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Cost-Effectiveness of Screening Mammography Beyond Age 75 Years

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Abstract

Background: The cost-effectiveness of screening mammography beyond age 75 years remains unclear.

Objective: Estimate benefits, harms, and cost-effectiveness of extending mammography to age 80, 85, or 90 years according to comorbidity burden.

Design: Markov microsimulation model.

Data Sources: Surveillance, Epidemiology, and End Results Program and Breast Cancer Surveillance Consortium.

Target Population: U.S. women age 65 to 90 years in groups defined by Charlson comorbidity score (CCS)

Time Horizon: Lifetime

Perspective: National health payer

Interventions: Screening mammography to ages 75, 80, 85, or 90 years

Outcome Measures: Breast cancer death, survival, costs.

Results of Base Case Analysis: Extending biennial mammography from age 75 to 80 years averted 1.7, 1.4 and 1.0 breast cancers and increased days of life gained by 5.8, 4.2, and 2.7 days per 1000 women for comorbidity scores 0, 1, and 2. Extending biennial mammography to age 80 was cost-effective ($54,000, $65,000, and $85,000 per QALY gained for women with CCS of 0, 1, and   2 respectively). Overdiagnosis cases were double the number of deaths averted from breast cancer. Annual mammography beyond age 75 years was not cost-effective.

Results of Sensitivity Analysis: Costs per QALY gained were sensitive to changes in invasive cancer incidence and shift of breast cancer stage with screening mammography.

Limitations: No randomized controlled trials of screening mammography beyond age 75 are available to provide model parameter inputs.

Conclusion: Although annual mammography is not cost-effective, biennial screening mammography to age 80 is cost-effective, but the absolute number of deaths averted is small especially for women with comorbidities. Women considering screening beyond age 75 should weigh the potential harms of overdiagnosis versus the potential benefit of averting death from breast cancer.

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Introduction

The U.S. Preventive Services Task Force (USPSTF) recommends biennial screening mammography through age 74 years, but considers evidence to be insufficient to recommend screening beyond that age (1). A meta-analysis of randomized controlled trials estimated screening mammography reduces breast cancer mortality for women with life expectancy 10 years (2), and American Cancer Society guidelines recommend screening mammography be continued for these individuals (3). Previous studies estimated biennial screening mammography between ages 70 to 79 years mildly reduced breast cancer death at reasonable cost (4–8). Mandelblatt and colleagues estimated that 25% of women at age 85 have a life expectancy exceeding 9.5 years (8), and that extending breast cancer screening beyond age 80 might be reasonable for particularly healthy women.

Landsorp-Vogelaar and colleagues concluded that extending biennial screening mammography to age 78 is cost-effective for women with no comorbid conditions but stopping screening at age 70 for women with moderate comorbidity would be appropriate (9) assuming that harms or benefits of screening mammography should be similar to persons with average health having screening up to age 74. Moreover, this study did not estimate the effect of comorbidity on the cost-effectiveness of annual mammography, the most common screening frequency among U.S women (10–12).

Our objective was to estimate the cost-effectiveness of extending screening mammography beyond age 75 to age 80, 85, or 90 years according to Charlson comorbidity score and biennial and annual screening frequencies.

Methods

Clinical Strategies

Among women aged 65 years and older without a previous diagnosis of ductal carcinoma in situ (DCIS) or invasive breast cancer, we compared annual or biennial mammography screening from age 65 to 75 years, 80 years, 85 years, and 90 years across comorbidity levels.

Natural History of Breast Cancer Model

We adapted a previously published Markov model of the natural history of breast cancer and its association with breast density as an annual risk of progression among six possible health states: healthy (no breast cancer or DCIS but with possible co-morbidities), DCIS, localized invasive breast cancer, regional breast cancer, distant breast cancer, and dead (Figure 1)(7). Using a national health payer perspective, the microsimulation model tracks costs and survival for a cohort of 65-year old individuals in one year intervals (Markov cycle length) over time with a lifetime horizon (maximum age 100 years). Each individual starts in the "Healthy" state and most likely remains breast cancer free over a year but may develop DCIS or local, regional, or distant invasive breast cancer (diagnosed by screening or clinical examination) or die of causes other than breast cancer. In following yearly cycles, if she had developed DCIS, she can remain in this state or develop an invasive breast cancer, or die of causes other than breast cancer. If she had developed local, regional, or distant invasive breast cancer, she may remain in that state or die from breast cancer or other causes. The simulation continues until that individual has died or reaches age 100 years. By repeating this simulation 1,000,000 times, the analysis provides estimates of the life expectancy and costs for each strategy.

Data Inputs

Model data inputs are based on costs, health benefits and harms, and mortality as functions of breast cancer stage at the time of diagnosis and years since diagnosis.

DCIS and Breast Cancer Incidence Rates—We estimated the 2011–2016 incidence of DCIS and invasive breast cancer by age from SEER 18 registry using Seer*Stat(13) (version 8.3.6, see Technical Appendix pages 4–7). The model assumed that individuals with DCIS have a 1.9-fold higher risk of subsequent invasive breast cancer than those without DCIS (14, 15).

Relative Risk of Mortality due to Breast Cancer—SEER Registry 13 provided the relative risks of mortality in women with invasive breast cancer versus the age-matched US female general population. SEER reports relative survival based on tumor stage at the time of diagnosis, so these survival data incorporate subsequent potential progressive disease (localized at diagnosis but subsequent transition to more advanced stages), and also reflect prevalent clinical treatments occurring from 1992 to 2016 (see Technical Appendix Tables 5a – 5c, pages 10–11).

All-Cause Population Mortality Rate—The age-specific all-cause death rates for each year of age from 65–100 years were calculated from 2015 US Life Tables for U.S. females (16). We used BCSC data linked to Medicare claims to estimate the relative risk of competing non-breast cancer mortality by comorbidity score in US women undergoing screening mammography (17). Comorbidity was evaluated at the time of the index screening mammogram from linked Medicare claims using the the Charlson Comorbidity Score (CCS) and categorized as 0, 1, or 2 (17–19).

Direct Costs of Breast Cancer Care—SEER-Medicare linked databases were used to estimate health care costs for breast cancer for the initial year after diagnosis, the final year before breast cancer death (terminal phase), and the intervening years (continuing phase) (20, 21), stratified by breast cancer stage at the time of diagnosis. These were updated to 2019 US dollars using the Centers for Medicare and Medicaid Services (CMS) inflation factors (Table 1; details provided in Technical Appendix).

Loss of Quality of Life due to Breast Cancer—The loss of quality of life for DCIS and invasive breast cancers compared to the healthy state was estimated using data of Lidgren and colleagues (Table 1, further details in Technical Appendix) (22). We performed secondary analyses using the same breast cancer disutility scores in Cancer Intervention and Surveillance Modeling Network (CISNET) models.(20, 23)

Benefits and Harms of Screening Mammography

Shift of Invasive Breast Cancer Stage at Time of Diagnosis with vs without Screening Mammography—Without any randomized controlled trials of screening mammography beyond age 75, our model estimates the health care costs and survival benefit of screening by assuming that screening would lead to detection of invasive breast cancer at earlier stages of disease. More frequent mammographic screening increased the likelihood of invasive breast cancers that were local stage at diagnosis, with correspondingly smaller proportions of regional or distant stage (Table 1). Localized breast cancer was associated with lower subsequent health care costs and breast cancer mortality than more advanced stages.

The stage distribution for invasive breast cancer among women age 66–94 receiving screening mammography were estimated based on BCSC data from 1996–2016 (Table 1). Women whose last mammogram was 9–17 months prior to diagnosis were used to estimate stage distribution for annual screening (mean interval 13.7 months [Supplemental Figure 1]); we set a lower bound of 9 months to exclude diagnostic mammograms following presumably previously abnormal mammograms. Women whose last mammogram was 18–30 months prior to diagnosis were used to estimate stage distribution for biennial screening (mean interval 23.0 months). These stage distributions included women whose breast cancer was detected by screening mammography and those whose breast cancer was diagnosed on self- or clinical exam followed by diagnostic mammography or other imaging and did not vary by comorbidity level (12).

We used SEER registry 9 data from 1973–1979, before screening mammography was introduced, to estimate the stage distribution of women not receiving mammography.

Proportions and Rates of False Positive and True Positive Screening Mammograms—We used BCSC data from 1999–2016 to estimate rates of breast biopsy procedures (fine needle aspiration, core biopsy, and surgical biopsy) and proportions of screening mammograms that yielded true positive and false positive results, stratified by age group (ages 66–74, 75–84, and 85–94), mammography frequency, and CCS (see Technical Appendix). We defined a Breast Imaging Reporting and Data System (BIRADS) assessment

of 0 (incomplete), 3, 4, or 5 followed by no diagnosis of breast cancer within the following 12 months as false-positives because they require additional examinations (24).

Costs and Disutility of Screening Mammography and Work-Up of False- and True-Positive Mammograms—We assumed the cost of screening mammography to be the National US Medicare allowable charge ($151.19) for 2019 (25). We used the cost estimates of Lowry and colleagues for work-up of true-positive and false-positive mammograms (20), and CMS inflation factors to update these to 2019 US dollars.

We assigned a disutility of 0.006 for one week (one-time deductions of −1 hour) for each screening mammogram exam, and a disutility of 0.105 for five weeks (−88 hours) if diagnostic evaluation of an abnormal screening mammogram was required (26).

Overdiagnosis—For the base case analyses, we assumed that DCIS discovered while receiving mammography compared to no mammography is a marker of higher risk of invasive breast cancer arising from anywhere in breast tissue (see Technical Appendix for details). (27, 28). We considered the excess cases of DCIS found when screening mammography is extended five years to be cases of overdiagnosis. We conducted secondary analyses assuming that 5% of invasive breast cancers are also instances of overdiagnosis. Finally, we performed secondary analyses assuming that only 20% of the excess incidence of DCIS from screening represents overdiagnosis, and that for the other 80% surgical excision of the DCIS lesion would prevent progression to invasive breast cancer.

Model Calculations

Lifetime outcomes tracked for each of the strategies were costs, life years gained, quality-adjusted life years (QALYs) gained, and cumulative incidences of DCIS, invasive breast cancer, and false-positive mammograms requiring a biopsy. We calculated absolute differences in breast cancer deaths, DCIS cases, one or more biopsies after false-positive mammograms, number needed to screen to prevent one breast cancer death, and the costs per QALY gained by extending the screening mammography stop age from 75 to 80, from 80 to 85, and from 85 to 90 years. All costs and health benefits were discounted at 3% per year.

Separate primary analyses were done for biennial and annual mammography each with CCS set to 0, 1, or 2. These, as well as univariate sensitivity analyses, were run as microsimulations, where 1,000,000 hypothetical individuals were simulated one at time (7).

Sensitivity Analyses—We ran univariate sensitivity analyses for biennial mammography in women with a CCS of 1. We varied direct medical costs of breast cancer, DCIS incidence, invasive breast cancer incidence, breast cancer mortality, disutility of breast cancer, cost of screening mammography, stage shift from regional to localized cancer with screening vs no screening, proportions of mammograms that yield false-positive results, and disutility of a false-positive mammogram over ranges shown in Supplement Table 1.

Probabilistic sensitivity analyses were run for all of the primary and secondary analyses as 500 simulations with 40,000 trials per simulation. For each simulation, input parameters

were randomly selected from the distributions shown in Supplement Table 1, except for the cost of screening mammography, which was fixed at the base case cost of $151.19. These analyses were used to provide estimates of uncertainty around model outcomes, presented as the 10th and 90th percentiles of the outcome distributions.

Model Validation—To assess potential bias from model miscalibration, we employed five model runs using the Stop Age 75 strategy to compare the cumulative incidence of invasive breast cancer between ages 65 and 90, and life expectancy for average risk 65 year-old women to published data not used to construct the model. Our estimates of the cumulative incidence of invasive breast cancer between ages 65 and 90 years ranged from 7.82% to 7.9%, very close to the cumulative incidence estimate of 7.8% of the NCI Breast Cancer Risk Assessment Tool (29). The average life expectancy according to Social Security actuarial tables for US women age 65 in 2015 was 20.49 years (16); the range of life expectancy predicted by our model at age 65 ranged from 20.55 to 20.57 years.

Role of the Funding Source

This study was funded by the National Cancer Institute, which had no role in the design, data collection or analysis, interpretation of the study results, or in the decision to submit the manuscript for publication.

Results

Biennial Mammography

Extending biennial mammography from age 75 to 80 for women with a CCS of 0 reduced breast cancer deaths by 1.7 per 1000 screened women (Table 2), increased life expectancy by 5.8 days per individual woman, and cost less than $100,000 per quality adjusted life year gained (Figure 2 and Supplemental Table 2). These health benefits were lower for women with a CCS of 1 (1.4 averted breast cancer deaths per 1000 women and 4.2 days of additional life per individual woman), and lower still for those with a CCS of 2 (1.0 averted breast cancer death per 1000 women and 2.7 days of additional life per individual woman). Extending screening mammography also increased lifetime DCIS incidence and the proportion of women requiring a biopsy following a false-positive mammogram. The cumulative incidence of these harms decreased with increasing comorbidity score, but not as much as health benefits. Overdiagnosis was higher than deaths averted from breast cancer at 3.2, 2.8, and 2.2 per 1,000 women screened among those with a CCS 0, 1, and 2, respectively. Similarly, the number of false-positive biopsies for each averted breast cancer death was 8.9, 10.1, and 12.5, respectively, among those with CCS 0, 1, and 2.

Fewer breast cancer deaths were averted by extending mammography to age 85 years, and especially to 90 (Table 2) and the costs per QALY gained were much higher (Figure 2, Supplemental Table 2).

Annual Mammography

Annual mammography reduced breast cancer deaths slightly more than did biennial mammography but there was a greater burden of overdiagnosis, exceeding the number

of averted breast cancer deaths by nearly 2.5-fold (Table 2). More biopsies were required to work-up false-positive mammograms (14.4, 16.7, and 20.3 per averted breast cancer death, respectively, among those with CCS 0, 1, and 2). Extending annual mammography stopping age from 75 to 80 years cost more than $100,000 per QALY gained for women for all levels of comorbidity (Figure 2 and Supplemental Table 2). Further incremental health benefit gains were much lower when extending annual screening mammography to age 85 and especially to age 90.

Sensitivity Analyses

The cost-effectiveness of biennial screening mammography was moderately sensitive to changes in breast cancer incidence and the magnitude of invasive breast cancer stage shift from regional to local with screening mammography vs. no mammography, and mildly sensitive to changes in mammography screening costs, costs of breast cancer, and false positive disutility (Figure 3, Supplemental Figure 2). Assuming a willingness to pay threshold of $100,000 per QALY gained, probabilistic sensitivity analyses showed that stopping biennial mammography at ages 75 and 80 was preferred in 10% and 51% of simulations for women with CCS of 0, and 17% and 59% of women with CCS of 1 (Supplement Figure 3). For women with a CCS of 2, stopping biennial mammography at age 75 and age 80 was preferred in 35% and 51% of simulations, respectively. For annual screening mammography, probabilistic sensitivity analyses showed that stopping mammography at age 75 was preferred in 68%, 85%, and 95% of simulations, respectively, for women with CCS of 0, 1, or 2 (Supplement Figure 4).

Secondary Analyses

Assuming that 5% of invasive breast cancers are instances of overdiagnosis, extending biennial screening from age 75 to 80 was associated with 4.0 overdiagnoses per 1000 women with a CCS of 0, 3.3 overdiagnoses per 1000 women with a CCS of 1, and 2.7 overdiagnoses per 1000 women with a CCS of 2; these values are 18% to 25% higher than when only excess cases of DCIS are considered to be overdiagnosis.

The costs per QALY gained by extending biennial mammography stop age from 75 to 80 years remained under $100,000 for women with CCS 0 or 1, but now exceeded $100,000 for women with CCS of 2 (Supplement Table 3).

When the DCIS and invasive breast cancer quality of life values from CISNET breast cancer models were employed, the costs per QALY gained by extending mammography from age 75 to 80 years were slightly higher than for the base case but remained under $100,000. (Supplement Table 4). If 80% of the excess risk of invasive breast cancer in those with DCIS compared to no DCIS is averted by surgical treatment of DCIS, then the costs per QALY gained by extending mammography beyond age 75 are slightly lower, and estimated overdiagnosis is also substantially reduced (Supplement Table 5)

Discussion

Our analyses show extending biennial screening mammography from age 75 to 80 years is associated with a small absolute number of breast cancer deaths averted (1.7, 1.4, and

1.0 per 1000 women) and minor gains in life expectancy. These small gains from screening are accompanied by DCIS overdiagnosis and additional invasive biopsies triggered by false-positive mammograms. The savings of life years (and quality adjusted life years) from extending screening biennial mammography beyond age 75 is significantly lower compared to those reported for screening mammography between the ages of 50 and 74 (30).

Another recent real-world observational study of Medicare beneficiaries reported −1.0 (−2.3 to 0.1) deaths per 1000 women over 8 years of follow-up for women receiving annual mammography (defined as <1.3 years after their last mammogram) between ages 70 to 74 years, but no difference in breast cancer death rate among those who had annual mammography between ages 75 to 84 years compared to those who did not (31). However, women receiving biennial mammography may have been misclassified as having stopped mammography screening, and survival benefits from mammography only incorporated 8 years of follow-up. In contrast, our model had a lifetime time horizon and found a small survival benefit, mostly for those ages 75 to 79 years.

Our study indicates that for healthy older women with little or no comorbidity burden, extending biennial screening mammography from age 75 to 80 years is associated with modest cost for the health benefits gained, and may be a reasonable choice for some women depending on their health preferences and values. For women with CCS of   2, which is associated with an increased risk of non-breast cancer mortality, our secondary and sensitivity analyses show the cost-effectiveness and balance of benefits vs harms of extending biennial screening mammography to age 80 is less certain than for healthier women. Extending *biennial* screening mammography beyond age 80 years was not cost-effective. Extending *annual* mammography beyond age 75 cost more than $100,000 per QALY gained even for women with CCS of 0 and was associated with higher burdens of overdiagnosis and benign breast biopsies compared to biennial mammography. These findings are important, because most screening mammography is performed at annual intervals in US women (10–12), and guidelines by some societies continue to recommend annual screening (32, 33).

These cost-effectiveness estimates are also mostly consistent with prior cost-effectiveness modeling studies. Mandelblatt and colleagues showed lower health benefits if a comorbid condition was present (6), and estimated that mammography remains cost-effective if life expectancy is 9.5 years or higher (8). Average life expectancy in the U.S drops below 10 years for US women at age 80 (16). Landsorp-Vogelaar and colleagues suggested that a stop age below 70 years might be appropriate for women with moderate to severe comorbidity (9). That study, unlike ours, assumed that a stop age of 75 is appropriate based on harms and benefits for women of average comorbid illness burden (mean CCS score 0.655 for women age 75 to 84 years in our BCSC study population).

Our study may inform new screening mammography guidelines for older women and supports some current guidelines regarding screening of women after age 75 (3, 34, 35). However, individual women facing these choices may have specific preferences and values regarding the small number of deaths avoided or risk for overdiagnosis and overtreatment that lead them to stop mammography at younger ages even if they have little or no comorbid

illness, or to continue screening even in the presence of a heavier comorbidity burden (36). These preferences need to be taken into account in a shared decision-making context when women and their health care providers consider extending screening mammography beyond age 75.

Strengths of our study include use of BCSC and SEER data that are broadly representative of the US population receiving screening mammography. Our study has important limitations. First, because no randomized controlled trials of screening mammography beyond age 75 have been conducted, we estimated shift of breast cancer stage with screening to estimate the effect of mammography on survival and breast cancer care costs. Second, stage distribution of invasive breast cancer in the absence of screening mammography might be different today than in the 1970s, due to heightened awareness of the value of early detection. Third, the reduction of mortality of invasive breast cancer over the last 40 years may be due to advances in breast cancer therapy more than mammography screening (37), and long-term SEER survival data may overestimate the survival benefit of diagnosing invasive breast cancer at an earlier stage. These latter two limitations would bias our estimates of cost-effectiveness in favor of screening mammography. Fourth, our results may not be applicable to those at particularly high breast cancer risk, such as BRCA carriers, who are still at high invasive breast cancer risk between ages 70 and 80 (38).

In conclusion, although annual mammography beyond age 75 years is not cost-effective, offering biennial screening mammography to women up to age 80 years appears to be cost-effective especially for women with little or no comorbidity. However, the absolute number of averted breast cancer deaths and days of life gained is small, especially for those with comorbidities. Women considering screening beyond age 75 need to weigh the harms of overdiagnosis versus the potential benefit of averting death from breast cancer.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

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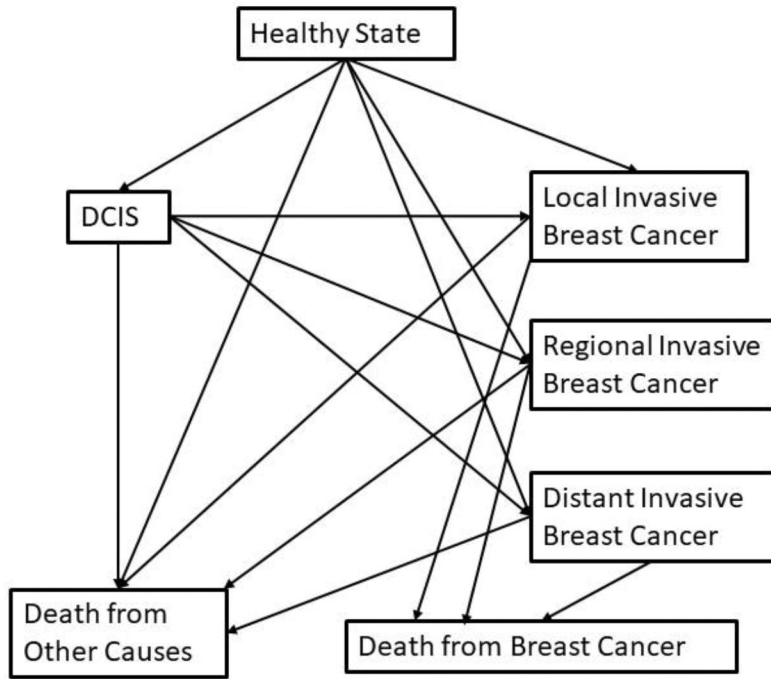
Figure 1: Markov State Transition Diagram
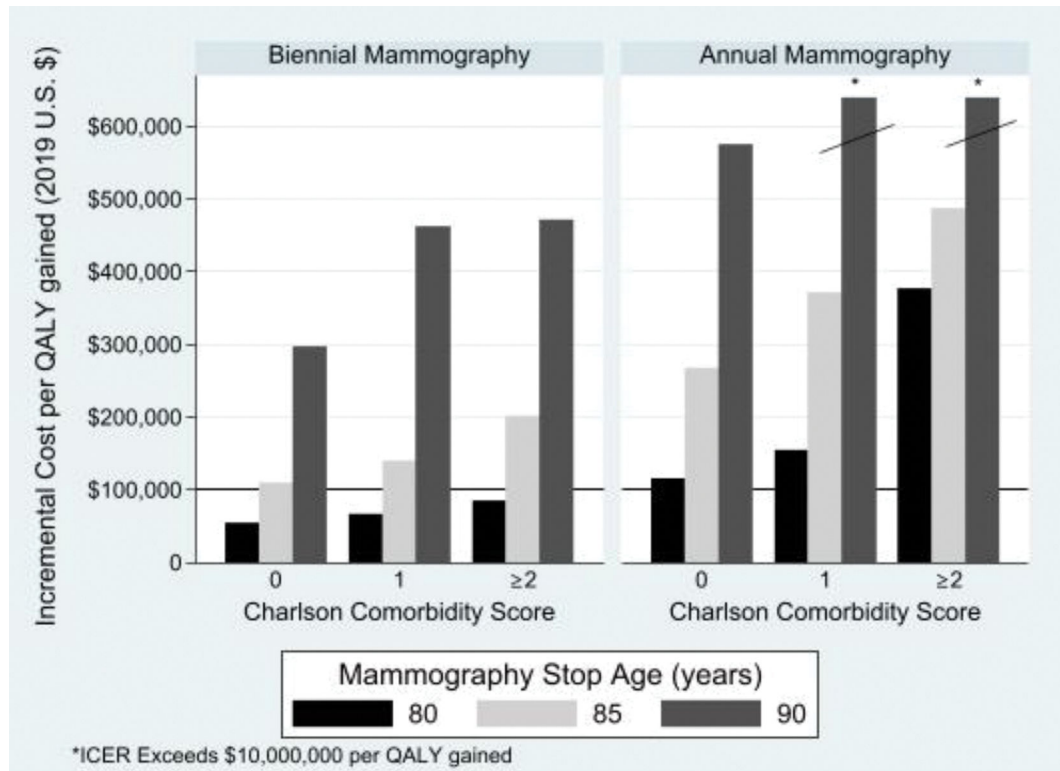
Figure 2: Cost per QALY Gained compared to next lower Stop Age
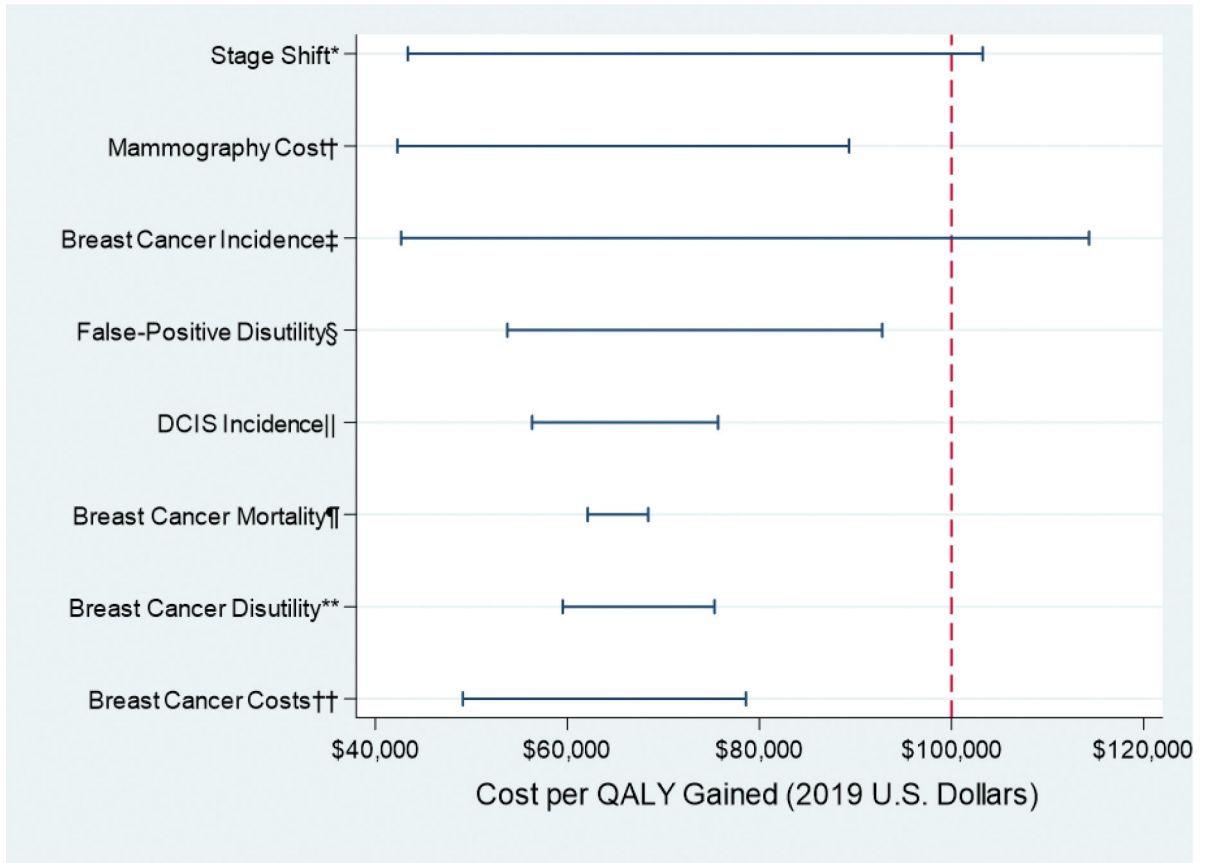
*Favorable shift of breast cancer stage from regional to local with screening mammography
    increased or decreased absolute 5% compared to Base Case
†Cost of screening mammography $101 vs $201
‡Invasive breast cancer rate decreased or increased 30% compared to Base Case
§Disutility associated with false positive mammography varied from 0 to 0.02
||Incidence of DCIS decreased or increased 50% compared to Base Case
¶Relative risk of breast cancer mortality decreased or increased 30% compared to Base Case
**Disutility of invasive breast cancer states (compared to Healthy State) increased or
    decreased 50%
††Direct medical costs of breast cancer increased or decreased 50%

**Figure 3: Univariate Sensitivity Analyses for Key Parameter Input Variables on Costs per QALY
Gained by Extending Biennial Mammography Stop Age from 75 to 80 Years**

Table 1:

Base Case Parameter Values   2

Parameter	Stage at Diagnosis			
	DCIS	Local	Regional	Distant
Proportions Within Each Invasive Breast Cancer Stage				
Age 65–74				
No Mammography		0.502	0.403	0.095
Biennial Mammography		0.748	0.228	0.024
Annual Mammography		0.761	0.213	0.026
Age 75–84				
No Mammography		0.533	0.381	0.085
Biennial Mammography		0.740	0.226	0.035
Annual Mammography		0.785	0.192	0.023
Age 85–100				
No Mammography		0.496	0.387	0.117
Biennial Mammography		0.701	0.254	0.046
Annual Mammography		0.780	0.203	0.018
Proportion of Healthy State Quality of Life (QALY) [*]				
1st Year	0.904	0.846	0.753	0.753
After 1st Year	1.000	0.985	0.932	0.832
Breast Cancer Cost (2008 U.S. $)				
1st Year	$14,657	$23,927	$40,818	$55,263
After 1st Year	$1,402	$2,288	$3,904	$5
Last Year of Life [†]	n/a	$58,781	$63,682	$80,602

[*] QALY value for each breast cancer stage is the age-specific QALY value for the health state multiplied by the proportion shown in these table rows. See also Technical Appendix Table 10b

[†] Applicable only to those dying of breast cancer

Table 2:

Additional Benefits vs Harms of Extending Screening Mammography Beyond Age 75

CCS	Stop Age	Breast Cancer Deaths (%) Averted per 1000 Women*	Years of Life Gained per 1000 Women*†	QALYs Gained per 1000 Women*†‡	Additional Screens per 1000 Women*†	False-Positive Screens per 1000 Women*†	False-Positive Biopsies per 1000 Women*†	Over-Diagnosis per 1000 Women*†
		Biennial Mammography						
0	80	1.7 (9.5%) (1.2; 2.2)	16.0 (11.7; 21.0)	10.9 (7.1; 14.4)	2007 (1977; 2035)	165 (133; 192)	14.7 (12.0; 17.2)	3.2 (1.8; 4.7)
	85	2.8 (15.6%) (2.0; 3.6)	24.7 (18.4; 31.3)	16.0 (10.8; 21.0)	3672 (3608; 3733)	301 (243; 351)	26.9 (21.9; 31.5)	5.4 (3.2; 8.0)
	90	3.5 (19.4%) (2.5; 4.4)	28.3 (21.6; 35.5)	17.6 (11.8; 23.2)	4885 (4790; 4977)	389 (314; 454)	33.7 (27.5; 39.4)	7.0 (4.1; 10.2)
1	80	1.4 (10.4%) (0.9; 1.9)	11.5 (9.6; 14.9)	7.3 (4.5; 10.6)	1739 (1716; 1765)	147 (118; 175)	14.3 (11.6; 17.0)	2.8 (1.2; 3.9)
	85	2.3 (16.9%) (1.5; 2.9)	17.3 (13.6; 22.6)	10.3 (6.6; 15.1)	3064 (3013; 3118)	259 (208; 308)	25.2 (20.4; 29.9)	4.6 (2.2; 6.5)
	90	2.7 (20.3%) (1.9; 3.5)	19.4 (15.0; 25.7)	11.3 (6.8; 16.7)	3929 (3853; 4006)	325 (262; 387)	30.6 (24.8; 36.4)	5.7 (2.8; 8.1)
2	80	1.0 (11.0%) (0.7; 1.4)	7.5 (5.1; 10.1)	4.9 (2.9; 6.8)	1371 (1352; 1391)	107 (89; 127)	12.9 (10.7; 15.4)	2.2 (1.3; 3.2)
	85	1.7 (17.5%) (1.1; 2.1)	10.8 (7.5; 15.3)	6.8 (4.0; 9.5)	2333 (2293; 2374)	182 (151; 216)	22.0 (18.2; 26.2)	3.6 (2.1; 5.1)
	90	2.0 (20.5%) (1.4; 2.5)	12.1 (8.2; 17.2)	7.2 (4.1; 10.3)	2898 (2880; 2953)	225 (188; 268)	26.4 (21.8; 31.5)	4.3 (2.5; 6.2)
		Annual Mammography						
0	80	2.0 (11.2%) (1.6; 2.6)	19.4 (15.1; 25.2)	11.7 (7.3; 16.0)	3993 (3934; 4055)	280 (225; 332)	29.2 (23.5; 34.4)	4.7 (2.8; 6.9)
	85	3.5 (19.4%) (2.6; 4.4)	29.6 (23.8; 37.8)	16.6 (9.9; 23.5)	7297 (7168; 7431)	511 (410; 607)	53.5 (42.9; 62.9)	8.3 (4.9; 11.8)
	90	4.4 (24.5%) (3.4; 5.5)	34.9 (28.1; 44.1)	18.4 (10.1; 26.8)	9701 (9513; 9902)	661 (530; 784)	66.9 (53.7; 78.7)	9.9 (5.8; 14.0)
1	80	1.7 (12.4%) (1.2; 2.2)	14.0 (10.2; 18.2)	7.7 (4.4; 12.1)	3459 (3403; 3516)	237 (190; 283)	28.4 (22.8; 33.3)	4.2 (2.5; 6.0)
	85	2.7 (20.1%) (2.0; 3.6)	21.1 (16.0; 26.4)	10.8 (5.7; 17.4)	6089 (5973; 6203)	417 (335; 499)	50.1 (40.1; 58.4)	6.9 (4.1; 9.8)

CCS	Stop Age	Breast Cancer Deaths (%) Averted per 1000 Women [*]	Years of Life Gained per 1000 Women [*][†]	QALYs Gained per 1000 Women [*][†][‡]	Additional Screens per 1000 Women [*][†]	False-Positive Screens per 1000 Women [*][†]	False-Positive Biopsies per 1000 Women [*][†]	Over-Diagnosis per 1000 Women [*][†]
	90	3.4 (25.0%) (2.5; 4.4)	24.3 (18.5; 30.5)	11.7 (5.5; 19.1)	7805 (7639; 7969)	533 (429; 638)	60.9 (48.8; 71.0)	8.0 (4.8; 11.3)
	80	1.3 (13.1%) (0.8; 1.6)	9.3 (6.4; 12.4)	5.1 (2.2; 7.9)	2733 (2687; 2775)	199 (161; 242)	25.7 (20.8; 30.4)	3.3 (1.9; 4.7)
2	85	2.0 (20.4%) (1.4; 2.6)	13.8 (10.1; 17.6)	6.8 (2.6; 11.0)	4647 (4553; 4729)	338 (274; 412)	43.7 (35.4; 51.7)	5.3 (3.1; 7.5)
	90	2.4 (24.9%) (1.7; 3.1)	15.6 (11.4; 19.9)	7.3 (2.4; 11.8)	5769 (5643; 5882)	414 (334; 504)	52.5 (42.5; 62.0)	6.0 (3.6; 8.5)

[*] Compared to stop age 75 years

[†] Uncertainty range in parentheses are the 10th to the 90th percentiles of the probabilistic sensitivity analyses (500 runs)

[‡] QALYs are undiscounted