# Intraoperative Neurophysiologic Monitoring

**Tests can be done on specific nerves during complex brain, spine, and neck surgeries to help make sure the nerves are not being harmed. This is known as intraoperative neurophysiologic monitoring (IONM). There are a number of ways to perform this monitoring. It often involves the use of sophisticated medical devices to assess the muscle or electrical response when a nerve is stimulated. The goal is to provide the surgeon with immediate feedback about whether a nerve is at risk of being injured. The surgeon can make a correction right away to avoid permanent damage. This type of monitoring is well proven in specific types of surgeries. Some surgeons are using IONM during surgery for nerves located outside of the brain and spinal cord (the peripheral nerves). There is not enough medical evidence to show whether IONM leads to better health results when used for the peripheral nerves. For this reason, IONM is considered not medically necessary for peripheral nerve surgery.**

**Note:** The Introduction section is for your general knowledge and is not to be taken as policy coverage criteria. The rest of the policy uses specific words and concepts familiar to medical professionals. It is intended for providers. A provider can be a person, such as a doctor, nurse, psychologist, or dentist. A provider also can be a place where medical care is given, like a hospital, clinic, or lab. This policy informs them about when a service may be covered.
<table>
<thead>
<tr>
<th>Intraoperative Monitoring</th>
<th>Medical Necessity</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Somatosensory-evoked potentials</td>
<td>Intraoperative neurophysiologic monitoring may be considered medically necessary when addressed in this policy and there is risk of nerve, recurrent laryngeal nerve or spinal cord injury during the following spinal, intracranial, or vascular surgical procedures: (this list may not be all inclusive)</td>
</tr>
<tr>
<td>• Motor-evoked potentials using transcranial electrical stimulation</td>
<td>• Aortic, thoracic, and abdominal aneurysm repair</td>
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<td>• Brainstem auditory-evoked potentials</td>
<td>• Aortic cross-clamping</td>
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<tr>
<td>• Electromyography (EMG) of cranial nerves</td>
<td>• Arteriovenous malformation repair of the spinal cord</td>
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<td>• Electroencephalography</td>
<td>• Brachial plexus surgery</td>
</tr>
<tr>
<td>• Electrocorticography</td>
<td>• Cerebral vascular surgery (eg, carotid endarterectomy, cerebral aneurysm)</td>
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<td></td>
<td>• Clipping of intracranial aneurysms</td>
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<td></td>
<td>• Cortical localization</td>
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<td></td>
<td>• Interventional neuroradiology</td>
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<tr>
<td></td>
<td>• Intracranial arteriovenous malformation</td>
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<td></td>
<td>• Parotid tumor resection</td>
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<td></td>
<td>• Pelvic fracture surgery</td>
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<td></td>
<td>• Release of a tethered cord</td>
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<td></td>
<td>• Repair of coarctation of the aorta</td>
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<td></td>
<td>• Resection of acoustic neuroma</td>
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<td>• Resection of fourth ventricular cyst</td>
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<td>• Resection of intracranial vascular lesions</td>
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<td>• Resection of skull base tumor</td>
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<td></td>
<td>• Resection of spinal cord tumor, cyst, or vascular lesion</td>
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<td></td>
<td>• Resection of tumor involving a cranial nerve</td>
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<td></td>
<td>• Scoliosis correction with instrumentation</td>
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<td></td>
<td>• Surgical stabilization of spine fractures</td>
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<td></td>
<td>• Stereotactic surgery of the brain or brain stem, thalamus, or cerebral cortex</td>
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<td></td>
<td>• Thalamus tumor resection or thalamotomy</td>
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<td></td>
<td>• Thyroid/parathyroid surgery</td>
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<td></td>
<td>• Thoracic to L1-L2 lumbar spine surgery (see below)</td>
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</tbody>
</table>
| | • Anterior cervical spine surgery associated with any of the following high-risk situations:
<table>
<thead>
<tr>
<th>Intraoperative Monitoring</th>
<th>Medical Necessity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>o Prior anterior cervical spine surgery (particularly revision anterior cervical discectomy and fusion)</td>
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<td></td>
<td>o Revision surgery through a scarred surgical field</td>
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<td></td>
<td>o Reoperation for pseudarthrosis</td>
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<td></td>
<td>o Revision for failed cervical fusion</td>
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<tr>
<td></td>
<td>o Multilevel anterior cervical discectomy and fusion</td>
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<td></td>
<td>o Preexisting recurrent laryngeal nerve pathology (when there is residual function of the recurrent laryngeal nerve)</td>
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<td></td>
<td>Intraoperative neurophysiologic monitoring for ANY other indication, including during routine cervical decompression, routine cervical fusion, cervical disc arthroplasty, and during lumbar spine surgery below L1/L2 is considered not medically necessary (baseline neurophysiologic studies performed at the same time are also considered not medically necessary)(see Related Information)</td>
</tr>
<tr>
<td></td>
<td>• EMG</td>
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<td></td>
<td>• Nerve conduction velocity monitoring</td>
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<tr>
<td></td>
<td>The listed types of intraoperative neurophysiologic monitoring during surgery on the peripheral nerves are considered not medically necessary.</td>
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<tr>
<td></td>
<td>• Train of four monitoring</td>
</tr>
<tr>
<td></td>
<td>Train of four monitoring is considered integral to intraoperative monitoring and/or administration of anesthesia. It is therefore not separately payable</td>
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<tr>
<td></td>
<td>Intraoperative Monitoring</td>
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<tr>
<td></td>
<td>Investigational</td>
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<tr>
<td></td>
<td>The listed types of intraoperative neurophysiologic monitoring during the following surgical procedure is considered investigational:</td>
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<tr>
<td></td>
<td>• Esophageal surgeries</td>
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</table>
**Intraoperative Monitoring**

**Investigational**

| Motor-evoked potentials using transcranial magnetic stimulation | Due to the lack of monitors approved by the U.S. Food and Drug Administration, intraoperative monitoring of motor-evoked potentials using transcranial magnetic stimulation is considered investigational. |

**Coding**

**Reviewed for Medical Necessity**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>CPT</strong></td>
<td></td>
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<tr>
<td>95940</td>
<td>Continuous intraoperative neurophysiology monitoring in the operating room, one on one monitoring requiring personal attendance, each 15 minutes (List separately in addition to code for primary procedure)</td>
</tr>
<tr>
<td>95941</td>
<td>Continuous intraoperative neurophysiology monitoring, from outside the operating room (remote or nearby) or for monitoring of more than one case while in the operating room, per hour (List separately in addition to code for primary procedure)</td>
</tr>
<tr>
<td>95999</td>
<td>Unlisted neurological or neuromuscular diagnostic procedure (train of four monitoring)</td>
</tr>
<tr>
<td><strong>HCPCS</strong></td>
<td></td>
</tr>
<tr>
<td>G0453</td>
<td>Continuous intraoperative neurophysiology monitoring, from outside the operating room (remote or nearby), per patient, (attention directed exclusively to one patient) each 15 minutes (list in addition to primary procedure)</td>
</tr>
</tbody>
</table>

**Note:** CPT codes, descriptions and materials are copyrighted by the American Medical Association (AMA). HCPCS codes, descriptions and materials are copyrighted by Centers for Medicare Services (CMS).

**Related Information**

These policy statements refer only to use of these techniques as part of intraoperative monitoring. Other clinical applications of these techniques, such as visual-evoked potentials and EMG, are not considered in this policy.
IONM of SSEPs/MEPs for evaluation of nerve injury when performed for spine surgery is performed above where the spinal cord terminates. Because the spinal cord ends at the level of vertebrae L1-L2, there is no clinical utility for IONM of SSEPs or MEPs for surgical procedures below the spinal level L1-L2. Intraoperative neurophysiologic monitoring including somatosensory-evoked potentials and motor-evoked potentials using transcranial electrical stimulation, brainstem auditory-evoked potentials, electromyography of cranial nerves, electroencephalography, and electrocorticography has broad acceptance, particularly for spine surgery and open abdominal aorta aneurysm repairs. Additionally, this policy addresses monitoring of the recurrent laryngeal nerve during neck surgeries and monitoring of peripheral nerves.

Intra-operative monitoring is considered reimbursable as a separate service only when a licensed health care practitioner, other than the operating surgeon, performs the monitoring, while in attendance in the operating room or present by means of a real-time remote mechanism and is immediately available to interpret the recording and advise the surgeon throughout the procedure.

Intra-operative monitoring consists of a physician monitoring not more than three cases simultaneously.

Constant communication between surgeon, neurophysiologist, and anesthetist are required for safe and effective intraoperative neurophysiologic monitoring.

Evidence Review

Description

Intraoperative neurophysiologic monitoring (IONM) describes a variety of procedures used to monitor the integrity of neural pathways during high-risk neurosurgical, orthopedic, and vascular surgeries. It involves the detection of electrical signals produced by the nervous system in response to sensory or electrical stimuli to provide information about the functional integrity of neuronal structures. This policy does not expound on established neurophysiologic monitoring (ie, somatosensory-evoked potentials, motor-evoked potentials using transcranial electrical stimulation, brainstem auditory-evoked potentials, electromyography of cranial nerves, electroencephalography, electrocorticography), during spinal, intracranial, or vascular procedures.
Background

Intraoperative Neurophysiologic Monitoring

The principal goal of intraoperative neurophysiologic monitoring (IONM) is the identification of nervous system impairment on the assumption that prompt intervention will prevent permanent deficits. Correctable factors at surgery include circulatory disturbance, excess compression from retraction, bony structures, hematomas, or mechanical stretching. The technology is continuously evolving with refinements in equipment and analytic techniques, including recording, with several patients monitored under the supervision of a physician who is outside the operating room.

The different methodologies of monitoring are described next.

Sensory-Evoked Potentials

Sensory-evoked potentials (SEPs) describes the responses of the sensory pathways to sensory or electrical stimuli. Intraoperative monitoring of SEPs is used to assess the functional integrity of central nervous system (CNS) pathways during surgeries that put the spinal cord or brain at risk for significant ischemia or traumatic injury. The basic principles of SEP monitoring involve identification of a neurologic region at risk, selection and stimulation of a nerve that carries a signal through the at-risk region and recording and interpretation of the signal at certain standardized points along the pathway. Monitoring of SEPs is commonly used in the following procedures: carotid endarterectomy, brain surgery involving vasculature, surgery with distraction compression or ischemia of the spinal cord and brainstem, and acoustic neuroma surgery. SEPs can be categorized by type of simulation used, as follows.

Somatosensory-Evoked Potentials

Somatosensory-evoked potentials (SSEPs) are cortical responses elicited by peripheral nerve stimulations. Peripheral nerves, such as the median, ulnar, or tibial nerves, are typically stimulated, but, in some situations, the spinal cord may be stimulated directly. The recording is done either cortically or at the level of the spinal cord above the surgical procedure. Intraoperative monitoring of SSEPs is most commonly used during orthopedic or neurologic surgery to prompt intervention to reduce surgically induced morbidity and/or to monitor the
level of anesthesia. One of the most common indications for SSEP monitoring is in patients undergoing corrective surgery for scoliosis. In this setting, SSEP monitors the status of the posterior column pathways and thus does not reflect ischemia in the anterior (motor) pathways. Several different techniques are commonly used, including stimulation of a relevant peripheral nerve with monitoring from the scalp, from interspinous ligament needle electrodes, or from catheter electrodes in the epidural space.

**Brainstem Auditory-Evoked Potentials**

Brainstem auditory-evoked potentials (BAEPs) are generated in response to auditory clicks and can define the functional status of the auditory nerve. Surgical resection of a cerebellopontine angle tumor, such as an acoustic neuroma, places the auditory nerves at risk, and BAEPs have been extensively used to monitor auditory function during these procedures.

**Visual-Evoked Potentials**

Visual-evoked potentials (VEPs) with light flashes are used to track visual signals from the retina to the occipital cortex. VEP monitoring has been used for surgery on lesions near the optic chiasm. However, VEPs are very difficult to interpret due to their sensitivity to anesthesia, temperature, and blood pressure.

**Motor-Evoked Potentials**

Motor-evoked potentials (MEPs) are recorded from muscles following direct or transcranial electrical stimulation of motor cortex or pulsed magnetic stimulation provided using a coil placed over the head. Peripheral motor responses (muscle activity) are recorded by electrodes placed on the skin at prescribed points along the motor pathways. MEPs, especially when induced by magnetic stimulation, can be affected by anesthesia. The Digitimer **electrical** cortical stimulator received U.S. Food and Drug Administration (FDA) premarket approval in 2002. Devices for transcranial **magnetic** stimulation have not been approved by the FDA for this use.

Multimodal IONM, in which more than one technique is used, most commonly with SSEPs and MEPs, has also been described.
Electromyogram Monitoring and Nerve Conduction Velocity Measurements

Electromyography (EMG) monitoring and nerve conduction velocity measurements can be performed in the operating room and may be used to assess the status of the cranial or peripheral nerves (eg, to identify the extent of nerve damage before nerve grafting or during resection of tumors). For procedures with a risk of vocal cord paralysis due to damage to the recurrent laryngeal nerve (ie, during carotid artery, thyroid, parathyroid, goiter, or anterior cervical spine procedures), monitoring of the vocal cords or vocal cord muscles has been performed. These techniques may also be used during procedures proximal to the nerve roots and peripheral nerves to assess the presence of excessive traction or other impairment. Surgery in the region of cranial nerves can be monitored by electrically stimulating the proximal (brain) end of the nerve and recording via EMG activity in the facial or neck muscles. Thus, monitoring is done in the direction opposite that of SEPs, but the purpose is similar, to verify that the neural pathway is intact.

Electroencephalogram Monitoring

Spontaneous electroencephalography (EEG) monitoring can also be used during surgery and can be subdivided as follows:

- EEG monitoring has been widely used to monitor cerebral ischemia secondary to carotid cross-clamping during a carotid endarterectomy. EEG monitoring may identify those patients who would benefit from the use of a vascular shunt during the procedure to restore adequate cerebral perfusion. Conversely, shunts, which have an associated risk of iatrogenic complications, may be avoided in those patients with normal EEG activity. Carotid endarterectomy may be done with the patient under local anesthesia so that monitoring of cortical function can be directly assessed.

- Electrocorticography (ECoG) is the recording of the EEG activity directly from a surgically exposed cerebral cortex. ECoG is typically used to define the sensory cortex and map the critical limits of a surgical resection. ECoG recordings have been most frequently used to identify epileptogenic regions for resection. In these applications, ECoG does not constitute monitoring, per se.

Intraoperative neurophysiologic monitoring (IONM), including SSEPs and MEPs using transcranial electrical stimulation, BAEPs, EMG of cranial nerves, EEG, and ECoG, has broad acceptance, particularly for spine surgery and open abdominal aorta aneurysm repairs. These indications have long been considered standard of care, as evidenced by numerous society guidelines, including those from the American Academy of Neurology, American Clinical
Neurophysiology Society, American Association of Neurological Surgeons, Congress of Neurologic Surgeons, and American Association of Neuromuscular & Electrodiagnostic Medicine. Therefore, this policy focuses on monitoring of the recurrent laryngeal nerve during neck and esophageal surgeries and monitoring of peripheral nerves.

Summary of Evidence

For individuals who are undergoing thyroid or parathyroid surgery and are at high risk of injury to the recurrent laryngeal nerve (RLN) who receive intraoperative neurophysiologic monitoring (IONM), the evidence includes a large randomized controlled trial (RCT) and systematic reviews. Relevant outcomes are morbid events, functional outcomes, and quality of life. The strongest evidence on neurophysiologic monitoring derives from an RCT of 1000 patients undergoing thyroid surgery. This RCT found a significant reduction in RLN injury in patients at high risk for injury. High risk in this trial was defined as surgery for thyroid or parathyroid cancer, thyrotoxicosis, retrosternal or giant goiter, or thyroiditis. The high-risk category may also include patients with prior thyroid or parathyroid surgery or total thyroidectomy. A low volume of surgeries might also contribute to a higher risk for RLN injury. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals who are undergoing anterior cervical spine surgery and are at high risk of injury to the RLN who receive IONM, the evidence includes systematic reviews of case series and cohort studies. Relevant outcomes are morbid events, functional outcomes, and quality of life. The evidence on the use of IONM to reduce RLN injury during cervical spinal surgery includes a 2017 systematic review and a meta-analysis. Of the ten studies assessed in the systematic review, two compared the risk of nerve injury with use of IONM vs no IONM and found no difference. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who are undergoing esophageal surgery who receive IONM, the evidence includes a nonrandomized comparative study. Relevant outcomes are morbid events, functional outcomes, and quality of life. One nonrandomized comparative study on surgery for esophageal cancer was identified. Interpretation of this study is confounded because only those patients who had visual identification of the nerve underwent neurophysiologic monitoring. Current evidence is not sufficiently robust to determine whether neurophysiologic monitoring reduces RLN injury in patients undergoing surgery for esophageal cancer. The evidence is insufficient to determine the effects of the technology on health outcomes.
For individuals who are undergoing surgery proximal to a peripheral nerve who receive IONM, the evidence includes case series and a controlled cohort study. Relevant outcomes are morbid events, functional outcomes, and quality of life. Surgical guidance with peripheral IONM and the predictive ability of monitoring of peripheral nerves have been reported. No prospective comparative studies were identified that assessed whether outcomes are improved with neurophysiologic monitoring. The evidence is insufficient to determine the effects of the technology on health outcomes.

Intraoperative neurophysiological monitoring is indicated in select spine surgeries when there is risk for additional spinal cord injury. Intraoperative monitoring has not been shown to be of clinical benefit for routine lumbar or cervical nerve root decompression (AANEM 2014), or during routine lumbar or cervical laminectomy or fusion (AANEM, 1999a) in the absence of myelopathy or other complicating conditions, which could increase the potential risk of damage to the nerve root or spinal cord, Resnick et al (2005) in published guidelines for the performance of fusion procedures for degenerative disease of the lumbar spine reported that based on the medical evidence of the literature reviewed there did not appear to be support for the hypothesis that any form of intraoperative monitoring improves patient outcomes following lumbar decompression or fusion procedures for degenerative spinal disease. The authors concluded in a 2014 update there was no evidence that intraoperative monitoring can prevent injury to the nerve roots.

Hadley, et.al. (2017) published guidelines for the use of electrophysiological monitoring during spine surgery. The authors made recommendations on the diagnostic, therapeutic (preventive) and cost effectiveness of IONM based on their systematic review of the literature. They concluded, IONM during spinal surgery is a reliable and valid diagnostic tool to assess spinal cord integrity (Level 1 evidence). However, the authors found IONM during spine surgery does not improve total tumor resection or improve neurological outcome when used during tumor resection procedures. (Level II evidence), nor did the literature reviewed support a therapeutic relationship between IONM and neurological outcome during spine surgery. The authors stated, “IONM may detect a neurological injury during spine surgery, but it does not result in improved neurological outcome, even if IONM alerts occur.” (Level III evidence).

Ongoing and Unpublished Clinical Trials

Some currently ongoing and unpublished trials that might influence this review are listed in Table 1.
Table 1. Summary of Key Trials

<table>
<thead>
<tr>
<th>NCT No.</th>
<th>Trial Name</th>
<th>Planned Enrollment</th>
<th>Completion Date</th>
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</thead>
<tbody>
<tr>
<td>Ongoing</td>
<td></td>
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<tr>
<td>NCT03773120</td>
<td>Effectiveness of Intraoperative Neuromonitoring of the External Branch of the Superior Laryngeal Nerve During Thyroid Surgery</td>
<td>126</td>
<td>Jun 2020</td>
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<tr>
<td>NCT01630785</td>
<td>Neurophysiological Monitoring IONM Retrospective Data Analysis of Neurophysiological Data for Intraoperative or Epilepsy Monitoring</td>
<td>5000</td>
<td>Dec 2025</td>
</tr>
<tr>
<td>Unpublished</td>
<td></td>
<td></td>
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<tr>
<td>NCT02395146</td>
<td>Intra-operative Monitoring of the External Branch of the Superior Laryngeal Nerve (EBSLN) During Thyroid Surgery: Does it Improve Voice Preservation?</td>
<td>60</td>
<td>Oct 2018 (updated 06/19/19)</td>
</tr>
<tr>
<td>NCT01585727</td>
<td>Continuous Intraoperative Monitoring of the Pelvic Autonomic Nerves During Total Mesorectal Excision (TME) for the Prevention of Urogenital and Anorectal Dysfunction in Patients With Rectal Cancer (NEUROS)</td>
<td>188</td>
<td>Dec 2018 (updated 02/27/19)</td>
</tr>
</tbody>
</table>

NCT: national clinical trial.

Denotes industry-sponsored or cosponsored trial.

Clinical Input Received from Physician Specialty Societies and Academic Medical Centers

While the various physician specialty societies and academic medical centers may collaborate with and make recommendations during this process, through the provision of appropriate reviewers, input received does not represent an endorsement or position statement by the physician specialty societies or academic medical centers, unless otherwise noted.

2017 Input

In response to requests, clinical input on intraoperative neurophysiologic monitoring (IONM) of the recurrent laryngeal nerve (RLN) for individuals undergoing cervical spine surgery was received from five specialty society-level responses while this policy was under review in 2017.
Based on the evidence and independent clinical input, the clinical input supports that the following indication provides a clinically meaningful improvement in the net health outcome and is consistent with generally accepted medical practice:

- Use of IONM of the recurrent laryngeal nerve for individuals undergoing cervical spine surgery with:
  - prior anterior cervical surgery, particularly revision anterior cervical discectomy and fusion, revision surgery through a scarred surgical field, reoperation for pseudarthrosis, or revision for failed fusion;
  - multilevel anterior cervical discectomy and fusion; and
  - preexisting recurrent laryngeal nerve (RLN) pathology, when there is residual function of the RLN

2014 Input

In response to requests, input was received from five physician specialty societies (seven responses) and two academic medical centers while this policy was under review in 2014. Input agreed that intraoperative neurophysiologic monitoring (IONM) with somatosensory-evoked potentials, motor-evoked potentials (MEPs) using transcranial electrical stimulation, brainstem auditory-evoked potentials, electromyography of cranial nerves, electroencephalography, or electrocorticography may be medically necessary during spinal, intracranial, or vascular procedures. There was general agreement that IONM of visual-evoked potentials and MEPs using transcranial magnetic stimulation is investigational. Input was mixed on whether IONM of peripheral nerves would be considered medically necessary. Some reviewers recommended monitoring some peripheral nerves during spinal surgery (eg, nerve roots, percutaneous pedicle screw placement, lateral transpsoas approach to the lumbar spine). Other reviewers suggested use of IONM during resection of peripheral nerve tumors or surgery around the brachial plexus or facial/cranial nerves.
Practice Guidelines and Position Statements

American Association of Neurological Surgeons and Congress of Neurological Surgeons

In 2018, the American Association of Neurological Surgeons (AANS) and Congress of Neurological Surgeons (CNS) updated their position statement on intraoperative neurophysiologic monitoring during routine spinal surgery. They stated that intraoperative neurophysiologic monitoring, especially motor evoked potential, “is a reliable diagnostic tool for assessment of spinal cord integrity during surgery” (Level 1 evidence). Intraoperative motor evoked potentials may also “predict recovery in traumatic cervical spinal cord injury.” However, AANS and Congress of Neurological Surgeons found no evidence that such monitoring provides a therapeutic benefit. The statement also recommends that intraoperative neurophysiologic monitoring should be used when the operating surgeon believes it is warranted for diagnostic value, such as with “deformity correction, spinal instability, spinal cord compression, intradural spinal cord lesions, and when in proximity to peripheral nerves or roots.” In addition, they recommend spontaneous and evoked electromyography “for minimally invasive lateral retroperitoneal transpsoas approaches to the lumbar spine” and during pedicle screw insertion.

American Association of Neuromuscular & Electrodiagnostic Medicine

In 2017, the American Association of Neuromuscular & Electrodiagnostic Medicine (AANEM) updated their position statement on electrodiagnostic medicine. The recommendations indicated that intraoperative sensory-evoked potentials have demonstrated usefulness for monitoring of spinal cord, brainstem, and brain sensory tracts. The AANEM stated that intraoperative SEP monitoring is indicated for select spine surgeries in which there is a risk of additional nerve root or spinal cord injury. Indications for SEP monitoring may include, but are not limited to, complex, extensive, or lengthy procedures, and when mandated by hospital policy. However, intraoperative SEP monitoring may not be indicated for routine lumbar or cervical root decompression.

American Clinical Neurophysiology Society

In 2009, the American Clinical Neurophysiology Society (ACNS) recommended standards for IONM. Guideline 11A included the following statement:

Guideline 11A

11A. Intraoperative monitoring is an adjunct to the surgeon's ability to assess the neurologic status of the patient. It is indicated when there is a risk of neurologic injury, such as with deformity correction, spinal instability, spinal cord compression, intradural spinal cord lesions, and when in proximity to peripheral nerves or roots. Intraoperative monitoring may include the use of somatosensory evoked potentials, motor evoked potentials, electromyography, and nerve stimulation. The decision to use intraoperative monitoring should be based on the individual patient's clinical condition and the specific surgical procedure. The monitoring should be performed by a qualified professional who is trained in the use of the specific monitoring equipment.

Guideline 11B

11B. The use of intraoperative monitoring should be carefully considered and tailored to the specific surgical procedure. The monitoring should be performed by a qualified professional who is trained in the use of the specific monitoring equipment. The monitoring should be performed in a standardized manner, with consistent data collection and interpretation. The monitoring should be terminated if there is a lack of evidence of neurologic injury or if the procedure is completed.

Guideline 11C

11C. The use of intraoperative monitoring should be carefully considered and tailored to the specific surgical procedure. The monitoring should be performed by a qualified professional who is trained in the use of the specific monitoring equipment. The monitoring should be performed in a standardized manner, with consistent data collection and interpretation. The monitoring should be terminated if there is a lack of evidence of neurologic injury or if the procedure is completed.

Guideline 11D

11D. The use of intraoperative monitoring should be carefully considered and tailored to the specific surgical procedure. The monitoring should be performed by a qualified professional who is trained in the use of the specific monitoring equipment. The monitoring should be performed in a standardized manner, with consistent data collection and interpretation. The monitoring should be terminated if there is a lack of evidence of neurologic injury or if the procedure is completed.

Guideline 11E

11E. The use of intraoperative monitoring should be carefully considered and tailored to the specific surgical procedure. The monitoring should be performed by a qualified professional who is trained in the use of the specific monitoring equipment. The monitoring should be performed in a standardized manner, with consistent data collection and interpretation. The monitoring should be terminated if there is a lack of evidence of neurologic injury or if the procedure is completed.

Guideline 11F

11F. The use of intraoperative monitoring should be carefully considered and tailored to the specific surgical procedure. The monitoring should be performed by a qualified professional who is trained in the use of the specific monitoring equipment. The monitoring should be performed in a standardized manner, with consistent data collection and interpretation. The monitoring should be terminated if there is a lack of evidence of neurologic injury or if the procedure is completed.

Guideline 11G

11G. The use of intraoperative monitoring should be carefully considered and tailored to the specific surgical procedure. The monitoring should be performed by a qualified professional who is trained in the use of the specific monitoring equipment. The monitoring should be performed in a standardized manner, with consistent data collection and interpretation. The monitoring should be terminated if there is a lack of evidence of neurologic injury or if the procedure is completed.

Guideline 11H

11H. The use of intraoperative monitoring should be carefully considered and tailored to the specific surgical procedure. The monitoring should be performed by a qualified professional who is trained in the use of the specific monitoring equipment. The monitoring should be performed in a standardized manner, with consistent data collection and interpretation. The monitoring should be terminated if there is a lack of evidence of neurologic injury or if the procedure is completed.

Guideline 11I

11I. The use of intraoperative monitoring should be carefully considered and tailored to the specific surgical procedure. The monitoring should be performed by a qualified professional who is trained in the use of the specific monitoring equipment. The monitoring should be performed in a standardized manner, with consistent data collection and interpretation. The monitoring should be terminated if there is a lack of evidence of neurologic injury or if the procedure is completed.

Guideline 11J

11J. The use of intraoperative monitoring should be carefully considered and tailored to the specific surgical procedure. The monitoring should be performed by a qualified professional who is trained in the use of the specific monitoring equipment. The monitoring should be performed in a standardized manner, with consistent data collection and interpretation. The monitoring should be terminated if there is a lack of evidence of neurologic injury or if the procedure is completed.

Guideline 11K

11K. The use of intraoperative monitoring should be carefully considered and tailored to the specific surgical procedure. The monitoring should be performed by a qualified professional who is trained in the use of the specific monitoring equipment. The monitoring should be performed in a standardized manner, with consistent data collection and interpretation. The monitoring should be terminated if there is a lack of evidence of neurologic injury or if the procedure is completed.

Guideline 11L

11L. The use of intraoperative monitoring should be carefully considered and tailored to the specific surgical procedure. The monitoring should be performed by a qualified professional who is trained in the use of the specific monitoring equipment. The monitoring should be performed in a standardized manner, with consistent data collection and interpretation. The monitoring should be terminated if there is a lack of evidence of neurologic injury or if the procedure is completed.

Guideline 11M

11M. The use of intraoperative monitoring should be carefully considered and tailored to the specific surgical procedure. The monitoring should be performed by a qualified professional who is trained in the use of the specific monitoring equipment. The monitoring should be performed in a standardized manner, with consistent data collection and interpretation. The monitoring should be terminated if there is a lack of evidence of neurologic injury or if the procedure is completed.

Guideline 11N

11N. The use of intraoperative monitoring should be carefully considered and tailored to the specific surgical procedure. The monitoring should be performed by a qualified professional who is trained in the use of the specific monitoring equipment. The monitoring should be performed in a standardized manner, with consistent data collection and interpretation. The monitoring should be terminated if there is a lack of evidence of neurologic injury or if the procedure is completed.

Guideline 11O

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The monitoring team should be under the direct supervision of a physician with training and experience in NIOM [neurophysiologic intraoperative monitoring]. The monitoring physician should be licensed in the state and privileged to interpret neurophysiologic testing in the hospital in which the surgery is being performed. He/she is responsible for real-time interpretation of NIOM data. The monitoring physician should be present in the operating room or have access to NIOM data in real-time from a remote location and be in communication with the staff in the operating room. There are many methods of remote monitoring, however any method used must conform to local and national protected health information guidelines. The monitoring physician must be available to be in the operating room, and the specifics of this availability (ie, types of surgeries) should be decided by the hospital credentialing committee. In order to devote the needed attention, it is recommended that the monitoring physician interpret no more than three cases concurrently.

American Academy of Neurology

In 1990 (updated in 2012), the American Academy of Neurology (AAN) published an assessment of IONM, with an evidence-based guideline update by the AAN and ACNS (2012).1,2 The 1990 assessment indicated that monitoring requires a team approach with a well-trained physician-neurophysiologist to provide or supervise monitoring. Electroencephalography (EEG) monitoring is used during carotid endarterectomy or for other similar situations in which cerebral blood flow is at high risk. Electrocorticography from surgically exposed cortex can help to define the optimal limits of surgical resection or identify regions of greatest impairment, while sensory cortex SSEPs can help to localize the central fissure and motor cortex. Auditory-evoked potentials, along with cranial nerve monitoring can be used during posterior fossa neurosurgical procedures. Spinal cord SSEPs are frequently used to monitor the spinal cord during orthopedic or neurosurgical procedures around the spinal cord, or cross-clamping of the thoracic aorta. Electromyographic monitoring during procedures near the roots and peripheral nerves can be used to warn of excessive traction or other impairment of motor nerves. At the time of the 1990 assessment, motor-evoked potentials (MEPs) were considered investigational by many neurophysiologists. The 2012 update, which was endorsed by the AANEM, concluded that the available evidence supported IONM using SSEPs or MEPs when conducted under the supervision of a clinical neurophysiologist experienced with IONM. Evidence was insufficient to evaluate IONM when conducted by technicians alone or by an automated device.
In 2012, the AAN published a model policy on principles of coding for IONM and testing.27 The background section of this document provides the following information on the value of IONM in averting neural injuries during surgery:

1. “Value of EEG Monitoring in Carotid Surgery. Carotid occlusion, incident to carotid endarterectomies, poses a high risk for cerebral hemispheric injury. EEG monitoring is capable of detecting cerebral ischemia, a serious prelude to injury. Studies of continuous monitoring established the ability of EEG to correctly predict risks of postoperative deficits after a deliberate, but necessary, carotid occlusion as part of the surgical procedure. The surgeon can then respond to adverse EEG events by raising blood pressure, implanting a shunt, adjusting a poorly functioning shunt, or performing other interventions.

2. Multicenter Data in Spinal Surgeries. An extensive multicenter study conducted in 1995 demonstrated that IOM [intraoperative neurophysiologic monitoring] using SEP reduced the risk of paraplegia by 60% in spinal surgeries. The incidence of false negative cases, wherein an operative complication occurred without having been detected by the monitoring procedure, was small: 0.06%.

3. Technology Assessment of Monitoring in Spinal Surgeries. A technology assessment by the McGill University Health Center reviewed 11 studies and concluded that spinal IOM is capable of substantially reducing injury in surgeries that pose a risk to spinal cord integrity. It recommended combined SEP/MEP monitoring, under the presence or constant availability of a monitoring physician, for all cases of spinal surgery for which there is a risk of spinal cord injury.

4. Value of Combined Motor and Sensory Monitoring. Numerous studies of post-surgical paraparesis and quadriplegia have shown that both SEP and MEP monitoring had predicted adverse outcomes in a timely fashion. The timing of the predictions allowed the surgeons the opportunity to intervene and prevent adverse outcomes. The two different techniques (SEP and MEP) monitor different spinal cord tracts. Sometimes, one of the techniques cannot be used for practical purposes, for anesthetic reasons, or because of preoperative absence of signals in those pathways. Thus, the decision about which of these techniques to use needs to be tailored to the individual patient’s circumstances.

5. Protecting the Spinal Cord from Ischemia during Aortic Procedures. Studies have shown that IOM accurately predicts risks for spinal cord ischemia associated with clamping the aorta or ligating segmental spinal arteries. IOM can assess whether the spinal cord is tolerating the degree of relative ischemia in these procedures. The surgeon can then respond by raising blood pressure, implanting a shunt, re-implanting segmental vessels, draining spinal fluid, or through other interventions.
6. **Value of EMG [electromyography] Monitoring.** Selective posterior rhizotomy in cerebral palsy significantly reduces spasticity, increases range of motion, and improves functional skills. Electromyography during this procedure can assist in selecting specific dorsal roots to transect. EMG can also be used in peripheral nerve procedures that pose a risk of injuries to nerves.

7. **Value of Spinal Monitoring using SSEPs and MEPs.** According to a recent review of spinal monitoring using SSEP and MEPs by the Therapeutics and Technology Assessment Subcommittee of AAN and ACNS, IOM is established as effective to predict an increased risk of the adverse outcomes of paraparesis, paraplegia, and quadriplegia in spinal surgery (4 Class I and 7 Class II studies). Surgeons and other members of the operating team should be alerted to the increased risk of severe adverse neurologic outcomes in patients with important IOM changes (Level A).

The AAN model policy also offered guidance on personnel and monitoring standards for IONM and SSEP.

**American Society of Neurophysiological Monitoring**

In 2018, the American Society of Neurophysiological Monitoring (ASNM) published practice guidelines for the supervising professional on IONM. The ASNM (2013) position statement on intraoperative MEP monitoring indicated that MEPs are an established practice option for cortical and subcortical mapping and monitoring during surgeries risking motor injury in the brain, brainstem, spinal cord or facial nerve.

**National Institute for Health and Care Excellence**

In 2008, a guidance from the National Institute for Health and Care Excellence on IONM during thyroid surgery found no major safety concerns. Regarding efficacy, IONM was indicated as helpful “in performing more complex operations such as reoperative surgery and operations on large thyroid glands.”

**Medicare National Coverage**

The Centers for Medicare & Medicaid Services has indicated that EEG monitoring “may be covered routinely in carotid endarterectomies and in other neurological procedures where
cerebral perfusion could be reduced. Such other procedures might include aneurysm surgery where hypotensive anesthesia is used or other cerebral vascular procedures where cerebral blood flow may be interrupted.\textsuperscript{31} Coverage determinations for other modalities were not identified.

The Centers for Medicare & Medicaid Services Physician Fee Schedule Final Rule (2013) discussed payment of neurophysiologic monitoring. The rule states that CPT code 95940, which is reported when a physician monitors a patient directly, is payable by Medicare. CPT code 95941, which is used for remote monitoring, was made invalid for submission to Medicare.

In the Final Rule, the Centers established a HCPCS G code for reporting physician monitoring performed from outside of the operating room (nearby or remotely). HCPCS code G0453 “may be billed only for undivided attention by the monitoring physician to a single beneficiary [1:1 technologist to oversight physician billing], and not for simultaneous attention by the monitoring physician to more than one patient.”\textsuperscript{32}

**Regulatory Status**

A number of electroencephalography (EEG) and electromyography (EMG) monitors have been cleared for marketing by the U.S. Food and Drug Administration (FDA) through the 510(k) process. FDA product code: GWQ.

Intraoperative neurophysiologic monitoring (IONM) of motor-evoked potentials (MEPs) using transcranial magnetic stimulation does not have FDA approval.

**References**


31. Centers for Medicare & Medicaid Services. National Coverage Determination (NCD) for Electroencephalographic Monitoring During Surgical Procedures Involving the Cerebral Vasculature (160.8). 2006; https://www.cms.gov/medicare-coverage-database/details/ncd-details.aspx?NCDId=77&ncdver=2&CoverageSelection=National&KeyWord=monitoring&KeyWordLookUp=Title&KeyWordLookUp=Title&KeyWordSearchType=And&KeyWordSearchType=And&KeyWordSearchType=And&KeyWordSearchType=And&KeyWordSearchType=And&KeyWordSearchType=And&bc=gAAAACAAAAAA& Accessed November 20, 2020.


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<th>Date</th>
<th>Comments</th>
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<tr>
<td>11/01/17</td>
<td>New policy, approved October 10, 2017, effective February 2, 2018. This policy was previously archived and is now reinstated. Add to Surgery section. Literature review through October 2016. Intraoperative monitoring is considered medically necessary for high risk thyroid and anterior cervical spine surgeries</td>
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<tr>
<td>04/01/18</td>
<td>Coding update, added CPT codes 95925, 95926, 95927, 95928, 95929, 95930, 95938, and 95939.</td>
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<tr>
<td>07/01/18</td>
<td>Annual Review, approved June 5, 2018. Policy updated with literature review through February 2018; references 8, 10, and 14 added; references 6-7 updated. Removed statement that ION of visual evoked potentials is investigational. Otherwise, policy statements unchanged. Removed CPT codes 95925, 95926, 95927, 95928, 95929, 95930, 95938, and 95939.</td>
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<tr>
<td>08/01/18</td>
<td>Interim Review, approved July 25, 2018. Minor edit. Thoracic spine surgery added to list of medically necessary surgical procedures for ION.</td>
</tr>
<tr>
<td>10/01/18</td>
<td>Interim Review, approved September 20, 2018. References 7 and 9 added. Content added to Related Information for greater clarification of not medically necessary policy statement.</td>
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<tr>
<td>07/01/19</td>
<td>Annual Review, approved June 11, 2019. Policy updated with literature review through February 2019; references added. Clarified that parathyroid surgery is included with medically necessary indication of thyroid surgery. Clarified the high-risk conditions for which anterior cervical spine surgery is considered medically necessary.</td>
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<tr>
<td>08/01/19</td>
<td>Interim Review, approved July 25, 2019. Clarified that the not medically necessary statement addressing IONM for any other indication, including during lumbar surgery below L1/L2 also considers baseline neurophysiologic studies performed at the same time as not medically necessary.</td>
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<td>09/01/19</td>
<td>Minor wording update for clarification.</td>
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<tr>
<td>07/01/20</td>
<td>Annual Review, approved June 4, 2020. Policy updated with literature review through February 2020; references added. Added medically necessary indications to list of surgical procedures.</td>
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<tr>
<td>10/01/20</td>
<td>Interim Review, approved September 8, 2020. Added statement that train of four monitoring is integral to intraoperative neuromonitoring and is therefore not separately payable.</td>
</tr>
<tr>
<td>12/01/20</td>
<td>Interim Review, approved November 3, 2020. Added policy statement that IONM during routine cervical decompression, routine cervical fusion, and cervical disc arthroplasty is considered not medically necessary.</td>
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</tbody>
</table>

**Disclaimer:** This medical policy is a guide in evaluating the medical necessity of a particular service or treatment. The Company adopts policies after careful review of published peer-reviewed scientific literature, national guidelines and local standards of practice. Since medical technology is constantly changing, the Company reserves the right to review and update policies as appropriate. Member contracts differ in their benefits. Always consult the member benefit booklet or contact a member service representative to determine coverage for a specific medical service or supply. CPT codes, descriptions and materials are copyrighted by the American Medical Association (AMA). ©2020 Premera All Rights Reserved.

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U.S. Department of Health and Human Services
200 Independence Avenue SW, Room 509F, HHH Building
Washington, D.C. 20201, 1-800-368-1019, 800-537-7697 (TDD)

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