Spinal Cord Stimulation

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Original Effective Date: 04/01/2008
Line(s) of Business: HMO; PPO; QUEST Integration
Current Effective Date: 01/01/2017
Section: Surgery
Place(s) of Service: Outpatient; Inpatient

I. Description

Spinal cord stimulation (SCS; also called dorsal column stimulation) involves the use of low-level epidural electrical stimulation of the spinal cord dorsal columns. The neurophysiology of pain relief after SCS is uncertain but may be related to either activation of an inhibitory system or to blockage of facilitative circuits. SCS has been used in a wide variety of chronic refractory pain conditions, including pain associated with cancer, failed back pain syndromes, arachnoiditis, and complex regional pain syndrome (ie, chronic reflex sympathetic dystrophy). There has also been interest in SCS as a treatment of critical limb ischemia, primarily in patients who are poor candidates for revascularization and in patients with refractory chest pain.

SCS devices consist of several components: (1) the lead that delivers the electrical stimulation to the spinal cord; (2) an extension wire that conducts the electrical stimulation from the power source to the lead; and (3) a power source that generates the electrical stimulation. The lead may incorporate from 4 to 8 electrodes, with 8 electrodes more commonly used for complex pain patterns. There are 2 basic types of power source. One type, the power source (battery), can be surgically implanted. The other, a radiofrequency receiver, is implanted, and the power source is worn externally with an antenna over the receiver. Totally implantable systems are most commonly used.

The patient’s pain distribution pattern dictates at what level in the spinal cord the stimulation lead is placed. The pain pattern may influence the type of device used; for example, a lead with 8 electrodes may be selected for those with complex pain patterns or bilateral pain. Implantation of the spinal cord stimulator is typically a 2-step process. Initially, the electrode is temporarily implanted in the epidural space, allowing a trial period of stimulation. Once treatment effectiveness is confirmed (defined as at least 50% reduction in pain), the electrodes and radio-receiver/transducer are permanently implanted. Successful SCS may require extensive programming of the neurostimulators to identify the optimal electrode combinations and stimulation channels.

Traditional SCS devices use electrical stimulation with a frequency on the order of 100 to 1000 Hz. Some devices allow adjustment of the frequency settings. At least 1 newer device is available that uses higher frequency stimulation (10,000 Hz). The high-frequency stimulation is proposed to be associated with fewer paresthesias, which are a recognized effect of SCS.
II. Criteria/Guidelines

A. Spinal cord stimulation with standard (non-high-frequency) stimulation is covered (subject to Limitations and Administrative Guidelines) for the treatment of severe and chronic pain of the trunk or limbs that is refractory to all other pain therapies.

B. Patient selection focuses on determining whether or not the patient is refractory to other types of treatment. All of the following criteria must be met prior to implantation of a temporary electrode:
   1. The treatment is used only as a last resort; other treatment modalities (pharmacological, surgical, psychological, physical, if applicable) have been tried and failed or are judged to be unsuitable or contraindicated;
   2. Pain is neuropathic in nature (i.e., resulting from actual damage to the peripheral nerves). Common indications include, but are not limited to, failed back syndrome, complex regional pain syndrome (i.e., reflex sympathetic dystrophy), arachnoiditis, radiculopathies, phantom limb/stump pain, and peripheral neuropathy;
   3. No serious untreated drug habituation exists;
   4. All the facilities, equipment, and professional and support personnel required for the proper diagnosis, treatment, and follow-up of the patient are available.

C. In addition to the above criteria, the patient must demonstrate at least 50% pain relief with a temporarily implanted electrode prior to permanent implantation.

III. Limitations

A. Spinal cord stimulation is not covered for all other indications including but not limited to treatment of critical limb ischemia to forestall amputation and treatment of refractory angina pectoris, heart failure, and cancer-related pain.

B. High-frequency spinal cord stimulation is not covered for the treatment of severe and chronic pain of the trunk or limbs.

IV. Administrative Guidelines

A. Precertification is required before implantation of a temporary electrode and before permanent implantation of the stimulator. To precertify, please complete HMSA’s Precertification Request and mail or fax the form as indicated along with documentation demonstrating that criteria have been met.
   1. The following documentation should be included with the precertification request for the implantation of a temporary electrode:
      a. Clinical notes related to the diagnosis and treatment of chronic neuropathic pain of the trunk or limbs.
      b. Documentation of all treatments tried and failed (e.g., medications, surgical notes, physical therapy notes, psychological notes, etc.).
      c. Consultation notes from a psychologist and/or psychiatrist.
   2. The following must be submitted before the permanent implantation of the stimulator:
      a. The patient's pain log (e.g., diary) and physician clinical notes documenting a successful one-week trial of a temporarily implanted electrode.

B. Precertification is not required for the replacement, revision, or removal of a permanently implanted spinal neurostimulator pulse generator.
C. Applicable Codes:

<table>
<thead>
<tr>
<th>CPT Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>63650</td>
<td>Percutaneous implantation of neurostimulator electrode array; epidural</td>
</tr>
<tr>
<td>63655</td>
<td>Laminectomy for implantation of neurostimulator electrodes, plate/paddle; epidural</td>
</tr>
<tr>
<td>63661</td>
<td>Removal of spinal neurostimulator electrode percutaneous array(s), including fluoroscopy, when performed</td>
</tr>
<tr>
<td>63662</td>
<td>Removal of spinal neurostimulator electrode plate/paddle(s) placed via laminotomy or laminectomy, including fluoroscopy, when performed</td>
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<td>63663</td>
<td>Revision including replacement, when performed, of spinal neurostimulator electrode percutaneous array(s), including fluoroscopy, when performed</td>
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<td>63664</td>
<td>Revision including replacement, when performed, of spinal neurostimulator electrode plate/paddle(s) placed via laminotomy or laminectomy, including fluoroscopy, when performed</td>
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<td>63685</td>
<td>Insertion or replacement of spinal neurostimulator pulse generator or receiver, direct or inductive coupling</td>
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<td>63688</td>
<td>Revision or removal of implanted spinal neurostimulator pulse generator or receiver</td>
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<tr>
<td>95970-95973</td>
<td>Neurostimulator programming and analysis code range</td>
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<tr>
<th>HCPCS Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>L8679</td>
<td>Implantable neurostimulator, pulse generator, any type</td>
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<tr>
<td>L8680</td>
<td>Implantable neurostimulator electrode, each</td>
</tr>
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<td>Implantable neurostimulator pulse generator, single array, rechargeable, includes extension</td>
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<td>L8688</td>
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<tr>
<th>ICD-10-CM Code</th>
<th>Description</th>
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<tr>
<td>G56.40-G56.42</td>
<td>Causalgia of upper limb code range</td>
</tr>
<tr>
<td>G57.70-G57.72</td>
<td>Causalgia of lower limb code range</td>
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<tr>
<td>G89.21-G89.8</td>
<td>Chronic pain, not elsewhere classified, code range</td>
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<td>G89.4</td>
<td>Chronic pain syndrome</td>
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<td>G90.50-G90.59</td>
<td>Complex regional pain syndrome I (CRPS I), code range</td>
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<tr>
<td>M25.50-M25.579</td>
<td>Pain in joint, code range</td>
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<td>M54.10-M54.18</td>
<td>Radiculopathy, code range</td>
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<td>M54.30-M54.32</td>
<td>Sciatica, code range</td>
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<tr>
<td>M54.40-M54.42</td>
<td>Lumbago with sciatica, code range</td>
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Spinal Cord Stimulation

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<tr>
<th>ICD-10-PCS Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>00HU0MZ, 00HU3MZ,</td>
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<tr>
<td>00HU4MZ</td>
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<td>lead, code by approach</td>
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<td>OJH60M8, OJH60M9,</td>
<td>code by body part, approach, number of arrays and whether rechargeable or</td>
</tr>
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<tr>
<td>OJPT0MZ, OJPT3MZ</td>
<td>Surgical, subcutaneous tissue and fascia, trunk, stimulator generator, code</td>
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<tr>
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D. Non-Covered Codes:

<table>
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<tr>
<th>HCPCS Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>C1820</td>
<td>Generator, neurostimulator (implantable), with rechargeable battery and</td>
</tr>
<tr>
<td></td>
<td>charging system (to be used for non-high frequency generators)</td>
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<tr>
<td>C1822</td>
<td>Generator, neurostimulator (implantable), high frequency, with rechargeable</td>
</tr>
<tr>
<td></td>
<td>battery and charging system</td>
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V. Regulatory Status

A large number of neurostimulator devices, some used for spinal cord stimulation (SCS), have been approved by the U.S. Food and Drug Administration (FDA) through the premarket approval (PMA) process. Examples of fully implantable SCS devices approved through the PMA process include the Cordis programmable neurostimulator (Cordis Corp., Downers Grove, IL), approved in 1981, the Itrel (Medtronic, Minneapolis, MN), approved in 1984, and the Precision Spinal Cord Stimulator (Advanced Bionics, Switzerland), approved in 2004.

In May 2015, FDA approved the Nevro Senza™ Spinal Cord Stimulator (Nevro Corp., Menlo Park, CA), a totally implantable neurostimulator device, for the following indications: “chronic intractable pain of the trunk and/or limbs, including unilateral or bilateral pain associated with the following: failed back surgery syndrome, intractable low back pain, and leg pain.” This device uses a higher frequency of electrical stimulation (10 kHz) than standard devices.

VI. Rationale

This policy was originally created in 1996 and has been updated regularly with searches of the MEDLINE database. Most recently, the literature was reviewed through February 19, 2016. Following is a summary of the key literature to date:

**Chronic Trunk or Limb Pain**

**Standard Spinal Cord Stimulation for Chronic Trunk or Limb Pain**

The evidence for standard spinal cord stimulation (SCS) for chronic trunk and limb pain includes randomized controlled trials (RCTs), some of which have been summarized in systematic reviews. Both the systematic reviews and more detailed results from the RCTs are assessed below.

**Systematic Reviews**

In 2016, Grider et al reported results of a systematic review of RCTs of SCS for chronic spinal pain. Six RCTs meeting the review selection criteria were identified. The authors stated that 3 RCTs reported on the efficacy of standard SCS, while the remaining 3 assessed adaptive stimulation, high-frequency stimulation (discussed below), and burst stimulation. Of the 3 RCTs assessing standard SCS, 2 were considered high quality and 1 moderate quality based on Cochrane review criteria and Interventional Pain Management Techniques – Quality Appraisal of Reliability and Risk of Bias Assessment. The 3 RCTs varied in their comparison groups. In 1 trial (Kapural et al), standard SCS was the standard care group in an evaluation of high-frequency SCS. This trial will be discussed below in the section on high-frequency SCS. In the other 2 efficacy trials, SCS was compared with reoperation (n=60 patients; 29 treated with SCS; North et al) or conventional medical management (CMM; n=100 patients; 52 treated with SCS; Kumar et al). In both trials, SCS was associated with higher rates of pain relief (39% with mean follow-up of 2.9 years in North et al; 48% at 6 months in Kumar et al) than the comparator groups (12% with mean follow-up of 2.9 years in North et al; 9% at 6 months in Kumar et al).

In 2009, a systematic review of randomized controlled trials (RCTs) and observational studies of SCS in failed back surgery syndrome (FBSS; defined as persistent pain after spinal surgery; the initial pain may have been secondary to various causes) was undertaken by Frey et al. Primary outcome measures were short-term (≤1 year) and long-term (>1 year) pain relief, and secondary
measures were improvement in functional status, psychologic status, return to work, and reduction in opioid intake. The authors included 2 RCTs, including those RCTs by North and Kumar, and 10 observational studies in a review of methodologic quality assessment and clinical relevance. They found the quality of reporting to be generally poor in the observational studies, which limited assessment of methodologic quality. Both RCTs and 8 of 9 observational studies that met quality criteria reported positive results for short- and long-term relief of pain. The authors caution that the paucity and heterogeneity of the literature limited conclusions drawn from the review. Using U.S. Preventive Services Task Force quality ratings, the authors found level II-1 evidence (from well-designed controlled trials without randomization) or II-2 evidence (from well-designed cohort or case-control analytic studies, preferably from >1 center or research group) for clinical use of the treatment on a long term-basis.

Also in 2009, Simpson et al reported on a health technology assessment, funded by the National Institute for Health and Care Excellence (NICE), to obtain clinical and cost-effectiveness data for SCS in adults with chronic neuropathic or ischemic pain with inadequate response to other medical or surgical treatments. NICE used the assessment as the basis for its guidance on SCS for chronic pain. Trials for FBSS and complex regional pain syndrome (CRPS) type I (reported by North et al, Kumar et al, and Kemler et al) suggested that SCS was more effective than CMM or reoperation in reducing pain.

Evidence from FBSS trials has suggested that SCS is more successful than CMM or reoperation in terms of pain relief. SCS resulted in greater reduction in use of opiates than reoperation. SCS was also more effective than CMM in improving functional ability and health-related quality of life (HRQOL).

Evidence from the CRPS trial has suggested that SCS is more effective than physical therapy in reducing pain at 6 months and 2 years, but not at 5 years, and is more successful in terms of patients’ Global Perceived Effect (GPE) scale of treatment.

Randomized Controlled Trials

RCTs have evaluated SCS for FBSS, CRPS, and painful peripheral diabetic neuropathy.

A multicenter randomized trial with primary results published in 2007 and 24-month follow-up results published in 2008 (PROCESS study) compared SCS (plus CMM) to medical management alone in 100 patients with FBSS. Leg pain relief (>50%) at 6 months was the primary outcome and was observed in 24 (48%) SCS-treated patients and in 4 (9%) controls (odds ratio [OR], 9.23; 99% confidence interval [CI], 1.99 to 42.84; p<0.001), with an average visual analog scale (VAS) score for leg pain of 40 (SD=26) in the SCS group and 67 (SD=24) in the conventional management control group (mean difference, -27; 99% CI, -40 to -13; p<0.001). At 24 months 17 (37%) of those randomized to SCS with available data and 1 (2%) of those randomized to medical management reported greater than 50% leg pain relief (p=0.003). Of the 50 participants in SCS and 44 participants in medical management using opioids at baseline, 28 (56%) in SCS and 31 (70%) in medical management continued to use opioids at 6 months (OR=0.53; 99% CI, 0.17 to 1.64; p=0.20). HRQOL was measured using the 36-Item Short-Form Health Survey (SF-36). The SCS group had significantly higher HRQOL at 6 months in 7 of 8 SF-36 domains (p≤0.02). Between 6 and 12 months, 5 (10%) patients in the SCS group and 32 (73%) patients in the control group crossed over to the other treatment group. Leg pain relief at 12-month follow-up was observed in 16 (34%) of
those randomized to SCS with available data and 3 (7%) of those randomized to medical management (p=0.005). Of the 84 patients who were implanted with a stimulator during the study, 27 (32%) experienced device-related complications.

A 2005, single-center, randomized trial published by North et al compared SCS (plus CMM) to reoperation (plus CMM) in 60 patients with FBSS. The primary outcome was “success,” defined as at least 50% pain relief and patient satisfaction with treatment. Of 60 participants randomized, 50 proceeded to treatment and 49 were still under follow-up at 6 months. After initial treatment, 15 (54%) of those assigned to reoperation crossed over to SCS and 5 (21%) of those assigned to SCS crossed over to reoperation. Mean follow-up was 2.9 (SD=1.1) years. Nine (39%) participants in the SCS assigned group and 3 (12%) reoperation assigned group achieved “success” (p=0.04). Twenty (87%) participants in the SCS group compared to 15 (58%) in the reoperation group had stable or decreased use of opioids (p=0.025). There were no statistically significant differences between the groups in patient-reported impairment in activities of daily living due to pain. One SCS participant developed infection requiring removal of the system and 3 SCS participants had technical problems with the system.

In 2000, Kemler et al reported 6-month outcomes from a randomized trial of 54 patients with CRPS. Twenty-four of 36 patients assigned to SCS and physical therapy were implanted with a permanent stimulator after successful test stimulation; 18 patients were assigned to physical therapy alone. Mean change in VAS pain score from baseline to 6 months was a 2.4-cm reduction in the SCS group and a 0.2-cm increase in the control group (p<0.001). Significantly more SCS patients than control patients reported being “much improved” as rated using the GPE scale at 6 months (p=0.01). There was no difference between the groups for functional outcomes. At 2-year follow-up, 35 participants from the SCS group and 16 participants from the control group were available. Mean change in VAS score from baseline to 2 years was a 2.1-cm (SD=2.8) reduction in SCS and a 0-cm (SD=1.5) change in the control group (p=0.001). In 2004, Kemler et al reported 5-year outcomes from the trial. Five-year follow-up showed a 1.7-cm reduction in VAS pain score compared to baseline in the SCS group (n=31) and a 1.0-cm reduction for the control group (n=13) (p=0.25). Nineteen (95%) patients who received an implant reported that for the same result, they would undergo the treatment again. Ten (42%) SCS assigned patients underwent reoperation due to complications.

Two European RCTs published in 2014 and 2015 evaluated SCS as a treatment for painful diabetic neuropathy of the lower extremities. Both enrolled patients from pain clinics, including patients refractive to medical therapy, and compared best medical treatment with and without SCS. Slangen et al included 36 patients, 22 were randomly assigned to SCS and 14 to continued best medical therapy. Patients in the SCS group underwent trial stimulation for 2 weeks, and 16 positive responders underwent implantation of an SCS device. Treatment success was predefined as at least a 50% reduction in pain intensity for 4 days or a score of at least 6 on a patient-reported global impression of change scale (7-point Likert scale: 1 = very much worse and 7 = very much improved). In an intention-to-treat analysis conducted after 6 months of treatment, 13 (59%) in the SCS group and 1 (7%) in the usual care group were considered treatment successes (p<0.01). Seven (32%) patients in the SCS group and none in the usual care group reduced their use of pain medication. Two patients in the SCS group experienced a serious adverse event; 1 infection and 1 post-dural puncture headache in the test stimulation phase. There were no differences between
the groups in health utility (EQ-5D), mood (Beck Depression Inventory), or HRQOL (SF-36) at 6 months. Two-year follow-up including only participants implanted with SCS from this trial were reported, with similar results in terms of treatment success at 24 months as at 6 months.

De Vos et al randomly assigned 40 patients with painful diabetic peripheral neuropathy to SCS and 20 to best medical therapy. After a maximum of 7 days of trial stimulation, 37 patients in the SCS group underwent device implantation. Fifty-four patients completed the 6-month follow-up. Analysis was intention to treat using last observation carried forward for missing data. The primary outcome (>50% pain relief at 6 months) was achieved by 25 (62.5%) of 40 patients in the SCS group and 1 (5%) of 20 in the control group (p<0.001). Mean scores on a 100-point VAS decreased from 73 to 31 in the SCS group and remained at 67 in the control group (p<0.001). The SCS group had a larger reduction in analgesic intake as measured by the Medication Quantification Scale III (not reported for comparison between groups). A follow-up publication focusing on quality of life (QOL) outcomes reported significant improvements in the SCS group compared to the medical therapy group at 6 months. Mean difference in change in HRQOL (EQ-5D) was -0.21 (95% CI, -0.39 to -0.04; p<0.05); mean difference in change for EQ VAS score was -20 (95% CI, -34 to -7; p<0.01), and mean difference in change for VAS for pain intensity was 37 (95% CI, 22 to 52; p<0.001).

**Section Summary: Standard Spinal Cord Stimulation for Chronic Trunk or Limb Pain**

The evidence on the efficacy of standard SCS for treatment of chronic limb or trunk pain consists of a number of small RCTs that include patients with refractory pain due to conditions such as FBSS, CRPS, and diabetic neuropathy. SCS is not designed to treat the underlying condition, but rather the symptoms; therefore, grouping the conditions is reasonable. These studies are heterogenous in terms of patient populations and outcomes and participants were not blinded (no studies used sham surgeries or devices) but consistently report an improvement in pain with large effect sizes and a reduction in requirement for medications for at least 6 months. Even with a sham surgery or device, blinded outcomes assessment may not be feasible for SCS, because active SCS stimulation is associated with paresthesias. Given the large treatment effects with consistent findings across studies, this evidence suggests that SCS is a reasonable treatment option.

**High-Frequency SCS for Chronic Trunk or Limb Pain**

In 2015, an SCS device, using a higher frequency of electrical stimulation (10 kHz) than predicate devices (which use frequencies on the order of 100-1000 Hz) was approved by the U.S. Food and Drug Administration through the premarket approval process. Potential proposed benefits of higher frequency stimulation include a lower incidence of paresthesias, which are a recognized side effect of SCS.

There is a small body of literature that addresses use of high-frequency SCS. Use of a high-frequency SCS device was originally described in a relatively small (N=24) pilot study reported by Tiede et al (2013) and a larger (N=83) prospective multicenter trial in patients with back pain reported by Van Buyten et al (2013).

Two RCTs identified addressed high-frequency SCS: 1 compared high-frequency stimulation with sham control in a crossover design and the other compared high-frequency SCS with standard SCS.

In 2013, Perruchoud et al reported results of an RCT comparing active high-frequency SCS therapy at 5 kHz to sham stimulation in 40 patients with chronic, treatment-refractory back pain previously
been treated with standard SCS. Patients were randomized to a 2-week sequence of high-frequency stimulation or sham stimulation after a 2-week period of standard stimulation; after that second 2-week period, all patients crossed over to the opposite treatment arm. Treatment was conducted with stimulator programmed to provide high-frequency (5 kHz) or standard stimulation. Results were available for 33 patients, all of whom received both modes of stimulation. For the study’s primary outcome (patient’s global impression of change), there was no statistically significant benefit from high-frequency treatment compared to sham stimulation, although the point estimate for proportion of patients responding was higher for high-frequency stimulation (42.4% for high-frequency vs 30.3% for sham, p=0.30).

In 2015, Kapural et al reported results of a randomized, unblinded, active-controlled trial of high-frequency SCS therapy (HF10) compared to standard SCS therapy in patients with back and leg pain. Selected patients had chronic, intractable pain of the trunk and/or limbs refractory to a minimum of 3 months of conservative therapy, and had average pain intensity of at least 5 on a 10-cm VAS. Patients underwent a trial SCS phase, consisting of up to 14 days with an external stimulator; those with 40% or greater back pain reduction from baseline were eligible for permanent implantation. For those treated with traditional SCS, stimulation parameters were adjusted based on overlap between paresthesias and the pain location. Oral analgesics could be adjusted through the trial. The study prespecified a noninferiority design. A total of 198 subjects were randomized to HF10 therapy (n=101, of whom 97 were trialed with SCS with 90 implanted and included in 3-month primary and 12-month secondary analyses) or standard SCS therapy (n=97, of whom 92 received trial SCS and 81 with implanted and included in the primary and secondary analyses). Patients had a variety of specific diagnoses, most frequently FBSS, radiculopathy, and degenerative disk disease.

For the primary end point, a composite safety and efficacy (percentage of subjects who responded to SCS therapy for back pain with ≥50% reduction in pain on VAS without a stimulation-related neurologic deficit), 84.5% in the HF10 group met the end point for back pain compared with 43.8% in the standard SCS group (p<0.001 for inferiority and superiority). For leg pain, 83.1% in the HF10 group met the primary end point compared with 43.8% in the standard SCS group (p<0.001 for inferiority and superiority). Responder rates were sustained through 12 months. No patients in either group experienced stimulation-related neurologic deficits.

**Section Summary: High-Frequency SCS for Chronic Trunk or Limb Pain**

High-frequency SCS is a more recent evolution of spinal neurostimulation, which may be associated with fewer adverse effects. Studies that offer direct comparisons between standard SCS and high-frequency SCS were sought to allow an evaluation of the incremental benefit of SCS. One RCT comparing high-frequency to standard stimulation found a large and statistically significant benefit associated with high-frequency SCS. Limitations to this trial include lack of patients and providers blinding; however, blinding may not be feasible given the known association between paresthesias and standard SCS. In contrast, a smaller study found no benefit for subjects receiving high-frequency stimulation compared with sham control. This study did use a lower frequency stimulation than that used in commercially available high-frequency SCS devices, implying that its results may not be applicable to current clinical practice. The available RCT comparing standard and high-frequency stimulation is suggestive of a benefit to high-frequency stimulation. However, given that the evidence consists of a single trial with positive
findings, with some uncertainty introduced by the second trial showing no benefit to high-frequency SCS compared with sham, additional trials are needed to corroborate the benefit of high-frequency stimulation.

**Critical Limb Ischemia**

Critical limb ischemia is described as pain at rest or the presence of ischemic limb lesions. If patients are not suitable candidates for limb revascularization (typically due to insufficient distal runoff), amputation may be required. SCS has been investigated in this subset of patients as a technique to relieve pain and decrease the incidence of amputation.

A systematic review from the Cochrane group on the use of SCS in peripheral vascular diseases was updated in 2013. The review included RCTs and non-RCTs evaluating the efficacy of SCS in adults with nonreconstructable chronic critical leg ischemia. Six trials were identified; all were conducted in Europe and 5 were single-country studies. SCS was compared with other nonsurgical interventions. One study was nonrandomized and none were blinded.

In a pooled analysis of data from all 6 studies, there was a significantly higher rate of limb survival in the SCS group than in the control group at 12 months (pooled risk difference [RD], -0.11; 95% CI, -0.20 to -0.02). The 11% difference in the rate of limb salvage means that 9 patients would need to be treated to prevent 1 additional amputation (number needed to treat, 9; 95% CI, 5 to 50). However, when the nonrandomized study was excluded, the difference in the rate of amputation no longer differed significantly between groups (RD = -0.09; 95% CI, -0.19 to 0.01). The SCS patients required significantly fewer analgesics, and more patients reached Fontaine stage II (intermittent claudication) than in the control group. There was no difference in ulcer healing (but only 2 studies were included in this analysis). In the 6 studies, 31 (15%) of 210 patients had a change in stimulation requiring intervention, 8 (4%) experienced end of battery life, 6 (3%) infections required device removal.

Previously, in 2009, Klomp et al published a meta-analysis that selected RCTs on SCS in patients with critical limb ischemia. The same 5 RCTs identified in the Cochrane review, previously described, were included. The authors did not find a statistically significant difference in the rate of amputation in the treatment or the control groups. There was a relative risk of amputation of 0.79 and a risk difference of -0.07 (p=0.15). The authors also conducted additional analyses of data from their 1999 RCT to identify factors associated with a better or worse prognosis. They found that patients with ischemic skin lesions had a higher risk of amputation than patients with other risk factors. There were no significant interactions between this or any other prognostic factor. The analyses did not identify subgroups of patients who might benefit from SCS.

A 2015 systematic review of nonrevascularization-based treatments, including SCS, for patients with critical limb ischemia also included 5 RCTs. In pooled analysis, the authors found that SCS was associated with reduced risk of amputation (odds ratio [OR], 0.53; 95% CI, 0.36 to 0.79). However, the reviewers concluded that there was “relatively low quality of the evidence mainly due to imprecision (ie, small sample size and wide CIs) and the risk of bias.”

**Section Summary: Critical Limb Ischemia**

A number of relatively small RCTs of SCS versus usual care have been completed on patients with critical limb ischemia. In some pooled analyses of these RCTs, SCS did not result in a significantly
lower rate of amputation, although 1 systematic review and meta-analysis did report a significant difference. This evidence is not sufficient to conclude that SCS improves outcomes for patients with critical limb ischemia.

**Refractory Angina Pectoris**

SCS has been used to treat refractory angina in Europe for 20 years, and much of the literature on SCS comes from European centers. Several systematic reviews have been published. In 2009, Taylor et al included 7 RCTs in a systematic review of SCS in the treatment of refractory angina. The authors noted that trials were small and varied considerably in quality. They concluded that “compared to a ‘no stimulation’ control, there was some evidence of improvement in all outcomes following SCS implantation with significant gains observed in pooled exercise capacity and health related quality of life,” however, “further high quality RCT and cost effectiveness evidence is needed before SCS can be accepted as a routine treatment for refractory angina.”

A systematic review from the Cochrane group on the use of SCS in peripheral vascular diseases was updated in 2013. The review included RCTs and non-RCTs evaluating the efficacy of SCS in adults with nonreconstructable chronic critical leg ischemia. Six trials were identified; all were conducted in Europe and 5 were single-country studies. SCS was compared with other nonsurgical interventions. One study was not randomized and none were blinded.

In 2008, a systematic review of the literature based on the Swedish Council on Technology Assessment in Health Care reported on SCS in severe angina pectoris was published. Seven controlled studies (5 randomized), 2 follow-up reports, and a preliminary report, as well as 2 nonrandomized studies determined to be of medium-to-high quality were included in the review. The largest RCT (N=104) compared SCS and coronary artery bypass graft (CABG) in patients accepted for CABG and who were considered to have only symptomatic indications (ie, no prognostic benefit) for CABG, to have an increased risk of surgical complications, and to be unsuitable for percutaneous transluminal coronary angioplasty. Between-group differences on nitrate consumption, anginal attack frequency, and self-estimated treatment effect were not statistically significant at the 6-month follow-up. At the 5-year follow-up, significantly fewer patients in the CABG group were taking long-acting nitrates, and between-group differences on QOL and mortality were not significant. Other studies assessed in the Swedish systematic review included McNab et al (2006), which compared SCS and percutaneous myocardial laser revascularization in a study with 68 subjects. Thirty subjects in each group completed a 12-month follow-up, and differences on mean total exercise time and mean time to angina were not significant. Eleven in the SCS group and 10 in the laser group had no angina during exercise. The remaining RCTs included in the systematic review included 25 or fewer subjects.

Several RCTs were published after the 2008 systematic review but had limitations, such as small sample sizes and short follow-ups. In 2012, Zipes et al published an industry-sponsored, single-blind, multicenter trial with sites in the United States and Canada. This study was terminated early. The data and safety monitoring board recommended termination for futility after the interim analysis. A total of 118 patients with severe angina, despite maximal medical treatment were enrolled in the study. Of these, 71 (60%) patients underwent SCS implantation with the Intrel III neurostimulator (Medtronic). The remaining 47 patients did not meet eligibility criteria postenrollment or had other issues (eg, withdrew consent). The investigators had originally been
Spinal Cord Stimulation

planning to randomize up to 310 patients, but enrollment was slow. Implantation was successful in 68 patients; this group was randomized to high-stimulation (n=32) or a low-stimulation control (n=36). The low-stimulation control was designed so that patients would feel paresthesia, but the effect of stimulation would be subtherapeutic. The primary outcome was a composite variable of major adverse cardiac events (MACE), which included death from any cause, acute myocardial infarction, or revascularization through 6 months. Fifty-eight (85%) of 68 patients contributed data to the 6-month analysis; analysis was by intention to treat. The proportion of patients experiencing MACE at 6 months did not differ significantly between groups (12.6% in the high-stimulation group and 14.6% in the low-stimulation group; p=0.81). The sample size of this study was small, and it may have been underpowered for clinically meaningful differences.

A small 2011 RCT from Italy randomly assigned 25 patients to 1 of 3 treatment groups: SCS with standard levels of stimulation (n=10), SCS with low-level stimulation (75%-80% of the sensory threshold) (n=7), or very low-intensity SCS (n=8). Thus, patients in groups 2 and 3 were unable to feel sensation during stimulation. After a protocol adjustment at 1 month, patients in the very low-intensity group were re-randomized to one of the other groups after which there were 13 patients in the standard stimulation group and 12 patients in the low-level stimulation group. At the 3-month follow-up (2 months after re-randomization), there were statistically significant between-group differences in 1 of 12 outcome variables. There were a median of 22 angina episodes in the standard stimulation group and 10 in the low-level stimulation group (p=0.002). Nonsignificant variables included use of nitroglycerin, QOL (VAS), Canadian Cardiovascular Society angina class, exercise-induced angina, and 5 subscales of the Seattle Angina Questionnaire.

In another small pilot RCT, conducted to address uncertainties related to recruitment, outcome measures, and care standardization for a larger trial comparing SCS to usual care for refractory angina, enrollment was planned for 45 patients, but the trial failed to meet its enrollment target. Among the 29 patients randomized to SCS (n=15) or usual care (n=14), there were no significant differences in primary or secondary outcomes between groups, but the trial was underpowered.

**Section Summary: Refractory Angina Pectoris**

Numerous small RCTs have evaluated SCS as a treatment for refractory angina. While some studies have reported benefit, most did not. In 2 of the larger, more recent RCTs (>100 patients), there was no benefit on the primary outcomes. Overall, this evidence is mixed and insufficient to allow conclusions on whether health outcomes are improved.

**Heart Failure**

Findings of a small pilot crossover RCT evaluating SCS for heart failure were published in 2014 by Torre-Amione et al. Eligibility included symptomatic heart failure despite optimal medical therapy, left ventricular ejection fraction less than 30%, hospitalization or need for intravenous inotropic support in the past year, and inability to walk more than 450 meters on a 6-minute walk test. All patients had an implanted heart device. Nine patients underwent SCS implantation and received 3 months of active treatment and 3 months of inactive (off position) treatment in random order. There was a 1-month washout period between treatments. The primary outcome was a composite of death, hospitalization for worsening heart failure, and symptomatic bradyarrhythmia or tachyarrhythmia requiring high-voltage therapy. Four patients experienced at least 1 of the events in the composite end point. The events occurred in 2 patients while the device was turned on and
2 while it was turned off. One patient died about 2 months after implantation while the device was turned off. The SCS devices did not interfere with the functioning of implantable cardioverter defibrillators.

In 2016, Zipes et al reported the results of the DEFEAT-HF trial, a prospective, multicenter, single-blind RCT trial comparing SCS with active stimulation to sham control in patients with New York Heart Association functional class III heart failure with a left ventricular ejection fraction of 35% or less. Sixty-six patients were implanted with an SCS and randomized in a 3:2 manner to SCS ON (n=42) or SCS OFF (sham; n=24). For the study’s primary end point (change in left ventricular end systolic volume index from baseline to 6 months), there was no significant difference between groups (p=0.30). Other end points related to heart failure hospitalization and heart failure-related QOL scores and symptoms did not differ significantly between groups. After completion of the 6 month randomization period, all subjects received active SCS stimulation. From baseline to 12 months of follow-up, there were no significant echocardiographic treatment effects in the overall patient population in echocardiographic parameters (p=0.36). The study was originally powered based on a planned enrollment of 195 implanted patients, but enrollment was stopped early due to enrollment futility. The nonsignificant difference between groups may have been the result of underpowering. However, the absence of any treatment effects or between-group differences is further suggestive of a lack of efficacy of SCS for heart failure.

Cancer-Related Pain

In 2013, a Cochrane review (Lihua et al) assessed SCS for treatment of cancer-related pain in adults. The authors did not identify any RCTs evaluating the efficacy of SCS in this population. Four case series using a before-after design (total N=92 patients) were identified. The Cochrane review was updated in 2015 (Peng et al), with no new studies meeting inclusion criteria identified. Peng et al concluded: “Current evidence is insufficient to establish the role of SCS in treating refractory cancer-related pain.”

Potential Adverse Effects

Whereas RCTs are useful for evaluating efficacy, observational studies can provide data on the likelihood of potential complications. In 2011, Mekhail et al published a retrospective review of 707 patients treated with SCS between 2000 and 2005. Patients’ diagnoses included CRPS (n=345 [49%]), FBSS (n=235 [33%]), peripheral vascular disease (n=20 [3%]), visceral pain in the chest, abdomen, or pelvis (n=37 [5%]), and peripheral neuropathy (n=70 [10%]). There was a mean follow-up of 3 years (range, 3 months to 7 years). A total of 527 (36%) of the 707 patients eventually underwent permanent implantation of an SCS device. Hardware-related complications included lead migration in 119 (23%) of 527 cases, lead connection failure in 50 (9.5%) patients, and lead break in 33 (6%) patients. Revisions or replacements corrected the hardware problems. The authors noted that rates of hardware failure have decreased in recent years due to advances in SCS technology. Documented infection occurred in 32 (6%) of 527 patients with implants; there were 22 cases of deep infection, and 18 patients had documented abscesses. There was no significant difference in the infection rate by diagnosis. All cases of infection were managed by device removal.

In 2012, Lanza et al reviewed observational studies on SCS in patients with refractory angina pectoris. The authors identified 16 studies (total N=1204 patients; although they noted that
patients may have been included in >1 report). The most frequently reported complications were lead issues (ie, electrode dislodgement or fracture requiring repositioning) or internal programmable generator (IPG) failure during substitution. Lead issues were reported by 10 studies (total N=450 patients). In these studies, 55 cases of lead or IPG failure were reported. No fatalities related to SCS treatment were reported.

**Ongoing and Unpublished Clinical Trials**

Some currently unpublished trials that might influence this review are listed in Table 1.

### Table 1. Summary of Key Trials

<table>
<thead>
<tr>
<th>NCT No.</th>
<th>Trial Name</th>
<th>Planned Enrollment</th>
<th>Completion Date</th>
</tr>
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<tr>
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<td></td>
</tr>
<tr>
<td>NCT01697358§²</td>
<td>Prospective, Randomized Study of Multicolumn Implantable Lead Stimulation</td>
<td>300</td>
<td>Apr 2016</td>
</tr>
<tr>
<td></td>
<td>for Predominant Low Back Pain</td>
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<tr>
<td>NCT02093793³</td>
<td>A Randomized Controlled Study to Evaluate the Safety and Effectiveness of</td>
<td>406</td>
<td>Oct 2016</td>
</tr>
<tr>
<td></td>
<td>the Precision Spinal Cord Stimulator System Adapted for High-Rate Spinal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cord Stimulation</td>
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| Unpublished    |                                                                           |                    |                 |
| ISRCTN65254102 | The RASCAL study (refractory angina spinal cord stimulation and usual care)| 45                 | Jul 2013        |

ISRCTN: International Standard Randomised Controlled Trial Number; NCT: national clinical trial.

§ Denotes industry-sponsored or cosponsored trial.

### Summary of Evidence

The evidence for standard spinal cord stimulation (SCS) in individuals who have treatment-refractory chronic pain of the trunk or limb includes systematic reviews and randomized controlled trials (RCTs). Relevant outcomes are symptoms, functional outcomes, quality of life, medication use, and treatment-related morbidity. Available RCTs are mixed in terms of the underlying diagnoses in the selected patient populations. However, those that have included patients with underlying neuropathic pain processes have shown a significant benefit with SCS. Systematic reviews have supported the use of SCS to treat refractory trunk or limb pain, and patients who have failed all other treatment modalities have very limited options. The evidence is sufficient to determine qualitatively that the technology results in a meaningful improvement in the net health outcome.

The evidence for high-frequency SCS in individuals who have treatment-refractory chronic pain of the trunk or limbs includes 2 RCTs. Relevant outcomes are symptoms, functional outcomes, quality of life, medication use, and treatment-related morbidity. One RCT comparing high-frequency to standard stimulation found a large and statistically significant benefit associated with high-frequency SCS. In contrast, a smaller study found no benefit for those receiving high-frequency stimulation compared with sham control. Given the uncertainty in these findings, additional trials are needed to corroborate the benefit of high-frequency stimulation. The evidence is insufficient to determine the effects of the technology on health outcomes.

The evidence for SCS in individuals who have critical limb ischemia or refractory angina pectoris or heart failure includes RCTs. Relevant outcomes are overall survival, symptoms, functional outcomes, quality of life, morbid events, hospitalizations, and treatment-related morbidity.
Available RCTs have not consistently demonstrated a benefit associated with SCS treatment. The evidence is insufficient to determine the effects of the technology on health outcomes.

The evidence for SCS in individuals who have cancer-related pain includes no RCTs. Relevant outcomes are symptoms, functional outcomes, quality of life, medication use, and treatment-related morbidity. No RCTs evaluating SCS in this population were identified. The evidence is insufficient to determine the effects of the technology on health outcomes.

**Practice Guidelines and Position Statements**

**International Association for the Study of Pain**
In 2013, the neuropathic pain special interest group of the International Association for the Study of Pain published recommendations on management of neuropathic pain. The interest group issued 2 recommendations on SCS; both were considered weak due to the amount and consistency of the evidence. The recommendations supported the use of SCS for failed back surgery syndrome (FBSS) and for complex regional pain syndrome (CRPS).

**Canadian Pain Society**
In 2012, a special interest group of the Canadian Pain Society published a guideline on interventions for neuropathic pain. The guideline stated that clinicians should consider offering a trial of SCS to patients with FBSS and CRPS who are not surgical candidates and who have failed conservative evidence-based treatments (recommendation based on good evidence with moderate certainty, grade B strength of recommendation). The guideline also stated that clinicians should consider offering a trial of SCS to patients with traumatic neuropathy and brachial plexopathy who are not surgical candidates and have failed conservative evidence-based treatments (recommendation based on fair evidence with moderate certainty, grade C strength of recommendation).

**American Society of Interventional Pain Physicians**
In 2013, the American Society of Interventional Pain Physicians (ASIPP) updated its evidence-based guidelines for interventional techniques in the management of chronic spinal pain. The guidelines included the statement that there is fair evidence in support of SCS in managing patients with FBSS.

An earlier evidence-based guideline from ASIPP found the evidence for SCS in FBSS and CRPS strong for short-term relief and moderate for long-term relief. Reported complications with SCS ranged from infection, hematoma, nerve damage, lack of appropriate paresthesia coverage, paralysis, nerve injury, to death.

**National Institute for Health and Clinical Excellence**
In October 2008, the National Institute for Health and Clinical Excellence issued a guideline on SCS for chronic pain of neuropathic or ischemic origin. The guideline stated that SCS is recommended as a treatment option for adults with chronic pain of neuropathic origin (measuring at least 50 mm on a 0-100 mm visual analog scale) that continues for at least 6 months despite appropriate conventional medical management, and who have had a successful trial of stimulation as part of an assessment by a specialist team.
European Federation of Neurological Societies
In 2007, a task force from the European Federation of Neurological Societies (EFNS) systematically reviewed the evidence and made recommendations on the use of neurostimulation therapy, including SCS, for neuropathic pain. The review identified RCTs of SCS for complex regional pain syndrome and FBSS, and concluded “We found level B evidence for the effectiveness of SCS in FBSS and CRPS I.”

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

Medicare National Coverage
According to Medicare policy, the implantation of central nervous system stimulators may be covered as therapies for the relief of chronic intractable pain, subject to the following conditions:
A. The implantation of the stimulator is used only as a late resort (if not a last resort) for patients with chronic intractable pain;
B. With respect to item A, other treatment modalities (pharmacological, surgical, physical, or psychological therapies) have been tried and did not prove satisfactory, or are judged to be unsuitable or contraindicated for the given patient;
C. Patients have undergone careful screening, evaluation, and diagnosis by a multidisciplinary team prior to implantation (such screening must include psychological, as well as physical evaluation);
D. All the facilities, equipment, and professional and support personnel required for the proper diagnosis, treatment training, and follow-up of the patient (including that required to satisfy item C must be available; and
E. Demonstration of pain relief with a temporarily implanted electrode precedes permanent implantation.

VII. Important Reminder
The purpose of this Medical Policy is to provide a guide to coverage. This Medical Policy is not intended to dictate to providers how to practice medicine. Nothing in this Medical Policy is intended to discourage or prohibit providing other medical advice or treatment deemed appropriate by the treating physician.

Benefit determinations are subject to applicable member contract language. To the extent there are any conflicts between these guidelines and the contract language, the contract language will control.

This Medical Policy has been developed through consideration of the medical necessity criteria under Hawaii’s Patients’ Bill of Rights and Responsibilities Act (Hawaii Revised Statutes §432E-1.4), generally accepted standards of medical practice and review of medical literature and government approval status. HMSA has determined that services not covered under this Medical Policy will not be medically necessary under Hawaii law in most cases. If a treating physician disagrees with HMSA’s determination as to medical necessity in a given case, the physician may request that HMSA reconsider the application of the medical necessity criteria to the case at issue in light of any supporting documentation.
VIII. References