Medical Policy

Title: Computer-Aided Evaluation of Malignancy with Magnetic Resonance Imaging of the Breast

See also: MRI of the Breast

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<th>Professional</th>
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<td>Original Effective Date: October 5, 2006</td>
<td>Original Effective Date: November 2, 2009</td>
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<td>Revision Date(s): April 19, 2007; November 2, 2009; August 13, 2012; April 26, 2013; April 28, 2015; April 1, 2017</td>
<td>Revision Date(s): August 13, 2012; April 26, 2013; April 28, 2015; April 1, 2017</td>
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<td>Current Effective Date: November 2, 2009</td>
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<th>Populations</th>
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<th>Comparators</th>
<th>Outcomes</th>
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<td>Individuals:</td>
<td>Interventions of interest are:</td>
<td>Comparators of interest are:</td>
<td>Relevant outcomes include:</td>
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<td>• With risk of breast cancer, with suspected breast cancer or diagnosed with breast cancer</td>
<td>• Computer-aided evaluation of breast malignancy with magnetic resonance imaging</td>
<td>• Magnetic resonance imaging of the breast without computer-aided evaluation</td>
<td>• Disease-specific survival</td>
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DESCRIPTION
The use of computer-aided evaluation (CAE) is proposed to assist radiologists’ interpretation of contrast-enhanced magnetic resonance imaging (MRI) of the breast and to improve the accuracy of diagnosis of malignancy.

The use of computer-aided evaluation (CAE) is proposed to assist radiologists’ interpretation of contrast-enhanced magnetic resonance imaging (MRI) of the breast. MRI of the breast is suggested as an alternative or adjunct to mammography or other screening and diagnostic tests because of its high sensitivity in detecting breast lesions. However, it has a high false positive rate because it is difficult to distinguish between benign and malignant lesions. MRI may be used to screen women at high genetic risk of breast cancer or to look for more extensive disease in women diagnosed with breast cancer who are eligible for breast-conserving surgery; it is also being studied to gauge the impact of cancer treatment.

The CAE systems reviewed here are intended to improve the specificity of MRI in detecting or measuring malignant tissue, while maintaining the generally high sensitivity of MRI. Improved ability to identify MRI-detected lesions that are almost certainly benign could potentially reduce biopsy rates. There is anecdotal evidence that MRI also may reduce reoperation rates among patients undergoing breast-conserving surgery by more clearly identifying the tissue that should be removed. CAE may also reduce the time needed to interpret breast MRI images, which currently takes longer than reading mammograms.

CAE systems for MRI essentially provide an easier way of interpret the patterns of contrast enhancement across a series of images, which in turn may help identify lesions and their likelihood of being malignant. Two key aspects of enhancement (also called kinetics) are examined: (1) Within the first minute or so, how quickly does the lesion enhance up to a certain threshold (eg, 50% or 100% of the initial value; rapid enhancement [>90% in 90 seconds] suggests malignancy)? (2) What is the subsequent pattern of enhancement (ie, continues to increase [persistently ascending], plateaus, or declines [called washout, which is associated with malignancy])?1

In contrast to computer-aided detection systems used with mammography, CAE for MRI is not primarily intended to identify lesions for consideration by a radiologist. Unlike the subtle appearance of lesions on mammography, most cancers enhance on MRI. The challenge is determining which lesions are benign and which are malignant. A large number of images are produced during MRI of the breast: images are taken at varying “depths” throughout each breast multiplied by the number of times the breast is imaged to capture different time points in the enhancement process; this can produce hundreds of images. Radiologists view the images to detect suspicious areas, and then they can pick a region of interest and look at the enhancement pattern. However, there may be variations across radiologists in the regions of interest selected and in the precise definition of the region of interest. CAE systems, in contrast, use color-coding and differences in hue to indicate the pattern of enhancement for each pixel in the breast image, thereby allowing the radiologist to analyze the enhancement patterns systematically.
Regulatory Status
Several computer-aided evaluation systems for use with magnetic resonance imaging (MRI) of the breast have 510(k) process, some systems of which may have broader uses beyond breast MRI. Examples of FDA-cleared devices include:

- SpectraLook™, part of iCAD’s VersaVue® Enterprise Suite (iCAD, Nashua, NH) was cleared for marketing by FDA through the 510(k) process in 2012. The VersaVue® Enterprise Suite is intended for postprocessing of magnetic resonance images as a means for visualizing these images. A previous version of this device, 3TP (3Time Point), was cleared in 2008.

- CADstream® (Merge Healthcare, Milwaukee, WI) was cleared for marketing by FDA through the 510(k) process in 2003, at which time it was distributed by Confirma (Kirkland, WA). Aegis™ Breast (Hologic Inc., Marlborough, MA; previously owned by Sentinelle Medical) was cleared for marketing by FDA through the 510(k) process in 2007. However, in the 510(k) documents, the manufacturer states that the primary goal of the technology is “to identify where and how deep a biopsy or localization needle should be inserted into an imaged breast.”

- DynaCAD for Breast (MRI Devices, Waukesha, WI; now from Invivo Corp., Gainesville, FL) was cleared for marketing by FDA through the 510(k) process in 2004.

POLICY
The use of computer-aided evaluation for interpretation of magnetic resonance imaging of the breast is considered experimental / investigational.

RATIONALE
This evidence review has been updated using the MEDLINE database. The most recent literature review was conducted on July 21, 2016.


Diagnostic Accuracy
To demonstrate the impact of computer-aided evaluation (CAE) in the diagnosis of breast cancer, studies that compare the sensitivity and specificity of magnetic resonance imaging (MRI) with and without the use of CAE systems are needed. Such studies can demonstrate the incremental diagnostic accuracy of CAE compared with no CAE. Ideally, these studies should be prospective and evaluate a population of patients similar to that presenting for breast cancer screening or diagnosis in a clinical setting.

Systematic Reviews
This review was originally based on a 2006 TEC Assessment on computer-aided detection of malignancy, which summarized 4 published articles and 4 abstracts that compared the accuracy of MRI with and without CAE. The reviewed studies focused on commercially available CAE systems, but articles on other systems were included. In addition, studies had to report on cancer detection based on histologic results. Three of the articles reported on development and validation of CAE systems aimed at distinguishing between malignant and benign lesions, and
they used information on women with known lesions. The fourth article provided information on one of the noncommercial systems used to evaluate women with cancer who were eligible for breast-conserving therapy. Conclusions of the TEC Assessment were that the literature on CAE with MRI of the breast was sparse overall and that few studies addressed specific situations in which CAE with MRI is used in a clinical setting. The articles and abstracts calculated test characteristics on the basis of lesions and not the number of women or breasts. In a screening population, many women would not have any lesions; including these women might alter the results. Given MRI’s lower sensitivity in detecting ductal carcinoma in situ (DCIS), the mix of DCIS versus masses would affect the calculations of sensitivity and specificity and might affect the impact of the CAE system.

The most recent systematic review of literature on CAE with MRI for breast cancer diagnosis was published in 2011 by Dorrius et al. This review identified 10 CAE studies in women with benign and/or malignant breast lesions (Breast Imaging Reporting and Data System [BI-RADS] category ≥2). In a meta-analyses of 3 studies (211 lesions, 55% malignant), 1 of which used 3.0-Tesla (T) MRI, sensitivity of experienced radiologists’ blinded readings was 89% both with and without CAE, but specificity decreased from 86% (95% confidence interval [CI], 79% to 91%) without CAE to 82% (95% CI, 76% to 87%) with CAE, a statistically nonsignificant difference. The reviewers attributed the decrease to a greater reliance by radiologists on the contrast enhancement pattern provided by CAE in the absence of morphology data, which CAE does not provide. For residents with limited breast MRI experience, specificity was approximately 78% with or without CAE, but sensitivity increased from 72% (95% CI, 62% to 81%) without CAE to 89% (95% CI, 80% to 94%) with CAE, a statistically nonsignificant difference. Statistical heterogeneity was moderate to substantial ($I^2$ range, 56%-83%) for all results except for the specificity of residents’ readings both with and without CAE, which had low-to-moderate statistical heterogeneity ($I^2$ range, 24%-33%).

**Retrospective Diagnostic Accuracy Studies**

Larger representative diagnostic accuracy studies published after the 2011 systematic review are described next. All studies have been retrospective analyses that included populations of patients not reflective of those seen in clinical care. Most were conducted in Asia where protocols may differ from those used in the United States.

Yun et al (2016) in South Korea retrospectively studied 124 patients newly diagnosed with breast cancer. Patients underwent conventional MRI and MRI with CAE as part of a preoperative assessment of the extent of breast cancer. A commercially available CAE device was used (CADstream). Images were evaluated by 2 experienced radiologists blinded to histopathology results and patient characteristics. Analysis focused on differences in CAE-MRI parameters in axillary lymph node (ALN)−positive patients (n=34 [26%]) and ALN-negative patients (n=90 [74%]). The diagnostic accuracy of conventional MRI for differentiating between benign and metastatic ALNs was a sensitivity of 82.4% and a specificity of 85.7%. When CAE with MRI was used, the sensitivity was 91.2% and the specificity was 94.4%. Sensitivity and specificity were not significantly higher with CAE ($p=0.403$ for sensitivity, $p=0.086$ for specificity). However, overall accuracy (defined by area under the receiver operating characteristic curve [AUC ROC]) increased from 83.7% without CAE to 93.5% with CAE.

Song et al (2015) in Korea retrospectively evaluated 86 patients with invasive breast cancer using MRI alone, MRI with CAE, mammography, ultrasound computed tomography (CT), and
fluorodeoxyglucose with positron emission tomography. Patients underwent all imaging procedures and did not have adjuvant chemotherapy or excisional biopsy during the previous 6 months. For MRI with CAE, the CADstream device was used and pathologic analysis was used, as the reference standard. Two experienced radiologists blinded to the pathology report independently evaluated each image and final decisions reached by consensus. There was no significant differences among all 6 imaging methods for measuring tumor size (p=0.017). In addition, there were no significant differences in measuring pathologic tumor size between MRI with and without CAE. For evaluation of lymph node status, there was no significant difference in the diagnostic accuracy of MRI alone and MRI with CAE.

Liu et al (2014) retrospectively compared radiologists’ readings of 3.0-T MRI images with readings by CAE (DynaCAD) in 78 consecutive patients with newly diagnosed breast lesions at a single institution in China. Lesions less than 0.8 cm in long-axis diameter were excluded (sensitivity was not assessed). Diagnoses of 93 mass-like and non-mass-like lesions (eg, DCIS, invasive lobular carcinoma, papilloma) were confirmed by needle core biopsy (n=13) or surgical histology (n=80). Of 51 mass-like lesions, 29 were malignant; of 42 non-mass-like lesions, 23 were malignant. Three experienced radiologists blinded to histologic diagnosis performed MRI readings and 3 radiologists performed CAE readings; it is unclear whether these were the same radiologists. Overall diagnostic accuracy was 74% for radiologists and 87% for CAE. For mass-like lesions, accuracy was similar between radiologists and CAE. For non-mass-like lesions, accuracy was 67% for radiologists and 86% for CAE. Limitations of this study included calculation of test characteristics based on the number of lesions rather than on the number of women or the number of breasts. Further, results may be applicable only to patients with lesions greater than 0.8 cm and possibly only to readings made by 3.0-T MRI.

Lehman et al (2013) reported on a U.S.-based multicenter, retrospective study of 9 experienced and 11 inexperienced radiologists who read a set of dynamic contrast-enhanced breast MRIs twice, once with and once without CADstream. Of 70 MRIs in the set, 27 had a benign outcome and 43 had a malignant outcome. Among experienced readers, sensitivity increased from 84% without CAE to 91% with CAE, a statistically significant difference of 7 percentage points (95% CI, 4 to 11). Among inexperienced readers, sensitivity increased from 77% to 83% with CAE, a difference of 6 percentage points (95% CI, 1 to 10). Specificity (BI-RADS category 3 [considered negative]) did not change with the addition of CAE for either group. Similarly, overall diagnostic accuracy did not change statistically for either group: For experienced readers, the AUC ROC was 0.80 without CAE and 0.83 with CAE (these values are reversed without subsequent correction in the narrative description of results). For inexperienced readers, the AUC was 0.77 without CAE and 0.79 with CAE. There was no significant difference in overall time to assessment with or without CAE.

Section Summary: Diagnostic Accuracy
A 2006 TEC assessment found insufficient literature on CAE of malignancy with breast MRI and a 2011 systematic review did not find statistically significant differences in diagnostic accuracy for CAE with MRI versus MRI alone. Several studies were published after the systematic review and most did not find that CAE, when added to MRI, resulted in statistically significant improvement in diagnostic accuracy. Studies were retrospective in nature and tended to include women already diagnosed with breast cancer.
Clinical Utility
To demonstrate clinical utility, prospective studies that evaluate whether incremental diagnostic accuracy leads to changes in management and improved outcomes are needed. Decisions for biopsies may be changed as a result of CAE; in particular, biopsies may be performed in areas of abnormality identified by CAE not seen on standard MRI. This might in turn improve the detection rate for malignancies. It is also possible that the number of false-positive biopsies might be increased when CAE is used.

There is no direct evidence (ie, prospective studies) that evaluates the impact of CAE on health outcomes. There are also no relevant modeling studies that estimate the impact of CAE on outcomes. Because incremental changes in sensitivity and specificity with CAE are unknown, it is not possible to estimate the number of additional malignancies that would be detected by CAE, nor is it possible to determine the number of additional false-positive biopsies that would be performed. As a result, the clinical utility of CAE when added to standard MRI of the breast has yet to be determined.

Section Summary: Clinical Utility
No published comparative studies were available on the impact of CAE with MRI on patient management and health outcomes compared with MRI alone. Furthermore, there is insufficient information to formulate a model of indirect evidence to support clinical utility. Thus, the utility of CAE with MRI in clinical care cannot be determined from the literature.

Ongoing and Unpublished Clinical Trials
A search of ClinicalTrials.gov in August 2016 did not identify any ongoing or unpublished trials that would likely influence this review.

Summary of Evidence
For individuals with risk of breast cancer, with suspected breast cancer, or diagnosed with breast cancer, who receive computer-aided evaluation (CAE) of breast malignancy with magnetic resonance imaging (MRI), the evidence includes diagnostic accuracy studies and systematic reviews. Relevant outcomes are disease-specific survival, test accuracy and validity, and resource utilization. The most recent systematic review (2011) did not find a statistically significant improvement in sensitivity and specificity with MRI plus CAE versus MRI alone. Moreover, retrospective studies published in the last 5 years generally did not find that CAE resulted in statistically significant improvement in diagnostic accuracy compared with MRI alone. Studies were generally conducted in women already diagnosed with breast cancer; there is less literature on breast cancer detection. In addition, there are no comparative studies evaluating the impact of CAE with MRI on patient management decisions or health outcomes compared to MRI alone. The evidence is insufficient to determine the effects of the technology on health outcomes.

Practice Guidelines and Position Statements
National Comprehensive Cancer Network
Current breast cancer guidelines from the National Comprehensive Cancer Network do not address the use of CAE for contrast-enhanced MRI. These guidelines include the breast cancer guideline (v.2.2016), the breast cancer risk reduction guideline (v.1.2016), the breast cancer screening and diagnosis guideline (v.1.2016), and the genetic/familial high risk assessment for breast and ovarian guideline (v.2.2016).
American College of Radiology
In 2016, the American College of Radiology amended its 2011 practice parameter for the use of MRI-guided breast interventional procedures. There are no recommendations on use of CAE with breast MRI.13

European Society of Breast Cancer Specialists
The European Society of Breast Cancer Specialists issued consensus recommendations for MRI of the breast in 2010.14 This document stated: “We recommend the use of standardized interpretation systems such as the above mentioned BI-RADS [Breast Imaging Reporting and Data System] lexicon, or equivalent. There is some evidence that software for breast MR computer-aided diagnosis (CAD) may be of benefit but insufficient to recommend the routine use of such systems.”

U.S. Preventive Services Task Force Recommendations
No U.S. Preventive Services Task Force recommendations for CAE of malignancy with breast MRI have been identified.

CODING
The following codes for treatment and procedures applicable to this policy are included below for informational purposes. Inclusion or exclusion of a procedure, diagnosis or device code(s) does not constitute or imply member coverage or provider reimbursement. Please refer to the member’s contract benefits in effect at the time of service to determine coverage or non-coverage of these services as it applies to an individual member.

CPT/HCPCS
0159T Computer-aided detection, including computer algorithm analysis of MRI image data for lesion detection/characterization, pharmacokinetic analysis, with further physician review for interpretation, breast MRI (List separately in addition to code for primary procedure)

- There is an add-on CPT category III code for the use of CAE with MRI of the breast: 0159T. This code would be used with the CPT code for breast MRI (77058-77059).

REVISIONS
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<td>04-19-2007</td>
<td>Policy added to the bcbsks.com web site.</td>
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<tr>
<td>11-02-2009</td>
<td>Title: Title changed From &quot;Magnetic Resonance Imaging (MRI) and Computer Assisted Detection (CAD)&quot; To &quot;Computer-Aided Evaluation of Malignancy with Magnetic Resonance Imaging of the Breast&quot;</td>
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REFERENCES


Other References
1. Blue Cross and Blue Shield of Kansas Radiology Liaison Committee, February 2007; February 2008; February 2009.