Effective Health Care Program

# Prognostic factor testing among older women with ductal carcinoma in situ and early invasive breast cancer

## *Breast Cancer Diagnostic Workup*

## Data Points # 15

The American Cancer Society estimates that in the United States in 2012, 229,060 new cases of invasive breast cancer were diagnosed, and 39,920 people died of the disease. 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 a variety of cell abnormalities confined to the ducts of the breast.[2] While we do not know the percentage of DCIS cases that will progress to invasive breast cancer, many studies suggest that women diagnosed with DCIS are at high risk for invasive breast cancer (see Virnig, Shamliyan, et al., for a review).[3]

Typical treatment for DCIS includes surgical removal of the tumor by mastectomy or breast-conserving surgery (BCS).[2-4] After tumor removal, some DCIS will recur or progress to invasive cancer. However, lack of knowledge about prognostic and predictive markers makes it difficult to assess a patient's prognosis. Known risk factors for DCIS progression and recurrence include comedo histology, younger age, larger tumor size, high pathologic or nuclear grade, and positive surgical margins.[3]

For invasive breast cancer, specific markers of tumor aggressiveness are used to guide assessment of patient prognosis. Well-recognized treatment pathways exist; however, scant evidence supports the applicability of this knowledge to DCIS.[3] In invasive breast cancer, removed tissue is tested for estrogen receptors (ERs), progesterone receptors (PRs), and human epidermal growth factor receptor 2 (HER2). These tests provide information about the tumor's aggressiveness, based on how it responds to external stimuli. ER and HER2 testing helps identify women who might benefit from treatments intended to reduce the risk of ipsilateral breast tumor recurrence (IBTR) and of contralateral breast cancer. ER and HER2 testing could be used to identify the subgroup of DCIS patients most likely to benefit from endocrine treatment or trastuzumab.[2,5]

Estrogen receptor (ER) testing rates have increased over time for both ductal carcinoma in situ (DCIS) and early invasive cancers. However, rates of positive ER tests have not increased.

Rates of BRCA genetic testing are very low (<2%) for both DCIS and early invasive breast cancers.

Current guidelines do not recommend routine testing for human epidermal growth factor receptor 2 (HER2) for women with DCIS. Yet, rates of this testing increased between 2004 and 2007 in both DCIS and early invasive breast cancer groups.

Rates of testing varied significantly across race groups for all tests. However, the pattern of change differed between tests.

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For women with ER+ DCIS and invasive breast cancer, treatment with antiestrogens such as tamoxifen and aromatase inhibitors might prevent recurrence or progression.

Randomized trials have evaluated the benefit of tamoxifen after BCS for DCIS.[3] In the National Surgical Adjuvant Breast and Bowel Project (NSAPB) B-24 trial, use of tamoxifen was associated with a modest decrease in ipsilateral and contralateral breast cancer events after BCS.[6] However, in a study conducted by the United Kingdom Coordinating Committee on Cancer Research, tamoxifen did not significantly reduce overall breast cancer events.[7] Neither study included ER testing.

A recent meta-analysis found ER+ DCIS to be associated with significantly lower IBTR rates, while HER2+ DCIS was significantly associated with higher IBTR rates.[3] However, none of the included studies had more than 140 subjects. Current National Comprehensive Cancer Network (NCCN) guidelines recommend ER testing for patients newly diagnosed with DCIS.[4] Further, these guidelines suggest that physicians "consider" tamoxifen for ER+ DCIS but note that use of tamoxifen is of unknown benefit for ER- DCIS.[4] ER testing is considered standard of care for women with early invasive cancer.[4] HER2 positivity may be linked to an increased risk of recurrence, as well as to tumor sensitivity to trastuzumab (Herceptin).[3,5]

At present, groups such as NCCN consider HER2 testing a standard of care for women with early invasive cancer but do not recommend it for women with DCIS.[4] Studies of PR testing are inconclusive in the context of DCIS.[3] Therefore, treatment guidelines do not include PR tests, despite their being considered standard care for early invasive breast cancer.[4]

Testing for BRCA (the "breast cancer gene") helps to identify women with a hereditary risk of breast cancer. Family history of breast cancer is thought to be associated with increased risk of both DCIS and invasive breast cancer recurrence.[3,7] BRCA testing for patients with DCIS offers the main benefit of identifying patients who have high rates of IBTR after BCS, contralateral breast cancer, and ovarian cancer.[3] For patients with BRCA-associated DCIS or invasive cancer, treatment recommendations frequently include bilateral mastectomy with or without bilateral oophorectomy.[7]

Lymph node testing is used to detect whether the cancer has progressed beyond the breast tissue. In the past decade, sentinel lymph node biopsy (SLNB) has replaced routine axillary lymph node dissection (ALND) for most patients with invasive breast cancer.[3] ALND has not been recommended for patients with confirmed DCIS, because the preinvasive cells do not metastasize and thus are not associated with risk of lymph node involvement.[4] In 1991, Silverstein, et al., reported that less than 1 percent of patients with DCIS had lymph node metastases detected by ALND.[9] Today, most DCIS diagnoses are made by image-guided core needle biopsy. About 15 percent of patients with DCIS originally diagnosed by core needle biopsy will have a final diagnosis of invasive breast cancer after excision or mastectomy.[3] If invasive breast cancer is identified in the excision or mastectomy specimen, axillary staging is recommended to determine stage and guide treatment decisions. Therefore, some scientists recommend SLNB for all or selected patients with DCIS detected by core needle biopsy.[10-12] A systematic review of studies evaluating SLNB for pure DCIS found the incidence of lymph node positivity and lymph node micrometastases to be 0.9 percent and 1.5 percent, respectively.[3] In women with invasive disease, lymph nodes are sampled to ascertain the extent to which the cancer has spread. This is an essential component to determining cancer stage.

This report examines variation in testing of ER, PR, HER2, BRCA, and lymph nodes in women ages 65 and older who were enrolled in the Medicare program and diagnosed with DCIS between 2004 and 2007. We analyzed how testing varied by patient age, tumor size, and tumor grade—all factors known to increase women's risk of developing invasive disease. We also examine how testing varies by race and geographic location, as well as over time. We compare the rates of testing for patients with DCIS and those with invasive disease to provide context and to better understand how testing rates differ between both groups.

## METHODS

We identified women diagnosed with DCIS and early invasive breast cancer (i.e., stage 1) in the SEER-Medicare data linkage from 2004 to 2007. The Surveillance, Epidemiology, and End Results program (SEER) is a network of cancer registries collecting information on persons with cancer from Medicare eligibility until death.[13] We limited the sample to women aged 65 and older enrolled in fee for service Medicare Parts A and B (entitlement indicator of "3" and HMO indicator of "0" or "A") for at least two months prior to diagnosis and four months post-diagnosis (see **Table 1** for population statistics). We excluded women with another cancer diagnosed before the breast cancer diagnosis and women without microscopically confirmed disease. We also excluded women diagnosed in Louisiana in 2005 because of the disruption in data collection following hurricane Katrina.

### Definitions

**DCIS:** We defined DCIS using data on 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:** Comedo subtype was defined using ICD-O-3 behavior code of 2 and ICD-O-3 histology 8501. We included women with comedo histology in the definition of DCIS. Results are presented separately for the comedo subtype where appropriate.

**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.

**Race/ethnicity:** We defined race using the SEER Race Recode Y variable. We used the SEER origin variable to indicate Hispanic ethnicity among whites, resulting in the following race/ethnicity categories: white, white Hispanic, black, Asian or Pacific Islander.

**Urban/rural:** We defined urban/rural status using the 2003 Rural/Urban Continuum Codes from the Department of Agriculture's Economic Research Service.[14] The codes categorize people based on their county of residence. "Big Metro" refers to counties in metro areas with at least 1 million in population. "Metro" refers to other counties in metro areas. "Urban" refers to counties not in metro areas with at least 20,000 population. "Less Urban" refers to counties with 2,500-19,999 people. "Rural" refers to counties with fewer than 2,500 residents.

**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. Other categories are included in the cohort but not reported (e.g., unknown and diffuse).

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

**Surgery type:** We determined whether women had BCS or mastectomy using the SEER Surgery of the Primary Site (sxprif1) values (BCS: 20-24 and mastectomy: 40-80).

**ER/PR:** For this report, we used ER and PR testing information from Medicare claims data; however, claims data do not allow separating of ER only, PR only, and combined ER/PR testing. We considered cases with a pathology claim within four months of diagnosis with a Health Care Procedure Coding System (HCPCS) code 88360, 88361, or 88342 (either technical or professional component or both) to have been tested for ER/PR positivity. Since SEER registries also collect information about ER and PR testing, we conducted a sensitivity analysis comparing the SEER testing rates to those detected using our claims-based algorithm. We classified women as "not tested" if they were reported by SEER as being not tested. The results of this analysis showed that our claims-based measure was, although slightly lower, close to SEER rates of testing (e.g., ER testing rates of 78 percent in SEER and 76 percent in the claims among DCIS patients; see **Figure 1** and **Appendix A**). Both datasets led to similar conclusions about testing patterns.

**HER2:** We used Medicare claims to assess use of immunohistochemistry (IHC) and fluorescence in situ hybridization (FISH) for measuring HER2 positivity. We extended the algorithm used by Liang, et al., to identify HER2 testing in the Medicare claims data within four months of diagnosis.[15] This algorithm uses FISH: HCPCS 88367 or 88368 with at least two units specified or HCPCS 88365 with at least one unit specified; IHC: HCPCS 88360, 88361, or 88342 with at least three total units of any combination. We defined units using the Carrier Miles/Time/Units/Services count variable.

If the HCPCS codes appeared on more than line, we summed the units, unless the lines represented the Technical and Professional components of the same service, to avoid double counting.

**BRCA:** We identified tests for BRCA 1 and 2 in the Medicare claims data using HCPCS codes 83080, 83890-83894, 83896-83898, 83900-83909, 83912-83914, and 96040. We counted these codes if they appeared within four months of diagnosis.

## Table 1: Percent distribution of ductal carcinoma in situ and early invasive breast cancer diagnoses in SEER, 2004-2007

| | DCIS | | Invasive | |
|---|---|---|---|---|
| | n | % | n | % |
| Total | 5,778 | 100.0 | 25,439 | 100.0 |
| Diagnosis Year | | | | |
| 2004 | 1,496 | 25.9 | 6,638 | 26.1 |
| 2005 | 1,453 | 25.1 | 6,075 | 23.9 |
| 2006 | 1,434 | 24.8 | 6,378 | 25.1 |
| 2007 | 1,395 | 24.1 | 6,348 | 25.0 |
| Age (years) | | | | |
| 65-69 | 1,783 | 30.9 | 6,487 | 25.5 |
| 70-74 | 1,543 | 26.7 | 6,057 | 23.8 |
| 75-79 | 1,299 | 22.5 | 5,702 | 22.4 |
| 80-84 | 791 | 13.7 | 4,302 | 16.9 |
| 85+ | 362 | 6.3 | 2,891 | 11.4 |
| Race | | | | |
| White | 4,639 | 80.3 | 21,507 | 84.5 |
| White Hispanic | 274 | 4.7 | 1,051 | 4.1 |
| Black | 457 | 7.9 | 1,422 | 5.6 |
| Asian/Pacific Islander | 287 | 5.0 | 1,014 | 4.0 |
| SEER Registry | | | | |
| Atlanta | 235 | 4.1 | 864 | 3.4 |
| Connecticut | 476 | 8.2 | 1,895 | 7.4 |
| Detroit | 470 | 8.1 | 1,817 | 7.1 |
| Greater California | 1,164 | 20.1 | 5,239 | 20.6 |
| Hawaii | 93 | 1.6 | 352 | 1.4 |
| Iowa | 358 | 6.2 | 1,801 | 7.1 |
| Kentucky | 407 | 7 | 1,980 | 7.8 |
| Los Angeles | 425 | 7.4 | 1,854 | 7.3 |
| Louisiana | 296 | 5.1 | 1,236 | 4.9 |
| New Jersey | 856 | 14.8 | 3,899 | 15.3 |
| New Mexico | 101 | 1.7 | 591 | 2.3 |
| San Francisco | 237 | 4.1 | 976 | 3.8 |
| San Jose | 140 | 2.4 | 621 | 2.4 |
| Seattle | 366 | 6.3 | 1,579 | 6.2 |
| Utah | 141 | 2.4 | 687 | 2.7 |
| Urbanicity | | | | |
| Big metro | 3,400 | 58.8 | 14,423 | 56.7 |
| Metro | 1,648 | 28.5 | 7,339 | 28.8 |
| Urban | 296 | 5.1 | 1,546 | 6.1 |
| Less urban | 359 | 6.2 | 1,755 | 6.9 |
| Rural | 75 | 1.3 | 375 | 1.5 |
| Tumor Size | | | | |
| Microscopic | 197 | 3.4 | 373 | 1.5 |
| <1 cm | 1,656 | 28.7 | 7,113 | 28.0 |
| <2 cm | 1,183 | 20.5 | 10,627 | 41.8 |
| 2-5 cm | 817 | 14.1 | 6,240 | 24.5 |
| >5 cm | 230 | 4.0 | 569 | 2.2 |
| Grade | | | | |
| Well differentiated | 664 | 11.5 | 7,242 | 28.6 |
| Moderately differentiated | 1,787 | 30.9 | 10,810 | 42.6 |
| Poorly differentiated | 1,678 | 29.0 | 5,531 | 21.8 |
| Undifferentiated | 793 | 13.7 | 223 | 0.9 |
| Surgery | | | | |
| BCS | 4,410 | 76.3 | 17,931 | 70.5 |
| Mastectomy | 1,361 | 23.6 | 7,479 | 29.4 |

Percentages may not add to 100 due to rounding.

**Lymph node testing:** SEER registries collect information regarding lymph node sampling and positivity. We excluded from this measure the women for whom node testing status was unknown (n=307).

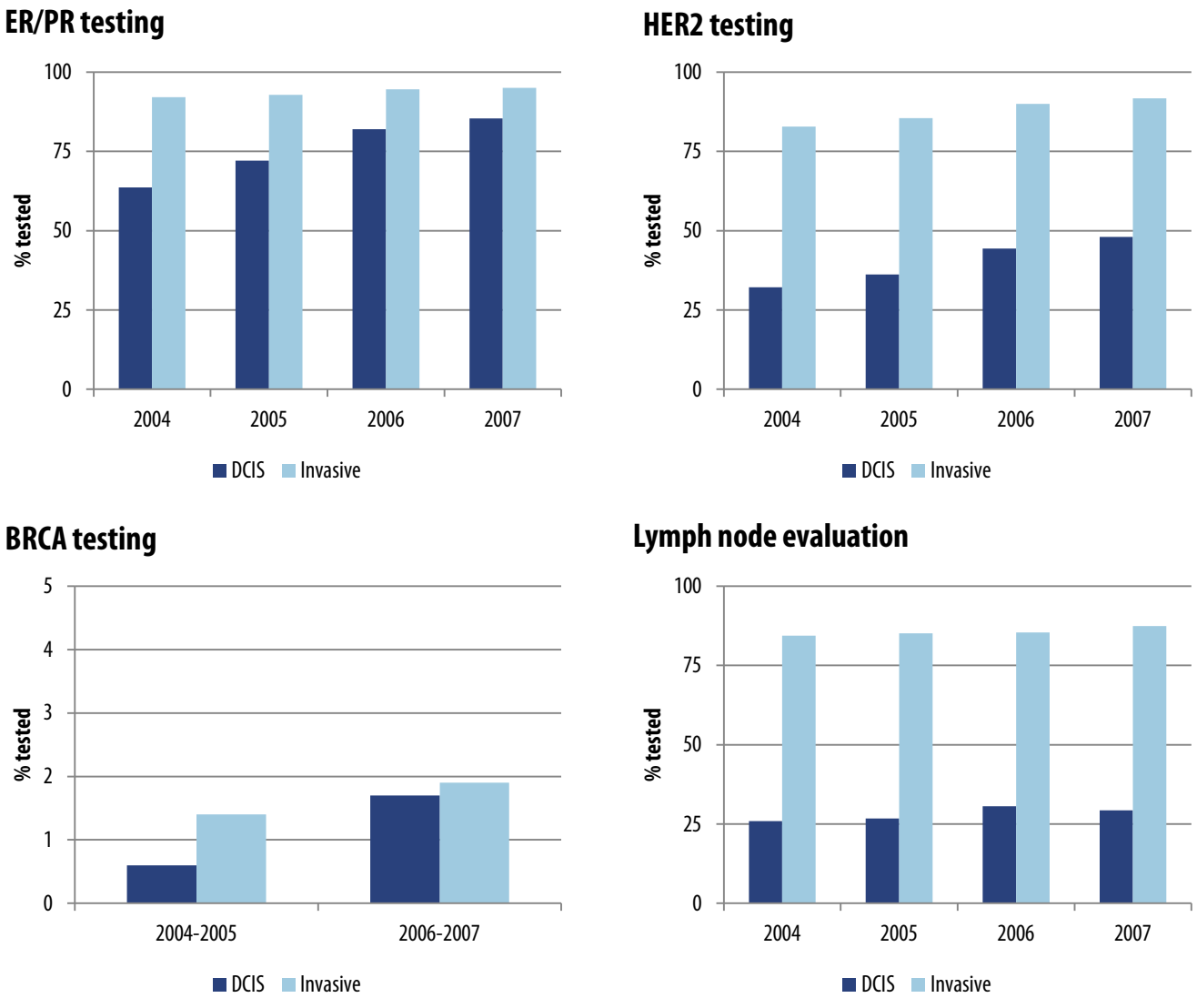
By definition, this cohort contains no women with positive lymph nodes. The SEER database re-classifies women originally diagnosed with DCIS or early invasive cancer who have positive lymph nodes as having regional disease. Therefore, this is a measure of the proportion of node negative women who had nodes tested.

## RESULTS

Between 2004 and 2007, 31,217 women in the SEER program who were also Medicare enrolled were diagnosed with either DCIS or early invasive breast cancer. Most of these women (81.5%) were diagnosed with early invasive breast cancer. Eleven percent of women with DCIS had comedo subtype.

Women with DCIS were younger than women diagnosed with early invasive breast cancer. In addition, a higher percentage of women with DCIS was black. Women with DCIS also had a higher incidence of unknown tumor size and grade (**Table 1**).

Figure 1: Trends in ER/PR, HER2, BRCA, and lymph node testing among ductal carcinoma in situ and early invasive breast cancer diagnoses in SEER, 2004-2007



Of those with known size and grade, women with DCIS were more likely to have smaller tumors and higher grade tumors. Women with DCIS were more likely to be treated with BCS.

## Estrogen and Progesterone Receptor Testing

Rates of ER/PR testing for women with DCIS varied strongly over the study period from 63.6 percent in 2004 to 85.4 percent in 2007 (**Figure 1, Appendices B, C, and D**). Therefore we could not easily interpret overall estimates.

We discuss results for 2007 only in the body of the report. See **Appendices B, C, and D** for data on years 2004-2006.

ER/PR testing rates did not vary importantly by age (**Table 2**). Among women with DCIS, black women were less likely to have ER/PR testing than other racial groups (82.1% versus >85% for all other races). Rates of testing varied greatly by SEER registry, from 71.4 percent in Utah to 97 percent in San Jose. Women in big metropolitan areas were the most likely to receive ER/PR testing.

**Table 2:** ER/PR and HER2 testing among ductal carcinoma in situ and early invasive breast cancer diagnoses in SEER, 2007

| | DCIS | | | Invasive | | |
|---|---|---|---|---|---|---|
| | n | ER/PR % | HER2 % | n | ER/PR % | HER2 % |
| Total | 1,395 | 85.4 | 48.0 | 6,348 | 95.0 | 91.7 |
| Age (years) | | | | | | |
| 65-69 | 408 | 85.5 | 45.3 | 1,693 | 92.9 | 90.3 |
| 70-74 | 391 | 85.9 | 48.1 | 1,529 | 96.1 | 92.5 |
| 75-79 | 298 | 85.9 | 48.7 | 1,347 | 95.8 | 92.7 |
| 80-84 | 209 | 84.2 | 50.7 | 1,013 | 95.5 | 92.0 |
| 85+ | 89 | 84.3 | 51.7 | 766 | 95.2 | 90.7 |
| Race | | | | | | |
| White | 1,114 | 85.5 | 46.9 | 5,282 | 95.3 | 92.1 |
| White Hispanic | 70 | 87.1 | 55.7 | 270 | 95.9 | 92.2 |
| Black | 106 | 82.1 | 51.9 | 372 | 92.5 | 88.4 |
| Asian/Pacific Islander | 80 | 87.5 | 51.3 | 277 | 91.3 | 87.0 |
| SEER Registry | | | | | | |
| Atlanta | 54 | 92.6 | 44.4 | 205 | 98.5 | 92.2 |
| Connecticut | 116 | 77.6 | 46.6 | 441 | 96.6 | 93.2 |
| Detroit | 89 | 94.4 | 50.6 | 407 | 99.3 | 95.6 |
| Greater California | 273 | 85.7 | 48.0 | 1,358 | 93.7 | 92.0 |
| Hawaii | 27 | 77.8 | 51.9 | 101 | 90.1 | 89.1 |
| Iowa | 84 | 85.7 | 54.8 | 419 | 97.6 | 90.0 |
| Kentucky | 101 | 86.1 | 49.5 | 477 | 95.6 | 89.3 |
| Los Angeles | 109 | 81.7 | 52.3 | 469 | 94.0 | 93.4 |
| Louisiana | 89 | 79.8 | 59.6 | 376 | 92.3 | 89.4 |
| New Jersey | 202 | 91.1 | 48.0 | 970 | 95.1 | 91.6 |
| New Mexico | 22 | 90.9 | 54.5 | 138 | 92.8 | 86.2 |
| San Francisco | 63 | 88.9 | 50.8 | 252 | 91.3 | 91.3 |
| San Jose | 33 | 97.0 | 42.4 | 184 | 94.6 | 90.2 |
| Seattle | 95 | 80.0 | 29.5 | 381 | 95.3 | 94.0 |
| Utah | 35 | 71.4 | 34.3 | 156 | 96.8 | 89.7 |
| Urbanicity | | | | | | |
| Big metro | 776 | 87.2 | 48.5 | 3,574 | 95.4 | 92.6 |
| Metro | 430 | 85.8 | 46.2 | 1,863 | 94.9 | 91.9 |
| Urban | 78 | 73.1 | 50.0 | 384 | 92.7 | 87.0 |
| Less urban | 90 | 78.9 | 38.5 | 431 | 94.0 | 87.5 |
| Rural | 21 | 85.7 | * | 95 | 93.7 | 90.5 |
| Tumor Size | | | | | | |
| Microscopic | 35 | 80.0 | 37.1 | 106 | 93.4 | 78.3 |
| <1 cm | 415 | 81.2 | 42.7 | 1,727 | 95.8 | 92.6 |
| <2 cm | 277 | 89.5 | 50.2 | 2,695 | 95.2 | 92.6 |
| 2-5 cm | 194 | 93.3 | 56.2 | 1,538 | 94.1 | 90.6 |
| >5 cm | 48 | 95.8 | 56.3 | 152 | 96.1 | 92.1 |
| Grade | | | | | | |
| Well differentiated | 149 | 82.6 | 46.3 | 1,876 | 96.0 | 92.3 |
| Moderately differentiated | 451 | 86.5 | 45.5 | 2,712 | 94.8 | 92.0 |
| Poorly differentiated | 426 | 90.1 | 52.6 | 1,334 | 93.8 | 90.6 |
| Undifferentiated | 162 | 85.2 | 49.4 | 46 | 97.8 | 93.5 |
| Surgery | | | | | | |
| BCS | 1,055 | 84.8 | 45.6 | 4,443 | 95.7 | 92.7 |
| Mastectomy | 340 | 87.4 | 55.6 | 1,896 | 93.4 | 89.4 |

* Number suppressed to protect patient confidentiality.

** ER = estrogen receptor, PR = progesterone receptor, HER2 = human epidermal growth factor receptor-2.

Rates of ER/PR testing were higher for larger tumor size (≥2 cm) and for higher versus lower tumor grades (90.1% vs. 82.6%). Undifferentiated tumors presented an exception to this pattern, with a rate of 85.2 percent. Rates of ER/PR testing were slightly lower for women treated with BCS as compared to mastectomy (84.8% vs. 87.4%; **Table 2**).

Women with DCIS had lower rates of ER/PR testing in 2007 than women with invasive disease (85.4% vs. 95.0%; **Table 2**). In contrast to DCIS patterns, Hispanic whites had the highest rates of testing for ER/PR status among women with early invasive tumors. Likewise, the association between tumor size and ER/PR testing differed between DCIS and invasive cancer. In women with invasive cancer, rates of ER/PR testing were relatively stable across tumor size. Registries with comparatively high rates of ER/PR testing for women with invasive cancer did not necessarily have comparatively high rates of ER/PR testing for DCIS; for example, Utah had the lowest rate of ER/PR testing for DCIS patients but among the highest (96.8%) for women with invasive disease. Women with invasive disease who had mastectomies were slightly less likely to receive ER/PR testing than those receiving BCS (93.4% vs. 95.7%; **Table 2**).

Although rates of ER/PR testing increased dramatically over the study period, rates of ER positivity held stable for both groups, according to SEER registry data. Women with DCIS had ER positivity rates of 82 percent in 2004 and 81 percent in 2007. Women with invasive disease had ER positivity rates of 85 percent in 2004 and 86 percent in 2007 (**Figure 2**). The percentage of women with ER+ tumors was similar for the DCIS and invasive cancer groups.

## HER2 Testing

As with ER/PR testing, HER2 testing increased dramatically among women with DCIS between 2004 and 2007 (32.2% to 48.0%; **Figure 1**). Therefore, we could not easily interpret overall estimates and thus discuss results for 2007 only in the body of the report. See **Appendices B, C, and D** for data on 2004-2006. Rates of HER2 testing increased by age (45.3% for ages 65-69 vs. 51.7% for ages 85+; **Table 2**). White women had the lowest rates of HER2 testing (46.9%), and White Hispanics the highest (55.7%).

**Figure 2:** Percentage of ER+ and ER testing among ductal carcinoma in situ and early invasive breast cancer diagnoses in SEER, 2004-2007

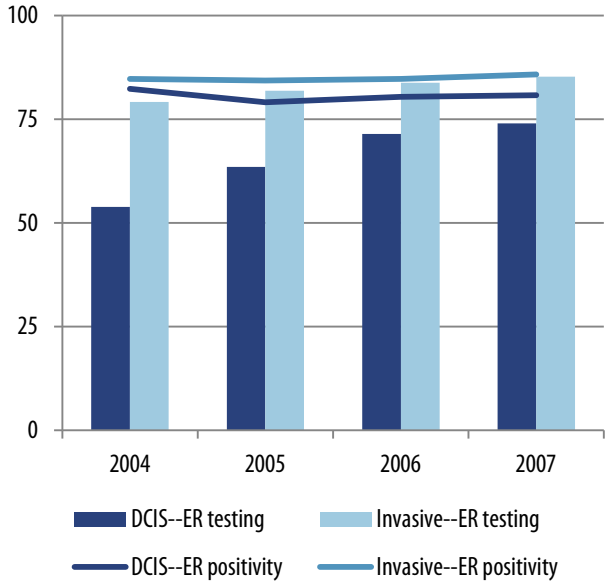



**Table 3:** BRCA testing among ductal carcinoma in situ and early invasive breast cancer diagnoses in SEER, 2004-2007

| | DCIS | | Invasive | |
|---|---|---|---|---|
| | n | BRCA % | n | BRCA % |
| Diagnosis Year | | | | |
| 2004-2005 | 2,949 | 0.6 | 12,715 | 1.4 |
| 2006-2007 | 2,832 | 1.7 | 12,734 | 1.9 |
| Age (years) | | | | |
| 65-74 | 3,329 | 1.4 | 12,551 | 2.2 |
| 75-84 | 2,090 | 0.9 | 10,007 | 1.2 |
| 85+ | 362 | 0.0 | 2,891 | 0.6 |
| Urbanicity | | | | |
| Big metro | 3,403 | 1.3 | 14,428 | 1.9 |
| Not big metro | 2,378 | 0.8 | 11,020 | 1.3 |
| Tumor Size | | | | |
| <2 cm | 3,038 | 1.1 | 18,120 | 1.7 |
| 2+ cm | 1,048 | 1.2 | 6,812 | 1.5 |
| Grade | | | | |
| Low-intermediate | 2,451 | 1.1 | 18,059 | 1.7 |
| High | 2,474 | 1.2 | 5,757 | 1.6 |
| Surgery | | | | |
| BCS | 4,412 | 1.0 | 17,939 | 1.7 |
| Mastectomy | 1,362 | 1.6 | 7,481 | 1.5 |

Rates of HER2 testing varied from a low of 29.5 percent in Seattle to 59.6 percent in Louisiana. Tumors larger than 1 cm and high-grade tumors were associated with higher rates of HER2 testing except for women with undifferentiated tumors. Women treated with mastectomy were more likely to have HER2 testing than women receiving BCS (55.6% vs. 45.6%). Women with DCIS had lower rates of HER2 testing than women with invasive disease in 2007 (48.0% vs. 91.7%). In general, we found less variability in HER2 testing rates among women with invasive disease, with one exception. Like those with DCIS, rates of HER2 testing were noticeably lower among those with microsopic tumors (78.3% vs. >90% for all other sizes).

## BRCA Testing

We found a low rate (0.6%) of BRCA testing among women with DCIS. From 2004 to 2007, rates increased slightly but remained low (0.6% to 1.7%; **Figure 1**). Due to small numbers, we cannot report annual rates for subgroups. Women undergoing mastectomy were more likely than women with BCS to have BRCA testing (1.6% vs. 1.0%; **Table 3).** Rates of BRCA testing among women with invasive cancer were only slightly higher (1.4%) than for women with DCIS. Among the Medicare older population, BRCA testing is not yet a major component of breast cancer workup.

**Table 4:** Lymph node testing among ductal carcinoma in situ and early invasive breast cancer diagnoses in SEER, 2007

| | DCIS | | Invasive | |
|---|---|---|---|---|
| | n | Lymph Node % | n | Lymph Node % |
| Total | 1,384 | 29.3 | 6,297 | 87.4 |
| Age (years) | | | | |
| 65-69 | 405 | 28.4 | 1,678 | 95.4 |
| 70-74 | 385 | 31.7 | 1,523 | 95.6 |
| 75-79 | 296 | 34.1 | 1,338 | 90.1 |
| 80-84 | 209 | 23.4 | 1,000 | 80.5 |
| 85+ | 89 | 21.3 | 758 | 57.3 |
| Race | | | | |
| White | 1,104 | 30.3 | 5,236 | 87.2 |
| White Hispanic | 69 | 33.3 | 268 | 88.8 |
| Black | 106 | 19.8 | 370 | 88.1 |
| Asian/Pacific Islander | 80 | 25.0 | 277 | 91.7 |
| SEER Registry | | | | |
| Atlanta | 54 | 24.1 | 202 | 92.1 |
| Connecticut | 115 | 19.1 | 431 | 77.3 |
| Detroit | 87 | 26.4 | 404 | 88 |
| Greater California | 269 | 32 | 1,352 | 90.8 |
| Hawaii | 27 | * | 101 | 91.1 |
| Iowa | 84 | 41.7 | 416 | 86.5 |
| Kentucky | 100 | 41 | 468 | 86.1 |
| Los Angeles | 108 | 32.4 | 468 | 88.2 |
| Louisiana | 88 | 34.1 | 373 | 91.7 |
| New Jersey | 201 | 21.4 | 961 | 84.7 |
| New Mexico | 22 | * | 138 | 81.2 |
| San Francisco | 63 | 17.5 | 250 | 84.4 |
| San Jose | 33 | 36.4 | 183 | 87.4 |
| Seattle | 95 | 37.9 | 380 | 90.5 |
| Utah | 35 | * | 156 | 87.8 |
| Urbanicity | | | | |
| Big metro | 770 | 28.2 | 3,545 | 87.4 |
| Metro | 425 | 30.1 | 1,847 | 87.1 |
| Urban | 78 | 17.9 | 382 | 88.0 |
| Less urban | 90 | 40.0 | 430 | 87.9 |
| Rural | * | * | 92 | 85.9 |
| Tumor Size | | | | |
| Microscopic | 35 | * | 106 | 73.6 |
| <1 cm | 412 | 22.8 | 1716 | 88.2 |
| <2 cm | 276 | 30.8 | 2675 | 89.8 |
| 2-5 cm | 191 | 41.4 | 1522 | 85.0 |
| >5 cm | 48 | 68.8 | 152 | 82.9 |
| Grade | | | | |
| Well differentiated | 146 | 20.5 | 1,865 | 87.8 |
| Moderately differentiated | 448 | 23.2 | 2,694 | 87.8 |
| Poorly differentiated | 423 | 36.2 | 1,323 | 88.9 |
| Undifferentiated | 161 | 43.5 | 45 | 77.8 |
| Surgery | | | | |
| BCS | 1,046 | 18.3 | 4,407 | 84.6 |
| Mastectomy | 338 | 63.6 | 1,882 | 93.8 |

* Number suppressed to protect patient confidentiality.

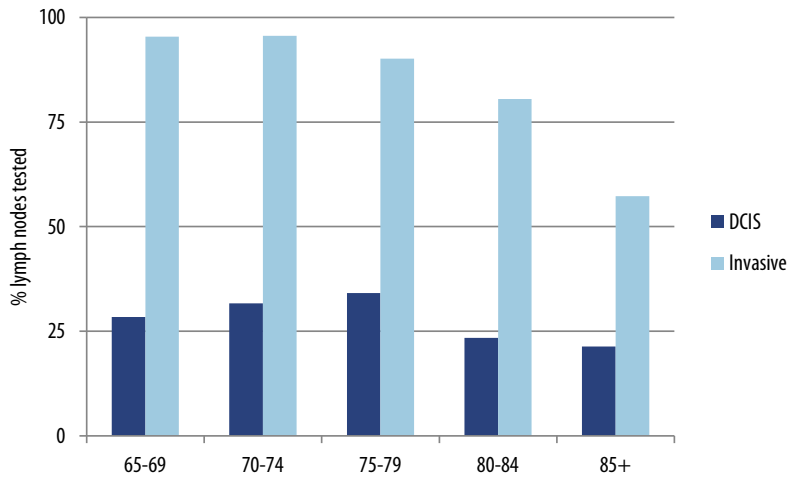
## Lymph Node Testing

Rates of lymph node testing were typically low among women with DCIS, although they increased slightly from 26.0 percent in 2004 to 29.3 percent in 2007. For consistency with our reporting of other tests, we discuss here patterns for 2007 only (see **Appendices E, F, and G** for other years). Lymph node testing rates were lowest among older women (<25% for women over 80; **Table 4** and **Figure 3**). Among racial groups, rates were highest (33.3%) for Hispanic white women and lowest for black women (19.8%).

Rates were highest among women with large tumors (68.8%) and those who received a mastectomy (63.6% vs. 18.3% in women with BCS). Rates were lowest in San Francisco (17.5%) and highest in Iowa (41.7%). Women with comedo subtype DCIS were more likely to have nodes tested than those without (34.6% versus 27.3%).

Women with invasive disease have higher rates of lymph node testing overall than women with DCIS, and the rate increased over time from 84.4 percent to 87.4 percent. In 2007, women with mastectomy were more likely to have nodes tested (93.8% vs. 84.6% with BCS). The rates of lymph node testing for women with invasive disease and women with DCIS differed greatly across geographic areas. Rates in nonurban areas were the highest for women with DCIS, but among the lowest for women with invasive disease. Similarly, Hawaii had one of the highest rates of lymph node testing for women with invasive disease (91.1%) but one of the lowest for women with DCIS (<20%, number suppressed to protect patient confidentiality; **Table 4**).

**Figure 3:** Percent lymph node testing among ductal carcinoma in situ and early invasive breast cancer diagnoses, by age at diagnosis in SEER, 2007




As with DCIS, the rate of lymph node testing decreased with age for women with invasive breast cancer. Of women ages 65-69, 95.4 percent had lymph nodes evaluated compared with 57.3 percent of women age 85 and older. Unlike with DCIS, however, tumor size and grade were not associated with differing patterns of lymph node testing in women with invasive disease.

## DISCUSSION

This report provides population-based information about the types of diagnostic data obtained for older women with DCIS or early invasive breast cancer. We found large increases in the use of ER/PR and HER2 testing between 2004 and 2007. These increases point to wider access to the benefits of current therapies.

Medicare data are not well suited to differentiating between ER and PR testing; however, testing rates are also available from SEER-based sources. In both cases, reported testing points to large changes in clinical practice.

Two key messages emerged from analysis of ER positivity: first, rates of positivity were almost identical for the DCIS and invasive breast cancer groups. Second, positivity rates were stable over time for both DCIS and invasive disease, despite dramatic increases in testing. This finding suggests that physicians have no information suggesting ER positivity on which to base testing and are thus testing randomly. Treatment targeted to ER+ tumors is very effective for women with invasive cancers and ER testing is considered vital for treatment decisions in that context.[16]

HER2 is overexpressed in about one-third of patients with DCIS. While current guidelines do not recommend routine testing of HER2 for DCIS, we found that HER2 testing significantly increased from 2004 to 2007. While trastuzumab is integral to treatment for HER2+ invasive breast cancer, it is not used in the treatment of DCIS. In one study using preoperative single-dose monotherapy for patients with HER2+ DCIS, trastuzumab resulted in no significant histologic or antiproliferative changes.[17] The NSABP is studying the potential efficacy and role of postoperative trastuzumab for DCIS in a Phase III randomized trial for patients treated with BCS.[18]

We found more variability by race and geography in HER2 testing rates among women with DCIS than we did among women with early invasive disease. Some of this variability may result from selective testing of DCIS patients assumed to be at higher risk of positivity. We cannot assess whether rates of HER2 positivity are similar between DCIS and early invasive breast cancer because neither SEER nor Medicare data contain HER2 testing results.

We found that rates of BRCA testing were quite low, likely as a result of the cohort selected for our study. Medicare coverage rules for BRCA testing require that older women have at least two primary breast tumors, personal history of ovarian cancer, two (one if male) close blood relatives with epithelial ovarian or breast cancers, or be a member of an ethnicity associated with higher BRCA mutation frequency. Importantly, neither SEER nor Medicare data include information on family history of breast or ovarian cancer, or information on the use of genetic counseling. The data do suggest that BRCA testing is not widely used in the Medicare population age 65 and older.

Rates of lymph node testing between DCIS and early invasive disease differ, which may be due to multiple factors. First, lymph node testing is considered a standard of care for women with invasive disease but is not uniformly recommended for women with DCIS. Second, the estimated rates of testing for both groups will be biased downward, because our cohort did not include women in whom positive lymph nodes were detected. Our findings are consistent with current recommendations regarding lymph node evaluation.

Within the DCIS population, we found that lymph node evaluation was significantly more frequent among mastectomy patients (63.6%) than among those undergoing BCS (18.3%). This is not surprising since SLNB can still be performed after BCS if occult invasive breast cancer is identified in the excised specimen. On the other hand, SLNB cannot be performed if occult invasive cancer is identified in the mastectomy specimen. However, lymph nodes may have been inadvertently retrieved from some of the women with DCIS who underwent mastectomy; thus, it is possible that for some women, the evaluation of lymph nodes was not intentional.

## CONCLUSION

As the incidence of DCIS has increased, so has the interest in factors predicting recurrence or subsequent invasive disease. For all examined tests, we found lower rates of testing for women with DCIS than for women with early invasive disease. In addition to significant geographic and racial variation in testing, we found large increases in the use of diagnostic tests over a relatively short period of time.

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## Appendix A: Agreement between SEER and Medicare claims data analyses of testing, 2004-2008

| | | SEER ER Tested | Claims ER Tested | Total Agreement |
|---|---|---|---|---|
| | n | % | % | % |
| DCIS | 5,788 | 78.1 | 75.6 | 80.8 |
| Invasive | 25,439 | 97.9 | 93.6 | 92.3 |

## Appendix B: ER/PR testing and HER2 testing among ductal carcinoma in situ and early invasive breast cancer diagnoses in SEER, 2004

| | DCIS | | | Invasive | | |
|---|---|---|---|---|---|---|
| | n | ER/PR % | HER2 % | n | ER/PR % | HER2 % |
| Total | 1,496 | 63.6 | 32.2 | 6,638 | 92.1 | 82.8 |
| Age (years) | | | | | | |
| 65-69 | 473 | 67.4 | 35.9 | 1,642 | 79.8 | 90.1 |
| 70-74 | 392 | 62.8 | 30.1 | 1,597 | 81.5 | 93.0 |
| 75-79 | 329 | 64.7 | 31.6 | 1,541 | 78.7 | 92.7 |
| 80-84 | 207 | 56.5 | 27.5 | 1,138 | 78.3 | 93.4 |
| 85+ | 95 | 60.0 | 34.7 | 720 | 74.7 | 91.4 |
| Race | | | | | | |
| White | 1,230 | 62.1 | 31.3 | 5,721 | 79.6 | 92.6 |
| White Hispanic | 73 | 63.0 | 37.0 | 216 | 76.4 | 92.1 |
| Black | 108 | 74.1 | 35.2 | 385 | 77.9 | 89.9 |
| Asian/Pacific Islander | 65 | 70.8 | 36.9 | 228 | 74.1 | 86.0 |
| SEER Registry | | | | | | |
| Atlanta | 66 | 78.8 | 36.4 | 224 | 86.6 | 70.1 |
| Connecticut | 114 | 54.4 | 28.1 | 526 | 97.0 | 87.8 |
| Detroit | 112 | 65.2 | 22.3 | 474 | 96.4 | 82.1 |
| Greater California | 296 | 53.0 | 25.7 | 1,292 | 90.6 | 85.1 |
| Hawaii | 24 | 66.7 | * | 79 | 86.1 | 82.3 |
| Iowa | 99 | 68.7 | 33.3 | 491 | 91.4 | 73.3 |
| Kentucky | 108 | 63.9 | 33.3 | 506 | 92.5 | 80.0 |
| Los Angeles | 104 | 75.0 | 32.7 | 436 | 94.3 | 86.9 |
| Louisiana | 105 | 58.1 | 35.2 | 472 | 89.6 | 87.1 |
| New Jersey | 203 | 73.9 | 47.8 | 1,018 | 94.1 | 88.9 |
| New Mexico | 35 | 57.1 | 34.3 | 152 | 88.2 | 66.4 |
| San Francisco | 54 | 51.9 | 27.8 | 244 | 83.6 | 65.2 |
| San Jose | 37 | 56.8 | 32.4 | 145 | 93.1 | 86.9 |
| Seattle | 98 | 72.4 | 35.7 | 369 | 92.7 | 84.8 |
| Utah | 35 | 62.9 | * | 202 | 91.1 | 78.2 |
| Urbanicity | | | | | | |
| Big metro | 868 | 66.7 | 32.9 | 3,689 | 92.4 | 83.5 |
| Metro | 421 | 58.9 | 29.5 | 1,943 | 93.2 | 85.2 |
| Urban | 83 | 62.7 | 39.8 | 405 | 86.7 | 71.9 |
| Less urban | 100 | 62.0 | 35.0 | 504 | 89.9 | 76.8 |
| Rural | 24 | 45.8 | * | 97 | 95.9 | 84.5 |
| Tumor Size | | | | | | |
| Microscopic | 62 | 48.4 | 21.0 | 91 | 72.5 | 84.6 |
| <1 cm | 418 | 62.2 | 30.4 | 1,866 | 82.7 | 92.6 |
| <2 cm | 324 | 67.6 | 36.1 | 2,768 | 79.7 | 92.8 |
| 2-5 cm | 199 | 69.3 | 33.2 | 1,651 | 76.1 | 91.6 |
| >5 cm | 68 | 76.5 | 42.6 | 132 | 76.5 | 91.7 |
| Grade | | | | | | |
| Well differentiated | 162 | 59.3 | 28.4 | 1,872 | 80.4 | 92.0 |
| Moderately differentiated | 442 | 60.4 | 30.1 | 2,768 | 79.7 | 92.9 |
| Poorly differentiated | 412 | 68.2 | 33.7 | 1,426 | 79.3 | 92.7 |
| Undifferentiated | 231 | 64.9 | 30.7 | 74 | 68.9 | 90.5 |
| Surgery | | | | | | |
| BCS | 1,121 | 63.2 | 32.1 | 4,586 | 92.9 | 83.7 |
| Mastectomy | 373 | 64.6 | 32.4 | 2,045 | 90.5 | 80.9 |

* Number suppressed to protect patient confidentiality.
ER = estrogen receptor, PR = progesterone receptor, HER2 = human epidermal growth factor receptor-2.

## Appendix C: ER/PR testing and HER2 testing among ductal carcinoma in situ and early invasive breast cancer diagnoses in SEER, 2005

| | DCIS | | | Invasive | | |
|---|---|---|---|---|---|---|
| | n | ER/PR % | HER2 % | n | ER/PR % | HER2 % |
| Total | 1,453 | 72.1 | 36.2 | 6,075 | 92.8 | 85.5 |
| Age (years) | | | | | | |
| 65-69 | 450 | 70.2 | 36.4 | 1,507 | 91.4 | 85.1 |
| 70-74 | 393 | 77.1 | 37.7 | 1,463 | 93.2 | 86.4 |
| 75-79 | 340 | 73.2 | 37.9 | 1,386 | 93.4 | 85.1 |
| 80-84 | 180 | 68.9 | 36.1 | 1,053 | 92.8 | 85.5 |
| 85+ | 90 | 61.1 | 22.2 | 666 | 93.7 | 85.4 |
| Race | | | | | | |
| White | 1,160 | 72.2 | 36.5 | 5,138 | 93.4 | 85.7 |
| White Hispanic | 70 | 72.9 | 40.0 | 281 | 89.3 | 83.6 |
| Black | 114 | 73.7 | 39.5 | 317 | 88.3 | 84.2 |
| Asian/Pacific Islander | 69 | 68.1 | 29.0 | 251 | 90.8 | 85.7 |
| SEER Registry | | | | | | |
| Atlanta | 56 | 75.0 | 33.9 | 225 | 93.8 | 78.7 |
| Connecticut | 138 | 65.9 | 35.5 | 440 | 93.6 | 85.0 |
| Detroit | 142 | 86.6 | 38.7 | 502 | 95.6 | 89.0 |
| Greater California | 310 | 64.2 | 34.2 | 1,292 | 91.4 | 86.1 |
| Hawaii | 20 | 90.0 | * | 88 | 88.6 | 86.4 |
| Iowa | 76 | 84.2 | 51.3 | 459 | 93.2 | 78.2 |
| Kentucky | 100 | 64.0 | 28.0 | 499 | 92.2 | 84.2 |
| Los Angeles | 119 | 63.9 | 35.3 | 486 | 93.0 | 90.7 |
| Louisiana** | n/a | n/a | n/a | n/a | n/a | n/a |
| New Jersey | 230 | 83.0 | 43.5 | 932 | 94.0 | 89.8 |
| New Mexico | 24 | 79.2 | * | 146 | 92.5 | 80.1 |
| San Francisco | 65 | 63.1 | 30.8 | 235 | 84.3 | 75.3 |
| San Jose | 36 | 69.4 | * | 161 | 96.3 | 87.6 |
| Seattle | 97 | 69.1 | 30.9 | 427 | 93.0 | 87.4 |
| Utah | 37 | 67.6 | * | 173 | 94.2 | 77.5 |
| Urbanicity | | | | | | |
| Big metro | 922 | 73.0 | 36.7 | 3,562 | 92.8 | 87.2 |
| Metro | 373 | 70.5 | 35.7 | 1,664 | 93.3 | 85.8 |
| Urban | 67 | 65.7 | 31.3 | 356 | 90.7 | 72.8 |
| Less urban | 73 | 71.2 | 39.7 | 395 | 92.9 | 83.5 |
| Rural | 18 | 83.3 | * | 98 | 90.8 | 72.4 |
| Tumor Size | | | | | | |
| Microscopic | 47 | 70.2 | 42.6 | 88 | 93.2 | 81.8 |
| <1 cm | 403 | 70.7 | 35.5 | 1,735 | 93.0 | 86.1 |
| <2 cm | 292 | 71.9 | 37.7 | 2,506 | 92.6 | 85.8 |
| 2-5 cm | 220 | 80.9 | 41.4 | 1,503 | 92.7 | 85.2 |
| >5 cm | 58 | 70.7 | 24.1 | 130 | 92.3 | 80.0 |
| Grade | | | | | | |
| Well differentiated | 177 | 72.3 | 35.0 | 1,705 | 92.0 | 83.5 |
| Moderately differentiated | 454 | 72.9 | 35.2 | 2,538 | 94.2 | 87.4 |
| Poorly differentiated | 409 | 76.0 | 36.4 | 1,381 | 92.3 | 85.8 |
| Undifferentiated | 209 | 71.8 | 38.8 | 52 | 94.2 | 78.8 |
| Surgery | | | | | | |
| BCS | 1,148 | 71.8 | 34.7 | 4,327 | 93.3 | 86.5 |
| Mastectomy | 302 | 72.8 | 42.4 | 1,742 | 91.5 | 83.1 |

* Number suppressed to protect patient confidentiality.
** Numbers not calculated for Louisiana in 2005 due to Hurricane Katrina.
ER = estrogen receptor, PR = progesterone receptor, HER2 = human epidermal growth factor receptor-2.

## Appendix D: ER/PR testing and HER2 testing among ductal carcinoma in situ and early invasive breast cancer diagnoses in SEER, 2006

| | DCIS | | | Invasive | | |
|---|---|---|---|---|---|---|
| | n | ER/PR % | HER2 % | n | ER/PR % | HER2 % |
| Total | 1,434 | 82.0 | 44.4 | 6,378 | 94.6 | 90.0 |
| Age (years) | | | | | | |
| 65-69 | 452 | 83.4 | 43.8 | 1,645 | 92.4 | 87.5 |
| 70-74 | 367 | 85.3 | 47.1 | 1,468 | 95.0 | 90.3 |
| 75-79 | 332 | 79.5 | 44.0 | 1,428 | 96.0 | 91.3 |
| 80-84 | 195 | 80.0 | 44.1 | 1,098 | 96.0 | 92.3 |
| 85+ | 88 | 75.0 | 37.5 | 739 | 94.0 | 88.6 |
| Race | | | | | | |
| White | 1,135 | 82.2 | 43.1 | 5,366 | 95.3 | 90.7 |
| White Hispanic | 61 | 82.0 | 50.8 | 284 | 90.5 | 84.9 |
| Black | 129 | 81.4 | 47.3 | 348 | 89.7 | 83.6 |
| Asian/Pacific Islander | 73 | 80.8 | 52.1 | 258 | 92.6 | 90.3 |
| SEER Registry | | | | | | |
| Atlanta | 59 | 84.7 | 35.6 | 210 | 94.3 | 75.7 |
| Connecticut | 108 | 78.7 | 44.4 | 488 | 97.5 | 92.6 |
| Detroit | 127 | 88.2 | 36.2 | 434 | 96.8 | 91.9 |
| Greater California | 285 | 77.5 | 43.9 | 1,297 | 93.1 | 90.1 |
| Hawaii | 22 | 81.8 | * | 84 | 95.2 | 92.9 |
| Iowa | 99 | 89.9 | 42.4 | 432 | 94.9 | 86.3 |
| Kentucky | 98 | 71.4 | 37.8 | 498 | 95.6 | 91.6 |
| Los Angeles | 93 | 86.0 | 59.1 | 463 | 95.5 | 93.3 |
| Louisiana | 102 | 79.4 | 52.9 | 388 | 92.8 | 88.1 |
| New Jersey | 221 | 91.0 | 54.3 | 979 | 94.7 | 90.9 |
| New Mexico | 20 | 90.0 | * | 155 | 92.3 | 83.2 |
| San Francisco | 55 | 80.0 | 50.9 | 245 | 92.7 | 90.6 |
| San Jose | 34 | 82.4 | 35.3 | 131 | 96.2 | 93.1 |
| Seattle | 76 | 73.7 | 28.9 | 402 | 93.5 | 89.6 |
| Utah | 34 | 64.7 | * | 156 | 96.8 | 91.0 |
| Urbanicity | | | | | | |
| Big metro | 834 | 83.8 | 43.9 | 3,598 | 94.5 | 89.9 |
| Metro | 424 | 80.4 | 46.2 | 1,869 | 95.3 | 91.2 |
| Urban | 68 | 83.8 | 50.0 | 401 | 92.8 | 86.5 |
| Less urban | 96 | 76.0 | 38.5 | 425 | 94.1 | 88.5 |
| Rural | 12 | * | * | 85 | 96.5 | 89.4 |
| Tumor Size | | | | | | |
| Microscopic | 53 | 66.0 | 37.7 | 88 | 90.9 | 81.8 |
| <1 cm | 420 | 82.1 | 37.4 | 1,785 | 96.6 | 90.9 |
| <2 cm | 290 | 84.8 | 50.7 | 2,658 | 94.1 | 90.2 |
| 2-5 cm | 204 | 85.8 | 51.5 | 1,548 | 95.0 | 91.2 |
| >5 cm | 56 | 91.1 | 51.8 | 155 | 89.0 | 85.2 |
| Grade | | | | | | |
| Well differentiated | 176 | 80.7 | 36.9 | 1,789 | 95.2 | 90.3 |
| Moderately differentiated | 440 | 80.9 | 41.1 | 2,762 | 94.9 | 91.2 |
| Poorly differentiated | 431 | 85.2 | 49.0 | 1,390 | 94.5 | 89.2 |
| Undifferentiated | 191 | 85.3 | 53.4 | 51 | 88.2 | 82.4 |
| Surgery | | | | | | |
| BCS | 1,086 | 81.8 | 42.4 | 4,575 | 95.2 | 92.7 |
| Mastectomy | 346 | 82.7 | 50.3 | 1,796 | 93.1 | 89.4 |

* Number suppressed to protect patient confidentiality.
ER = estrogen receptor, PR = progesterone receptor, HER2 = human epidermal growth factor receptor-2.

## Appendix E: Lymph node testing among ductal carcinoma in situ and early invasive breast cancer diagnoses in SEER, 2004

| | DCIS | | Invasive | |
|---|---|---|---|---|
| | n | Lymph Node % | n | Lymph Node % |
| Total | 1,483 | 26.0 | 6,552 | 84.4 |
| Age (years) | | | | |
| 65-69 | 467 | 29.6 | 1,627 | 94.0 |
| 70-74 | 391 | 26.6 | 1,574 | 91.9 |
| 75-79 | 324 | 26.2 | 1,524 | 87.1 |
| 80-84 | 206 | 21.8 | 1,118 | 77.1 |
| 85+ | 95 | 13.7 | 709 | 51.3 |
| Race | | | | |
| White | 1,220 | 25.0 | 5,643 | 84.2 |
| White Hispanic | 72 | 36.1 | 215 | 86.5 |
| Black | 107 | 28.0 | 381 | 82.2 |
| Asian/Pacific Islander | 64 | 31.3 | 227 | 93.4 |
| SEER Registry | | | | |
| Atlanta | 66 | 21.2 | 222 | 82.4 |
| Connecticut | 114 | 20.2 | 517 | 77.8 |
| Detroit | 110 | 23.6 | 461 | 84.8 |
| Greater California | 296 | 24.3 | 1,287 | 87.0 |
| Hawaii | * | * | * | * |
| Iowa | 98 | 30.6 | 483 | 85.0 |
| Kentucky | 105 | 27.6 | 497 | 83.3 |
| Los Angeles | 103 | 30.1 | 433 | 87.8 |
| Louisiana | 105 | 28.6 | 464 | 83.0 |
| New Jersey | 199 | 27.6 | 997 | 81.1 |
| New Mexico | 35 | * | 150 | 1.0 |
| San Francisco | 53 | * | 243 | 82.7 |
| San Jose | 37 | * | 143 | 89.5 |
| Seattle | 98 | 35.7 | 366 | 89.0 |
| Utah | 35 | * | 202 | 87.6 |
| Urbanicity | | | | |
| Big metro | 861 | 25.8 | 3,639 | 84.8 |
| Metro | 416 | 26.0 | 1,923 | 84.3 |
| Urban | 83 | 28.9 | 396 | 86.6 |
| Less urban | 99 | 26.3 | 497 | 80.5 |
| Rural | * | * | 79 | 81.4 |
| Tumor Size | | | | |
| Microscopic | 60 | * | 91 | 69.2 |
| <1 cm | 415 | 16.6 | 1,850 | 84.5 |
| <2 cm | 320 | 26.6 | 2,732 | 86.1 |
| 2-5 cm | 199 | 40.7 | 1,620 | 83.3 |
| >5 cm | 68 | 55.9 | 132 | 81.8 |
| Grade | | | | |
| Well differentiated | 162 | 14.2 | 1,853 | 84.1 |
| Moderately differentiated | 439 | 23.0 | 2,766 | 85.0 |
| Poorly differentiated | 410 | 31.2 | 1,402 | 85.8 |
| Undifferentiated | 228 | 36.4 | 74 | 78.4 |
| Surgery | | | | |
| BCS | 1,112 | 15.3 | 4,527 | 81.0 |
| Mastectomy | 369 | 58.0 | 2,018 | 92.2 |

* Number suppressed to protect patient confidentiality.
ER = estrogen receptor, PR = progesterone receptor, HER2 = human epidermal growth factor receptor-2.

## Appendix F: Lymph node testing among ductal carcinoma in situ and early invasive breast cancer diagnoses in SEER, 2005

| | DCIS | | Invasive | |
|---|---|---|---|---|
| | n | Lymph Node % | n | Lymph Node % |
| Total | 1,445 | 26.8 | 6,015 | 85.2 |
| Age (years) | | | | |
| 65-69 | 447 | 30.4 | 1,497 | 95.3 |
| 70-74 | 391 | 25.6 | 1,445 | 92.2 |
| 75-79 | 338 | 27.2 | 1,375 | 88.7 |
| 80-84 | 179 | 22.9 | 1,042 | 76.2 |
| 85+ | 90 | 20.0 | 656 | 53.2 |
| Race | | | | |
| White | 1,153 | 26.5 | 5,090 | 85.1 |
| White Hispanic | 70 | 38.6 | 276 | 87.3 |
| Black | 113 | 26.5 | 313 | 81.5 |
| Asian/Pacific Islander | 69 | 21.7 | 249 | 87.1 |
| SEER Registry | | | | |
| Atlanta | 56 | 25.0 | 224 | 84.8 |
| Connecticut | 138 | 15.9 | 432 | 77.3 |
| Detroit | 142 | 23.9 | 499 | 86.6 |
| Greater California | 309 | 30.7 | 1,281 | 86.7 |
| Hawaii | * | * | 88 | 85.0 |
| Iowa | 75 | 38.7 | 459 | 86.0 |
| Kentucky | 96 | 29.2 | 481 | 85.0 |
| Los Angeles | 119 | 21.8 | 486 | 86.2 |
| Louisiana** | n/a | n/a | n/a | n/a |
| New Jersey | 230 | 30.0 | 922 | 84.7 |
| New Mexico | * | * | 143 | 84.6 |
| San Francisco | 65 | 21.5 | 233 | 78.5 |
| San Jose | 36 | 33.3 | 160 | 86.0 |
| Seattle | 95 | 21.1 | 425 | 90.6 |
| Utah | 37 | 32.4 | 172 | 84.0 |
| Urbanicity | | | | |
| Big metro | 919 | 26.4 | 3,533 | 85.3 |
| Metro | 370 | 25.7 | 1,645 | 85.0 |
| Urban | 67 | 28.4 | 355 | 87.0 |
| Less urban | 71 | 33.8 | 387 | 85.3 |
| Rural | * | * | 73 | 76.8 |
| Tumor Size | | | | |
| Microscopic | 47 | * | 87 | 69.0 |
| <1 cm | 401 | 18.0 | 1,723 | 86.2 |
| <2 cm | 292 | 26.4 | 2,485 | 87.4 |
| 2-5 cm | 219 | 40.2 | 1,485 | 83.1 |
| >5 cm | 58 | 44.8 | 128 | 73.4 |
| Grade | | | | |
| Well differentiated | 177 | 18.6 | 1,693 | 84.1 |
| Moderately differentiated | 453 | 19.9 | 2,519 | 86.3 |
| Poorly differentiated | 407 | 33.2 | 1,364 | 86.7 |
| Undifferentiated | 207 | 39.1 | 52 | 86.5 |
| Surgery | | | | |
| BCS | 1,141 | 16.0 | 4,284 | 82.2 |
| Mastectomy | 301 | 67.8 | 1,727 | 92.6 |

* Number suppressed to protect patient confidentiality.
** Numbers not calculated for Louisiana in 2005 due to Hurricane Katrina.
ER = estrogen receptor, PR = progesterone receptor, HER2 = human epidermal growth factor receptor-2.

## Appendix G: Lymph node testing among ductal carcinoma in situ and early invasive breast cancer diagnoses in SEER, 2006

| | DCIS | | Invasive | |
|---|---|---|---|---|
| | n | Lymph Node % | n | Lymph Node % |
| Total | 1,420 | 30.6 | 6,314 | 85.4 |
| Age (years) | | | | |
| 65-69 | 448 | 31.9 | 1,628 | 94.0 |
| 70-74 | 364 | 33.5 | 1,457 | 92.0 |
| 75-79 | 328 | 27.7 | 1,414 | 88.8 |
| 80-84 | 193 | 30.1 | 1,090 | 79.9 |
| 85+ | 87 | 23.0 | 725 | 53.9 |
| Race | | | | |
| White | 1,124 | 30.5 | 5,312 | 85.4 |
| White Hispanic | 61 | 41.0 | 283 | 83.7 |
| Black | 127 | 25.2 | 343 | 84.8 |
| Asian/Pacific Islander | 72 | 34.7 | 256 | 88.7 |
| SEER Registry | | | | |
| Atlanta | 58 | 20.7 | 210 | 89.5 |
| Connecticut | 106 | 21.7 | 482 | 78.6 |
| Detroit | 126 | 23.0 | 430 | 85.6 |
| Greater California | 283 | 35.7 | 1,280 | 87.3 |
| Hawaii | * | * | * | * |
| Iowa | 97 | 33.0 | 430 | 84.0 |
| Kentucky | 98 | 40.8 | 489 | 83.0 |
| Los Angeles | 92 | 42.4 | 462 | 83.8 |
| Louisiana | 101 | 42.6 | 386 | 89.9 |
| New Jersey | 218 | 23.9 | 961 | 84.0 |
| New Mexico | 20 | * | 155 | 76.0 |
| San Francisco | 55 | * | 243 | 81.5 |
| San Jose | 34 | 32.4 | 130 | 90.8 |
| Seattle | 76 | 26.3 | 402 | 91.0 |
| Utah | 34 | * | 155 | 85.8 |
| Urbanicity | | | | |
| Big metro | 826 | 28.6 | 3,563 | 85.6 |
| Metro | 420 | 33.8 | 1,852 | 85.3 |
| Urban | 66 | 36.4 | 398 | 86.7 |
| Less urban | 96 | 29.2 | 417 | 84.7 |
| Rural | * | * | 60 | 71.4 |
| Tumor Size | | | | |
| Microscopic | 53 | 24.5 | 88 | 79.5 |
| <1 cm | 413 | 22.8 | 1,765 | 84.9 |
| <2 cm | 289 | 31.8 | 2,629 | 87.5 |
| 2-5 cm | 203 | 41.4 | 1,535 | 84.3 |
| >5 cm | 55 | 61.8 | 155 | 81.9 |
| Grade | | | | |
| Well differentiated | 174 | 21.8 | 1,770 | 83.7 |
| Moderately differentiated | 434 | 24.2 | 2,736 | 86.8 |
| Poorly differentiated | 427 | 37.0 | 1,379 | 86.9 |
| Undifferentiated | 191 | 43.5 | 51 | 86.3 |
| Surgery | | | | |
| BCS | 1,074 | 17.9 | 4,524 | 82.8 |
| Mastectomy | 344 | 69.8 | 1,783 | 91.9 |

* Number suppressed to protect patient confidentiality.
ER = estrogen receptor, PR = progesterone receptor, HER2 = human epidermal growth factor receptor-2.