Gastric Pacing/Gastric Electrical Stimulation (GES)

**Coverage Policy**

Permanent gastric electrical stimulation (GES) or gastric pacing (e.g., Enterra™ Therapy) as is considered medically necessary when provided in accordance with the Humanitarian Device Exemption (HDE) specifications of the U.S. Food and Drug Administration (FDA) for intractable nausea and vomiting secondary to gastroparesis with failure, contraindication, or intolerance of pharmaceutical therapy.

**Gastric electrical stimulation (GES) or gastric pacing is considered experimental, investigational or unproven for any other indication.**

**Overview**

This Coverage Policy addresses gastric electrical stimulation (GES) for the treatment of intractable nausea and vomiting secondary to gastroparesis.

**General Background**

Gastric electrical stimulation (GES) (e.g., Enterra™ Therapy), also referred to as gastric pacing, has been proposed for patients with gastroparesis who are refractory to medical treatment. The device is implanted in the body and delivers high-frequency electrical stimulation at four times the basal rate (12 cycles per minute [cpm]) to the stomach. It is proposed that use of this device reduces the symptoms of gastroparesis such as nausea and vomiting and fosters improved gastric emptying.
A gastric pacemaker utilizes an external programmer and implanted electrical leads to the stomach. It transmits low-frequency, high-energy electrical stimulation to the stomach to entrain and pace the gastric slow waves to foster satiety. It has also been proposed for use in patients with morbid obesity.

**Gastric Electrical Stimulation for Gastroparesis**

Gastroparesis is a chronic motility disorder of the stomach characterized by gastric retention in the absence of mechanical obstruction. Diabetes mellitus is the most common disease associated with gastroparesis. Diabetic gastroparesis is believed to be a form of neuropathy of the vagus nerve. Hyperglycemia can also cause delayed gastric emptying. Idiopathic gastroparesis is the second most common type of gastroparesis, followed by postsurgical gastroparesis (Abell, et al., 2006; American Gastroenterological Association [AGA], 2004; Parkman, et al., 2003).

Symptoms of gastroparesis include early satiety, nausea, vomiting, bloating, and upper abdominal discomfort. Postprandial vomiting (1–3 hours after meals) of undigested food is typical. Abdominal discomfort is of varying degrees and is not usually the predominant symptom. The symptoms of gastroparesis are nonspecific and may mimic other conditions such as ulcer disease, partial gastric or small bowel obstruction, gastric cancer, gallbladder or pancreatic disorders. There is also an overlap of symptoms with functional dyspepsia (Abell, et al., 2006; AGA, 2004; Parkman, et al., 2003).

Primary medical management for gastroparesis includes dietary modification and pharmacologic therapy with prokinetic (metoclopramide and erythromycin) and antiemetic agents. Patients refractory to treatment are difficult to manage. Treatment may involve changing or combining medications; placement of a gastrostomy or jejunostomy tube for enteral feedings; or in severe cases, total parenteral nutrition (TPN) for brief periods (Abell, et al., 2006; AGA, 2004; Parkman, et al., 2003). Some patients, however, remain refractory to gastroparesis treatment.

Although proposed as a treatment for refractory gastroparesis, the exact mechanism of action of GES is not clearly known. The Enterra™ Therapy System (Medtronic, INC., Minneapolis, MN) is a gastric electrical stimulator. According to the manufacturer, the Enterra Therapy system is composed of a neurostimulator or implanted pulse generator (IPG), two implantable intramuscular leads and an external programming system. The intramuscular stomach leads are implanted laparoscopically on the greater curvature of the stomach. The IPG is implanted in a subcutaneous pocket typically created on the abdomen, and is then connected to the leads. The IPG provides the energy source that delivers the electrical pulse to the stomach muscle through the stomach leads. The generator stimulates the stomach muscle at a set of stimulation parameters determined by the physician (U.S. Food and Drug Administration [FDA], 2000b). The electrical stimulation produced by this device stimulates the stomach to contract and helps control the symptoms associated with gastroparesis, including nausea and vomiting (Medtronic Inc., 2016).

**U.S. Food and Drug Administration (FDA):** The Enterra Therapy System (Medtronic Inc., Minneapolis, MN) is a GES which received FDA marketing approval as a Class III medical device under the Humanitarian Device Exemption (HDE) on March 31, 2000. It is indicated for the treatment of chronic, intractable (drug refractory) nausea and vomiting secondary to gastroparesis of diabetic or idiopathic etiology. This system has not been evaluated for patients under age 18 or over age 70 (FDA, 2000b). According to the FDA, a humanitarian use device (HUD) is a device that is intended to benefit patients by treating or diagnosing a disease or condition that affects fewer than 4000 individuals in the United States per year. An HUD application is not required to contain the results of scientifically valid clinical investigations demonstrating that the device is effective for its intended purpose (FDA, 2014).

**Literature Review:** The evidence in the published peer-reviewed medical literature examining the safety and effectiveness of permanent GES for the treatment of gastroparesis primarily consists of observational studies and case series and few randomized control trials (RCTs). A Hayes Medical Technology Directory report analyzed the evidence (n=10 studies) for GES for the treatment of gastroparesis. The report evaluated controlled studies (n=7studies/18-241 patients) and uncontrolled studies (n=3 studies/131-233 patients). The controlled trials included RCTs (n=3 studies), prospective (n=2), and retrospective studies (n=2). Patients were selected who had symptomatic gastroparesis refractory to medical treatment with diagnoses of diabetic gastric...
neuropathy or idiopathic gastroparesis. Exclusion criteria included the structural cause of symptoms, psychogenic vomiting, chemical dependency, previous gastric surgery, and pregnancy. Outcomes measured were gastroparesis symptom severity and gastric retention assessed by scintigraphy. Additional outcomes included the need for nutritional support, and changes in antiemetic and/or prokinetic medications. Follow-up timeframe varied among studies, the longest follow-up being four years. The report found poor to fair quality evidence indicating that GES may improve gastroparesis symptoms and gastric emptying as well as decrease the need for nutritional support in some patients with refractory gastroparesis. Overall, GES was found to be safe with the device removal rate ranging from 7%-12% in most studies, primarily due to lack of symptom improvement. It was noted that despite the low quality of the supportive evidence, GES may be an option for patients with debilitating gastroparesis that is refractory to medical treatment (Hayes, 2013). Studies identified in a 2016 update of the Hayes Medical Technology Directory report did not change this conclusion.

McCallum et al. (2010) conducted a prospective, multicenter, double-blinded, randomized cross-over study (n=55) to evaluate the safety and efficacy of the Enterra gastric stimulation system in the treatment of intractable (drug-refractory) nausea and vomiting secondary to gastroparesis of diabetic etiology. The primary outcome measure was the reduction in weekly vomiting frequency when the device was turned on, relative to when the device was turned off during the blinded cross-over phase. Post-implantation, all patients had the stimulator turned on for six weeks and then were randomly assigned to groups that had consecutive three-month cross-over periods with the device on or off. After this period, the device was turned on in all patients with un-blinded follow-up for four months. Of the 55 subjects enrolled and implanted, 10 were not randomized. A total of 43 subjects completed the cross-over phase and 39 subjects completed 12-month visit follow up. Device-related adverse events included lead migration or dislodgements (n=3), device migrations (n=2), an implant site hematoma, and one implant site infection. The weekly vomiting frequency at 12 months decreased significantly when compared to baseline, with a median reduction of 67.8% (p<0.001). Gastric emptying was significantly improved at 12 months with a median retention at four hours of 20.5% compared with 46.5% at baseline (p=0.001). Although there were no statistical differences observed in the cross-over period, weekly vomiting frequency was reported to be somewhat better controlled during the on state than the off state (McCallum, et al., 2010). Study limitations include small sample size and loss to follow-up.

O’Grady et al. (2009) performed a meta-analysis of 13 studies evaluating GES for the treatment of medically refractory gastroparesis. Uncontrolled observational studies (n=12) and one blinded randomized control trial (RCT) (Abell, et al., 2003) were included. The findings reported from this review were that following GES, patients had statistically significant improvements in total symptom severity score (p=0.01), vomiting severity score (p<0.0001), and nausea severity score (p< 0.0001). The device removal or reimplantation rate was 8.3%.

Case series with patient populations ranging from 9─214 support the findings that GES may significantly improve upper GI symptoms and reduce the need for nutritional support in some patients with refractory diabetic or idiopathic gastroparesis (McCallum, et al., 2011; Islam et al., 2008; Anand, et al., 2007; Maranki, et al, 2007; McCallum, et al., 2005; Lin, et al., 2005; Lin, et al., 2004).

Temporary GES: Temporary GES or percutaneous stimulation has been investigated as a potential method for a less invasive trial prior to permanent GES insertion, but has not been proven. Use of endoscopically placed temporary stimulating electrodes has been proposed to help predict who might respond to a permanently implanted device. With this technique, a cannula with an internal needle is introduced through the skin and into the gastric submucosal region. A self-anchoring electrode is then placed through the needle. This method has been used to deliver electrical stimuli for up to eight weeks in patients with gastroparesis. Electrodes that can be placed during percutaneous gastrostomy placement have also been utilized (Hasler, 2017).

Literature Review: There is a paucity of studies in the published peer-reviewed medical literature evaluating temporary GES for gastroparesis or any other indication. Singh et al. (2015) published the results of a cohort study (n=551) which aimed to clarify the role of GES in gastroparesis-like syndrome (GLS), defined as gastroparesis-like symptoms with normal gastric scintigraphy. Inclusion criteria were as follows:

- gastroparesis symptoms of diabetic, surgically related or idiopathic etiology
- aged 18-70 years old
- symptoms of gastroparesis for ≥ one year
• refractory or intolerant to prokinetic and antiemetic drug classes
• chronic vomiting or nausea or severe dyspepsia like syndrome consistent with gastroparesis irrespective of gastric emptying test (GET) values

Patients were excluded if they were not candidates for endoscopic or surgical procedures or were pregnant. A total of 452 patients underwent gastric scintigraphy and were stratified into: delayed gastric emptying (n=273), normal gastric emptying (n=137), and rapid gastric emptying categories (n=42). Of the 551 patients in the larger cohort, 379 had IGES implantation. Outcomes measured were changes in gastric scintigraphy and total symptom score. After IGES, two-hour gastric retention decreased for the delayed patients (p<0.01), and increased for normal and rapid patients (p<0.001). These changes were accompanied by improvements (p<0.001) in vomiting, nausea, and total symptom scores in all three subgroups. Study limitations include the uncontrolled study design and the possibility of the treatment benefit being due to a placebo effect. Although study results suggest that tGES may be effective for treating GLS, well-designed RCTs are needed to support these findings.

Abell et al. (2011) published the results of a randomized, placebo-controlled, crossover trial (n=58) to measure the effects of endoscopically placed temporary GES (tGES) on gastroparesis symptoms. The study consisted of two consecutive, 4-day sessions (session 1 and session 2). Inclusion criteria were as follows:

• patients between the ages of 18 and 70 years, with a ≥ one-year history of gastroparesis symptoms from diabetic (n=13), postsurgical (n=7), or idiopathic (n=38) etiology
• gastroparesis symptoms refractory or intolerant to antiemetic drug classes with ≥ seven episodes of chronic vomiting and/or nausea per week, irrespective of gastric emptying time values

Patients with an active infection or pregnancy were excluded. Temporary GES was provided to 37/58 enrolled patients (group A [n=21]; group B [n=16]). During session 1 treatment was activated for 72 continuous hours in group A, and likewise activated in group B during session 2. The primary outcome measure was a 50% improvement in baseline symptom values. Secondary outcomes were gastric emptying, electrogastrography, and quality of life measured at baseline and session close. An overall treatment effect of a slight, non-significant daily decrease in average vomiting scores (p=0.116) was observed by pooling stimulation effects across sessions. The single reported adverse event was dislodged electrodes for six patients in group A and seven in group B. Study limitations include the small sample size and the fact that patients were allowed to continue medication for nausea or pain (prokinetics, anti-emetics) during the trial. The small sample size and non-significant improvement in symptoms make it difficult to draw conclusions from this study.

Gastric Electrical Stimulation for Other Indications

The use of GES is currently under investigation for the treatment of obesity and type 2 diabetes mellitus (T2DM).

Obesity: GES has been proposed as a device therapy for the treatment of morbid obesity. GES for obesity is currently registered by the FDA as investigational. In Europe, however, GES is being used clinically to treat obesity. Transneuronix, Inc., (Mt. Arlington, NJ), acquired in 2005 by Medtronic Inc. (Minneapolis, MN), developed the Transcend™ Gastric Stimulation System for obesity. This implantable gastric stimulator (IGS) has not been approved by the FDA. The device includes a pulse generator, an external programmer and a gastric stimulation lead, and is implanted laparoscopically in the subcutaneous tissue. The Transcend is intended to induce satiety by delaying gastric emptying (Greenway and Zheng, 2007).

A number of unresolved issues regarding the use of GES for treatment of obesity have been identified. The mechanism of action is unclear. Proposed possibilities include: a local enteric nervous system effect, an effect mediated by the autonomic nervous system, possible central nervous system changes and neurohormonal changes. Optimal stimulation patterns are unknown, as is the importance of the number of leads and the location of electrodes. Optimal screening of patients for GES for obesity has not yet been determined. Also, the best combination of behavioral, drug, device and surgical therapies has not been determined (Abell, et al., 2006a). As a result, the use of a gastric pacing device for these indications remains under investigation.
Literature Review: GES for the treatment of obesity has been evaluated in case series, randomized controlled trials (RCTs) and systematic reviews. Cha et al. (2014) performed a systematic review (n=31 studies/1367 patients) of the evidence to evaluate the effect of different types of gastric electrical stimulation (GES) on obesity. Published studies investigating the effect of GES using the Tantalus and Transcend devices, as well as vagus nerve stimulation, were included. Exclusion criteria for published studies were GES used for diseases other than obesity (e.g., gastroparesis); non-gastric stimulation, and non-clinical primary outcome. Studies were primarily non-randomized, with 4/31 randomized trials. In all studies, the generator was externalized and in most cases they were implanted in subcutaneous layers of the anterior abdominal wall. The electrodes connected to the generator were implanted in different locations of the stomach, depending on the type of GES. The primary outcome was weight loss, with secondary outcomes of appetite or satiety changes and biochemical marker changes. Almost all studies in each device group achieved statistically significant weight loss during the first 12 months. Only a small percentage of studies had a follow-up longer than one year, and found significant weight loss maintenance. Findings were inconsistent for secondary outcomes. Gastric penetration was the most common device-related complication. In general, the level of evidence was found to be low with few studies having a large population and low loss to follow-up. Results of studies in this systematic review suggest that GES may be effective for short-term weight loss. However well-designed studies with larger patient population and long-term follow up are needed to determine safety and effectiveness of the technology for this indication.

Shikora et al. (2009) conducted a randomized, double-blinded, placebo-controlled study (n=190), the Screened Health Assessment and Pacer Evaluation (SHAPE) trial. The SHPE study compared gastric stimulation therapy (n=96) to a standard diet and behavioral therapy regimen (n=94) in a group of obese patients. Subjects were required to be 18–65 years of age and have a BMI of 35–55 kg/m². Exclusion criteria included pregnancy, previous gastrointestinal bariatric surgery, the presence of other electrostimulation devices (e.g., pacemakers), gastrointestinal motility disorders, peptic ulcer disease, and clinically significant comorbidities such as poorly controlled diabetes. Follow-up occurred monthly for 12 months. The difference in excess weight loss (%EWL) between the control group and the treatment group was not found to be statistically significant (p=0.717) at 12 months of follow-up. These results suggest that this technology is not effective in achieving significant weight loss in severely obese individuals.

Shikora (2004a) reported an update of two U.S. clinical trials for gastric stimulation in obesity. The first was an RCT in 2000 that included patients (n=103) age 18–50 who had a BMI of 40–55 kg/m² (mean 46 kg/m²). No statistical difference in the weight loss between study and control groups was found at six-month follow-up. At 29 months, the overall mean EWL increased to > 12.0%. A total of 69 patients were lost to follow-up. The second trial (n=30), the Dual-Lead Implantable Gastric Electrical Stimulation Trial (DIGEST), was a non-randomized, open-label study of patients with a BMI 40–55 kg/m² or 35–39 kg/m² and one or more significant comorbidities. At the 12-month follow-up point, 71% of participants lost weight (54% lost > 10% of excess, and 29% lost > 20% excess). At the 16-month follow-up, mean EWL was 23%.

Several case series (n=11–91 patients) have investigated the implantation of GES for the treatment of obesity reporting varying rates of excess weight loss and improvement of comorbidities (Bohdjalian, et al., 2006; Miller, et al., 2006; Cigaina, et al., 2003). In addition to the lack of randomization, in general studies have been limited by small sample sizes and short-term follow-up.

There is insufficient evidence in the published scientific literature to support the use of gastric pacing for the treatment of morbid obesity.

Type 2 Diabetes Mellitus (T2DM): The effect of GES on HbA1c and blood glucose levels, along with changes in body weight is also being investigated. The DIAMOND® (Diabetes Improvement And MetabOlic Normalization Device), formerly known as the TANTALUS device, has been developed by MetaCure, Inc. (Kfar-Saba, Israel). The DIAMOND device consists of three pairs of bipolar electrodes. One pair is attached to the gastric fundus and the other two pairs are attached to the anterior and the posterior antrum of the stomach. The electrodes are implanted laparoscopically and connected to a pulse generator inserted into the subcutaneous tissue of the abdomen. The pulse generator uses a rechargeable battery as an external power source. The delivered electrical signal characteristics are set by a programmer within the first week after the implantation (Lebovitz, et
Clinical trials are now being conducted using this device for overweight and obese patients with type 2 diabetes.

**Literature Review:** The evidence in the published peer-reviewed medical literature examining the safety and effectiveness of GES for obese patients with T2DM consists of few case series (Lebovitz, et al., 2015; Bohdijalian, et al., 2009; Policker, et al., 2009; Sanmiguel, et al., 2009). Patient populations in these studies have ranged from 14–61, with a follow-up of primarily six–12 months. Although preliminary results suggest that GES may improve glycemic control and induce weight loss in patients with T2DM, additional evidence in the form of well-designed RCTs is needed to confirm these findings.

**Professional Societies/Organizations**
The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) states that gastric electrical stimulation may be effective for some people whose nausea and vomiting do not improve with dietary changes or medications (NIDDK, 2012).

In a technical review of the diagnosis and treatment of gastroparesis, the American Gastroenterology Association (AGA) (2004), determined that there are a number of issues with gastric electrical stimulation that require further investigation and evaluation. These include confirmation of the effectiveness of gastric stimulation in a long-term, blinded fashion, identification of patients most likely to respond, and determination of optimal electrode position and stimulation parameters. In a technical review on obesity (AGA, 2002), the AGA stated that randomized controlled trials are needed to determine the effectiveness and safety of new surgical approaches to obesity (gastric pacing, laparoscopic techniques).

**Use Outside of the US**
The Australia and New Zealand Horizon Scanning Network’s (ANZHSN) scanning program is a collaborative Commonwealth and State initiative guided by the Health Policy Advisory Committee on Technology (HealthPACT). HealthPACT provides jurisdictions with evidence-based advice on emerging technologies. This information is used to inform jurisdiction financing decisions and to assist in the managed introduction of new technologies. According to HealthPACT, it is unclear how widely Enterra therapy is employed for the treatment of gastroparesis in European countries, although it does seem to be used in the U.K. at present. In March 2002, Enterra Therapy received the Conformité Européene (CE) mark making the device commercially available in Europe (HealthPACT, 2006).

A 2006 Horizon Scanning report prepared by the Australian safety and Efficacy Register of New Intervventional Procedures – Surgical (ASERNIP-S) for HealthPACT provided recommendations on the Enterra device. Stage of development was determined to be “not yet emerged” in Australia, with limited use in Europe and the US. The Enterra system was not listed or registered in the Australian Register of Therapeutic Goods (ARTG). The HealthPACT advisory states that “the available evidence regarding the Enterra system provides sufficient encouragement and the potential to improve the symptoms and overall quality of life of patients with gastroparesis to warrant the conduct of more robust randomized multi-center research, including an economic evaluation. It is not recommended that this procedure be used outside the context of a clinical trial protocol” (HealthPACT, 2006).

The Transcend IGS (manufactured by Transneuronix; Medtronic acquired Transneuronix in July 2005) is being used to treat obesity in Europe and was granted CE mark approval in 2001 (HealthPACT, 2005).

A 2005 Horizon Scanning Prioritizing Summary prepared by ASERNIP-S for the Health Policy Advisory Committee on Technology (HealthPACT) provided recommendations on the Transcend device. Stage of development in Australia was deemed experimental and use limited in Italy, Austria, Sweden, Germany, Belgium, France, and a trial is underway in the USA. It was reported that “the use of gastric electrical stimulation for the treatment of obesity offers a potentially safe and effective alternative for patients who are not suited for surgery. Based on the evidence available, it is proposed that this technology is monitored until the publication of RCT results” (HealthPACT, 2005). A 2009 update found the new evidence to be in line with inconsistent results of previous studies and stated that “given the inconsistency of results and the lack of development, further assessment will not be conducted” (HealthPACT, 2009).
The National Institute for Health and Care Excellence (NICE) (United Kingdom) issued a statement in 2014 which supports the use of gastric electrical stimulation for gastroparesis. NICE states that “current evidence on the efficacy and safety of gastric electrical stimulation for gastroparesis is adequate to support the use of this procedure with normal arrangements for clinical governance, consent and audit” (NICE, 2014).

**Coding/Billing Information**

**Note:**
1) This list of codes may not be all-inclusive.
2) Deleted codes and codes which are not effective at the time the service is rendered may not be eligible for reimbursement.

**Intractable Nausea and Vomiting Secondary to Gastroparesis:**

**Considered Medically Necessary when criteria in the applicable policy statements listed above are met:**

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<th>CPT® Codes</th>
<th>Description</th>
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<td>43647</td>
<td>Laparoscopy, surgical; implantation or replacement of gastric neurostimulator electrodes, antrum</td>
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<tr>
<td>43881</td>
<td>Implantation or replacement of gastric neurostimulator electrodes, antrum, open</td>
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<tr>
<td>64590</td>
<td>Insertion or replacement of peripheral or gastric neurostimulator pulse generator or receiver, direct or inductive coupling</td>
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<tr>
<td>95980</td>
<td>Electronic analysis of implanted neurostimulator pulse generator system (eg, rate, pulse amplitude and duration, configuration of wave form, battery status, electrode selectability, output modulation, cycling, impedance and patient measurements) gastric neurostimulator pulse generator/transmitter; intraoperative, with programming</td>
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<td>95981</td>
<td>Electronic analysis of implanted neurostimulator pulse generator system (eg, rate, pulse amplitude and duration, configuration of wave form, battery status, electrode selectability, output modulation, cycling, impedance and patient measurements) gastric neurostimulator pulse generator/transmitter; subsequent, without reprogramming</td>
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<td>95982</td>
<td>Electronic analysis of implanted neurostimulator pulse generator system (eg, rate, pulse amplitude and duration, configuration of wave form, battery status, electrode selectability, output modulation, cycling, impedance and patient measurements) gastric neurostimulator pulse generator/transmitter; subsequent, with reprogramming</td>
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**Any Other Indication:**

**Considered Experimental/Investigational/Unproven when used to report open or laparoscopic implantation or replacement of gastric stimulation electrodes, lesser curvature (i.e., morbid obesity):**

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<tr>
<th>CPT®* Codes</th>
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**References**


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