Effective Health Care Program

# Use of preoperative MRI among older women with ductal carcinoma in situ and locally invasive breast cancer

## *Use of Preoperative Breast MRI* Data Points # 13

The American Cancer Society estimates that 229,060 new cases of invasive breast cancer were diagnosed and 39,920 people died of the disease in the United States in 2012. In the same year, approximately 63,300 women were diagnosed with ductal carcinoma in situ (DCIS) of the breast.[1] DCIS is noninvasive breast cancer representing a wide variety of cell abnormalities confined to the ducts of the breast. DCIS encompasses a wide spectrum of tumors with varying histologic patterns, grades, and sizes. DCIS has been implicated as a precursor to invasive breast cancer.[2] While we do not know the percentage of cases of DCIS that would progress to invasive breast cancer, studies suggest a very high risk of invasive breast cancer among women diagnosed with DCIS.[3-6] Therefore, optimal management of DCIS to prevent subsequent invasive breast cancer is of strong clinical interest.

The typical treatment for both DCIS and early invasive breast cancer is surgical removal of the tumor by mastectomy or breast-conserving surgery (BCS) plus radiation therapy, and use of MRI may influence treatment planning.[6] For some patients, mammography can underestimate the extent of DCIS and invasive cancer.[7] Magnetic resonance imaging (MRI) findings may lead to changes in treatment plans such as wider excisions, unilateral mastectomy, and/or early detection and treatment of contralateral breast cancer.[8-12] Nevertheless, preoperative breast MRI has not been significantly associated with improvement in oncologic outcomes, such as lower recurrence rates or mortality.[6] Some argue that the occult disease detected by MRI is eradicated by radiation therapy, chemotherapy, and/or endocrine therapy following BCS or mastectomy regardless of MRI use, making the benefit of MRI minimal.[13] Moreover, breast MRI has several potential disadvantages, including costs, unnecessary biopsies, increased anxiety, and higher mastectomy rates.[14]

Rates of MRI use prior to surgery increased dramatically from 2002 to 2007 for both women with DCIS (<1% to 12.9%) and with invasive disease (1% to 14.3%).

MRI use varied across geographic areas and demographic characteristics, with higher use in urban areas and for younger women diagnosed with breast cancer.

MRI use was not consistently different between women diagnosed with DCIS and with locally invasive breast cancer. For both groups, preoperative MRI use was higher for women treated with mastectomy than with breast-conserving surgery.

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Our study describes the use of preoperative MRI among older women with DCIS and early invasive breast cancer. We discuss changes in use over time and provide a cross-sectional view of use in 2007.

## METHODS

We identified women diagnosed with DCIS or early invasive breast cancer (i.e., stage I) in the SEER-Medicare data linkage from 2002 to 2007. (SEER is the Surveillance, Epidemiology, and End Results program.) We limited the sample to elderly women (age 65 and older) who were enrolled in Medicare fee-for-service Parts A and B (entitlement indicator of "3" and HMO indicator of "0" or "4") for at least two months prior to diagnosis and four months postdiagnosis. We excluded women with another cancer diagnosed prior to breast cancer diagnosis and women without microscopically confirmed disease. Women who were diagnosed in Louisiana in 2005 were also excluded from this analysis because of the disruption in data collection following hurricane Katrina. MRI used in diagnostic evaluation is excluded from this analysis.

Rates of MRI increased dramatically from 2002 to 2007; therefore, we limited the analysis of covariates associated with the use of MRI to cases diagnosed in 2007 only.

### Definitions

**DCIS:** We defined DCIS using histology, stage, and behavior information collected by the SEER registries. Specifically, we included International Classification of Diseases for Oncology, Third Edition (ICD-O-3) histologies 8500, 8521, 8501, 8230, 8522, and 8523 with an ICD-O-3 behavior code of 2 and ICD-O-3 histology 8500 with an ICD-O-3 behavior code of 5.

**Comedo subtype:** We defined comedo subtype using ICD-O-3 behavior code of 2 and ICD-O-3 histology 8501. We included women with comedo histology in our definition of DCIS. We present results for the comedo subtype where there is adequate sample size.

**Early invasive breast cancer:** We defined early invasive breast cancer using SEER summary local stage and ICD-O-3 behavior code of 3. SEER stage takes into account all information available through the first course of treatment.

**MRI:** We defined preoperative MRI use as any use of MRI occurring between diagnosis and surgical treatment. Diagnosis date was defined using the SEER variables for month and year of diagnosis. We used Current Procedural Terminology (CPT) codes 76093, 76094, 77058, 77059, and Health Care Common Procedure Coding System (HCPCS) codes C8903-C8908 to identify claims for MRI in the Part B claims data.

**Race/ethnicity:** We combined the SEER Race Recode Y and Origin variables to create the following categories: white, white Hispanic, black, Asian or Pacific Islander.

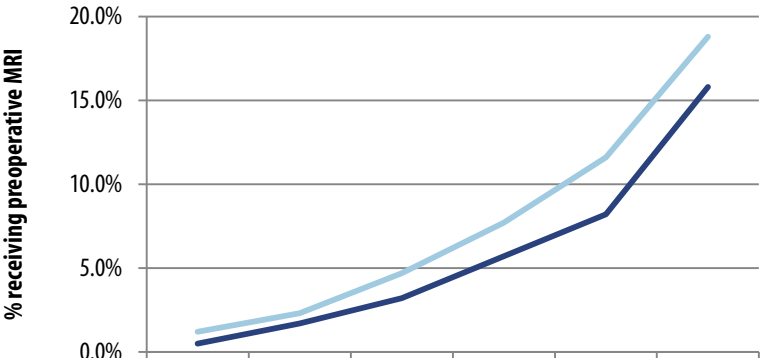
**Urban/rural:** We defined urban/rural status using the 2003 Rural/Urban Continuum Codes from Economic Research Service (ERS), Department of Agriculture, based on the county of residence. "Big Metro" refers to counties in metro areas with populations of at least 1 million. "Metro" refers to other counties in metro areas. "Urban" refers to counties not in metro areas with at least 20,000 people. "Less Urban" refers to counties with 2,500-19,999 people. Rural refers to counties with fewer than 2,500 people.[15]

**Tumor size:** We defined tumor size using the SEER collaborative staging tumor extension field. We report rates for microscopic, <1 cm, <2 cm, 2-5 cm, and >5 cm. We included other categories in the cohort but do not report them separately (e.g., unknown and diffuse).

**Grade:** We defined grade using the field provided by SEER: well differentiated, moderately/intermediately differentiated, poorly differentiated, and undifferentiated/anaplastic. Unknowns are included but not reported.

**ER status:** We used SEER reported Estrogen Receptor (ER) and Progesterone Receptor (PR) testing results. Women classified as ER status unknown may have not been tested.

**Figure 1:** Percent MRI use among elderly women diagnosed with ductal carcinoma in situ or locally invasive breast cancer, 2002-2007




| | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|
| DCIS | 0.5% | 1.7% | 3.2% | 5.7% | 8.2% | 15.8% |
| Invasive | 1.2% | 2.3% | 4.7% | 7.7% | 11.6% | 18.8% |

**Surgery type:** We used the Medicare Provider Analysis and Review (MedPAR), National Claims History (NCH), and outpatient (OP) data to determine whether women had BCS or mastectomy. We defined surgery type as the surgery identified after breast cancer diagnosis date.

BCS HCPCS: 19120, 19125, 19126, 19160, 19162, 19301, 19302
Mastectomy HCPCS: 19180, 19200-19220, 19240, 19303, 19305-19307
Bilateral mastectomy NCH/OP: Mastectomy HCPCS + HCPCS modifier = '50'
BCS ICD-9 PX: 85.2X
Mastectomy ICD-9 PX: 85.4X, except 85.42, 85.44, 85.46
Bilateral Mastectomy ICD-9 PX: 85.42, 85.44, 85.46

**State assistance:** We categorized women identified as receiving State assistance for at least one month in 2007 using the State Reported Dual Eligible Status Code monthly indicator variables (codes "01"-"09") as receiving State assistance.

## RESULTS

Between 2002 and 2007, 47,407 women in the SEER program who were Medicare enrolled were diagnosed with either DCIS or early invasive breast cancer. Most of these women (81.9%) were diagnosed with early invasive breast cancer.

Rates of MRI use prior to surgery increased dramatically from 2002 to 2007 for both DCIS (<1% to 15.8%) and invasive disease (1.2% to 18.8%; **Figure 1**). In all years, MRI use was slightly lower for women with DCIS than for women with invasive cancer.

Overall 2007 rates of preoperative MRI are slightly higher for women with invasive disease (18.8% versus 15.8%; **Figure 1**), but for some tumors (larger than 2 cm, high grade, and ER negative), rates of MRI use are greater for DCIS than invasive. MRI use varied substantially by geography. Rates of MRI use for women with early invasive disease ranged from 30 percent or greater in Los Angeles and Seattle to about 13 percent in other areas. Preoperative MRI use was more common in large metropolitan areas (DCIS: 18.9%; invasive: 22.1%) than in non-metropolitan areas (DCIS: 9.6%; invasive:10.7%; **Table 1**).

MRI use was most common among white Hispanics (DCIS: 18.6%; invasive: 22.1%; **Table 1**). MRI use was less common among nonwhites (DCIS: 10.4%; invasive: 11.4%; **Table 1**). Of note, use was least common among African Americans (DCIS: 4.9%; invasive: 7.5%; data not shown due to small numbers). Use of MRI prior to surgery decreased with age. Among women with DCIS, rates of preoperative MRI varied from 19.2 percent for women under 70 to 7.5 percent for women over 80. Among women with invasive disease, rates varied from 27.5 percent for women under 70 to 9.4 percent for women over 80 (**Table 1**).

Increasing size and higher grade are related to higher rates of MRI use for women with DCIS but not for women with invasive disease. Among women with invasive cancer, rates of MRI use decreased with higher grade disease. Women tested for ER status compared with those not tested had much higher rates of MRI use for both invasive disease and DCIS. Among women with DCIS, ER negative women were more likely to have MRI than ER positive women (23.1% versus 15.8%; **Table 1**).

However, among women with invasive disease, ER negative and ER positive women had similar rates of MRI (19.3% versus 19.2%; **Table 1**).

Women who had mastectomies were more likely than women who had lumpectomies to use MRI preoperatively; however, the difference was greater for DCIS (25.2% versus 14.6%) than for invasive disease (21.6% versus 18.1%; **Table 1**). Of the women with invasive disease who received bilateral mastectomies, 31.9 percent had preoperative MRI, and the overall rate of bilateral mastectomies was low (<2%). We found only 19 (1.4%) bilateral mastectomies in women with DCIS.

## DISCUSSION

From 2002 to 2007, the use of preoperative MRI rose steeply among women diagnosed with DCIS or early invasive breast cancer. Use of MRI was lower for nonwhite women, older women, and women receiving assistance from States with the payment of Medicare premiums and/or cost sharing. Use was higher for women with larger or higher grade tumors. Women not tested for ER status were less likely to receive a preoperative MRI. Women with ER-DCIS were more likely to undergo an MRI; however, MRI use did not vary by ER status among women with early invasive cancers.

MRI use did not increase uniformly across geographic areas. For example, use was higher in urban than rural areas but varied over the study timeframe. The variability of the rate of increase across markets points to the role of technology diffusion in MRI use. We have no information on incident cases after 2007 and cannot comment on whether this increase has stabilized or whether urban/rural variation has lessened.

**Table 1:** Use of preoperative MRI among older women with ductal carcinoma in situ or locally invasive breast cancer, 2007

| | DCIS | | Invasive | |
|---|---|---|---|---|
| | N | % MRI | N | % MRI |
| Total | 1,371 | 100.0 | 6,232 | 100.0 |
| Registry | | | | |
| Connecticut | 113 | 15.9 | 438 | 17.4 |
| Seattle | 89 | 23.6 | 367 | 30.2 |
| Los Angeles | 108 | 26.9 | 462 | 33.1 |
| Greater California | 267 | 20.2 | 1,326 | 23.2 |
| New Jersey | 201 | 18.4 | 959 | 19.5 |
| Other* (excl HI) | 564 | 9.9 | 2,570 | 13.0 |
| State Assistance | | | | |
| No | 1,208 | 16.6 | 5,493 | 20.0 |
| Yes | 163 | 9.8 | 739 | 10.4 |
| Urbanicity | | | | |
| Big metro | 763 | 18.9 | 3,505 | 22.1 |
| Metro | 421 | 13.1 | 1,829 | 16.5 |
| Nonmetro | 187 | 9.6 | 897 | 10.7 |
| Race | | | | |
| Non-Hispanic White | 1,097 | 16.7 | 5,201 | 19.8 |
| White Hispanic | 70 | 18.6 | 263 | 22.1 |
| Nonwhite | 182 | 10.4 | 642 | 11.4 |
| Age (years) | | | | |
| 65-69 | 396 | 19.2 | 1,641 | 27.5 |
| 70-74 | 386 | 18.7 | 1,507 | 22.4 |
| 75-79 | 295 | 15.9 | 1,331 | 16.5 |
| 80+ | 294 | 7.5 | 1,753 | 9.4 |
| Size | | | | |
| <1 cm (incl micro) | 438 | 13.9 | 1,801 | 19.0 |
| <2 cm | 274 | 17.5 | 2,643 | 19.4 |
| ≥2 cm | 240 | 22.5 | 1,669 | 17.7 |
| Grade | | | | |
| Low to intermediate | 591 | 13.7 | 4,505 | 19.7 |
| High | 579 | 19.9 | 1,355 | 16.9 |
| ER Status | | | | |
| Not tested/unknown | 311 | 10.3 | 394 | 13.2 |
| Positive | 822 | 15.8 | 5,002 | 19.2 |
| Negative | 234 | 23.1 | 828 | 19.3 |
| Surgery | | | | |
| Lumpectomy | 1,208 | 14.6 | 4,979 | 18.1 |
| Mastectomy | 163 | 25.2 | 1,253 | 21.6 |

*Other registries combines results for San Francisco, Detroit, Iowa, New Mexico, Utah, Atlanta, San Jose, Kentucky, and Louisiana.

The potential advantages of preoperative MRI rest primarily in its superior sensitivity in detecting occult disease not identified by mammography.[7-11,16-20] Therefore, breast MRI compared with mammography alone may provide better assessment of tumor extent in the ipsilateral breast and increased detection of ipsilateral multicentric disease and occult contralateral breast cancer. A meta-analysis of 19 studies (2,610 patients) published by Houssami, et al., determined that MRI detected additional lesions in the ipsilateral breast in 16 percent of women, with 66 percent of those lesions malignant on histology.[8] In addition, a systematic review of 22 studies (3,253 patients) published by Brennan, et al., found the estimated cancer detection rate with MRI in the contralateral breast to be 4.1 percent.[11]

The information provided by breast MRI's detection capabilities may contribute to surgical planning, but studies have not confirmed improvement in oncologic outcomes with preoperative MRI use. A randomized controlled trial (COMICE) published by Turnbull, et al., in 2010 demonstrated that regardless of MRI use, 19 percent of patients underwent re-excision after BCS.[21] Only a few studies have evaluated the relationship between preoperative MRI and local recurrence rates. Fischer, et al., demonstrated that patients with preoperative MRI had fewer local recurrences than patients without MRI (1.2% vs. 6.8%, respectively; p-value <0.001).[22] However, studies by Solin, et al., and Hwang, et al., reported no statistically significant difference in the eight-year ipsilateral breast tumor recurrence rates between patients with and without MRI .[23,24]

In our analysis, women with DCIS or invasive breast cancer who underwent MRI were more likely to receive mastectomy than BCS. This observation is consistent with the findings from several single-center studies. In a study of 5,405 patients, Katipamula, et al., reported that 54 percent of patients receiving MRI had mastectomy compared with just 36 percent of patients without MRI.[25] Bleicher, et al., reported that MRI use predicted a 1.8-fold increase in the odds of undergoing mastectomy at a single institution.[14] Moreover, a randomized controlled trial published by Turnbull, et al., found that women scheduled for BCS who were randomly assigned to receive MRI underwent more mastectomies at initial operation than those assigned to the no-MRI group (7% vs. 1%, respectively).[21]

Several factors may explain the association between MRI and mastectomy. For example, it is possible that women who undergo MRI are more likely to have had suspicious lesions on their mammograms; thus, the association between MRI and mastectomy may be due to more aggressive treatment of these additional lesions. Women who undergo MRI may have a stronger family history of breast cancer and be more likely to undergo mastectomy, regardless of MRI. Alternatively, some women or their surgeons may have a preference for more aggressive care. This aggressive care could influence both imaging strategy and surgical care. Also, preoperative MRI may generate greater patient anxiety that leads to mastectomy over BCS.

Finally, analytic decisions may affect interpretation of these findings. We excluded women with multiple tumors in their breast (i.e., multicentric disease) and women with bilateral breast cancers. Both conditions are more likely to be diagnosed among women undergoing MRI, while also being indications for an MRI. Because we could not disentangle cause and effect, we excluded these women from our report. Thus, our analysis underestimates the use of preoperative breast MRI and should not be used to assess the yield of MRI.

## CONCLUSION

Rates of preoperative MRI use have increased over time, despite limited evidence of improved outcomes. The increase was observed for both women with DCIS and early invasive disease. Rates varied strongly by location (residence in big metropolitan areas and certain registries), race, and receipt of State assistance. This suggests greater use where the technology is available. Consistent with this finding, variation by registry fluctuated over time. This likely reflected differences in availability or adoption of this technology.

Rates also varied by clinical characteristics. In general, women with higher risk DCIS (larger tumor size, higher grade disease, or ER-negative tumors) received more MRIs prior to surgery than those with lower risk disease. However, for women with early invasive disease, MRI use did not vary by risk of recurrence.

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