

# Delays in Breast Cancer Diagnosis and Treatment by Racial/Ethnic Group

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**Background:** Although white women have the highest incidence of breast cancer, African American, followed by Hispanic, American Indian/Alaskan Native, and Asian American or Pacific Islander, women have higher death rates from the disease. Timely initiation of treatment has been shown to improve survival, and may help to lessen the mortality differences among racial/ethnic groups.

**Methods:** The purpose of this study was to describe time delays in the initial diagnosis and treatment of primary breast carcinoma across diverse ethnic/racial groups. Data are from the Surveillance, Epidemiology, and End Results–Medicare database. Women in this study were diagnosed as having breast cancer between January 1, 1992, and December 31, 1999. Billing claims from outpatient and inpatient visits were used. A total of 49 865 female Medicare recipients 65 years and older were enrolled in the study. Racial/ethnic groups were compared in their diagnostic, treatment, and clinical delay (ie, women with a diagnostic and treatment delay).

**Results:** African American women experienced the greatest diagnostic, treatment, and clinical delay. After controlling for other predictors, compared with white women, African American women had a 1.39-fold odds (95% confidence interval, 1.18–1.63) of diagnostic delay beyond 2 months, a 1.64-fold odds (95% confidence interval, 1.40–1.91) of treatment delay beyond 1 month, and a 2.24-fold odds (95% confidence interval, 1.75–2.86) of having a combined clinical delay.

**Conclusions:** In a population-based study, African American women experienced the most delays in initial diagnosis and initiation of breast cancer treatment, relative to women of other racial/ethnic subgroups. Despite the limitations of a claims database, the magnitude and direction of the findings are consistent across the research, suggesting the critical importance of reducing these delays.

*Arch Intern Med.* 2006;166:2244–2252

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**A**LTHOUGH WHITE WOMEN have the highest incidence of breast cancer, African American women have the highest death rates from the disease, followed by Hispanics (people of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race), American Indians/Alaskan Natives, and Asian Americans or Pacific Islanders.<sup>1</sup> This mortality difference has been attributed to a variety of factors, including poorer use of screening, later stage at diagnosis, and access to care.<sup>2–4</sup> Completion of follow-up after abnormal screening results is more frequently delayed or incomplete among women in minority groups, compared with white women.<sup>5</sup> Delay in cancer treatment by women of color has been explained by knowledge and beliefs,<sup>6,7</sup> poor social support,<sup>8</sup> financial barriers and reduced access to care,<sup>9</sup> poor physician-patient communication,<sup>10</sup> and system inefficiencies.<sup>11</sup>

Most research<sup>12</sup> has found a possible relationship between delay and survival because of a complex interaction of clinical and sociocultural factors. Delay contributes to later stage at breast cancer diagnosis.<sup>13</sup> In a

review of 87 studies, Richards et al<sup>12</sup> found that patients with a delay of 3 months or more had a 12% lower 5-year survival than those without delay. Inadequate or delayed follow-up for positive findings is the most common reason for breast cancer-related litigation.<sup>14</sup>

This study examines the likelihood of delay in breast cancer diagnosis and treatment among women enrolled in Medicare, comparing white, African American, Hispanic, and Asian American or Pacific Islander women. The study uses a comprehensive definition of delay,<sup>15</sup> with adjustment for clinical and nonclinical factors. While further examination of racial/ethnic differences in clinical presentation and treatment is needed, to our knowledge, no similar population-based study of an insured population has been conducted.

## METHODS

### DATA SOURCES

The Surveillance, Epidemiology, and End Results (SEER) Program was developed by the National Cancer Institute to provide ongoing information on cancer incidence and mortality.

Information from SEER registries is the most widely used source of data on cancer incidence and treatment in the United States; the SEER Program collects annual audits of its data to ensure quality and completeness, with an ascertainment standard of 98%.<sup>16</sup>

Medicare is the primary health insurer for 97% of the US population 65 years and older.<sup>17,18</sup> The Medicare Claims Data System, administered by the Centers for Medicare and Medicaid Services, collects information on all services provided to Medicare beneficiaries under its hospital (part A) and supplemental (part B) insurance plans. Claims from 3 Medicare sources were used for the study: the Medicare Provider Analysis and Review file, the Outpatient Standard Analytic File, and the 100% Physician/Supplier File. Medicare Provider Analysis and Review files include all part A short stay, long stay, and skilled nursing facility bills and contain 1 summarized record per admission, with up to 10 *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnoses.<sup>19</sup> The Outpatient Standard Analytic File is derived from the National Claims History File, which includes all Medicare part B (physician/supplier) claims for each calendar year.<sup>20</sup> The 100% Physician/Supplier File is a subset of the National Claims History File, and data are reported at the level of the medical service claim.

Linkage among the SEER-Medicare files, based on an algorithm involving a match of social security number, name, sex, and date of birth, has been described in detail elsewhere.<sup>17</sup> Individuals are not identifiable. Of persons 65 years and older appearing in the SEER records, Medicare eligibility can be identified for 93% of these cases.<sup>21</sup> The linkage allows for a population-based analysis of breast cancer diagnosis and treatment.

## STUDY POPULATION

Women were included in the analysis if they were diagnosed as having pathologically confirmed primary breast carcinoma between January 1, 1992, and December 31, 1999, while residing in 1 of the 11 SEER catchment areas. Subjects chosen had no previous SEER cancer diagnosis. Included subjects were age eligible for Medicare, had a known diagnosis date and cancer stage, and were members of Medicare parts A and B. To reduce missing data in the cohort, we excluded all women whose billings were unavailable throughout the research period, such as those who were enrolled in Medicare health maintenance organizations; this is a common approach in studies of this type.<sup>22-24</sup> To increase representativeness of the sample and measurement accuracy over time, we included women whose billings were available for 5 years around the date of diagnosis (3 years before and 2 years after the diagnosis). The mean number of years of data per person was 7.5 (SD, 3.5 years).

## OUTCOME MEASURES

Based on work by Gwyn et al,<sup>15</sup> 3 delay intervals were created: diagnosis delay of 2 months or more, treatment delay of 1 month or more, and combined clinical delay of 3 months or more (ie, 2-month diagnosis delay and 1-month treatment delay). Diagnosis delay was the period (in days) between initial consultation and the biopsy-proved diagnosis. The initial consultation date was defined as the date of diagnostic mammography or diagnostic ultrasonography or the date of a consultation for breast symptoms. Breast symptoms were identified with *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnostic codes 611.7x (signs and symptoms in the breast) or 611.9 (unspecified breast disorder) occurring within 3 years before the biopsy date. Biopsies with fine-needle aspiration, core biopsy (stereotactic, ultrasonographic guided, or other), incision, or excision (with or without needle localization) were coded using *Current Procedural Terminology* and *International Classification of Diseases, Ninth Revision, Clinical Modification* codes.

*International Classification of Diseases, Ninth Revision, Clinical Modification* codes.

Mammograms were identified using *Current Procedural Terminology* codes 76 092 (screening mammography, bilateral), 76 091 (mammography, bilateral), and 76 090 (mammography, unilateral). Diagnostic mammography was differentiated from screening mammography using the method defined by Freeman et al.<sup>25</sup> Diagnostic ultrasonography was identified using *Current Procedural Terminology* code 76 645 (echography, breast[s], unilateral or bilateral; B-scan; and/or real-time imaging with image documentation).

Treatment delay was the period (in days) between biopsy-proved diagnosis and the beginning of treatment. Treatment was defined as definitive surgery, neoadjuvant chemotherapy or radiation, or the initiation of chemotherapy or hormonal therapy for metastatic disease, whichever came first. Use of prescription medication, such as tamoxifen, is not yet available from this database. Chemotherapy was identified from Medicare billings using the Health Care Financing Administration Common Procedure Coding System J codes. By comparison to medical chart audits, chemotherapy claims in the SEER-Medicare database have 88% sensitivity and high internal validity, with 98% agreement ( $\kappa=0.82$ ).<sup>26</sup> Surgical and radiation codes were collected by the SEER Program.

To decrease redundancy in the interpretation of the study's findings, overall clinical delay was defined as the combination of diagnostic and treatment delay. Combined clinical delay was coded as a binary variable.

## PREDICTOR VARIABLES

Clinical factors, such as stage, and nonclinical factors, such as census tract, were selected for inclusion because they had been associated with delay in previous studies.<sup>15,27</sup> Socioeconomic status was measured by the average percentage of persons in poverty at the census tract level because it is considered a reasonable and useful measure of economic deprivation, when individual data are not reported.<sup>17,28</sup> Urban residence was derived from the source geographic cancer registry. Comorbidity was measured using the Deyo-Charlson comorbidity index for all dates before and until 6 months after SEER diagnosis, to increase sensitivity.<sup>29</sup> Tumor stage and characteristics were derived from SEER data. Stage may be considered a predictor and outcome of delay, because clinical prognosis and chemotherapy treatment choices for breast cancer are determined by stage, and nodal status, tumor size, and estrogen and progesterone receptor status<sup>30</sup>; these factors were included in all analyses.

We adjusted for the year of diagnosis in the analyses to account for any differences in delay over time. We adjusted for health maintenance organization membership in the analysis to account for varied database entry and exit periods. Screening or diagnostic mammography results, which are reliably reported breast cancer detection approaches in this claims database,<sup>31</sup> were included in the models. To account for contact with a physician during the study period, the mean number of visits was analyzed using the Berenson-Eggers Type of Service codes and the approach of Bach et al.<sup>32</sup>

## STATISTICAL ANALYSIS

All analyses were done using SAS statistical software, version 9.1 (SAS Institute Inc, Cary, NC). We used  $\chi^2$  analysis to compare ethnic/racial groups with respect to delay and delay risk factors. We then used a computer program (PROC GLIMMIX) to analyze the association between ethnic/racial groups and delay, with the average percentage of persons in poverty at the

census tract level as a random effect to account for clustering within neighborhoods.

## RESULTS

Of the 137 391 women originally identified by the SEER Program, 27 849 (20.3%) were excluded because they were enrolled in Medicare health maintenance organizations throughout the study period and, therefore, their billings were not available. From the original population, 23 022 (16.8%) were excluded because their first SEER diagnosis occurred before the age of 65 years, 15 464 (11.3%) because they were diagnosed as having breast cancer before 1992, 8627 (6.3%) because they were not a member of Medicare part B, 7113 (5.2%) because their first SEER diagnosis was not breast cancer, 5436 (4.0%) because no cancer stage was reported, and 15 (<1.0%) because their Medicare eligibility was due to end-stage renal disease.

We identified 49 865 women who were diagnosed as having breast cancer, of whom 36 959 had billings for diagnosis delay, 43 359 had billings for treatment delay, and 36 959 had billings for combined clinical delay. These differences are because of administrative variations such as the bundling of claims (Joan L. Warren, PhD, written communication, December 30, 2005). When comparing demographic and tumor-related characteristics across ethnic/racial groups (**Table 1**), study participants differed across all measured factors.

There were significant differences across ethnic/racial groups in the percentage experiencing diagnosis, treatment, and combined clinical delay (**Figures 1, 2, and 3**, respectively). African American women experienced the most diagnostic delay (median, 29 days; interquartile range [IQR], 74 days), with more than one fifth (22.1%) delayed for more than 2 months. Fewer (18.3%) white women were delayed for more than 2 months (median, 21 days; IQR, 41 days) than were African Americans. Eighteen percent of Hispanics were delayed for more than 2 months. Similarly, 18% of Asian American or Pacific Islander women had diagnostic delays (median, 21 days; IQR, 46 days); and, for women whose race was other or unknown, 19.5% experienced diagnostic delays of more than 2 months (median, 26 days; IQR, 55 days).

African American women experienced the greatest amount of treatment delay (median, 20 days; IQR, 27 days), with nearly one third (30.1%) of subjects delayed 1 month or more (Figure 2). Less than 20% (18.7%) of white women experienced 1 month or more of treatment delay (median, 14 days; IQR, 19 days). Of Hispanics, 19.7% experienced treatment delays of 1 month or more (median, 15 days; IQR, 21 days). Among Asian American or Pacific Islander women, 21.7% experienced treatment delays of 1 month or more (median, 4 days; IQR, 19 days). For women whose race was other or unknown, 16.7% experienced treatment delays of 1 month or more.

Of African American women, 11.2% experienced clinical delay (Figure 3). By comparison to other women, 6.6% of women of unknown race or ethnicity, 6.5% of His-

panics, 6.5% of Asian Americans or Pacific Islanders, and 5.1% of whites experienced clinical delay. While the absolute differences in clinical delay between African American and white women illustrated in Figure 3 seem relatively small, greater variations may be masked because the findings are not adjusted for confounding factors or for clustering within census tracts.

By using generalized linear mixed models, African American race was a strong and consistent predictor of all forms of delay, after controlling for age, presence of comorbidities, marital status, size of the city of residence, cancer stage, tumor characteristics, health maintenance organization status during the study, cancer detection method, and average percentage of persons in poverty at the census tract level (**Figures 4, 5, and 6**). African American women had a 40% increased odds of diagnostic delay beyond 2 months, a 61% increased odds of treatment delay beyond 1 month, and a 117% increased odds of delay of both types. The referent group for all analyses was white women.

Overall, women 80 years and older experienced fewer delays than younger women. Women 90 years and older were nearly half as likely to experience treatment delays as other women (**Table 2**). Unmarried women, including single, divorced, and widowed women, were no more likely than married women to experience delays (Table 2). Participants living in the largest metropolitan areas (population, >1 million) experienced the most delays compared with those in smaller cities, towns, and rural areas. Those in the most rural areas experienced 60% of the odds of clinical delay, 68% of the odds of treatment delay, and 79% of the odds of diagnostic delay of women in large cities.

We found few significant differences by cancer stage among the participants, although women diagnosed as having stage II cancer were significantly less likely to delay treatment than were other women, perhaps because of confounding (Table 2). Of the other tumor characteristics measured in the study (estrogen receptor/progesterone receptor status, tumor size, and nodal status), only tumor size was statistically significant, with larger tumor sizes associated with decreased odds of delay.

Three or more comorbid conditions significantly decreased the odds of clinical delay by nearly half (Table 2). Compared with screening tests, diagnostic tests were consistently associated with significantly increased odds of delay. Health maintenance organization membership at any time during the study did not significantly affect delay. Diagnosis in earlier years of the study decreased the likelihood of delay, while treatment in later years increased the odds of delay, perhaps reflecting a cohort effect. More mean visits to a physician during the study period seemed to associate with significantly increased odds of diagnostic and combined clinical delay (Table 2).

## COMMENT

In this population-based study across insured women who have been diagnosed as having pathology-confirmed breast cancer over 8 years, African Americans had significantly increased diagnosis, treatment, and combined clinical

**Table 1. Population Characteristics Among Women With Breast Cancer, by Race/Ethnicity\***

| Characteristic                               | Race/Ethnicity        |                                   |   |                        |                                  |
|--|-----------------------|-----------------------------------|---|------------------------|----------------------------------|
|  | White<br>(n = 43 627) | African<br>American<br>(n = 2982) | Asian American<br>or Pacific Islander<br>(n = 1617) | Hispanic<br>(n = 1296) | Other or<br>Unknown<br>(n = 343) |
| Age at cancer diagnosis, y                   |                       |                                   |   |                        |                                  |
| 65-69  | 9902 (22.7)           | 762 (25.6)                        | 537 (33.2)  | 365 (28.2)             | 86 (25.1)                        |
| 70-74  | 11 553 (26.5)         | 792 (26.6)                        | 520 (32.2)  | 369 (28.5)             | 111 (32.4)                       |
| 75-79  | 10 136 (23.2)         | 691 (23.2)                        | 324 (20.0)  | 280 (21.6)             | 76 (22.2)                        |
| 80-84  | 6961 (16.0)           | 422 (14.2)                        | 161 (10.0)  | 167 (12.9)             | 44 (12.8)                        |
| 85-89  | 3560 (8.2)            | 213 (7.1)                         | 59 (3.6)  | 79 (6.1)               | 14 (4.1)                         |
| ≥90  | 1515 (3.5)            | 102 (3.4)                         | 16 (1.0)  | 36 (2.8)               | 12 (3.5)                         |
| Year of diagnosis                            |                       |                                   |   |                        |                                  |
| 1992   | 5806 (13.3)           | 419 (14.1)                        | 161 (10.0)  | 162 (12.5)             | 37 (10.8)                        |
| 1993   | 5534 (12.7)           | 340 (11.4)                        | 163 (10.1)  | 137 (10.6)             | 29 (8.5)                         |
| 1994   | 5442 (12.5)           | 362 (12.1)                        | 156 (9.6)   | 152 (11.7)             | 24 (7.0)                         |
| 1995   | 5497 (12.6)           | 379 (12.7)                        | 197 (12.2)  | 170 (13.1)             | 29 (8.5)                         |
| 1996   | 5233 (12.0)           | 355 (11.9)                        | 193 (11.9)  | 160 (12.3)             | 55 (16.0)                        |
| 1997   | 5366 (12.3)           | 383 (12.8)                        | 249 (15.4)  | 175 (13.5)             | 45 (13.1)                        |
| 1998   | 5380 (12.3)           | 382 (12.8)                        | 241 (14.9)  | 165 (12.7)             | 66 (19.2)                        |
| 1999   | 5369 (12.3)           | 362 (12.1)                        | 257 (15.9)  | 175 (13.5)             | 58 (16.9)                        |
| No. of comorbid conditions†                  |                       |                                   |   |                        |                                  |
| 0  | 34 471 (79.0)         | 2087 (70.0)                       | 1406 (87.0)   | 995 (76.8)             | 287 (83.7)                       |
| 1  | 5136 (11.8)           | 382 (12.8)                        | 109 (6.7)   | 142 (11.0)             | 36 (10.5)                        |
| 2  | 2364 (5.4)            | 262 (8.8)                         | 60 (3.7)  | 85 (6.6)               | 12 (3.5)                         |
| ≥3   | 1656 (3.8)            | 251 (8.4)                         | 42 (2.6)  | 74 (5.7)               | 8 (2.3)                          |
| Marital status                               |                       |                                   |   |                        |                                  |
| Single                                       | 3024 (6.9)            | 366 (12.3)                        | 119 (7.4)   | 147 (11.3)             | 27 (7.9)                         |
| Married                                      | 18 947 (43.4)         | 757 (25.4)                        | 869 (53.7)  | 497 (38.3)             | 151 (44.0)                       |
| Divorced or separated                        | 2394 (5.5)            | 301 (10.1)                        | 55 (3.4)  | 114 (8.8)              | 14 (4.1)                         |
| Widowed                                      | 18 264 (41.9)         | 1443 (48.4)                       | 543 (33.6)  | 501 (38.7)             | 102 (29.7)                       |
| Unknown                                      | 998 (2.3)             | 115 (3.9)                         | 31 (1.9)  | 37 (2.9)               | 49 (14.3)                        |
| Population of city of residence              |                       |                                   |   |                        |                                  |
| ≥1 000 000                                   | 26 004 (59.6)         | 2751 (92.3)                       | 741 (45.8)  | 853 (65.8)             | 231 (67.3)                       |
| 250 000-999 999                              | 9811 (22.5)           | 211 (7.1)                         | 700 (43.3)  | 247 (19.1)             | 70 (20.4)                        |
| 20 000-249 999                               | 3124 (7.2)            | 16 (0.5)                          | 171 (10.6)  | 62 (4.8)               | 29 (8.5)                         |
| ≤19 999                                      | 4688 (10.7)           | 4 (0.1)                           | 5 (0.3)   | 134 (10.3)             | 13 (3.8)                         |
| Member of a health maintenance organization‡ |                       |                                   |   |                        |                                  |
| No   | 40 860 (93.7)         | 2747 (92.1)                       | 1453 (89.9)   | 1146 (88.4)            | 326 (95.0)                       |
| Yes  | 2767 (6.3)            | 235 (7.9)                         | 164 (10.1)  | 150 (11.6)             | 17 (5.0)                         |
| Physician visits per year§                   | 9.4 (5.8)             | 9.6 (6.3)                         | 11.2 (6.6)  | 10.5 (6.8)             | 9.2 (5.3)                        |
| Cancer stage                                 |                       |                                   |   |                        |                                  |
| In situ                                      | 5059 (11.6)           | 430 (14.4)                        | 262 (16.2)  | 175 (13.5)             | 77 (22.4)                        |
| I  | 20 892 (47.9)         | 1026 (34.4)                       | 790 (48.9)  | 510 (39.4)             | 156 (45.5)                       |
| II   | 13 225 (30.3)         | 989 (33.2)                        | 425 (26.3)  | 438 (33.8)             | 87 (25.4)                        |
| III  | 2400 (5.5)            | 294 (9.9)                         | 80 (4.9)  | 98 (7.6)               | 14 (4.1)                         |
| IV   | 2051 (4.7)            | 243 (8.1)                         | 60 (3.7)  | 75 (5.8)               | 9 (2.6)                          |

(continued)

cal delays by comparison to all other female Medicare enrollees. These disparities were generally consistent regardless of stage; therefore, they are profound. The findings were consonant with previous research<sup>13,15,33-36</sup> using varied measures and more limited samples, and may be attributed to clinical and nonclinical factors.

While access to physicians, as measured by mean number of visits, seems to have been greater among African American, Hispanic, and Asian American or Pacific Islander women than among white Medicare enrollees in this study, more visits led to significantly increased diagnostic and combined clinical delay. This finding suggests that visits to a health care provider were not sufficient to ensure timely use of diagnostic and treatment services, perhaps because of inadequate access by pro-

viders to diagnostic imaging and specialists,<sup>32</sup> deficits in physician training, and inadequate or misinterpreted findings from the clinical breast examination and mammography.<sup>10</sup> Inappropriate physician assurance to the patient has also contributed to patient delays in treatment. Given an insured population, system inefficiencies, including busy clinics, have been implicated in differences in delay by ethnic/racial groups.<sup>10,36,37</sup>

Cultural variations in approaches to cancer detection and follow-up for abnormal findings, including levels of acculturation, or attitudes and beliefs toward cancer causation, preferences in cancer detection, or the perceived effectiveness of treatment may influence the timeliness of services.<sup>38</sup> Although these predictors, too, were unmeasured in this study, patient psychosocial fac-

**Table 1. Population Characteristics Among Women With Breast Cancer, by Race/Ethnicity (cont)\***

| Characteristic                                 | Race/Ethnicity        |                                   |   |                        |                                  |
|--|-----------------------|-----------------------------------|---|------------------------|----------------------------------|
|  | White<br>(n = 43 627) | African<br>American<br>(n = 2982) | Asian American<br>or Pacific Islander<br>(n = 1617) | Hispanic<br>(n = 1296) | Other or<br>Unknown<br>(n = 343) |
| Estrogen receptor/progesterone receptor status |                       |                                   |   |                        |                                  |
| Both negative                                  | 4276 (17.0)           | 445 (30.3)                        | 183 (19.1)  | 135 (19.2)             | 21 (13.0)                        |
| Both positive                                  | 20 914 (83.0)         | 1024 (69.7)                       | 776 (80.9)  | 568 (80.8)             | 140 (87.0)                       |
| Tumor size, cm                                 |                       |                                   |   |                        |                                  |
| <1   | 9477 (23.8)           | 505 (19.7)                        | 408 (27.2)  | 204 (17.6)             | 78 (27.1)                        |
| 1-3  | 24 934 (62.6)         | 1479 (57.6)                       | 893 (59.6)  | 752 (64.8)             | 178 (61.8)                       |
| >3   | 5398 (13.6)           | 584 (22.7)                        | 197 (13.2)  | 205 (17.7)             | 32 (11.1)                        |
| Lymph nodes involved                           |                       |                                   |   |                        |                                  |
| No   | 29 491 (76.0)         | 1776 (68.5)                       | 1196 (79.2)   | 859 (72.2)             | 244 (79.5)                       |
| Yes  | 9295 (24.0)           | 818 (31.5)                        | 315 (20.8)  | 331 (27.8)             | 63 (20.5)                        |
| Method of cancer detection                     |                       |                                   |   |                        |                                  |
| Screening test                                 | 33 342 (76.4)         | 2190 (73.4)                       | 1195 (73.9)   | 939 (72.5)             | 279 (81.3)                       |
| Diagnostic test                                | 10 284 (23.6)         | 792 (26.6)                        | 422 (26.1)  | 357 (27.5)             | 64 (18.7)                        |
| Census tract percentage in poverty§            | 8.3 (11.1)            | 25.3 (15.2)                       | 9.4 (8.5)   | 15.3 (10.8)            | 11.6 (13.8)                      |

\*Data are given as number (percentage) of each group, excluding missing data, unless otherwise indicated. Percentages are based on totals for each characteristic, and may not total 100 because of rounding. Race and ethnicity are derived from Surveillance, Epidemiology, and End Results Program data. All Hispanics are included (people of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race).  $P < .001$  for all characteristics. The  $P$  value was 2 sided and computed using either the Pearson  $\chi^2$  test or the analysis of variance  $F$  test.

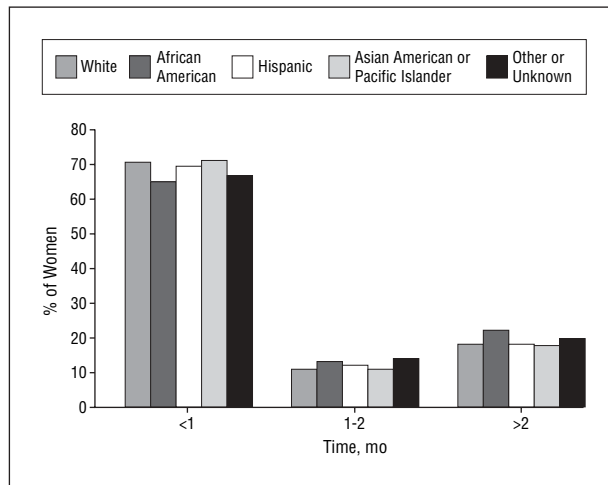
†Using the Deyo-Charlson index.

‡Health maintenance organization membership outside of 3 years before and 2 years after the date of breast cancer diagnosis.

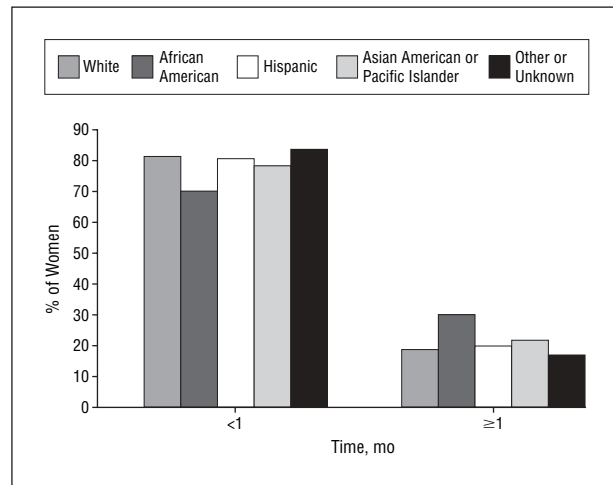
§Data are given as mean (SD).

||Using Berenson-Eggers Type of Service codes.

¶Taken from Surveillance, Epidemiology, and End Results Program data.



**Figure 1.** Women experiencing diagnosis delay by race/ethnicity. Diagnosis delay was calculated as the period (in days) between the initial consultation and the date of biopsy. All Hispanics were included (people of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race). There were significant differences ( $P < .001$ , 2 sided) across ethnic/racial groups in the percentage experiencing diagnosis delay. The denominator on which each proportion was based is found in Table 1.



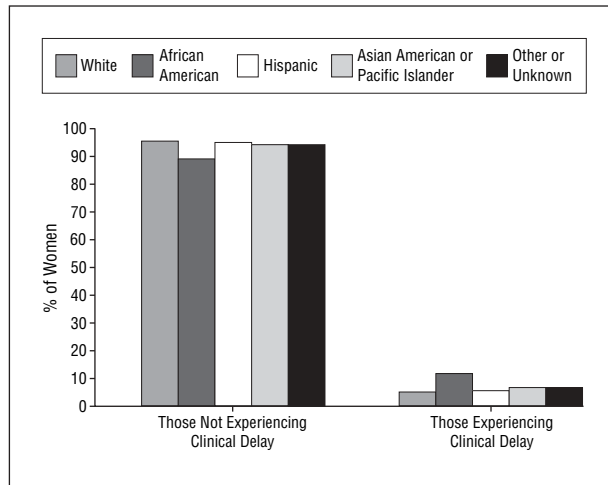
**Figure 2.** Women experiencing treatment delay by race/ethnicity. Treatment delay was calculated as the period (in days) between biopsy and the beginning of treatment. All Hispanics were included (people of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race). There were significant differences ( $P < .001$ , 2 sided) across ethnic/racial groups in the percentage experiencing treatment delay. The denominator on which each proportion was based is found in Table 1.

tors, such as fear and anxiety, a sense of fatalism, perceived risk, misunderstanding, body image, the competing demands of caring for others, and social norms, may also delay diagnostic evaluation and treatment.<sup>7,13,33,35,39,40</sup>

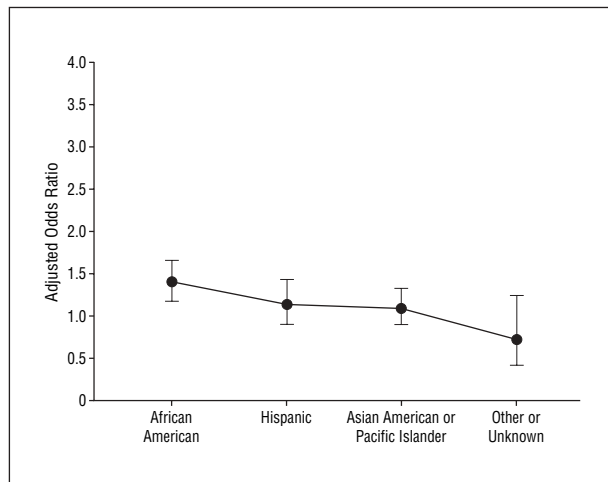
Low socioeconomic status and lack of health insurance coverage combined have been cited as a predictor of delay in all previous studies<sup>15,41-43</sup> but one.<sup>44</sup> While census tract-level poverty did not consistently predict risk

in this study, it is possible that unmeasured individual socioeconomic status may have contributed to the delays that were found.<sup>2</sup>

The urban-rural discrepancies found herein were similar to those found in the National Breast and Cervical Cancer Early Detection Program.<sup>5</sup> These findings are particularly striking, given that rural settings may be less likely to have specialized equipment or trained personnel.<sup>36</sup>



**Figure 3.** Women experiencing clinical delay by race/ethnicity. Clinical delay was defined as the combination of 2-month diagnostic delay and 1-month treatment delay. All Hispanics were included (people of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race). There were significant differences ( $P < .001$ , 2 sided) across ethnic/racial groups in the percentage experiencing clinical delay. The denominator on which each proportion was based is found in Table 1.

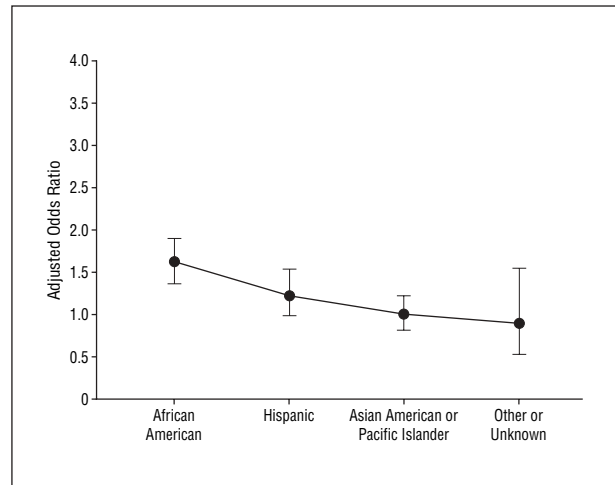


**Figure 4.** Adjusted odds ratios of diagnosis delay of 2 months or more by race/ethnicity. Diagnosis delay was calculated as the period (in days) between initial consultation and the date of biopsy. The odds ratios were estimated from a generalized linear mixed model, adjusted by age, number of comorbid conditions, marital status, size of residence, cancer stage, estrogen receptor/progesterone receptor status, tumor size, nodal status, detection method, year of diagnosis, health maintenance organization status, mean physician visits, and average percentage of persons in poverty at the census tract level, as detailed in Table 1. All Hispanics were included (people of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race). Bars represent 95% confidence intervals for the odds ratios.

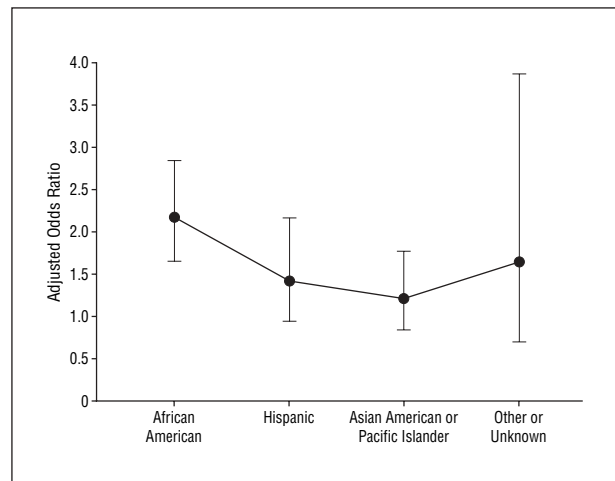
Separate analyses of delay by SEER region did not reveal any other significant geographic variations.

Delay was less among the older old ( $>80$  years) relative to younger women. These findings are consistent with those of Asch et al,<sup>45</sup> suggesting that women and their physicians may be more aggressive in pursuing problems once they have been identified.

This study's interpretation is limited by the inherent design of the SEER-Medicare database. Because it is an administrative database, we could only detect proce-



**Figure 5.** Adjusted odds ratios of treatment delay of 1 month or more by race/ethnicity. Treatment delay was calculated as the period (in days) between biopsy and the beginning of treatment. The odds ratios were estimated from a generalized linear mixed model, adjusted by age, number of comorbid conditions, marital status, size of residence, cancer stage, estrogen receptor/progesterone receptor status, tumor size, nodal status, detection method, year of diagnosis, health maintenance organization status, mean physician visits, and average percentage of persons in poverty at the census tract level, as detailed in Table 1. All Hispanics were included (people of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race). Bars represent 95% confidence intervals for the odds ratios.



**Figure 6.** Adjusted odds ratios of clinical delay by race/ethnicity. Clinical delay, a binary variable, is the combination of 2-month diagnosis delay and 1-month treatment delay. The odds ratios were estimated from a generalized linear mixed model, adjusted by age, number of comorbid conditions, marital status, size of residence, cancer stage, estrogen receptor/progesterone receptor status, tumor size, nodal status, detection method, year of diagnosis, health maintenance organization status, mean physician visits, and average percentage of persons in poverty at the census tract level, as detailed in Table 1. All Hispanics were included (people of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race). Bars represent 95% confidence intervals for the odds ratios.

dures and diagnoses that providers included on billings to Medicare; for example, we could not examine the types of symptoms presented, nor who detected them first. No information was available on any delays before diagnosis. Although algorithms have been validated to distinguish between claims for breast cancer screening and diagnosis,<sup>25</sup> medical record studies are needed to examine the validity of biopsy codes. Some older women may have

**Table 2. Estimated Data for Diagnosis, Treatment, and Clinical Delays by Predictors\***

| Characteristic                                  | Diagnosis Delay<br>(n = 18 286) | Treatment Delay<br>(n = 21 126) | Clinical Delay<br>(n = 18 286) |
|---|---------------------------------|---------------------------------|--------------------------------|
| Race/Ethnicity                                  |                                 |                                 |                                |
| White   | 1.00                            | 1.00                            | 1.00                           |
| African American                                | 1.39 (1.18-1.63)                | 1.64 (1.40-1.91)                | 2.24 (1.75-2.86)               |
| Asian American or Pacific Islander              | 1.09 (0.91-1.32)                | 0.95 (0.79-1.15)                | 1.13 (0.79-1.61)               |
| Hispanic  | 1.07 (0.86-1.32)                | 1.13 (0.91-1.40)                | 1.33 (0.90-1.97)               |
| Other or unknown                                | 0.95 (0.55-1.64)                | 0.78 (0.47-1.30)                | 1.30 (0.56-2.99)               |
| Age, y  |                                 |                                 |                                |
| 65-69   | 1.00                            | 1.00                            | 1.00                           |
| 70-74   | 1.05 (0.96-1.16)                | 1.07 (0.97-1.17)                | 1.03 (0.85-1.24)               |
| 75-79   | 1.02 (0.92-1.12)                | 0.97 (0.88-1.08)                | 1.06 (0.87-1.29)               |
| 80-84   | 0.92 (0.81-1.04)                | 0.91 (0.80-1.03)                | 0.79 (0.61-1.02)               |
| 85-89   | 0.75 (0.63-0.90)                | 0.82 (0.69-0.97)                | 0.86 (0.60-1.24)               |
| ≥90   | 0.94 (0.69-1.30)                | 0.55 (0.40-0.77)                | 0.84 (0.42-1.69)               |
| Marital status                                  |                                 |                                 |                                |
| Married   | 1.00                            | 1.00                            | 1.00                           |
| Unmarried                                       | 0.94 (0.87-1.01)                | 1.07 (0.99-1.15)                | 0.96 (0.83-1.12)               |
| Population of city of residence                 |                                 |                                 |                                |
| ≥1 000 000                                      | 1.00                            | 1.00                            | 1.00                           |
| 250 000-999 999                                 | 0.78 (0.72-0.85)                | 0.84 (0.76-0.92)                | 0.73 (0.60-0.87)               |
| 20 000-249 999                                  | 0.81 (0.70-0.95)                | 0.89 (0.76-1.04)                | 0.73 (0.53-1.01)               |
| ≤19 999   | 0.79 (0.69-0.90)                | 0.68 (0.58-0.80)                | 0.60 (0.44-0.80)               |
| Cancer stage†                                   |                                 |                                 |                                |
| In situ   | 1.00                            | 1.00                            | 1.00                           |
| I   | 0.93 (0.74-1.16)                | 0.86 (0.69-1.07)                | 0.85 (0.57-1.26)               |
| II  | 0.88 (0.69-1.12)                | 0.68 (0.54-0.87)                | 0.65 (0.41-1.03)               |
| III   | 1.03 (0.75-1.41)                | 0.73 (0.53-1.01)                | 0.75 (0.40-1.42)               |
| IV  | 0.68 (0.44-1.05)                | 0.89 (0.61-1.30)                | 0.98 (0.45-2.14)               |
| Estrogen receptor/progesterone receptor status‡ |                                 |                                 |                                |
| Both negative                                   | 1.00                            | 1.00                            | 1.00                           |
| Both positive                                   | 0.93 (0.84-1.02)                | 1.01 (0.92-1.11)                | 1.05 (0.87-1.27)               |
| Tumor size, cm†                                 |                                 |                                 |                                |
| <1  | 1.00                            | 1.00                            | 1.00                           |
| 1-3   | 0.87 (0.79-0.95)                | 0.83 (0.76-0.91)                | 0.77 (0.65-0.91)               |
| >3  | 0.81 (0.69-0.95)                | 0.85 (0.73-0.99)                | 0.82 (0.59-1.14)               |
| Lymph nodes involved†                           |                                 |                                 |                                |
| No  | 1.00                            | 1.00                            | 1.00                           |
| Yes   | 1.04 (0.92-1.17)                | 0.97 (0.86-1.10)                | 0.92 (0.70-1.19)               |
| No. of comorbid conditions‡                     |                                 |                                 |                                |
| 0   | 1.00                            | 1.00                            | 1.00                           |
| 1   | 0.97 (0.87-1.09)                | 0.97 (0.86-1.09)                | 1.09 (0.87-1.35)               |
| 2   | 0.91 (0.77-1.08)                | 0.87 (0.73-1.03)                | 0.78 (0.54-1.12)               |
| ≥3  | 0.83 (0.68-1.02)                | 0.99 (0.82-1.21)                | 0.52 (0.31-0.87)               |
| Method of cancer detection                      |                                 |                                 |                                |
| Screening test                                  | 1.00                            | 1.00                            | 1.00                           |
| Diagnostic test                                 | 2.23 (2.00-2.48)                | 1.10 (1.01-1.20)                | 1.83 (1.45-2.29)               |
| Member of a health maintenance organization§    |                                 |                                 |                                |
| Yes   | 1.00                            | 1.00                            | 1.00                           |
| No  | 1.05 (0.91-1.22)                | 1.02 (0.88-1.19)                | 1.17 (0.86-1.60)               |
| Year of diagnosis                               | 0.98 (0.97-1.00)                | 1.05 (1.03-1.07)                | 1.02 (0.99-1.05)               |
| Physician visits per year¶                      | 1.04 (1.03-1.04)                | 1.00 (1.00-1.01)                | 1.02 (1.01-1.04)               |
| Census tract percentage in poverty  †           | 1.00 (1.00-1.00)                | 1.00 (0.99-1.00)                | 1.00 (1.00-1.01)               |

\*Data are given as odds ratio (95% confidence interval). Data are from generalized linear mixed models with race/ethnicity as the main predictor, adjusted for age, marital status, comorbidity, size of city of residence, cancer detection method, cancer stage, estrogen receptor/progesterone receptor status, tumor size, nodal status, health maintenance organization membership, average percentage of persons in poverty at the census tract level, year of diagnosis, and mean physician visits, as detailed in Table 1. The number of subjects given for each column was the actual number of subjects used in the model fit.

†All tumor characteristics were taken from Surveillance, Epidemiology, and End Results Program data.

‡Using the Deyo-Charlson index.

§Membership outside of 3 years before and 2 years after the date of breast cancer diagnosis.

||The odds ratio was associated with a 1-U increment.

¶Using Berenson-Eggers Type of Service codes.

been screened by programs such as the National Breast and Cervical Cancer Early Detection Program, so their follow-up procedures may not have been included in the database; there are few older National Breast and Cervical

Cancer Early Detection Program participants, and biopsies are not covered in the program.<sup>5</sup> Because oral medications are not captured reliably in these databases, we did not measure the administration of hormonal therapies (ta-

moxifen citrate [Nolvadex] or anastrozole [Arimidex]); we did control for hormone receptor status. Because 86% of elderly hormone receptor-positive women diagnosed as having breast cancer receive tamoxifen, however,<sup>46</sup> women are likely to have received this common treatment.

The findings on delay in breast cancer diagnosis and treatment suggest decreased quality of care among African Americans across the cancer continuum, from diagnosis to palliation, even though the overall percentage of recommended care received by African Americans and Hispanics may be higher than among whites.<sup>45</sup> One of the most widespread performance measurement systems, the Health Plan Employer Data and Information Set, targets early detection rather than the diagnostic process or the care received after diagnosis, suggesting the importance of enhanced measurement to detect disparities.

Some efforts to decrease these disparities, however, are promising. The median overall delay in this study was less than that for a more homogeneous sample of women ascertained by the Nova Scotia Cancer Registry (median delay, 91 days).<sup>47</sup> And, with targeted investments to improve access, breast cancer screening has reached near parity between African Americans and whites.<sup>48</sup> Some barriers to delay can be further lessened by the automation of systems, such as computer-generated messages to remind patients of the need for follow-up. Others may be reduced by physician- and/or patient-directed educational interventions.<sup>49-51</sup> Follow-up for positive test findings is a central concern of Medicare in a pay-for-performance system.

These robust findings using a US population-based sample on increased diagnostic, treatment, and combined clinical delays for breast cancer among African Americans by comparison to other older women have important implications for reducing ethnic/racial disparities in health care.

**Accepted for Publication:** July 30, 2006.

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**Author Contributions:** Dr Gorin had full access to all of the data in the study and takes responsibility for its integrity; Drs Gorin and Cheng take responsibility for the accuracy of the data analysis. *Study concept and design:* Gorin, Heck, and Smith. *Acquisition of data:* Gorin. *Analysis and interpretation of data:* Gorin, Heck, and Cheng. *Drafting of the manuscript:* Gorin and Heck. *Critical revision of the manuscript for important intellectual content:* Gorin, Cheng, and Smith. *Statistical analysis:* Gorin, Heck, and Cheng. *Obtained funding:* Gorin. *Administrative, technical, and material support:* Gorin and Smith. *Study supervision:* Gorin.

**Financial Disclosure:** None reported.

**Funding/Support:** This study was supported by grant U57/CCU220685-01 from the Centers for Disease Control and Prevention (Dr Gorin).

**Role of the Sponsor:** The funding body had no role in data extraction and analyses, in the writing of the manuscript, or in the decision to submit the manuscript for publication.

**Acknowledgment:** We thank Joan L. Warren, PhD, for her assistance in highlighting nuances in the database and for several suggestions on revisions to the manuscript; Melissa Bondy, PhD, for her review of and comments on the manuscript; Stephen B. Edge, MD, for his oral comments on the early findings; the 3 anonymous reviewers for the journal whose comments enriched the final article; and the efforts of the Applied Research Program, National Cancer Institute, the Office of Information Services, and the Office of Strategic Planning, Centers for Medicare and Medicaid Services, Information Management Services, Inc, and the SEER Program tumor registries in the creation of the SEER-Medicare database.

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