An Actuarial Analysis of Breast Cancer Screening and Follow-on Diagnostics in a Commercially Insured Population

Prepared by
Milliman, Inc., NY

Kathryn Fitch, RN, MEd
Principal and Healthcare Management Consultant

Ellynne Dec, ASA, MAAA
Associate Actuary

Jonah Broulette, ASA, MAAA
Associate Actuary

Tyler Engel
Actuarial Analyst

Commissioned by Gamma Medica, Inc.

Copyright © 2014 Milliman. Inc.

February 20, 2014

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Breast cancer screening has been a US Preventive Services Task Force (USPSTF) recommendation since the task force issued its first Guide to Clinical Preventive Services in 1989.[1,2] Breast cancer screening recommendations are based on landmark studies that showed screening significantly increased the detection of breast cancer at earlier stages when the prognosis for cure is higher: 99% five-year relative survival rate when breast cancer is diagnosed at the local stage, 84% when diagnosed at the regional stage and 24% when diagnosed at the distant stage.[2,3] Adherence to breast cancer screening has remained steady since 1999 according to the 2013 Healthcare Effectiveness Data and Information Set (HEDIS) report: 66.5% of PPO and 70.3% of HMO commercially insured women age 40-69 adhere to biennial (every other year) screening recommendations.[4] The Affordable Care Act (ACA) has defined breast cancer screening as an essential health benefit and has eliminated patient cost sharing for breast cancer screening as ACA has for certain preventive services.[5] The ACA's elimination of cost sharing is expected to lead to higher patient adherence to breast cancer screening.

The increase in adherence to breast cancer screening will result in increased follow-on diagnostics—the topic of this study. Follow-on diagnostics are performed after screening mammograms that have suspicious findings. Follow-on diagnostics include diagnostic mammographic imaging, sonography, magnetic resonance imaging (MRI), molecular breast imaging (MBI) /scintimammography, breast biopsy and infrequently used breast SPECT, PET and CT. The vast majority of follow-on diagnostics do not discover cancer—in other words, cancer is ruled out.

The growing awareness of the higher cancer risk for women with dense breasts is also expected to increase follow-on diagnostics after screening mammography. Mammography is not as sensitive in detecting breast cancer in the approximately 40% of women with dense breasts.[6,7] So-called "dense breast legislation", which has passed in 14 states to date, generally requires that women be informed of their breast density noted on screening mammography and that individuals with dense breasts be informed that they may benefit from supplemental screening tests. A federal bill with these features was introduced in October 2013.

Studies report wide variation in follow-on testing among radiologists and facilities. The Breast Cancer Surveillance Consortium (BCSC), which collects breast cancer screening data on more than 2 million women across the U.S., reports a follow-on diagnostic testing rate, also referred to as a "recall rate", of 5% -14%, and the pattern of diagnostic technology used varies.[8,9] A Medicare study published in 2013 reported more than a two-fold regional variation in age standardized cost per beneficiary for breast cancer screening and follow-on diagnostics. Statistically significant regional variation in utilization of follow-on diagnostics including diagnostic mammogram, other breast imaging and biopsy, were reported.[10] Because clinical guidelines provide many options for follow-on testing after suspicious screening mammograms, it may be difficult to assess the variation by measuring physician adherence to guidelines, a method that has worked well in other clinical areas.

To examine breast cancer screening episode costs and patterns of follow-on diagnostics for payers/employers, we analyzed Truven MarketScan® 2009-2011 commercial data. Our database analysis found that 17% of screening mammograms had follow-on diagnostic testing. We found the average breast cancer screening episode cost per 30-64 year old screened woman was $249.70. The screening mammogram itself contributed 62% of the cost and the remaining 38% of the cost ($94.11) was contributed by follow-on diagnostics: 17.9% of the total breast cancer screening episode cost was from biopsies, 8.3% from sonograms, 7.2% from diagnostic mammograms, and 4.2% from MRIs. Less than 1% of the total cost was attributed to MBI/scintimammography, CT, PET or SPECT of the breast.

Our analysis noted wide variation in the pattern of follow-on diagnostics at a patient level. Some women had one follow-on diagnostic followed by a biopsy, while others received four follow-on diagnostics, with or without biopsy. Variation in the sequence of diagnostics was also noted. We noted a breast biopsy rate of 2.4% among the breast cancer screening population, which is approximately twice as high as that reported in the BCSC data.[2,11,12] Another finding of interest was the "false positive" rate of biopsies – the portion of biopsies that do not lead to breast cancer surgery. We identified a 19% breast cancer surgery rate after biopsy which suggests an 81% false positive rate of breast biopsy procedures. The rate did not vary appreciably by the diagnostic(s) that preceded the biopsy. This false positive rate is higher than the 66%-72% reported in the literature.[8,11]

Our findings of higher follow-on diagnostic rates, variation in patterns of follow-on diagnostics, higher breast biopsy rates and higher false positive biopsy rates, compared to BCSC rates, highlights the need for payers/employers to evaluate the quality and value of breast cancer screening follow-on diagnostic patterns. Variation studies have helped quality-focused organizations promote best practices and we hope this material will raise awareness of practice pattern variation in breast cancer screening episodes.

There are disagreements over the appropriate age to begin screening average risk women for breast cancer and whether screening is effective at reducing breast cancer mortality. This report does not address these issues but rather explores the patient pathways and costs associated with follow-on services to screening mammography.

This report was commissioned by Gamma Medica, Inc. which manufactures LumaGEM Molecular Breast Imaging (MBI), a diagnostic tool for detecting early-stage cancers in dense breast tissue. Two of the authors, Jonah Broulette and Ellynne Dec are Members of the American Academy of Actuaries and meet its qualification standards for this communication. The findings reflect the research of the authors; Milliman does not intend to endorse any product or organization. If this report is reproduced, we ask that it be reproduced in its entirety, as pieces taken out of context can be misleading. As with any economic or actuarial analysis, it is not possible to capture all factors that may be significant. Because we present national average data, the findings should be interpreted carefully before they are applied to any particular situation.

BACKGROUND

Breast cancer is the most common cancer among women in the U.S. and the second most common cause of cancer-related death in women after lung cancer.[13] U.S. women have an average lifetime risk of breast cancer of about 1 in 8.[14] Treatment of breast cancer at earlier stages is correlated with better survival outcomes, with a five-year relative survival rate of 99% if the cancer is diagnosed at the local stage, 84% if diagnosed at the regional stage and 24% if diagnosed at the distant stage.[2,3] Early detection is reported to result in cost savings associated with lower treatment costs at earlier compared to later stages.[15]

Mammographic screening has been the foundation of early detection of breast cancer since 1989 when the U.S. Preventive Services Task Force (USPSTF) issued breast cancer screening guidelines. The systematic use of breast cancer screening and follow-on diagnostics has led to significant increases in the early detection of breast cancer in the past 20 years.[13] Two organizations provide slightly differing recommendations for the age and frequency of breast cancer screening. The American Cancer Society (ACS) recommends yearly mammograms for all women 40 and older.[1] In its most recent recommendations, issued in 2009, the U.S. Preventive Services Task Force (USPSTF) recommends biennial (every two years) screening mammograms for women age 50-74. For women under 50, the USPSTF states that "the decision to start regular, biennial screening mammography before the age of 50 years should be an individual one and take patient context into account, including the patient's values regarding specific benefits and harms".[13,16] According to HEDIS reports, biennial breast cancer screening rates among 40-69 year old commercially insured women were 66%-70% in 2012 and have been approximately at this level since 1999.[4] Other reports have noted that about 65% of women age 40-49 received biennial screens in 2012.[17,18]

Guidelines for follow-on diagnostic testing after suspicious mammograms are not as clear-cut as guidelines for screening mammograms and have not received as much attention as the screening guidelines. The decision to recall a patient for follow-on diagnostic testing after an initial breast cancer screening mammogram is based on the radiologist's interpretation of the initial screening mammogram. A range of different follow-on diagnostic technologies are used, including further mammographic imaging, sonography, MRI, molecular breast imaging (MBI/ scintimammography), breast biopsy and infrequently used breast SPECT, PET and CT. The radiologist is required to characterize findings according to standard terminology and assessments for classifying mammographic breast images provided by The American College of Radiology (ACR). The Breast Imaging Reporting and Data System (BI-RADS) defines screening assessment categories 0-5 and provides clinical recommendations for subsequent testing. National Comprehensive Cancer Network (NCCN) guidelines for breast cancer screening and diagnosis call for follow-up of BI-RADS category 4 or 5 findings with biopsy.[19] NCCN clinical recommendations and BI-RADs categories are summarized below.[20,21]

BI-RADs: Summary of Screening Mammography Categories and Clinical Recommendations

Assessment category	Description	Clinical Management Recommendation (Bevers, Anderson et al. 2009)
0	Needs additional imaging evaluation	Review previous mammograms and/or diagnostic mammogram and/or ultrasound "as indicated"
1	Negative	Continue routine screening
2	Benign finding	Continue routine screening
3	Probably benign; short-interval (6-month) follow-up suggested	Diagnostic imaging is expected, in order to make a Category 3 assessment. "There may be occasions where biopsy is done (patient wishes or clinical concerns)"
4	Suspicious abnormality; biopsy should be considered	After diagnostic mammogram, follow with core needle biopsy
5	Highly suggestive of malignancy; take appropriate action	After diagnostic mammogram, follow with core needle biopsy

The rate of women having follow-on diagnostics, sometimes referred to as the "recall rate", is highly variable by individual facility and many facilities fall above or below published averages.[9,22] It is recognized that patient mix could account for some of this variability, but studies cite quality of care and quality of data as other drivers of variance.[9] Based on an analysis of Breast Cancer Surveillance Consortium (BCSC) data of over 2 million breast cancer screening mammograms in 2005-2008 from a broad cross-section of American women, the recall rate

averaged 10% and was higher for women under 49.[11] The American College of Radiology reports that recall rates are generally less than 10% across the population of screened women (typically ages 30-79).[23] In addition to variation in recall rates, the type, number and sequence of follow-on diagnostics varies. A Medicare study published in 2013 reported more than a two-fold regional variation in age-standardized cost per beneficiary for breast cancer screening and follow-on diagnostics. Statistically significant regional variation in utilization of follow-on diagnostics including diagnostic mammogram, other breast imaging and biopsy were reported.[10] Recall rates are about twice as high in the U.S. as in the U.K., with similar overall outcomes in breast cancer detection.[13,24]

Another metric of interest in evaluating breast cancer screening episodes is the rate at which cancer is detected following a recall. This is referred to as positive predictive value 1 (PPV1). A 2010 study reported a range of 3%-8% for PPV1 based on a meta-analysis of previous studies.[25] The National Cancer Institute (NCI) reports an overall PPV1 for all ages of 4.3%, based on 2004-2008 BCSC data. For women ages 40-59, NCI reports PPV1 increasing with age, ranging from 1.6% to 4.6%.[11] Reports indicate that women 40-49 have a higher rate of false-positive screens (lower PPV1), as well as more subsequent diagnostic procedures than older women.[26] Another study reports that almost half of women aged 40-69 experience at least one false-positive mammogram in ten screens.[27] The NCI analysis of BCSC data also reports the rate at which cancer is detected after breast biopsy referred to as positive predictive value 3 (PPV3). 100% minus PPV3 is often used as an indicator of false positive rate for biopsies. Based on BCSC data, the average PPV3 rate for cancer detection after biopsy was 29.0%-33.8% which implies a 66.2%-71% false-positive rate for breast biopsies. PPV3 was lower than average for women under 55, indicating a higher false positive rate for biopsies among younger women.[8,11]

The rate of screening adherence is expected to increase under the Affordable Care Act (ACA), which requires that all non-grandfathered plans provide screening mammograms with no patient cost-sharing.[28] As breast cancer screening rates improve, follow-on diagnostic testing will increase. Dense breast legislation is also expected to contribute to an increase in follow-on diagnostics. Dense breast legislation requires that women be informed of their breast density noted on screening mammography and that individuals with dense breasts (approximately 40% of women) be informed that they may benefit from supplemental screening tests because mammography is not as sensitive in detecting breast cancer in women with dense breasts.[6,7] Dense breast legislation was first enacted in Connecticut in 2009 to require physicians to notify women of their breast density.[6,29,30] Since then, 13 other states have passed dense breast legislation and bills introduced in many other states as well as a federal bill that was introduced in October 2013.[7] (See the appendix for States that have passed dense breast legislation.)

Although commercial payers have estimated the increased breast cancer screening mammography cost associated with the elimination of cost sharing, they may not be aware of the increased cost associated with follow-on diagnostic testing. The cost of follow on diagnostics may come under more scrutiny as screening rates increase and dense breast legislation expands. To date, most studies have analyzed breast cancer screening cost in a Medicare population and details of follow-on diagnostic testing are limited. Our analysis provides claim-based utilization patterns and cost of breast cancer screening episodes for a commercially insured population. In the appendix we provide the claim-based logic for payers/employers to perform this type of analysis on their own population claim data.

FINDINGS FROM CLAIM DATA ANALYSIS

Using Truven MarketScan® 2010, we identified all 30-64 year old women with a mammogram claim (see methodology for a description of the MarketScan® database and for mammogram coding logic). The first mammogram in 2010 was set as the index mammogram. In order to identify screening mammograms versus diagnostic mammograms, we performed a 12 month look back using 2009 data to exclude all women with a diagnosis for breast cancer or a breast cancer surgical procedure in the 12 months prior to the first 2010 mammogram and excluded patients with a mammogram or other breast cancer diagnostic procedure in the 9 months prior to the index mammogram (see methodology for coding logic). In order to evaluate breast diagnostic patterns after the screening mammogram, we required eligibility in 2011, thus all women were required to have eligibility in all of 2009-2011. Our study population of screening mammogram patients totaled approximately 1 million members presented in Table 1.

Table 1: MarketScan® Study Population Attrition Table

	Members	% of Total MarketScan®
Total MarketScan® 2010	38,555,033	100%
After standard exclusions (no pharmacy data or capitation)	25,671,134	67%
Eligibility all of 2009-2011 (eligible population)	9,659,067	25%
Women 30-64 years old in 2010 (target population)	3,046,073	8%
Having mammogram claim in 2010	1,152,872	3%
After excluding women with a breast imaging claim or biopsy within 9 months prior to screening mammogram or a claim coded with breast cancer or breast cancer surgery 12 months prior to index mammogram	1,072,018	2.8%

SOURCE: Milliman's Analysis of Truven MarketScan® commercial claims database for 2009-2011

Although the ACS guidelines recommend screening start at age 40, we included 30-39 year olds in our breast cancer screening analysis, as some high risk individuals may get screening at these ages. Table 2 shows the screening rate increasing with each age band with the 60-64 year old age band having 50.6% annual screening rate equivalent to 100% adherence based on an every other year screening recommendation. On a population basis, 10% of the total commercial population has a screening mammogram claim annually.

Table 2: Annual # Screening Mammogram Patients for an Illustrative 1 Million Member Commercial Plan

Member age band	# of women per 1,000,000 members*	# of screening mammogram patients per 1,000,000 members*	% distribution of all screening mammogram patients	% of women having a screening mammogram
30-34	40,191	993	1.0%	2.5%
35-39	41,610	4,472	4.4%	10.7%
40-44	43,992	17,446	17.1%	39.7%
45-49	47,539	21,058	20.7%	44.3%
50-54	47,337	22,395	22.0%	47.3%
55-59	41,052	19,989	19.6%	48.7%
60-64	30,764	15,563	15.3%	50.6%
Women 40-64	210,484 (21% of commercial population)	96,451 (10% of commercial population)	100.0%	34.8%

* Assuming standard commercial demographics
SOURCE: Milliman's Analysis of MarketScan® commercial claims database for 2009-2011

To investigate follow-on diagnostic practice patterns and cost, we followed all screening mammogram patients for 6 months after mammogram index date to identify relevant diagnostic imaging or breast biopsy. If no claims for any of these follow-on services were identified within 6 months of the screening mammogram, the episode ended and the woman was classified as having no further diagnostics. If a follow-on diagnostic claim was identified, we followed woman for 9 months from index screening mammogram or in the case of a breast biopsy, we looked forward two months for the presence of a breast cancer surgery claim. The frequency of follow-on diagnostic imaging, breast biopsy and breast cancer surgery appear in Table 3. 17% of women had subsequent diagnostics after initial screening mammogram and multiple combinations of diagnostic follow-on scenarios were observed. The rate of women with follow-on diagnostics, often referred to as "recall rates" was higher in our analysis than the 5%-14% reported in other studies.[9]

Table 3: Distribution of Screening Mammogram Patients - Illustrative 1 Million Member Commercial Plan

Diagnostic treatment pattern following initial screening mammogram (cohorts are mutually exclusive)	# of women in each diagnostic follow-on cohort following screening mammogram for 1,000,000 member plan*	% distribution of screening mammogram patients
Total Screening Mammogram Patients	**101,917**	**100 %**
- No relevant procedures in 6 months after initial screening mammogram	84,826	83.2%
- Diagnostic mammogram only	3,840	3.8%
- Sonogram	10,342	10.1%
- Sonogram – Biopsy	1,398	1.3%
- Sonogram - Biopsy - Surgery**	353	0.3%
- Sonogram – Surgery**	24	0.02%
- Sonogram - Advanced Imaging***	206	0.2%
- Sonogram - Advanced Imaging*** - Biopsy	56	0.06%
- Sonogram - Advanced Imaging*** - Biopsy - Surgery**	16	0.01%
- Sonogram - Advanced Imaging*** - Surgery**	5	-
- Advanced Imaging***	194	0.2%
- Advanced Imaging*** - Biopsy	19	0.02%
- Advanced Imaging*** - Biopsy - Surgery**	4	-
- Advanced Imaging*** - Surgery**	3	-
- Biopsy	525	0.5%
- Biopsy - Surgery**	99	0.1%
- Surgery**	6	-

Some patients in all of the cohorts, excluding the "no relevant procedures in 6 months after initial screening mammogram" cohort, may have had a diagnostic mammogram as part of the follow-on diagnostics
* Assumes standard demographics
** Surgery refers to breast cancer surgeries (i.e. lumpectomy/mastectomy)
*** Advanced Imaging includes: MRI, CT, PET, SPECT, and MBI/scintamammography
A procedure is listed in the diagnostic treatment pattern category only if it occurred in the indicated order:
Sonogram -> Advanced Imaging -> Breast Biopsy -> Surgery
For example, if a patient's first sonogram was performed after the first breast biopsy then that individual's pattern would be the "- Biopsy" group and not the "- Sonogram - Biopsy" group.
Numbers may not add to total due to rounding
SOURCE: Milliman's Analysis of MarketScan® commercial claims database for 2009-2011

The rate of follow-on diagnostics is provided in table 4 which is all inclusive and not just the first follow-on diagnostics shown in table 3. Sonogram is the highest utilized diagnostic followed by a diagnostic mammogram (mammogram following the initial screening mammogram). MRI is the most frequent advanced imaging

diagnostic. Breast biopsy was identified for 2.4% (2.2% for 40-64 year olds) of patients after a screening mammogram, which was higher than the rate reported by BCSC of 0.9% to 1.2% for women age 40-69.[2,11]

Table 4: Rate of Breast Cancer Screening Diagnostic Procedures Across all Screening Episodes

Diagnostic procedure	Procedures per million members (101,917 mammogram women)*	Average # of procedures per screening mammogram patient (30-64 year olds)
Initial Screening Mammogram	101,917	1.0
Repeat Mammogram	11,745	0.12
Breast Sonogram	14,443	0.14
Breast MRI	769	0.008
Breast MBI/Scintimammography	79	0.001
Breast CT	0.6	0.00001
Breast PET	2.3	0.00002
Breast SPECT	0.3	0.00000
Breast Biopsy	2,844	0.03
Total	**131,801**	**1.3**

* Assuming standard commercial demographics
SOURCE: Milliman's Analysis of MarketScan® commercial claims database for 2009-2011

The average cost of a breast cancer screening episode was $249.70 per screening mammogram patient, including the initial screening mammogram for 100% of the cases and subsequent breast cancer screening diagnostics for 17% of cases. (see table 5). The initial screening mammogram is the largest contributor (62%) while breast biopsy follows at 18%, sonogram at 8%, diagnostic mammogram at 7% and MRI at 4% of total screening episode costs.

Table 5: Allowed Cost of Breast Screening and Follow-on Diagnostics During a Breast Screening Episode

Diagnostic procedure	Average allowed cost per procedure*	Average allowed cost per all screening mammogram patients	Average allowed cost PMPM**	% of total breast cancer screening episode costs
Initial Screening Mammogram	$155.58	$155.58	$1.32	62.31%
Repeat Mammogram	$155.58	$17.93	$0.15	7.18%
Breast Sonogram	$146.25	$20.73	$0.18	8.30%
Breast MRI	$1,392.95	$10.51	$0.09	4.21%
Breast MBI/ Scintimammography	$305.57	$0.24	$0.00	0.10%
Breast CT	$241.50	$0.00	$0.00	0.00%
Breast PET	$2,143.65	$0.05	$0.00	0.02%
Breast SPECT	$739.07	$0.00	$0.00	0.00%
Breast Biopsy	$1,600.03	$44.65	$0.38	17.88%
Total		**$249.70**	**$2.12**	**100.0%**

* Related costs on the day of procedure have been included – see methodology for coding associated with related costs
** Assuming standard commercial demographics
***Patient cost sharing for screening mammogram is $0 since 2012 ACA legislation
SOURCE: Milliman's Analysis of MarketScan® commercial claims database for 2009-2011

The average PMPM for a standard commercial population is $347 PMPM and breast cancer screening episodes contribute $2.12 PMPM. For women age 30-64, breast cancer screening costs contribute an even greater portion to total costs: $7.25 PMPM out of $512.51 PMPM (see Table 6). With elimination of patient cost sharing and the passage of dense breast legislation, this amount is expected to increase.

Table 6: PMPM Contribution of Breast Cancer Screening Episodes

Population	PMPM total health expenditures	PMPM breast cancer screening episodes	PMPM initial Mammogram	PMPM follow on diagnostics
Standard commercial population	$347.17	$2.12	$1.32	$0.80
Only Females 30-64	$512.51	$7.25	$4.52	$2.73

SOURCE: Milliman's Analysis of MarketScan® commercial claims database for 2009-2011

BCSC aggregates data submitted by a broad range of radiologists across the US, and provides the largest reported experience involving mammography practice – experience for 1.8 million screening mammograms. Table 7 compares the MarketScan® experience to the BCSC experience for several quality metrics and shows a higher recall rate, higher biopsy rate and a lower rate of cancer detection after biopsy (higher "false positive" rate) in the MarketScan data compared with the BCSC data. The MarketScan® findings suggest opportunity for more efficient management of follow-on diagnostics.

Table 7: Recall Rate and PPV3 for Screening Mammography Patients Age 40-64

Member age band	MarketScan recall rate	BCSC recall rate	MarketScan biopsy rate	BCSC biopsy rate	MarketScan PPV3 rate	BCSC PPV3 rate
40-44	19.3%	12.5%	2.6%	0.9% (40-49)	12.3%	13.0%
45-49	17.5%	11.8%	2.4%		16.3%	19.2%
50-54	15.1%	10.0%	2.2%	1.1% (50-59)	20.5%	24.0%
55-59	12.8%	8.6%	2.0%		25.8%	30.1%
60-64	12.6%	8.2%	2.1%	1.2% (60-69)	31.3%	35.9%
Women 40-64	**15.5%**		**2.2%**		**20.4%**	

SOURCE: Milliman's Analysis of MarketScan® commercial claims database for 2009-2011
Breast Cancer Surveillance Consortium (BCSC) http://breastscreening.cancer.gov/data/performance/screening/2009/perf_age.html
Recall rate: portion of screening mammogram women having one or more follow-on diagnostics
PPV3: portion of breast biopsy women diagnosed with breast cancer – the BCSC PPV3 rate does not incude lobular carcinoma insitu (LCIS) cases- the MarketScan rate includes LCIS cases that result in mastectomy or partial mastectomy.
Surgical breast biopsies may remove a breast cancer lesion with no additional surgery required. In this analysis we considered surgical breast biopsies that were not followed by mastectomy or partial mastectomy codes to be biopsies that did not result in detection of breast cancer. Surgical breast biopsies were 18% of total biopsies.

We split women into 4 cohorts to distinguish frequency of biopsy and cancer detection rates with distinct follow-on diagnostic testing patterns (see Table 8). 91% of the biopsies were performed on women after basic follow-on imaging (diagnostic mammogram or sonogram) only. The rate of biopsies not followed by surgery, often referred to as "false positive rate", ranged from 78% to 86%.

Table 8: Rate of Biopsies and Subsequent Surgery by Breast Cancer Screening Cohort

Imaging received after initial screening mammogram	% distribution of screening mammogram patients	% of women having a biopsy	% distribution of biopsy patients	% of biopsies followed by surgery***	% of biopsies NOT followed by surgery
Patients receiving no further Imaging	83.4%	0.2%	5.5%	14.4%	85.6%
Patients receiving basic imaging* only	16.1%	13.6%	90.7%	19.3%	80.7%
Patients receiving Advanced imaging** not preceded by basic imaging*	0.2%	9.4%	0.8%	18.0%	82.0%
Patients receiving Advanced imaging** preceded by basic imaging*	0.3%	25.1%	3.1%	21.7%	78.3%
Total	**100.0%**	**2.4%**	**100.0%**	**19.1%**	**80.9%**

* Basic imaging includes a second mammogram or sonogram
** Advanced Imaging includes: MRI (90.3%) CT (0.1%), PET (0.3%), SPECT (0.1%), MBI/Scint (9.3%)
*** Surgery refers to breast cancer surgeries (i.e. lumpectomy/mastectomy)
SOURCE: Milliman's Analysis of MarketScan® commercial claims database for 2009-2011
Surgical breast biopsies may remove a breast cancer lesion with no additional surgery required. In this analysis we considered surgical breast biopsies that were not followed by mastectomy or partial mastectomy codes to be biopsies that did not result in detection of breast cancer. Surgical breast biopsies were 18% of total biopsies.

The rate of "surgical" biopsies as a portion of total biopsies has been reported to be a quality concern. Minimally invasive breast biopsy is recommended in most instances, using either a core needle or fine needle approach. An appropriate rate of surgical biopsies is suggested to be 5%-10% of all breast biopsies.[31] Our data indicates surgical breast biopsies to be 18% of total breast biopsies in this population. Table 9 provides the rate of types of biopsies with surgical biopsies having the highest cost.

Table 9: Average Allowed Biopsy Cost and Patient Distribution by Biopsy

Type of biopsy	Average allowed cost per diagnostic procedure *	Number of breast biopsies performed per 1,000,000 members (101,917 screening mammogram women)	% of total biopsies performed
Biopsy - Needle Core	$1,528.91	2,178	76.6%
Biopsy - Surgical	$2,281.04	503	17.7%
Biopsy - Fine Needle	$447.70	163	5.7%

* Related costs on the day of procedure are included in these figures
Costs are average 2010-2011
SOURCE: Milliman's Analysis of MarketScan® commercial claims database for 2009-2011
Surgical breast biopsies may remove a breast cancer lesion with no additional surgery required. In this analysis we considered surgical breast biopsies that were not followed by mastectomy or partial mastectomy codes to be biopsies that did not result in detection of breast cancer.

CONSIDERATIONS FOR PAYERS AND EMPLOYERS

This report presents recent cost estimates for screening mammography and the pattern of care and cost contribution of follow-on diagnostics, A high portion of screening mammography women receive follow-on diagnostics and the vast majority are not diagnosed with cancer. A wide range of follow-on treatment patterns are evident in the data. Clearly, efforts by payers to manage the cost and quality of screening mammography should extend to follow-on services.

Screening protocols for breast cancer are likely to evolve. There are disagreements over the appropriate age to begin screening average risk women and whether mammography is effective at reducing breast cancer mortality. This report does not address these issues but rather explores the patient pathways and costs associated with follow-on services.

Costs associated with breast cancer screening are expected to increase with ACA's elimination of cost sharing and the expected increase in use. Higher screening rates will drive higher follow-on diagnostic testing. Concerns over the risk of women with dense breasts will also likely increase follow–on diagnostic testing.

In order to examine the quality and value of breast cancer screening follow-on diagnostic testing, payers/employers can proactively:

- Watch for the emergence of best practices that can be used to benchmark experience.
- Review their own plan/employee experience to examine the rate of recall, biopsy rates, and evidence of subsequent cancer detection rates within their screened population.
- Analyze episodes of care for women who are recalled to identify follow-on testing practice patterns
- Analyze distribution of breast biopsy procedure types.
- Profile providers to identify potential outliers with respect to breast cancer screening episode of care practices and technologies used.
- Guidelines may change rapidly because of new evidence, new technologies, and emerging systems of care. We recommend reviewing coverage policies periodically to be consistent with emerging best practices.

As breast cancer screening guidelines change and breast cancer screening systems and technologies emerge, payers/employers should consider the impact on the quality and value of breast cancer screening episodes of care. Opportunities for reducing variation in breast cancer screening practice patterns should be evaluated.

APPENDIX A: METHODOLOGY

Data Source

Thomson Reuters MarketScan® claims data contains all paid claims generated by approximately 30 million commercially insured lives annually from approximately 100 private sector payers. The MarketScan® database represents the inpatient and outpatient healthcare service use of individuals nationwide who are covered by the benefit plans of large employers, health plans, government and public organizations. The MarketScan® database links paid claims and encounter data to detailed patient information across sites and types of providers, and over time. Member identification codes are consistent from year to year and allow for multiyear longitudinal studies. The database contains ICD-9-CM diagnosis codes; procedure codes and diagnosis-related group (DRG) codes; national drug codes (NDCs); and site of service information and the amounts allowed and paid by commercial insurers. For this study, we used MarketScan® 2009 through 2011.

To insure the data was representative of all paid claims for a commercially insured population, we limited the data to that generated by full time employees and their families under age 65, having pharmacy claims and we removed contributors with capitated services as claims may be incomplete.

Methodology

We identified all women having a mammogram in 2010. The first mammogram in 2010 was considered the index mammogram. In order to identify screening mammograms, we excluded all women with a diagnosis for breast cancer or a breast cancer surgical procedure in the 12 months prior to the index mammogram. We also excluded all patients with a mammogram or other breast cancer diagnostic procedure in the 9 months prior to the index screening mammogram. The remaining mammogram patients made up the screening mammography study cohort. We followed all screening mammogram patients for 6 months following mammogram index date to identify relevant diagnostic imaging or breast biopsy. If no claims for any of these follow-on services were identified within 6 months of the screening mammogram, the episode ended and the woman was classified as having no further diagnostics. If a follow-on diagnostic claim was identified, we followed the woman for 9 full months from index mammogram or in the case a breast biopsy claim was identified, we looked forward two months for the presence of a breast cancer surgery claim.

Coding on index mammogram

	Percent of total index mammograms coded with listed code:
ICD9 Procedure codes	
87.36 - Xerography Of Breast	0.0%
87.37 - Other Mammography	0.4%
HCPCS codes:	
77057 - Mammogram screening	24.0%
G0202 - Screening mammography digital, bilateral	68.5%
77055 - Mammogram one breast	0.2%
77056 - Mammogram both breasts	1.8%
G0204 - Diagnostic mammography digital, bilateral	6.0%
G0206 - Diagnostic mammography digital, unilateral	0.8%

Mammograms can be coded with multiple codes, so totals in table will add up to greater than 100% of total index mammograms

SOURCE: Milliman's Analysis of MarketScan® commercial claims database for 2009-2011

Prior Breast Cancer Diagnosis Exclusion codes	
ICD-9 diagnosis code	**Description**
174.x	Malignant neoplasm of female breast
233.0	Carcinoma in situ of breast

For diagnostic procedures noted with a "yes" in the "Require ICD9 Diagnosis Code?" column in the follow-on diagnostic tables below, we required the claim to be coded with one or more of the below ICD-9 diagnosis codes.

Codes for specifying breast related diagnostic procedures	
Dx code	**Description**
174x	Malignant neoplasm of female breast
19881	Secondary malignant neoplasm of breast
217	Benign neoplasm of breast
2330	Carcinoma in situ of breast
2383	Neoplasm of uncertain behavior of breast
2393	Neoplasm of unspecified nature of breast
610x	Benign mammary dysplasias
6117x	Signs and symptoms in breast
6118x	Other specified disorders of breast
6119x	Unspecified breast disorder
7866	Swelling, mass, or lump in chest
7938x	Nonspecific (abnormal) findings on radiological and other examination of breast
V103	Personal history of malignant neoplasm of breast
V163	Family history of malignant neoplasm of breast
V761x	Screening for malignant neoplasms of the breast

Breast Cancer Screening Follow-on Diagnostic Identification coding

Identification of Procedure			Additional costs to include on the same day			Code description
HCPCS	ICD-9 proc code	Require ICD-9 diagnosis code?	HCPCS	ICD-9 proc code	Rev code	
Mammogram						
77057		no				screening mammography, bilateral (2-view film study of each breast)
G0202		no				screening mammography, producing direct digital image, bilateral, all views
77055		no				mammography; unilateral
77056		no				mammography; bilateral
G0204		no				diagnostic mammography, producing direct digital image, bilateral, all views
G0206		no				diagnostic mammography, producing direct digital image, unilateral, all views
	87.36	no				xerography of breast
	87.37	no				other mammography
			77052			computer-aided detection (computer algorithm analysis of digital image data for lesion detection) with further review for interpretation, with or without digitization of film radiographic images; screening mammography (list separately in addition to code for primary procedure)
			77051			computer-aided detection (computer algorithm analysis of digital image data for lesion detection) with further review for interpretation, with or without digitization of film radiographic images; diagnostic mammography (list separately in addition to code for primary procedure)
					0401	other imaging services - diagnostic mammography
					0403	other imaging services - screening mammography
Breast Sonogram						
76645		no				ultrasound, breast(s) (unilateral or bilateral), real time with image documentation
			3014F			screening mammography results documented and reviewed (pv)
			76377			3d rendering with interpretation and reporting of computed tomography, magnetic resonance imaging, ultrasound, or other tomographic modality with image postprocessing under concurrent supervision; requiring image postprocessing on an independent workstation
			76376			3d rendering with interpretation and reporting of computed tomography, magnetic resonance imaging, ultrasound, or other tomographic modality with image postprocessing under concurrent supervision; not requiring image postprocessing on an independent workstation
				88.73		diagnostic ultrasound of other sites of thorax

Identification of Diagnostic			Add-on costs			
HCPCS	ICD-9 Proc	Require ICD9 Diagnosis Code?	HCPCS	ICD-9 Proc	Rev Code	Code Description
Breast MRI						
77058		no				magnetic resonance imaging, breast, without and/or with contrast material(s); unilateral
77059		no				magnetic resonance imaging, breast, without and/or with contrast material(s); bilateral
C8903		no				magnetic resonance imaging with contrast, breast; unilateral
C8904		no				magnetic resonance imaging without contrast, breast; unilateral
C8905		no				magnetic resonance imaging without contrast followed by with contrast, breast; unilateral
C8906		no				magnetic resonance imaging with contrast, breast; bilateral
C8907		no				magnetic resonance imaging without contrast, breast; bilateral
C8908		no				magnetic resonance imaging without contrast followed by with contrast, breast; bilateral
			0159T			computer-aided detection, including computer algorithm analysis of mri image data for lesion detection/characterization, pharmacokinetic analysis, with further physician review for interpretation, breast mri (list separately in addition to code for primary procedure)
			76376			3d rendering with interpretation and reporting of computed tomography, magnetic resonance imaging, ultrasound, or other tomographic modality with image postprocessing under concurrent supervision; not requiring image postprocessing on an independent workstation
			76377			3d rendering with interpretation and reporting of computed tomography, magnetic resonance imaging, ultrasound, or other tomographic modality with image postprocessing under concurrent supervision; requiring image postprocessing on an independent workstation
				88.92		magnetic resonance imaging of chest and myocardium

Identification of Diagnostic			Add-on costs			
HCPCS	ICD-9 Proc	Require ICD9 Diagnosis Code?	HCPCS	ICD-9 Proc	Rev Code	Code Description
PET or PET/CT						
78811		yes				positron emission tomography (pet) imaging; limited area (eg, chest, head/neck)
78814		yes				positron emission tomography (pet) with concurrently acquired computed tomography (ct) for attenuation correction and anatomical localization imaging; limited area (eg, chest, head/neck)
			76376			3d rendering with interpretation and reporting of computed tomography, magnetic resonance imaging, ultrasound, or other tomographic modality with image postprocessing under concurrent supervision; not requiring image postprocessing on an independent workstation
			76377			3d rendering with interpretation and reporting of computed tomography, magnetic resonance imaging, ultrasound, or other tomographic modality with image postprocessing under concurrent supervision; requiring image postprocessing on an independent workstation
				92.19		scan of other sites
Scint						
78800		yes				radiopharmaceutical localization of tumor or distribution of radiopharmaceutical agent(s); limited area
78801		yes				radiopharmaceutical localization of tumor or distribution of radiopharmaceutical agent(s); multiple areas
76499		yes				unlisted diagnostic radiographic procedure
S8080		no				scintimammography (radioimmunoscintigraphy of the breast), unilateral, including supply of radiopharmaceutical
			A9500			technetium tc-99m sestamibi, diagnostic, per study dose
				92.19		scan of other sites
Breast SPECT						
78803		yes				radiopharmaceutical localization of tumor or distribution of radiopharmaceutical agent(s); tomographic (spect)
			A9541			technetium tc-99m sulfur colloid, diagnostic, per study dose, up to 20 millicuries
				92.19		scan of other sites

Identification of Diagnostic			Add-on costs			
HCPCS	ICD-9 Proc	Require ICD9 Diagnosis Code?	HCPCS	ICD-9 Proc	Rev Code	Code Description
Computed Tomgraphy						
76380		yes				computed tomography, limited or localized follow-up study
76497		yes				unlisted computed tomography procedure (eg, diagnostic, interventional)
Fine needle aspiration breast biopsy						
10021		yes				fine needle aspiration; without imaging guidance
10022		yes				fine needle aspiration; with imaging guidance
Core Needle Biopsy						
19100		no				biopsy of breast; percutaneous, needle core, not using imaging guidance (separate procedure)
19102		no				biopsy of breast; percutaneous, needle core, using imaging guidance
19103		no				biopsy of breast; percutaneous, automated vacuum assisted or rotating biopsy device, using imaging guidance
	85.11	no				closed [percutaneous] [needle] biopsy of breast
Surgical Breast Biopsy						
19101		no				biopsy of breast; open, incisional
19120		no				excision of cyst, fibroadenoma, or other benign or malignant tumor, aberrant breast tissue, duct lesion, nipple or areolar lesion (except 19300), open, male or female, 1 or more lesions
19125		no				excision of breast lesion identified by preoperative placement of radiological marker, open; single lesion
19126		no				excision of breast lesion identified by preoperative placement of radiological marker, open; each additional lesion separately identified by a preoperative radiological marker (list separately in addition to code for primary procedure)
	85.12	no				open biopsy of breast
	85.21	no				local excision of lesion of breast

Identification of Diagnostic			Add-on costs			
HCPCS	ICD-9 Proc	Require ICD9 Diagnosis Code?	HCPCS	ICD-9 Proc	Rev Code	Code Description
			For all breast biopsies			
			76098			radiological examination, surgical specimen
			19290			preoperative placement of needle localization wire, breast
			19291			preoperative placement of needle localization wire, breast; each additional lesion (list separately in addition to code for primary procedure)
			19295			image guided placement, metallic localization clip, percutaneous, during breast biopsy/aspiration (list separately in addition to code for primary procedure)
			76942			ultrasonic guidance for needle placement (eg, biopsy, aspiration, injection, localization device), imaging supervision and interpretation
			77002			fluoroscopic guidance for needle placement (eg, biopsy, aspiration, injection, localization device)
			77012			computed tomography guidance for needle placement (eg, biopsy, aspiration, injection, localization device), radiological supervision and interpretation
			77021			magnetic resonance guidance for needle placement (eg, for biopsy, needle aspiration, injection, or placement of localization device) radiological supervision and interpretation
			77031			stereotactic localization guidance for breast biopsy or needle placement (eg, for wire localization or for injection), each lesion, radiological supervision and interpretation
			77032			mammographic guidance for needle placement, breast (eg, for wire localization or for injection), each lesion, radiological supervision and interpretation

In some cases, surgical breast biopsies remove a breast cancer lesion which does not require additional mastectomy. In this anlaysis we considered surgical breast biopsies that were not followed by mastectomy or partial mastectomy codes to be biopsies that did not result in detection of breast cancer.

Identification of Procedure			Add-on costs			
HCPCS	ICD-9 Proc	Require ICD9 Diagnosis Code?	HCPCS	ICD-9 Proc	Rev Code	Code Description
Mastectomy or Partial Mastectomy						
19301		no				mastectomy, partial (eg, lumpectomy, tylectomy, quadrantectomy, segmentectomy)
19302		no				mastectomy, partial (eg, lumpectomy, tylectomy, quadrantectomy, segmentectomy); with axillary lymphadenectomy
19305		no				mastectomy, radical, including pectoral muscles, axillary lymph nodes
19306		no				mastectomy, radical, including pectoral muscles, axillary and internal mammary lymph nodes (urban type operation)
19307		no				mastectomy, modified radical, including axillary lymph nodes, with or without pectoralis minor muscle, but excluding pectoralis major muscle
	85.22	no				resection of quadrant of breast
	85.23	no				subtotal mastectomy
	85.43	no				unilateral extended simple mastectomy
	85.44	no				bilateral extended simple mastectomy
	85.45	no				unilateral radical mastectomy
	85.46	no				bilateral radical mastectomy
	85.47	no				unilateral extended radical mastectomy
	85.48	no				bilateral extended radical mastectomy
19303*		no				mastectomy, simple, complete
19304*		no				mastectomy, subcutaneous
	85.41*	no				unilateral simple mastectomy
	85.42*	no				bilateral simple mastectomy

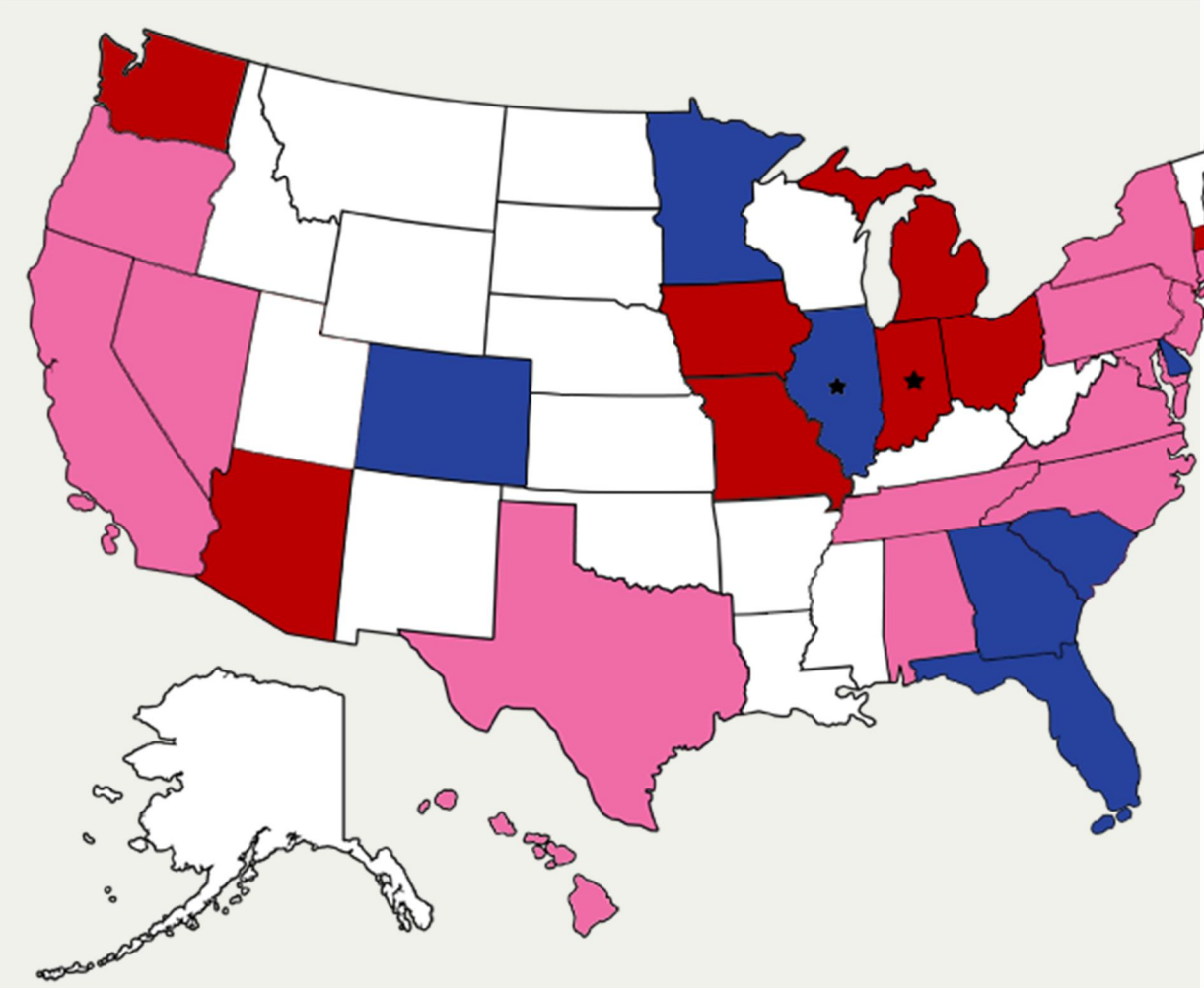
* These surgeries are often done for breast cancer risk reduction without evidence of breast cancer. To insure women with these surgical claims truly have breast cancer we require the patient to have 2+ claims code with either axillary node sampling or chemotherapy or radiation therapy within 2 months of the claim (prior to for neoadjuvant or after for non neo-adjuvant) in order to be considered a mastectomy.

Identification of breast cancer for those having breast cancer surgeries 19303, 19304, 85.41, 85.42			
HCPCS	**ICD-9 Proc**	**Hospital Revenue Code**	**Code Description**
Axillary Node Sampling			
38500			biopsy or excision of lymph node(s); open, superficial
38505			biopsy or excision of lymph node(s); by needle, superficial (eg, cervical, inguinal, axillary)
38525			biopsy or excision of lymph node(s); open, deep axillary node(s)
38740			axillary lymphadenectomy; superficial
38745			axillary lymphadenectomy; complete
	40.23		excision of axillary lymph node
	40.3		regional lymph node excision
	40.51		radical excision of axillary lymph nodes
Radiation Therapy			
77261-77263			Therapeutic Radiology: Treatment Planning
77280-77299			Radiation Therapy Simulation
77300-77370			Radiation Physics Services
77371-77399			Stereotactic Radiosurgery (SRS) Planning and Delivery
77401-77417			Radiation Treatment
77418			IMRT Delivery
77421			Stereoscopic Imaging Guidance
77422-77423			Neutron Therapy
77427-77499			Radiation Therapy Management
77520-77525			Proton Therapy
77600-77620			Hyperthermia Treatment
77750-77799			Brachytherapy
		333	radiology - therapeutic and/or chemotherapy administration- RT
Oral Chemotherapy			
NDC code list available upon request			
J8510			oral busulfan
J8520			capecitabine, oral, 150 mg
J8521			capecitabine, oral, 500 mg
J8530			cyclophosphamide oral 25 mg
J8560			etoposide oral 50 mg
J8561			oral everolimus
J8565			gefitinib oral
J8600			melphalan oral 2 mg
J8610			methotrexate oral 2.5 mg
J8700			temozolomide
J8705			topotecan oral
J8999			oral prescription drug chemo

Infused Chemotherapy			
J9000-J9999			

States with Dense Breast Legislation

2014 Dense Breast Legislation State Efforts from: http://www.areyoudenseadvocacy.org/dense/
States with mandatory dense breast notification law and introduced bills



PINK: Enacted Law — RED: Introduced Bill — BLUE: Working on Bill — WHITE: No Action — BLACK ★: Insurance Coverage Law

REFERENCES

1. American Cancer Society. Chronological History of ACS Recommendations for the Early Detection of Cancer in Asymptomatic People. 2013; Chronological History of ACS Recommendations for the Early Detection of Cancer in Asymptomatic People. Available at: http://www.cancer.org/healthy/findcancerearly/cancerscreeningguidelines/chronological-history-of-acs-recommendations. Accessed January 9, 2014.
2. Harris JR. *Diseases of the breast*. 4th ed. Philadelphia: Lippincott Williams & Wilkins; 2010.
3. National Cancer Institute SEER Breast Cancer Facts. http://seer.cancer.gov/statfacts/html/breast.html. Accessed January 14, 2014.
4. National Committee for Quality Assurance. *State of Health Care Quality Report*: NCQA;2013.
5. United States Preventative Services Task Force. USPSTF Services for ACA. 2013; http://www.uspreventiveservicestaskforce.org/uspstf/uspsabrecs.htm#dag. Accessed January 14, 2014.
6. Cappello NM. Decade of 'normal' mammography reports-the happygram. *Journal of the American College of Radiology : JACR.* Dec 2013;10(12):903-908.
7. Dehkordy SF, Carlos RC. Dense breast legislation in the United States: state of the States. *Journal of the American College of Radiology : JACR.* Dec 2013;10(12):899-902.
8. Rosenberg RD, Yankaskas BC, Abraham LA, et al. Performance benchmarks for screening mammography. *Radiology.* Oct 2006;241(1):55-66.
9. Rauscher GH, Murphy AM, Orsi JM, Dupuy DM, Grabler PM, Weldon CB. Beyond the mammography quality standards act: measuring the quality of breast cancer screening programs. *AJR. American journal of roentgenology.* Jan 2014;202(1):145-151.
10. Gross CP, Long JB, Ross JS, et al. The cost of breast cancer screening in the Medicare population. *JAMA internal medicine.* Feb 11 2013;173(3):220-226.
11. National Cancer Institute. Performance Benchmarks for Screening Mammography. 2009; http://breastscreening.cancer.gov/data/benchmarks/screening/. Accessed February 13, 2014.
12. Nelson HD, Tyne K, Naik A, et al. Screening for breast cancer: an update for the U.S. Preventive Services Task Force. *Annals of internal medicine.* Nov 17 2009;151(10):727-737, W237-742.
13. Nelson HD, Tyne K, Naik A, et al. *Screening for Breast Cancer: Systematic Evidence Review Update for the US Preventive Services Task Force*. Rockville (MD)2009.
14. Howlader N NA, Krapcho M, Garshell J, Neyman N, Altekruse SF, Kosary CL, Yu M, Ruhl J, Tatalovich Z, Cho H, Mariotto A, Lewis DR, Chen HS, Feuer EJ, Cronin KA (eds). SEER Cancer Statistics Review, 1975-2010. 2013; based on November 2012 SEER data submission: http://seer.cancer.gov/csr/1975_2010/.
15. Konski A. Clinical and economic outcomes analyses of women developing breast cancer in a managed care organization. *American journal of clinical oncology.* Feb 2005;28(1):51-57.
16. United States Preventative Services Task Force Breast Screening Recommendations 2009. 2009. http://www.uspreventiveservicestaskforce.org/uspstf/uspsbrca.htm. Accessed January 14, 2014.
17. Howard DH, Adams EK. Mammography rates after the 2009 US Preventive Services Task Force breast cancer screening recommendation. *Preventive medicine.* Nov 2012;55(5):485-487.
18. Mitka M. Physicians, patients not following advice from USPSTF on mammography screening. *JAMA : the journal of the American Medical Association.* May 22 2013;309(20):2084.
19. Bevers TB, Anderson BO, Bonaccio E, et al. NCCN clinical practice guidelines in oncology: breast cancer screening and diagnosis. *Journal of the National Comprehensive Cancer Network : JNCCN.* Nov 2009;7(10):1060-1096.
20. American College of Radiology. BI-RADS Mammography, Fourth Edition - Guidance Chapter. 2003.
21. American College of Radiology. ACR appropriateness criteria: screening mammography. 2013.
22. Yankaskas BC, Cleveland RJ, Schell MJ, Kozar R. Association of recall rates with sensitivity and positive predictive values of screening mammography. *AJR. American journal of roentgenology.* Sep 2001;177(3):543-549.
23. American College of Radiology. BI-RADS Analysis of Medical Audit Data: Desirable Goals. *BI-RADS® – Mammography, Fourth Edition* 2003; http://www.acr.org/~/media/ACR/Documents/PDF/QualitySafety/Resources/BIRADS/MammoAudit.pdf. Accessed January 11, 2014.
24. Smith-Bindman R, Chu PW, Miglioretti DL, et al. Comparison of screening mammography in the United States and the United kingdom. *JAMA : the journal of the American Medical Association.* Oct 22 2003;290(16):2129-2137.

25. Carney PA, Sickles EA, Monsees BS, et al. Identifying minimally acceptable interpretive performance criteria for screening mammography. *Radiology.* May 2010;255(2):354-361.
26. Arleo EK, Dashevsky BZ, Reichman M, Babagbemi K, Drotman M, Rosenblatt R. Screening mammography for women in their 40s: a retrospective study of the potential impact of the U.S. Preventive Service Task Force's 2009 breast cancer screening recommendations. *AJR. American journal of roentgenology.* Dec 2013;201(6):1401-1406.
27. Elmore JG, Barton MB, Moceri VM, Polk S, Arena PJ, Fletcher SW. Ten-year risk of false positive screening mammograms and clinical breast examinations. *The New England journal of medicine.* Apr 16 1998;338(16):1089-1096.
28. Levy AR, Bruen BK, Ku L. Health care reform and women's insurance coverage for breast and cervical cancer screening. *Preventing chronic disease.* 2012;9:E159.
29. Hooley RJ, Greenberg KL, Stackhouse RM, Geisel JL, Butler RS, Philpotts LE. Screening US in patients with mammographically dense breasts: initial experience with Connecticut Public Act 09-41. *Radiology.* Oct 2012;265(1):59-69.
30. Weigert J, Steenbergen S. The connecticut experiment: the role of ultrasound in the screening of women with dense breasts. *The breast journal.* Nov-Dec 2012;18(6):517-522.
31. Gutwein LG, Ang DN, Liu H, et al. Utilization of minimally invasive breast biopsy for the evaluation of suspicious breast lesions. *American journal of surgery.* Aug 2011;202(2):127-132.