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Magnetoencephalography (MEG) and Magnetic Source Imaging (MSI)

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Related Policies (if applicable)
None

Disclaimer

Carefully check state regulations and/or the member contract.
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Coverage

This medical policy has become inactive as of the end date above. There is no current active version and this policy is not to be used for current claims adjudication or business purposes.

Magnetoencephalography (MEG) and magnetic source imaging (MSI) **may be considered medically necessary** in the following situations:

- For the purpose of determining the laterality of language function, as a substitute for the Wada test, in individuals being prepared for surgery for epilepsy, brain tumors, and other indications requiring brain resection; or
- As part of the preoperative evaluation of individuals with intractable epilepsy (seizures refractory to at least two first-line anticonvulsants), when standard techniques, such as magnetic resonance imaging (MRI) and electroencephalogram (EEG), do not provide satisfactory localization of epileptic lesion(s).

Magnetoencephalography/magnetic source imaging **is considered experimental, investigational and/or unproven** for all other indications.

Policy Guidelines

None.

Description

Magnetoencephalography
Magnetoencephalography (MEG) is a noninvasive functional imaging technique that records weak magnetic forces associated with brain electrical activity. Using mathematical modeling, recorded data are then analyzed to provide an estimated location of electrical activity. This information can be superimposed on an anatomic image of the brain, typically a magnetic resonance imaging (MRI) scan, to produce a functional/anatomic image of the brain, referred to as magnetic source imaging (MSI). The primary advantage of MSI is that, while conductivity and thus measurement of electrical activity as recorded by EEG (Electroencephalogram) is altered by surrounding brain structures, magnetic fields are not. Therefore, MSI permits a high-resolution image.

Detection of weak magnetic fields requires gradiometer detection coils coupled to a superconducting quantum interference device (SQUID), which requires a specialized room shielded from other magnetic sources. Mathematical modeling programs based on idealized assumptions are then used to translate detected signals into functional images. In its early evolution, clinical applications were limited by the use of only 1 detection coil requiring lengthy imaging times, which, because of body movement, also were difficult to match with the MRI. However, more recently, the technique has evolved to multiple detection coils in an array that can provide data more efficiently over a wide extracranial region.

Applications
One clinical application is localization of epileptic foci, particularly for screening of surgical candidates and surgical planning. Alternative techniques include MRI, positron emission tomography (PET), or single photon emission computed tomography (SPECT) scanning. Anatomic imaging (i.e., MRI) is effective when epilepsy is associated with a mass lesion, such as a tumor, vascular malformation, or hippocampal atrophy. If an anatomic abnormality is not detected, patients may undergo a PET scan. In a small subset of patients, extended electrocorticography (ECoG) or stereotactic electroencephalography (SEEG) with implanted electrodes is considered the criterion standard for localizing epileptogenic foci. MEG/MSI has principally been investigated as a supplement to or an alternative to invasive monitoring.

Another clinical application is localization of the pre- and postcentral gyri as a guide to surgical planning in patients scheduled to undergo neurosurgery for epilepsy, brain neoplasms, arteriovenous malformations, or other brain lesions. These gyri contain the "eloquent"

sensorimotor areas of the brain, the preservation of which is considered critical during any type of brain surgery. In normal situations, these areas can be identified anatomically by MRI, but frequently, anatomy is distorted by underlying disease processes. In addition, location of eloquent functions varies, even among healthy people. Therefore, localization of the eloquent cortex often requires such intraoperative invasive functional techniques as cortical stimulation with the patient under local anesthesia or somatosensory-evoked responses on ECoG. Although these techniques can be done at the same time as the planned resection, they are cumbersome and can add up to 45 minutes of anesthesia time. Furthermore, these techniques can sometimes be limited by the small surgical field. A preoperative test, which is often used to localize the eloquent hemisphere, is the Wada test. MEG/MSI has been proposed as a substitute for the Wada test.

Regulatory Status

The U.S. Food and Drug Administration (FDA) regulates MEG devices as class II devices cleared for marketing through the 510(k) process. The FDA product codes OLX and OXY are used to identify the different components of these devices. OLX-coded devices are source localization software for EEG or MEG; the software correlates electrical activity of the brain using various neuroimaging modalities. This code does not include electrodes, amplitude-integrated electroencephalograph, automatic event-detector software used as the only or final electroencephalograph analysis step, EEG software with comparative databases (normal or otherwise, or EEG software that outputs an index, diagnosis, or classification.

FDA OLY-coded devices are magnetoencephalographs that acquire, display, store, and archive biomagnetic signals produced by electrically active nerve tissue in the brain to provide information about the location of active nerve tissue responsible for certain brain functions relative to brain anatomy. This includes the magnetoencephalograph recording device (hardware, basic software).

The intended use of these devices is to “non-invasively detect and display biomagnetic signals produced by electrically active nerve tissue in the brain. When interpreted by a trained clinician, the data enhance the diagnostic capability by providing useful information about the location relative to brain anatomy of active nerve tissue responsible for critical brain functions.” (1) More recent approval summaries add: “MEG is routinely used to identify the locations of visual, auditory, somatosensory, and motor cortex in the brain when used in conjunction with evoked response averaging devices. MEG is also used to noninvasively locate regions of epileptic activity within the brain. The localization information provided by MEG may be used, in conjunction with other diagnostic data, in neurosurgical planning.” (2)

The MagView Biomagnetometer System (Tristan Technologies) has the unique intended use for patient populations who are neonates, infants, and those children with head circumferences of 50 cm or less. (3)

Table 1 summarizes relevant MEG devices (hardware, software). Refer to the FDA website for the most up to date listing of MEG devices.

Table 1. MEG Devices Cleared by the FDA (Product Codes OLX and OLY)

Device	Manufacturer	Date Cleared	510(k) No.
Neuromagneometer	Biogmagnetic Technologies	Feb 1986	K854466
700 Series Biomagnetometer	Biogmagnetic Technologies	Jun 1990	K901215
Neuromag-122	Phillips Medical Systems	Oct 1996	K962764
Magnes 2500 Wh Biomagnetometer	Biogmagnetic Technologies	May 1997	K962317
CTF Systems, Whole-Cortex Meg System	CTF Systems	Nov 1997	K971329
Magnes II Biomagnetometer	Biogmagnetic Technologies	May 1998	K941553
Image VUE EEG	Sam Technology	Aug 1988	K980477
Electroencephalograph Software eemagine	eemagine Medical Imaging Solutions	Oct 2000	K002631
Curry Multimodal Neuroimaging Software	Neurosoft	Feb 2001	K001781
Neurosoft's Source	Neurosoft	Sep 2001	K011241
Megvision Model Eq 1000c Series	Eagle Technology	Mar 2004	K040051
Elekta Oy	Elekta Neuromag Oy	Aug 2004	K041264
MaxInsight	eemagine Medical Imaging Solutions	Jul 2007	K070358
Elekta Neuromag With Maxfilter	Elekta Neuromag Oy	Oct 2010	K091393
Geosource	Electrical Geodesics	Dec 2010	K092844
Babymeg Biomagnetometer System (also called Artemis 123 Biomagnetometer)	Tristan Technologies	Jul 2014	K133419
MagView Biomagnetometer System	Tristan Technologies	Apr 2016	K152184
Orion Lifespan Meg	Compumedics Limited	Feb 2020	K191785
Ricoh Meg	Ricoh Company, Ltd.	Jul 2021	K210199
Persyst 15 Eeg Review and Analysis Software	Persyst Development Corp.	Dec 2022	K222002
Isyncbrain-C	IMediSync Inc.	Mar 2023	K222838
Lvis Neuromatch	LVIS Corporation	Jun 2023	K222450

EEG: electroencephalogram; FDA: Food and Drug Administration; MEG: Magnetoencephalography.

In 2000, Biomagnetic Technologies acquired Neuromag and began doing business as 4-D NeuroImaging. The latter company ceased operations in 2009.

Rationale

This medical policy was created in 2002 and has been updated regularly with searches of the PubMed database. The most recent literature update was performed through January 2024.

Medical policies assess whether a medical test is clinically useful. A useful test provides information to make a clinical management decision that improves the net health outcome. That is, the balance of benefits and harms is better when the test is used to manage the condition than when another test or no test is used to manage the condition.

The first step in assessing a medical test is to formulate the clinical context and purpose of the test. The test must be technically reliable, clinically valid, and clinically useful for that purpose. Medical policies assess the evidence on whether a test is clinically valid and clinically useful. Technical reliability is outside the scope of these reviews, and credible information on technical reliability is available from other sources.

Localization of Seizure Foci

Clinical Context and Test Purpose

The purpose of magnetoencephalography (MEG) and magnetic source imaging (MSI) in the mapping of epileptic foci is to facilitate surgical treatment planning for individuals with drug-resistant epilepsy.

The following PICO was used to select literature to inform this policy.

Populations

The relevant population of interest is individuals with drug-resistant epilepsy who are being evaluated for resective surgery.

Interventions

The intervention of interest is MEG/MSI used to map epileptic foci. MEG/MSI is primarily used as a preoperative adjunct to other noninvasive tests used in clinical practice for epileptic foci localization. These tests include electroencephalography (EEG), magnetic resonance imaging (MRI), positron emission tomography (PET), and single-photon emission computerized tomography.

Comparators

The following practice is currently being used to make decisions about managing drug-resistant epilepsy: standard evaluation for seizure focus localization.

Outcomes

Outcomes of interest are diagnostic accuracy (e.g., test sensitivity and specificity) and clinical utility (e.g., consideration of avoidance of invasive testing)

Review of Evidence

Ideally, a randomized trial comparing the outcomes of patients who receive MEG as part of their diagnostic workup compared with patients who do not receive MEG could determine whether MEG improves patient outcomes. However, almost all the studies evaluating MEG have been retrospective, where MEG, other tests, and surgery have been selectively applied to

patients. Because patients often drop out of the diagnostic process before having invasive intracranial EEG (IC-EEG), and many patients ultimately do not undergo surgery, most studies of associations between diagnostic tests and between diagnostic tests and outcomes are biased by selection and ascertainment biases. For example, studies that evaluate the correlation between MEG and IC-EEG invariably do not account for the fact that MEG information was sometimes used to deselect a patient from undergoing IC-EEG. In addition, IC-EEG findings only imperfectly correlate with surgical outcomes, meaning that it is an imperfect reference standard.

Numerous studies have shown associations between MEG findings and other noninvasive and invasive diagnostic tests, including IC-EEG, and between MEG findings and surgical outcomes. However, such studies do not allow any conclusions whether MEG added incremental information to aid the management of such patients and whether patients' outcomes were improved as a result of the additional diagnostic information.

A comparative study of MEG by Knowlton et al. (2008) demonstrated many of the problematic issues of evaluating MEG. (4) In this study of 160 patients with nonlesional epilepsy, all had MEG, but only 72 proceeded to IC-EEG. The calculations of diagnostic characteristics of MEG are biased by incomplete ascertainment of the reference standard. However, even examining the diagnostic characteristics of MEG using the 72 patients who underwent IC-EEG, sensitivities and specificities were well below 90%, indicating the likelihood of both false-positive and false-negative studies. Predictive values based on these sensitivities and specificities mean that MEG can neither rule in nor rule out a positive IC-EEG, and that MEG cannot be used as a triage test before IC-EEG to avoid potential morbidity in a subset of patients.

One systematic review more specifically addressed whether MEG could improve the yield of IC-EEG, thus, allowing more patients to receive surgery. In a 2009 study by Knowlton et al., MEG results modified the placement of electrodes in 18 (23%) of 77 patients who were recommended to have IC-EEG. (5) Seven (39%) of 18 patients had positive intracranial seizure recordings involving additional electrode placement because of MEG results. It was concluded that 4 (5%) patients were presumed to have had surgery modified as a result of the effect of MEG electrode placement.

Several studies have correlated MEG findings with surgical outcomes. Lau et al. (2008) performed a systematic review of 17 such studies. (6) In this systematic review, sensitivity and specificity had unorthodox definitions. Sensitivity was the proportion of patients cured with surgery in whom the MEG-defined epileptic region was resected, and specificity was the proportion of patients not cured with surgery in whom the MEG-defined epileptic region was not resected. Pooled sensitivity was 84%, meaning that, among the total number of cured patients, 16% occurred despite the MEG-defined region not being resected. Pooled specificity was 52%, meaning that, among 48% of patients not cured, the MEG-localized region was resected. Another more recent systematic review by Mouthaan et al. (2019) from the E-PILEPSY consortium which used a more conservative analytic approach to pool data from a smaller subset of studies found similar but slightly lower MSI sensitivity (79% vs 84%) and specificity

(46% vs 52%). (7) These results are consistent with an association between resection of the MEG-defined region and surgical cure but that it is an imperfect predictor of surgical success. However, it does not address the question of whether MEG contributed original information to improve the probability of cure. In a retrospective review of 22 children with medically intractable focal epilepsy (median age at epilepsy surgery, 11 years), Kim et al. (2013) used a cutoff of 70% or more for the number of MEG identified spike dipole sources located within the resection margin to define a positive study. (8) Sensitivity, specificity, and positive and negative predictive values for seizure-free status postoperatively were 67%, 14%, 63%, and 17%, respectively.

Prospective Observational Study

Other studies have implied value of MEG but it is difficult to make firm conclusions regarding its value. In a study by Schneider et al. (2013), 14 patients with various findings on MEG, IC-EEG, and interictal single-photon emission computed tomography underwent surgery for nonlesional neocortical focal epilepsy. (9) Concordance between IC-EEG and MEG occurred in five patients, four of whom became seizure-free. This concordance of the two tests was the best predictor of becoming seizure-free. Although this was prognostic for success, whether this would actually change surgical decision making, such as declining to operate where there is no such concordance, is uncertain. A similar study by Widjaja et al. (2013) showed that concordance between MEG findings and the location of surgical resection correlated with better seizure outcomes. (10) However, the authors acknowledged that MEG was entrenched in clinical practice, and the decision to proceed further in diagnostic and therapeutic endeavors was based on results of MEG and other tests.

Case Series

Other case series of surgical patients have suggested value to MEG. A study by Albert et al. (2014) reviewed a series of pediatric patients undergoing surgery for epilepsy who had only undergone noninvasive monitoring prior to surgery. (11) MEG was proposed to have avoided the need for the morbidity associated with invasive monitoring. Of 16 patients, 62.5% were seizure-free following surgery, and 20% experienced improvement. Two cases required additional surgery with invasive monitoring. Although most patients improved, it could not be determined whether the outcomes were equivalent to the standard practice of pre-resection invasive monitoring. A study by Wang et al. (2015) compared fluorine 18 fluorodeoxyglucose positron emission tomography with MEG in identifying the epileptogenic zone, using invasive monitoring as the reference standard. (12) Fluorodeoxyglucose positron emission tomography identified the zone in 8 (50%) of patients and MEG identified the zone in 12 (75%) of patients. Although MEG was more sensitive than fluorodeoxyglucose positron emission tomography in this study, it still missed epileptogenic areas identified by invasive monitoring. Another study, by Koptelova et al. (2013), compared MEG with video-EEG monitoring in 22 patients. (13) Of 75 "irritative" zones identified in the 22 patients by either method, a higher proportion was identified by MEG. Note that there is no true reference standard in this type of analysis. However, in analyses of intraoperative EEG, several zones identified only with this method were only identified by MEG, confirming to some extent increased sensitivity over video-EEG. These recent studies have suggested clinical utility for MEG in the evaluation of

epilepsy patients, but, due to the aforementioned problems, firm conclusions about the clinical utility of MEG cannot be determined.

Section Summary: Localization of Seizure Foci
There are no clinical trials or other high-quality studies demonstrating the diagnostic accuracy of MEG in determining location of seizure foci. Evidence supporting the effect of MEG on patient outcomes is indirect and incomplete. Surgical management may be altered in a minority of patients based on MEG, but the evidence does not support conclusion that outcomes are improved as a result of these management changes. Trials with a control group are needed to determine whether improved outcomes can be attributed to the change in management induced by knowledge of MEG findings.

Localization of Eloquent and Sensorimotor Areas
Clinical Context and Test Purpose
The purpose of MEG/MSI in the localization of eloquent and sensorimotor areas of the brain in individuals with cortical brain lesions is to create a precise surgical plan for resective procedures to avoid postoperative speech, sensory, and motor dysfunction where possible.

The following PICO was used to select literature to inform this policy.

Populations
The relevant population of interest is individuals with brain lesions who are being evaluated for resective surgery.

Interventions
The intervention of interest is use of MEG/MSI to map eloquent and sensorimotor brain areas. MEG/MSI is a noninvasive alternative to the preoperative Wada test (intracarotid sodium amobarbital procedure) used to map eloquent brain areas.

Comparators
The following test and practice are currently being used to make decisions about localization of eloquent function areas: the Wada test and other standard evaluations.

Outcomes
Outcomes of interest are diagnostic accuracy (e.g., test accuracy, specificity) and clinical utility (e.g., consideration of avoidance of invasive testing).

Review of Evidence
Several studies have shown high concordance between the Wada test and MEG. In the largest study, by Papanicolaou et al. (2004) reported concordance between the MEG and Wada tests in 74 (87%). (14) In no cases were the tests discordant in a way that the findings were completely opposite. Discordant cases occurred mostly when the Wada test indicated left dominance and MEG indicated bilateral language function. In an alternative type of analysis, when the test is being used to evaluate the absence or presence of language function in the side in which

surgical treatment is being planned, using the Wada procedure as the criterion standard, MEG was 98% sensitive and 83% specific. Thus, if the presence of language function in the surgical site requires intraoperative mapping and/or a tailored surgical approach, use of MEG rather than Wada would have "missed" 1 case where such an approach would be needed (false-negative MEG) and resulted in 5 cases where such an approach was unnecessary (false-positive MEG). However, it should be noted that the Wada test is not a perfect reference standard, and some discordance may reflect inaccuracy of the reference standard. In another study by Hirata et al. (2004), MEG and the Wada test agreed in 19 (95%) of 20 cases. (15)

Balart-Sanchez and colleagues (2021) noted that cognitive reserve (CR) is the capacity to adapt to (future) brain damage without any or only minimal clinical symptoms, however, the underlying neuroplastic mechanisms remain unclear. Electrocorticography (ECoG), EEG, and MEG may help elucidate the brain mechanisms underlying CR, as CR is thought to be related to efficient utilization of remaining brain resources. (16) In a systematic review, these investigators examined the findings on neural correlates of CR estimates using ECOG, EEG, and MEG. They assessed studies that were published from the first standardized definition of CR; 11 EEG and 5 MEG cross-sectional studies met the inclusion criteria. They concerned original research, analyzed MEG in humans, used a validated CR estimate, and related MEG to CR. Quality assessment was performed using an adapted form of the Newcastle-Ottawa scale. No ECoG study met the inclusion criteria. A total of 1,383 subjects from heterogeneous patient, young and older healthy groups were divided into 3 categories by MEG methodology: 8 MEG studies employed event related fields or potentials, 6 studies analyzed brain oscillations at rest (of which 1 also analyzed a cognitive task), and 3 studies analyzed brain connectivity. Various CR estimates were used; and all studies compared different MEG measures and CR estimates. Several associations between MEG measures and CR estimates were observed. The authors concluded that the findings of the current review support that MEG measures are related to CR estimates, especially in healthy individuals. The presence and character of this relationship is highly variable and depends on the population and task that were studied and on the analysis technique that was used. It should also be noted that some of these relationships were reflected in differences in MEG measures between groups with high or low estimated CR, without establishing a direct relationship such as a correlation or in a predictive model, between MEG measures and CR estimates. These researchers stated that it remains unclear why such a relationship was only found in one patient study using EEG oscillations. To elucidate this issue and avoid the variability in populations and tasks that was encountered in this review, a sufficiently powered study in neurologically afflicted patients that compares the correlation between different MEG measures and different CR estimates, within this one group, might help.

One potential use (utility) of MEG would be to map the sensorimotor area of the brain to avoid such areas in the surgical resection area. Intraoperative mapping just before resection is generally done as the reference standard. Preoperative mapping as potentially done by MEG might aid in determining the suitability of the patient for surgery or for assisting in the planning of other invasive testing. Similar to the situation for localization of epilepsy focus, the literature is problematic in terms of evaluating the comprehensive outcomes of patients due to

ascertainment and selection biases. Studies tend to be limited to correlations between MEG and intraoperative mapping. Intraoperative mapping would be performed anyway in most resection patients. A 2006 TEC assessment of functional brain imaging prepared by the Ontario Ministry of Health reviewed 10 studies of MEG and invasive functional mapping and showed good to high correspondence between the two tests. (17) However, these studies do not demonstrate that MEG would replace intraoperative mapping or reduce the morbidity of such mapping by allowing a more focused procedure.

Studies of the use of MEG in localizing the sensorimotor area provide only indirect evidence of utility. A 2013 study by Niranjan et al. reviewed results of 45 patients in whom MEG was used for localizing somatosensory function. (18) In 32 patients who underwent surgery, surgical access routes were planned to avoid regions identified as somatosensory by MEG. All patients retained somatosensory function. It is unknown to what extent MEG provided unique information not provided by other tests. In a 2012 study by Tarapore et al., 24 patients underwent MEG, transcranial magnetic stimulation, and intraoperative direct cortical stimulation to identify the motor cortex. (19) MEG and navigated transcranial magnetic stimulation were both able to identify several areas of motor function, and the median distance between corresponding motor areas was 4.71 mm. When comparing MEG with direct cortical stimulation, median distance between corresponding motor sites (12.1 mm) was greater than the distance between navigated transcranial magnetic stimulation and direct cortical stimulation (2.13 mm). This study did not determine whether MEG provided unique information that contributed to better patient outcomes.

Section Summary: Localization of Eloquent and Sensorimotor Areas
There are no clinical trials that demonstrate the clinical utility of using MEG for localization and lateralization of eloquent and sensorimotor regions of the brain. Because MEG is a less invasive alternative to the Wada test, this evidence indicates that it is a reasonable alternative. There is also some evidence that the correlation of MEG and intraoperative mapping of eloquent and sensorimotor regions is high, but the test has not demonstrated sufficient accuracy to replace intraoperative mapping.

There is insufficient evidence to support the use of MSI/MEG for other indications including the diagnosis and treatment of various neurological conditions/diseases. (28-33)

Summary of Evidence
For individuals who have drug-resistant epilepsy and are being evaluated for possible resective surgery who receive magnetoencephalography (MEG)/magnetic source imaging (MSI), the evidence for MEG/MSI as an adjunct to standard clinical workup includes various types of case series. Relevant outcomes are test accuracy and functional outcomes. Published evidence on MEG is suboptimal, with no clinical trials demonstrating clinical utility. Literature on diagnostic accuracy has methodologic limitations, primarily selection and ascertainment bias. Studies of functional outcomes do not fully account for the effects of MEG, because subjects who received MEG are not fully accounted for in the studies. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have brain lesions and a planned brain resection who receive MEG/MSI, the evidence for MEG/MSI for localization of eloquent function areas includes comparative studies. Relevant outcomes include test accuracy and functional outcomes. Available studies have reported that this test has high concordance with the Wada test, which is currently the main alternative to localize eloquent functions. Management is changed in some patients based on MEG testing, but it has not been demonstrated that these changes lead to improved outcomes. The evidence is insufficient to determine the effects of the technology on health outcomes.

Practice Guidelines and Position Statements

American Clinical Magnetoencephalography Society (ACMEGS)

The American Clinical Magnetoencephalography Society (2009) released a position statement supporting the routine clinical use of MEG plus MSI for presurgical evaluation of patients with medically intractable seizures. (20) This statement cited a study by Sutherling et al. (2008) as being a "milestone class I study." Class I evidence usually refers to randomized comparisons of treatment. However, the authors of Sutherling et al. (2008) study described it as a "prospective, blinded crossover-controlled, single-treatment, observational case series." (21) The study attempted to determine the proportion of patients in whom diagnostic or treatment strategy was changed as a consequence of MEG. They concluded the test provided nonredundant information in 33% of patients, changed treatment in 9% of surgical patients, and benefited 21% of patients who had surgery. There was no control group in this study. The benefit of MEG was inferred by assumptions of what might have occurred in the absence of MEG results. Less than half of 69 enrolled patients went on to receive IC-EEG; thus, there appeared to be incomplete accounting for outcomes of all patients in the study. A similar study by De Tiege et al. (2012) also attempted to determine the number of patients in whom management decisions were altered based on MEG results. (22) They concluded that clinical management was altered in 13% of patients.

ACMEGS (2011) issued a series of practice guidelines on magnetic evoked fields addressing different aspects of this technology (recording and analysis of spontaneous cerebral activity, (23) presurgical functional brain mapping using magnetic evoked fields, (24) MEG and electroencephalogram reporting, (25) and qualifications of MEG-electroencephalogram personnel). (26) Methods of guideline development were not described.

Guideline 2 on presurgical functional brain mapping indicated that:
“Magnetoencephalography shares with EEG high temporal resolution, but its chief advantage in pre-surgical functional brain mapping is in its high spatial resolution. Magnetic evoked fields are therefore done for localization; unlike electrical evoked potentials (EPs), MEF latencies and latency asymmetries are not typically used to detect abnormalities.” (24)

Proposed indications for MEG include localization of somatosensory, auditory, language, and motor evoked fields. (24)

In 2017, ACMEGS issued another position statement supporting routine use of MEG/MSI for obtaining noninvasive localizing or lateralizing information regarding eloquent cortices (somatosensory, motor, visual, auditory, and language) in the presurgical evaluation of patients with operable lesions preparing for surgery. (27)

Ongoing and Unpublished Clinical Trials

A search of ClinicalTrials.gov on January 5, 2024 did not identify any ongoing or unpublished trials that would likely influence this policy.

Coding

Procedure codes on Medical Policy documents are included **only** as a general reference tool for each policy. **They may not be all-inclusive.**

The presence or absence of procedure, service, supply, or device codes in a Medical Policy document has no relevance for determination of benefit coverage for members or reimbursement for providers. **Only the written coverage position in a Medical Policy should be used for such determinations.**

Benefit coverage determinations based on written Medical Policy coverage positions must include review of the member's benefit contract or Summary Plan Description (SPD) for defined coverage vs. non-coverage, benefit exclusions, and benefit limitations such as dollar or duration caps.

CPT Codes	95965, 95966, 95967
HCPCS Codes	S8035

*Current Procedural Terminology (CPT®) ©2024 American Medical Association: Chicago, IL.

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Centers for Medicare and Medicaid Services (CMS)

The information contained in this section is for informational purposes only. HCSC makes no representation as to the accuracy of this information. It is not to be used for claims adjudication for HCSC Plans.

The Centers for Medicare and Medicaid Services (CMS) does not have a national Medicare coverage position. Coverage may be subject to local carrier discretion.

A national coverage position for Medicare may have been developed since this medical policy document was written. See Medicare's National Coverage at <https://www.cms.hhs.gov>.

Policy History/Revision	
Date	**Description of Change**
12/31/2025	Document became inactive
04/01/2025	Reviewed. No changes.
03/15/2024	Document updated with literature review. Coverage unchanged. References 28-33 added.
03/15/2023	Reviewed. No changes.
07/01/2022	Document updated with literature review. Coverage unchanged. Reference 19 added, others removed.
02/15/2021	Reviewed. No changes.
05/15/2020	Document updated with literature review. Coverage unchanged. Reference 8 added.
04/01/2019	Reviewed. No changes.
05/15/2018	Document updated with literature review. Coverage unchanged. References 3 and 27 added; some references removed.
12/01/2017	Reviewed. No changes.
05/15/2016	Document updated with literature review. Coverage unchanged.
04/01/2015	Reviewed. No changes.
05/01/2014	Document updated with literature review. Coverage unchanged. CPT/HCPCS code(s) updated.
12/15/2013	Document updated with literature review. Coverage unchanged.
11/15/2011	Document updated with literature review. The following was added to the Coverage: Magnetoencephalography (MEG) and magnetic source imaging (MSI) may be considered medically necessary as part of the preoperative evaluation of patients with intractable epilepsy (seizures refractory to at least two first-line anticonvulsants), when standard techniques, such as magnetic resonance imaging (MRI) and electroencephalogram (EEG), do not provide satisfactory localization of epileptic lesion(s).
04/01/2009	Revised/updated entire document
05/15/2007	Revised/updated entire document
02/01/2002	New medical document