Policy Statement

Quantitative sensory testing, including but not limited to current perception threshold testing, pressure-specified sensory device testing, vibration perception threshold testing, and thermal threshold testing, is considered investigational.

Policy Guidelines

The following CPT codes are specific to quantitative sensory testing:
- **0106T**: Quantitative sensory testing (QST), testing and interpretation per extremity; using touch pressure stimuli to assess large diameter sensation
- **0107T**: Quantitative sensory testing (QST), testing and interpretation per extremity; using vibration stimuli to assess large diameter fiber sensation
- **0108T**: Quantitative sensory testing (QST), testing and interpretation per extremity; using cooling stimuli to assess small nerve fiber sensation and hyperalgesia
- **0109T**: Quantitative sensory testing (QST), testing and interpretation per extremity; using heat-pain stimuli to assess small nerve fiber sensation and hyperalgesia
- **0110T**: Quantitative sensory testing (QST), testing and interpretation per extremity; using other stimuli to assess sensation

NOTE: This series of codes describes "psychophysical" testing of subjective feelings of sensation to assess endocrine and neurologic disorders such as neuropathies. These tests are more complex and standardized than physical examination services. Quantitative sensory testing (QST) is performed in the office or outpatient setting by physicians such as internists, geriatricians, family practitioners, neurologists, and endocrinologists. The codes are “per extremity,” so one could receive as many as 4 units per code. Previously, these tests would have been coded using 95999 (for other, unlisted neurological or neuromuscular diagnostic procedures). These stimuli are not electrical like those used in current perception threshold testing.

The following HCPCS code is specific to this test:
- **G0255**: Current perception threshold/sensory nerve conduction test, (SNCT) per limb, any nerve

Another distinction between a nerve conduction test and the current perception threshold test is that the former is performed in a laboratory setting, while the latter is performed in an office setting. Codes 95907-95913 might be incorrectly reported for these services.

Description

Quantitative sensory testing (QST) systems are used for the noninvasive assessment and quantification of sensory nerve function in patients with symptoms of, or the potential for neurologic damage or disease. Types of sensory testing include current perception threshold testing, pressure-specified sensory testing (PSST), vibration perception testing, and thermal sensory testing. Information on sensory deficits identified using QST has been used in research settings to understand neuropathic pain better. It could be used to diagnose conditions linked to nerve damage and disease, and to improve patient outcomes by impacting management strategies.
Related Policies

- N/A

Benefit Application

Benefit determinations should be based in all cases on the applicable contract language. To the extent there are any conflicts between these guidelines and the contract language, the contract language will control. Please refer to the member's contract benefits in effect at the time of service to determine coverage or non-coverage of these services as it applies to an individual member.

Some state or federal mandates (e.g., Federal Employee Program [FEP]) prohibits plans from denying Food and Drug Administration (FDA)-approved technologies as investigational. In these instances, plans may have to consider the coverage eligibility of FDA-approved technologies on the basis of medical necessity alone.

Regulatory Status

A number of QST devices have been cleared for marketing by the U.S. Food and Drug Administration through the 510(k) process. Examples are listed in Table 1.

Table 1. FDA-Approved Quantitative Sensory Testing Devices

<table>
<thead>
<tr>
<th>Device</th>
<th>Manufacturer</th>
<th>Date Cleared</th>
<th>510(k)</th>
<th>Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurometer®</td>
<td>Neurotron</td>
<td>Jun 1986</td>
<td>K853608</td>
<td>Current perception threshold testing</td>
</tr>
<tr>
<td>NK Pressure-Specified Sensory Device, Model PSSD</td>
<td>NK Biotechnical Engineering</td>
<td>Aug 1994</td>
<td>K934368</td>
<td>Pressure-specified sensory testing</td>
</tr>
<tr>
<td>AP-4000, Air Pulse Sensory Stimulator</td>
<td>Pentax Precision Instrument</td>
<td>Sep 1997</td>
<td>K964815</td>
<td>Pressure-specified sensory testing</td>
</tr>
<tr>
<td>Neural-Scan</td>
<td>Neuro-Diagnostic Assoc.</td>
<td>Dec 1997</td>
<td>K964622</td>
<td>Current perception threshold testing</td>
</tr>
<tr>
<td>Vibration Perception Threshold (VPT) METER</td>
<td>Xilas Medical</td>
<td>Dec 2003</td>
<td>K030829</td>
<td>Vibration perception testing</td>
</tr>
<tr>
<td>Contact Heat-Evoked Potential Stimulator (Cheps)</td>
<td>Medoc, Advanced Medical Systems</td>
<td>Feb 2005</td>
<td>K041908</td>
<td>Thermal sensory testing</td>
</tr>
</tbody>
</table>

FDA product code: LLN

FDA product code: NTU

Rationale

Background

Nerve Damage and Disease

Nerve damage and nerve diseases can reduce functional capacity and lead to neuropathic pain.

Treatment

There is a need for tests that can objectively measure sensory thresholds. Moreover, quantitative sensory testing (QST) could aid in the early diagnosis of disease, before patients would be diagnosed clinically. Also, although the criterion standard for evaluation of myelinated, large fibers is electromyography nerve conduction study, there are no criterion standard reference tests to diagnose small fiber dysfunction.
Quantitative Sensory Testing

QST systems measure and quantify the amount of physical stimuli required for sensory perception to occur. As sensory deficits increase, the perception threshold of QST will increase, which may be informative in documenting the progression of neurologic damage or disease. QST has not been established for use as a sole tool for diagnosis and management but has been used with standard evaluative and management procedures (e.g., physical and neurologic examination, monofilament testing, pinprick, grip and pinch strength, Tinel sign, and Phalen and Roos test) to enhance the diagnosis and treatment-planning process, and to confirm physical findings with quantifiable data. Stimuli used in QST include touch, pressure, pain, thermal (warm and cold), or vibratory stimuli.

The criterion standard for evaluation of myelinated, large fibers is the electromyography nerve conduction study. However, the function of smaller myelinated and unmyelinated sensory nerves, which may show pathologic changes before the involvement of the motor nerves, cannot be detected by nerve conduction studies. Small fiber neuropathy has traditionally been a diagnosis of exclusion in patients who have symptoms of distal neuropathy and a negative nerve conduction study.

Depending on the type of stimuli used, QST can assess both small and large fiber dysfunction. Touch and vibration measure the function of large myelinated A alpha and A beta sensory fibers. Thermal stimulation devices are used to evaluate pathology of small myelinated and unmyelinated nerve fibers; they can be used to assess heat and cold sensation, as well as thermal pain thresholds. Pressure-specified sensory devices assess large myelinated sensory nerve function by quantifying the thresholds of pressure detected with light, static, and moving touch. Finally, current perception threshold testing involves the quantification of the sensory threshold to transcutaneous electrical stimulation. In current perception threshold testing, typically 3 frequencies are tested: 5 Hz, designed to assess C fibers; 250 Hz, designed to assess A delta fibers; and 2000 Hz, designed to assess A beta fibers. Results are compared with those of a reference population.

Because QST combines the objective physical, sensory stimuli with the subject patient response, it is psychophysical and requires patients who are alert, able to follow directions, and cooperative. Also, to get reliable results, examinations need to include standardized instructions to the patients, and stimuli must be applied consistently by trained staff. Psychophysical tests have greater inherent variability, making their results more difficult to reproduce. QST has primarily been applied in patients with conditions associated with nerve damage and neuropathic pain. There have also been preliminary investigations to identify sensory deficits associated with conditions such as autism spectrum disorder, Tourette syndrome, restless legs syndrome, musculoskeletal pain, and response to opioid treatment.

Literature Review

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.

Literature searches focus on types of quantitative sensory testing (QST) approved or cleared by the U.S. Food and Drug Administration (FDA). This includes current perception threshold testing, pressure-specified sensory testing (PSST), vibration perception threshold (VPT) testing, and thermal threshold testing.
Clinical Context and Test Purpose
The purpose of current perception threshold testing is to provide a diagnostic option and a treatment that is an alternative to or an improvement on existing tests, such as standard clinical evaluation and other sensory assessment tests, in patients with conditions linked to nerve damage or disease (e.g., diabetic neuropathy, carpal tunnel syndrome).

The question addressed in this evidence review is: Does QST improve the net health outcome in patients with conditions linked to nerve damage or disease?

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

Patients
The relevant population of interest are individuals with conditions linked to nerve damage or disease (e.g., diabetic neuropathy, carpal tunnel syndrome).

Interventions
The test being considered is current perception threshold testing.

QST systems are used for the noninvasive assessment and quantification of sensory nerve function in patients with symptoms of or the potential for neurologic damage or disease. Types of sensory testing include current perception threshold testing. Information on sensory deficits identified using QST has been used in research settings to understand neuropathic pain better. It could be used to diagnose conditions linked to nerve damage and disease, and to improve patient outcomes by impacting management strategies.

Patients with conditions linked to nerve damage or disease (e.g., diabetic neuropathy, carpal tunnel syndrome) are actively managed by occupational therapists, physical therapists, neurologists, and primary care providers in an outpatient clinical setting.

Comparators
Comparators of interest include standard clinical evaluation and other sensory assessment tests. Comparators are managed by occupational therapists, physical therapists, neurologists, and primary care providers in an outpatient clinical setting.

Outcomes
The general outcomes of interest are test accuracy, test validity, symptoms, and functional outcomes.

Study Selection Criteria
Below are selection criteria for studies to assess whether a test is clinically valid.

a. The study population represents the population of interest. Eligibility and selection are described.

b. The test is compared with a credible reference standard.

c. If the test is intended to replace or be an adjunct to an existing test; it should also be compared with that test.

d. Studies should report sensitivity, specificity, and predictive values. Studies that completely report true- and false-positive results are ideal. Studies reporting other measures (e.g., receiver operating characteristic [ROC], area under receiver operating characteristic [AUROC]), c-statistic, likelihood ratios) may be included but are less informative.

e. Studies should also report reclassification of diagnostic or risk category.
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).

Limited published evidence is available on diagnostic performance. Several studies have compared current perception threshold testing with other testing methods, but sensitivity and specificity have not been reported. For example, Ziccardi et al (2012) evaluated 40 patients presenting with trigeminal nerve injuries involving the lingual branch. Patients underwent current perception threshold testing and standard clinical sensory testing. Statistically significant correlations were found between findings of electrical stimulation testing at 250 Hz and the reaction to pinprick testing (p=0.02), reaction to heat stimulation (p=0.01), and reaction to cold stimulation (p=0.004). Also, significant correlations were found between electrical stimulation at 5 Hz and the reaction to heat stimulation (p=0.017), to cold stimulation (p=0.004), but not to pinprick testing (p=0.096).

In addition, Park et al (2001) compared current perception threshold testing with standard references for thermal sensory testing and von Frey tactile hair stimulation in a randomized, double-blind, placebo-controlled trial with 19 healthy volunteers. All current perception threshold measurements showed a higher degree of variability than thermal sensory testing and von Frey measurements but there was some evidence that similar fiber tracts can be measured, especially C-fiber tract activity at 5 Hz, with current perception threshold, thermal sensory, and von Frey testing methods. This study only included healthy volunteers.

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.

Direct Evidence
Direct evidence of clinical utility is provided by studies that have compared health outcomes for patients managed with and without the test. Because these are intervention studies, the preferred evidence would be from randomized controlled trials (RCTs).

No direct evidence from comparative studies evaluating the impact of current perception testing on patient management decisions or health outcomes was 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.

Because the evidence is insufficient to demonstrate test performance for current perception threshold testing, no inferences can be made about clinical utility.

Section Summary: Current Perception Threshold Testing
There is insufficient evidence on the accuracy of current perception threshold testing for diagnosing any condition linked to nerve damage or disease using current perception threshold testing. Several studies have compared current perception threshold testing with other testing methods but sensitivity and specificity were not reported. No direct evidence was identified for
the clinical utility of current perception testing and, since there is insufficient evidence on test performance, a chain of evidence for clinical utility cannot be constructed.

**Pressure-Specified Sensory Testing**

**Clinical Context and Test Purpose**
The purpose of PSST is to provide a diagnostic option that is an alternative to or an improvement on existing tests, such as standard clinical evaluation and other sensory assessment tests, in patients with conditions linked to nerve damage or disease (e.g., diabetic neuropathy, carpal tunnel syndrome).

The question addressed in this evidence review is: Does QST improve the net health outcome in patients with conditions linked to nerve damage or disease?

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

**Patients**
The relevant population of interest are individuals with conditions linked to nerve damage or disease (e.g., diabetic neuropathy, carpal tunnel syndrome).

**Interventions**
The test being considered is PSST.

**Comparators**
Comparators of interest include standard clinical evaluation and other sensory assessment tests. Comparators are managed by occupational therapists, physical therapists, neurologists, and primary care providers in an outpatient clinical setting.

**Outcomes**
The general outcomes of interest are test accuracy, test validity, symptoms, and functional outcomes.

**Study Selection Criteria**
Below are selection criteria for studies to assess whether a test is clinically valid.

a. The study population represents the population of interest. Eligibility and selection are described.

b. The test is compared with a credible reference standard.

c. If the test is intended to replace or be an adjunct to an existing test; it should also be compared with that test.

d. Studies should report sensitivity, specificity, and predictive values. Studies that completely report true- and false-positive results are ideal. Studies reporting other measures (e.g., ROC, AUROC, c-statistic, likelihood ratios) may be included but are less informative.

e. Studies should also report reclassification of diagnostic or risk category.

**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 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.
Standard evaluation and management of patients with potential nerve compression, disease, or damage consists of physical examination techniques and may include Semmes-Weinstein monofilament testing and, in more complex cases, nerve conduction velocity testing. Several studies have compared the performance of PSST devices. For example, a study by Weber et al (2000) evaluated the sensitivity and specificity of PSST and nerve conduction velocity testing in 79 patients, including 26 healthy controls. The nerve conduction velocity test had a sensitivity of 80% and a specificity of 77%; the PSST had a sensitivity of 91% and a specificity of 82%. The difference between the two tests was not statistically significant.

A study by Nath et al (2010) evaluated 30 patients with winged scapula and upper trunk injury and 10 healthy controls. They used the PSST device by Sensory Management Services cleared by the FDA to measure the minimum perceived threshold in both arms for detecting 1-point static and 2-point static stimuli. The authors used a published standard reference threshold value for the dorsal hand first web (DHFW) skin and calculated threshold values for both the DHFW and the deltoid using the upper limit of the 99% normal confidence interval. No published threshold values were available for the deltoid location. PSST was done on both arms of all participants, and electromyography testing only on the affected arms of symptomatic patients. Using calculated threshold values, patients with normal electromyography results had positive PSST results on 50% (8/16) of 1-point static deltoid, 71% (10/14) of 2-point static deltoid, 65% (11/17) of 1-point static DHFW, and 87% (13/15) of 2-point static DHFW tests. Study findings suggested that PSST is more sensitive than needle electromyography in detecting brachial plexus upper trunk injury.

A systematic review by Hubscher et al (2013) evaluated the relation between QST and self-reported pain and disability in patients with spinal pain. Twenty-eight of 40 studies identified used PSST devices. The overall analysis found low or no correlations between pain thresholds, as assessed by QST and self-reported pain intensity or disability. For example, the pooled estimate of the correlation between pain threshold and pain was -0.15 (95% confidence interval, -0.18 to -0.11) and -0.16 (95% confidence interval, -0.22 to -0.10) between pain threshold and disability. The findings suggested that QST provides low accuracy for diagnosing patients' level of spinal pain and disability.

**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.

**Direct Evidence**
Direct evidence of clinical utility is provided by studies that have compared health outcomes for patients managed with and without the test. Because these are intervention studies, the preferred evidence would be from RCTs.

No direct evidence from clinical trials identified has demonstrated that use of the PSST resulted in changes in patient management or improved patient outcomes. Suokas et al (2012) published a systematic review of studies evaluating QST for painful osteoarthritis; most studies used pressure testing. Reviewers did not report finding any studies evaluating the impact of QST on health outcomes.

**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.

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

**Section Summary: PSST**
The available evidence on the diagnostic accuracy of PSST for conditions linked with nerve damage or disease is limited, but available studies have reported relatively low diagnostic accuracy. There is insufficient direct evidence on the clinical utility of PSST and, because there is insufficient evidence on test performance, an indirect chain of evidence for clinical utility cannot be constructed.

**Vibration Perception Testing**

**Clinical Context and Test Purpose**
The purpose of VPT is to provide a diagnostic option that is an alternative to or an improvement on existing tests, such as standard clinical evaluation and other sensory assessment tests, in patients with conditions linked to nerve damage or disease (e.g., diabetic neuropathy, carpal tunnel syndrome).

The question addressed in this evidence review is: Does QST improve the net health outcome in patients with conditions linked to nerve damage or disease?

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

**Patients**
The relevant population of interest are individuals with conditions linked to nerve damage or disease (e.g., diabetic neuropathy, carpal tunnel syndrome).

**Interventions**
The test being considered is VPT.

**Comparators**
Comparators of interest include standard clinical evaluation and other sensory assessment tests. Comparators are managed by occupational therapists, physical therapists, neurologists, and primary care providers in an outpatient clinical setting.

**Outcomes**
The general outcomes of interest are test accuracy, test validity, symptoms, and functional outcomes.

**Study Selection Criteria**
Below are selection criteria for studies to assess whether a test is clinically valid.

- The study population represents the population of interest. Eligibility and selection are described.
- The test is compared with a credible reference standard.
- If the test is intended to replace or be an adjunct to an existing test; it should also be compared with that test.
- Studies should report sensitivity, specificity, and predictive values. Studies that completely report true- and false-positive results are ideal. Studies reporting other measures (e.g., ROC, AUROC, c-statistic, likelihood ratios) may be included but are less informative.
- Studies should also report reclassification of diagnostic or risk category.

**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).
A study from India, Mythili et al (2010) evaluated 100 patients with type 2 diabetes using a VPT device (Sensitometer; Dhansai Lab). The device is not FDA-approved or cleared. The authors reported on sensitivities and specificities for the device and standard nerve conduction study (NCS). For vibration testing, a positive finding (i.e., the presence of neuropathy) was defined as patients reporting no vibration sensation at more than 15 volts. According to NCSs, 70 of 100 patients had evidence of neuropathy. VPT had a sensitivity of 86% and a specificity of 76% Semmes-Weinstein monofilament testing, which was also done, had a higher sensitivity than vibration testing (98.5%) but lower specificity (55%). Finally, a Diabetic Neuropathy Symptom Score, determined by responses to a patient questionnaire, had a sensitivity of 83% and a specificity of 79%. The authors noted that the simple neurologic examination score appeared to be as accurate as vibration testing. It is not known how similar the Sensitometer device is to FDA-approved vibration threshold testing devices.

Abraham et al (2015) retrospectively reviewed the charts of 70 patients with chronic inflammatory demyelinating polyneuropathy (CIDP) who were evaluated with a VPT device (Neurothesiometer). The stimulus was applied to the first finger and toe on each side; the voltage was gradually increased, and patients were asked to state when they first perceived vibration. The threshold for a normal test result was 5 volts or less in the fingers and 15 volts or less in the toes. Data on the results of neurologic examinations were also reviewed, including testing using semiquantitative vibration testing with a 128-Hz tuning fork. Fifty-five (79%) patients had elevated VPT values. Abnormal neurologic findings were more common in CIDP patients with elevated VPT scores (92.7%) at the toes than those without elevated VPT scores (46.7%; p<0.001). Compared with patients with normal VPT values, patients with elevated VPT values were more likely to meet European Federation of Neurological Societies and Peripheral Nerve Society electrophysiologic criteria for CIDP (51% vs 13%; p=0.01) and had significantly lower treatment response rates (54% vs 93%; p=0.03). The authors did not report the sensitivity or specificity of the device compared with standard diagnostic tests. The Neurothesiometer is not FDA-approved or cleared.

Goel et al (2017) published a cross-sectional study comparing the diagnostic performance of several testing methods to detect early symptoms of diabetic peripheral neuropathy (DPN). Five hundred twenty-three patients with type 2 diabetes between the ages of 18 and 65 (mean, 49.4 years) were first assessed with the modified Neuropathy Disability Score as the reference standard; then both feet were tested with electrochemical skin conductance, VPT, and Diabetic Neuropathy Symptom Score. For feet electrochemical skin conductance less than 60 μS, VPT, and Diabetic Neuropathy Symptom Score, the sensitivity was 85%, 72%, and 52%, respectively; specificity was 85%, 90%, and 60%, respectively. There was a significant inverse linear relation between VPT and feet electrochemical skin conductance (r = -0.45, p<0.001); feet electrochemical skin conductance was determined to be superior to VPT for identifying early signs of DPN. The study lacked follow-up data.

Azzopardi et al (2018) published a prospective multicenter cross-sectional study comparing 3 types of vibration screening used to diagnose DPN. The study collected data from 100 patients (age range, 40-80 years) who had type 2 diabetes for at least 10 years. Each participant was assessed with a VibraTip (not registered with the FDA), neurothesiometer, and 128-Hz tuning fork in both feet. Vibrations were not perceived by 28.5% of patients when using VibraTip, 21% using a neurothesiometer, and 12% using a tuning fork; a small-to-moderately strong association (Cramer's V, 0.167) was found between the instruments. The study lacked a criterion standard for assessing neuropathy. The authors concluded that multiple methods of assessment would be necessary to avoid a false-negative diagnosis.

**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.
Direct Evidence
Direct evidence of clinical utility is provided by studies that have compared health outcomes for patients managed with and without the test. Because these are intervention studies, the preferred evidence would be from RCTs.

No direct evidence from clinical trials was identified demonstrating that use of vibration testing resulted in changes in patient management or improved patient outcomes.

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.

Indirect evidence on clinical utility rests on clinical validity. Because the evidence does not demonstrate the test performance of VPT, no inferences can be made about clinical utility.

Section Summary: VPT
A few studies have evaluated the diagnostic performance of VPT using devices, not FDA-cleared. In one study, a neurologic examination score had similar diagnostic accuracy to vibration testing, and Semmes-Weinstein monofilament testing had a higher sensitivity than VPT but a lower specificity. The other study did not report sensitivity or specificity for VPT but reported that patients with elevated VPT findings were significantly more likely to meet society criteria for CIDP compared with patients with normal VPT results. Another study compared VPT with electrochemical skin conductance and determined that electrochemical skin conductance was superior for early identification of DPN, while a fourth study concluded that multiple methods of assessment were necessary to diagnose DPN. No direct evidence for the clinical utility of VPT was identified and, because there is insufficient evidence about test performance, an indirect chain of evidence on clinical utility cannot be constructed.

Thermal Sensory Testing
Clinical Context and Test Purpose
The purpose of thermal sensory testing is to provide a diagnostic option that is an alternative to or an improvement on existing tests, such as standard clinical evaluation and other sensory assessment tests, in patients with conditions linked to nerve damage or disease (e.g., diabetic neuropathy, carpal tunnel syndrome).

The question addressed in this evidence review is: Does QST improve the net health outcome in patients with conditions linked to nerve damage or disease?

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

Patients
The relevant population of interest are individuals with conditions linked to nerve damage or disease (e.g., diabetic neuropathy, carpal tunnel syndrome).

Interventions
The test being considered is thermal sensory testing.

Comparators
Comparators of interest include standard clinical evaluation and other sensory assessment tests. Comparators are managed by occupational therapists, physical therapists, neurologists, and primary care providers in an outpatient clinical setting.

Outcomes
The general outcomes of interest are test accuracy, test validity, symptoms, and functional outcomes.
Study Selection Criteria

Below are selection criteria for studies to assess whether a test is clinically valid.

a. The study population represents the population of interest. Eligibility and selection are described.

b. The test is compared with a credible reference standard.

c. If the test is intended to replace or be an adjunct to an existing test; it should also be compared with that test.

d. Studies should report sensitivity, specificity, and predictive values. Studies that completely report true- and false-positive results are ideal. Studies reporting other measures (e.g., ROC, AUROC, c-statistic, likelihood ratios) may be included but are less informative.

e. Studies should also report reclassification of diagnostic or risk category.

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).

Devigili et al (2008) assessed 150 patients referred for suspected sensory neuropathy and tested with a Medoc thermal perception testing device. Patients underwent (1) clinical examination, (2) a sensory and motor NCS, (3) warm and cooling thresholds assessed by QST, and (4) skin biopsy with distal intraepidermal nerve fiber (IENF) density. Based on the combined assessments, neuropathy was ruled out in 26 patients; 124 patients were diagnosed with sensory neuropathy and, of these, 67 patients were diagnosed with small nerve fiber neuropathy. Using a cutoff of 7.63 IENF per millimeter at the distal leg (based on the 5th percentile of controls), 59 (88%) patients were considered to have abnormal IENF (small nerve fiber) density. Only 7.5% of patients had abnormal results for all 3 examinations (clinical, QST, skin biopsy), 43% of patients had both abnormal skin biopsy and clinical findings, and 37% of patients had both abnormal skin biopsy and QST results. The combination of abnormal clinical and QST results was observed in only 12% of patients. These results indicated that most patients evaluated showed an IENF density of less than 7.63 together with either abnormal spontaneous or evoked pain (clinical examination) or abnormal thermal thresholds (QST). Study authors recommended a new diagnostic criterion based on the presence of at least two of three abnormal results (clinical, QST, IENF density).

Lefaucheur et al (2015) compared 5 tests for diagnosing small fiber neuropathy (SFN), including QST using a Medoc thermal perception testing device. The QST device was used to assess the warm detection threshold and cold detection threshold. Other tests were laser-evoked potential (LEP), sympathetic skin response, and electrochemical skin conductance. The study enrolled 87 consecutive patients being evaluated for definite (n=33) or possible (n=54) painful SFN. All five tests were conducted in a single session. Findings were compared with those for 174 healthy subjects, matched for age and sex. Results of each test were categorized as normal or abnormal, using findings in healthy subjects as the reference range for normal values. All patients with definite SFN and 70% of those with possible SFN had at least 1 abnormal test. The sensitivity and specificity of each test in the series of 87 patients are shown in Table 2.

Table 2. Sensitivity and Specificity (N=87)

<table>
<thead>
<tr>
<th>Test</th>
<th>Sensitivity, %</th>
<th>Specificity, %</th>
</tr>
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<tbody>
<tr>
<td>Warm detection threshold</td>
<td>44.8</td>
<td>91.4</td>
</tr>
<tr>
<td>Cold detection threshold</td>
<td>26.4</td>
<td>97.1</td>
</tr>
<tr>
<td>Laser-evoked potential</td>
<td>64.4</td>
<td>87.4</td>
</tr>
<tr>
<td>Sympathetic skin response</td>
<td>33.3</td>
<td>77.6</td>
</tr>
<tr>
<td>Electrochemical skin conductance</td>
<td>49.4</td>
<td>92.5</td>
</tr>
</tbody>
</table>
Adapted from Lefaucheur et al (2015).11, LEP was the most sensitive test. However, not all patients were correctly categorized with LEP. Fifteen patients with at least one abnormal test had normal LEP tests, but abnormal warm detection threshold or electrochemical skin conductance tests. Findings of the other two tests (cold detection threshold, sympathetic skin response) were redundant. As noted by the authors, their study lacked a definitive criterion standard for SFN with which to compare test findings.

Anand et al (2017) assessed 30 patients with nonfreezing cold injury, or trench foot, described as a peripheral vasoneuropathy.12 The authors evaluated use of skin biopsies immunohistochemistry, clinical examination of the feet, including pinprick, as well as QST assessments, and NCSs as diagnostic tools. Abnormal pinprick sensation was reported in 67% of patients. Monofilament perception threshold was abnormal in 63% of patients, 40% for VPT thresholds, and between 67% and 83% for the various thermal thresholds; NCSs showed 23% of subjects had a mixed peripheral neuropathy. It was noted that performing QST could be difficult for patients with cutaneous hypersensitivity and severe limb pain. No study limitations were reported.

**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.

**Direct Evidence**

Direct evidence of clinical utility is provided by studies that have compared health outcomes for patients managed with and without the test. Because these are intervention studies, the preferred evidence would be from RCTs.

No direct evidence from clinical trials was identified demonstrating that use of thermal testing resulted in changes in patient management or improved patient outcomes.

**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.

Indirect evidence on clinical utility rests on clinical validity. Because of limited evidence about test performance for thermal threshold testing, no inferences can be made about clinical utility.

**Section Summary: Thermal Sensory Testing**

Two studies have evaluated the diagnostic accuracy of thermal QST using the same FDA-cleared device. Neither found a high diagnostic accuracy of thermal QST but both found the test had potential when used in combination with other tests. The optimal combination of tests is not well-defined. No studies reporting on the clinical utility for thermal sensory testing were identified, and, because there is insufficient evidence on test performance, an indirect chain of evidence on clinical utility cannot be constructed.

**Summary of Evidence**

For individuals who have conditions linked to nerve damage or disease (e.g., diabetic neuropathy, carpal tunnel syndrome) who receive current perception threshold testing, the evidence includes several studies on technical performance and diagnostic accuracy. The relevant outcomes are test accuracy and validity, symptoms, and functional outcomes. The existing evidence does not support the accuracy of current perception threshold testing for diagnosing any condition linked to nerve damage or disease. Studies comparing current perception threshold testing with other testing methods have not reported on sensitivity or specificity. Also, there is a lack of direct evidence on the clinical utility of current perception testing and, because there is insufficient evidence on test performance, an indirect chain of
evidence on clinical utility cannot be constructed. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have conditions linked to nerve damage or disease (e.g., diabetic neuropathy, carpal tunnel syndrome) who receive PSST, the evidence includes several studies on diagnostic accuracy. The relevant outcomes are test accuracy and validity, symptoms, and functional outcomes. Current evidence does not support the diagnostic accuracy of PSST for diagnosing any condition linked to nerve damage or disease. A systematic review found that PSST had low accuracy for diagnosing spinal conditions. Also, there is a lack of direct evidence on the clinical utility of current perception testing and, because there is insufficient evidence on test performance, an indirect chain of evidence on clinical utility cannot be constructed. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have conditions linked to nerve damage or disease (e.g., diabetic neuropathy, carpal tunnel syndrome) who receive VPT, the evidence includes several studies on diagnostic accuracy. The relevant outcomes are test accuracy and validity, symptoms, and functional outcomes. A few studies have assessed the diagnostic performance of vibration testing using devices not cleared by the FDA. Also, there is a lack of direct evidence on the clinical utility of VPT and, in the absence of sufficient evidence on test performance, an indirect chain of evidence on clinical utility cannot be constructed. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have conditions linked to nerve damage or disease (e.g., diabetic neuropathy, carpal tunnel syndrome) who receive thermal sensory testing, the evidence includes diagnostic accuracy. The relevant outcomes are test accuracy and validity, symptoms, and functional outcomes. Two studies identified evaluated the diagnostic accuracy of thermal QST using the same FDA-cleared device. Neither found a high diagnostic accuracy for thermal QST but both studies found the test had potential when used with other tests. The optimal combination of tests is currently unclear. Also, there is a lack of direct evidence on the clinical utility of thermal sensory testing and, because there is insufficient evidence on test performance, an indirect chain of evidence on clinical utility cannot be constructed. The evidence is insufficient to determine the effects of the technology on health outcomes.

Supplemental Information
Clinical Input From Physician Specialty Societies and Academic Medical Centers
While the various physician specialty societies and academic medical centers may collaborate with and make recommendations during this process, through the provision of appropriate reviewers, input received does not represent an endorsement or position statement by the physician specialty societies or academic medical centers, unless otherwise noted.

In response to the requests from Blue Cross Blue Shield Association, physician specialty societies and academic medical centers, input was received from 1 specialty society and 1 academic medical center while the in 2008. Input from both sources agreed with the policy statement that quantitative sensory testing is considered investigational.

Practice Guidelines and Position Statements
American Academy of Neurology
The American Academy of Neurology (2003; reaffirmed 2016) concluded that quantitative sensory testing (QST) is probably (level B recommendation) an effective tool for documenting of sensory abnormalities and changes in sensory thresholds in longitudinal evaluation of patients with diabetic neuropathy.\textsuperscript{13,14} Evidence was weak or insufficient to support the use of QST in patients with other conditions (small fiber sensory neuropathy, pain syndromes, toxic neuropathies, uremic neuropathy, acquired and inherited demyelinating neuropathies, or malingering).

American Association of Neuromuscular & Electrodiagnostic Medicine
The American Association of Neuromuscular & Electrodiagnostic Medicine (AANEM; 2004) published a technology literature review on QST (light touch, vibration, thermal, pain). The review concluded that QST is a reliable psychophysical test of large- and small-fiber sensory modalities but is highly dependent on the full patient cooperation. Abnormalities do not localize dysfunction to the central or peripheral nervous system, and no algorithm can reliably distinguish between psychogenic and organic abnormalities. The AANEM review also indicated that QST had been shown to be reasonably reproducible over a period of days or weeks in normal subjects, but, for individual patients, more studies are needed to determine the maximum allowable difference between two quantitative sensory tests that can be attributed to experimental error.

The AANEM with American Academy of Neurology and American Academy of Physical Medicine & Rehabilitation (2005) developed a formal case definition of distal symmetrical polyneuropathy based on a systematic analysis of peer-reviewed literature supplemented by consensus from an expert panel. QST was not included as part of the final case definition, given that the reproducibility of QST ranged from poor to excellent, and the sensitivities and specificities of QST varied widely among studies.

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

Medicare National Coverage
Medicare (2002) announced a national noncoverage policy on sensory nerve conduction threshold testing. Medicare reconsidered its policy, but affirmed it, concluding that any use of sensory nerve conduction threshold testing to diagnose sensory neuropathies or radiculopathies is not reasonable and necessary. This decision was reaffirmed in 2004. Medicare has not addressed coverage for other types of QST.

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.

References


**Documentation for Clinical Review**

- No records required

**Coding**

This Policy relates only to the services or supplies described herein. Benefits may vary according to product design; therefore, contract language should be reviewed before applying the terms of the Policy. Inclusion or exclusion of codes does not constitute or imply member coverage or provider reimbursement.

**IE**

The following services may be considered investigational.

<table>
<thead>
<tr>
<th>Type</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPT®</td>
<td>0106T</td>
<td>Quantitative sensory testing (QST), testing and interpretation per extremity; using touch pressure stimuli to assess large diameter sensation</td>
</tr>
<tr>
<td></td>
<td>0107T</td>
<td>Quantitative sensory testing (QST), testing and interpretation per extremity; using vibration stimuli to assess large diameter fiber sensation</td>
</tr>
</tbody>
</table>
### Type | Code | Description
--- | --- | ---
0108T | Quantitative sensory testing (QST), testing and interpretation per extremity; using cooling stimuli to assess small nerve fiber sensation and hyperalgesia
0109T | Quantitative sensory testing (QST), testing and interpretation per extremity; using heat-pain stimuli to assess small nerve fiber sensation and hyperalgesia
0110T | Quantitative sensory testing (QST), testing and interpretation per extremity; using other stimuli to assess sensation

**HCPCS**

G0255 | Current perception threshold/sensory nerve conduction test, (SNCT) per limb, any nerve

**ICD-10 Procedure**

None

### Policy History

This section provides a chronological history of the activities, updates and changes that have occurred with this Medical Policy.

<table>
<thead>
<tr>
<th>Effective Date</th>
<th>Action</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/07/2006</td>
<td>Adopted BCBSA policy</td>
<td>Medical Policy Committee</td>
</tr>
<tr>
<td>10/01/2010</td>
<td>Policy revision without position change</td>
<td>Medical Policy Committee</td>
</tr>
<tr>
<td>06/30/2015</td>
<td>Coding update</td>
<td>Administrative Review</td>
</tr>
<tr>
<td>09/30/2015</td>
<td>Policy revision with position change</td>
<td>Medical Policy Committee</td>
</tr>
<tr>
<td>04/01/2016</td>
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</tr>
<tr>
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</tr>
<tr>
<td>08/01/2018</td>
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</tr>
<tr>
<td>08/01/2019</td>
<td>Policy revision without position change</td>
<td>Medical Policy Committee</td>
</tr>
</tbody>
</table>

### Definitions of Decision Determinations

**Medically Necessary:** A treatment, procedure, or drug is medically necessary only when it has been established as safe and effective for the particular symptoms or diagnosis, is not investigational or experimental, is not being provided primarily for the convenience of the patient or the provider, and is provided at the most appropriate level to treat the condition.

**Investigational/Experimental:** A treatment, procedure, or drug is investigational when it has not been recognized as safe and effective for use in treating the particular condition in accordance with generally accepted professional medical standards. This includes services where approval by the federal or state governmental is required prior to use, but has not yet been granted.

**Split Evaluation:** Blue Shield of California/Blue Shield of California Life & Health Insurance Company (Blue Shield) policy review can result in a split evaluation, where a treatment, procedure, or drug will be considered to be investigational for certain indications or conditions, but will be deemed safe and effective for other indications or conditions, and therefore potentially medically necessary in those instances.

### Prior Authorization Requirements (as applicable to your plan)

Within five days before the actual date of service, the provider must confirm with Blue Shield that the member's health plan coverage is still in effect. Blue Shield reserves the right to revoke an authorization prior to services being rendered based on cancellation of the member's eligibility. Final determination of benefits will be made after review of the claim for limitations or exclusions.
Questions regarding the applicability of this policy should be directed to the Prior Authorization Department. Please call (800) 541-6652 or visit the provider portal at www.blueshieldca.com/provider.

Disclaimer: This medical policy is a guide in evaluating the medical necessity of a particular service or treatment. Blue Shield of California may consider published peer-reviewed scientific literature, national guidelines, and local standards of practice in developing its medical policy. Federal and state law, as well as contract language, including definitions and specific contract provisions/exclusions, take precedence over medical policy and must be considered first in determining covered services. Member contracts may differ in their benefits. Blue Shield reserves the right to review and update policies as appropriate.