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Breast MRI BI-RADS Assessments and Abnormal Interpretation Rates by Clinical Indication in U.S. Community Practices

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Abstract

Rationale and Objectives—As breast MRI use grows, benchmark performance parameters are needed for auditing and quality assurance purposes. We describe the variation in breast MRI abnormal interpretation rates (AIRs) by clinical indication among a large sample of U.S. community practices.

Materials and Methods—We analyzed data from 41 facilities across five Breast Cancer Surveillance Consortium imaging registries. Each registry obtained IRB approval for this HIPAA compliant analysis. We included 11,654 breast MRI exams conducted in 2005–2010 among women aged 18–79 years. We categorized clinical indications as: 1) screening; 2) extent of disease; 3) diagnostic (e.g., breast symptoms); and 4) other (e.g., short-interval follow-up). We characterized assessments as positive (i.e., BI-RADS 0, 4, and 5) or negative (i.e., BI-RADS 1, 2, 6), and provide results with BI-RADS 3 categorized as positive and as negative. We tested for differences in AIRs across clinical indications both unadjusted and adjusted for patient characteristics and registry, and assessed for changes in AIRs by indication over time.

Results—When categorizing BI-RADS 3 as positive, AIRs were 21.0% (95% CI: 19.8, 22.3) for screening, 31.7% (95% CI: 29.6, 33.8) for extent of disease, 29.7% (95% CI: 28.3, 31.1) for diagnostic, and 27.4% (95% CI: 25.0, 29.8) for other indications ($p<0.0001$). When categorizing BI-RADS 3 as negative, AIRs were 10.5% (95% CI: 9.5, 11.4) for screening, 21.8% (95% CI: 19.9, 23.6) for extent of disease, 17.7% (95% CI: 16.5, 18.8) for diagnostic, and 13.3% (95% CI: 11.6, 15.2) for other indications ($p<0.0001$). The significant differences in AIRs by indication persisted even after adjusting for patient characteristics and registry ($p<0.0001$). In addition, for most indications, there were no significant changes in AIRs over time.

Conclusion—Breast MRI AIRs differ significantly by clinical indication. Practices should stratify breast MRI exams by indication for quality assurance and auditing purposes.

Keywords

breast magnetic resonance imaging; audit; quality assurance

INTRODUCTION

Breast magnetic resonance imaging (MRI) is the most sensitive modality for detecting breast cancer, often identifying malignancy otherwise occult by mammography, ultrasound, and clinical breast examination (1). As the technology improves and the interpretation and reporting by radiologists becomes standardized, breast MRI is used for an increasing number of purposes, including high-risk screening, evaluation of extent of malignancy, evaluation of patients with metastatic axillary adenopathy and unknown primary cancer, and surveillance after cancer treatment (2–9). Moreover, the technology has now become readily available in

community settings throughout the U.S. with interpretation and reporting completed by both subspecialty-trained breast imagers and general radiologists (10).

To facilitate consistent reporting of and management recommendations for breast MRI findings, the American College of Radiology published the first edition of the Breast Imaging Reporting and Data System (11) MRI lexicon in 2003, with the most recently revised edition published in 2013 (12). Similar to the previously established BI-RADS mammography lexicon, the breast MRI lexicon provides common terminology for describing MRI findings. Standardized use of the lexicon and BI-RADS assessment categories allows for improved communication among radiologists and clinicians with regards to suspicious imaging findings and clinical recommendations (13). Recent studies have shown that the MRI BI-RADS assessment categories can accurately predict the risk of malignancy (14, 15).

Under the Medicare Improvement for Patients and Providers Act (MIPPA) of 2008, all radiology practices that bill for the technical component of breast MRI under part B of the Medicare Physician Fee Schedule must be accredited as of January 1, 2012 to qualify for reimbursements (16). To be awarded accreditation, practices must meet minimum quality standards, including mandatory use of MRI BI-RADS lexicon in reporting. In addition, imaging centers must maintain a medical outcomes audit program to follow-up positive BI-RADS assessments and correlate pathology results with suspicious imaging findings (17). In general, medical audits are widely recognized as important and effective quality assurance tools for improved patient care (18, 19).

Creating and maintaining a medical outcomes audit program for mammography can be difficult for community radiology practices without robust linkages to pathology and oncology databases (19). It is expected that similar challenges will affect the development of breast MRI outcomes audits, and practices will need to rely upon data that are readily available, such as clinical indications and image-guided biopsy results, to begin developing medical audit programs. Given the requirement for standardized use of MRI BI-RADS assessments, overall abnormal interpretation (i.e., recall) rates for breast MRI (recorded as a proportion of MRI exams with positive BI-RADS assessments) are realistic audit parameters readily determined by most community radiology practices developing breast MRI quality assurance programs.

Our study objective was to estimate abnormal interpretation rates (AIRs) overall and by clinical indications for breast MRI encountered in routine community practice. We provide a descriptive analysis of all breast MRI exams performed across a geographically diverse set of radiology practices over a six-year period. Based on our experience with mammography audits, we hypothesized that the proportion of positive BI-RADS assessments differs for screening versus diagnostic MRI exams.

MATERIALS AND METHODS

Data Source

Each of the National Cancer Institute-funded Breast Cancer Surveillance Consortium (BCSC) registries sends data for breast MRI exams to a central Statistical Coordinating Center (SCC) for pooled analyses. Each registry and the SCC follow previously reported data management and quality control procedures to ensure accurate data collection across registries (20). Each registry and the SCC obtain institutional review board approval for either passive or active patient consent or waiver of consent, linkage of patient characteristics to imaging-related outcomes, and performance of statistical analyses and results reporting. The SCC and each registry have a Federal Certificate of Confidentiality and other protections for the identity of individual women, physicians, and practices that are subjects of this research. All study procedures were compliant with the Health Insurance Portability and Accountability Act.

For this descriptive analysis, we used data from five breast imaging registries of the BCSC: the San Francisco Mammography Registry, Vermont Breast Cancer Surveillance System, New Hampshire Mammography Network, Carolina Mammography Registry, and Group Health Cooperative (Washington State). These registries comprise a geographically diverse group of breast imaging facilities in U.S. community settings that prospectively collect patient demographic and clinical information and breast imaging interpretation data as part of routine clinical care. A total of 41 individual imaging facilities across the five registries provided breast MRI data.

Study Population

We included data from all breast MRI exams conducted in 2005–2010 among women aged 18–79 years with reported clinical indication(s) and final BI-RADS assessment across the five BCSC registries. The registries collected standardized data on breast MRI exams, including the clinical indication(s) for the exam and the final BI-RADS assessments for each breast, from electronic data systems, billing information, and abstraction of radiology reports. Patient risk factor information was obtained at the time of the MRI exam or from the most recent mammogram within one year prior to the breast MRI exam, including: the patient's age, race/ethnicity, any personal history of breast cancer (self-reported or via linkage with tumor registries), family history (first degree relative) of breast cancer, and the reported mammographic BI-RADS breast density.

Clinical Indication Categorization

We stratified reported clinical indications for breast MRI into one of the following four categories: 1) screening (i.e., asymptomatic); 2) extent of disease; 3) diagnostic; and 4) other. Our "diagnostic" indication category included MRI exams performed for additional evaluation of a recent abnormality identified by mammography or ultrasound, evaluation of specific breast symptoms, and differentiation of cancer recurrence from post-surgical scar. Our "other" indication category included MRI exams performed for short interval follow-up of a probably benign MRI finding, evaluation of treatment response to neoadjuvant chemotherapy, and all other recorded indications not conforming to any other indication

category. For the minority of exams with multiple reported clinical indications (11%), we categorized clinical indication using the following hierarchy to isolate true screening breast MRI examinations in asymptomatic women from examinations performed for other reasons: 1) extent of disease; 2) evaluation of treatment response to neoadjuvant chemotherapy (= other); 3) axillary adenopathy of unknown primary (= other); 4) additional evaluation of recent abnormality on another breast imaging modality (= diagnostic); 5) evaluation of breast problem (= diagnostic); 6) differentiation of cancer recurrence from post-surgical scar (= diagnostic); 7) short interval follow-up of prior breast MRI examination (= other); 8) screening; and 9) other.

BI-RADS Assessment Categorization

We characterized overall assessments as either positive (i.e., needing further initial or short-term evaluation; BI-RADS 0, 3, 4, and 5) or negative (i.e., no further imaging evaluation needed; BI-RADS 1, 2, 6). We present results by categorizing BI-RADS 3 assessments as both positive and negative. The dichotomous or binary categorization of BI-RADS assessments allows for calculation of AIRs defined as the proportion of examinations with positive assessments by study clinical indication.

We included both unilateral and bilateral breast MRI exams in our analysis. Each breast in bilateral breast MRI exams was given a separate BI-RADS assessment. We categorized BI-RADS assessment as the highest order for the examination, and used the following BI-RADS assessment hierarchy: 5 > 4 > 3 > 0 > 6 > 2 > 1. Therefore, if a suspicious abnormality (BI-RADS 4) was identified in one breast but no abnormality was identified in the other (BI-RADS 1), then the overall exam assessment would be BI-RADS 4. Similarly, if an additional suspicious abnormality (BI-RADS 4) was identified in a patient with known, biopsy-proven malignancy (BI-RADS 6), then the overall exam assessment would be BI-RADS 4 since additional diagnostic work-up is recommended (it is assumed that BI-RADS 6 assessments do not require additional diagnostic work-up since the malignancy has already been proven by tissue sampling).

Statistical Analysis

We performed all analyses using SAS® Version 9.2 (SAS Institute, Cary, NC). Our univariate descriptive statistics included frequencies of the patient characteristics (age, race/ethnicity, family history of breast cancer, personal history of breast cancer, and BI-RADS breast density on mammography) stratified by four clinical indications. We calculated 95% exact confidence intervals for the BI-RADS assessment and used the Pearson chi-square test to identify statistically significant differences in positive versus negative BI-RADS assessment across clinical indications. In multivariate analyses, we used a logistic regression model to adjust for BCSC registry as well as patient age, race/ethnicity, family history of breast cancer, personal history of breast cancer, and mammographic breast density. Finally, we performed the Cochran-Armitage test for trend to identify significant changes in breast MRI AIRs by clinical indication over time. We considered a two-sided $p<0.05$ as statistically significant.

RESULTS

Population Characteristics

Between 2005 and 2010, a total of 15,242 breast MRI exams were performed across five BCSC breast imaging registries. Of these, 3,533 exams (23%, 3,533/15,242) did not meet our inclusion criteria and we excluded these from our analysis (589 exams due to patient age > 79 years-old, 2,451 exams due to missing clinical indication, 493 exams due to missing BI-RADS assessments, and 55 exams performed to evaluate for implant rupture). Thus, we included a total of 11,654 breast MRI exams performed between 2005 and 2010 in our analysis.

The characteristics of patients undergoing breast MRI exams during the study period are described by clinical indication in Table 1. Briefly, 36.9% (4300/11654) of breast MRI exams were performed for diagnostic purposes, 34.2% (3989/11654) were performed for screening, 16.8% (1954/11654) were performed to evaluate extent of disease among newly diagnosed breast cancer patients, and 12.1% (1411/11654) were performed for other clinical indications. The majority of breast MRI exams were performed among women who are in the routine age-based mammographic screening population, aged 40 to 79 years (82.4%, 9599/11654). The majority of breast MRI exams were performed among Caucasian women (83.9%, 8973/10689), women with a personal history of breast cancer (74.9%, 6114/8166), women without a first-degree family history of breast cancer (63.8%, 7054/11050), and women with heterogeneously or extremely dense breasts on mammography (65.7%, 5414/8242).

MRI BI-RADS Assessments by Clinical Indication

We provide a detailed distribution of MRI BI-RADS assessments by clinical indication in Table 2. The overall proportion of breast MRI exams with positive assessments differed across clinical indications. When categorizing BI-RADS 3 assessments as positive, AIRs were 21.0% (839/3989; 95% CI: 19.8, 22.3) for screening exams, 31.7% (619/1954; 95% CI: 29.6, 33.8) for extent of disease exams, 29.7% (1276/4300; 95% CI: 28.3, 31.1) for diagnostic exams, and 27.4% (386/1411; 95% CI: 25.0, 29.8) for exams done for other indications ($p<0.0001$). When categorizing BI-RADS 3 assessments as negative, the AIRs declined to 10.5% (417/3989; 95% CI: 9.5, 11.4) for screening exams, 21.8% (425/1954; 95% CI: 19.9, 23.6) for extent of disease exams, 17.7% (759/4300; 95% CI: 16.5, 18.8) for diagnostic exams, and 13.3% (188/1411; 95% CI: 11.6, 15.2) for exams done for other indications ($p<0.0001$). The significant association between AIR and clinical indication persisted even after adjusting for BCSC registry, patient age, race/ethnicity, family history of breast cancer, personal history of breast cancer, and mammographic breast density in our multiple logistic regression ($p<0.0001$).

We provide a trend analysis of breast MRI AIRs by indication over time in Table 3. We did not find any significant changes in AIRs for most indications over time regardless of whether BI-RADS 3 assessments were categorized as positive or negative. The exception was breast MRI AIR for diagnostic indications, which significantly decreased over time when BI-RADS 3 assessments were categorized as negative ($p<0.0001$). However, this trend

bordered on significant when BI-RADS 3 assessments were re-categorized as positive (p=0.06).

DISCUSSION

Our study is the first to report proportions of positive BI-RADS assessments by clinical indication for breast MRI exams performed across a large, geographically diverse set of U.S. radiology practices over multiple years. Since positive BI-RADS assessments suggest that further imaging evaluation or work-up is required, our reported proportions of positive BI-RADS assessments also constitute overall average abnormal interpretation (i.e., recall) rates. We found that the rate was lower for breast MRI exams conducted for screening compared to exams conducted for diagnostic work-up or extent of disease. Given statistical significance in the difference in AIRs across clinical indications even after adjusting for multiple covariates, radiology practices should audit screening breast MRI exams separately from diagnostic and extent of disease breast MRI exams.

Our conclusion, that AIRs for breast MRI exams vary by indication, is consistent with previous studies demonstrating significantly different BI-RADS outcomes for diagnostic mammography compared with screening mammography, with diagnostic exams defined as those performed for indications other than screening asymptomatic women (21–23). Similar to mammography, AIRs for breast MRI are higher for non-screening examinations than screening examinations. However, unlike screening and diagnostic mammography exams, which are already categorized as different types of exams for administrative and billing purposes, there is currently no such delineation by clinical indication for breast MRI exams. Since the same MR sequences are obtained regardless of indication, all breast MRI exams are treated the same for scheduling and billing purposes. Our findings, therefore, suggest that capturing the clinical indication for breast MRI exams at the practice level will be critical to the development of accurate breast MRI audit and quality assurance programs.

Prior data regarding population-based breast MRI AIRs have been limited to those from Europe. For example, a population-based screening study from the UK demonstrated a 10% AIR for screening breast MRI (24). However, this study involved only 649 women age 35–49 years in a clinical trial setting, with inclusion of women with at least a 60% chance of carrying BRCA mutations and exclusion of women with a prior breast cancer history (25). In comparison, our study includes data from 11,654 MRI examinations in the U.S. among women aged 18 –79 years in real-world community practice settings, without rigid study inclusion and exclusion criteria. Moreover, we provide average AIRs among a large, national sample of practices for all other clinical indications for breast MRI exams beyond asymptomatic screening.

Our analysis is also the first to describe trends in breast MRI interpretation by clinical indication over several years. We found that the average annual breast MRI AIRs for most clinical indications did not change significantly over time. The one exception was the trend of AIRs for diagnostic indications, which decreased over time if BI-RADS 3 assessments were categorized as negative. This suggests that community radiologists in the U.S. may be

improving in their interpretive performance of breast MRI exams indicated for diagnostic purposes with increasing experience.

While our reported proportion of positive BI-RADS assessments and AIRs represent performance in U.S. community settings, it should not be inferred that these are recommended targets for performance. The issues of defining standards of care or creating performance benchmarks and guidelines are beyond the scope of this work. Rather, our reported measures are a starting point for such discussions, and can be used as one source of information for examining variation in breast MRI BI-RADS assessments in U.S. community practice. Yet, given the sparse available data to which practices and radiologists may compare their breast MRI performance, our data can serve as “ballpark” figures from large aggregate averages that may be used by clinical practices to gauge their AIRs by clinical indication observed in their facility and individual audits, for the purpose of continuous quality improvement.

A major strength of our study is the large sample of breast MRI data from diverse community radiology practices across different geographic regions. Another major strength is that we consider scenarios where BI-RADS 3 assessments are classified as either positive or negative, accounting for their likely variable categorization across practices. Moreover, we adjust for patient demographic and clinical characteristics that are potential confounders for breast MRI AIR, including age, race/ethnicity, family history of breast cancer, personal history of breast cancer, and BI-RADS breast density (26–29). However, there are limitations to our analysis. First, we did not evaluate how physician characteristics such as interpretative volume and experience level or facility type influenced the proportion of positive MRI BI-RADS assessments. Second, we were unable to determine outcomes measures such as cancer detection rate or positive predictive value (PPV) as we do not yet have complete cancer capture for most of these exams due to lags in cancer registry reporting. Acceptability of reported AIRs may depend upon concomitant acceptability of these outcomes. Third, we did not evaluate the effect of technical parameters, such as magnetic field strength, on breast MRI AIR. However, a recent survey demonstrated that 94% of all BCSC facilities met both ACRIN and European Society of Breast Imaging technical standards for breast MRI equipment, including the use of ≥ 1.5 Tesla field strength for all breast MRI exams (30).

Finally, we assume that positive BI-RADS assessments were associated with the proper clinical management recommendations for suspicious imaging findings requiring further diagnostic work-up, and that women with negative assessments were not recalled for further workup. Yet, prior studies with regards to application of mammography BI-RADS shortly after its adoption into clinical practice demonstrated inconsistencies between the assessments and expected clinical management recommendations (31–33). Given the relatively recent adoption of breast MRI and the ACR breast MRI BI-RADS lexicon into clinical practice, there may be inconsistencies between MRI BI-RADS and clinical management recommendations in community practice. Therefore, as a next step, we are planning an analysis of the agreement between recorded MRI BI-RADS assessments and recorded clinical management recommendations.

In conclusion, we present data on the proportion of positive BI-RADS assessments by clinical indication for breast MRI examinations among a geographically diverse set of radiology practices across the U.S. These measures can be used as first available figures by individual breast imaging practices and radiologists to compare with their own performance as part of periodic mandatory audits and quality improvement initiatives. Our report, based on a large national sample of imaging practices, can also be used as a starting point by governing bodies and breast imaging experts who aim to determine performance benchmarks for breast MRI exams. Based on our statistically significant findings, radiology practices should determine and report their breast MRI AIRs stratified by clinical indications.

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Table 1

Study Population Characteristics by Breast MRI Clinical Indication

Patient Characteristic	Screening		Extent of Disease		Diagnostic		Other		Total		p-value
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	
	3989		1954		4300		1411		11654		
Age											
<40	494	(12.4)	172	(8.8)	426	(9.9)	163	(11.6)	1255	(10.8)	p<0.0001
40–49	1256	(31.5)	494	(25.3)	1208	(28.1)	432	(30.6)	3390	(29.1)	
50–59	1378	(34.5)	626	(32.0)	1328	(30.9)	486	(34.4)	3818	(32.8)	
60–69	707	(17.7)	452	(23.1)	940	(21.9)	247	(17.5)	2346	(20.1)	
70–79	154	(3.9)	210	(10.7)	398	(9.3)	83	(5.9)	845	(7.3)	
Race											
White, non- Hispanic	3092	(85.0)	1479	(80.9)	3315	(85.6)	1087	(80.6)	8973	(83.9)	p<0.0001
Black, non- Hispanic	53	(1.5)	63	(3.4)	174	(4.5)	35	(2.6)	325	(3.0)	
Hispanic	122	(3.4)	49	(2.7)	106	(2.7)	42	(3.1)	319	(3.0)	
Asian or Pacific Islander	256	(7.0)	170	(9.3)	185	(4.8)	139	(10.3)	750	(7.0)	
Other	115	(3.2)	68	(3.7)	94	(2.4)	45	(3.3)	322	(3.0)	
Missing	351		125		426		63		965		
Family history of breast cancer											
No	1844	(48.3)	1372	(78.5)	2992	(72.0)	846	(63.5)	7054	(63.8)	p<0.0001
Yes	1973	(51.7)	376	(21.5)	1161	(28.0)	486	(36.5)	3996	(36.2)	
Missing	172		206		147		79		604		
Personal history of breast cancer											
No	489	(21.4)	26	(1.4)	1406	(44.7)	131	(14.7)	2052	(25.1)	p<0.0001
Yes	1794	(78.6)	1822	(98.6)	1738	(55.3)	760	(85.3)	6114	(74.9)	
Missing	1706		106		1156		520		3488		
Yes, assuming Missing = No		(45.0)		(93.2)		(40.4)		(53.9)		(52.5)	p<0.0001
BI-RADS breast density											
Almost entirely fat	132	(4.6)	40	(3.2)	108	(3.4)	40	(4.2)	320	(3.9)	p<0.0001
Scattered fibroglandular densities	885	(30.7)	402	(31.8)	980	(31.1)	241	(25.5)	2508	(30.4)	
Heterogeneously dense	1287	(44.7)	631	(49.9)	1612	(51.2)	452	(47.8)	3982	(48.3)	
Extremely dense	576	(20.0)	192	(15.2)	451	(14.3)	213	(22.5)	1432	(17.4)	

Patient Characteristic	Screening		Extent of Disease		Diagnostic		Other		Total		p-value
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	
Missing	1109		689		1149		465		3412		

* Note: Missing information assumed to be no personal history of breast cancer

Table 2

Breast MRI BI-RADS Assessment by Clinical Indication

Assessment	Clinical Indication								Total	
	Screening		Extent of disease		Diagnostic		Other			
	N	% [95% CI]	N	% [95% CI]	N	% [95% CI]	N	% [95% CI]	N	[95% CI]%
Total	3989		1954		4300		1411		11654	
BI-RADS 1, 2, or 6*	**3150**	**(79.0)** [77.7,80.2]	**1335**	**(68.3)** [66.2,70.4]	**3024**	**(70.3)** [68.9,71.7]	**1025**	**(72.6)** [70.2, 75.0]	**8534**	**(73.2)** [72.4,74.0]
BI-RADS 1	990	(24.8)	16	(0.8)	1249	(29.0)	235	(16.7)	2490	(21.4)
BI-RADS 2	2116	(53.0)	235	(12.0)	1416	(32.9)	647	(45.9)	4414	(37.9)
BI-RADS 6	44	(1.1)	1084	(55.5)	359	(8.3)	143	(10.1)	1630	(14.0)
BI-RADS 3	**422**	**(10.6)** [9.6,11.6]	**194**	**(9.9)** [8.6, 11.3]	**517**	**(12.0)** [11.1, 13.0]	**198**	**(14.0)** [12.3,16.0]	**1331**	**(11.4)** [10.8,12.0]
BI-RADS 0, 4, or 5*	**417**	**(10.5)** [9.5,11.4]	**425**	**(21.8)** [19.9,23.6]	**759**	**(17.7)** [16.5, 18.8]	**188**	**(13.3)** [11.6, 15.2]	**1789**	**(15.4)** [14.7,16.0]
BI-RADS 0	144	(3.6)	88	(4.5)	147	(3.4)	42	(3.0)	421	(3.6)
BI-RADS 4	259	(6.5)	246	(12.6)	455	(10.6)	126	(8.9)	1086	(9.3)
BI-RADS 5	14	(0.4)	91	(4.7)	157	(3.7)	20	(1.4)	282	(2.4)
BI-RADS 0, 3, 4 or 5*	**839**	**(21.0)** [19.8,22.3]	**619**	**(31.7)** [29.6,33.8]	**1276**	**(29.7)** [28.3,31.1]	**386**	**(27.4)** [25.0, 29.8]	**3120**	**(26.8)** [26.0,27.6]

* Note: There was a statistically significant ($p<0.0001$) difference in positive versus negative assessment by clinical indication, regardless of the classification of BI-RADS 3 assessments.

Table 3

Trends in Breast MRI Abnormal Interpretation Rate by Clinical Indication and Year

	Clinical Indication								Total	
	Screening		Extent of Disease		Diagnostic		Other			
Year(s)	# exams	% AIR	# exams	% AIR	# exams	% AIR	# exams	% AIR	# exams	% AIR
Abnormal BI-RADS assessments: 0, 3, 4, or 5										
2005–6	655	19.1	361	27.4	1019	32.6	250	28.0	2285	27.4
2007	789	22.6	343	34.7	970	30.6	224	25.9	2326	28.0
2008	669	24.4	262	30.9	851	25.4	277	32.5	2059	26.7
2009	824	21.6	367	31.6	838	28.9	289	25.3	2318	26.3
2010	1052	18.5	621	32.9	622	30.4	371	25.6	2666	25.6
p-value trend		0.62		0.18		0.06		0.48		
Abnormal BI-RADS assessments: 0, 4, or 5										
2005–6	655	10.4	361	19.1	1019	21.7	250	16.0	2285	17.4
2007	789	11.0	343	23.3	970	19.8	224	12.1	2326	16.6
2008	669	12.9	262	21.4	851	12.8	277	15.2	2059	14.2
2009	824	8.9	367	18.3	838	15.5	289	9.7	2318	12.9
2010	1052	9.8	621	24.6	622	17.2	371	13.7	2666	15.5
p-value trend		0.36		0.16		<0.0001		0.27		

Note: MRI exams for 2005 and 2006 were combined due to lower number of exams in the earliest years. AIR = abnormal interpretation rate.