

MEDICAL POLICY – 7.01.562

Intraoperative Neurophysiologic Monitoring

BCBSA Ref. Policy: 7.01.58

Effective Date: Jul. 1, 2026

Last Revised: Jun. 9, 2026


Replaced: 7.01.58

RELATED MEDICAL POLICIES:

None

Select a hyperlink below to be directed to that section.

[POLICY CRITERIA](#) | [CODING](#) | [RELATED INFORMATION](#)
[EVIDENCE REVIEW](#) | [REFERENCES](#) | [HISTORY](#)

 Clicking this icon returns you to the hyperlinks menu above.

Introduction

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.

Policy Coverage Criteria

Note: 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 electromyography, are not considered in this policy.

Intraoperative Monitoring	Medical Necessity
<ul style="list-style-type: none"> • Brainstem auditory-evoked potentials • Electrocorticography • Electroencephalography • Electromyography (EMG) of cranial nerves • Motor-evoked potentials using transcranial <u>electrical</u> stimulation • Somatosensory-evoked potentials 	<p>Intraoperative neurophysiologic monitoring (of the listed primary electrophysiologic modalities) may be considered medically necessary when 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):</p> <ul style="list-style-type: none"> • Aortic, thoracic, or abdominal aneurysm repair • Aortic cross-clamping • Arteriovenous malformation repair of the spinal cord • Brachial plexus surgery • Cavernous sinus tumor removal • Cerebral vascular surgery (e.g., carotid endarterectomy, cerebral aneurysm) • Clipping of intracranial aneurysms • Cortical localization • Decompression of facial nerve • Interventional neuroradiology • Intracranial arteriovenous malformation • Location of the hypoglossal nerve during implantation of a hypoglossal nerve stimulator • Multilevel cervical fusion (anterior, posterior, artificial disc arthroplasty) • Parotid tumor resection • Pelvic fracture surgery • Release of a tethered cord • Repair of coarctation of the aorta • Removal of acoustic neuroma (vestibular schwannoma) • Resection of epileptogenic brain tissue or tumor • Resection of fourth ventricular cyst



Intraoperative Monitoring	Medical Necessity
	<ul style="list-style-type: none"> • Resection of intracranial vascular lesions • Resection of skull base tumor (including posterior fossa tumor, Chiari decompression) • Resection of spinal cord tumor, cyst, or vascular lesion • Resection of tumor involving an auditory nerve • Resection of tumor involving a cranial nerve • Resection of tumor involving a facial nerve • Scoliosis correction with instrumentation • Surgical stabilization of spine fractures • Stereotactic surgery of the brain or brain stem, thalamus, or cerebral cortex • Thalamus tumor resection or thalamotomy • Thyroid/parathyroid surgery • Thoracic to L1-L2 lumbar spine surgery (see below) • Anterior cervical spine surgery associated with any of the following high-risk situations: <ul style="list-style-type: none"> ○ Prior anterior cervical spine surgery (particularly revision anterior cervical discectomy and fusion) ○ Revision surgery through a scarred surgical field ○ Reoperation for pseudarthrosis ○ Revision for failed cervical fusion ○ Preexisting recurrent laryngeal nerve pathology (when there is residual function of the recurrent laryngeal nerve) <p>Intraoperative neurophysiologic monitoring (of the listed primary electrophysiologic modalities) is considered not medically necessary for ANY of the following indications during:</p> <ul style="list-style-type: none"> • Decompression, neurectomy, radiosurgery, or rhizotomy of the trigeminal nerve • Epidural injections • Facet joint injections or medial branch blocks • Lumbar spine surgery below L1/L2 • Placement of an intrathecal pain pump • Placement or removal of spinal cord or dorsal root ganglion stimulators



Intraoperative Monitoring	Medical Necessity
	<ul style="list-style-type: none"> • Radiofrequency facet ablation/denervation procedures • Routine cervical spine surgery (e.g., decompression, routine single-level cervical fusion, cervical single-level disc arthroplasty) • Sacroiliac injections <p>Note: Baseline neurophysiologic studies (with the primary modalities listed above on the left) performed for any of the procedures considered not medically necessary noted directly above are also considered not medically necessary (see Related Information)</p>
<ul style="list-style-type: none"> • EMG • Nerve conduction velocity monitoring 	<p>Intraoperative neurophysiologic monitoring (of the listed primary electrophysiologic modalities) during surgery on the peripheral nerves are considered not medically necessary.</p>
<ul style="list-style-type: none"> • Train of four monitoring 	<p>Train of four monitoring is considered integral to intraoperative monitoring and/or administration of anesthesia. It is therefore not separately reimbursable.</p>

Intraoperative Monitoring	Investigational
<ul style="list-style-type: none"> • Brainstem auditory-evoked potentials • Electrocorticography • Electroencephalography • Electromyography (EMG) of cranial nerves • Motor-evoked potentials using transcranial electrical stimulation • Somatosensory-evoked potentials 	<p>Intraoperative neurophysiologic monitoring (of the listed primary electrophysiologic modalities) during the following surgical procedure is considered investigational:</p> <ul style="list-style-type: none"> • Esophageal surgeries
<p>Motor-evoked potentials using transcranial <u>magnetic</u> stimulation</p>	<p>Due to the lack of monitors approved by the US Food and Drug Administration, intraoperative monitoring of motor-evoked potentials using transcranial <u>magnetic</u> stimulation is considered investigational.</p>



Coding

Reviewed for Medical Necessity

Code	Description
CPT	
95940	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)
95941	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)
95999	Unlisted neurological or neuromuscular diagnostic procedure (when used to report train of four monitoring)
HCPCS	
G0453	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)

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 the 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-L2.⁷⁴

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.

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

Benefit Application

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 is present by means of a real-time remote mechanism and is immediately available to interpret the recording and advise the surgeon throughout the procedure.

Coding for intraoperative monitoring uses time-based codes; they are not based on the number (single vs. multiple) of modalities used.

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

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.



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 individuals monitored under the supervision of a physician who is outside the operating room. The different methodologies of monitoring are described below.

Sensory-Evoked Potentials

Sensory-evoked potentials (SEPs) describe 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 interpreting 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 further categorized by type of stimulation 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 individuals 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 US 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 (e.g., 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 (i.e., 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 individuals 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 individuals with normal EEG activity. Carotid endarterectomy may be done with the individual under local anesthesia so that monitoring of cortical function can be directly assessed.
- Electrocorticography (ECoG) is the recording of 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 the 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.¹⁻⁶



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 individuals undergoing thyroid surgery. This RCT found a significant reduction in RLN injury in individuals 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 individuals 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 an improvement in the net health outcome. (see [Clinical Input](#))

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 four systematic reviews of case series and cohort studies. Relevant outcomes are morbid events, functional outcomes, and quality of life. Three of the four analyses compared the risk of nerve injury using intraoperative neurophysiologic monitoring with no intraoperative neurophysiologic monitoring and found no statistically significant difference. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who are undergoing esophageal surgery who receive IONM, the evidence includes a systematic review of mainly nonrandomized comparative studies. Relevant outcomes are morbid events, functional outcomes, and quality of life. The systematic review found less recurrent laryngeal nerve palsy with intraoperative neurophysiologic monitoring, but conclusions are limited by the design of the included studies. Current evidence is not sufficiently robust to determine whether neurophysiologic monitoring reduces RLN injury in individuals undergoing esophageal surgery. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

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 that the technology results in an improvement in the net health outcome.



For individuals who are undergoing spinal instrumentation requiring screws or distraction who receive intraoperative neurophysiologic monitoring, the evidence includes systematic reviews of nonrandomized studies. Relevant outcomes are morbid events, functional outcomes, and quality of life. The available evidence suggests that intraoperative neurophysiologic monitoring has high sensitivity and specificity for detecting neurologic deficits. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

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 individual 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 that 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 trials that might influence this review are listed in [Table 1](#).



Table 1. Summary of Key Trials

NCT No.	Trial Name	Planned Enrollment	Completion Date
Ongoing			
NCT01630785	Retrospective Data Analysis of Neurophysiological Data for Intraoperative or Epilepsy Monitoring	5000	Dec 2025

NCT: national clinical 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

Clinical input was sought to help determine whether the use of intraoperative neurophysiologic monitoring of the recurrent laryngeal nerve for individuals undergoing cervical spine surgery would provide a clinically meaningful improvement in net health outcome and whether the use is consistent with generally accepted medical practice. 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.

For individuals undergoing cervical spine surgery who receive intraoperative neurophysiologic monitoring of the recurrent laryngeal nerve, clinical input supports this use provides a clinically meaningful improvement in net health outcome and indicates this use is consistent with generally accepted medical practice in a subgroup of appropriately selected individuals. The following individual selection criteria are based on clinical expert opinion and information from clinical study populations:



- 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
- 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 (SEPs), motor-evoked potentials (MEPs) using transcranial **electrical** stimulation, brainstem auditory-evoked potentials, electromyography of cranial nerves, electroencephalography, or electrocorticography might 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 (e.g., nerve roots, percutaneous pedicle screw placement, lateral transpsoas approach to the lumbar spine). Other reviewers suggested using IONM during resection of peripheral nerve tumors or surgery around the brachial plexus or facial/cranial nerves.

Practice Guidelines and Position Statements

The purpose of the following information is to provide reference material. Inclusion does not imply endorsement or alignment with the policy conclusions.

Guidelines or position statements will be considered for inclusion if they were issued by, or jointly by, a US professional society, an international society with US representation, or the National Institute for Health and Care Excellence (NICE). Priority will be given to guidelines that are informed by a systematic review, include strength of evidence ratings, and include a description of management of conflict of interest.



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 the American Clinical Neurophysiology Society (ACNS) in 2012 (guideline last reaffirmed on October 21, 2023).^{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 (last amended July 31, 2018).⁶⁵ 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 IONM [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 IONM 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 quadriparesis 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's circumstances.
5. Protecting the Spinal Cord from Ischemia during Aortic Procedures. Studies have shown that IONM accurately predicts risks for spinal cord ischemia associated with clamping the aorta or ligating segmental spinal arteries. IONM 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, IONM 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 individuals with important IONM changes (Level A)."

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



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.⁶⁶ 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.

In 2014, the same organizations published guidance on electrophysiological monitoring for lumbar fusion procedures.⁶⁷ The authors concluded that there was a lack of high-quality studies and that routine intraoperative monitoring during lumbar fusion could not be recommended. Evidence regarding the efficacy of intraoperative monitoring to recover nerve function or affect the outcome of surgery.

American Association of Neuromuscular & Electrodiagnostic Medicine

In 2023, the American Association of Neuromuscular & Electrodiagnostic Medicine (AANEM) updated their position statement on electrodiagnostic medicine.⁵ 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.⁴ Guideline 11A included the following statement⁶⁸:

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 specifics of this availability (i.e., 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 Head and Neck Society

In 2022, the American Head and Neck Society Endocrine Surgery Section and the International Neural Monitoring Study Group published a clinical review of intraoperative nerve monitoring during pediatric thyroid surgery.⁶⁹ The review stated that intraoperative neurophysiologic monitoring can be considered in all pediatric thyroid surgeries. Procedures for which monitoring may be most beneficial include total thyroidectomy, hemithyroidectomy in which the contralateral vocal cord is paralyzed, and reoperative surgeries.

American Society of Neurophysiological Monitoring

In 2018, the American Society of Neurophysiological Monitoring (ASNM) published practice guidelines for the supervising professional on IONM.¹⁶ 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.⁷⁰



Scoliosis Research Society

In 2020, the Scoliosis Research Society published an information statement on neurophysiologic monitoring during spinal deformity surgery.⁷¹ The Society concluded that neurophysiologic monitoring could allow for early detection of complications and possibly prevent postoperative neurologic injury, and is considered optimal care when the spinal cord is at risk, which warrants a strong recommendation unless there are contraindications. The standard method of intraoperative monitoring should include transcranial motor evoked potentials and somatosensory evoked potentials with or without electromyographic monitoring.

National Institute for Health and Care Excellence

In 2008, a guidance from the National Institute for Health and Care Excellence (NICE) on IONM during thyroid surgery found no major safety concerns.⁷² Regarding efficacy, IONM was indicated as helpful "in performing more complex operations such as reoperative surgery and operations on large thyroid glands."

North American Spine Society

In 2024, the North American Spine Society (NASS) published draft coverage recommendations on intraoperative neurophysiologic monitoring.⁷³ Relevant recommendation statements regarding cervical spine surgery and spinal instrumentation or distraction are below. [North American Spine Society. NASS Coverage Recomm.... 2024. ISBN 978-1-929988-82-2.] The recommendations state that whenever the clinical scenario requires IONM, the standard multimodality IONM plan for spine should typically involve "use of all three primary IONM modalities of MEPs, SSEPs, and EMG", although there may be clinical reasons to exclude the use of certain modalities.

Surgical procedures with associated typical diagnoses	Coverage recommendation
Instrumented deformity corrections for scoliosis or other deforming dorsopathies in the cervical, thoracic, or lumbar spine	Coverage of multimodality IONM is recommended
Spinal realignment procedures that involve significant distraction that may occur during vertebral corpectomies or interbody fusion	Coverage of multimodality IONM is recommended



Surgical procedures with associated typical diagnoses	Coverage recommendation
procedures involving very significant disc space distraction in the cervical, thoracic, or lumbar spine	
Pediatric spinal procedures including tethered cord release, selective dorsal rhizotomies for cerebral palsy, or placement of growing instrumentation elements (rods, expandable ribs).	Coverage of multimodality IONM is recommended
Cervical/thoracic disectomy, fusion, or arthroplasty procedures involving decompression of the spinal cord in patients with spondylotic myelopathy, spinal cord compression, or vertebral artery compression syndrome.	Coverage of multimodality IONM is recommended
Cervical disectomy, fusion, or arthroplasty procedures involving decompression of spinal nerve roots in patients with cervical radiculopathy, but without myelopathy or spinal cord compression if any of the following are present/ performed: laminectomy, weakness/ absent reflexes/ preoperative diagnostic electromyographic evidence of denervation, patient history of previous surgical treatment for cervical or thoracic myelopathy or spinal cord compression. Note: Anterior cervical decompression (fusion or arthroplasty) as a treatment for isolated cervical radiculopathy without myelopathy or spinal cord compression not meeting previously recommended criteria (see NASS policy) is insufficient to meet this level of indication for multimodality IONM.	Coverage of multimodality IONM is conditionally recommended (evidentiary support, but lack of full consensus)
Placement of a cervical or thoracic spinal cord paddle lead for spinal cord stimulation via laminotomy if: the procedure is performed under general anesthesia and neuromonitoring is being utilized to guide both the safe and effective placement of the electrodes.	Coverage of multimodality IONM is conditionally recommended (evidentiary support, but lack of full consensus)
Instrumented spinal fusion procedures in the cervical, thoracic, or lumbar spine not meeting the more stringent criteria listed in sections 1 or 2 of the NASS coverage recommendations document	Coverage of multimodality IONM is recommended on an exceptional basis if there is a demonstrable, elevated potential risk of neurologic injury, due to patient or procedural factors not listed in previous sections, that may be mitigated by multimodal IONM
Cervical and thoracic laminectomy procedures involving decompression of the spinal cord not meeting the more stringent criteria listed in sections 1 or 2 of the NASS coverage recommendations document	Coverage of multimodality IONM is recommended on an exceptional basis if there is a demonstrable, elevated potential risk of neurologic injury, due to patient or procedural factors not listed in previous sections, that may be mitigated by multimodal IONM



Surgical procedures with associated typical diagnoses	Coverage recommendation
<p>During anterior cervical discectomy, arthroplasty, or fusion procedures, the following may be employed: cranial nerve EMG of the recurrent laryngeal nerve, laryngeal adductor reflex monitoring.</p> <p>During lumbosacral laminectomy, detethering or fusion procedures the following may be employed: EMG of anal/urethral sphincter and/or sacral reflex monitoring.</p>	<p>These modalities are at the surgeon's discretion as additional to standard multimodal IONM.</p>

Abbreviation: IONM, Intraoperative neuromonitoring

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.”⁷⁴ 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 an individual 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 individual.”⁷⁵

Regulatory Status

A number of electroencephalography (EEG) and electromyography (EMG) monitors have been cleared for marketing by the 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

1. Assessment: intraoperative neurophysiology. Report of the Therapeutics and Technology Assessment Subcommittee of the American Academy of Neurology. *Neurology*. Nov 1990; 40(11): 1644-6. PMID 2234418
2. Nuwer MR, Emerson RG, Galloway G, et al. Evidence-based guideline update: intraoperative spinal monitoring with somatosensory and transcranial electrical motor evoked potentials: report of the Therapeutics and Technology Assessment Subcommittee of the American Academy of Neurology and the American Clinical Neurophysiology Society. *Neurology*. Feb 21 2012; 78(8): 585-9. PMID 22351796
3. Skinner SA, Cohen BA, Morledge DE, et al. Practice guidelines for the supervising professional: intraoperative neurophysiological monitoring. *J Clin Monit Comput*. Apr 2014; 28(2): 103-11. PMID 24022172
4. American Clinical Neurophysiology Society. ACNS Guidelines and Consensus Statements. <http://www.acns.org/practice/guidelines>. Accessed May 5, 2026.
5. American Association of Neuromuscular & Electrodiagnostic Medicine. Position Statement: Recommended Policy for Electrodiagnostic Medicine. updated 2023; <https://www.aanem.org/Advocacy/Position-Statements/Recommended-Policy-for-Electrodiagnostic-Medicine>. Accessed May 5, 2026.
6. Resnick DK, Choudhri TF, Dailey AT, et al. Guidelines for the performance of fusion procedures for degenerative disease of the lumbar spine. Part 15: electrophysiological monitoring and lumbar fusion. *J Neurosurg Spine*. Jun 2005; 2(6): 725-32. PMID 16028743
7. Merchavy S, Kassem K, Awawde R, et al. Intraoperative Nerve Monitoring Parameters and Risk of Recurrent Laryngeal Nerve Injury in Thyroidectomy: A Systematic Review and Meta-Analysis. *Biomedicines*. Oct 15 2025; 13(10). PMID 41153796
8. Cozzi AT, Ottavi A, Lozza P, et al. Intraoperative Neuromonitoring Does Not Reduce the Risk of Temporary and Definitive Recurrent Laryngeal Nerve Damage during Thyroid Surgery: A Systematic Review and Meta-Analysis of Endoscopic Findings from 73,325 Nerves at Risk. *J Pers Med*. Sep 23 2023; 13(10). PMID 37888040
9. Henry BM, Graves MJ, Vikse J, et al. The current state of intermittent intraoperative neural monitoring for prevention of recurrent laryngeal nerve injury during thyroidectomy: a PRISMA-compliant systematic review of overlapping meta-analyses. *Langenbecks Arch Surg*. Jun 2017; 402(4): 663-673. PMID 28378238
10. Pisanu A, Porceddu G, Podda M, et al. Systematic review with meta-analysis of studies comparing intraoperative neuromonitoring of recurrent laryngeal nerves versus visualization alone during thyroidectomy. *J Surg Res*. May 01 2014; 188(1): 152-61. PMID 24433869
11. Sun W, Liu J, Zhang H, et al. A meta-analysis of intraoperative neuromonitoring of recurrent laryngeal nerve palsy during thyroid reoperations. *Clin Endocrinol (Oxf)*. Nov 2017; 87(5): 572-580. PMID 28585717
12. Pardal-Refoyo JL, Ochoa-Sangrador C. Bilateral recurrent laryngeal nerve injury in total thyroidectomy with or without intraoperative neuromonitoring. Systematic review and meta-analysis. *Acta Otorrinolaringol Esp*. 2016; 67(2): 66-74. PMID 26025358
13. Barczyński M, Konturek A, Cichoń S. Randomized clinical trial of visualization versus neuromonitoring of recurrent laryngeal nerves during thyroidectomy. *Br J Surg*. Mar 2009; 96(3): 240-6. PMID 19177420
14. Vasileiadis I, Karatzas T, Charitoudis G, et al. Association of Intraoperative Neuromonitoring With Reduced Recurrent Laryngeal Nerve Injury in Patients Undergoing Total Thyroidectomy. *JAMA Otolaryngol Head Neck Surg*. Oct 01 2016; 142(10): 994-1001. PMID 27490310



15. El Choueiri J, Pellicanò F, Caimi E, et al. Intraoperative neuromonitoring in cervical degenerative spine surgery: a meta-analysis of its impact on neurological outcomes. *Neurosurg Rev.* Apr 12 2025; 48(1): 360. PMID 40216635
16. Daniel JW, Botelho RV, Milano JB, et al. Intraoperative Neurophysiological Monitoring in Spine Surgery: A Systematic Review and Meta-Analysis. *Spine (Phila Pa 1976).* Aug 2018; 43(16): 1154-1160. PMID 30063222
17. Ajiboye RM, Zoller SD, Sharma A, et al. Intraoperative Neuromonitoring for Anterior Cervical Spine Surgery: What Is the Evidence?. *Spine (Phila Pa 1976).* Mar 15 2017; 42(6): 385-393. PMID 27390917
18. Erwood MS, Hadley MN, Gordon AS, et al. Recurrent laryngeal nerve injury following reoperative anterior cervical discectomy and fusion: a meta-analysis. *J Neurosurg Spine.* Aug 2016; 25(2): 198-204. PMID 27015129
19. Chen B, Yang T, Wang W, et al. Application of Intraoperative Neuromonitoring (IONM) of the Recurrent Laryngeal Nerve during Esophagectomy: A Systematic Review and Meta-Analysis. *J Clin Med.* Jan 10 2023; 12(2). PMID 36675495
20. Komatsu S, Konishi T, Matsubara D, et al. Continuous Recurrent Laryngeal Nerve Monitoring During Single-Port Mediastinoscopic Radical Esophagectomy for Esophageal Cancer. *J Gastrointest Surg.* Dec 2022; 26(12): 2444-2450. PMID 36221021
21. Huang CL, Chen CM, Hung WH, et al. Clinical Outcome of Intraoperative Recurrent Laryngeal Nerve Monitoring during Thoracoscopic Esophagectomy and Mediastinal Lymph Node Dissection for Esophageal Cancer. *J Clin Med.* Aug 23 2022; 11(17). PMID 36078880
22. Zhao L, He J, Qin Y, et al. Application of intraoperative nerve monitoring for recurrent laryngeal nerves in minimally invasive McKeown esophagectomy. *Dis Esophagus.* Jul 12 2022; 35(7). PMID 34864953
23. Yuda M, Nishikawa K, Ishikawa Y, et al. Intraoperative nerve monitoring during esophagectomy reduces the risk of recurrent laryngeal nerve palsy. *Surg Endosc.* Jun 2022; 36(6): 3957-3964. PMID 34494155
24. Takeda S, Iida M, Kanekiyo S, et al. Efficacy of intraoperative recurrent laryngeal neuromonitoring during surgery for esophageal cancer. *Ann Gastroenterol Surg.* Jan 2021; 5(1): 83-92. PMID 33532684
25. Fujimoto D, Taniguchi K, Kobayashi H. Intraoperative neuromonitoring during prone thoracoscopic esophagectomy for esophageal cancer reduces the incidence of recurrent laryngeal nerve palsy: a single-center study. *Updates Surg.* Apr 2021; 73(2): 587-595. PMID 33415692
26. Kobayashi H, Kondo M, Mizumoto M, et al. Technique and surgical outcomes of mesenterization and intra-operative neural monitoring to reduce recurrent laryngeal nerve paralysis after thoracoscopic esophagectomy: A cohort study. *Int J Surg.* Aug 2018; 56: 301-306. PMID 29879478
27. Zhu W, Yang F, Cao J, Zhao C, Dong B, Chen D. Application of recurrent laryngeal nerve detector in the neck anastomosis of upper or middle-thoracic esophageal carcinoma. *Cancer Res Clin.* 2018;30:233236.
28. Hikage M, Kamei T, Nakano T, et al. Impact of routine recurrent laryngeal nerve monitoring in prone esophagectomy with mediastinal lymph node dissection. *Surg Endosc.* Jul 2017; 31(7): 2986-2996. PMID 27826777
29. Zhong D, Zhou Y, Li Y, et al. Intraoperative recurrent laryngeal nerve monitoring: a useful method for patients with esophageal cancer. *Dis Esophagus.* Jul 2014; 27(5): 444-51. PMID 23020300
30. Kneist W, Kauff DW, Juhre V, et al. Is intraoperative neuromonitoring associated with better functional outcome in patients undergoing open TME? Results of a case-control study. *Eur J Surg Oncol.* Sep 2013; 39(9): 994-9. PMID 23810330
31. Kneist W, Kauff DW, Rubenwolf P, et al. Intraoperative monitoring of bladder and internal anal sphincter innervation: a predictor of erectile function following low anterior rectal resection for rectal cancer? Results of a prospective clinical study. *Dig Surg.* 2013; 30(4-6): 459-65. PMID 24481247
32. Clarkson JHW, Ozyurekoglu T, Mujadzic M, et al. An evaluation of the information gained from the use of intraoperative nerve recording in the management of suspected brachial plexus root avulsion. *Plast Reconstr Surg.* Mar 2011; 127(3): 1237-1243. PMID 21364425



33. Zhang W, Chen M, Zhang W, et al. Use of electrophysiological monitoring in selective rhizotomy treating glossopharyngeal neuralgia. *J Craniomaxillofac Surg*. Jul 2014; 42(5): e182-5. PMID 24095216
34. Ochs BC, Herzka A, Yaylali I. Intraoperative neurophysiological monitoring of somatosensory evoked potentials during hip arthroscopy surgery. *Neurodiagn J*. Dec 2012; 52(4): 312-9. PMID 23301281
35. Jahangiri FR. Multimodality neurophysiological monitoring during tibial/fibular osteotomies for preventing peripheral nerve injuries. *Neurodiagn J*. Jun 2013; 53(2): 153-68. PMID 23833842
36. Nagda SH, Rogers KJ, Sestokas AK, et al. Neer Award 2005: Peripheral nerve function during shoulder arthroplasty using intraoperative nerve monitoring. *J Shoulder Elbow Surg*. 2007; 16(3 Suppl): S2-8. PMID 17493556
37. Reddy RP, Chang R, Coutinho DV, et al. Triggered Electromyography is a Useful Intraoperative Adjunct to Predict Postoperative Neurological Deficit Following Lumbar Pedicle Screw Instrumentation. *Global Spine J*. Jun 2022; 12(5): 1003-1011. PMID 34013769
38. Thirumala PD, Crammond DJ, Loke YK, et al. Diagnostic accuracy of motor evoked potentials to detect neurological deficit during idiopathic scoliosis correction: a systematic review. *J Neurosurg Spine*. Mar 2017; 26(3): 374-383. PMID 27935448
39. Alemo S, Sayadipour A. Role of intraoperative neurophysiologic monitoring in lumbosacral spine fusion and instrumentation: a retrospective study. *World Neurosurg*. Jan 2010; 73(1): 72-6; discussion e7. PMID 20452872
40. Bindal RK, Ghosh S. Intraoperative electromyography monitoring in minimally invasive transforaminal lumbar interbody fusion. *J Neurosurg Spine*. Feb 2007; 6(2): 126-32. PMID 17330579
41. Bose B, Wierzbowski LR, Sestokas AK. Neurophysiologic monitoring of spinal nerve root function during instrumented posterior lumbar spine surgery. *Spine (Phila Pa 1976)*. Jul 01 2002; 27(13): 1444-50. PMID 12131744
42. Clements DH, Morledge DE, Martin WH, et al. Evoked and spontaneous electromyography to evaluate lumbosacral pedicle screw placement. *Spine (Phila Pa 1976)*. Mar 01 1996; 21(5): 600-4. PMID 8852316
43. Darden BV, Wood KE, Hatley MK, et al. Evaluation of pedicle screw insertion monitored by intraoperative evoked electromyography. *J Spinal Disord*. Feb 1996; 9(1): 8-16. PMID 8727451
44. Luo W, Zhang F, Liu T, et al. Minimally invasive transforaminal lumbar interbody fusion aided with computer-assisted spinal navigation system combined with electromyography monitoring. *Chin Med J (Engl)*. Nov 2012; 125(22): 3947-51. PMID 23158122
45. Maguire J, Wallace S, Madiga R, et al. Evaluation of intrapedicular screw position using intraoperative evoked electromyography. *Spine (Phila Pa 1976)*. May 01 1995; 20(9): 1068-74. PMID 7631237
46. Papadopoulos EC, Girardi FP, Sama A, et al. Accuracy of single-time, multilevel registration in image-guided spinal surgery. *Spine J*. 2005; 5(3): 263-7; discussion 268. PMID 15863081
47. Sutter MA, Eggspuehler A, Grob D, et al. Multimodal intraoperative monitoring (MIOM) during 409 lumbosacral surgical procedures in 409 patients. *Eur Spine J*. Nov 2007; 16 Suppl 2(Suppl 2): S221-8. PMID 17912559
48. Welch WC, Rose RD, Balzer JR, et al. Evaluation with evoked and spontaneous electromyography during lumbar instrumentation: a prospective study. *J Neurosurg*. Sep 1997; 87(3): 397-402. PMID 9285605
49. Wood MJ, Mannion RJ. Improving accuracy and reducing radiation exposure in minimally invasive lumbar interbody fusion. *J Neurosurg Spine*. May 2010; 12(5): 533-9. PMID 20433301
50. Wood MJ, McMillen J. The surgical learning curve and accuracy of minimally invasive lumbar pedicle screw placement using CT based computer-assisted navigation plus continuous electromyography monitoring - a retrospective review of 627 screws in 150 patients. *Int J Spine Surg*. 2014; 8. PMID 25694919
51. Melachuri SR, Melachuri MK, Anetakis K, et al. Diagnostic Accuracy of Thresholds Less Than or Equal to 8mA in Pedicle Screw Testing During Lumbar Spine Procedures to Predict New Postoperative Lower Extremity Neurological Deficits. *Spine (Phila Pa 1976)*. Jan 15 2021; 46(2): E139-E145. PMID 33347093



52. Accadbled F, Henry P, de Gauzy JS, et al. Spinal cord monitoring in scoliosis surgery using an epidural electrode. Results of a prospective, consecutive series of 191 cases. *Spine (Phila Pa 1976)*. Oct 15 2006; 31(22): 2614-23. PMID 17047554
53. Eggspuehler A, Sutter MA, Grob D, et al. Multimodal intraoperative monitoring during surgery of spinal deformities in 217 patients. *Eur Spine J*. Nov 2007; 16 Suppl 2(Suppl 2): S188-96. PMID 17632737
54. El-Hawary R, Sucato DJ, Sparagana S, et al. Spinal cord monitoring in patients with spinal deformity and neural axis abnormalities: a comparison with adolescent idiopathic scoliosis patients. *Spine (Phila Pa 1976)*. Sep 01 2006; 31(19): E698-706. PMID 16946643
55. Feng B, Qiu G, Shen J, et al. Impact of multimodal intraoperative monitoring during surgery for spine deformity and potential risk factors for neurological monitoring changes. *J Spinal Disord Tech*. Jun 2012; 25(4): E108-14. PMID 22367467
56. Kundnani VK, Zhu L, Tak H, et al. Multimodal intraoperative neuromonitoring in corrective surgery for adolescent idiopathic scoliosis: Evaluation of 354 consecutive cases. *Indian J Orthop*. Jan 2010; 44(1): 64-72. PMID 20165679
57. Lo YL, Dan YF, Teo A, et al. The value of bilateral ipsilateral and contralateral motor evoked potential monitoring in scoliosis surgery. *Eur Spine J*. Sep 2008; 17 Suppl 2(Suppl 2): S236-8. PMID 17874145
58. Luk KD, Hu Y, Wong YW, et al. Evaluation of various evoked potential techniques for spinal cord monitoring during scoliosis surgery. *Spine (Phila Pa 1976)*. Aug 15 2001; 26(16): 1772-7. PMID 11493849
59. Macdonald DB, Al Zayed Z, Al Saddigi A. Four-limb muscle motor evoked potential and optimized somatosensory evoked potential monitoring with decussation assessment: results in 206 thoracolumbar spine surgeries. *Eur Spine J*. Nov 2007; 16 Suppl 2(Suppl 2): S171-87. PMID 17638028
60. Noonan KJ, Walker T, Feinberg JR, et al. Factors related to false- versus true-positive neuromonitoring changes in adolescent idiopathic scoliosis surgery. *Spine (Phila Pa 1976)*. Apr 15 2002; 27(8): 825-30. PMID 11935104
61. Pastorelli F, Di Silvestre M, Plasmati R, et al. The prevention of neural complications in the surgical treatment of scoliosis: the role of the neurophysiological intraoperative monitoring. *Eur Spine J*. May 2011; 20 Suppl 1(Suppl 1): S105-14. PMID 21416379
62. Péréon Y, Bernard JM, Fayet G, et al. Usefulness of neurogenic motor evoked potentials for spinal cord monitoring: findings in 112 consecutive patients undergoing surgery for spinal deformity. *Electroencephalogr Clin Neurophysiol*. Jan 1998; 108(1): 17-23. PMID 9474058
63. Schwartz DM, Auerbach JD, Dormans JP, et al. Neurophysiological detection of impending spinal cord injury during scoliosis surgery. *J Bone Joint Surg Am*. Nov 2007; 89(11): 2440-9. PMID 17974887
64. Tsirikos AI, Duckworth AD, Henderson LE, et al. Multimodal Intraoperative Spinal Cord Monitoring during Spinal Deformity Surgery: Efficacy, Diagnostic Characteristics, and Algorithm Development. *Med Princ Pract*. 2020; 29(1): 6-17. PMID 31158841
65. American Academy of Neurology. Model Coverage Policy: Principles of Coding for Intraoperative Neurophysiologic Monitoring (IOM) and Testing. 2012; https://www.aan.com/siteassets/home-page/tools-and-resources/practicing-neurologist--administrators/billing-and-coding/model-coverage-policies/18iommodelpolicy_tr.pdf . Accessed May 5, 2026.
66. American Association of Neurological Surgeons (AANS)/Congress of Neurological Surgeons (CNS). Joint Section on Disorders of the Spine and Peripheral Nerves updated position statement: intraoperative electrophysiological monitoring. January 2018. <https://spinesection.org/about/position-statements/interoperative-electrophysiological-monitoring/>. Accessed May 5, 2026.
67. Sharan A, Groff MW, Dailey AT, et al. Guideline update for the performance of fusion procedures for degenerative disease of the lumbar spine. Part 15: electrophysiological monitoring and lumbar fusion. *J Neurosurg Spine*. Jul 2014; 21(1): 102-5. PMID 24980592
68. American Clinical Neurophysiology Society. Guideline 11A: Recommended Standards for Neurophysiologic Intraoperative Monitoring Principles. 2009; <https://www.acns.org/pdf/guidelines/Guideline-11A.pdf>. Accessed May 5, 2026.
69. Diercks GR, Rastatter JC, Kazahaya K, et al. Pediatric intraoperative nerve monitoring during thyroid surgery: A review from the American Head and Neck Society Endocrine Surgery Section and the International Neural Monitoring Study Group. *Head Neck*. Jun 2022; 44(6): 1468-1480. PMID 35261110



70. Macdonald DB, Skinner S, Shils J, et al. Intraoperative motor evoked potential monitoring - a position statement by the American Society of Neurophysiological Monitoring. *Clin Neurophysiol*. Dec 2013; 124(12): 2291-316. PMID 24055297
71. Halsey MF, Myung KS, Ghag A, et al. Neurophysiological monitoring of spinal cord function during spinal deformity surgery: 2020 SRS neuromonitoring information statement. *Spine Deform*. Aug 2020; 8(4): 591-596. PMID 32451978
72. National Institute for Health and Care Excellence (NICE). Intraoperative nerve monitoring during thyroid surgery [HTG164]. 2008; <https://www.nice.org.uk/guidance/htg164>. Accessed May 5, 2026.
73. North American Spine Society. NASS Coverage Recommendations: Intraoperative Neurophysiological Monitoring. Burr Ridge, IL: North American Spine Society; 2024. ISBN 978-1-929988-82-2.
74. 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&KeywordLookup=Title&KeywordSearchType=And&KeywordSearchType=And&KeywordSearchType=And&bc=gAAAACAAAAA&>. Accessed May 5, 2026.
75. Centers for Medicare & Medicaid Services. Billing Medicare for Remote Intraoperative Neurophysiology Monitoring in CY 2013. Updated September 2020; <https://www.cms.gov/medicare/medicare-fee-for-service-payment/physicianfeesched/downloads/faq-remote-ionm.pdf>. Accessed May 5, 2026.
76. American Association of Neuromuscular and Electrodiagnostic Medicine (AANEM). Somatosensory evoked potentials. Clinical uses. Chapter 5. *Muscle Nerve* 22: Supplement 8: S111-S118, 1999a. Available online at: <https://www.aanem.org/getmedia/d26768d2-f94e-4939-9eb4-1a549e70a455/SEPClinicalUses.pdf> Accessed May 5, 2026.
77. Jameson LC, Janik DJ, Sloan TB. Electrophysiologic monitoring in neurosurgery. *Anesthesiol Clin*. 2007; 25 (3):605-30, x. PMID: 17884710.
78. American Society of Neurophysiological Monitoring (ASNM). Intraoperative monitoring using somatosensory evoked potentials. A position statement by the American Society of Neurophysiological Monitoring. Updated December 2010. Available online at: <https://asnm.org/wp-content/uploads/2023/05/sep.pdf> Accessed May 5, 2026.
79. Hadley MN, Shank CD, Rozzelle CJ et al. Guidelines for the use of electrophysiological monitoring for surgery of the human spinal column and spinal cord. *Neurosurgery* 2017; 81 (5): 713-732. PMID: 29029325.
80. Ajiboye R, D'Oro A, Ashana A, et al. Routine use of intraoperative neuromonitoring during ACDs for the treatment of spondylotic myelopathy and radiculopathy is questionable: A review of 15,395 cases. *Spine (Phila Pa 1976)*. 2017; 42(1):14-19. PMID: 27120059.
81. Charalampidis A, Jiang F, Wilson JRF, et al. The use of intraoperative neurophysiological monitoring in spine surgery. *Global Spine J*. 2020; 10 (1 Suppl):104S-114S. PMID: 31934514.
82. Alluri RK, Vaishnav AS, Sivaganesan A, et al. Multimodality Intraoperative Neuromonitoring in Lateral Lumbar Interbody Fusion: A Review of Alerts in 628 Patients. *Global Spine J*. 2021 Mar 18: 21925682211000321. doi: 10.1177/21925682211000321. Online ahead of print. PMID: 33733881.
83. Austerman RJ, Sulhan S, Steele WJ, et al. The utility of intraoperative neuromonitoring on simple posterior lumbar fusion- analysis of the National Inpatient Sample. *J Spine Surg*. 2021; 7(2): 132-140. PMID: 34296025.
84. Hayes, Inc. Health Technology Assessment. Intraoperative neuromonitoring for lumbar spinal fusion and discectomy. Lansdale, PA., Hayes, Inc., December 30, 2021.
85. Chang R, Reddy RP, Coutinho DV, et al. Diagnostic Accuracy of SSEP Changes During Lumbar Spine Surgery for Predicting Postoperative Neurological Deficit: A Systematic Review and Meta-Analysis. *Spine (Phila Pa 1976)*. 2021;46(24):E1343-E1352. PMID: 33958542.



86. Brock S, Scaioli V, Ferroli P, Broggi G. Neurovascular decompression in trigeminal neuralgia: Role of intraoperative neurophysiological monitoring in the learning period. *Stereotact Funct Neurosurg.* 2004;82(5-6):199-206.PMID: 15583464.Minahan RE, Mandir AS. Neurophysiologic intraoperative monitoring of trigeminal and facial nerves. *J Clin Neurophysiol* 2011; 28(6): 551-565. PMID: 2214632.
87. Sturm JJ, Modik O, Suurna MV. Neurophysiological monitoring of tongue muscle activation during hypoglossal nerve stimulation. *Laryngoscope.* 2020; 130(7):1836-1843. PMID: 31742709.

History

Date	Comments
11/01/17	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
12/01/17	Interim Review, approved November 14, 2017, effective February 2, 2018. Identified spinal, intracranial and vascular, and recurrent laryngeal nerve surgical procedures that meet policy criteria. References 31-36 added. Removed CPT codes 92585 - 95939 and 95955.
04/01/18	Coding update, added CPT codes 95925, 95926, 95927, 95928, 95929, 95930, 95938, and 95939.
07/01/18	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.
08/01/18	Interim Review, approved July 25, 2018. Minor edit. Thoracic spine surgery added to list of medically necessary surgical procedures for ION.
10/01/18	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.
07/01/19	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.
08/01/19	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.



Date	Comments
09/01/19	Minor wording update for clarification.
07/01/20	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.
10/01/20	Interim Review, approved September 8, 2020. Added statement that train of four monitoring is integral to intraoperative neuromonitoring and is therefore not separately payable.
12/01/20	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.
07/01/21	Annual Review, approved June 1, 2021. Policy updated with literature review through March 2, 2021; References added. Policy statements unchanged.
07/01/22	Annual Review, approved June 27, 2022. Policy updated with literature review through March 3, 2022; references added. Policy statements unchanged.
10/01/22	Interim Review, approved September 13, 2022. Clarified IONM use during a single-level cervical artificial disc arthroplasty is considered not medically necessary; however, IONM use during a multilevel cervical artificial disc arthroplasty may be considered medically necessary. Added IONM during the following procedures is considered not medically necessary: epidural injections, sacroiliac injections, facet joint injections/medial branch blocks, radiofrequency facet ablation/denervation procedures, placement of spinal cord or dorsal root ganglion stimulators, placement of hypoglossal nerve stimulator, and placement of an intrathecal pain pump.
11/04/22	Minor revision for clarification. Moved multilevel anterior cervical artificial disc arthroplasty indication under the bullet pertaining to anterior cervical spine surgery. Intent unchanged.
03/01/23	Interim Review, approved February 6, 2023. Clarified that IONM may be considered medically necessary for all multilevel cervical fusions (anterior, posterior, artificial disc arthroplasty). Changed the wording from "patient" to "individual" throughout the policy for standardization.
07/01/23	Annual Review, approved June 13, 2023. Policy updated with literature review through March 6, 2023; references added. Added policy statement that IONM during decompression, neurectomy, radiosurgery, or rhizotomy of the trigeminal nerve is considered not medically necessary. Changed policy statement for placement of hypoglossal nerve stimulator from not medically necessary to medically necessary. Changed the wording from "patient" to "individual" throughout the policy for standardization.
07/01/24	Annual Review, approved June 11, 2024. Policy updated with literature review through March 1, 2024; reference added. Added decompression of facial nerve and resection of tumor involving the facial nerve to the list of procedures for which IONM is considered



Date	Comments
	medically necessary. Other editorial refinements were made for clarity only, policy intent unchanged.
02/04/25	Minor corrections made to formatting.
07/01/25	Annual Review, approved June 23, 2025. Policy updated with literature review through February 27, 2025; reference added. Policy statements unchanged.
07/01/26	Annual Review, approved June 9, 2026. Policy updated with literature review through March 9, 2026; references added. Added the following to the list of procedures in which IONM may be considered medically necessary: cavernous sinus tumor removal, resection of epileptogenic brain tissue or tumor, and resection of tumor involving an auditory nerve.

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). ©2026 Premera All Rights Reserved.

Scope: Medical policies are systematically developed guidelines that serve as a resource for Company staff when determining coverage for specific medical procedures, drugs or devices. Coverage for medical services is subject to the limits and conditions of the member benefit plan. Members and their providers should consult the member benefit booklet or contact a customer service representative to determine whether there are any benefit limitations applicable to this service or supply. This medical policy does not apply to Medicare Advantage.

