosacral plexopathy
- Motor neuron diseases
  - o Amyotrophic lateral sclerosis
  - o Progressive muscular atrophy
  - o Progressive bulbar palsy
  - o Pseudobulbar palsy
  - o Primary lateral sclerosis
- Neuromuscular junction disorders
  - o Myasthenia gravis
  - o Myasthenic syndrome
  - o Lambert-Eaton syndrome

2. A repeat electrodiagnostic assessment is considered ***medically necessary*** when at least one of the following criteria have been met:

- Development of new symptoms or signs suggesting a second diagnosis in a member who has received an initial diagnosis; OR
- Interim progression of disease following an initial test that was inconclusive, such that a repeat test is likely to elicit additional findings; OR
- Unexpected change(s) in the course of disease or response to treatment, suggesting that the initial diagnosis may be incorrect and that re-examination is indicated.

(NOTE: The following recommendations on the number of repeat services are reproduced from the American Association of Neuromuscular & Electrodiagnostic Medicine (AANEM) P do not represent absolute maximums for all patients; they are defined by AANEM as being sufficient to make a diagnosis in at least 90% of patients with that particular diagnosis. Ther cases that require a greater number of tests than specified in Table PG1.)

Table PG1. Recommended Maximum Number of Electrodiagnostic Studies for Specific Diagnoses

Indication	Needle EMG	NCSs		Other Studies	
	No. of Tests	Motor NCS (± F Wave)	Sensory NCS	H-Reflex	RNS Testing
Carpal tunnel syndrome (unilateral)	1	3	4	0	0
Carpal tunnel syndrome (bilateral)	2	4	6	0	0
Radiculopathy	2	3	2	2	0
Mononeuropathy	1	3	3	2	0
Polyneuropathy or mononeuropathy multiplex	3	4	4	2	0
Myopathy	2	2	2	0	2
Motor neuropathy (eg, amyotrophic lateral sclerosis)	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

Adapted from American Association of Electrodiagnostic Medicine (1999).
EMG: electromyography; NCS: nerve conduction study; RNS: repetitive nerve stimulation.

3. Electrodiagnostic studies performed beyond the number of studies recommended by the AANEM for a specific diagnosis *(please refer to the table above)* which are not supported by appr ***medically necessary***.

4. Electrodiagnostic assessment, consisting of EMG, NCS, and related measures, is ***investigational*** when the above criteria are not met, including but not limited to, the following situations:

- ☐ Screening of asymptomatic individuals
- ☐ Serial assessments to evaluate progression of disease in a patient with a previously diagnosed neuropathy or myopathy
- ☐ Evaluation of treatment response in a patient with previously diagnosed neuropathy or myopathy
- ☐ Evaluation of severity of disease in a patient with previously diagnosed neuropathy or myopathy

Medicare Coverage:
There is no National Coverage Determination (NCD) for Nerve Conduction Studies and Electromyography. In the absence of an NCD, coverage decisions are left to the discretion of Local M the Local Medicare Carrier for jurisdiction JL, has determined that Nerve Conduction Studies and Electromyography are covered when LCD L35081 criteria is met. Please refer to Novitas S Studies and Electromyography (L35081). Available to be accessed at Novitas Solutions, Inc., Medical Policy Search page: https://www.novitas-solutions.com/webcenter/portal/MedicareJL/I _afrLoop=90769712476969#!%40%40%3F_afrLoop%3D90769712476969%26centerWidth%3D100%2525%26leftWidth%3D0%2525%26rightWidth%3D0%2525%26showFooter%3Dfal state%3D63y7eftob_46.

There is a National Coverage Determination (NCD) for Sensory Nerve Conduction Threshold Tests (sNCTs). Per NCD 160.23, Sensory Nerve Conduction Threshold Tests (sNCTs) are diffe conduction velocity, amplitude and latency. sNCTS are also different from short-latency somatosensory evoked potentials. Effective October 1, 2002, CMS initially concluded that there was to consider the sNCT test and the device used in performing this test reasonable and necessary within the meaning of section 1862(a)(1)(A). Therefore sNCTs are noncovered.

Effective April 1, 2004, based on a reconsideration of current Medicare policy for sNCT, CMS concludes that the use of any type of sNCT device (eg, "current output" type device used to pe pain perception threshold [PPT], or pain tolerance threshold [PTT] testing or "voltage input" type device used for voltage-nerve conduction threshold (v-NCT) testing) to diagnose sensory ne beneficiaries is not reasonable and necessary.

For additional information, refer to National Coverage Determination (NCD) for Sensory Nerve Conduction Threshold Tests (sNCTs) (160.23). NCD 160.23 available to be accessed at CMS (NCDs) Alphabetical Index search page: https://www.cms.gov/medicare-coverage-database/indexes/ncd-alphabetical-index.aspx.

Local Coverage Article: Nerve Conduction Studies and Electromyography (A54095). Available to be accessed at Novitas Solutions, Inc., Medical Policy Search page: https://www.novitas-solutions.com/webcenter/portal/MedicareJL/pagebyid?contentId=00024370.

***Policy Guidelines**: (Information to guide medical necessity determination based on the criteria contained within the policy statements above.)*

The AANEM position statement (1999) also included minimum standards for a lab performing electrodiagnostic evaluation. These are:

- *The tests should be medically indicated.*
- *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.*
- *The NCS should be performed by a physician or by a trained technician under the direct supervision of a physician.*
- *A trained physician must perform the needle EMG exam.*
- *One physician should perform and supervise all components of the electrodiagnostic testing.*

*[**RATIONALE**: This policy was created in 2014 and has been updated regularly with searches of the MEDLINE database. The most recent literature update was performed through April 3,*

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, t 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 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 sourc

Suspected Peripheral Neuropathy or Myopathy

Clinical Context and Test Purpose

The purpose of electrodiagnostic testing in patients who have suspected peripheral neuropathy or myopathy is to aid in the diagnosis of disease and to guide treatment.

The question addressed in this policy is: Does electrodiagnostic testing improve health outcomes in patients who have suspected peripheral neuropathy or myopathy but no definitive diagnos imaging studies?

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

Patients

The relevant population of interest are individuals who have suspected peripheral neuropathy or myopathy. The population falls into the broad categories of compressive neuropathies, nerve injuries, generalized and focal neuropathies and myopathies, plexopathy, motor neuron disease, and neuromuscular junction disorders.

Interventions

The relevant intervention of interest is electrodiagnostic assessment, consisting of electromyography (EMG), nerve conduction studies (NCS), and related measures, to evaluate the integrity 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 myo 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, 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 results in a reductionin symptoms such as pain, numbness, or tingling, and improvements in functio 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 mo

The tests should be performed in a dedicated electrodiagnostic laboratory using equipment that provides an assessment of all parameters of the recorded signals. An EMS and NCS should be technician under the direct supervision of a physician.

Study Selection Criteria

Methodologically credible studies were selected using the following principles:

a. To assess efficacy outcomes, comparative controlled prospective trials were sought, with a preference for randomized controlled trials;

b. In the absence of such trials, comparative observational studies were sought, with a preference for prospective studies.

c. To assess long-term outcomes and adverse events, single-arm studies that capture longer periods of follow-up and/or larger populations were sought.

Studies with duplicative or overlapping populations were excluded.

Technically Reliable

Assessment of technical reliability focuses on specific tests and operators and requires a review of unpublished and often proprietary information. Review of specific tests, operators, and unp policy, and alternative sources exist. This policy 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 st

Beloware 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 (AAOS) in support of its guia prospective studies were identified that enrolled a population of patients similar to that seen in clinical practice. AAOS offered the following appraisal of the evidence base:

"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 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 published studies, no one test could be identified as a 'gold standard' for carpal tunnel syndrome diagnosis."

As a result, AAOS concluded that the sensitivity and specificity of electrodiagnostic assessment for CTS were unknown. Evidence-based recommendations could not be developed, and all rec level V (expert opinion).

Observational Studies

Two studies identified calculated the sensitivity and specificity of EMG and NCS.[5,6,] One study used Carpal Tunnel Syndrome-6 (CTS-6) test results as a comparator[5,] and the other used mea comparators.[6,]

Fowler et al (2014) evaluated the diagnostic accuracy of electrodiagnostictesting and ultrasound for diagnosing CTS, using validated clinical diagnostic criteria as the reference standard (s a validated clinical diagnostic tool (CTS-6 score). The electrodiagnostic exam was considered positive when there was a distal motor latency of 4.2 ms or more or a distal sensory latency of positive predictive value, and negative predictive values were calculated (see Table 3). This study was limited by the imperfect nature of the reference standard (CTS-6 is not a true criterion s sensitivity.

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 contro 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 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)[5,]	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)[6,]	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: media 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 velo

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)[5,]	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)[6,]								
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 sens 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 sens 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.[7,8,] Homan et al (1999) evaluated the association among cl electrodiagnostic studies in 824 individuals with suspected work-related CTS from 6 job facilities.[7,] A total of 449 individuals had at least 1 positive finding on any exam. Of these, only 3% h (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 treat 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 H 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.[9,] These guidelines were based on a systematic revie diagnostic techniques. Five studies on the diagnostic accuracy of electrophysiologic tests were discussed-two case-control studies and three case series. Sensitivities for various EMG and NC In the 2 studies that included a normal control group, specificity for EMG abnormalities was 100% and 87%, respectively.

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 radiculop combination of clinical symptoms and magnetic resonance imaging results.[10,] A total of 108 consecutive patients with monoradiculopathy at L4, L5, or S1 were enrolled from 4 electrodiagno 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 p muscle weakness, abnormal reflexes, and the presence of paresthesias.

Peroneal Neuropathy

The Association of Neuromuscular & Electrodiagnostic Medicine (AANEM;2005) published an evidence review in support of practice parameters on the utility of electrodiagnostic testing fo neuropathy.[11,] 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. NCS, eight described the use of sensory NCS, and five described the use of needle EMG. Strength of evidence assessments considered the studies to be class III or IV level of evidence. The st 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 speci Specificity was not reported. Reviewers concluded that certain NCS parameters were useful for diagnosing peroneal neuropathy and proposed a specific testing strategy to maximize sensitivi 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 a suspected myopathy. The intent of this line of research is to evaluate whether a diagn clinical exam plus EMG or NCS, thereby avoiding muscle biopsy.

Rabie et al (2007) compared the diagnostic accuracy of EMG with muscle biopsy in children who had neuropathies or myopathies.[12,] The authors retrospectively identified 27 children betwe 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), con (three patients), juvenile myasthenia gravis (one patient), arthrogryposis multiplex congenital (two patients), hereditary motor and sensory neuropathy (one patient), bilateral peroneal neuro (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 (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 comp patients in each group.

Ghosh and Sorenson (2014) performed a retrospective chart review of 227 patients who received EMG studies between the 2009 and 2013.[13] Seventy-two (32%) patients also received mus constituted the study group. The criterion standard was myopathy confirmed by muscle biopsy or by genetic testing. The overall sensitivity of EMG was 91%, with the most commonly missed overall specificity was 67%, which is lower than most other reports of specificity, raises concern whether the sensitivity of muscle biopsy is lower than expected, thus resulting in EMG result false-positives.

Section Summary: Clinically Valid

EMG/NCS testing is generally considered to be specific but not sensitive. However, the evidence on the diagnostic accuracy of EMG and NCS is poor, in part because of the lack of a true ref 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 estima 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 correc 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 treatm 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 and NCS is reflected by the lack of evidence-based guidelines. Most existing guidelines rely on expert consensus. This section from three organizations, focusing on the methods of the development process, and the rigor of evidence review. The three organizations are AANEM, AAOS (CTS only), and the American Ac Guidelines and Position Statements discussion in the Supplemental Information section summarizes the recommendations of the guidelines.

The AANEM (2009) made recommendations on electrodiagnostic medicine based on the consensus of 43 experts in the field of electrodiagnostic medicine.[2,]The AANEM provided no informa individuals but noted that they were neurologists or physiatrists representing diverse practice types and locations.

The AAOS (2007) published practice guidelines on the diagnosis and treatment of CTS.[13,]The AAOS made the following statement on its guideline methodology:

"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 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 Co and Technology prior to final approval by the AAOS Board of Directors."

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

The AAN (2004) published a position statement on electrodiagnostic assessment.[14,] According to AAN, "A position statement is a concise explanation of AAN's position on a certain issue tha the rationale behind the Academy's position. The position statement, generally not exceeding 1000 words, is in-depth and must reference all supporting evidence." The AAN document on EM references to accompany recommendations.

Section Summary: Clinically Useful

No studies were identified that evaluated clinical utility. Existing guidelines from prominent major specialty societies in electrodiagnostic medicine consist primarily of expert consensus. For such as the AAOS guidelines, the evidence was not sufficient to make evidence-based recommendations. All three societies have included general recommendations on the utility of electrodia 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 d radiculopathy, and myopathy. The relevant outcomes are test accuracy, symptoms, functional outcomes, and quality of life. Because electrodiagnostic assessment is considered the criterion s 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 cli 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 speci 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 ins either sensitivity or specificity. The evidence is insufficient to determine the effects of the technology on health outcomes.

SUPPLEMENTAL INFORMATION

Practice Guidelines and Position Statements

American Association of Neuromuscular & Electrodiagnostic Medicine

The AANEM has published several position statements on the recommended coverage policy for electromyography (EMG) and nerve conduction study (NCS). The first, initially published in was published in 2010.[16] Needle EMG and NCS testing was recommended for the following indications:

1. "Focal neuropathies, entrapment neuropathies, or compressive lesions/syndromes such as carpal tunnel syndrome, ulnar neuropathies, or root lesions, for localization

2. Traumatic nerve lesions, for diagnosis and prognosis

3. Diagnosis or confirmation of suspected generalized neuropathies, such as diabetic, uremic, metabolic, or immune

4. Repetitive nerve stimulation in diagnosis of neuromuscular junction disorders such as myasthenia gravis, myasthenic syndrome

5. Symptom-based presentations such as 'pain in limb', weakness, disturbance in skin sensation or 'paresthesia' when appropriate pretest evaluations are inconclusive and the clinical assess the study

6. Radiculopathy-cervical, lumbosacral

7. Polyneuropathy-metabolic, degenerative, hereditary

8. Plexopathy-idiopathic, trauma, infiltration

9. Myopathy-including polymyositis and dermatomyositis, myotonic, and congenital myopathies

10. Precise muscle location for injections such as botulinum toxin, phenol, etc."

This document also listed situations where electrodiagnostic assessment is considered investigational.

The AANEM (2005) published practice parameters on the utility of EMG/NCS for the diagnosis of peroneal neuropathy.[11,] This evidence-based review focused on whether EMG/NCS are use 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 digitorumbrevis; EDX: electrodiagnostic; EMG: electromyography; LOR: level of recommendation; NCS: nerve conduction stu

A 2003 consensus statement on diagnosing multifocal motor neuropathy from AANEM[15,] 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 elec block of motor axons."

The AANEM (2004) approved a position statement, endorsed by the American Academy of Neurology and the American Academy of Physical Medicine & Rehabilitation, on diagnostic electr

• "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 weakne 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 th 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 exclusiv

The AANEM (2018) published a policy statement on the use of EMG for distal symmetric polyneuropathy.[16] The statement described five situations in which EMG would be beneficial for pa polyneuropathy: "1) determining primary and alternative diagnoses; 2) determining severity, duration, and prognosis of disease; 3) evaluating risk of associated problems; 4) determining th the effect of toxic exposures."

American Academy of Orthopaedic Surgeons

The American Academy of Orthopaedic Surgeons (2007) issued guidelines on the diagnosis of carpal tunnel syndrome.[13] 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; AAN: American Academy of Neurology; AAPM&R: American Academy of Physical Medicine and Rehabili 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 (2012) published guidelines on the diagnosis and treatment of lumbar disc herniation.[9] This document made the following statement about the use of EM 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 are not specific to the diagnosis of lumbar disc herniation. (Grade of Recommendation: B)"

U.S. Preventive Services Task Force Recommendations

Not applicable.

Ongoing and Unpublished Clinical Trials

A search of ClinicalTrials.gov in April 2019 did not identify any ongoing or unpublished trials that would likely influence this review.]

Horizon BCBSNJ Medical Policy Development Process:

This Horizon BCBSNJ Medical Policy (the "Medical Policy") has been developed by Horizon BCBSNJ's Medical Policy Committee (the "Committee") consistent with generally accepted standards of medical practice, and reflects Ho services, supplies or procedures, and in what circumstances they are deemed to be medically necessary or experimental/ investigational in nature. This Medical Policy also considers whether and to what degree the subject health care appropriate, in terms of type, frequency, extent, site and duration and if they are considered effective for the illnesses, injuries or diseases discussed. Where relevant, this Medical Policy considers whether the subject health care servic primarily for the convenience of the covered person or the health care provider. It may also consider whether the services, supplies or procedures are more costly than an alternative service or sequence of services, supplies or procedu therapeutic or diagnostic results as to the diagnosis or treatment of the relevant illness, injury or disease. In reaching its conclusion regarding what it considers to be the generally accepted standards of medical practice, the Committe scientific evidence published in peer-reviewed medical literature generally recognized by the relevant medical community, physician and health care provider specialty society recommendations, the views of physicians and health care (including, but not limited to, the prevailing opinion within the appropriate specialty) and any other relevant factor as determined by applicable State and Federal laws and regulations.

Index:

Electromyography and Nerve Conduction Studies
EMG (Electromyography)
Nerve Conduction Studies (NCS)
Electrodiagnostic Assessment
EPAD™
CERSR® Electromyography System
Physical Monitoring Registration Unit-S (PMRU-S)
Myovision 3G Wirefree™ System
Nuvasive® NV M5 System
Neuro Omega™ System
Carefusion Nicolet® EDX

References:

1. Gooch CL, Weimer LH. The electrodiagnosis of neuropathy: basic principles and common pitfalls. Neurol Clin. Feb 2007;25(1):1-28. PMID 17324718

2. American Association of Electrodiagnostic Medicine. Guidelines in electrodiagnostic medicine. Recommended policy for electrodiagnostic medicine. Muscle Nerve Suppl. 1999;8:S91-10

3. Lee DH, Claussen GC, Oh S. Clinical nerve conduction and needle electromyography studies. J Am Acad Orthop Surg. Jul-Aug 2004;12(4):276-287. PMID 15473679

4. American Academy of Orthopaedic Surgeons (AAOS). Clinical Practice Guideline on the Diagnosis of Carpal Tunnel Syndrome. 2004; https://www.aaos.org/research/guidelines/CTS_gui

5. Fowler JR, Munsch M, Tosti R, et al. Comparison of ultrasound and electrodiagnostic testing for diagnosis of carpal tunnel syndrome: study using a validated clinical tool as the reference 2014;96(17):e148. PMID 25187592

6. Chang MH, Liu LH, Lee YC, et al. Comparison of sensitivity of transcarpal median motor conduction velocity and conventional conduction techniques in electrodiagnosis of carpal tunnel 2006;117(5):984-991. PMID 16551510

7. Homan MM, Franzblau A, Werner RA, et al. Agreement between symptom surveys, physical examination procedures and electrodiagnostic findings for the carpal tunnel syndrome. Scand
1999;25(2):115-124. PMID 10360466

8. Tulipan JE, Lutsky KF, Maltenfort MG, et al. Patient-reported disability measures do not correlate with electrodiagnostic severity in carpal tunnel syndrome. Plast Reconstr Surg Glob Ope

9. North American Spine Society (NASS) Evidence-Based Clinical Guidelines Committee. Evidence-Based Clinical Guidelines for Multidisciplinary Spine Care. 2012;
https://www.spine.org/Documents/ResearchClinicalCare/Guidelines/LumbarDiscHerniation.pdf. Accessed April 9, 2018.

10. Mondelli M, Aretini A, Arrigucci U, et al. Clinical findings and electrodiagnostic testing in 108 consecutive cases of lumbosacral radiculopathy due to herniated disc. Neurophysiol Clin.
24094906

11. Marciniak C, Armon C, Wilson J, et al. Practice parameter: utility of electrodiagnostic techniques in evaluating patients with suspected peroneal neuropathy: an evidence-based review. M
PMID 15768387

12. Rabie M, Jossiphov J, Nevo Y. Electromyography (EMG) accuracy compared to muscle biopsy in childhood. J Child Neurol. Jul 2007;22(7):803-808. PMID 17715269

13. American Academy of Orthopaedic Surgeons. Clinical guidelines: diagnosis of carpal tunnel syndrome. 2007; https://www.aaos.org/research/guidelines/CTS_summary.pdf. Accessed Ap

14. American Academy of Neurology (AAN). Position Statement: diagnostic electromyography in the practice of medicine. 2004; https://www.aanem.org/getmedia/3275d71c-81dc-4b23-96
03173ecf8446/Recommended_Policy_EDX_Medicine_062810.pdf. Accessed April 11, 2018.

15. Olney RK, Lewis RA, Putnam TD, et al. Consensus criteria for the diagnosis of multifocal motor neuropathy. Muscle Nerve. Jan 2003;27(1):117-121. PMID 12508306

16. AANEM policy statement on electrodiagnosis for distal symmetric polyneuropathy. Muscle Nerve. Feb 2018;57(2):337-339. PMID 29178499

17. Centers for Medicare & Medicaid Services. National Coverage Determination (NCD) for Sensory Nerve Conduction Threshold Tests (sNCTs) (160.23). 2004; https://www.cms.gov/medi
details.aspx?NCDId=270&ncdver=2&CoverageSelection=National&KeyWord=Sensory+Nerve+Conduction+Thre shold+Tests&KeyWordLookUp=Title&KeyWordSearchType=And&bc=g
Accessed April 11, 2018.

Codes:
*(The list of codes is not intended to be all-inclusive and is included below for informational purposes only. Inclusion or exclusion of a procedure, diagnosis, drug or device code(s) does not constitute or imply authorization, certificatio
payment.)*

CPT*

95860 - 95872
95885 - 95887
95907 - 95913

HCPCS
