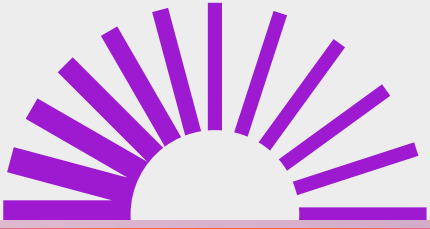
LivaNova | VNS Therapy™ Epilepsy

MRI Guidelines



To ensure effective communication with the MRI center, complete the Patient MRI Form. Send with the patient to their MRI appointment. Download from easy-mri.com

Pre-MRI instructions

An appropriate healthcare professional with access to a VNS Therapy™ programming system must prepare the VNS Therapy generator before the patient enters an MR system room.

- Interrogate the VNS Therapy generator* and record the generator settings
- Perform System Diagnostics to ensure proper operation of the generator
- If using a M3100 Programming System:
  Navigate to the "Pause Therapy" feature. Select Pause Therapy. This will set the output current (mA), magnet current (mA), AutoStim Current (mA)† and Tachycardia† detection to OFF. Patient's original settings will be resumed when "Resume Therapy" is selected.
- If using a legacy M3000 Programming system, reprogram the VNS Therapy stimulation output to OFF:
  - Output current (mA): 0.0
  - Magnet Current (mA): 0.0
  - AutoStim Current† (mA): 0.0 and Tachycardia† detection to OFF
- Turn off any other optional device features (Model 1000 and 1000-D only)
- Interrogate the generator* to verify that programming was successful
- Verify that placement of the VNS Therapy system is located between the C7 and T8 vertebrae

Post-MRI instructions

After the MRI procedure, an appropriate healthcare professional with access to a VNS Therapy™ programming system should assess the condition of the VNS Therapy system.

- Interrogate the VNS Therapy generator
  NOTE: If you pause therapy using a Model 3100 Programmer and then interrogate the device with a Model 3000 Programmer, you will encounter a Therapy Disabled error. To confirm the therapy paused, interrogate the VNS device with a Model 3100 is Programmer.
- Evaluate device status.
  - *If the device is in a paused state, select RESUME THERAPY. Interrogation is performed as part of the Resume Therapy workflow. Follow on-screen instructions to restore therapy.*
  - *If the device was programmed to 0, continue with "Reset" instructions below.*
- If reset: If the generator was reset during the MRI scan, reprogram the serial number, patient ID, and implant date, as needed.
  NOTE: For Model 102R and earlier devices, refer to the applicable programming guidance required to restore device settings.
- Program the patient's therapeutic parameters to the settings used prior to the MRI procedure.
- Perform System Diagnostics. Results should indicate Impedance = OK**
- Interrogate the generator again to confirm that reprogramming was successful.

* Interrogation retrieves the latest parameter settings and generator information from the VNS device.

†For select models with AutoStim Mode (AspireSR™ [Model 106] and SenTiva™ generators [Models 1000 and 1000-D]).

**If lead impedance is not OK after System Diagnostics, troubleshoot the system as appropriate and contact LivaNova Technical Support for further assistance (U.S.: 1-800-332-1375).

The latest VNS Therapy™ technology* provides expanded access to high quality 1.5T and 3T MRI

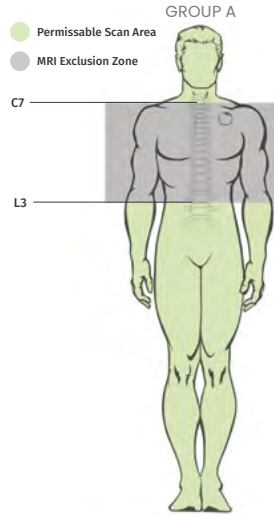
Scan Conditions - Latest VNS Therapy technology

*Demipulse™ Model 103, AspireHC™ Model 105, AspireSR™ Model 106, SenTiva™ Model 1000 and SenTiva DUO™ Model 1000-D implanted in the left chest higher than rib 4 (above armpit level)†

No special MRI equipment/coils required

Note: The scan iso-center must be outside the exclusion zone

† Patients with implants in other locations must follow Group B scan conditions



Performing MRI with a body coil is safe when the specified conditions are followed

MR Conditional	Yes
Static Magnet Strength	1.5T or 3T
Scanner Type	Horizontal field, cylindrical closed-bore 1.5T or 3T scanner
Operating Mode	Normal Operating Mode
Exclusion Zone	**Body coil:** C7-L3 **Transmit-receive head or extremity coil:** C7-T8
Max Spatial Gradient	≤3000 Gauss/cm
Max Slew Rate	200 T/m/s
RF Coil	**Transmit:** Body coil or Transmit-receive head or extremity coils **Receive:** No Restrictions
Max SAR	**Transmit head coil:** 3.2 W/kg **Transmit body coil:** 2.0 W/kg
System Programming	**Stimulation OFF Sensing OFF*** *for select models with AutoStim mode Optional device features OFF (Model 1000 only)
Exposure Time	**Transmit head or extremity coil:** No restrictions **Transmit body coil:** ≤ 15 minutes of active scan time within a 30 minute window
Additional Restrictions	**Transmit head or extremity coil:** none **Transmit body coil:** Circularized Polarized mode only

1.5T and 3T MRI scans are safe with ALL VNS Therapy™ models

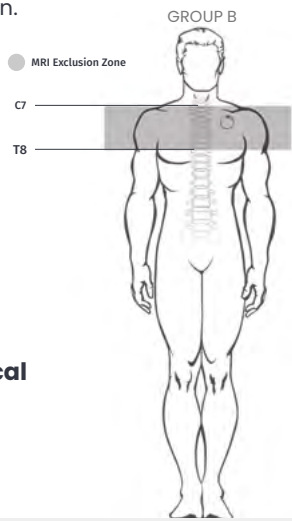
provided specific guidelines are followed

Scan Conditions

The following generators, when implanted in the left chest below rib 4 (below armpit level): Pulse™ Model 102, Pulse Duo™ Model 102R, DemiPulse™ Model 103, DemiPulse Duo™ Model 104, AspireHC™ Model 105, AspireSR™ Model 106, SenTiva™ Model 1000, and SenTiva DUO™ Model 1000-D. Older generator models are subject to these conditions regardless of implant location.

Requires local transmit-receive coil
Availability may vary

Permissable scans include head, knee, ankle, and wrist



Performing MRI with a local transmit/receive coil is safe when the specified conditions are followed

MR Conditional	Yes
Static Magnet Strength	1.5T or 3T
Scanner Type	Horizontal field, cylindrical closed-bore 1.5T or 3T scanner
Operating Mode	Normal Operating Mode
Exclusion Zone	C7-T8
Max Spatial Gradient	≤3000 Gauss/cm
Max Slew Rate	200 T/m/s
RF Coil	Transmit-receive head or extremity coils
Max SAR	**Transmit-receive head coil:** 3.2 W/kg
System Programming	**Stimulation OFF Sensing OFF*** *for select models with AutoStim mode Optional device features OFF (Model 1000 only)
Exposure Time	**Transmit-receive head or extremity coil:** No restrictions
Additional Restrictions	None

Special Cases

	Suspected Lead Break  OR Lead > 2 cm remaining 	Lead only ≤ 2 cm remaining* 
Exclusion Zone	C7-T8	None
MR Conditional	Yes	Yes
Static Magnet Strength	1.5T or 3T	1.5T or 3T
Operating Mode	Normal Operating Mode	Normal Operating Mode
Max Spatial Gradient	≤3000 Gauss/cm	≤3000 Gauss/cm
Max Slew Rate	200 T/m/s	200 T/m/s
RF Coil	Transmit-Receive head or extremity coils only	**Transmit:** Body or transmit-receive head or extremity coils **Receive:** No Restrictions
Max SAR	**Transmit/receive head coil:** 3.2 W/kg	**Transmit head coil:** 3.2 W/kg **Transmit body coil:** 2.0 W/kg

*Equivalent to clipping the lead at the anchor tether

Diagnostic imaging procedures, including computed tomography (CT), x-ray, and diagnostic ultrasound, have no known adverse effects on VNS Therapy generators or leads.

The device has been evaluated for MRI induced risks, including heating, unintended stimulation, force, torque, device malfunction and device vibration and has been determined to be safe under the conditions specified in labeling; however, the patient may feel sensations of warmth or vibration at the implant site during the MRI scan.

For **important safety information,** including the Online **VNS Therapy™ Brief Summary,** visit: VNSTherapy.com/hcp/safety

For technical product questions, contact LivaNova Technical Services at 1-866-882-8804

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LivaNova

Brief Summary of Safety Information for Physicians VNS Therapy System [Epilepsy Indication] (US) April 2025

The information contained in this Brief Summary for Physicians represents partial excerpts of important prescribing information taken from the physician's manuals. (Copies of VNS Therapy physician's and patient's manuals are posted at www.livanova.com). The information is not intended to serve as a substitute for a complete and thorough understanding of the material presented in all of the physician's manuals for the VNS Therapy and its component parts nor does this information represent full disclosure of all pertinent information concerning the use of this product, potential safety complications, or efficacy outcomes.

Physicians should inform patients about all potential risks and adverse events discussed in the physician's manuals. This document is not intended to serve as a substitute for the complete physician's manuals.

INTENDED USE / INDICATIONS

The VNS Therapy system is indicated for use as an adjunctive therapy in reducing the frequency of seizures in patients 4 years of age and older with partial onset seizures that are refractory to antiepileptic medications.

CONTRAINDICATIONS

Vagotomy — The VNS Therapy system cannot be used in patients with a bilateral or left cervical vagotomy.

Diathermy — Do not use shortwave diathermy, microwave diathermy, or therapeutic ultrasound diathermy (hereafter referred to as diathermy) on patients implanted with a VNS Therapy system.

WARNINGS — ALL IMPLANTS

Use — The VNS Therapy system should only be prescribed and monitored by physicians who have specific training and expertise in the management of seizures and the use of this device.It should only be implanted by physicians who are trained in surgery of the carotid sheath and have received specific training in the implantation of this device.
Not a Cure — Physicians should warn patients that VNS Therapy is not a cure for epilepsy. Since seizures may occur unexpectedly, patients should consult with a physician before they engage in unsupervised activities that could harm them or others (e.g., drive, swim, bathe, participate in strenuous sports).
Safety and Efficacy Not Established — The safety and efficacy of the VNS Therapy system have not been established for uses outside its approved indications for use. The safety and efficacy of VNS Therapy have not been shown for people with these conditions: ; Cardiac arrhythmias or other abnormalities; History of dysautonomias; History of previous therapeutic brain surgery or CNS injury History of respiratory diseases or disorders, including dyspnea and asthma; History of ulcers (gastric, duodenal, or other); History of vasovagal syncope; Only one vagus nerve; Other concurrent forms of brain stimulation; Pre-existing hoarseness; Progressive neurological diseases other than epilepsy; Primary generalized seizures; Under 4 years of age
Dysfunctional Cardiac Conduction Systems — The safety and effectiveness of the VNS Therapy system in patients with predisposed dysfunction of cardiac conduction systems (re-entry pathway) have not been established. Evaluation by a cardiologist is recommended if the family history, patient history, or electrocardiogram suggests an abnormal cardiac conduction pathway. Serum electrolytes, magnesium, and calcium should be documented before implantation. Additionally, postoperative bradycardia can occur among patients with certain underlying cardiac arrhythmias. Post-implant electrocardiograms and Holter monitoring are recommended if clinically indicated.
Bradycardia or Asystole During Implantation — It is important to follow recommended implantation procedures and intra-operative product tests described in the Implantation Procedure Overview. During the intra-operative System Diagnostics infrequent incidents of bradycardia and/or asystole have occurred. If asystole, severe bradycardia (heart rate < 40 bpm), or a clinically significant change in heart rate is encountered during a System Diagnostics or during initiation of stimulation, physicians should be prepared to follow guidelines consistent with Advanced Cardiac Life Support (ACLS).
External Defibrillation or Cardioversion (electrical) — External defibrillation or cardioversion (electrical) procedures may damage the generator and can temporarily or permanently damage the nerve. Follow these recommendations to minimize the flow of current through the generator and lead system: Position defibrillation patches or paddles perpendicular to the generator and lead system, and as far from the generator as possible; Use the lowest clinically appropriate energy output (watt-seconds); Confirm generator function after any internal or external defibrillation, or cardioversion treatment.
Magnetic Resonance Imaging (MRI) — Patients with the VNS Therapy system, or any part of the system, implanted should have MRI procedures performed only as described in the MRI Guidance instructions for use. In some cases, surgery will be required to remove the VNS Therapy system if a scan using a transmit RF body coil is needed.
MR Unsafe Devices — The Wand, Programmer, and patient magnet are MR Unsafe devices. These devices are projectile hazards and must not be brought into the MR scanner room.
Excessive Stimulation — Excessive stimulation is the combination of an excess duty cycle (i.e., one that occurs when ON time is greater than OFF time) and high frequency stimulation (i.e., stimulation at ≥ 50 Hz). Excessive stimulation has resulted in degenerative nerve damage in laboratory animals.
Device Manipulation — Patients who manipulate the generator and lead through the skin (Twiddler's Syndrome) may damage or disconnect the lead from the generator and/or possibly cause damage to the vagus nerve. For patients with the Model 1000/ Model 1000-D, recalibration of Prone Position detection may be required. Patients, parents, and caregivers should be warned against manipulating the generator and lead.
Swallowing Difficulties — Dysphagia (difficulty swallowing) may occur with active stimulation, and aspiration may result from the increased swallowing difficulties. Patients with pre- existing swallowing difficulties and those with a history of drooling or hypersalivation are at greater risk for aspiration. Appropriate aspiration precautions should be taken for such patients. Use of the magnet to temporarily stop stimulation while eating may mitigate the risk of aspiration.
Dyspnea or Shortness of Breath — Dyspnea (shortness of breath) may occur with active VNS Therapy. Any patient with underlying pulmonary disease or insufficiency, such as chronic obstructive pulmonary disease or asthma, may be at increased risk for dyspnea and should have their respiratory status evaluated prior to implantation and monitored following initiation of stimulation.
Obstructive Sleep Apnea (OSA) — Patients with obstructive sleep apnea (OSA) may have an increase in apneic events during stimulation. Lowering stimulus frequency or prolonging "OFF" time may prevent exacerbation of OSA. Vagus nerve stimulation may also cause new onset sleep apnea in patients who have not previously been diagnosed with this disorder. It is recommended that patients being considered for VNS Therapy who demonstrate signs or symptoms of OSA, or who are at increased risk for developing OSA, should undergo the appropriate evaluation prior to implantation.
Device Malfunction — Device malfunction could cause painful stimulation or direct current stimulation. Either event could cause nerve damage and other associated problems. Instruct patients, parents, and caregivers to use the magnet to stop stimulation if they suspect a

malfunction, and then to contact their physician immediately for further evaluation. Prompt surgical intervention may be required if a malfunction occurs.
Sudden Unexplained Death in Epilepsy (SUDEP) — Through August 1996, 10 sudden and unexpected deaths (definite, probable, and possible) were recorded among the 1,000 patients implanted and treated with the VNS Therapy device. During this period, these patients had accumulated 2,017 patient-years of exposure. Some of these deaths could represent seizure-related deaths in which the seizure was not observed, at night, for example. This number represents an incidence of 5.0 definite, probable, and possible SUDEP deaths per 1,000 patient-years. Although this rate exceeds that expected in a healthy (nonepileptic) population matched for age and sex, it is within the range of estimates for epilepsy patients not receiving vagus nerve stimulation, ranging from 1.3 SUDEP deaths for the general population of patients with epilepsy, to 3.5 (for definite and probable) for a recently studied antiepileptic drug (AED) clinical trial population similar to the VNS Therapy system clinical cohort, to 9.3 for patients with medically intractable epilepsy who were epilepsy surgery candidates.

WARNINGS — GENERATORS

Generators with AutoStim: Cardiac Arrhythmia— The AutoStim Mode feature should not be used in patients with clinically meaningful arrhythmias currently being managed by devices or treatments that interfere with normal intrinsic heart rate responses (e.g., pacemaker dependency, implantable defibrillator, beta adrenergic blocker medications). Patients also should not have a history of chronotropic incompetence commonly seen in patients with sustained bradycardia (heart rate < 50 bpm).
Generators with AutoStim: Pre- Surgical Surface Assessment — For anticipated use of the AutoStim feature, it is important to follow the recommended pre-surgical surface assessment described in the implantation procedure. For the device to detect heart rate, patients must have a peak-to-peak R-wave amplitude ≥ 0.4 mV on ECG measured from the proposed electrode location in the neck to the proposed generator location in the chest via surface ECG electrodes in the body positions described in Determine Acceptable
Implant Locations.
Potential Loss of Function (Model 1000 and Model 1000-D — Serial Numbers <500,000 Only) — The generator has an internal sensor that starts Magnet Mode stimulation when you pass the magnet over the generator or temporarily inhibits stimulation when you hold the magnet over the generator. This sensor component may fail to operate properly in a small number of Model 1000 and Model 1000-D generators, causing the following: The generator stops delivering therapy (i.e., Normal Mode, Magnet Mode, and AutoStim Mode stimulation); Detection functions (i.e., Tachycardia, Low Heart Rate, and Prone Position) stop working;
The generator cannot successfully complete an on-demand diagnostic test, and an error code may
display during attempts to perform diagnostic testing; If an intentional generator reset is performed
while the component is in a nonfunctional condition, diagnostic testing may result in LOW lead impedance. For implanted Model 1000 and Model 1000-D generators, perform an on-demand System Diagnostic test at each visit to monitor the generator's status and confirm function. Advise patients to use the magnet daily to verify that stimulation is felt and report any change in perceived clinical symptoms related to stimulation (e.g., increase in seizures, changes in perception of stimulation). Contact Technical Support if you observe
an error code or LOW lead impedance.

PRECAUTIONS — ALL IMPLANTS

Physician Training — Physicians who prescribe should be experienced in the diagnosis and treatment of epilepsy and should be familiar with the programming and use of the VNS Therapy system.

Use During Pregnancy — The safety and effectiveness of the VNS Therapy system have not been established for use during pregnancy.
Effects on Other Medical Devices — The VNS Therapy system may affect the operation of other implanted devices (e.g., cardiac pacemakers, implanted defibrillators). Possible effects include sensing problems and inappropriate device responses. If the patient requires concurrent implantable pacemaker, defibrillator therapy, or other types of stimulators, careful programming of each system may be necessary to optimize the patient's benefit from each device. Furthermore, when the VNS Therapy system and another stimulator are implanted in the same patient, the two stimulators should be placed at least 10 centimeters (4 inches) apart to avoid communication interference. Users should refer to the product labeling for the concurrent device to determine if there are additional precautions that should be observed.
Device Reset — Models 103 through 1000-D: When the generator is reset, its stimulation output is disabled; however, all settings and device history are preserved. After a successful reset, the generator stimulation output may be re- enabled to resume operation at the previously programmed settings.
Device Reset — Model 102 and Model 102R: A reset of the device will program the device OFF (output current = 0 mA).
Device History Loss — Model 102 and Model 102R: A reset of the device causes all device history information to be lost. The device history information (e.g., programmed patient initials, implant date, device serial number) should be documented before it is reset.

PRECAUTIONS — GENERATOR AND LEAD

Unintended Stimulation — Generators with AutoStim: For devices that sense changes in heart rate, false positive detection may cause unintended stimulation. Examples of instances where heart rate may increase include exercise, physical activity, and normal autonomic changes in heart rate, both awake and asleep, etc. Depending on the amount of unintended stimulation, adjustments to the AutoStim feature's detection threshold should be considered. If necessary, the feature can be disabled.
Battery Depletion or Drain — Generators with AutoStim: Talk to your patient about the AutoStim feature. Use of this feature will result in reduced battery longevity leading to more frequent replacements. Since the AutoStim feature can significantly affect the generator battery life, patients should return to their physician at appropriate intervals to evaluate whether they are receiving benefit from the current AutoStim settings.
Battery Depletion or Drain — Model 102 and Model 102R: Do not use frequencies of 5 Hz or below for long-term stimulation.
Scheduled Programming — Model 1000 and Model 1000- D: Since this feature allows the generator to apply therapy increases at scheduled intervals, it may not be appropriate for use in patients who are nonverbal or are unable to use the patient magnet to stop undesired stimulation. Similarly, exercise caution for use of this feature in patients with a history of obstructive sleep apnea, shortness of breath, coughing, swallowing difficulties, or aspiration.

PRECAUTIONS — RELATED TO IMPLANTATION

Vagus Nerve Placement — The VNS Therapy system is indicated for use only in stimulating the left vagus nerve in the neck area inside the carotid sheath, below where the superior and inferior cervical cardiac branches separate from the vagus nerve. The safety and efficacy of the VNS Therapy system have not been established for stimulation of the right vagus nerve or of any other

nerve, muscle, or tissue.
Reversal of Lead Polarity — Reversal of lead polarity has been associated with an increased chance of bradycardia in animal studies. It is important that the electrodes are attached to the left vagus nerve in the correct orientation.
Device Placement — Generators with AutoStim: For the AutoStim feature, the physical location of the device critically affects its ability to properly sense heart beats. Therefore, care must be taken to follow the implant location selection process outlined in the Implantation Procedure. Note that this implant location selection procedure may be performed pre-operatively as part of the patient's surgical work-up.
Infection Control — It is important to follow infection control procedures. Infections related to any implanted device are difficult to treat and may require that the device be explanted. The patient should be given antibiotics pre-operatively. The surgeon should ensure that all instruments are sterile prior to the operation. Children (4–11 years of age) may have a greater risk for infection when compared to adolescent and adult patients (≥12 years). Careful monitoring for site infection as well as the avoidance of manipulation of the surgical site post implant should be stressed.
Lead Stabilization — The patient can use a neck brace for the first week to help ensure proper lead
stabilization.
Programming After Surgery — Do not program the VNS Therapy system to an ON or periodic stimulation treatment for at least 14 days after the initial or replacement implantation. Failure to observe this precaution may result in patient discomfort or adverse events.
Laryngeal Irritation — Laryngeal irritation may result from stimulation. Patients who smoke may have an increased risk of laryngeal irritation.

PRECAUTIONS — HOSPITAL AND MEDICAL ENVIRONMENTS

VNS Therapy System Operation — Always perform device diagnostics after any of the procedures mentioned herein. Additional precautions for these procedures are described below.
Mammography — To obtain clear images, patients may need to be specially positioned for mammography procedures because of the location of the generator in the chest.
Therapeutic Radiation — Therapeutic radiation may damage the generator's circuitry. Sources of such radiation include therapeutic radiation, cobalt machines, and linear accelerators. The radiation effect is cumulative, with the extent of damage determined by the total dosage. The effects of exposure to such radiation can range from a temporary disturbance to permanent damage and may not be detectable immediately.
Electrosurgery — Use of electrosurgery [electrocautery or radio frequency (RF) ablation devices] may damage the generator.
Extracorporeal Shockwave Lithotripsy — Extracorporeal Shockwave Lithotripsy may damage the generator. If therapeutic ultrasound is required, do not position the area of the body where the generator is implanted in the water bath or in any other position that would expose it to ultrasound therapy. If that position cannot be avoided, program the generator output to 0 mA for the treatment, and then after therapy, reprogram the generator to the original parameters.
Treatment That Involves Electrical Currents — If the patient receives medical treatment for which electric current is passed through the body (e.g., from a TENS unit), either the generator output should be set to 0 mA or the function of the generator should be monitored during the initial stages of treatment.
Therapeutic Ultrasound — Routine therapeutic ultrasound could damage the generator and may be inadvertently concentrated by the device, causing harm to the patient.Diagnostic ultrasound has no known adverse effects on the generator or lead.
Magnetic Resonance Imaging (MRI) — An MRI should not be performed using a transmit RF body coil for certain VNS Therapy device configurations or under certain specific conditions. In some cases, heating of the lead caused by the transmit RF body coil during MRI may result in serious injury. Static, gradient, and radio frequency (RF) electromagnetic fields associated with MRI may change the generator settings (i.e., reset parameters) or activate the VNS Therapy device if the Magnet Mode (epilepsy) or Normal Mode (depression) output remains "ON".
Receive RF Coils — Certain magnetic resonance (MR) system head coils operate in receive-only mode and require use of the transmit RF body coil. Other MR systems use a transmit/receive RF head coil. Local or surface coils may also be receive-only RF coils that require the transmit RF body coil for MRI. The use of a receive RF coil does not alter hazards of the transmit RF body coil.
Transmit RF Coils — Exposure of the VNS Therapy system to any transmit RF coil must be avoided. Do not perform MRI scans using any transmit RF coil in the defined exclusion zones.

PRECAUTIONS — HOME OCCUPATIONAL ENVIRONMENTS

Avoid Strong Electric or Magnetic Fields — Patients should exercise reasonable caution in avoiding devices that generate a strong electric or magnetic field. If a generator ceases operation while in the presence of electromagnetic interference (EMI), moving away from the source may allow it to return to its normal mode of operation.

ADVERSE EVENTS

Adverse Events reported during clinical studies as statistically significant are listed below in alphabetical order: ataxia (loss of the ability to coordinate muscular movement); dyspepsia (indigestion); dyspnea (difficulty breathing, shortness of breath); hypoesthesia (impaired sense of touch); increased coughing; infection; insomnia (inability to sleep); laryngismus (throat, larynx spasms); nausea; pain; paresthesia (prickling of the skin); pharyngitis (inflammation of the pharynx, throat); voice alteration (hoarseness); vomiting. Adverse Events reported in clinical investigation of the AutoStim feature were comparable.

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