Magnetic resonance spectroscopy (MRS) is a noninvasive technique that can be used to measure the concentrations of different chemical components within tissues. The technique is based on the same physical principles as magnetic resonance imaging and the detection of energy exchange between external magnetic fields and specific nuclei within atoms.

**OBJECTIVE**

The objective of this evidence review is to evaluate whether magnetic resonance spectroscopy improves health outcomes in patients with brain tumors, breast cancer, prostate cancer, and various non-cancer indications.

**POLICY STATEMENT**

Magnetic resonance spectroscopy is considered investigational.
POLICY GUIDELINES

None

BENEFIT APPLICATION

Experimental or investigational procedures, treatments, drugs, or devices are not covered (See General Exclusion Section of brochure).

FDA REGULATORY STATUS

Multiple software packages for performing proton MRS have been cleared for marketing by the U.S. Food and Drug Administration through the 510(k) process since 1993. Single-voxel MRS is available on all modern MRI scanners. Food and Drug Administration product code: LNH.

RATIONALE

Summary of Evidence

For individuals who have brain tumors who receive magnetic resonance spectroscopy (MRS), the evidence includes a number of small studies and systematic reviews. The relevant outcomes are test accuracy, change in disease status, morbidity events, and functional outcomes. Small studies have evaluated detection, characterization, grading, prognosis, and differentiation of tumor recurrence vs necrosis. Most studies included in the meta-analyses were small, retrospective, and used various ratios of MRS spectra. The largest prospective studies found that combining MRS with MRI resulted in a greater percentage of correct diagnoses of pediatric brain tumor type. These reports had limited information on the specific MRS spectra associated with different tumor types. Additional study is needed to define better the spectra associated with tumor characteristics, to evaluate the diagnostic accuracy, and to determine the effect on health outcomes. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have breast cancer, prostate cancer, dementia, liver disease, multiple sclerosis (MS), or psychiatric disorders who receive MRS, the evidence includes prospective studies on diagnostic accuracy and systematic reviews. The relevant outcomes are test accuracy, change in disease status, morbidity events, and functional outcomes. A number of studies have examined the use of MRS for localized prostate cancer for biopsy, for diagnosis, and for the monitoring of patients with prostate cancer. However, the cumulative evidence remains uncertain. Data comparing the diagnostic accuracy of MRS with alternative imaging strategies are limited. A systematic review of MRS to identify dementia concluded that to characterize Alzheimer disease-associated neurochemical changes effectively, future approaches need to analyze interactively multiple quantifiable metabolites from different brain regions. A study of MRS as a noninvasive alternative to liver biopsy indicated that dual-gradient echo MRI outperforms MRS. Data on the use of MRS in MS has indicated that the measure is not sufficiently reliable to predict the future disease course. Research assessing MRS for the management of bipolar disorder has thus far failed to demonstrate its ability to predict treatment response. The evidence is insufficient to determine the effects of the technology on health outcomes.

SUPPLEMENTAL INFORMATION

Practice Guidelines and Position Statements

National Comprehensive Cancer Network (NCCN)

The NCCN clinical guidelines on central nervous system cancers (v.1.2019) identifies magnetic resonance spectroscopy (MRS), as a modality that can be considered to rule out radiation necrosis, as compared with a recurrence of brain tumors. The guidelines also state that MRS may be helpful in grading tumors or assessing response and that the most abnormal area on MRS would be the best...
target for biopsy. The limitations include tumors near vessels, air spaces, or bone, and the extra time required in a magnetic resonance imaging machine.

The NCCN clinical guidelines on prostate cancer (v.2.2019) list MRS as an advanced imaging technique but make no recommendations for its use.52.

The NCCN clinical guidelines on breast cancer (v.2.2019) do not mention MRS.53.

**American Association of Neurological Surgeons et al**

The American Association of Neurological Surgeons and Congress of Neurological Surgeons (2015) gave a level III recommendation (level C) for the addition of MRS to anatomic imaging for the management of diffuse low-grade glioma because the diagnostic accuracy is not well-defined and the role in clinical practice is still being defined.54.

**Congress of Neurological Surgeons**

The Congress of Neurological Surgeons (2016) published an evidence-based guideline on preoperative imaging assessment of patients with suspected nonfunctioning pituitary adenomas.55. The Congress found that although the results were promising, there was insufficient evidence to recommend the use of MRS formally.

**American College of Radiology et al**

The American College of Radiology, American Society of Neuroradiology, and Society for Pediatric Radiology (2013) updated their joint practice parameters on MRS of the central nervous system.56. Most of the update addressed the actual performance of MRS, but it also listed 22 possible indications for MRS when magnetic resonance imaging or computed tomography is inadequate for answering specific clinical questions.

American College of Radiology appropriateness criteria for prostate cancer (last reviewed in 2016), stated that MRS cannot yet be considered to provide significant advantages in local staging before treatment.57.

American College of Radiology appropriateness criteria for imaging of dementia and movement disorders (updated in 2015) considered MRS to be usually inappropriate.58.

**U.S. Preventive Services Task Force Recommendations**

Not applicable.

**Medicare National Coverage**

Medicare (2004) issued a decision memorandum for MRS for brain tumors that reaffirmed its national noncoverage determination.59. After reviewing updated literature, a technology assessment it commissioned from the Agency for Healthcare Research and Quality, and the TEC Assessment,6 Medicare found the evidence inadequate to conclude that MRS is reasonable and necessary for the diagnosis of brain tumors. The current noncoverage policy applies to all indications of MRS.60.
REFERENCES


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<tr>
<th>Date</th>
<th>Action</th>
<th>Description</th>
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<td>June 2012</td>
<td>New policy</td>
<td>Policy updated with literature search. References 13, 14, 31-33 and 40 added. No change to policy statement.</td>
</tr>
<tr>
<td>March 2013</td>
<td>Replace policy</td>
<td>Policy updated with literature review. References 28, 31, 35-36, 49 and 58-59 added. No change to policy statement.</td>
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<tr>
<td>March 2014</td>
<td>Replace policy</td>
<td>Policy updated with literature review; references 31 and 36 added. Policy statement unchanged.</td>
</tr>
<tr>
<td>March 2015</td>
<td>Replace policy</td>
<td>Policy updated with literature review through July 21, 2017; references 1, 12, 36, and 41-42 added; notes 44-45 updated. Policy statement unchanged.</td>
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<tr>
<td>December 2017</td>
<td>Replace policy</td>
<td>Policy updated with literature review through July 9, 2018; references 3, 8, 23, and 44-45 added; reference 43 updated. Policy statement unchanged.</td>
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