The Influence of Health Status, Age, and Race on Screening Mammography in Elderly Women

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Background: Screening mammography is controversial for elderly women because of an absence of efficacy data. Decisions to screen are based on individualized assessment of risks and benefits. Our objective was to determine how screening mammography varies by age and race when adjusted for propensity to die.

Methods: In a retrospective cohort study, rates of screening mammogram performed in 2000-2001 based on claims, adjusted for propensity to die in 2000, were determined for a nationally representative 5% random sample of female fee-for-service Medicare beneficiaries 65 years and older (N=722,310).

Results: The overall rate of screening was 39%. When stratified into quintiles by propensity to die, 2-year rates ranged from 61% in the lowest-risk group to 5% in the highest-risk group. In analyses stratified by age and adjusted for propensity to die, 42% of women aged 65 to 69 years were screened, declining to 26% of women 85 years and older (P<.001). Adjusted screening rates for white women, black women, and women of other races were 40%, 30%, and 25%, respectively (P<.001). Thus, among women with similar health status, the youngest women were 1.61 times more likely to be screened compared with the oldest; compared with black women and women of other races, white women were 1.38 and 1.60 times, respectively, more likely to be screened.

Conclusions: Decisions to screen for breast cancer are related not only to health status but also to age and race. Underuse and overuse of screening mammography likely occurs owing to age- and race-associated decision making. Assessment of life expectancy may more accurately identify women who could benefit from screening.

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We hypothesized that physicians and patients use health status to guide their decisions about screening mammography. Because the use of a single indicator such as age does not fully capture overall health status, we examined whether patterns of use in female Medicare beneficiaries varied by risk of death (as a proxy for health status), age, and race.

**METHODS**

**DATA SOURCE**

The data originate from the Standard Analytic File of paid claims in 2000-2001 for a 3% random sample of Medicare beneficiaries. Standard Analytic Files are managed by the Centers for Medicare and Medicaid Services and contain information on demographics, health care utilization, and diagnoses. Inclusion criteria were female sex, enrollment in parts A and B Medicare, and age of 65 years or older in 2000. Exclusion criteria were a breast cancer diagnosis, residence outside the United States, any termination of coverage not due to death, or enrollment in managed care. The latter was necessary because of incomplete utilization data. Our final sample consisted of 722,310 female beneficiaries 65 years and older.

Race in the Standard Analytic File is coded according to the self-reported categories used by the Social Security Administration. The accuracy of the designation for races other than white and black is only fair (vs good or excellent). We chose to analyze the data according to white, black, and other (which includes unknown race) rather than exclude those with less accurate race data.

We used the Clinical Classification System, developed by the Agency for Health Care Research and Quality, to define the 30 most common comorbid conditions in our sample. The Clinical Classification System clusters International Classification of Disease, Ninth Revision codes and procedures into clinically similar categories. Comorbid conditions were defined as 1 claim from Medicare part A or 2 claims from part B within a Clinical Classification System category.

**DEFINITION OF SCREENING MAMMOGRAPHY**

Screening mammography is indicated in Medicare claims by the Current Procedural Terminology code 76092, “bilateral screening mammogram.” This code was not commonly used prior to 1991 because screening mammography was not a covered benefit; most mammograms were coded as bilateral diagnostic (76091). The practice of using the diagnostic mammography code appears to be diminishing. The frequency of Current Procedural Terminology code 76091 use has declined from 61% of all mammography claims in 1993 to 24% in 1998 and 15% in the current data set. A study evaluating coding in claims data found that the screening mammogram code frequency was within 2% of an algorithm designed to eliminate diagnostic mammograms. We tested the sensitivity of screening estimates to miscategorization by using all mammography codes, which increased rates by 5%, and results did not vary in any analysis. We chose to identify screening mammograms by 1 or more claims for bilateral screening mammogram (76092) in 2000-2001.

**ANALYSIS**

To determine the health status of a beneficiary, we estimated an individual’s probability of dying within 1 year using a propensity score. Propensity score methods using logistic regression have been used previously to reduce the bias between exposure groups in observational studies. In brief, we determined the logistic regression model that best predicted deaths in 2000 based on patient characteristics (the predictors used are given in the Table). Estimates of individual probabilities from this model represent the individual’s propensity (or probability) of dying, ranging from 0% to 100%. The advantage of propensity scoring is its ability to combine the many demographic and clinical factors we studied into a single, composite score. Goodness of model fit was assessed using the log likelihood and C statistic.

Using the propensity scores, we stratified individuals into quintiles of increasing probability of death to create 5 clinically interpretable low- to high-risk categories. To ensure the performance of our propensity scores, we checked for balance among the predictors for the screened and unscreened population within each quintile. Owing to the large sample size, all statistical tests are highly significant; therefore, balance was checked using effect size.

χ² Tests were used to assess differences across categories. Analysis of variance tests (Tukey-Kramer) with propensity quintiles, race, and/or age group as classification variables were used to assess differences of adjusted and unadjusted means. The Cochran-Armitage test for trend was used to test for trends of the categorical variables across propensity quintiles. Adjusted rates of mammogram screening were computed as least-squares means using generalized linear models for unbalanced analysis of variance with variables of interest as classification effects. SAS release 8.2 statistical software (SAS Institute Inc, Cary, NC) was used for all statistical analyses. This study was exempt from review by the local institutional review board policies.

Our analysis involved 722,310 female Medicare beneficiaries in the Standard Analytic File Medicare files for 2000 and 2001. The propensity to die model including clinically and statistically significant variables had a C statistic of 0.89, indicating excellent discriminant ability. Stratifying the data by propensity score, we found sufficient balance among the predictors within each quintile for patients with and without mammography to ensure the removal of intraquintile confounding.

The Table gives the demographic and clinical characteristics of women included in the study sample, stratified by propensity to die quintiles. Age closely correlated with propensity to die. While the majority of the sample were white, race distribution varied across propensity quintiles, with a higher percentage of white women occupying the highest propensity categories. With regard to chronic illness burden, the healthiest women tended to have a similar number of chronic conditions, as did the most severely ill. Indolent conditions were more prevalent in the healthy, whereas more life-threatening conditions were more prevalent in the most severely ill (Table). This finding does not reflect actual disease prevalence but rather is an artifact of billing rules that require a diagnosis for every visit but limit the number. The most serious conditions are likely to be coded, leaving less room for indolent conditions among ill individuals.

Most women did not receive a screening mammogram during the course of the 2-year observation period.
Even among women in the best health category, 61% received a screening mammogram during 2000 and 2001. The screening rate diminished markedly with worsening health, declining to 5% of women in propensity quintile 5 (P < .001 for trend).

Unadjusted for propensity to die, both age and race were significant determinants of which women received screening mammography (Figure 2 and Figure 3). With regard to age, 52% of beneficiaries aged 65 to 69 years received screening over the 2-year period, compared with 11% for women 85 years and older (P < .001). By race, unadjusted rates were 40%, 30%, and 28% for white women, black women, and women of other races, respectively.

Controlling for propensity to die reduced but did not eliminate the age-related disparity. Within quintile 1 (the lowest risk of death), 70% of women aged 65 to 69 years were screened, compared with 48% of women 85 years and older. Within quintile 5 (the highest risk of death), 19% of women in the youngest group were screened, declining to 5% of women in the oldest group. The overall screening rates adjusted for propensity to die were 42% of women aged 65 to 69 years and 26% of women 85 years and older (P < .001). Thus, among women of the same health status, the youngest women were 1.61 times more likely to be screened compared with the oldest (Figure 2).

With regard to race-related disparities, white women were significantly more likely to receive a screening mammogram compared with black women or women of other races (Figure 3). Adjusted for propensity to die, screening rates for white women, black women, and women of other races were 40%, 30%, and 25%, respectively (P < .001 for all pairwise comparisons). Adjusted probabilities did not differ markedly from unadjusted probabilities. After adjustment, white women were still 1.38 times and 1.60 times more likely to receive screening mammography compared with black women and women of other races, respectively (P < .001 for pairwise comparisons). Black women were 1.16 (P < .001) times more likely to receive screening compared with women of other races.

### Table. General Characteristics of Female Medicare Beneficiaries 65 Years and Older Compared Across Propensity to Die in 2000*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Overall</th>
<th>Propensity to Die in 2000 by Quintile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Died, 2000</td>
<td>5</td>
<td>0.2</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65.0-69.9</td>
<td>22</td>
<td>40</td>
</tr>
<tr>
<td>70.0-74.9</td>
<td>24</td>
<td>32</td>
</tr>
<tr>
<td>75.0-79.9</td>
<td>22</td>
<td>20</td>
</tr>
<tr>
<td>80.0-84.9</td>
<td>16</td>
<td>7</td>
</tr>
<tr>
<td>≥85.0</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>88</td>
<td>88</td>
</tr>
<tr>
<td>Black</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Total No. of unique health care providers</td>
<td>4.9 (3.9)</td>
<td>8.4 (4.3)</td>
</tr>
<tr>
<td>Total No. of inpatient stays, 2000</td>
<td>0.4 (0.9)</td>
<td>0.2 (0.6)</td>
</tr>
<tr>
<td>Total No. of comorbid conditions</td>
<td>3.4 (2.9)</td>
<td>4.2 (2.3)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>50</td>
<td>67</td>
</tr>
<tr>
<td>Lipid disorders</td>
<td>27</td>
<td>65</td>
</tr>
<tr>
<td>Ocular disorders†</td>
<td>21</td>
<td>44</td>
</tr>
<tr>
<td>Osteoarthritis/rheumatoid arthritis</td>
<td>18</td>
<td>28</td>
</tr>
<tr>
<td>Diabetes</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Coronary atherosclerosis</td>
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<td>17</td>
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<tr>
<td>Thyroid disorders</td>
<td>15</td>
<td>23</td>
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<tr>
<td>Cardiac dysrhythmias</td>
<td>12</td>
<td>23</td>
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<tr>
<td>Chronic heart failure</td>
<td>12</td>
<td>3</td>
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<tr>
<td>Alzheimer disease/dementia</td>
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<td>2</td>
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<tr>
<td>Osteoporosis</td>
<td>10</td>
<td>13</td>
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<tr>
<td>Chronic obstructive pulmonary disease</td>
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<td>6</td>
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<tr>
<td>Any cancer</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Spondylosis/intervertebral disc disorder</td>
<td>7</td>
<td>15</td>
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<tr>
<td>Peripheral vascular disease</td>
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<td>6</td>
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<tr>
<td>Depression</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Heart valve disorders</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Other connective tissue disease</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

*Data are given as percentage of patients (N = 722,310) or mean (SD) number. The conditions with less than a 5% point prevalence that are not displayed but included in the propensity modeling included anxiety/personality disorder, asthma, conduction disorders, other ill-defined heart disease, other nutrition/endocrine/metabolic conditions, other diseases of kidneys and ureters, chronic renal failure, respiratory failure/arrest, other nervous system disorders, and chronic ulcers of the skin. Categorical variables were compared across propensity to die quintiles by the Cochran-Armitage trend test; continuous variables were compared by 1-way analysis of variance; statistical significance for trends across propensity to die quintiles were all P < .001 owing, in part, to the large sample size.

†Ocular disorders include cataracts, glaucoma, retinal detachments, and other eye disorders.

(overall probability, 39%) (Figure 1). Even among women in the best health category, 61% received a screening mammogram during 2000 and 2001. The screening rate diminished markedly with worsening health, declining to 5% of women in propensity quintile 5 (P < .001 for trend).

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When not adjusted for those who die, the overall rate is 33%. Mean (dashed line) across quintiles because death is not evenly distributed.

In addition to the model that adjusted for propensity to die, we created a logistic regression model that also adjusted for age and race. Incorporating these 2 variables did not materially influence the independent age-related disparities observed in our more parsimonious model, which adjusted for propensity to die only (data not shown).

Among women 65 years and older receiving Medicare benefits, age reduces the likelihood of receiving a screening mammogram beyond the reduction related to poorer health status. To our knowledge, this is the first study to demonstrate that there is an association of age with reduced screening that is independent of its association with risk of death and is also the first study of mammography to use propensity to die as a health status indicator.

Previous studies have shown that age influences screening but have had mixed results regarding measures of health status. Self-reported health has not been associated with probability of screening mammography.20-22 The literature on how chronic illness affects screening is small and conflicting.20,23,24 There is some evidence for lower screening mammography rates in women with functional impairment.20,21,25,26 The variability among the results could be related to varying correlations of these health status measures with life expectancy. One study used an unvalidated index of mortality combining age, function, and illness and reported a decline in screening rates with worsening prognosis similar to ours, but the authors did not isolate the effect of age independent of life expectancy.27 Our data suggest that the decision not to undergo screening mammography is associated with worse patient prognosis, but it is also associated independently with increasing age.

Our findings suggest both underuse and overuse of screening mammography. For the youngest and healthiest women, the screening rate was 70%, which equals the Healthy People 2010 goal of 70%.28 However, older women in the healthiest group were screened at a much lower rate. Assuming the need to survive at least 5 years to benefit from screening, healthy women in their mid-80s, who have a life expectancy of 6.8 to 9.6 years, may still benefit from screening.4,6,29 Conversely, in the least healthy subgroup, there were still significant numbers of women being screened, including 19% of the youngest women in this subgroup. We are limited in our ability to comment on the appropriateness of not screening the healthy older population because we did not examine patient outcomes and there are no clinical trial data in this population. However, the absence of a survival benefit from early detection of breast cancer in women with significant comorbidity30 calls into question the appropriateness of screening the least healthy segment of the population for early disease.

It is possible that the age effects observed in this study are due to residual confounding of age in the propensity model. For instance, with the same 1-year risk of death, a 65-year-old woman could be more likely to survive 5 years and potentially benefit from screening than could someone aged 85 years. While statistically possible, the clinical process would necessitate a careful assessment of prognosis to obtain the consistent decline in screening with age that we observed. In addition, even in quintile 5, in which the prognosis was universally poor and we would expect...
very little screening if life expectancy were the only indicator used, we still observed age effects. Finally, the available evidence suggests that patients and physicians are only fair (vs good or excellent) in estimating life expectancy.31,32

While age is arguably a factor that should be considered in deciding on whether to undergo mammography, the lower rate of screening among women of race other than white is more troubling. We found that only 30% of black women had a screening mammogram within 2 years compared with 38% of white women. This race disparity persisted after controlling for propensity to die. Prior studies based on claims data reveal similar disparities based on black race.33-35 The cause of the disparity is unclear. Studies using self-report data have examined whether socioeconomic factors could account for the observed racial differences with conflicting results.10,36-40 Our data suggest that racial disparities remain that cannot be attributed to poorer health status.

The disparity in screening between black and white elderly women is especially concerning because black women are at increased risk of death from breast cancer.41 The cause of the higher death rate is uncertain; some have implicated greater comorbidity and presentation with more advanced disease.41 Our study shows that black women of comparable health status are screened less often compared with white women. Whether this disparity is due to patient preference, residual access barriers, biases in physician recommendations, or differences in quality where black women receive care is a critical area of investigation.

Mammography use in women of other races is similar to that for black women, consistent with a previous study examining black and Hispanic breast cancer screening practices. This prior study showed that screening rates vary significantly among specific ethnic subgroups, even within the Hispanic group.39 Studies with a more nuanced classification of race and ethnicity would be needed to understand practices in the heterogeneous population represented in our other race category.

Using our data, we cannot identify the causal mechanisms for overuse or underuse of screening. Possible causes of the overuse of screening in those with high risk of death may be adherence to age-based guidelines and physician incentives tied to those guidelines; poor ability to prognosticate life expectancy; automatic recall systems; or patient desire. Lower rates of screening among those who have the potential to benefit may be related to physician referral patterns; absence of efficacy data in the elderly; patient beliefs about risks and benefits; and access issues such as transportation, copayments, and functional impairments. These are all areas for future research.

There are limitations in the interpretation of our screening mammography rates as they relate to the general population and previous studies. Our estimate of the screening mammography rate is likely to be lower than the “true” rate for the general population because a small percentage of screening mammograms may be miscoded as diagnostic.16 Also, we did not capture mammograms provided by community health centers, Veterans Administration Medical Centers, and managed Medicare programs. Our 2-year overall estimate of 39% appears low compared with previous studies because of methodological differences. Another claims-based study reported 49% of women aged 65 to 75 years received either diagnostic or screening mammography.35 Limiting our sample, 50% of women aged 65 to 75 years received screening mammography. According to the National Health Interview Survey, the 2-year mammography rate in 2000 among women 65 years and older was 68%, up from 43% in 1998. The National Health Interview Survey, however, may overestimate actual rates because of self-reported data and changes in question wording.42,43

Our study’s most important potential limitation is the dependency of the results on the accuracy of diagnostic coding in the Standard Analytic File data set. Inaccurate coding of medical conditions could result in measurement error in the propensity scores. Any such error, however, should not create bias because the predictors in the propensity model were balanced between the screened and unscreened groups.

The goal of this study was to observe the behavior of patients and physicians in the use of screening mammography in the setting of uncertain benefit. The US Preventive Services Task Force attempts to specify who is likely to benefit by recommending screening for those older than 70 years if other chronic diseases do not compromise life expectancy.44 Similarly, the American Geriatrics Society recommends screening with no upper age limit provided that life expectancy is anticipated to be at least 5 years.40 We have shown that these types of judgments appear to occur but are inaccurate at the extremes of illness and age. From a policy perspective, using recommendations based on life expectancy may more effectively allocate screening resources. However, these recommendations cannot be codified, applied, and evaluated without easily applied measures of life expectancy. Our statistical model to predict risk of death has too many variables to be clinically useful. With additional research, one could develop a life expectancy calculator, much like the Framingham 10-year cardiovascular disease risk calculator,46 which could be used online or by using software.

CONCLUSIONS

In summary, screening mammography use is associated with age and race, even after considering patients’ likelihood of survival. More research is needed on the efficacy of mammography for women older than 70 years so that more precise guidelines can be developed to inform screening decisions for older patients. Physicians should be aware that age, though important, is only 1 component of predicting life expectancy and mammography benefit. In addition, physicians should be aware that extremely sick patients might not live long enough to benefit from mammography. Finally, efforts to eliminate racial disparity from mammography screening among older women are of utmost urgency.

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