MEDICAL POLICY

POLICY TITLE	IMPLANTABLE ELECTRICAL NERVE STIMULATORS (VAGUS, AUTONOMIC NERVE AND PERIPHERAL NERVE STIMULATORS)
POLICY NUMBER	MP-1.034

Original Issue Date (Created):	**7/1/2002**
Most Recent Review Date (Revised):	**3/25/2020**
Effective Date:	**6/1/2020**

I. POLICY

Vagus Nerve Stimulator

The vagus nerve stimulator may be considered **medically necessary** as a treatment of medically refractory seizures. Medically refractory seizures are defined as seizures that occur in spite of therapeutic levels of antiepileptic drugs or seizures that cannot be treated with therapeutic levels of antiepileptic drugs because of intolerable adverse effects of these drugs.

The use of a vagus nerve stimulator is considered **investigational** for treatment of other conditions including but not limited to depression, heart failure, upper-limb impairment due to stroke, essential tremor, headaches, fibromyalgia, tinnitus, and traumatic brain injury, as there is insufficient evidence to support a conclusion concerning the health outcomes or benefits associated with this procedure.

.

Peripheral Nerve Stimulator

Implantation of a peripheral nerve stimulator may be considered **medically necessary** to alleviate chronic intractable pain.

Autonomic (Phrenic) Nerve Stimulator

Implantation of an autonomic (phrenic) nerve stimulator may be considered **medically necessary** for the treatment of patients with partial or complete respiratory insufficiency. Implantation of an autonomic nerve stimulator other than phrenic nerve is considered **investigational,** as there is insufficient evidence to support a conclusion concerning the health outcomes or benefits associated with this procedure.

Implantation of an autonomic (phrenic) nerve stimulator for conditions other than partial or complete respiratory insufficiency is considered **investigational,** as there is insufficient evidence to support a conclusion concerning the health outcomes or benefits associated with this procedure.

POLICY TITLE	IMPLANTABLE ELECTRICAL NERVE STIMULATORS (VAGUS, AUTONOMIC NERVE AND PERIPHERAL NERVE STIMULATORS)
POLICY NUMBER	MP-1.034

Cross-references:

MP-1.042 Deep Brain Stimulation
MP-6.020 Transcutaneous Electrical Nerve Stimulation
MP-1.141 Peripheral Subcutaneous Field Stimulation (PSFS)
MP-1.069 Spinal Cord Stimulation

II. PRODUCT VARIATIONS

TOP

FEP PPO - Refer to FEP Benefit Brochure for information on Durable Medical Equipment: https://www.fepblue.org/benefit-plans/benefit-plans-brochures-and-forms

Note* - The Federal Employee Program (FEP) Service Benefit Plan does not have a medical policy related to these services.

This policy is applicable to all programs and products administered by Capital BlueCross unless otherwise indicated below.

The FEP program dictates that all drugs, devices or biological products approved by the U.S. Food and Drug Administration (FDA) may not be considered investigational. Therefore, FDA-approved drugs, devices or biological products may be assessed on the basis of medical necessity.

III. DESCRIPTION/BACKGROUND

TOP

Vagus Nerve Stimulation

Vagus nerve stimulation (VNS) was initially investigated as a treatment alternative in patients with medically refractory partial-onset seizures for whom surgery is not recommended or for whom surgery has failed. Over time, the use of VNS has expanded to include generalized seizures, and it has been investigated for a range of other conditions.

While the mechanisms for the therapeutic effects of VNS are not fully understood, the basic premise of VNS in the treatment of various conditions is that vagal visceral afferents have a diffuse central nervous system projection, and activation of these pathways has a widespread effect on neuronal excitability. An electrical stimulus is applied to axons of the vagus nerve, which have their cell bodies in the nodose and junctional ganglia and synapse on the nucleus of the solitary tract in the brainstem. From the solitary tract nucleus, vagal afferent pathways project to multiple areas of the brain. VNS may also stimulate vagal efferent pathways that innervate the heart, vocal cords, and other laryngeal and pharyngeal muscles, and provide parasympathetic innervation to the gastrointestinal tract.

POLICY TITLE	IMPLANTABLE ELECTRICAL NERVE STIMULATORS (VAGUS, AUTONOMIC NERVE AND PERIPHERAL NERVE STIMULATORS)
POLICY NUMBER	MP-1.034

A type of VNS device addressed in this evidence review consists of an implantable, programmable electronic pulse generator that delivers stimulation to the left vagus nerve at the carotid sheath. The pulse generator is connected to the vagus nerve via a bipolar electrical lead. Surgery for implantation of a vagal nerve stimulator involves implantation of the pulse generator in the infraclavicular region and wrapping 2 spiral electrodes around the left vagus nerve within the carotid sheath. The programmable stimulator may be programmed in advance to stimulate at regular intervals or on demand by patients or family by placing a magnet against the subclavicular implant site.

Various types of devices that transcutaneously stimulate the vagus nerve have been developed as well. The U.S. Food and Drug Administration (FDA) has not approved any transcutaneous VNS devices.

Other types of implantable vagus nerve stimulators that are placed in contact with the trunks of the vagus nerve at the gastroesophageal junction are not addressed in this evidence review.

Indications

VNS was originally approved for the treatment of medically refractory epilepsy. Significant advances have been made since then in the surgical and medical treatment of epilepsy, and newer, more recently approved medications are available. Despite these advances, however, 25% to 50% of patients with epilepsy experience breakthrough seizures or suffer from debilitating adverse events of antiepileptic drugs. For these patients, VNS therapy has been used as an alternative or adjunct to epilepsy surgery or medications.

Based on observations that patients treated with VNS experience improvements in mood, VNS has been evaluated for the treatment of refractory depression. VNS has been investigated for multiple other conditions which may be affected by either the afferent or efferent stimulation of the vagus nerve, including heart failure, headaches, tremor, fibromyalgia, tinnitus, and traumatic brain injury.

REGULATORY STATUS

In 1997, the NeuroCybernetic Prosthesis (NCP®) System (Cyberonics), a VNS device, was approved by FDA through the premarket approval process for use in conjunction with drugs or surgery "…as an adjunctive treatment of adults and adolescents over 12 years of age with medically refractory partial onset seizures."[1] There have been subsequent expanded approvals. FDA product code: LYF.

In May 2015, a related VNS therapy, AspireSR® (LivaNova), received supplemental premarketing approval from FDA, although the device was recalled in August 2017.[2] The AspireSR® device detects high heart rates associated with seizures and responds with stimulation. Adjunctive use of the AspireSR® for the treatment of epileptic seizures was indicated for patients over 4 years of age who suffer from partial-onset seizures that do not respond to antiepileptic medication.

In May 2017, the gammaCore-S® (electroCore), a noninvasive VNS device, was cleared for marketing by FDA through the 510(k) process (K171306) for the acute treatment of adults with episodic cluster headaches.[3] When the device is applied to the side of the neck by the patient, mild electrical stimulation of the vagus nerve is carried to the central nervous system. Each stimulation using gammaCore-S® lasts 2 minutes. The patient controls the stimulation strength. FDA product codes: PKR, QAK.

Cerbomed (Erlangen, Germany) has developed a transcutaneous VNS (t-VNS®) system that uses a combined stimulation unit and ear electrode to stimulate the auricular branch of the vagus nerve, which supplies the skin over the concha of the ear. Patients self-administer electrical stimulation for several hours a day; no surgical procedure is required. The device received the CE mark in Europe in 2011 but has not been FDA-approved for use in the United States.

Table 1. FDA-Approved or -Cleared Vagus Nerve Stimulators

Device Name	Manufacturer	Cleared	PMA/510(k)	Indications
NeuroCybernetic Prosthesis (NCP®)	Cyberonics	1997	P970003	Indicated or adjunctive treatment of adults and adolescents >12 y of age with medically refractory partial-onset seizures
		2005	P970003/S50	Expanded indication for adjunctive long-term treatment of chronic or recurrent depression for patients ≥18 y of age experiencing a major depressive episode and have not had an adequate response to ≥4 adequate antidepressant treatments
		2017	P970003/S207	Expanded indicated use as adjunctive therapy for seizures in patients ≥4 y of age with partial-onset seizures that are refractory to antiepileptic medications
gammaCore®	ElectroCore	2017	K171306	Indicated for acute treatment of pain associated with episodic cluster headache in adults using noninvasive VNS on the side of the neck

FDA: Food and Drug Administration; PMA: premarket approval; VNS: vagus nerve stimulation

Peripheral Nerve Stimulator
Peripheral nerve stimulation involves the implantation of electrodes around a selected peripheral nerve and is used to treat chronic intractable pain. The stimulating electrode is connected by an insulated lead to a receiver unit that is inserted subcutaneously at a depth not greater than half an inch. Sciatic and ulnar nerves are common sites for implantation. Stimulation of the nerve is created by a generator that is connected to an antenna that is attached to the skin surface over the receiver unit.

Autonomic (Phrenic) Nerve Stimulator
The phrenic nerve stimulator provides electrical stimulation of the patient's phrenic nerve to contract the diaphragm rhythmically and produce breathing in patients who have hypoventilation (a state in which an abnormally low amount of air enters the lungs). The device has been used successfully to treat hypoventilation caused by a variety of conditions, including respiratory paralysis resulting from lesions of the brain stem and cervical spinal cord and chronic pulmonary disease with ventilatory insufficiency. The phrenic nerve stimulator is intended to be an alternative to management of patients with respiratory insufficiency who are dependent upon the usual therapy of intermittent or permanent use of a mechanical ventilator as well as maintenance of a permanent tracheotomy stoma.

However, an implanted phrenic nerve stimulator can be effective only if the patient has an intact phrenic nerve and diaphragm. Moreover, nerve injury may occur during the surgical procedure and if sufficient injury has incurred, the device will not prove useful to the patient. Consequently, it is possible for such a device to be indicated for a patient but, due to injury sustained during implant, fail to assist the patient, resulting in a return to the use of mechanical ventilation.

IV. RATIONALE

TOP

Summary of Evidence

Vagus Nerve Stimulation
For individuals who have seizures refractory to medical treatment who receive VNS, the evidence includes RCTs and multiple observational studies. Relevant outcomes are symptoms, change in disease status, and functional outcomes. The RCTs have reported significant reductions in seizure frequency for patients with partial-onset seizures. The uncontrolled studies have consistently reported large reductions in a broader range of seizure types in both adults and children. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals who have treatment-resistant depression who receive VNS, the evidence includes an RCT, nonrandomized comparative studies, and case series. Relevant outcomes are symptoms, change in disease status, and functional outcomes. The RCT only reported short-term results and

found no significant improvement in the primary outcome. Other available studies are limited by small sample sizes, potential selection bias, and lack of a control group in the case series. The evidence is insufficient to determine the effects of the technology on health outcomes.

Other Conditions
For individuals who have chronic heart failure who receive VNS, the evidence includes RCTs and case series. Relevant outcomes are symptoms, change in disease status, and functional outcomes. The RCTs evaluating chronic heart failure did not show significant improvements in the primary outcomes. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have upper-limb impairment due to stroke who receive VNS, the evidence includes a single pilot study. Relevant outcomes are symptoms, change in disease status, and functional outcomes. This pilot study has provided preliminary support for improvement in functional outcomes. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have other neurologic conditions (e.g., essential tremor, headache, fibromyalgia, tinnitus, autism) who receive VNS, the evidence includes case series. Relevant outcomes are symptoms, change in disease status, and functional outcomes. Case series are insufficient to draw conclusions regarding efficacy. The evidence is insufficient to determine the effects of the technology on health outcomes.

Transcutaneous Vagus Nerve Stimulation
For individuals with episodic cluster headaches who receive transcutaneous VNS, the evidence includes three RCTs. One RCT for a cluster headache showed a reduction in headache frequency but did not include a sham treatment group. Two randomized, double-blind, sham-controlled studies showed efficacy of achieving pain-free status within 15 minutes of treatment with noninvasive VNS in patients with episodic cluster headaches but not in patients with chronic cluster headaches. The RCTs for episodic cluster headaches are promising; however, additional studies with larger relevant populations are required to establish the treatment efficacy. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have other neurologic, psychiatric, or metabolic disorders (e.g., epilepsy, depression, schizophrenia, non-cluster headache, impaired glucose tolerance) who receive transcutaneous VNS, the evidence includes RCTs and case series for some of the conditions. Relevant outcomes are symptoms, change in disease status, and functional outcomes. The RCTs are all-small and have various methodologic problems. None showed definitive efficacy of transcutaneous VNS in improving patient outcomes. The evidence is insufficient to determine the effects of the technology on health outcomes.

V. DEFINITIONS

TOP

EPILEPSY is a group of neurologic disorders characterized by recurrent episodes of convulsive seizures, sensory disturbances, abnormal behavior, loss of consciousness, or all of these. Common to all types of epilepsy is an uncontrolled electrical discharge from the nerve cells of the cerebral cortex.

MEDICALLY REFRACTORY SEIZURES are defined as seizures that occur despite therapeutic levels of antiepileptic drugs or seizures that cannot be treated with therapeutic levels of antiepileptic drugs because of intolerable adverse events of these drugs.

PARTIAL ONSET SEIZURES refers to seizures that have a discrete focal onset. There are three subtypes of partial onset seizures:

- Simple partial seizures: these do not involve alteration of consciousness but may have observable motor components or may solely be a subjective sensory or emotional phenomenon.
- Complex partial seizures: these are partial-onset seizures that involve an alteration of consciousness.
- Complex partial seizures, secondarily generalized: These are partial-onset seizures that progress to involve both sides of the brain and result in a complete loss of consciousness.

PHRENIC NERVE is a nerve that arises mainly from the fourth cervical nerve and is primarily the motor nerve of the diaphragm but also sends sensory fibers to the pericardium.

VAGUS NERVE refers to either one of the longest pair of cranial nerves mainly responsible for parasympathetic control over the heart and many other internal organs, including thoracic and abdominal viscera.

VISCERAL AFFERENT FIBERS are the nerve fibers of the visceral nervous system that receive stimuli, carry impulses toward the central nervous system, and share the sensory ganglia of the cerebrospinal nerves with the somatic sensory fibers.

VI. BENEFIT VARIATIONS

TOP

The existence of this medical policy does not mean that this service is a covered benefit under the member's contract. Benefit determinations should be based in all cases on the applicable contract language. Medical policies do not constitute a description of benefits. A member's individual or group customer benefits govern which services are covered, which are excluded, and which are subject to benefit limits and which require preauthorization. Members and providers should consult the member's benefit information or contact Capital BlueCross for benefit information.

POLICY TITLE	IMPLANTABLE ELECTRICAL NERVE STIMULATORS (VAGUS, AUTONOMIC NERVE AND PERIPHERAL NERVE STIMULATORS)
POLICY NUMBER	MP-1.034

VII. DISCLAIMER

TOP

Capital BlueCross's medical policies are developed to assist in administering a member's benefits, do not constitute medical advice and are subject to change. Treating providers are solely responsible for medical advice and treatment of members. Members should discuss any medical policy related to their coverage or condition with their provider and consult their benefit information to determine if the service is covered. If there is a discrepancy between this medical policy and a member's benefit information, the benefit information will govern. Capital BlueCross considers the information contained in this medical policy to be proprietary and it may only be disseminated as permitted by law.

VIII. CODING INFORMATION

TOP

Note: This list of codes may not be all-inclusive, and codes are subject to change at any time. The identification of a code in this section does not denote coverage as coverage is determined by the terms of member benefit information. In addition, not all covered services are eligible for separate reimbursement.

Covered when medically necessary; Vagus nerve stimulator to treat medically refractory seizures:

CPT Codes ®							
61885	61886	64553	64568	64569	64570	95970	95976
95977							

ICD-10-CM Diagnosis Codes	Description
G40.011	Localization-related (focal) (partial) idiopathic epilepsy and epileptic syndromes with seizures of localized onset, intractable, with status epilepticus
G40.019	Localization-related (focal) (partial) idiopathic epilepsy and epileptic syndromes with seizures of localized onset, intractable, without status epilepticus
G40.111	Localization-related (focal) (partial) symptomatic epilepsy and epileptic syndromes with simple partial seizures, intractable, with status epilepticus
G40.119	Localization-related (focal)(partial) symptomatic epilepsy and epileptic syndromes with simple partial seizures, intractable, without status epilepticus
G40.211	Localization-related (focal) (partial) symptomatic epilepsy and epileptic syndromes with complex partial seizures, intractable, with status epilepticus

POLICY TITLE	IMPLANTABLE ELECTRICAL NERVE STIMULATORS (VAGUS, AUTONOMIC NERVE AND PERIPHERAL NERVE STIMULATORS)
POLICY NUMBER	MP-1.034

ICD-10-CM Diagnosis Codes	Description
G40.219	Localization-related (focal) (partial) symptomatic epilepsy and epileptic syndromes with complex partial seizures, intractable, without status epilepticus
G40.311	Generalized idiopathic epilepsy and epileptic syndromes, intractable, with status epilepticus
G40.319	Generalized idiopathic epilepsy and epileptic syndromes, intractable, without status epilepticus
G40.411	Other generalized epilepsy and epileptic syndromes, intractable, with status epilepticus
G40.419	Other generalized epilepsy and epileptic syndromes, intractable, without status epilepticus
G40.803	Other epilepsy, intractable, with status epilepticus
G40.804	Other epilepsy, intractable, without status epilepticus
G40.813	Lennox-Gastaut syndrome, intractable, with status epilepticus
G40.814	Lennox-Gastaut syndrome, intractable, without status epilepticus
G40.823	Epileptic spasms, intractable, with status epilepticus
G40.824	Epileptic spasms, intractable, without status epilepticus
G40.911	Epilepsy, unspecified, intractable, with status epilepticus
G40.919	Epilepsy, unspecified, intractable, without status epilepticus
G40.A11	Absence epileptic syndrome, intractable, with status epilepticus
G40.A19	Absence epileptic syndrome, intractable, without status epilepticus
Z45.42	Encounter for adjustment and management of neuropacemaker (brain) (peripheral nerve) (spinal cord)
Z45.49	Encounter for adjustment and management of other implanted nervous system device
Z46.2	Encounter for fitting and adjustment of other devices related to nervous system and special senses

Covered when medically necessary; Peripheral nerve stimulator to alleviate chronic intractable pain:

CPT Codes ®							
64555	64575	64585	64590	64595			

POLICY TITLE	IMPLANTABLE ELECTRICAL NERVE STIMULATORS (VAGUS, AUTONOMIC NERVE AND PERIPHERAL NERVE STIMULATORS)
POLICY NUMBER	MP-1.034

ICD-10-CM Diagnosis Codes	Description
G89.0	Central pain syndrome
G89.21	Chronic pain due to trauma
G89.22	Chronic post-thoracotomy pain
G89.28	Other chronic postprocedural pain
G89.29	Other chronic pain
G89.3	Neoplasm related pain (acute) (chronic)
G89.4	Chronic pain syndrome
G90.50	Complex regional pain syndrome I, unspecified
G90.59	Complex regional pain syndrome I of other specified site
Z45.42	Encounter for adjustment and management of neuropacemaker (brain) (peripheral nerve) (spinal cord)
Z45.49	Encounter for adjustment and management of other implanted nervous system device

Covered when medically necessary: Autonomic (phrenic) nerve stimulator to treat patients with partial or complete respiratory insufficiency:

CPT Codes ®							
64575	64580	64585	64590	64595			

ICD-10-CM Diagnosis Codes	Description
J80	Acute respiratory distress syndrome
J95.1	Acute pulmonary insufficiency following thoracic surgery
J95.2	Acute pulmonary insufficiency following nonthoracic surgery
J95.3	Chronic pulmonary insufficiency following surgery
J95.82	Postprocedural respiratory failure
J96.0	Acute respiratory failure
J96.1	Chronic respiratory failure

POLICY TITLE	IMPLANTABLE ELECTRICAL NERVE STIMULATORS (VAGUS, AUTONOMIC NERVE AND PERIPHERAL NERVE STIMULATORS)
POLICY NUMBER	MP-1.034

ICD-10-CM Diagnosis Codes	Description
J96.2	Acute and chronic respiratory failure
Z45.42	Encounter for adjustment and management of neuropacemaker (brain) (peripheral nerve) (spinal cord)
Z45.49	Encounter for adjustment and management of other implanted nervous system device
Z46.2	Encounter for fitting and adjustment of other devices related to nervous system and special senses

Covered when Medically Necessary when billed with an allowed surgery:

HCPCS Codes	Description
C1767	Generator, neurostimulator (implantable), non-rechargeable
C1778	Lead, neurostimulator (implantable)
C1816	Receiver and/or transmitter, neurostimulator (implantable)
C1820	Generator, neurostimulator (implantable), with rechargeable battery and charging system
C1883	Adaptor/extension, pacing lead or neurostimulator lead (implantable)
C1897	Lead, neurostimulator test kit (implantable)
L8679	Implantable neurostimulator, pulse generator, any type
L8680	Implantable neurostimulator electrode (with any number of contact points), each
L8681	Pt program for implant neurostim
L8682	Implantable neurostimulator radiofrequency receiver
L8683	Radiofrequency transmitter (external) for use with implantable neurostimulator radiofrequency receiver
L8685	Implantable neurostimulator pulse generator, single array, rechargeable, includes extension
L8686	Implantable neurostimulator pulse generator, single array, non-rechargeable, includes extension
L8687	Implantable neurostimulator pulse generator, dual array, rechargeable, includes extension
L8688	Implantable neurostimulator pulse generator, dual array, non-rechargeable, includes extension
L8689	External recharging system for battery (internal) for use with implantable neurostimulator, replacement only

POLICY TITLE	IMPLANTABLE ELECTRICAL NERVE STIMULATORS (VAGUS, AUTONOMIC NERVE AND PERIPHERAL NERVE STIMULATORS)
POLICY NUMBER	MP-1.034

HCPCS Codes	Description
L8695	External recharging system for battery (external) for use with implantable neurostimulator, replacement only

IX. REFERENCES

TOP

Vagus Nerve Stimulation

1. *Panebianco M, Rigby A, Weston J, et al. Vagus nerve stimulation for partial seizures. Cochrane Database Syst Rev. Apr 03 2015(4):Cd002896. PMID 25835947*
2. *Englot DJ, Chang EF, Auguste KI. Vagus nerve stimulation for epilepsy: a meta-analysis of efficacy and predictors of response. J Neurosurg. Dec 2011;115(6):1248-1255. PMID 21838505*
3. *Ben-Menachem E, Hellstrom K, Waldton C, et al. Evaluation of refractory epilepsy treated with vagus nerve stimulation for up to 5 years. Neurology. Apr 12 1999;52(6):1265-1267. PMID 10214754*
4. *Parker AP, Polkey CE, Binnie CD, et al. Vagal nerve stimulation in epileptic encephalopathies. Pediatrics. Apr 1999;103(4 Pt 1):778-782. PMID 10103302*
5. *Labar D, Murphy J, Tecoma E. Vagus nerve stimulation for medication-resistant generalized epilepsy. E04 VNS Study Group. Neurology. Apr 22 1999;52(7):1510-1512. PMID 10227649*
6. *DeGiorgio C, Heck C, Bunch S, et al. Vagus nerve stimulation for epilepsy: randomized comparison of three stimulation paradigms. Neurology. Jul 26 2005;65(2):317-319. PMID 16043810*
7. *Chavel SM, Westerveld M, Spencer S. Long-term outcome of vagus nerve stimulation for refractory partial epilepsy. Epilepsy Behav. Jun 2003;4(3):302-309. PMID 12791333*
8. *Vonck K, Boon P, D'Have M, et al. Long-term results of vagus nerve stimulation in refractory epilepsy. Seizure. Sep 1999;8(6):328-334. PMID 10512772*
9. *Vonck K, Thadani V, Gilbert K, et al. Vagus nerve stimulation for refractory epilepsy: a transatlantic experience. J Clin Neurophysiol. Jul-Aug 2004;21(4):283-289. PMID 15509917*
10. *Majoie HJ, Berfelo MW, Aldenkamp AP, et al. Vagus nerve stimulation in children with therapy-resistant epilepsy diagnosed as Lennox-Gastaut syndrome: clinical results, neuropsychological effects, and cost-effectiveness. J Clin Neurophysiol. Sep 2001;18(5):419-428. PMID 11709647*
11. *Marangell LB, Rush AJ, George MS, et al. Vagus nerve stimulation (VNS) for major depressive episodes: one-year outcomes. Biol Psychiatry. Feb 15 2002;51(4):280-287. PMID 11958778*
12. *Huf RL, Mamelak A, Kneedy-Cayem K. Vagus nerve stimulation therapy: 2-year prospective open-label study of 40 subjects with refractory epilepsy and low IQ who are living in long-term care facilities. Epilepsy Behav. May 2005;6(3):417-423. PMID 15820352*

13. *Kang HC, Hwang YS, Kim DS, et al. Vagus nerve stimulation in pediatric intractable epilepsy: a Korean bicentric study. Acta Neurochir Suppl. Mar 2006;99:93-96. PMID 17370772*
14. *Ardesch JJ, Buschman HP, Wagener-Schimmel LJ, et al. Vagus nerve stimulation for medically refractory epilepsy: a long-term follow-up study. Seizure. Oct 2007;16(7):579-585. PMID 17543546*
15. *Michael JE, Wegener K, Barnes DW. Vagus nerve stimulation for intractable seizures: one-year follow-up. J Neurosci Nurs. Dec 1993;25(6):362-366. PMID 8106830*
16. *Ben-Menachem E, Manon-Espaillat R, Ristanovic R et al. Vagus nerve stimulation for treatment of partial seizures: 1. A controlled study of effect on seizures. First International Vagus Nerve Stimulation Study Group. Epilepsia. 1994 May;35(3). PMID 8026408*
17. *Handforth A, DeGiorgio CM, Schachter SC, et al. Vagus nerve stimulation therapy for partial-onset seizures: a randomized active-control trial. Neurology. Jul 1998;51(1):48-55. PMID 9674777*
18. *Klinkenberg S, Aalbers MW, Vles JS, et al. Vagus nerve stimulation in children with intractable epilepsy: a randomized controlled trial. Dev Med Child Neurol. Sep 2012;54(9):855-861. PMID 22540141*
19. *Ryvlin P, Gilliam FG, Nguyen DK, et al. The long-term effect of vagus nerve stimulation on quality of life in patients with pharmacoresistant focal epilepsy: the PuLsE (Open Prospective Randomized Long-term Effectiveness) trial. Epilepsia. Jun 2014;55(6):893-900. PMID 24754318*
20. *Englot DJ, Rolston JD, Wright CW, et al. Rates and predictors of seizure freedom with vagus nerve stimulation for intractable epilepsy. Neurosurgery. Sep 2016;79(3):345-353. PMID 26645965*
21. *Garcia-Navarrete E, Torres CV, Gallego I, et al. Long-term results of vagal nerve stimulation for adults with medication-resistant epilepsy who have been on unchanged antiepileptic medication. Seizure. Jan 2013;22(1):9-13. PMID 23041031*
22. *Hornig GW, Murphy JV, Schallert G, et al. Left vagus nerve stimulation in children with refractory epilepsy: an update. South Med J. May 1997;90(5):484-488. PMID 9160063*
23. *Murphy JV. Left vagal nerve stimulation in children with medically refractory epilepsy. The Pediatric VNS Study Group. J Pediatr. May 1999;134(5):563-566. PMID 10228290*
24. *Patwardhan RV, Stong B, Bebin EM, et al. Efficacy of vagal nerve stimulation in children with medically refractory epilepsy. Neurosurgery. Dec 2000;47(6):1353-1357; discussion 1357-1358. PMID 11126906*
25. *Frost M, Gates J, Helmers SL, et al. Vagus nerve stimulation in children with refractory seizures associated with Lennox-Gastaut syndrome. Epilepsia. Sep 2001;42(9):1148-1152. PMID 11580762*
26. *You SJ, Kang HC, Kim HD, et al. Vagus nerve stimulation in intractable childhood epilepsy: a Korean multicenter experience. J Korean Med Sci. Jun 2007;22(3):442-445. PMID 17596651*

27. *Cukiert A, Cukiert CM, Burattini JA, et al. A prospective long-term study on the outcome after vagus nerve stimulation at maximally tolerated current intensity in a cohort of children with refractory secondary generalized epilepsy. Neuromodulation. Nov 2013;16(6):551-556. PMID 23738578*
28. *Healy S, Lang J, Te Water Naude J, et al. Vagal nerve stimulation in children under 12 years old with medically intractable epilepsy. Childs Nerv Syst. Nov 2013;29(11):2095-2099. PMID 23681311*
29. *Terra VC, Furlanetti LL, Nunes AA, et al. Vagus nerve stimulation in pediatric patients: Is it really worthwhile? Epilepsy Behav. Feb 2014;31:329-333. PMID 24210463*
30. *Yu C, Ramgopal S, Libenson M, et al. Outcomes of vagal nerve stimulation in a pediatric population: A single-center experience. Seizure. Feb 2014;23(2):105-111. PMID 24309238*
31. *Daban C, Martinez-Aran A, Cruz N, et al. Safety and efficacy of Vagus Nerve Stimulation in treatment-resistant depression. A systematic review. J Affect Disord. Sep 2008;110(1-2):1-15. PMID 18374988*
32. *Rush AJ, Marangell LB, Sackeim HA, et al. Vagus nerve stimulation for treatment-resistant depression: a randomized, controlled acute phase trial. Biol Psychiatry. Sep 1 2005;58(5):347-354. PMID 16139580*
33. *Food and Drug Administration. Summary of Safety and Effectiveness Data: VNS TherapyTM System. 2005;* https://www.accessdata.fda.gov/cdrh_docs/pdf/p970003s050b.pdf*. Accessed March 25, 2020.*
34. *Martin JL, Martin-Sanchez E. Systematic review and meta-analysis of vagus nerve stimulation in the treatment of depression: variable results based on study designs. Eur Psychiatry. Apr 2012;27(3):147-155. PMID 22137776*
35. *Berry SM, Broglio K, Bunker M, et al. A patient-level meta-analysis of studies evaluating vagus nerve stimulation therapy for treatment-resistant depression. Med Devices (Auckl). Mar 2013;6:17-35. PMID 23482508*
36. *Bajbouj M, Merkl A, Schlaepfer TE, et al. Two-year outcome of vagus nerve stimulation in treatment-resistant depression. J Clin Psychopharmacol. Jun 2010;30(3):273-281. PMID 20473062*
37. *Aaronson ST, Carpenter LL, Conway CR, et al. Vagus nerve stimulation therapy randomized to different amounts of electrical charge for treatment-resistant depression: acute and chronic effects. Brain Stimul. Jul 2013;6(4):631-640. PMID 23122916*
38. *George MS, Rush AJ, Marangell LB, et al. A one-year comparison of vagus nerve stimulation with treatment as usual for treatment-resistant depression. Biol Psychiatry. Sep 01 2005;58(5):364-373. PMID 16139582*
39. *De Ferrari GM, Crijns HJ, Borggrefe M, et al. Chronic vagus nerve stimulation: a new and promising therapeutic approach for chronic heart failure. Eur Heart J. Apr 2011;32(7):847-855. PMID 21030409*
40. *Rush AJ, George MS, Sackeim HA, et al. Vagus nerve stimulation (VNS) for treatment-resistant depressions: a multicenter study. Biol Psychiatry. Feb 15 2000;47(4):276-286. PMID 10686262*

41. *Sackeim HA, Rush AJ, George MS, et al. Vagus nerve stimulation (VNS) for treatment-resistant depression: efficacy, side effects, and predictors of outcome. Neuropsychopharmacology. Nov 2001;25(5):713-728. PMID 11682255*
42. *Marangell LB, Suppes T, Zboyan HA, et al. A 1-year pilot study of vagus nerve stimulation in treatment-resistant rapid-cycling bipolar disorder. J Clin Psychiatry. Feb 2008;69(2):183-189. PMID 18211128*
43. *Tisi G, Franzini A, Messina G, et al. Vagus nerve stimulation therapy in treatment-resistant depression: a series report. Psychiatry Clin Neurosci. Aug 2014;68(8):606-611. PMID 25215365*
44. *Premchand RK, Sharma K, Mittal S, et al. autonomic regulation therapy via left or right cervical vagus nerve stimulation in patients with chronic heart failure: results of the ANTHEM-HF trial. J Card Fail. Nov 2014;20(11):808-816. PMID 25187002*
45. *Zannad F, De Ferrari GM, Tuinenburg AE, et al. Chronic vagal stimulation for the treatment of low ejection fraction heart failure: results of the NEural Cardiac TherApy foR Heart Failure (NECTAR-HF) randomized controlled trial. Eur Heart J. Feb 14 2015;36(7):425-433. PMID 25176942*
46. *Dawson J, Pierce D, Dixit A, et al. Safety, feasibility, and efficacy of vagus nerve stimulation paired with upper- limb rehabilitation after ischemic stroke. Stroke. Jan 2016;47(1):143-150. PMID 26645257*
47. *Kimberley TJ, Pierce D, Prudente CN, et al. Vagus Nerve Stimulation Paired With Upper Limb Rehabilitation After Chronic Stroke. Stroke, 2018 Oct 26;49(11). PMID 30355189*
48. *Lange G, Janal MN, Maniker A, et al. Safety and efficacy of vagus nerve stimulation in fibromyalgia: a phase I/II proof of concept trial. Pain Med. Sep 2011;12(9):1406-1413. PMID 21812908*
49. *De Ridder D, Vanneste S, Engineer ND, et al. Safety and efficacy of vagus nerve stimulation paired with tones for the treatment of tinnitus: a case series. Neuromodulation. Feb 2014;17(2):170-179. PMID 24255953*
50. *Engineer CT, Hays SA, Kilgard MP. Vagus nerve stimulation as a potential adjuvant to behavioral therapy for autism and other neurodevelopmental disorders. J Neurodev Disord. Jul 2017;9:20. PMID 28690686*
51. *International Headache Society. International Classification of Headache Disorders. 2018;* https://www.ichd-3.org*. Accessed March 25, 2020.*
52. *Tfelt-Hansen, PP, Pascual, JJ, Ramadan, NN, Dahlf, CC, D'Amico, DD, Diener, HH, Hansen, JJ, Lanteri-Minet, MM, Loder, EE, McCrory, DD, Plancade, SS, Schwedt, TT. Guidelines for controlled trials of drugs in migraine: third edition. A guide for investigators.. NA. PMID 22384463*
53. *Gaul C, Diener HC, Silver N, et al. Non-invasive vagus nerve stimulation for PREVention and Acute treatment of chronic cluster headache (PREVA): A randomised controlled study. Cephalalgia. May 2016;36(6):534-546. PMID 26391457*
54. *Gaul C, Magis D, Liebler E et al. Effects of non-invasive vagus nerve stimulation on attack frequency over time and expanded response rates in patients with chronic cluster headache:*

a post hoc analysis of the randomised, controlled PREVA study. J Headache Pain. 2017 Dec;18(1). PMID 28197844

55. *Silberstein SD, Mechtler LL, Kudrow DB, et al. Non-invasive vagus nerve stimulation for the ACute Treatment of Cluster Headache: findings from the randomized, double-blind, sham-controlled ACT1 Study. Headache. Sep 2016;56(8):1317-1332. PMID 27593728*
56. *Goadsby PJ, de Coo IF, Silver N, et al. Non-invasive vagus nerve stimulation for the acute treatment of episodic and chronic cluster headache: A randomized, double-blind, sham-controlled ACT2 study. Cephalalgia. Jan 1 2017:333102417744362. PMID 29231763*
57. *de Coo IF, Marin JC, Silberstein SD, et al. Differential efficacy of non-invasive vagus nerve stimulation for the acute treatment of episodic and chronic cluster headache: A meta-analysis. Cephalalgia, 2019 Jun 28;39(8). PMID 31246132*
58. *Silberstein SD, Calhoun AH, Lipton RB et al. Chronic migraine headache prevention with noninvasive vagus nerve stimulation: The EVENT study. Neurology. 2016 Aug;87(5). PMID 27412146*
59. *Diener HC, Goadsby PJ, Ashina M, et al. Non-invasive vagus nerve stimulation (nVNS) for the preventive treatment of episodic migraine: The multicentre, double-blind, randomised, sham-controlled PREMIUM trial.. Cephalalgia, 2019 Sep 17;39(12). PMID 31522546*
60. *Tassorelli C, Grazzi L, de Tommaso M et al. Noninvasive vagus nerve stimulation as acute therapy for migraine: The randomized PRESTO study. Neurology. 2018 Jul;91(4). PMID 29907608*
61. *Grazzi, LL, Tassorelli, CC, de Tommaso, MM, Pierangeli, GG, Martelletti, PP, Rainero, II, Geppetti, PP, Ambrosini, AA, Sarchielli, PP, Liebler, EE, Barbanti, PP, Tassorelli, CC, Bitetto, VV, De Icco, RR, Martinelli, DD, Sances, GG, Bianchi, MM, Grazzi, LL, Padovan, AA, de Tommaso, MM, Ricci, KK, Vecchio, EE, Cortelli, PP, Cevoli, SS, Pierangeli, GG, Terlizzi, RR, Martelletti, PP, Negro, AA, Chiariello, GG, Rainero, II, De Martino, PP, Gai, AA, Govone, FF, Masuzzo, FF, Rubino, EE, Torrieri, MM, Vacca, AA, Geppetti, PP, Chiarugi, AA, De Cesaris, FF, Puma, SS, Lupi, CC, Marone, II, Ambrosini, AA, Perrotta, AA, Sarchielli, PP, Bernetti, LL, Corbelli, II, Romoli, MM, Simoni, SS, Verzina, AA, Barbanti, PP, Aurilia, CC, Egeo, GG, Fofi, LL, Liebler, EE, Andersson, AA, Spitzer, LL, Marin, JJ, McClure, CC, Thackeray, LL, Baldi, MM, Di Maro, DD. Practical and clinical utility of non-invasive vagus nerve stimulation (nVNS) for the acute treatment of migraine: a post hoc analysis of the randomized, sham-controlled, double-blind PRESTO trial. J Headache Pain. 2019 Jan 7;20(1):1. PMID 30340460*
62. *Martelletti, PP, Barbanti, PP, Grazzi, LL, Pierangeli, GG, Rainero, II, Geppetti, PP, Ambrosini, AA, Sarchielli, PP, Tassorelli, CC, Liebler, EE, de Tommaso, MM, Tassorelli, CC, Bitetto, VV, De Icco, RR, Martinelli, DD, Sances, GG, Bianchi, MM, Grazzi, LL, Padovan, AA, de Tommaso, MM, Ricci, KK, Vecchio, EE, Cortelli, PP, Cevoli, SS, Pierangeli, GG, Terlizzi, RR, Martelletti, PP, Negro, AA, Chiariello, GG, Rainero, II, De Martino, PP, Gai, AA, Govone, FF, Masuzzo, FF, Rubino, EE, Torrieri, MM, Vacca, AA, Geppetti, PP, Chiarugi, AA, De Cesaris, FF, Puma, SS, Lupi, CC, Marone, II, Ambrosini, AA, Perrotta, AA, Sarchielli, PP, Bernetti, LL, Corbelli, II, Romoli, MM, Simoni, SS, Verzina,*

AA, Barbanti, PP, Aurilia, CC, Egeo, GG, Fofi, LL, Liebler, EE, Andersson, AA, Spitzer, LL, Marin, JJ, McClure, CC, Thackeray, LL, Baldi, MM, Di Maro, DD. Consistent effects of non-invasive vagus nerve stimulation (nVNS) for the acute treatment of migraine: additional findings from the randomized, sham-controlled, double-blind PRESTO trial. J Headache Pain. 2018 Dec 18;19(1):120. PMID 30382909

63. *Trimboli M, Al-Kaisy A, Andreou AP et al. Non-invasive vagus nerve stimulation for the management of refractory primary chronic headaches: A real-world experience. Cephalalgia. 2018 Jun;38(7). PMID 28899205*
64. *Grazzi, LL, Egeo, GG, Calhoun, AA, McClure, CC, Liebler, EE, Barbanti, PP. Non-invasive Vagus Nerve Stimulation (nVNS) as mini-prophylaxis for menstrual/menstrually related migraine: an open-label study.. NA. PMID 27699586*
65. *Kinfe TM, Pintea B, Muhammad S et al. Cervical non-invasive vagus nerve stimulation (nVNS) for preventive and acute treatment of episodic and chronic migraine and migraine-associated sleep disturbance: a prospective observational cohort study. J Headache Pain. 2015;16:101. PMID 26631234*
66. *Aihua L, Lu S, Liping L, et al. A controlled trial of transcutaneous vagus nerve stimulation for the treatment of pharmacoresistant epilepsy. Epilepsy Behav. Oct 2014;39:105-110. PMID 25240121*
67. *Stefan H, Kreiselmeyer G, Kerling F, et al. Transcutaneous vagus nerve stimulation (t-VNS) in pharmacoresistant epilepsies: a proof of concept trial. Epilepsia. Jul 2012;53(7):e115-118. PMID 22554199*
68. *He W, Jing X, Wang X, et al. Transcutaneous auricular vagus nerve stimulation as a complementary therapy for pediatric epilepsy: a pilot trial. Epilepsy Behav. Sep 2013;28(3):343-346. PMID 23820114*
69. *Hein E, Nowak M, Kiess O, et al. Auricular transcutaneous electrical nerve stimulation in depressed patients: a randomized controlled pilot study. J Neural Transm. May 2013;120(5):821-827. PMID 23117749*
70. *Hasan A, Wolff-Menzler C, Pfeiffer S, et al. Transcutaneous noninvasive vagus nerve stimulation (tVNS) in the treatment of schizophrenia: a bicentric randomized controlled pilot study. Eur Arch Psychiatry Clin Neurosci. Oct 2015;265(7):589-600. PMID 26210303*
71. *Shiozawa P, Silva ME, Carvalho TC, et al. Transcutaneous vagus and trigeminal nerve stimulation for neuropsychiatric disorders: a systematic review. Arq Neuropsiquiatr. Jul 2014;72(7):542-547. PMID 25054988*
72. *Huang F, Dong J, Kong J, et al. Effect of transcutaneous auricular vagus nerve stimulation on impaired glucose tolerance: a pilot randomized study. BMC Complement Altern Med. Jun 26 2014;14:203. PMID 24968966*
73. *Fisher RS, Handforth A. Reassessment: vagus nerve stimulation for epilepsy: a report of the Therapeutics and Technology Assessment Subcommittee of the American Academy of Neurology. Neurology. Sep 11 1999;53(4):666-669. PMID 10489023*
74. *Morris GL, 3rd, Gloss D, Buchhalter J, et al. Evidence-based guideline update: vagus nerve stimulation for the treatment of epilepsy: report of the Guideline Development Subcommittee*

of the American Academy of Neurology. Neurology. Oct 15 2013;81(16):1453-1459. PMID 23986299

75. *National Institute for Health and Care Excellence. Transcutaneous stimulation of the cervical branch of the vagus nerve for cluster headache and migraine (IPG552). 2016;* https://www.nice.org.uk/guidance/ipg552*. Accessed March 25, 2020.*
76. *National Institute for Health and Care Excellence. gammaCore for cluster headache (MIB162). 2018. https://www.nice.org.uk/advice/mib162. Accessed March 25, 2020.*
77. *National Institute for Health and Care Excellence. Medical technologies guidance [MTG46]: gammaCore for cluster headache. December 2019. https://www.nice.org.uk/guidance/MTG46. Accessed March 25, 2020.*
78. *Centers for Medicare & Medicaid Services (CMS). National Coverage Determination (NCD) for VAGUS Nerve Stimulation (VNS) (160.18). 2007;* https://www.cms.gov/medicare-coverage-database/details/ncd-details.aspx?NCDId=230&ncdver=2&CoverageSelection=National&KeyWord=vagus&KeyWordLookUp=Title&KeyWordSearchType=And&where=%252520index&nca_id=%252520195&bc=gAAAABAAAAAAAA%3d%3d&*. Accessed March 25, 2020.*
79. *Blue Cross Blue Shield Association Medical Policy Reference Manual. 7.01.20 Vagus Nerve Stimulation, March 2020.*

Peripheral Nerve Stimulation

Huntoon MA, Burgher AH. Ultrasound-Guided Permanent Implantation of Peripheral Nerve Stimulation (PNS) System for Neuropathic Pain of the Extremities: Original Cases and Outcomes. Pain Med. 2009 Nov; 10(8):1369-1377.

Autonomic (phrenic) nerve Stimulator

Marion, D. Pacing the diaphragm: Patient selection, evaluation, implantation and complications. In: UptoDate Online Journal [serial online}. Waltham, MA: UpToDate; updated Apr 30, 2018*. [Website]: www.uptodate.com. Accessed March 25, 2020.*

X. POLICY HISTORY

TOP

MP 1.034	**CAC 7/27/04**
	CAC 10/26/04
	CAC 10/25/05
	CAC 10/31/06
	CAC 9/25/07
	CAC 7/29/08
	CAC 1/27/09
	CAC 1/26/10 Consensus
	CAC 4/26/11 Consensus
	CAC 8/28/12 Minor revision. Two new investigational indications were added

POLICY TITLE	IMPLANTABLE ELECTRICAL NERVE STIMULATORS (VAGUS, AUTONOMIC NERVE AND PERIPHERAL NERVE STIMULATORS)
POLICY NUMBER	MP-1.034

	for vagus nerve stimulation to include treatment of heart failure and fibromyalgia. Codes reviewed 8/13/12
	01/3/13 2013 New codes added
	CAC 7/30/2013 Consensus
	12/20/2013- New 2014 Code updates made.
	01/2015-New 2015 codes added to policy.
	CAC 3/25/14 Consensus review. References updated. No changes to the policy statements. FEP variation revised to refer to the FEP medical policy manual.
	CAC 3/24/15 Consensus review. Tinnitus, and traumatic brain injury added to list of "all other" investigational indications. Rationale added. References updated. Codes reviewed.
	CAC 3/29/16 Consensus review. Peripheral subcutaneous field stimulation codes removed from this policy refer to MP-1.141, Peripheral Subcutaneous Field Stimulation (PSFS). Rationale and references updated. Coding updated.
	Admin Change 11/15/16 Variation Reformatting
	CAC 7/25/17 Consensus review. Variation to NCD 160.18 added. Cross-Reference, Description/Background, Regulatory Status, Rationale and Reference sections updated. Coding reviewed.
	1/1/18 Admin Update: Medicare variations removed from Commercial Policies.
	5/3/18 Consensus review. No change to policy statements. Background and references updated. Rationale condensed.
	1/1/19 Admin Update: Removed deleted codes 95974 & 95975. Added new codes 95976 & 95977 effective 1/1/19.
	3/20/2019 Consensus review. Policy statement was not changed. References reviewed.
	8/1/2019 Coding reviewed and updated.
	3/25/2020 Consensus review. Policy statement unchanged. Variations, definitions and references updated. Coding reviewed.

TOP