Effective for dates of service on or after April 1, 2013, refer to: https://www.bcbsal.org/providers/policies/careCore.cfm

Name of Policy:
Functional Magnetic Resonance Imaging (MRI)

Policy #: 295
Category: Radiology
Latest Review Date: February 2013
Policy Grade: A

Background/Definitions:
As a general rule, benefits are payable under Blue Cross and Blue Shield of Alabama health plans only in cases of medical necessity and only if services or supplies are not investigational, provided the customer group contracts have such coverage.

The following Association Technology Evaluation Criteria must be met for a service/supply to be considered for coverage:

1. The technology must have final approval from the appropriate government regulatory bodies;
2. The scientific evidence must permit conclusions concerning the effect of the technology on health outcomes;
3. The technology must improve the net health outcome;
4. The technology must be as beneficial as any established alternatives;
5. The improvement must be attainable outside the investigational setting.

Medical Necessity means that health care services (e.g., procedures, treatments, supplies, devices, equipment, facilities or drugs) that a physician, exercising prudent clinical judgment, would provide to a patient for the purpose of preventing, evaluating, diagnosing or treating an illness, injury or disease or its symptoms, and that are:

1. In accordance with generally accepted standards of medical practice; and
2. Clinically appropriate in terms of type, frequency, extent, site and duration and considered effective for the patient’s illness, injury or disease; and
3. Not primarily for the convenience of the patient, physician or other health care provider; and
4. Not more costly than an alternative service or sequence of services at least as likely to produce equivalent therapeutic or diagnostic results as to the diagnosis or treatment of that patient’s illness, injury or disease.
**Description of Procedure or Service:**
Functional magnetic resonance imaging (fMRI) is a noninvasive method for evaluation of eloquent brain areas. Images are collected while specific activities are performed in order to assist in the presurgical localization of critical cortical areas and evaluation of language lateralization.

Before neurological surgery for seizure disorders or resection of brain tumors, localization of certain areas of the brain, such as speech centers, is important. For example, from 25% to 60% of patients who undergo left anterior temporal lobectomy develop dysnomia (language/naming difficulties).

Most often these “eloquent” areas are assessed using the Wada test and direct electrical simulation. Both of these tests are invasive and both also require involvement various specialists. The Wada test involves angiography and injection of amobarbital into the carotid artery. Direct electrical stimulation involves surgical placement of electrodes in the brain.

Functional magnetic Resonance Imaging (MRI) is proposed as a noninvasive alternative method for evaluation of these eloquent brain areas. Functional MR imaging uses sequences based on T2-weighted blood oxygen. Images are collected as various activities are conducted. Laterality indices are calculated reflecting the interhemispheric difference between activated volumes in the left and right hemispheric regions of interest. These studies are often done on MR scanners with field strengths of 1.5 Tesla or greater.

**Policy:**

**Effective for dates of service on or after April 1, 2013, refer to:**
https://www.bcbsal.org/providers/policies/careCore.cfm

**Effective for dates of service on or after July 1, 2009 through March 31, 2013:**
Functional MRI meets Blue Cross and Blue Shield of Alabama’s medical criteria for coverage as a **complementary test in the preoperative evaluation of patients with refractory epilepsy or brain tumors who are candidates for neurosurgery when the lesion is in close proximity to an eloquent area of the brain** (e.g., controlling verbal or motor function) and **testing is expected to have an important role in assessing the spatial relationship between the lesion and eloquent brain area.**

Functional MRI does not meet Blue Cross and Blue Shield of Alabama’s medical criteria for coverage and is considered investigational for **all other applications.**

**Effective for dates of service January 1, 2007 through June 30, 2009:**
Functional MRI meets Blue Cross and Blue Shield of Alabama’s medical criteria for coverage in the **preoperative evaluation of patients with seizures or brain tumors** who are candidates for neurosurgical therapy **when the results of testing will obviate the need for either the Wada test or direct electrical stimulation.**
**Functional MRI does not meet** Blue Cross and Blue Shield of Alabama’s medical criteria for coverage for **all other applications** and is considered **investigational**.

*Blue Cross and Blue Shield of Alabama does not approve or deny procedures, services, testing, or equipment for our members. Our decisions concern coverage only. The decision of whether or not to have a certain test, treatment or procedure is one made between the physician and his/her patient. Blue Cross and Blue Shield of Alabama administers benefits based on the members' contract and corporate medical policies. Physicians should always exercise their best medical judgment in providing the care they feel is most appropriate for their patients. Needed care should not be delayed or refused because of a coverage determination.*

**Key Points:**
The high degree of concordance of language lateralization of functional MR imaging and either Wada test or direct electrical stimulation is well documented in the literature. In one summary, functional MRI was concordant with the Wada test in 78 of 83 (94%) cases and with direct electrical stimulation in 23 of 26 (88%) cases.

Sabsevitz et al (2003) reported on a series of 24 consecutive patients who underwent both functional MRI and Wada testing before left anterior temporal lobectomy for seizure disorders. Whole both tests were predictive of language changes, in this study, functional MRI had a sensitivity of 100% and specificity of 57% while results for the Wada test were 100% and 43% respectively.

Medina et al (2005) evaluated 60 consecutive patients prior to surgery. In 53 patients, language mapping was performed, in 33 motor mapping, and in seven visual mapping. The functional MRI study revealed change in anatomic location or lateralization of language-receptive in 28% of patients and in language-expressive in 21% of patients. In 38 (63%) patients, functional MRI helped to avoid further studies, including Wada test. In 31 (52%) and 25 (42%) patients, intraoperative mapping and surgical plans were altered because of functional MRI results.

Petrella et al (2006) reported on the impact of functional MRI preoperatively on 39 consecutive patients with brain tumors. In four patients, additional tests, e.g., the Wada test, were not ordered because of the functional MRI result. Treatment plans differed in 19 patients. However, the impact of the altered treatment plans on patient outcome was not assessed. Functional MRI resulted in reduced surgical time for 22 patients; it also led to decisions to perform craniotomy in 12 patients where less invasive approaches had been initially planned.

Thus, studies show that functional MRI is comparable to the Wada test and direct electrical stimulation in localizing certain eloquent functions; although there are less data for direct electrical stimulation. In patients who are to undergo neurosurgery for seizures or brain tumors, functional MRI may obviate the need for these tests. However, the impact of functional MRI on other outcomes in these patients is still uncertain.

Additional research appears to focus on improving and establishing standardized protocols for pre-surgical evaluation of the eloquent cortex. One report described a routine preoperative
functional MRI protocol in 81 consecutive patients (70 with tumors on the left side and 11 with tumors on the right side and language deficits). Patients were trained to recall simple sentences (picture cues) or to generate demanding word generation task, the combination of tasks allowed localization of both the Broca and Wernicke areas and determination of hemispheric language dominance in 79 (98%) patients. Surgical plans were modified in 9 (11%) patients based on the functional MRI findings (seven patients underwent radiation therapy instead of surgery and two patients had partial resection of large malignant gliomas). Results of the surgeries were not described. The authors noted that although functional MRI is capable of localizing the center of a functional area, resection borders cannot be reliably determined by this technique.

In another report the preoperative localization of epileptic focus was assessed in 29 complex cases (unclear focus and/or multifocality) that had been rejected for epilepsy surgery. Patients were included in the study if they had no contraindications for MRI, had more than 10 interictal discharges in 40 minutes of previously recorded electroencephalogram (EEG), and if the reason for rejection was the inability to localize a single source with EEG. Functional MRI results were considered robust if a consensus-defined interictal electrical discharge was associated with a significant positive blood oxygen level-dependent (BOLD) response. In eight (28%) patients, a robust fMRI response was considered to be topographically related to interictal electrical discharges. The EEG-functional MRI findings improved localization in four of six unclear foci and advocated one of multiple foci in another patient; in four other patients multiple foci were confirmed. As a result of the testing, four patients (14%) were considered to be surgical candidates and one of the four had undergone surgery at the time of the publication. The authors of this European-based study describe this as the first report of the clinical use of EEG-functional MRI. Although promising, the use of functional MRI to localize epileptic foci requires additional study.

Bizzi et al (2008) assessed the sensitivity and specificity of fMRI for mapping language and motor functions using intraoperative intracortical mapping as the reference standard. Thirty-four consecutive patients with a focal mass adjacent to eloquent cortex were included in the study. A site-by-site comparison between fMRI and intracortical mapping was performed with verb generation or finger tapping of the contralateral hand. A total of 251 sites were tested; 141 in patients evaluated with verb generation and 110 in patients evaluated with finger tapping. For hand motor function alone, sensitivity and specificity were 88% and 87% respectively. For language, sensitivity and specificity were 80% and 78% respectively. Functional MRI for Broca’s area showed 100% sensitivity and 68% specificity, while Wernicke’s area showed 64% sensitivity and 85% specificity. Functional MR imaging sensitivity decreased from 93% for World Health Organization grade II gliomas to 65% for grade IV gliomas. Other authors reported that successful pre-operative fMRI decreased intracortical mapping time from about 50 minutes to 30 minutes, and total operative time from an average 8.5 hours to about seven hours.

Wellmer et al (2008) assessed whether currently recommended thresholds for the fMRI-lateralization index (LI) allowed identification of atypical dominant patients (i.e., not left-dominant) with sufficient safety for presurgical settings. Out of 65 patients who had presurgical workup for epilepsy surgery, 22 were identified as atypical dominant by the Wada test. Lateralization indices were calculated for three functionally determined regions of interest comprising Broca’s area, a prefrontal area outside Broca’s, and temporoparietal cortex.
overlapping with the Wernicke area. In patients in whom the Wada test results were compatible
with typical left dominance, the fMRI-LI of the frontal and tempora-parietal regions of interest
ranged from 1 to -1. Depending on the chosen LI-threshold for unilateral language dominance,
between two and five patients (9% and 23%) out of this sample of atypical dominant patients
would have been misclassified as typical dominant. Another study compared presurgical
mapping by fMRI with either verb generation or semantic decision/tone decision and the Wada
test in 28 patients with epilepsy. The study found moderate correlation between the two tasks
(r=0.495) and between the language tasks and the Wada test (r=0.652 and r=0.735). It was
estimated that the language tasks explained approximately 58% of the variability of the Wada
test with moderate convergent validity. With a LI threshold of ±0.25, eight of the 28 patients
(29%) may have been misclassified based on fMRI alone. Another study assessed the language
laterality index across different statistical thresholds in 13 patients with brain tumor and seven
controls; results were not compared with the Wada test. In both groups, the language LI varied
as a result of statistical thresholding, presence of tumor, prior surgery, and language threshold.
The study found no optimal threshold for reliably determining the LI.

2010 Update
A search of the literature identified a case series on the use of preoperative fMRI in combination
with intra-operative MRI (iOMRI) to allow more complete resection of tumors without affecting
eloquent neurologic function. In the case series of 29 patients, preoperative fMRI was
performed to identify and co-register areas of brain activation for motor, speech, and short-term
memory prior to brain tumor resection. Areas of brain activation that were identified
preoperatively were superimposed on 1.5-T or 3-T scanners during the operative procedure,
allowing the surgeon to avoid brain areas where damaged would result in a postoperative
neurologic deficit. Post-operative neurologic morbidity was reported to be low in the 27 patients
where an fMRI-guided tumor resection was possible; seven patients (26%) had transient
neurologic impairments consisting of left hemiparesis, speech apraxia, motor apraxias, speech
and motor apraxia, or temporary work finding difficulty. No permanent neurologic impairment
was observed in the 27 patients.

2012 Update
In 2011, Dym et al reported a meta-analysis of fMRI determined lateralization of language
function compared to the Wada test. Inclusion criteria were examination of the same patients
with both fMRI and the Wada test; preoperative examination of at least four patients; and
reporting of the concordance in individual patients. Twenty-three studies with a total of 442
patients were included in the meta-analysis. Language dominance for each patient was classified
as typical (left hemispheric language dominance) or atypical (right hemispheric language
dominance or bilateral language representation), with most studies using a lateralization index
threshold of 0.2. Sensitivity was defined as the ability of functional MRI (fMRI) to depict
atypical language representation, and specificity was the ability of fMRI to depict typical
language representation. Most of the studies did not specify whether the evaluators were blinded
to the results of the other test. With the Wada test as the reference standard, fMRI had a
sensitivity of 83.5% and specificity of 88.1%. Specificity was significantly higher with use of a
word generation task (95.6%) than with a semantic decision task (69.5%). This analysis may
oversimplify the role of fMRI, which in addition to providing information on hemispheric
dominance, provides information on the localization of language and motor areas in relation to
the tumor or lesion. It is also unlikely that current fMRI protocols utilize a single task (e.g., word generation) to evaluate the eloquent cortex.

In a 2011 report, Wengenroth et al compared localization of eloquent tumor-adjacent brain areas by fMRI versus structural MRI imaging in 77 consecutive patients with brain tumors of the central region. During fMRI, the patients performed self-paced tongue up and down movements with closed lips, complex finger tapping with sequential finger-to-thumb opposition, as well as repetitive toe flexion-extension of the side contralateral to the respective lesion. The motor hand area was localized in 76/77 patients (99%) by fMRI and in 66/77 patients (86%) by structural MRI. Motor areas of the foot and tongue were investigated in 70 patients and could be identified by fMRI in 96% (tongue representation) and 97% (foot representation) of patients. Morphologic landmarks for the motor hand area were found to be reliable in the unaffected hemisphere (97% success rate) but not in the tumor-affected hemisphere (86% success rate). In 14% of patients, it was not possible to identify the motor hand area at all according to anatomic criteria. There are no reliable morphological landmarks for motor foot and tongue areas, and these representations could only be located by fMRI. After consideration of the clinical condition, tumor etiology, and fMRI results, the decision for neurosurgical operation was made in 52 patients (67.5%). In 16 patients, the decision against surgery was based mainly on fMRI results, which provided evidence that major neurologic impairments would be expected after surgery. fMRI-based risk assessment before surgery had a high correlation with the clinical outcome and corresponded in 46 of 52 operative patients (88%) who had only minimal deficits or functional improvement postoperatively.

Moeller et al reported an EEG-fMRI study for the work-up of nine patients with refractory frontal lobe epilepsy who did not have a clear lesion or seizure focus. A minimum of ten interictal discharges in 60 minutes in previously recorded scalp EEGs was required to be in the study, and the number of interictal discharges recorded during the fMRI session ranged from nine to 744. There was concordance between spike localization and positive BOLD response in eight of the patients and positron emission tomography (PET) and single-photon emission computed tomography (SPECT) results corresponded with BOLD signal changes in six of seven studies. Surgery was subsequently performed on two patients, one of whom was seizure-free at the time of publication.

A 2011 multicenter study compared presurgical interictal discharge-related BOLD signal changes with intracranial EEG and postoperative outcome in 23 patients with refractory epilepsy. The 23 patients were selected for analysis based on a diagnosis of focal cortical dysplasia from structural MRI or histology out of 65 patients who were undergoing presurgical evaluation for refractory focal epilepsy. The EEG-fMRI results were not used in the planning of intracranial EEG or surgical resections. Twelve of the 23 patients (52%) had interictal discharges during EEG-fMRI recording, and 11 of the 12 (92%) had significant interictal discharge-related hemodynamic changes. In the 11 patients with a BOLD response, fMRI results were concordant with the intracranial EEG-determined seizure onset zone in five patients (45%), and the majority (four of the five) had a 50% or greater reduction in seizure frequency following resective surgery. The other six of 11 patients had widespread or discordant regions of fMRI signal change, and the majority (n=5) had either a poor surgical outcome or a widespread seizure onset zone that precluded surgery. This study is described as the first prospective systematic evaluation
of the potential role of EEG-fMRI in the presurgical evaluation of patients with focal cortical
dysplasia. It should be considered exploratory. Another 2011 paper from many of the same
investigators describes a recently developed method to evaluate EEG-fMRI results in the absence
of visually identifiable interictal epileptiform spikes.

Summary
Overall, the literature indicates that fMRI is complementary to the Wada test and direct electrical
stimulation in localizing certain eloquent functions. Evidence suggest that although bilateral
activation patterns in fMRI cannot be conclusively interpreted, fMRI in patients who are to
undergo neurosurgery for seizures or brain tumors may help to define eloquent areas, reduce the
surgical time and alter treatment decisions. Therefore, fMRI may be considered medically
necessary in the preoperative evaluation for patients being considered for neurosurgery, when the
lesion is in close proximity to an eloquent area of the brain (e.g., controlling verbal or motor
function) and testing is expected to have an important role in assessing the spatial relationship
between the lesion and eloquent brain area.

The use of EEG-fMRI to identify seizure focus requires additional study and is considered
investigational.

Practice Guidelines and Position Statements
The American College of Radiology (ACR) and the American Society of Neuroradiology
(ASNR) jointly published a 2007 guideline stating that fMRI using BOLD is a proven and useful
tool for the evaluation of eloquent cortex in relation to a focal brain lesion, such as neoplasm or
vascular malformation. The guideline’s primary indications for fMRI include presurgical
planning, surgical planning, and therapeutic follow-up for the assessment of intracranial tumoral
disease, and assessment of language functions for epilepsy surgery.

Key Words:
Functional Magnetic Resonance Imaging, Functional MRI, fMRI

Approved by Governing Bodies:
Not applicable

Benefit Application:
Coverage is subject to member’s specific benefits. Group specific policy will supersede this
policy when applicable.

ITS: Home Policy provisions apply
FEP contracts: Special benefit consideration may apply. Refer to member’s benefit plan.

Pre-certification requirements: Effective for dates of service on or after November 1, 2007,
required when ordered by a provider in a Blue Cross and Blue Shield of Alabama’s Preferred or
Participating Network for a patient covered by Blue Cross and Blue Shield of Alabama who will
receive outpatient imaging services(s) from a Preferred Medical Doctor (PMD) or Preferred Radiology Participating (PRP) provider.

**Exceptions to the Alabama PMD and PRP pre-certification requirement:** NASCO, Wal-Mart, Blue Advantage, Flowers Foods, Inc., FEP.

In addition to the above Blue Cross and Blue Shield of Alabama PMD/PRP Network requirement, some self-insured national account groups may require pre-certification for all MRIs effective for dates of service on or after January 1, 2009. Please confirm during your benefit verification process if a pre-certification is required.

Reviews to verify accuracy of pre-certification information will be conducted.

**Coding:**

CPT Codes:

70554 Magnetic resonance imaging, brain, functional MRI; including test selection and administration of repetitive body part movement and/or visual stimulation, not requiring physician or psychologist administration

70555 Magnetic resonance imaging, brain, functional MRI; requiring physician or psychologist administration of entire neurofunctional testing

96020 Neurofunctional testing selection and administration during noninvasive imaging functional brain mapping, with test administered entirely by a physician or other qualified health care professional (i.e., psychologist), with review of test results and report

**References:**


5. Grouiller F, Thornton RC, Groening K et al. With or without spikes: localization of focal epileptic activity by simultaneous electroencephalography and functional magnetic resonance imaging. Brain 2011; 134(Pt 10):2867-86.

Policy History:
Medical Policy Group, December 2006 (2)
Medical Policy Administration Committee, December 2006
Available for comment December 21, 2006-February 2, 2007
Medical Policy Panel, June 2009
Medical Policy Group, June 2009 (2)
Medical Policy Administration Committee, July 2009
Available for comment July 2-August 15, 2009
Medical Policy Panel June 2010
Medical Policy Group, June 2010 (2)
Medical Policy Group, July 2012 (2): Update to Key Points and References
Medical Policy Group, December 2012 (3): 2013 Coding Updates: Verbiage change to Code 96020 – added “other qualified health care professional”.
Medical Policy Group, February 2013 (2): Updated policy with link to CareCore National ©
Medical Policy Administration Committee, March 2013
Available for comment February 15 through March 31, 2013
Medical Policy Group, November 2013 (2): Updated policy with link to CareCore National ©

This medical policy is not an authorization, certification, explanation of benefits, or a contract. Eligibility and benefits are determined on a case-by-case basis according to the terms of the member’s plan in effect as of the date services are rendered. All medical policies are based on (i) research of current medical literature and (ii) review of common medical practices in the treatment and diagnosis of disease as of the date hereof. Physicians and other providers are solely responsible for all aspects of medical care and treatment, including the type, quality, and levels of care and treatment.

This policy is intended to be used for adjudication of claims (including pre-admission certification, pre-determinations, and pre-procedure review) in Blue Cross and Blue Shield’s administration of plan contracts.