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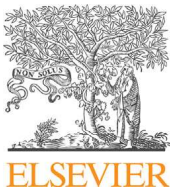

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Time from Screening Mammography to Biopsy and from Biopsy to Breast Cancer Treatment among Black and White, Women Medicare Beneficiaries Not Participating in a Health Maintenance Organization

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A B S T R A C T

Purpose: There is a breast cancer mortality gap adversely affecting Black women in the United States. This study assessed the relationship between number of days between abnormal mammogram, biopsy, and treatment among Medicare (Part B) beneficiaries ages 65 to 74 and 75 to 84 years, accounting for race and comorbidity.
Methods: A cohort of non-Hispanic Black and non-Hispanic White women residing in the continental United States and receiving no services from a health maintenance organization was randomly selected from the Center for Medicare and Medicaid Services denominator file. The cohort was followed from 2005 to 2008 using Center for Medicare and Medicaid Services claims data. The sample included 4,476 women (weighted $n = 70{,}731$) with a diagnosis of breast cancer. Cox proportional hazard modeling was used to identify predictors of waiting times.
Findings: Black women had a mean of 16.7 more days between biopsy and treatment ($p < .001$) and 15.7 more days from mammogram to treatment ($p = .003$) than White women. Median duration from abnormal mammogram to treatment exceeded National Quality Measures for Breast Centers medians regardless of race, age, or number of comorbidities (overall 43 days vs. the National Quality Measures for Breast Centers value of 28 days).
Conclusions: Medical care delays may contribute, in part, to the widening breast cancer mortality gap between Black women and White women. Further study, with additional clinical and social information, is needed to broaden scientific understanding of racial determinants and assess the clinical significance of mammogram to treatment times among Medicare beneficiaries.

Breast cancer has the highest incidence of all neoplastic diseases affecting U.S. women (Centers for Disease Control and Prevention, 2015). Moreover, breast cancer frequency among White women (122 in 100,000) exceeds that among Black women (117 in 100,000; Centers for Disease Control and Prevention, 2015). Nonetheless, mortality from breast cancer is higher among Black women. This is especially true for older non-Hispanics. In 2014, the most recent year for which data is available (Centers for Disease Control and Prevention, 2016), the U.S. breast cancer mortality rate among Black women ages 65 to 84 years was 102.65 (95% confidence interval [CI], 98.24–107.05) for non-Hispanics and 37.75 (95% CI, 24.88–54.92) for Hispanics, whereas corresponding values for White women were 84.84 (95% CI, 83.43–86.25) and 58.14 (95% CI, 54.38–61.91). In contrast, the mortality rate for Black women ages 35 to 64 years

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was 36.28 (95% CI, 35.01–37.55) for non-Hispanics and 9.19 (95% CI, 6.60–12.47) for Hispanics, whereas corresponding values for White women were 21.33 (95% CI, 20.90–21.75) and 17.59 (95% CI, 16.68–18.49). Moreover, the U.S. Black–White mortality gap has been widening for several decades (Hunt, Whitman, & Hurlbert, 2014). Explanations for this phenomenon have identified later stages of cancer at the time of diagnosis (Chatterjee, He, & Keating, 2013; Silber et al., 2013) and poor access to high-quality care among Black women (Curtis, Quale, Haggstrom, & Smith-Bindman, 2008; Field et al., 2011; Hunt et al., 2014) as key problems. Specifically, significantly longer time intervals have been observed between abnormal mammogram and treatment initiation for Black women as compared with White women (Ashing-Giwa et al., 2010; Bleicher et al., 2012; George et al., 2015; Gorin, Heck, Cheng, & Smith, 2006). In particular, Gorin et al. (2006) reported that Black women ages 65 years and older were 1.39 times more likely to wait more than 60 days between an abnormal mammogram and a diagnostic biopsy, and 1.64 times more likely to wait more than 30 days for treatment once breast cancer was diagnosed. Longer intervals between diagnostic biopsy and treatment among Black women relative to White women have also been apparent after controlling for insurance coverage, cancer stage, and age (Fedewa et al., 2011; Johnston, Blake, Andes, Chien, & Adams, 2014).

The present study tested the hypotheses that the duration of critical intervals between abnormal mammogram and breast cancer treatment within a large cohort of Medicare beneficiaries vary by age, race, and medical comorbidities.

Methods

Medicare Sample Selection

Administrative data from a cohort of randomly selected Medicare beneficiaries was purchased from the Center for Medicare and Medicaid Services. The cohort consisted of non-Hispanic Black and White beneficiaries ages 65 and older who resided in the continental United States and whose claims were tracked from 2005 to 2008. Beneficiaries who did not have outpatient service coverage (Medicare Part B) were excluded because screening mammography is generally an outpatient procedure. Also, beneficiaries receiving services from a health maintenance organization at any time during the observation period were excluded because health maintenance organizations do not provide billing claims data to Medicare.

Place of Residence

Using Federal Information Processing Standard codes, we formulated a separate sampling frame for each continental U.S. county or county equivalent (the District of Columbia, parishes in Louisiana; and cities in Maryland, Missouri, and Virginia are all considered to be county equivalents), and stratified by race (Black or White). Unless there were fewer than 250 Black or 250 White beneficiaries, we randomly selected 250 Black women and 250 White women from each county. When there were fewer than 250, all beneficiaries from the group(s) with less than 250 beneficiaries were included. Race- and age-specific sampling weights were obtained by dividing the number of women in the Medicare Denominator File for each particular county by the race- and age-specific number of women in that county. Because only 250 cases are needed in each group to provide sufficient power for racial comparisons (Cohen, 1992), the present data provide sufficient power to detect differences according to race.

Medicare Claims Selection and Definition of Screening and Diagnostic Mammograms

Outpatient, inpatient, and physician (carrier) claims data for 2005 to 2008 were identified from the outpatient and carrier files, and then outpatient, inpatient, and physician files were linked to the claims for mammography using the following Healthcare Common Procedure Coding System codes: 76082, 76090, 76091, 77051, 77055, 77056, G0203, G0204, G0205, and G0206 for diagnostic mammograms, and 76083, 76092, 77052, 77057, and G0202 for screening mammograms. Because coding errors preclude direct use of these Healthcare Common Procedure Coding System codes for defining screening mammograms as differentiated from diagnostic mammograms, we used algorithms specifically validated for that purpose to do so (Smith-Bindman, Quale, Chu, Rosenberg & Kerlikowske, 2006; Fenton et al., 2014). As part of this process, we also noted whether there was a diagnosis of a lump or breast mass (with the diagnosis codes of 611.72 or 217) at the time of mammography. Breast cancer diagnoses included the *International Classification of Disease* 10th edition codes C50 and D05. Comorbidity was estimated with the Charlson score (Charlson, Pompei, Ales, & MacKenzie, 1987).

Timeliness of Care

Times to biopsy following abnormal mammogram and to treatment following positive biopsy have been considered as quality of care indicators (Kaufman et al., 2010; Landercasper et al., 2010; Logan, Weiss, Hagan-Aylor, & Herbertson, 2013; Richardson et al., 2010). Among more than 175 members of the National Consortium of Breast Centers, the National Quality Measures for Breast Centers (NQMBC) program identified medians of 7 days for the former, 14 days for the latter, and 28 days from abnormal mammogram to treatment (Kaufman et al., 2010) as measures of timely care. These were used for Cox proportional hazards modeling as described in the Analyses section.

Analyses

All analyses accounted for weighting by using survey procedures in SAS v9.23 (SAS, Inc., Cary, NC). The independent effects of age, race/ethnicity, and comorbidity were assessed with two types of multivariate analysis. Cox proportional hazard models were used to estimate outcomes specified as duration or waiting times, that is, the duration between events. Logistic regression models were used to estimate the likelihood of a discrete event. Referent categories were assigned to ensure that longer durations were associated with hazard ratio (HR)/odds ratio greater than 1.0. In the logistic regression analyses, odds ratios indicated greater ($>$1.0) or lesser ($<$1.0) likelihood of receiving biopsies or treatment consistent with the aforementioned NQBMC median standards (Kaufman et al., 2010).

Approval

This study was approved by the Institutional Review Board of Tennessee State University.

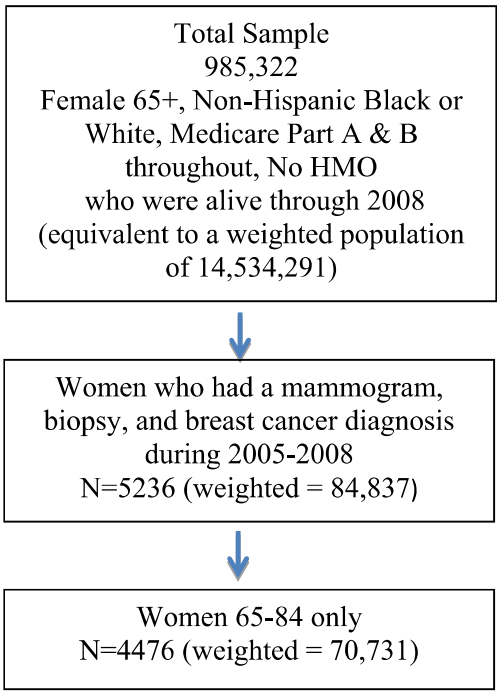

Figure 1. Summary of sample selection: U.S. Medicare beneficiaries, 2005 to 2008. *Abbreviation*: HMO, health maintenance organization.

Results

There were 4,476 women (weighted n = 70,731) with a diagnosis of breast cancer included in these analyses (Figure 1). Table 1 shows that, among women aged 65 to 84 years, the mean duration from abnormal mammogram to biopsy was 33.50 days (95% CI, 25.35–41.65), with a median duration of 14 days. Additionally, the mean number of days from biopsy to treatment was 31.20 days (95% CI, 29.04–33.36) with a median of 23 days. On average, the overall time from mammogram to treatment was 65.07 days (95% CI, 56.17–73.98), with a median of 40 days. As shown by consistently overlapping 95% CIs, there were no differences within each category (mammogram to biopsy, biopsy to treatment, and mammogram to treatment) according to age (65–74 or 75–84), race (Black or White), or Charlson Comorbidity coefficient (none, 1, or ≥2).

Table 2 shows results for Cox proportional hazard modeling for intervals longer than the aforementioned NQMBC medians. Black women had a significantly greater risk for longer duration between diagnostic biopsy and initiation of treatment (HR, 1.424; p = .003), and between abnormal mammogram and initiation of treatment (HR, 1.267; p = .015). Table 3 presents the likelihood of receiving biopsies or treatment consistent with the same NQMBC standards. Logistic regression indicated that none of the factors examined were significant predictors of longer duration in these data.

Discussion

In this cohort of non-Hispanic Black or non-Hispanic White Medicare beneficiaries residing in the continental United States and undergoing breast cancer treatment completely outside health maintenance organization settings between 2005 and 2008, the data support the hypothesis that Black race is associated with a delay between diagnostic biopsy and breast cancer treatment. Medical care delays may therefore be part of the reason for the widening racial gap in breast cancer mortality noted by Hunt et al. (2014). Many barriers related to health care use are more likely to affect Black women, including lack of transportation, fears of mammography-related pain, embarrassment, partner abandonment, inability to meet care giving and other obligations if a diagnosis of cancer were made, a belief that surgery may increase the chance of metastasis, lack of knowledge (about mammography, breast cancer risk factors, breast cancer treatment, and breast cancer screening guidelines), poor health literacy, a propensity for placing a lower priority on prevention as compared with more acute problems, religious beliefs that "God will provide," fatalism, and mistrust of the health care system (Bartle-Haring, 2010; Corrarino, 2015; Gerend & Pai, 2008). Additionally, Sheppard et al. (2013) observed a significant difference in days between breast cancer surgery and chemotherapy initiation for Black women (72 days) in comparison with White women (55 days). However, the difference was not significant after adjusting for self-reported quality of trust in the relationship with the treating physicians. Overall, the present data give evidence that the benefit of physician reimbursement provided to all members of the present cohort by Medicare may have been insufficient to overcome these additional barriers.

In addition to racial differences, the data suggest overall delays beyond the NQNBC benchmark equally affect Black women and White women. The median interval from abnormal mammogram to biopsy (14 days) was double the NQMBC median of 7 days, and the median of 23 days from biopsy to treatment initiation in these data was more than 60% greater than the

Table 1
Number of Days between Mammogram and Biopsy, Biopsy to Treatment, and Mammogram to Treatment

	N (%)	Mammogram to Biopsy		*N* (%)	Biopsy to Treatment		Mammogram to Treatment	
		Mean (95% CI)	Median (d)		Mean (95% CI)	Median (d)	Mean (95% CI)	Median (d)
Total	70,731 (100)	33.50 (25.35–41.65)	14	67,924 (100)	31.20 (29.04–33.36)	23	65.07 (56.17–73.98)	40
Age (y)								
65–74	31,079 (43.94)	39.52 (21.96–57.08)	14	30,051 (44.24)	31.18 (27.82–34.53)	23	71.42 (52.56–90.28)	40
75–84	39,652 (56.06)	28.79 (24.75–32.83)	14	37,873 (55.76)	31.22 (28.40–34.04)	23	60.04 (55.10–64.98)	41
Race/ethnicity								
Black	5,268 (7.45)	31.75 (22.37–41.13)	14	4,626 (6.81)	44.66 (32.29–57.02)	27	77.45 (62.68–92.23)	46
White	65,463 (92.55)	33.65 (24.87–42.42)	14	63,298 (93.19)	30.22 (28.10–32.34)	23	64.17 (51.66–73.68)	40
Charlson Comorbidity Coefficient								
None	46,035 (65.08)	30.07 (23.50–36.63)	13	44,271 (65.18)	30.02 (27.70–32.35)	23	60.61 (53.37–67.84)	39
1	15,912 (22.50)	29.70 (22.53–36.86)	14	15,192 (22.37)	30.59 (26.33–34.84)	20	59.57 (50.79–68.35)	40
≥2	8,784 (12.42)	58.42 (8.27–108.58)	17	8,461 (12.46)	38.48 (29.24–47.73)	27	98.32 (26.68–150.73)	52

Abbreviation: CI, confidence interval.

Table 2
Factors Predicting the Hazard of a Duration Longer than National Quality Measures for Breast Centers Times to Biopsy after an Abnormal Mammogram, from Biopsy to Treatment, and from Mammogram to Treatment

	Mammogram to Biopsy		Biopsy to Treatment		Mammogram to Treatment	
	Hazard Ratio (95% CI)	*p*	Hazard Ratio (95% CI)	*p*	Hazard Ratio (95% CI)	*p*
Age (y) ≥75–84, (<75 referent)	1.063 (0.916–1.232)	.421	1.088 (0.956–1.238)	.202	1.071 (0.931–1.232)	.337
Non-Hispanic Black (non-Hispanic White referent)	1.031 (0.868–1.224)	.726	1.424 (1.131–1.794)	.003*	1.267 (1.047–1.534)	.015*
One comorbid condition (0 is referent)	1.093 (0.947–1.260)	.224	1.003 (0.866–1.162)	.967	1.038 (0.898–1.200)	.611
More than 1 comorbid condition (0 is referent)	1.367 (0.891–2.096)	.152	1.208 (0.977–1.494)	.082	1.428 (0.941–2.165)	.094

Abbreviation: CI, confidence interval.
* $p < .05$.

NQMBC median of 14 days. Furthermore, the median of 40 days from abnormal mammogram to treatment initiation in these data was greater than the 29 days reported by Bleicher et al. (2012), who counted from first breast-related claim from a physician to surgery. Treatment initiation more than 84 to 90 days after diagnosis may be associated with reduced survival (Eastman et al., 2013; Jung et al., 2011). Additionally, in a study of low-income North Carolina women (44% non-White) McLaughlin et al. (2012) found that those with an interval of greater than 60 days between diagnosis and treatment initiation had a significantly higher risk of death related to breast cancer (HR, 1.85; 95% CI, 1.04–3.27; $p = .04$) and a borderline increased risk of death from all causes (HR, 1.66; 95% CI, 1.00–2.77; $p = .05$). The interval between abnormal mammogram and treatment initiation has been lengthening for all U.S. women over the past several decades (Bleicher et al., 2012; Caplan, 2014; Hulvat, Sandalow, Rademaker, Helenowski, & Hansen, 2010).

Findings of no significant delay in obtaining diagnostic resolution after an abnormal mammogram associated with comorbidities, while ascertaining that the interval between diagnostic biopsy and treatment is significantly longer for women with two or more comorbidities, parallels others' observations (Fedewa et al., 2011; Freedman, He, Winer, & Keating, 2013; Liederbach et al., 2015). When navigators are available, and when diagnostic centers are proactive, women with varying levels of comorbidity may be more likely to move at a fairly similar pace (Borugian et al., 2008; Hoffman et al., 2012) in obtaining a diagnosis. Qualitative interviews have indicated that facilitators of timely diagnostic procedures also include staff and social support (Allen, Shelton, Harden, & Goldman, 2008), which may have been distributed similarly among women with differing numbers of comorbidities in this study sample. However, the interval from diagnostic procedures to treatment involves more complex decisions about treatment, and physicians may recommend additional procedures which may contribute to frequent findings of lengthier times for women with more complex medical conditions (Ashing-Giwa et al., 2010; Balasubramanian et al., 2012; Fedewa et al., 2011).

Previous research shows strong and consistent associations between number of comorbidities and breast cancer survival (Land, Dalton, Jørgensen, & Ewertz, 2012). Positive associations have also been found between comorbidity and treatment delays (Freedman et al., 2013; Liederbach et al., 2015). The present results, however, do not show an association between medical care delay and comorbidity. In part, this may reflect the study design. Because the primary purpose of the investigation was to determine regular mammography use from 2005 to 2008, women who died between 2005 and 2007, and who may have had more severe disease, were not included. Conflicting results could also reflect, in part, the wide variety of factors associated with timing of resolution and treatment, including patient-level barriers that compromise an individual's ability to access health care services, and system-level factors such as communications from providers that are difficult to understand (Katz et al., 2014), presence or absence of hospital–academic affiliations (Liederbach et al., 2015), rural location, or lower volume of breast cancer treatment (Freedman et al., 2013). There is evidence that older minority women with advanced breast cancer and/or comorbid conditions may have pretreatment impairment in executive functioning (Mandelblatt et al., 2014) that may contribute to delays in time from positive biopsy to treatment. Therefore, brief routine screening for impaired cognitive functioning (Athilingam, Visovsky, Elliott, & Rogal, 2015), especially among women with comorbidities, may be used to alert care providers to needs for additional support for patients to receive timely care.

Additionally, individualized patient navigation services have been found to decrease the number of days from one stage in cancer care to the next (Ferrante, Chen, & Kim, 2008; Hoffman et al., 2012; Katz et al., 2014; Lee et al., 2013; Markossian, Darnell, & Calhoun, 2012). Improved data collection in varied clinical settings that includes multiple patient- and system-level

Table 3
Factors Predicting the Likelihood of Receiving a Biopsy within 7 Days of an Abnormal Mammogram, Treatment within 21 Days of a Positive Biopsy, and Treatment within 28 Days of an Abnormal Mammogram with a Cancer Diagnosis

	Mammogram to Biopsy		Biopsy to Treatment		Mammogram to Treatment	
	Odds Ratio	*p*	Odds Ratio	*p*	Odds Ratio	*p*
Age (y) ≥ 75–84, (<75 referent)	0.814 (0.601–1.104)	.1855	1.021 (0.782–1.332)	.8795	0.957 (0.728–1.259)	.7544
Non-Hispanic Black (non-Hispanic White referent)	1.132 (0.723–1.771)	.5877	0.906 (0.624–1.314)	.6020	1.165 (0.742–1.829)	.5067
One comorbid condition (0 is referent)	0.866 (0.610–1.229)	.4199	1.240 (0.912–1.685)	.1693	0.994 (0.717–1.376)	.9688
More than one comorbid condition (0 is referent)	0.684 (0.422–1.108)	.1227	0.783 (0.486–1.261)	.3143	0.760 (0.478–1.209)	.2471
Depression diagnosis (none is referent)	1.096 (0.722–1.663)	.6669	0.963 (0.661–1.405)	.8455	1.004 (0.668–1.509)	.9835

Abbreviation: CI, confidence interval.

factors could lead to a better understanding of the interplay between these factors (Smedley, Stith, & Nelson, 2003).

Limitations of this study include a lack of information about clinical stage at diagnosis as well as specific patient- and system-level barriers. Moreover, the data did not include information about psychiatric comorbidities, such as depression and anxiety (Chang et al., 2014; Kronman et al. 2012; Goodwin, Zhang, & Ostir, 2004; Morris, Hadley, & Koehly, 2013), which some have found to be a mediator of adherence to follow-up of abnormal mammograms and biopsies. Future exploration of variations in treatment should examine these kinds of comorbid conditions. In addition, although median values were used to compare the results of this study with NQMBC benchmarks, the wide ranges in interval duration associated with some variables, such as those for women with more than two comorbid conditions, warrants closer examination in future studies.

Despite these and other limitations, the strengths of the present data, including the availability of data from a large national cohort of Medicare beneficiaries, are sufficient to provide support for the hypothesis that widening gaps in breast cancer survival between Black women and White women may be owing, in part, to poorer access to high-quality care among Black women. Although definitive timelines associated with increased harm have yet to be established (Kaufman et al., 2010), we agree with Chen, King, Pearcey, Kerba, and Mackillop (2008) that, "Studies do not suggest that there is a threshold below which delay has a lesser impact on the risk of local recurrence" (p. 8). Furthermore, the results support the call for continued investigation of correlates of treatment delays affecting mammograms, biopsies, and treatments (Tian, Goovaerts, Zhan, Chow, & Wilson, 2012) and suggestions that equalization of timely diagnosis and treatment following abnormal screening results is an essential step toward reducing disparities in mortality for all women (Bowen et al., 2013; Kiely, 2014). The longer duration of time from diagnosis to treatment among Black women in the present data suggests that such equalization may remain to be achieved among a significant portion of Medicare beneficiaries.

Implications for Practice and/or Policy

Improving care for Black women after abnormal mammography outcomes may reduce disparities in survival among those diagnosed with breast cancer. Clinical support staff or nurse navigators could use electronic flags to draw attention to delays in follow-up, and contact women to identify barriers to diagnostic biopsies and treatment after diagnosis. Furthermore, at the time a woman is notified of an abnormal mammogram or positive biopsy, she could be queried about the potential impact of comorbidities on scheduling and following through with biopsies and treatment initiation, which then could be addressed by a patient navigator. Documentation of biopsy or treatment delays owing to physician-recommended additional testing or scheduling difficulties could be used to guide quality improvement efforts in clinical settings. In addition, there is evidence that older minority women with advanced breast cancer and/or comorbid conditions may have pretreatment impairment in executive functioning (Mandelblatt et al., 2014) that may contribute to delays in time from positive biopsy to treatment. Therefore, brief routine screening for impaired cognitive functioning (Athilingam et al., 2015), especially among women with comorbidities, may be used to alert care providers to needs for additional support for patients to receive timely care.

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