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Position Statement	Billing/Coding	Reimbursement	Program Exceptions	Definitions	Related Guidelines
Other	References	Updates			

DESCRIPTION:

Percutaneous electrical nerve stimulation (PENS) is similar in concept to transcutaneous electrical nerve stimulation, but differs in that needles are inserted either around or immediately adjacent to the nerves serving the painful area, and then stimulated. PENS is generally reserved for those who fail to get pain relief from transcutaneous electrical nerve stimulation. PENS is also distinguished from acupuncture with electrical stimulation. In electrical acupuncture, needles are also inserted just below the skin, but the placement of needles is based on specific theories regarding energy flow throughout the human body. In PENS, the location of stimulation is determined by proximity to the pain.

Percutaneous neuromodulation therapy (PNT) is a variant of PENS in which fine filament electrode arrays are placed near the area causing pain. Some use the terms PENS and PNT interchangeably. It is proposed that PNT inhibits pain transmission by creating an electrical field that hyperpolarizes C fibers, thus preventing action potential propagation along the pain pathway.

Another type of neuromodulation, peripherally implanted nerve stimulators (also known as peripheral subcutaneous field stimulation, or peripheral nerve field stimulation) purport to treat chronic pain by targeting the peripheral nerve causing the chronic pain directly. An electrical current is transmitted via an electrode that has been implanted around the selected peripheral nerve. It is thought the electrical current blocks or disrupts the normal transmission of pain signals. The electrodes are connected by a wire to the peripherally implanted neurostimulator. An external generator (similar to a remote control device) controls the degree of stimulation the individual receives.

Percutaneous electrical nerve field stimulation (PENFS) (auricular neurostimulation) targets branches of cranial Nerves V, VII, IX and X, and the occipital nerves. It has been proposed as a treatment for functional abdominal pain associated with irritable bowel syndrome (IBS) in children and adolescents (IB-Stim®); treatment of pain associated with opioid withdrawal (Bridge, Drug Relief V1, Morph Device);

treatment of chronic intractable pain due to diabetic peripheral neuropathy (First Relief); post-cesarean section pain (Primary Relief); and treatment of pain after cardiac surgery (Primary Relief).

Remote electrical neuromodulation (REN) is purported to offer an alternative to pharmacologic interventions for acute migraine and/or prevention of migraines. The Nerivio® REN device is cleared for use by the Food and Drug Administration (FDA) and is worn on the upper arm. It stimulates the peripheral nerves to induce conditioned pain modulation (CPM). The conditioned pain in the arm induced by the Nerivio REN device is believed to reduce the perceived migraine pain intensity. Control of the REN device is accomplished through Bluetooth communication between the device and a smartphone or tablet. For acute treatment, at onset of migraine or aura and no later than within 1 hour of onset, the user initiates use of the device through their mobile application. When used for preventive treatment, the device should be used every other day, controlled by the individual through their smartphone or tablet application.

Restorative neurostimulation is described as a novel form of stimulation for refractory chronic mechanical low back pain (CLBP), targeting impaired neuromuscular control and degeneration of the multifidus muscle. The ReActiv8® Restorative Neurostimulation System targets underlying multifidus muscle dysfunction by delivering electrical pulses through proprietary self-anchoring lead technology placed adjacent to the medial branch of the dorsal ramus.

Summary and Analysis of Evidence: Beltran-Alacreu et al (2022) evaluated the effectiveness of PENS compared to transcutaneous electrical nerve stimulation (TENS) on the reduction of musculoskeletal pain. This systematic review and meta-analysis included a total of 9 RCTs in the qualitative analysis, with 7 in the quantitative analysis. Overall, there was low-quality evidence for increased pain intensity reduction with PENS over TENS, but the difference found was not deemed to be clinically significant. When only studies with low risk of bias were meta-analyzed, there was a moderate quality of evidence that there is no difference between TENS and PENS for pain intensity. Six out of the 9 studies presented high risk for the blinding of participants, and 7 out of 9 were high risk for blinding of personnel. Beyond these 2 items, the risk of bias in the included trials was either low or unclear. Protocols and parameters for the application of PENS and TENS were heterogenous across all trials.

In 2013, the National Institute for Health and Care Excellence (NICE) published guidance on PENS (Percutaneous electrical nerve stimulation for refractory neuropathic pain [IPG450]). It concluded that “current evidence on the safety of [PENS] for refractory neuropathic pain raises no major safety concerns and there is evidence of efficacy in the short term.”

Yokoyama et al (2004) compared percutaneous electrical nerve stimulation (PENS) with transcutaneous electrical nerve stimulation (TENS) for long-term pain relief in chronic low back pain. The authors concluded “(a) cumulative analgesic effect was observed in patients with chronic low back pain (LBP) after repeated percutaneous electrical nerve stimulation (PENS), but this effect gradually faded after the treatment was terminated. Results indicate that although PENS is effective for chronic LBP, treatments need to be continued to sustain analgesia.”

Schwab et al (2025) reported outcomes of the RESTORE trial. Candidates were assessed for CLBP associated with multifidus dysfunction, with no indication for or history of lumbar spine surgery. The primary endpoint was a comparison of the mean change in the Oswestry Disability Index (ODI) between the treatment and control arms at 1 year, and secondary endpoints included pain (numeric rating scale [NRS]) and health-related quality of life (EuroQol Five-Dimension [EQ-5D-5L]). A total of 203 patients,

average age 47 years, and with an average 11-year history of low back pain, were included in the analysis. The primary endpoint was a statistically significant demonstration of a clinically relevant mean improvement in the Oswestry Disability Index (ODI) between restorative neurostimulation and OMM arms. Additionally, improvements in both the numeric rating scale and EuroQol Five-Dimension were statistically and clinically significant in the restorative neurostimulation arm compared to the OMM arm. The authors concluded that the RESTORE trial “demonstrates that restorative neurostimulation is a safe, reversible, clinically effective, and highly durable option for patients suffering with nonoperative CLBP associated with multifidus dysfunction”. The authors further states the RESTORE trial has several limitations: “Participants in this trial were not blinded to their treatment, and as a result, those randomized to the control arm may have experienced a nocebo effect underestimating the clinical effect of OMM medical management. In addition, patients in the treatment arm may have experienced a placebo effect after being randomized to interventional treatment. Both of these effects were anticipated and contributed to the rationale for the timing of the 1-year primary endpoint. This timing allows for their impact to subside and for the full effects of OMM or restorative neurostimulation to accrue. The additional attention and monitoring afforded to patients in the treatment arm of this RCT were above standard management protocols for restorative neurostimulation. These additional clinical contact points may have resulted in consideration of additional interventions, artificially inflating healthcare utilization in the short term above what may typically be expected. The effect of longer follow-up on interventions will be reported in due course.”

James, Ahern et al (2025) investigated whether targeted muscle activation via neurostimulation reverses or resolves muscle spindle fibrosis in a model of IVD injury. In eighteen sheep, lumbar L1–2 and L3–4 IVD degeneration was induced by partial thickness anulus fibrosis incision and a neurostimulator was implanted. After IVD-degeneration developed for 3 months, neurostimulation of the L2 nerve root activated multifidus in nine randomly selected animals. Multifidus muscle adjacent to the spinous process of L2 (non-stimulated) and L4 (stimulated) was harvested 3 months after activation. Muscle spindles were identified in Van Giessen’s-stained sections. Connective tissue spindle capsule thickness, and cross-sectional area (CSA) of the spindle, its periaxial fluid and sensory elements were measured. Immunofluorescence assays evaluated Collagen-I and -III. Multifidus muscle spindle capsule thickness and Collagen-1 were significantly less in the neurostimulation animals than IVD-injury animals at L4 (stimulated muscle), but not L2 (non-stimulated muscle). Spindle capsule thickness was less in lateral than medial regions. CSA of the muscle spindle and sensory elements was less in neurostimulated animals at L4. The authors concluded “targeted multifidus activation reverses or prevents accumulation of connective tissue of the multifidus muscle spindle capsule caused by IVD injury. Reduced fibrosis should maintain sensory function of this important muscle mechanoreceptor and might provide an effective solution to resolve the commonly identified proprioceptive deficits in back pain and maintain healthy spine function.” Several methodological considerations were noted, including infection at the site of the battery insertion in several animals; no animals without IVD injury were included in this study; no direct measure of the consequence of thickening on spindle mechanics and sensitivity; and no available data to make direct comparison between human and sheep multifidus muscles.

Gilligan, Volschenk (2024) conducted a prospective five-year longitudinal follow-up of the ReActiv8-B pivotal trial, participants (N = 204) had activity-limiting, moderate-to-severe, refractory, mechanical chronic low back pain, a positive prone instability test result indicating impaired multifidus muscle control, and no indications for spine surgery. Low back pain intensity (10-cm visual analog scale [VAS]),

disability (Oswestry Disability Index), and quality of life (EuroQol's "EQ-5D-5L" index) were compared with baseline and following the intent-to-treat principle, with a supporting mixed-effects model for repeated measures that accounted for missing data. At five years (n = 126), low back pain VAS had improved from 7.3 to 2.4 cm, and 71.8% of participants had a reduction of $\geq 50\%$. The Oswestry Disability Index improved from 39.1 to 16.5, and 61.1% of participants had reduction of ≥ 20 points. The EQ-5D-5L index improved from 0.585 to 0.807. Although the mixed-effects model attenuated completed-case results, conclusions and statistical significance were maintained. Of 52 subjects who were on opioids at baseline and had a five-year visit, 46% discontinued, and 23% decreased intake. The safety profile compared favorably with neurostimulator treatments for other types of back pain. No lead migrations were observed. The authors concluded that "over a five-year period, restorative neurostimulation provided clinically substantial and durable benefits with a favorable safety profile in patients with refractory chronic low back pain associated with multifidus muscle dysfunction." Potential study limitations included that owing to elective cross-over to therapeutic stimulation for ethical and trial-practical considerations, the sham-control group could not be maintained during the long-term follow-ups; device removals for various reasons, including 18 participants who underwent elective removals for resolution of symptoms (ie, success), contributed to participant withdrawals and subsequent missing data, and direct correlations with objective device usage and multifidus structure and function were not included in this follow-up.

Restorative neurostimulation therapy with the ReActiv8 system was evaluated in a multicenter, sham controlled RCT enrolling 204 individuals with chronic, refractory low back pain (ReActiv8-B, NCT02577354). Control group participants received treatment with the ReActiv8 system set to deliver low-level stimulation. The primary endpoint was the difference in proportions of responders in the treatment and control groups. Response was defined as the composite of 30% or greater reduction in VAS and no increase in pain medications, assessed at 120 days. At 120 days, there was no difference between groups on the primary endpoint of treatment response or the individual components of the primary endpoint. The controlled phase was only 120 days. In the longer-term, uncontrolled follow-up phase of the trial, there was continued improvement in VAS scores over time in those who were assessed, but the lack of a control group and high attrition limits drawing conclusions from these results. Data was available for 86.3% of participants at 1 year, 79% of participants at 2 years, and 63.7% of participants at 3 years. An uncontrolled follow-up phase of the RCT reported continued improvement in pain scores through 3 years but results are at high risk of bias due to lack of a control group and high attrition.

In September 2022, NICE published guidance on neurostimulation of lumbar muscles (Neurostimulation of lumbar muscles for refractory non-specific chronic low back pain [IPG739]) with the ReActiv8 system for refractory non-specific chronic low back pain. The guidance was based on a rapid review conducted in July 2021 and included the following statements "evidence on the efficacy and safety of neurostimulation of lumbar muscles for refractory non-specific chronic low back pain is limited in quantity and quality. Therefore, this procedure should only be used with special arrangements for clinical governance, consent, and audit or research." It also stated that "(f)urther research should include suitably powered randomized controlled trials comparing the procedure with current best practice with appropriate duration. It should report details of patient selection and long-term outcomes."

Ardeshiri et al (2024) examined the effect of restorative neurostimulation in an older demographic using data from three clinical studies: ReActiv8-B (prospectively followed 204 patients); ReActiv8-C

(prospectively followed 87 patients); and ReActiv8-PMCF (prospectively followed 42 patients). Two hundred and sixty-one patients were identified with complete 2-year follow-up and divided into cohorts of equal size based on age quartiles. The oldest quartile (n=65) had a median age of 60 (56-82) years compared with the entire population (n=261) who had a median age of 49 (22-82) years. The complete analysis on patients with 2 years of continuous data showed improvement of a 50% in pain was achieved by 62% and 65% and a 15-point ODI improvement in 48% and 60% in the oldest quartile and entire population, respectively. Author-noted limitations of this study include the small cohort of patients identified in the upper age group and the retrospective identification of the cohorts. Pain was collected differently between studies enabling a responder rate analysis only and no direct assessment of mean change from baseline. The inclusion and exclusion criteria for the various studies used in this analysis did vary slightly, however, the identification of these patients was achieved by applying the minimum requirements for inclusion for all patients.

Wong et al (2023) conducted an evidence review on the effectiveness of peripheral nerve field stimulation on chronic low back pain and persistent spinal pain syndrome. A total of 15 studies were included, including 4 randomized controlled trials (RCTs), 9 observational studies, and 2 case series. For patients receiving PNFS, a significant decrease in back pain intensity and analgesic consumption, together with a significant improvement in physical functioning, was observed upon implant of the permanent system. The authors stated “PNFS, when used alone or in combination with SCS, appears to be effective in managing back pain. However, high-quality evidence that supports the long-term analgesic efficacy and safety is still lacking. Hence, RCTs with a larger patient population and of a longer follow-up duration are warranted.” In 2013, NICE issued guidance on peripheral subcutaneous field stimulation for chronic low back pain (Peripheral nerve-field stimulation for chronic low back pain [IPG451]), which stated “(c)urrent evidence on the efficacy of peripheral nerve-field stimulation for chronic low back pain is limited in both quantity and quality, and duration of follow-up is limited. Evidence on safety is also limited and there is a risk of complications from any implanted device.

Kalia et al (2025) conducted a retrospective observational study (9/1/19-1/31/23) of patients from the Nalu medical database to the OM1 Real-World Data Cloud (RWDC). Eligible patients received the micro-IPG implant for PNS, were identifiable in both databases, and had ≥ 12 months of RWDC pre/post-implantation claims data. Primary outcomes were all-cause HCRU and medical costs (12 months pre- and post-implantation); secondary outcomes were all-cause pharmacy costs, including opioids, over the same time. Patients (N = 122) had a higher mean number of outpatient visits pre-implantation than post-implantation. Post-implantation, the proportion of patients using opioids was 31.4% lower. The authors concluded that “PNS using the micro-IPG had reduced HCRU, costs, and opioid use.” This study included several limitations, including a relatively small sample size with no formal statistical testing implemented due to the relatively recent introduction of the micro-IPG to the market (2019); missing data made it difficult to characterize this population in reference to the general population of patients with severe intractable chronic pain of peripheral nerve origin; patients with a cancer diagnosis were excluded, for example, because it is common for oncology patients to receive regular MRIs, and because patients with earlier PNS implants cannot receive MRIs, cancer centers do not currently treat patients with PNS. In addition, missing data included limits on available race and ethnicity (missing for approximately two-thirds of patients) and BMI and smoking status (unknown for $\geq 90\%$). It is also not known whether or to what extent the COVID-19 pandemic influenced patient healthcare utilization and therefore the results of this study in 2020 and 2021.

Hatheway et al (2024) reported the results from the first large, postmarket, multicentre, randomised controlled trial (RCT) evaluating peripheral nerve stimulation (PNS) for the treatment of chronic peripheral pain with a micro-implantable pulse generator (micro-IPG). Subjects meeting eligibility were randomised (2:1) to either the active arm receiving PNS and conventional medical management (CMM) or the control arm receiving CMM alone. Treatments were limited to the following areas: lower back, shoulder, knee and foot/ankle. At 6 months, the active arm achieved an 88% responder rate with a 70% average reduction in pain. At the 3-month primary endpoint, the active arm achieved an 84% responder rate with an average pain reduction of 67% compared with the control arm, which achieved a 3% responder rate with an average pain reduction of 6%. Both responder rate and pain reduction in the active arm were significantly better than in the control arm. A majority of patient-reported outcomes also reached statistical significance. There were no reports of pocket pain and no serious adverse device effects. 81% of subjects found the external wearable component of the PNS system to be comfortable. The authors concluded that this study “successfully reached its primary endpoint-the active arm achieved a statistically significant superior responder rate as compared with the control arm at 3 months. These RCT results demonstrated that PNS, with this micro-IPG, is efficacious and safe. This ongoing study will follow subjects for 3 years, the results of which will be reported as they become available.” Limitations of this study included that the control arm remained in CMM only for 3 months; a longer period was considered but was thought to be ethically problematic for those subjects with significant pain; in addition, the prevalence of females (70%) over males was unanticipated, but the randomization addressed potential bias, and this reflected the real-world population at the clinical sites.

McRoberts et al (2013) compared different methods of peripheral subcutaneous field stimulation. Among trial participants, 24 of 30 patients had at least a 50% reduction in pain with any type of peripheral subcutaneous field stimulation. However, because the RCT did not include a sham group or comparator with a different active intervention, this trial offers little evidence for efficacy beyond that of a prospective, uncontrolled study. Another RCT (Johnson et al, 2021) compared sham to external non-invasive peripheral electrical nerve stimulation, but found no significant differences in pain scores between groups after intervention. A third small, pilot RCT (Ilfeld et al, 2021) found significantly reduced opioid consumption and mean daily pain scores within the first 7 postoperative days in subjects receiving foot, ankle, knee, or shoulder surgery. However, differences in average pain, worst pain, and Defense and Veterans Pain Rating Scale scores were not significantly different between treatment and sham groups following completion of the treatment period on postoperative days 15 and 30. A fourth small, pilot feasibility RCT (Albright-Trainer et al, 2022) compared peripheral nerve stimulation with standard medical care to standard medical care alone in veterans undergoing lower extremity amputation. Greater reductions in average phantom limb pain, residual limb pain, and daily opioid consumption were reported through 3 months with the addition of peripheral nerve stimulation. Case series are insufficient to evaluate patient outcomes due to the variable nature of pain and the subjective nature of pain outcome measures. Larger, prospective controlled trials comparing peripheral subcutaneous field stimulation with placebo or alternative treatment modalities are needed to determine the efficacy of peripheral subcutaneous field stimulation for chronic pain.

There are few pharmacologic treatment options for children and adolescents with IBS. Non-pharmacologic options are commonly explored. Percutaneous electrical nerve field stimulation (PENFS) (auricular neurostimulation) is a potential treatment option for these individuals. The evidence for PENFS with IB Stim® includes 2 randomized, double-blind, sham-controlled trials. PENFS has proven to be an

effective and safe treatment for children and adolescents with functional abdominal pain disorders. PENFS with IB-Stim® showed an 81% improvement in overall symptoms, and approximately 59% of test subjects showed at least a 30% reduction in their worst pain (Kovacik et al, 2017; Krasaelap et al, 2020). The evidence for PENFS (auricular neurostimulation) for all other indications is insufficient.

UpToDate review “Acute treatment of migraine in adults” (Schwedt, Garza, 2025) states, “Data from several trials suggest that a <remote electrical neuromodulation> device applying nonpainful electrical skin stimulation can reduce acute migraine pain. In a sham-controlled crossover pilot trial of 71 patients, the proportion of responders was higher with active stimulation compared with sham stimulation.” Mild device-associated adverse events occurred in approximately 4 percent and included a warm sensation, arm or hand numbness, redness, itching, tingling, muscle spasm, arm pain, shoulder pain, and neck pain. There were no serious adverse events. UpToDate review “Preventive treatment of episodic migraine in adults” (Schwedt, Garza, 2025) states, “In a placebo-controlled trial of 248 patients with migraine, patients assigned to remote electrical neuromodulation had a greater reduction in the baseline number of monthly migraine days at 12 weeks than those assigned sham stimulation. Additional studies are needed to confirm these findings and clarify the potential role of this modality for migraine treatment.” UpToDate review “Preventive treatment of migraine in children” (Mack, 2024) states, “(i)n an observational study of 83 adolescents who used the <REN> device at least 10 days a month, REN was associated with a reduction in monthly migraine treatment days from 12.6 days in the first treatment month to 7.4 days in the third month.”

For individuals with acute migraine due to episodic or chronic migraine who receive remote electrical neuromodulation (REN), the evidence includes 2 randomized controlled trials (RCTs) and nonrandomized, uncontrolled studies. Use of an active REN device resulted in more patients with improved pain and symptoms at 2-hour follow-up compared with a sham device based on 2 RCTs (N=212) with numerous relevance limitations. Based on the existing evidence, it is unclear how Nerivio would fit into the current acute migraine management pathway. No significant between-group difference in functional disability or quality of life was noted in a post hoc analysis of the pivotal RCT. Additionally, controlled studies in adolescent and pediatric populations are lacking. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For adult individuals who may benefit from preventive migraine therapy, including those with frequent or long lasting episodic or chronic migraines, migraine attacks that diminish quality of life or cause significant disability despite acute treatment, contraindications to or failure of acute therapies, and risk of medication overuse headache, who receive REN, the evidence includes 1 RCT and 1 prospective, observational study. Use of an active REN device resulted in more adults with decreased migraine days per month, regardless of episodic or chronic subtype, when used every other day for 8 weeks compared with a sham device based on 1 RCT (N=248). Prospective, observational data in 2 real world evidence studies using the device for acute treatment of migraine demonstrated a significant reduction in migraine headache days from baseline to months 2 and 3 with device use in adolescent patients. Based on the existing evidence, it is unclear how Nerivio would fit into the current migraine prevention pathway, although it could provide benefit for those who do not receive adequate benefit from pharmacologic first- or second-line therapies, or who may have a contraindication to pharmacologic therapies. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For adolescent individuals who may benefit from preventive migraine therapy who receive REN, the evidence includes data from the summary submitted in the FDA approval packet and 1 RWE analysis. The data in the FDA summary were collected from adolescents who used the device for acute migraine treatment, but use was equivalent to the suggested preventive use (10 times per month or higher). There was substantial reduction from baseline during months 2 and 3 of device use. This data is limited by a lack of comparator and no description of medications or alternative interventions patients were additionally using. A prospective, real-world evidence analysis investigated the use of Nerivio in adolescents over a 3 month period. There was a statistically significant monthly reduction in mean monthly migraine treatment days. Well-defined, controlled studies are required to confirm benefit in this population. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome. For children who may benefit from preventive migraine therapy who receive REN, the evidence includes the FDA summary for the expanded approval of preventive use of Nerivio in pediatric patients (ages 8-11) based on a retrospective real-world analysis. Preventive use of the device was assumed by analyzing patients whose frequency of use in month one was suggestive of preventive treatments. No specific data on proportion of patients in whom preventive use was assumed or efficacy outcomes in the assumed preventive use population were reported. Well-defined, controlled studies are required to confirm benefit in this population. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

POSITION STATEMENT:

Percutaneous electrical nerve stimulation/percutaneous neuromodulation **meets the definition of medical necessity** when **ALL** of the following are met:

- Pain relief from TENS was not obtained due to presence of physical barriers to electrical conduction (e.g., obesity, scar tissue)
- Used for a trial period of 7 days to test the effectiveness of electrical stimulation (by PENS/PNS) to relieve pain*
- Used for one of the following:
 - Pain related to musculoskeletal conditions
 - Pain associated with active injury
 - Pain associated with post-trauma injury

***NOTE:** This diagnostic procedure involves stimulation of peripheral nerves by a needle electrode inserted through the skin. If pain is effectively controlled by percutaneous stimulation, implantation of electrodes is warranted.

Percutaneous peripheral implantable nerve stimulators, including but not limited to the Freedom Peripheral Nerve Stimulator (previously the StimQ PNS), Nalu Peripheral Neurostimulation System, Neuspera Nuity Neurostimulation System (NNS), the StimRouter Neuromodulation System, and the Sprint PNS System are considered **experimental or investigational**. Data in published medical literature are inadequate to permit scientific conclusions on long-term and net health outcomes.

Remote Electrical Neuromodulation (REN) (e.g., Nerivio®)

Acute treatment

Remote electrical neuromodulation for acute migraine is considered **experimental or investigational**. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

Preventive treatment: Initiation of Use

Remote electrical neuromodulation (REN [e.g. Nerivio]) for the prevention of migraine **meets the definition of medical necessity** in individuals when the following criteria are met:

- Individual is 18 years of age or older; **AND**
- Headaches meet the International Classification of Headache Disorders (ICHD-3) diagnostic criteria for migraine with or without aura; **AND**
- The REN device will be used in the following clinical scenario:
 - For the prevention of migraine in individuals with 6 to 24 headache days (defined as a calendar day with headache regardless of severity or duration) per 28-day period in each of the 3 months preceding use of the REN device); **AND**
 - 1 of the following additional criteria must also be met:
 - Insufficient response, contraindication, or intolerance to 2 or more guideline-recommended preventive headache medications (e.g., anticonvulsants, antihypertensives, antidepressants, CGRP inhibitors); **OR**
 - Pregnancy, breastfeeding, or planning to conceive; **OR**
 - At risk for or have a history of medication overuse headache; **OR**
 - At risk for drug-drug interactions with medications for comorbid conditions.

Preventive treatment: Continuation of Use

Continued use of the REN device and/or accessories for the prevention of migraine is **meets the definition of medical necessity** in individuals when the following criteria are met:

- Compliance with ongoing use; **AND**
- Documentation of clinical benefit*.

Remote electrical neuromodulation for prevention of migraine outside of the above criteria is considered **experimental or investigational**. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

Note: Nerivio is contraindicated in patients with uncontrolled epilepsy and patients with an active implantable medical device, such as a pacemaker, hearing aid implant, or any implanted electronic device. Nerivio has not been evaluated in patients with congestive heart failure, severe cardiac or cerebrovascular disease, pregnancy, or patients under the age of 8 years.

*Documentation of clinical benefit for continuation of use may include a clinician attestation regarding any of the following outcomes:

- Improvements in pain relief or freedom, particularly for acute use;
- Reduction in headache frequency, duration, or severity;
- Reduction in functional disability;
- Reduction in absenteeism;

- Reduction in concomitant headache medications.

Based on observed outcomes of pivotal studies of Nerivio and study duration recommendations from the International Headache Society concerning migraine neuromodulation trial designs, assessment for clinical benefit is reasonable after a minimum of 8-12 weeks for preventive treatment.

Restorative neurostimulation (e.g., ReActiv8® Restorative Neurostimulation System) is considered **experimental or investigational**. There is a lack of clinical scientific evidence published in peer-reviewed literature to permit conclusions on safety and efficacy.

Percutaneous electrical nerve field stimulation (PENFS) with IB-STIM® **meets the definition of medical necessity** in children and adolescents when **ALL** of the following are met:

- Age 8-21
- Diagnosed with a ROME IV criteria* defined-functional gastrointestinal disorder (functional abdominal pain, functional abdominal pain syndrome, irritable bowel syndrome, functional dyspepsia, or abdominal migraine) with symptoms present for at least 3 months
- Organic gastrointestinal disease (e.g., neoplasm, infection, etc.) has been ruled out
- Failed treatment with diet modification and probiotics
- Failed at least 3 months of treatment with acid suppressors**, antispasmodics***, and neuromodulators****
- Device will be used up to 120 hours per week, up to 3 consecutive weeks, not to exceed 4 weeks
- Will be applied to healthy, intact skin
- None of the following contraindications are present:
 - Cardiac pacemakers
 - Hemophilia
 - Psoriasis vulgaris

****Acid suppression** (includes H2-blockers and PPIs)

*****Antispasmodics** (includes hyoscyamine, dicyclomine erythromycin/linaclootide, prucalopride)

******Neuromodulators** (includes amitriptyline/nortriptyline/gabapentin)

Percutaneous electrical nerve field stimulation (PENFS) for all other indications is considered **experimental or investigational**. There is insufficient published clinical evidence to support safety and effectiveness.

***ROME Foundation**

ROME IV Diagnostic Criteria Disorders of Gut-Brain Interaction (DGBI)

<p>H. CHILDHOOD FUNCTIONAL GI DISORDERS: CHILD/ADOLESCENT</p>
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H2. FUNCTIONAL ABDOMINAL PAIN DISORDER

H2a. Functional Dyspepsia

Diagnostic criteria:

Must include one or more of the following bothersome symptoms at least 4 times a month for at least 2 months prior to diagnosis:

1. Postprandial fullness
2. Early satiation
3. Epigastric pain or burning not associated with defecation
4. After appropriate evaluation, the symptoms cannot be fully explained by another medical condition

Functional dyspepsia subtypes:

H2a1. Postprandial distress syndrome includes bothersome postprandial fullness or early satiation which prevents finishing a regular meal. Supportive features include upper abdominal bloating, postprandial nausea, or excessive belching.

H2a2. Epigastric pain syndrome which includes all of the following: bothersome (severe enough to interfere with normal activities) pain or burning localized to the epigastrium. The pain is not generalized or localized to other abdominal or chest regions and is not relieved by defecation or passage of flatus. Supportive criteria can include (a) burning quality of the pain but without a retrosternal component, and (b) commonly induced or relieved by ingestion of a meal but may occur while fasting.

H2b. Irritable Bowel Syndrome

Diagnostic criteria:

Must include abdominal pain at least 4 days per month over at least 2 months associated with one or more of the following:

1. Related to defecation
2. A change in frequency of stool
3. A change in form (appearance) of stool
4. In children with abdominal pain and constipation, the pain does not resolve with resolution of the constipation (children in whom the pain resolves have functional constipation, not IBS)
5. After appropriate evaluation, the symptoms cannot be fully explained by another medical condition
6. *Criteria fulfilled for at least 2 months prior to diagnosis

H2c. Abdominal Migraine

Diagnostic criteria:

Must include all of the following occurring at least twice:

1. Paroxysmal episodes of intense, acute periumbilical, midline or diffuse abdominal pain lasting 1 hour or more (should be the most severe and distressing symptom)
2. Episodes are separated by weeks to months
3. The pain is incapacitating and interferes with normal activities
4. Stereotypical pattern and symptoms in the individual patient
5. The pain is associated with two or more of the following:
 - Anorexia
 - Nausea
 - Vomiting
 - Headache
 - Photophobia
 - Pallor
6. After appropriate evaluation, the symptoms cannot be fully explained by another medical condition
7. *Criteria fulfilled for at least 6 months prior to diagnosis

H2d. Functional Abdominal Pain – Not Otherwise Specified

Diagnostic criteria:

Must be fulfilled at least 4 times per month and include all of the following:

1. Episodic or continuous abdominal pain that does not occur solely during physiologic events (e.g., eating, menses)
2. Insufficient criteria for irritable bowel syndrome, functional dyspepsia, or abdominal migraine
3. After appropriate evaluation, the abdominal pain cannot be fully explained by another medical condition
4. *Criteria fulfilled for at least 2 months prior to diagnosis

BILLING/CODING INFORMATION:

CPT Coding

64555	Percutaneous implantation of neurostimulator electrode array; peripheral nerve (excludes sacral nerve)
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64567	Percutaneous electrical nerve field stimulation, cranial nerves, without implantation
64596	Insertion or replacement of percutaneous electrode array, peripheral nerve, with integrated neurostimulator, including imaging guidance, when performed; initial electrode array
64597	Insertion or replacement of percutaneous electrode array, peripheral nerve, with integrated neurostimulator, including imaging guidance, when performed; each additional electrode array (List separately in addition to code for primary procedure)
64598	Revision or removal of neurostimulator electrode array, peripheral nerve, with integrated neurostimulator

HCPCS Coding

A4540	Distal transcutaneous electrical nerve stimulator, stimulates peripheral nerves of the upper arm
C9807	Nerve stimulator, percutaneous, peripheral (e.g., Sprint peripheral nerve stimulation system), including electrode and all disposable system components, non-opioid medical device (must be a qualifying medicare non-opioid medical device for post-surgical pain relief in accordance with section 4135 of the caa, 2023) (investigational)
L8678	Electrical stimulator supplies (external) for use with implantable neurostimulator, per month (investigational)

LOINC Codes:

The following information may be required documentation to support medical necessity: physician history and physical, physician progress notes, treatment plan, radiology report(s) and diagnostic studies.

Documentation Table	LOINC Codes	LOINC Time Frame Modifier Code	LOINC Time Frame Modifier Codes Narrative
Physician history and physical	28626-0	18805-2	Include all data of the selected type that represents observations made six months or fewer before starting date of service for the claim
Attending physician visit note	18733-6	18805-2	Include all data of the selected type that represents observations made six months or fewer before starting date of service for the claim.
Treatment plan	18776-5	18805-2	Include all data of the selected type that represents observations made six months or fewer before starting date of service for the claim.
Radiology report	18726-0	18805-2	Include all data of the selected type that represents observations made six months or fewer before starting date of service for the claim

Diagnostic studies (non-lab)	27899-4	18805-2	Include all data of the selected type that represents observations made six months or fewer before starting date of service for the claim.
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REIMBURSEMENT INFORMATION:

Refer to section entitled **POSITION STATEMENT**.

PROGRAM EXCEPTIONS:

Federal Employee Program (FEP): Follow FEP guidelines.

State Account Organization (SAO): Follow SAO guidelines.

Medicare Advantage products: The following National Coverage Determination (NCD) was reviewed on the last guideline reviewed date: Treatment of Motor Function Disorders with Electric Nerve Stimulation (160.2); Electrical Nerve Stimulators (160.7); and Assessing Patient's Suitability for Electrical Nerve Stimulation Therapy (160.7.1), located at cms.gov.

If this Medical Coverage Guideline contains a step therapy requirement, in compliance with Florida law 627.42393, members or providers may request a step therapy protocol exemption to this requirement if based on medical necessity. The process for requesting a protocol exemption can be found at Coverage Protocol Exemption Request.

DEFINITIONS:

None applicable.

RELATED GUIDELINES:

Transcutaneous Electric Nerve Stimulation (TENS), 02-61000-04

OTHER:

None applicable.

REFERENCES:

1. Ailani J, Burch RC, Robbins MS; Board of Directors of the American Headache Society. The American Headache Society Consensus Statement: Update on integrating new migraine treatments into clinical practice. Headache. 2021 Jul;61(7):1021-1039. doi: 10.1111/head.14153. Epub 2021 Jun 23.
2. Ailani J, Rabany L, Tamir S, Ironi A, Starling A. Real-World Analysis of Remote Electrical Neuromodulation (REN) for the Acute Treatment of Migraine. Front Pain Res (Lausanne). 2022 Jan 18;2:753736. doi: 10.3389/fpain.2021.753736.

3. Albright-Trainer B, Phan T, Trainer RJ, Crosby ND, Murphy DP, Disalvo P, Amendola M, Lester DD. Peripheral nerve stimulation for the management of acute and subacute post-amputation pain: a randomized, controlled feasibility trial. *Pain Manag.* 2022 Apr;12(3):357-369. doi: 10.2217/pmt-
4. Ardeshiri A, Amann M, Thomson S, Gilligan CJ. Application of restorative neurostimulation for chronic mechanical low back pain in an older population with 2-year follow up. *Reg Anesth Pain Med.* 2025 Mar 5;50(3):231-236. doi: 10.1136/rapm-2023-105032.
5. Ardeshiri A, Shaffrey C, Stein KP, Sandalcioğlu IE. Real-World Evidence for Restorative Neurostimulation in Chronic Low Back Pain-a Consecutive Cohort Study. *World Neurosurg.* 2022 Dec;168:e253-E259. doi: 10.1016/j.wneu.2022.09.104.
6. Babaei M, Rapoport AM. Device profile of Nerivio for the acute and preventive treatment of episodic or chronic migraine in patients 12 years and older. *Expert Rev Med Devices.* 2023 Jun;20(6):433-447. doi: 10.1080/17434440.2023.2202815. Epub 2023 May 15. PMID: 37042425.
7. Babygirija R, Sood M, Kannampalli P, Sengupta JN, Miranda A. Percutaneous electrical nerve field stimulation modulates central pain pathways and attenuates post-inflammatory visceral and somatic hyperalgesia in rats. *Neuroscience.* 2017 Jul 25;356:11-21. doi: 10.1016/j.neuroscience.2017.05.012. Epub 2017 May 17.
8. Beltran-Alacreu H, Serrano-Muñoz D, Martín-Caro Álvarez D, Fernández-Pérez JJ, Gómez-Soriano J, Avendaño-Coy J. Percutaneous Versus Transcutaneous Electrical Nerve Stimulation for the Treatment of Musculoskeletal Pain. A Systematic Review and Meta-Analysis. *Pain Med.* 2022 Aug 1;23(8):1387-1400. doi: 10.1093/pm/pnac027.
9. Blue Cross Blue Shield Association Evidence Positioning System®. 1.01.31 - Implantable Peripheral Nerve Stimulation for Chronic Pain Conditions, 08/25.
10. Blue Cross Blue Shield Association Evidence Positioning System®. 2.01.106 - Percutaneous Electrical Nerve Field Stimulation for Irritable Bowel Syndrome, 11/25.
11. Blue Cross Blue Shield Association Evidence Positioning System®. 7.01.29 - Percutaneous Electrical Nerve Stimulation, Percutaneous Neuromodulation Therapy, and Restorative Neurostimulation Therapy, 07/25.
12. Blue Cross Blue Shield Association Evidence Positioning System®. 7.01.139 - Peripheral Subcutaneous Field Stimulation, 05/25.
13. Blue Cross Blue Shield Association Evidence Positioning System®. 7.01.171 - Remote Electrical Neuromodulation for Migraines, 11/25.
14. Bora G, Atkinson SN, Pan A, Sood M, Salzman N, Karrento K. Impact of auricular percutaneous electrical nerve field stimulation on gut microbiome in adolescents with irritable bowel syndrome: A pilot study. *J Dig Dis.* 2023 May;24(5):348-358. doi: 10.1111/1751-2980.13203. Epub 2023 Aug 9.
15. Busch C, Smith O, Weaver T, Vallabh J, Abd-Elseyed A. Peripheral Nerve Stimulation for Lower Extremity Pain. *Biomedicines.* 2022 Jul 11;10(7):1666. doi: 10.3390/biomedicines10071666.
16. Castillo DF, Denson LA, Haslam DB, Hommel KA, Ollberding NJ, Sahay R, Santucci NR. The microbiome in adolescents with irritable bowel syndrome and changes with percutaneous electrical nerve field stimulation. *Neurogastroenterol Motil.* 2023 Jul;35(7):e14573. doi: 10.1111/nmo.14573. Epub 2023 Apr 24.
17. Centers for Medicare and Medicaid Services (CMS). National Coverage Determination (NCD) for Electrical Nerve Stimulators (160.7) (08/07/95).
18. Centers for Medicare and Medicaid Services (CMS). National Coverage Determination (NCD) for Assessing Patient's Suitability for Electrical Nerve Stimulation Therapy (160.7.1) (06/19/06).
19. Centers for Medicare and Medicaid Services (CMS). National Coverage Determination (NCD) for Treatment of Motor Function Disorders with Electric Nerve Stimulation (160.2) (04/01/03).

20. Chakravarthy K, Lee D, Tram J, et al. Restorative Neurostimulation: A Clinical Guide for Therapy Adoption. *J Pain Res*. 2022 Jun 20;15:1759-1774. doi: 10.2147/JPR.S364081.
21. Charugulla SN, Dhore MR, Stark-Inbar A, Kotak BP, Singh S. Evaluating the effectiveness and safety of a remote electrical neuromodulation wearable device in treating chronic and episodic migraine: a retrospective, observational real-world evidence from India. *Expert Rev Med Devices*. 2025 Oct 2;1-7. doi: 10.1080/17434440.2025.2566742. Epub ahead of print.
22. Chitneni A, Berger AA, Orhurhu V, Kaye AD, Hasoon J. Peripheral Nerve Stimulation of the Saphenous and Superior Lateral Genicular Nerves for Chronic Pain After Knee Surgery. *Orthop Rev (Pavia)*. 2021 May 31;13(2):24435. doi: 10.52965/001c.24435.
23. Chogle A, El-Chammas K, Santucci N, Grimm M, Dorfman L, Graham K, Kelly DR, Dranove JE, Rosen R, Nurko S, Croffie J, Balakrishnan K, Chiou EH, Zhang L, Simpson P, Karrento K. A multicenter registry study on percutaneous electrical nerve field stimulation for pediatric disorders of gut-brain interaction. *J Pediatr Gastroenterol Nutr*. 2024 Mar 7. doi: 10.1002/jpn3.12174. Epub ahead of print.
24. Chogle A, Visnagra K, Janchoi J, Tran T, Davis R, Callas N, Ornelas E. Prospective study of the effect of auricular percutaneous electrical nerve field stimulation on quality of life in children with pain related disorders of gut-brain interaction. *Front Pain Res (Lausanne)*. 2023 Sep 8;4:1223932. doi: 10.3389/fpain.2023.1223932.
25. Chou R, Qaseem A et al. Diagnosis and Treatment of Low Back Pain: A Joint Clinical Practice Guideline from the American College of Physicians and the American Pain Society. *Ann Intern Med*. 2007;147:478-491.
26. Chow RM, Lee RY, Rajput K. Peripheral Nerve Stimulation for Pain Management: A Review. *Curr Pain Headache Rep*. 2023 Sep;27(9):321-327. doi: 10.1007/s11916-023-01143-0. Epub 2023 Jul 31. PMID: 37523121.
27. ClinicalTrials.gov. NCT03783689: The SNAP Trial: SPRINT® Peripheral Nerve Stimulation for the Treatment of Neuropathic Post-Amputation Pain (SNAP). SPR Therapeutics, Inc. (September 2019).
28. ClinicalTrials.gov. NCT03255200: ReActiv8 Post Market Surveillance Registry (ReActiv8-C) (MainStay Medical) (March 2023).
29. ClinicalTrials.gov. NCT04803214: ReActiv8 Stimulation Therapy vs Optimal Medical Management: A Randomized Evaluation (RESTORE) (MainStay Medical) (March 2023).
30. ClinicalTrials.gov. NCT02577354: ReActiv8 Implantable Neurostimulation System for Chronic Low Back Pain (ReActiv8-B) (MainStay Medical) (March 2023).
31. Cohen S, Gilmore C, et al. Percutaneous Peripheral Nerve Stimulation for Pain Reduction and Improvements in Functional Outcomes in Chronic Low Back Pain. *Mil Med*. 2019 Mar 1;184(Suppl 1):537-541. doi: 10.1093/milmed/usy310. PMID: 30901473.
32. Copley S, Batterham A, Shah A, Foly A, Hagedorn JM, Deer T, Gilligan C, Eldabe S. Systematic Review and Meta-analysis of Stimulation of the Medial Branch of the Lumbar Dorsal Rami for the Treatment of Chronic Low Back Pain. *Neuromodulation*. 2024 Dec;27(8):1285-1293. doi: 10.1016/j.neurom.2024.08.002. Epub 2024 Sep 24. PMID: 39320283.
33. Corriveau M, Lake W, Hanna A. Nerve Stimulation for Pain. *Neurosurg Clin N Am*. 2019 Apr;30(2):257-264. doi: 10.1016/j.nec.2018.12.008. PMID: 30898276.
34. Crawford S, Graca M, Mata R, Horn D. Peripheral Nerve Stimulation for Rotator Cuff-Induced Chronic Shoulder Pain: A Literature Review. *Pain Med Case Rep*. 2025 Feb;9(1):15-19.
35. Deckers K, De Smedt K, Mitchell B, et al. New Therapy for Refractory Chronic Mechanical Low Back Pain-Restorative Neurostimulation to Activate the Lumbar Multifidus: One Year Results of a Prospective Multicenter Clinical Trial. *Neuromodulation*. 2018 Jan;21(1):48-55. doi: 10.1111/ner.12741. Epub 2017 Dec 15.

36. Deer TR, Eldabe S, Falowski SM, Huntoon MA, Staats PS, Cassar IR, Crosby ND, Boggs JW. Peripherally Induced Reconditioning of the Central Nervous System: A Proposed Mechanistic Theory for Sustained Relief of Chronic Pain with Percutaneous Peripheral Nerve Stimulation. *J Pain Res.* 2021 Mar 12;14:721-736. doi: 10.2147/JPR.S297091.
37. Deer TR, Esposito MF, McRoberts WP, Grider JS, Sayed D, Verrills P, Lamer TJ, Hunter CW, Slavin KV, Shah JM, Hagedorn JM, Simopoulos T, Gonzalez DA, Amirdelfan K, Jain S, Yang A, Aiyer R, Antony A, Azeem N, Levy RM, Mekhail N. A Systematic Literature Review of Peripheral Nerve Stimulation Therapies for the Treatment of Pain. *Pain Med.* 2020 Aug 1;21(8):1590-1603. doi: 10.1093/pm/pnaa030.
38. Deer T, Pope J, et al. Prospective, Multicenter, Randomized, Double-Blinded, Partial Crossover Study to Assess the Safety and Efficacy of the Novel Neuromodulation System in the Treatment of Patients With Chronic Pain of Peripheral Nerve Origin. *Neuromodulation.* 2016 Jan;19(1):91-100. doi: 10.1111/ner.12381. PMID: 26799373.
39. Dey S. Comparing neuromodulation modalities involving the suprascapular nerve in chronic refractory shoulder pain: retrospective case series and literature review. *Clin Shoulder Elb.* 2021 Mar;24(1):36-41. doi: 10.5397/cise.2021.00038. Epub 2021 Mar 2.
40. ECRI TARGET database. Percutaneous neuromodulation therapy (PNT) for low-back pain. Target report 877. April 2005.
41. Engle M, Gutierrez G, Hersel A, Netzel C, Khemlani V. A confirmatory randomized controlled trial evaluating a micro-implantable pulse generator for the treatment of peripheral neuropathic pain: 3- and 6-month results from the COMFORT 2 Study. *Chron Pain Manag.* 2025;9:171.
42. Esparham A, Stark-Inbar A, Jekel L, Tamir S, Rabany L, Ironi A, Gautreaux J, Rao R. Acute Treatment of Migraine in Adolescents: Real-World Analysis of Remote Electrical Neuromodulation (REN). *Pediatr Neurol.* 2023 May;142:51-55. doi: 10.1016/j.pediatrneurol.2023.02.008. Epub 2023 Feb 21.
43. First Coast Service Options, Inc. (FCSO). Local Coverage Determination (LCD): Noncovered Services (L33777) (10/01/15) (Retired 07/01/20).
44. Gill B, Tidwell C, Hagedorn JM, Moreira AM, Lawandy M, Boyett B, Schappell J, Latif U, Pritzlaff S, Skaribas I, Kalia H, Sheth S, Schnur M, Li S, Lester D, Ellico T, Naidu R, Russo D, Massey C, Ottestad E, Vorenkamp K, Vucetic H, Pingree MJ, Abejón D, Desai MJ, Dickerson D, Gulati A, Sayed D, Deer TR. Consensus Guidelines from the American Society of Pain and Neuroscience for the Use of 60-Day Peripheral Nerve Stimulation Therapy. A NEURON Living Guideline Project. *J Pain Res.* 2025 Jun 24;18:3117-3139. doi: 10.2147/JPR.S521788.
45. Gilligan C, Burnside D, Grant L, Yong RJ, Mullins PM, Schwab F, Mekhail N. ReActiv8 Stimulation Therapy vs. Optimal Medical Management: A Randomized Controlled Trial for the Treatment of Intractable Mechanical Chronic Low Back Pain (RESTORE Trial Protocol). *Pain Ther.* 2023 Apr;12(2):607-620. doi: 10.1007/s40122-023-00475-4. Epub 2023 Feb 14.
46. Gilligan C, Volschenk W, Russo M, Green M, et al. Three-Year Durability of Restorative Neurostimulation Effectiveness in Patients With Chronic Low Back Pain and Multifidus Muscle Dysfunction. *Neuromodulation.* 2023 Jan;26(1):98-108. doi: 10.1016/j.neurom.2022.08.457. Epub 2022 Sep 27.
47. Gilligan C, Volschenk W, Russo M, et al; ReActiv8-B investigators. An implantable restorative-neurostimulator for refractory mechanical chronic low back pain: a randomized sham-controlled clinical trial. *Pain.* 2021 Oct 1;162(10):2486-2498. doi: 10.1097/j.pain.0000000000002258.
48. Gilligan C, Volschenk W, Russo M, et al; ReActiv8-B Investigators. Long-Term Outcomes of Restorative Neurostimulation in Patients With Refractory Chronic Low Back Pain Secondary to Multifidus Dysfunction: Two-Year Results of the ReActiv8-B Pivotal Trial. *Neuromodulation.* 2021 Dec 18:S1094-7159(21)06386-8. doi: 10.1016/j.neurom.2021.10.011. Epub ahead of print.

49. Gilligan C, Volschenk W, Russo M, et al. Three-Year Durability of Restorative Neurostimulation Effectiveness in Patients With Chronic Low Back Pain and Multifidus Muscle Dysfunction. *Neuromodulation*. 2022 Sep 26:S1094-7159(22)01254-5. doi: 10.1016/j.neurom.2022.08.457. Epub ahead of print.
50. Gilligan C, Volschenk W, Russo M, Green M, Gilmore C, Mehta V, Deckers K, De Smedt K, Latif U, Sayed D, Georgius P, Gentile J, Mitchell B, Langhorst M, Huygen F, Baranidharan G, Patel V, Mironer E, Ross E, Carayannopoulos A, Hayek S, Gulve A, Van Buyten JP, Tohmeh A, Fischgrund J, Lad S, Ahadian F, Deer T, Klemme W, Rauck R, Rathmell J, Maislin G, Heemels JP, Eldabe S. Five-Year Longitudinal Follow-Up of Restorative Neurostimulation Shows Durability of Effectiveness in Patients With Refractory Chronic Low Back Pain Associated With Multifidus Muscle Dysfunction. *Neuromodulation*. 2024 Jul;27(5):930-943. doi: 10.1016/j.neurom.2024.01.006. Epub 2024 Mar 12.
51. Gilligan C, Volschenk W, Russo M, et al; ReActiv8-B Investigators. Long-Term Outcomes of Restorative Neurostimulation in Patients With Refractory Chronic Low Back Pain Secondary to Multifidus Dysfunction: Two-Year Results of the ReActiv8-B Pivotal Trial. *Neuromodulation*. 2023 Jan;26(1):87-97. doi: 10.1016/j.neurom.2021.10.011. Epub 2021 Dec 18.
52. Gilmore CA, Deer TR, Desai MJ, Hopkins TJ, Li S, DePalma MJ, Cohen SP, McGee MJ, Boggs JW. Durable patient-reported outcomes following 60-day percutaneous peripheral nerve stimulation (PNS) of the medial branch nerves. *Interventional Pain Medicine*. 2023 Mar 1;2(1):100243.
53. Gilmore C, Ilfeld B, Rosenow J, Li S, Desai M, Hunter C, Rauck R, Kapural L, Nader A, Mak J, Cohen S, Crosby N, Boggs J. Percutaneous peripheral nerve stimulation for the treatment of chronic neuropathic postamputation pain: a multicenter, randomized, placebo-controlled trial. *Reg Anesth Pain Med*. 2019 Jun;44(6):637-645. doi: 10.1136/rapm-2018-100109. Epub 2019 Apr 5.
54. Gilmore CA, Deer TR, Desai MJ, Li S, DePalma MJ, Cohen SP, Swan BD, McGee MJ, Boggs JW. Four-Year Follow-Up from a Prospective, Multicenter Study of Percutaneous 60-Day Peripheral Nerve Stimulation for Chronic Low Back Pain. *Pain Ther*. 2025 Jun;14(3):1103-1115. doi: 10.1007/s40122-025-00737-3. Epub 2025 Apr 22.
55. Groen J, Gordon M, Chogle A, Benninga M, Borlack R, Borrelli O, Darbari A, Dolinsek J, Khlevner J, Di Lorenzo C, Person H, Sanghavi R, Snyder J, Thapar N, Vlieger A, Sinopoulou V, Tabbers M, Saps M. ESPGHAN/NASPGHAN guidelines for treatment of irritable bowel syndrome and functional abdominal pain-not otherwise specified in children aged 4-18 years. *J Pediatr Gastroenterol Nutr*. 2025 Aug;81(2):442-471. doi: 10.1002/jpn3.70070. Epub 2025 May 30.
56. Grosberg B, Rabany L, Lin T, Harris D, Vize M, Iron' A, O'Carroll CP, Schim J. Safety and efficacy of remote electrical neuromodulation for the acute treatment of chronic migraine: an open-label study. *Pain Rep*. 2021 Oct 14;6(4):E966. doi: 10.1097/PR9.0000000000000966.
57. Hagedorn JM, Pittelkow TP, Bendel MA, Moeschler SM, Orhurhu V, Sanchez-Sotelo J. The painful shoulder arthroplasty: appropriate work-up and review of interventional pain treatments. *JSES Rev Rep Tech*. 2022 May 30;2(3):269-276. doi: 10.1016/j.xrrt.2022.04.008.
58. Hasoon J, Chitneni A, Urits I, Viswanath O, Kaye AD. Peripheral Stimulation of the Saphenous and Superior Lateral Genicular Nerves for Chronic Knee Pain. *Cureus*. 2021 Apr 29;13(4):e14753. doi: 10.7759/cureus.14753.
59. Hatheway J, Hersel A, Engle M, Gutierrez G, Khemlani V, Kapural L, Moore G, Ajakwe R, Trainor D, Hah J, Staats PS, Makous J, Heit G, Kottalgi S, Desai MJ; COMFORT Study Group. Clinical study of a micro-implantable pulse generator for the treatment of peripheral neuropathic pain: 12-month results from the COMFORT-randomized controlled trial. *Reg Anesth Pain Med*. 2024 Nov 20:rapm-2024-106099. doi: 10.1136/rapm-2024-106099. Epub ahead of print.
60. Hatheway J, Hersel A, Song J, Engle M, Gutierrez G, Khemlani V, Kapural L, Moore G, Ajakwe R, Trainor D, Hah J, Staats PS, Lynch P, Makous J, Heit G, Kottalgi S, Desai MJ. Clinical study of a micro-implantable pulse generator for the treatment of peripheral neuropathic pain: 3-month and 6-month results from the COMFORT-randomised controlled trial. *Reg Anesth Pain Med*. 2024 May 31:rapm-2023-105264. doi: 10.1136/rapm-2023-105264. Epub ahead of print.

61. Hatheway J, Hersel AP, Song J, Engle MP, Gutierrez G, Khemlani V, Kapural L, Moore G, Ajakwe RC, Trainor DM, Hah JM, Staats P, Lynch P, Makous J, Heit G, Kottalgi S, Desai MJ. Design of a Multicenter, Randomized Controlled Trial for the Treatment of Peripheral Neuropathic Pain (COMFORT Study) with a Micro-Implantable Pulse Generator. *J Pain Res.* 2024 Sep 4;17:2891-2901. doi: 10.2147/JPR.S460563.
62. Hatheway JA, Ratino T, Swain AR, Ratino T, Latif U. Long-Term Pain Relief Delivered by Micro-Implantable Pulse Generator: Findings from a Large-Scale, Real-World Data Peripheral Nerve Stimulation Patient Registry. *Chron Pain Manag.* 2025;9:169.
63. Hayes, Inc. Hayes Medical Technology Directory. Electrical Stimulation of the Occipital Nerve for the Treatment of Occipital Neuralgia and Cervicogenic Headache. Lansdale, PA: Hayes, Inc., 12/13/06.
64. Hayes, Inc. Revolving Evidence Review. ReActiv8 Implantable Neuromuscular Stimulation System (Mainstay Med Ltd.) for Chronic Low Back Pain. ©2022 Hayes (May 2022).
65. He DP, Zhang J, Bai ZF. Percutaneous Electrical Nerve Stimulation for Chronic Knee Pain: A Randomized, Sham-controlled Trial. *Altern Ther Health Med.* 2019 Mar;25(2):30-34. PMID: 29101777.
66. Helm S, Shirsat N, Calodney A, Abd-Elseyed A, Kloth D, Soin A, Shah S, Trescot A. Peripheral Nerve Stimulation for Chronic Pain: A Systematic Review of Effectiveness and Safety. *Pain Ther.* 2021 Dec;10(2):985-1002. doi: 10.1007/s40122-021-00306-4. Epub 2021 Sep 3.
67. Hershey AD, Irwin S, Rabany L, Gruper Y, Ironi A, Harris D, Sharon R, McVige J. Comparison of Remote Electrical Neuromodulation and Standard-Care Medications for Acute Treatment of Migraine in Adolescents: A Post Hoc Analysis. *Pain Med.* 2022 Apr 8;23(4):815-820. doi: 10.1093/pm/pnab197. PMID: 34185084.
68. Hershey AD, Lin T, Gruper Y, Harris D, Ironi A, Berk T, Szperka CL, Berenson F. Remote electrical neuromodulation for acute treatment of migraine in adolescents. *Headache.* 2021 Feb;61(2):310-317. doi: 10.1111/head.14042. Epub 2020 Dec 21. PMID: 33349920.
69. Hershey AD, Shmueli S, Stark-Inbar A, Asmar Y, Ironi A, Strong E, Kabbouche M. Patterns, Barriers, and Preferences of Treating Migraine Within the School Setting: A Survey Study of Students. *Children (Basel).* 2024 Oct 25;11(11):1286. doi: 10.3390/children11111286.
70. Hoffmann C, Fautsch KJ, D'Souza RS. Incidence of Lead Tip Fracture and Retention After Percutaneous Lead Implantation for Peripheral Nerve Stimulation With an External Pulse Generator: A Multicenter Comparative Analysis of 456 Lead Implants Across Two Lead Hardware Generations. *Neuromodulation.* 2025 Jun;28(4):611-618. doi: 10.1016/j.neurom.2025.01.009. Epub 2025 Feb 15. PMID: 39955665.
71. Ilfeld BM, Gilmore CA, Grant SA, Bolognesi MP, Del Gaizo DJ, Wongsarnpigoon A, Boggs JW. Ultrasound-guided percutaneous peripheral nerve stimulation for analgesia following total knee arthroplasty: a prospective feasibility study. *J Orthop Surg Res.* 2017 Jan 13;12(1):4. doi: 10.1186/s13018-016-0506-7.
72. Ilfeld BM, Plunkett A, Vijjeswarapu AM, Hackworth R, Dhanjal S, Turan A, Cohen SP, Eisenach JC, Griffith S, Hanling S, Sessler DI, Mascha EJ, Yang D, Boggs JW, Wongsarnpigoon A, Gelfand H; PAINfRE Investigators. Percutaneous Peripheral Nerve Stimulation (Neuromodulation) for Postoperative Pain: A Randomized, Sham-controlled Pilot Study. *Anesthesiology.* 2021 Jul 1;135(1):95-110. doi: 10.1097/ALN.0000000000003776.
73. James G, Ahern B, Goodwin W, Goss B, Hodges P. ISSLS Prize in Basic Science 2025: Structural changes of muscle spindles in the multifidus muscle after intervertebral disk injury are resolved by targeted activation of the muscle. *Eur Spine J.* 2025 Jan 15. doi: 10.1007/s00586-025-08646-x. Epub ahead of print. Erratum in: *Eur Spine J.* 2025 Mar 3. doi: 10.1007/s00586-025-08744-w.

74. James G, Ahern BJ, Goodwin W, Goss B, Hodges PW. Targeted multifidus muscle activation reduces fibrosis of multifidus muscle following intervertebral disc injury. *Eur Spine J.* 2024 Jun;33(6):2166-2178. doi: 10.1007/s00586-024-08234-5. Epub 2024 Apr 12.
75. Johnson S, Marshall A, Hughes D, Holmes E, Henrich F, Nurmikko T, Sharma M, Frank B, Bassett P, Marshall A, Magerl W, Goebel A. Mechanistically informed non-invasive peripheral nerve stimulation for peripheral neuropathic pain: a randomised double-blind sham-controlled trial. *J Transl Med.* 2021 Nov 6;19(1):458. doi: 10.1186/s12967-021-03128-2. Erratum in: *J Transl Med.* 2023 Apr 29;21(1):289.
76. Kalia H, Pritzlaff S, Li AH, Ottestad E, Gulati A, Makous J, Chakravarthy K. Application of the novel Nalu™ Neurostimulation System for peripheral nerve stimulation. *Pain Manag.* 2022 Oct;12(7):795-804. doi: 10.2217/pmt-2021-0050. Epub 2022 Aug 10. PMID: 35946308.
77. Kalia H, Thapa B, Staats P, Martin P, Stetter K, Feldman B, Marci C. Real-world healthcare utilization and costs of peripheral nerve stimulation with a micro-IPG system. *Pain Management.* 2025 Jan 8:1-0.
78. Karrento K, Venkatesan T, Zhang L, Pawela L, Simpson P, Li BUK. Percutaneous Electrical Nerve Field Stimulation for Drug-Refractory Pediatric Cyclic Vomiting Syndrome. *J Pediatr Gastroenterol Nutr.* 2023 Sep 1;77(3):347-353. doi: 10.1097/MPG.0000000000003876. Epub 2023 Jun 26. PMID: 37364137.
79. Kloimstein H,, Likar R, et al. Peripheral nerve field stimulation (PNFS) in chronic low back pain: a prospective multicenter study. *Neuromodulation.* 2014 Feb;17(2):180-7. doi: 10.1111/ner.12139. Epub 2013 Dec 9. PMID: 24320718 .
80. Kovacic K, Hainsworth K, Sood M, et al. Neurostimulation for abdominal pain-related functional gastrointestinal disorders in adolescents: a randomised, double-blind, sham-controlled trial. *Lancet Gastroenterol Hepatol.* 2017 Oct;2(10):727-737. doi: 10.1016/S2468-1253(17)30253-4. Epub 2017 Aug 18. PMID: 28826627.
81. Krasaelap A, Sood MR, Li BUK, Unteutsch R, Yan K, Nugent M, Simpson P, Kovacic K. Efficacy of Auricular Neurostimulation in Adolescents With Irritable Bowel Syndrome in a Randomized, Double-Blind Trial. *Clin Gastroenterol Hepatol.* 2020 Aug;18(9):1987-1994.e2. doi: 10.1016/j.cgh.2019.10.012. Epub 2019 Oct 14. PMID: 31622740.
82. Kurt E, van Eijk T, Henssen D, Arnts I, Steegers M. Neuromodulation of the Suprascapular Nerve. *Pain Physician.* 2016 Jan;19(1):E235-9.
83. Latif U, Moghim R, Valimahomed A, Lam CM, Abd-Elsayed A, Gulati A, Aman MM, Desai MJ, Dickerson DM, Tieppo Francio V, Gilmore C. Consensus Guidelines for the Use of Peripheral Nerve Stimulation in the Treatment of Chronic Pain and Neurological Diseases: A Neuron Project from the American Society of Pain and Neuroscience. *Journal of Pain Research.* 2025 Dec 31:5949-90.
84. Li AH, Bhatia A, Gulati A, Ottestad E. Role of peripheral nerve stimulation in treating chronic neuropathic pain: an international focused survey of pain medicine experts. *Reg Anesth Pain Med.* 2023 Jun;48(6):312-318. doi: 10.1136/rapm-2022-104073. Erratum in: *Reg Anesth Pain Med.* 2023 Nov;48(11):e1. doi: 10.1136/rapm-2022-104073corr1. PMID: 37080584.
85. Lin CP, Chang KV, Wu WT, Özçakar L. Ultrasound-Guided Peripheral Nerve Stimulation for Knee Pain: A Mini-Review of the Neuroanatomy and the Evidence from Clinical Studies. *Pain Med.* 2020 Aug 1;21(Suppl 1):S56-S63. doi: 10.1093/pm/pnz318.
86. Lorio M, Lewandrowski KU, Coric D, Phillips F, Shaffrey CI. International Society for the Advancement of Spine Surgery Statement: Restorative Neurostimulation for Chronic Mechanical Low Back Pain Resulting From Neuromuscular Instability. *Int J Spine Surg.* 2023 Oct;17(5):728-750. doi: 10.14444/8525. Epub 2023 Aug 10.

87. Luna D, Hettie G, Pirrotta L, Salmasi V, Hah JM. Real-world long-term outcomes of peripheral nerve stimulation: a prospective observational study. *Pain Manag.* 2025 Jan;15(1):37-44. doi: 10.1080/17581869.2025.2451605. Epub 2025 Jan 21.
88. Mach S, Javed S, Chen GH, Huh BK. Peripheral Nerve Stimulation for Back Pain in Patients With Multiple Myeloma as Bridge Therapy to Radiation Treatment: A Case Series. *Neuromodulation.* 2023 Apr;26(3):694-699. doi: 10.1016/j.neurom.2023.01.018. Epub 2023 Mar 2. PMID: 36870933.
89. Manchikanti L, Sanapati MR, Soin A, Kaye AD, Kaye AM, Solanki DR, Chen GH, Nampiarampil D, Knezevic NN, Christo P, Bautista A, Karri J, Shah S, Helm li S, Navani A, Wargo BW, Gharibo CG, Rosenblum D, Luthra K, Patel KG, Javed S, Reuland W, Gupta M, Abd-Elseyed A, Limerick G, Pasupuleti R, Schwartz G, Chung M, Slavin KV, Pampati V, Hirsch JA. Comprehensive Evidence-Based Guidelines for Implantable Peripheral Nerve Stimulation (PNS) in the Management of Chronic Pain: From the American Society Of Interventional Pain Physicians (ASIPP). *Pain Physician.* 2024 Nov;27(S9):S115-S191.
90. Mansfield JT, Desai MJ. Axillary Peripheral Nerve Stimulation for Chronic Shoulder Pain: A Retrospective Case Series. *Neuromodulation.* 2020 Aug;23(6):812-818. doi: 10.1111/ner.13096. Epub 2020 Jan 13.m.
91. Mazzola A, Spinner D. Ultrasound-Guided Peripheral Nerve Stimulation for Shoulder Pain: Anatomic Review and Assessment of the Current Clinical Evidence. *Pain Physician.* 2020 Sep;23(5):E461-E474.
92. McRoberts WP, Wolkowitz R, et al. Peripheral nerve field stimulation for the management of localized chronic intractable back pain: results from a randomized controlled study. *Neuromodulation.* 2013 Nov-Dec;16(6):565-74; discussion 574-5. doi: 10.1111/ner.12055. Epub 2013 Apr 11. PMID: 23577773.
93. Miranda A. Opinion: Percutaneous electrical nerve field stimulation compared to standard medical therapy in adolescents with functional abdominal pain disorders. *Front Pain Res (Lausanne).* 2024 Jan 11;5:1279946. doi: 10.3389/fpain.2024.1279946.
94. Mishra LN, Kulkarni G, Gadgil M. Modeling the Impact of the Variation in Peripheral Nerve Anatomy on Stimulation. *J Pain Res.* 2022 Dec 30;15:4097-4111. doi: 10.2147/JPR.S380546.
95. Mitchell B, Deckers K, De Smedt K, et al. Durability of the Therapeutic Effect of Restorative Neurostimulation for Refractory Chronic Low Back Pain. *Neuromodulation.* 2021 Aug;24(6):1024-1032. doi: 10.1111/ner.13477. Epub 2021 Jul 9.
96. Monteith TS, Stark-Inbar A, Shmueli S, Harris D, Garas S, Ironi A, Kalika P, Irwin SL. Remote electrical neuromodulation (REN) wearable device for adolescents with migraine: a real-world study of high-frequency abortive treatment suggests preventive effects. *Front Pain Res (Lausanne).* 2023 Nov 6;4:1247313. doi: 10.3389/fpain.2023.1247313.
97. Lorio M, Lewandrowski KU, Coric D, Phillips F, Shaffrey CI. International Society for the Advancement of Spine Surgery Statement: Restorative Neurostimulation for Chronic Mechanical Low Back Pain Resulting From Neuromuscular Instability. *Int J Spine Surg.* 2023 Oct;17(5):728-750. doi: 10.14444/8525. Epub 2023 Aug 10.
98. Naidu R, Li S, Desai MJ, Sheth S, Crosby ND, Boggs JW. 60-Day PNS Treatment May Improve Identification of Delayed Responders and Delayed Non-Responders to Neurostimulation for Pain Relief. *J Pain Res.* 2022 Mar 14;15:733-743. doi: 10.2147/JPR.S349101.
99. National Guideline Clearing House. Guideline Summary NGC-8519. Pain (chronic). Work Loss Data Institute; 2008. Last updated 2011.
100. National Institute for Health and Care Excellence (NICE). Neurostimulation of lumbar muscles for refractory non-specific chronic low back pain [IPG739]. 2022. Accessed at <https://www.nice.org.uk/>.
101. National Institute for Health and Care Excellence (NICE). Percutaneous electrical nerve stimulation for refractory neuropathic pain [IPG450]. 2013. Accessed at <https://www.nice.org.uk/>.

102. National Institute for Health and Care Excellence (NICE). Peripheral nerve-field stimulation for chronic low back pain [IPG451]. 2013. Accessed at <https://www.nice.org.uk/>.
103. Nierenburg H, Stark-Inbar A. Nerivio® remote electrical neuromodulation for acute treatment of chronic migraine. *Pain Manag*. 2022 Apr;12(3):267-281. doi: 10.2217/pmt-2021-0038. Epub 2021 Sep 20. PMID: 34538078.
104. Nierenburg H, Vieira JR, Lev N, Lin T, Harris D, Vziel M, Ironi A, Lewis B, Wright P. Remote Electrical Neuromodulation for the Acute Treatment of Migraine in Patients with Chronic Migraine: An Open-Label Pilot Study. *Pain Ther*. 2020 Dec;9(2):531-543. doi: 10.1007/s40122-020-00185-1. Epub 2020 Jul 9.
105. Pingree MJ, Hurdle MF, Spinner DA, Valimahomed A, Crosby ND, Boggs JW. Real-world evidence of sustained improvement following 60-day peripheral nerve stimulation treatment for pain: a cross-sectional follow-up survey. *Pain Manag*. 2022 Jul;12(5):611-621. doi: 10.2217/pmt-2022-0005. Epub 2022 May 5.
106. ReActiv8® Payer Dossier. Mainstay Medical.
107. Rome Foundation. Rome IV Diagnostic Criteria for FGIDs (2019). Accessed at <https://theromefoundation.org/wp-content/uploads/Rome-Foundation-Diagnostic-Criteria-Booklet-2019.pdf>.
108. Ruan QZ, Bellotti A, Gulati A, Gfrerer L, Pak D, Reece D, Li S, Ku JB, Robinson CL, Jotwani R. Fluoroscopy-Guided Percutaneous Placement of Peripheral Nerve Stimulator of the Cervical Medial Branches in Patients With Treatment-Refractory Occipital Neuralgia: A Case Series. *Neuromodulation*. 2025 Jun;28(4):592-599. doi: 10.1016/j.neurom.2025.02.004. Epub 2025 Mar 23. PMID: 40121569.
109. Santucci NR, Beigarten AJ, Khalid F, El-Chammas KI, Graham K, Sahay R, Fei L, Rich K, Mellon M. Percutaneous Electrical Nerve Field Stimulation in Children and Adolescents With Functional Dyspepsia-Integrating a Behavioral Intervention. *Neuromodulation*. 2024 Feb;27(2):372-381. doi: 10.1016/j.neurom.2023.07.005. Epub 2023 Aug 16.
110. Santucci NR, King C, El-Chammas KI, et al. Effect of percutaneous electrical nerve field stimulation on mechanosensitivity, sleep, and psychological comorbidities in adolescents with functional abdominal pain disorders. *Neurogastroenterol Motil*. 2022 Mar 16:e14358. doi: 10.1111/nmo.14358. Epub ahead of print.
111. Santucci NR, Sahay R, El-Chammas KI, Graham K, Wheatley M, Vandenbrink M, Hardy J, Fei L. Percutaneous electrical nerve field stimulation compared to standard medical therapy in adolescents with functional abdominal pain disorders. *Front Pain Res (Lausanne)*. 2023 Sep 19;4:1251932. doi: 10.3389/fpain.2023.1251932.
112. Sayed D, Grider J, Strand N, et al. The American Society of Pain and Neuroscience (ASPN) Evidence-Based Clinical Guideline of Interventional Treatments for Low Back Pain. *J Pain Res*. 2022 Dec 6;15:3729-3832. doi: 10.2147/JPR.S386879. Erratum in: *J Pain Res*. 2022 Dec 24;15:4075-4076.
113. Schwab F, Mekhail N, Patel KV, Langhorst M, Heros RD, Gentile J, Costandi S, Moore G, Gilmore C, Manion S, Chakravarthy K, Meyer SC, Bundy JV, Tate JL, Sanders R, Vaid S, Szentirmai O, Goree J, Patel VV, Lehmen J, Desai MJ, Pope JE, Giuffrida A, Hayek S, Virk SS, Paicius R, Klemme WR, Levy R, Gilligan C; RESTORE investigators. Restorative Neurostimulation Therapy Compared to Optimal Medical Management: A Randomized Evaluation (RESTORE) for the Treatment of Chronic Mechanical Low Back Pain due to Multifidus Dysfunction. *Pain Ther*. 2025 Feb;14(1):401-423. doi: 10.1007/s40122-024-00689-0. Epub 2025 Jan 15.
114. Shaffrey C, Gilligan C. Effect of Restorative Neurostimulation on Major Drivers of Chronic Low Back Pain Economic Impact. *Neurosurgery*. 2023 Apr 1;92(4):716-724. doi: 10.1227/neu.0000000000002305. Epub 2023 Feb 14. PMID: 36786565; PMCID: PMC9988326.

115. Shah E, Eswaran S, Harer K, Lee A, Nojkov B, Singh P, Chey WD. Percutaneous electrical nerve field stimulation for adolescents with irritable bowel syndrome: Cost-benefit and cost-minimization analysis. *J Pediatr Gastroenterol Nutr.* 2024 Mar;78(3):608-613. doi: 10.1002/jpn3.12118. Epub 2024 Jan 15.
116. Smirnoff L, Bravo M, Hyppolite T. Neuromodulation for Headache Management in Pregnancy. *Curr Pain Headache Rep.* 2025 Jan 7;29(1):14. doi: 10.1007/s11916-024-01344-1.
117. SPR SPRINT® PNS System Publication Library. May 2025.
118. SPR SPRINT® PNS System Technology Dossier. May 2025. MA-000047[02].
119. Staats P, Deer T, Ottestad E, Erdek M, Spinner D, Gulati A. Understanding the role of patient preference in the treatment algorithm for chronic low back pain: results from a survey-based study. *Pain Manag.* 2022 Apr;12(3):371-382. doi: 10.2217/pmt-2021-0011. Epub 2021 Sep 2.
120. Stabingas K, Bergman J, Patterson M, Tomycz ND. Peripheral subcutaneous field stimulation for the treatment of spinal cord injury at-level pain: case report, literature review, and 5-year follow-up. *Heliyon.* 2020 Jul 24;6(7):e04515. doi: 10.1016/j.heliyon.2020.e04515.
121. Strand N, D'Souza RS, Hagedorn JM, Pritzlaff S, Sayed D, Azeem N, Abd-Elsayed A, Escobar A, Huntoon MA, Lam CM, Deer TR. Evidence-Based Clinical Guidelines from the American Society of Pain and Neuroscience for the Use of Implantable Peripheral Nerve Stimulation in the Treatment of Chronic Pain. *J Pain Res.* 2022 Aug 23;15:2483-2504. doi: 10.2147/JPR.S362204.
122. Sudek EW, Mach S, Huh B, Javed S. Use of Temporary Percutaneous Peripheral Nerve Stimulation in an Oncologic Population: A Retrospective Review. *Neuromodulation.* 2024 Jan;27(1):118-125. doi: 10.1016/j.neurom.2023.06.009. Epub 2023 Sep 15. PMID: 37715753.
123. Synowiec A, Stark-Inbar A, Weinstein M, Ironi A, Mauskop A. One-Year Consistent Safety, Utilization, and Efficacy Assessment of Remote Electrical Neuromodulation (REN) for Migraine Treatment. *Adv Ther.* 2024 Jan;41(1):170-181. doi: 10.1007/s12325-023-02697-6. Epub 2023 Oct 19.
124. Tepper SJ, Rabany L, Cowan RP, Smith TR, Grosberg BM, Torphy BD, Harris D, Vize M, Ironi A, Stark-Inbar A, Blumenfeld AM. Remote electrical neuromodulation for migraine prevention: A double-blind, randomized, placebo-controlled clinical trial. *Headache.* 2023 Mar;63(3):377-389. doi: 10.1111/head.14469. Epub 2023 Jan 27.
125. Thomson S, Chawla R, Love-Jones S, Sharma M, Vajramani G, Williams A, Eldabe S; ReActiv8 PMCF Investigators. Restorative Neurostimulation for Chronic Mechanical Low Back Pain: Results from a Prospective Multi-centre Longitudinal Cohort. *Pain Ther.* 2021 Dec;10(2):1451-1465. doi: 10.1007/s40122-021-00307-3. Epub 2021 Sep 3.
126. Tieppo Francio V, Glicksman M, Leavitt L, Gill B, Shah A, Westerhaus BD, Lam CM, D'Souza RS. Multifidus atrophy and/or dysfunction following lumbar radiofrequency ablation: A systematic review. *PM R.* 2024 Dec;16(12):1384-1394. doi: 10.1002/pmrj.13202. Epub 2024 May 16. PMID: 38757474.
127. Tieppo Francio V, Gustafson K, Leavitt L, Zwick R, Lam CM, Sack A, Sayed D, Latif U. Temporary Peripheral Nerve Stimulation (PNS) of the Cervical Medial Branch Nerve (CMBN) for Chronic Axial Neck Pain-A Literature Review and Case Series. *J Clin Med.* 2025 Aug 21;14(16):5910. doi: 10.3390/jcm14165910.
128. Tieppo Francio V, Westerhaus BD, Rupp A, Sayed D. Non-Spinal Neuromodulation of the Lumbar Medial Branch Nerve for Chronic Axial Low Back Pain: A Narrative Review. *Front Pain Res (Lausanne).* 2022 Feb 25;3:835519. doi: 10.3389/fpain.2022.835519.
129. Trent AR, Chopra P, Jain A. Peripheral Nerve Stimulator. [Updated 2023 Mar 13]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK539703/>.
130. UpToDate. Acute treatment of migraine in adults. 2025. Accessed at uptodate.com.

131. UpToDate. Functional abdominal pain in children and adolescents: Management in primary care. 2025. Accessed at uptodate.com.
132. UpToDate. Interventional therapies for chronic pain. 2025. Accessed at uptodate.com.
133. UpToDate. Overview of the clinical uses of acupuncture. 2025. Accessed at uptodate.com.
134. UpToDate. Preventive treatment of episodic migraine in adults. 2025. Accessed at uptodate.com.
135. UpToDate. Patient education: Headache in children (Beyond the Basics). 2025. Accessed at uptodate.com.
136. UpToDate. Preventive treatment of migraine in children. 2025. Accessed at uptodate.com.
137. UpToDate. Subacute and chronic low back pain: Management. 2025. Accessed at uptodate.com.
138. UpToDate. Subacute and chronic low back pain: Nonpharmacologic and pharmacologic treatment. 2023. Accessed at uptodate.com.
139. Urits I, Schwartz RH, Patel P, Zeien J, Connor D, Hasoon J, Berger AA, Kassem H, Manchikanti L, Kaye AD, Viswanath O. A Review of the Recent Findings in Minimally Invasive Treatment Options for the Management of Occipital Neuralgia. *Neurol Ther.* 2020 Dec;9(2):229-241. doi: 10.1007/s40120-020-00197-1. Epub 2020 Jun 2.
140. U.S. Food & Drug Administration (FDA). DE NOVO CLASSIFICATION REQUEST FOR IB-STIM. SUBMISSION NUMBER: DEN180057 (October 2018).
141. U.S. Food & Drug Administration (FDA). 510(k) premarket notification K241533: NeurAxis IB-Stim (01-1020).
142. U.S. Food & Drug Administration (FDA). 510(k) premarket notification K201824: Nerivio (October 23, 2020).
143. U.S. Food & Drug Administration (FDA). 510(k) premarket notification K203181: Nerivio (January 21, 2023).
144. U.S. Food & Drug Administration (FDA). 510(k) premarket notification K223169: Nerivio (February 6, 2023).
145. U.S. Food & Drug Administration (FDA). 510(k) premarket notification K232152: NerivioInfinity (November 8, 2023).
146. Vangeison CT, Bintrim DJ, Helms J, Saha AK, Samant AN, Chung M. The role of peripheral nerve stimulation in refractory non-operative chronic knee osteoarthritis. *Pain Manag.* 2023 Apr;13(4):213-218. doi: 10.2217/pmt-2023-0025. Epub 2023 May 24. PMID: 37222150.
147. Weatherall MW, Nandi D. Percutaneous electrical nerve stimulation (PENS) therapy for refractory primary headache disorders: a pilot study. *Br J Neurosurg.* 2019 Dec;33(6):608-612. doi: 10.1080/02688697.2019.1671951. Epub 2019 Oct 3. PMID: 31578882.
148. Werner K, Gerson T, Stark-Inbar A, Shmueli S, Ironi A, Szperka CL, Hershey AD. Acute treatment of migraine in children aged 6– 11: Real-world analysis of remote electrical neuromodulation (REN). *Annals of Child Neurology Society.* 2024 Jun 1;2(2):135-45.
149. West T, Hussain N, Bhatia A, ElSaban M, Kilgore AE, Palettas M, Abdel-Rasoul M, Javed S, D'Souza RS. Pain intensity and opioid consumption after temporary and permanent peripheral nerve stimulation: a 2-year multicenter analysis. *Reg Anesth Pain Med.* 2024 Jul 26:rapm-2024-105704. doi: 10.1136/rapm-2024-105704. Epub ahead of print.
150. Wilson RD, Knutson JS, Bennett ME, Chae J. The Effect of Peripheral Nerve Stimulation on Shoulder Biomechanics: A Randomized Controlled Trial in Comparison to Physical Therapy. *Am J Phys Med Rehabil.* 2017 Mar;96(3):191-198. doi: 10.1097/PHM.0000000000000677.
151. Wong CH, Chan TCW, Wong SSC, Russo M, Cheung CW. Efficacy of Peripheral Nerve Field Stimulation for the Management of Chronic Low Back Pain and Persistent Spinal Pain Syndrome: A

- Narrative Review. *Neuromodulation*. 2023 Apr;26(3):538-551. doi: 10.1016/j.neurom.2022.07.011. Epub 2022 Sep 1. PMID: 36058792.
152. Woodbury A, Krishnamurthy LC, Bohsali A, et al. Percutaneous electric nerve field stimulation alters cortical thickness in a pilot study of veterans with fibromyalgia. *Neurobiol Pain*. 2022 May 17;12:100093. doi: 10.1016/j.ynpai.2022.100093.
 153. Yaccarino V, Jin MY, Abd-Elseyed A, Kraemer JM, Sehgal N. Peripheral Nerve Stimulation in Painful Conditions of the Upper Extremity-An Overview. *Biomedicines*. 2022 Nov 1;10(11):2776. doi: 10.3390/biomedicines10112776.
 154. Yarnitsky D, Dodick DW, Grosberg BM, Burstein R, Ironi A, Harris D, Lin T, Silberstein SD. Remote Electrical Neuromodulation (REN) Relieves Acute Migraine: A Randomized, Double-Blind, Placebo-Controlled, Multicenter Trial. *Headache*. 2019 Sep;59(8):1240-1252. doi: 10.1111/head.13551. Epub 2019 May 9.
 155. Yarnitsky D, Volokh L, Ironi A, Weller B, Shor M, Shifrin A, Granovsky Y. Nonpainful remote electrical stimulation alleviates episodic migraine pain. *Neurology*. 2017 Mar 28;88(13):1250-1255. doi: 10.1212/WNL.0000000000003760. Epub 2017 Mar 1. PMID: 28251920.
 156. Yokoyama M, Sun X, Oku S, Taga N, Sato K, Mizobuchi S, Takahashi T, Morita K. Comparison of percutaneous electrical nerve stimulation with transcutaneous electrical nerve stimulation for long-term pain relief in patients with chronic low back pain. *Anesth Analg*. 2004 Jun;98(6):1552-1556. doi: 10.1213/01.ANE.0000112312.94043.DF.

COMMITTEE APPROVAL:

This Medical Coverage Guideline (MCG) was approved by the Florida Blue Medical Policy and Coverage Committee on 12/04/25.

GUIDELINE UPDATE INFORMATION:

09/15/02	Medical Coverage Guideline Reformatted.
09/15/04	Scheduled review and revision to guideline; consisting of updated references and changed non-covered statement to investigational for electrical stimulation used for motor function disorders.
01/01/05	Annual HCPCS update; consisting of the revision of 64590.
01/01/07	HCPCS coding update consisting of the revision of 64590 and 64595.
07/15/07	Scheduled review, coverage and limitations maintained, Description, Billing/Coding Information, and Reimbursement Information section updated with CPT codes, guideline reformatted, and references updated.
09/15/09	Scheduled review; no change in position statement.
05/15/11	Revision; formatting changes.
09/15/11	Scheduled review; no change in position statement. Updated description section, billing/coding section and references, formatting changes.
05/11/14	Revision: Program Exceptions section updated.
01/01/18	Annual CPT/HCPCS coding update: deleted 64565 from Billing/Coding Information section. Revised Programs Exceptions section. Reformatted guideline.
10/15/19	Scheduled review. Revised description and index terms. Maintained position statement. Updated references.

11/15/19	Revision. Revised description, added coverage statement for peripherally implanted nerve stimulators. Updated references.
08/15/21	Scheduled review. Maintained position statement and updated references.
07/01/22	Quarterly CPT/HCPCS coding update. Added 0720T.
08/15/22	Unscheduled review. Updated references and added E/I coverage statement for percutaneous electrical nerve field stimulation (PENFS).
12/15/22	Revision. Updated references and maintained position statement.
04/01/23	Quarterly CPT/HCPCS coding update. Code L8678 added.
05/15/23	Scheduled review. Maintained position statement and updated references.
05/25/23	Update to Program Exceptions section.
09/15/23	Added code 64555.
01/01/24	Annual CPT/HCPCS coding update. Added 64596, 64597, 64598.
05/15/24	Scheduled review. Revised description and position statement (added coverage criteria for IB-Stim®). Updated references.
09/15/24	Revision. Revised description, maintained position statement and updated references.
11/15/24	Revision. Revised description, added coverage statement for remote electrical neuromodulation (REN) (eg, Nerivio®), added code A4540, and updated references.
12/15/24	Revision. Updated age criteria for PENFS with IB-STIM®. Updated references.
01/01/25	Annual CPT/HCPCS coding update. Added C9807.
04/15/25	Revision. Revised description. Updated references for remote electrical neuromodulation (REN) (eg, Nerivio®), peripheral nerve stimulation (PNS) with Nalu, and restorative neurostimulation with Reactiv8. Maintained position statement.
01/01/26	Scheduled review. Policy title, description, position statements, coding and references updated. Annual CPT/HCPCS coding update. Code 64567 added; 0720T deleted.