Timely Care After an Abnormal Mammogram Among Low-Income Women in a Public Breast Cancer Screening Program

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Background: Since 1990, the National Breast and Cervical Cancer Early Detection Program (BCCEDP) has funded breast cancer screening and diagnostic services for low-income, underinsured women. Case management was implemented in 2001 to address barriers to follow-up after an abnormal mammogram, and free treatment was introduced in 2004. However, the effect of these policies on timeliness of care has not been empirically evaluated.

Methods: Among 2252 BCCEDP participants in Massachusetts during 1998 through 2007, we conducted a time-to-event analysis with prepolicy-postpolicy comparisons to examine associations of case management and free treatment with diagnostic and treatment delays (>60 days and >90 days, respectively) after an abnormal mammogram.

Results: The proportion of women experiencing a diagnostic delay decreased from 33% to 23% after the introduction of case management ($P<.001$), with a significant reduction in the adjusted risk of diagnostic delay (relative risk [RR], 0.65; 95% confidence interval [CI], 0.53-0.79) that did not differ by race and ethnicity. However, case management was not associated with changes in treatment delay (RR, 0.93; 95% CI, 0.80-1.10). Free treatment was not associated with changes in the adjusted risk of diagnostic delay (RR, 0.61; 95% CI, 0.33-1.14) or treatment delay (RR, 0.77; 95% CI, 0.43-1.38) beyond improvements associated with case management.

Conclusions: Case management to assist women in overcoming logistic and psychosocial barriers to care may improve time to diagnosis among low-income women who receive free breast cancer screening and diagnostic services. Programs that provide services to coordinate care, in addition to free screening and diagnostic tests, may improve population health.

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THE GOAL TO EXPAND HEALTH insurance coverage in the United States has placed new emphasis on the effectiveness of existing public health programs. With limited resources for health care financing, policymakers will have to decide which programs to cut or retain. To inform the current health reform debate, empirical evaluations are needed to determine whether established programs provide measurable benefits to population health, including the elimination of disparities.

Disparities in breast cancer outcomes exist by race and ethnicity, insurance status, and income level and include more advanced stage at diagnosis, lower stage-specific survival rates, and higher death rates for low-income or uninsured women.[1-5] To reduce the disproportionate burden of breast cancer among women with these characteristics[1,3] the US Congress authorized the National Breast and Cervical Cancer Early Detection Program (BCCEDP) in 1990 (Public Law 101-354).[6] This program serves a critical role in reducing barriers to breast cancer detection by funding breast cancer screening and diagnostic services for women who have historically been underserved by the medical system.[6]

However, improved access to health services alone does not necessarily translate into healthier populations.[2,7,8] Two subsequent laws enacted by Congress recognized the need to facilitate timely diagnosis and initiation of treatment among National BCCEDP participants. In the Women's Health Research and Prevention Amendments of 1998 (Public Law 105-340), targeted funding was provided for case managers to assist National BCCEDP clients complete timely diagnostic testing after an abnormal mammogram and to enroll women in affordable treatment if breast cancer was diagnosed.[6] In the Breast and Cervical Cancer Prevention and Treatment Act of 2000 (Public Law 106-354), states were given the option to use Medicaid to cover the cost of breast cancer treatment for eligible women.[6]

The BCCEDP case management process provides women with support to reduce anxiety, coordinates patient-doctor communications, and reduces health sys-

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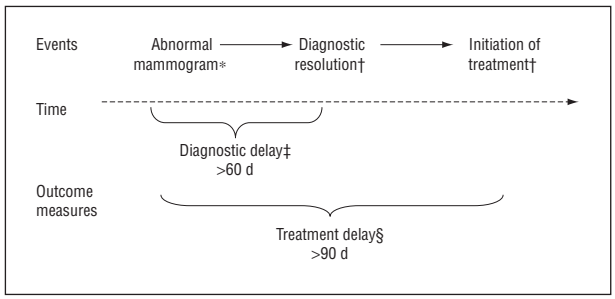

Figure. Outcome measures of delay. *Abnormal index mammograms were obtained from July 1, 1998, through March 31, 2007; †follow-up events occurred July 1, 1998, through June 30, 2007; ‡based on the Centers for Disease Control and Prevention recommendations[19] for timely follow-up; §based on evidence suggesting that treatment delays as short as 3 months may contribute to poorer survival.[20]

tem barriers similar to patient navigation programs reported in the literature. Studies of patient navigation suggest that it can improve timely resolution after an abnormal mammogram.[9-14] To our knowledge, no systematic study has been performed to evaluate change in diagnostic and treatment delays after implementation of the BCCEDP case management program and free treatment policy. To address this gap in knowledge, we used data from the Massachusetts BCCEDP to examine the following research questions: (1) Was implementation of the case management policy associated with lower risk of diagnostic and treatment delay after an abnormal mammogram? (2) Was implementation of the free treatment policy associated with lower risk of diagnostic and treatment delay after an abnormal mammogram? and (3) Did associations between these policies and risk of delays in diagnosis and treatment of breast cancer differ by race and ethnicity?

METHODS

DATA SOURCE

Data were obtained from the Massachusetts BCCEDP, which was established in 1993 and administered by the Massachusetts Department of Public Health. Women eligible for the program have annual incomes less than 250% of the federal poverty level, are uninsured or underinsured, and are primarily 40 to 64 years old. However, occasionally women younger than 40 years or older than 64 years qualify for the program and are not turned away owing to age restrictions. Since the inception of the Massachusetts BCCEDP, 45 contractors (including community health centers, hospitals, and visiting nurse programs) have participated to provide outreach to eligible women and health education, breast cancer screening, diagnostic tests, and case management to participants.

This research protocol used existing, deidentified data and was thus deemed exempt from review by the Harvard School of Public Health human subjects committee. The study protocol was approved by the Massachusetts Department of Public Health research and data access review committee.

CASE MANAGEMENT

Starting on July 1, 2001, all Massachusetts BCCEDP clients, with a mammogram result of Breast Imaging Reporting and Data System (BI-RADS) 4 (suspect abnormality) or 5 (highly suggestive of malignant neoplasm)[15] were offered case management. Further details of case management, including client consent to participate, actual services provided, and additional revenues paid to contractors, were not available in the data source used for this study and have not been previously summarized. Minimum credentials for a case manager included a current licensure or national certificate in case management and either a bachelor's degree in health and human services or registered nurse license in Massachusetts. Contractors were encouraged to hire case managers fluent in languages of the women served. Case managers assisted women to obtain timely subsequent diagnostic tests by educating patients, scheduling follow-up visits, communicating with providers, providing transportation vouchers, scheduling interpreter services, and enrolling clients in treatment programs.[16]

FREE TREATMENT

As of January 1, 2004, free treatment was made available through Medicaid for Massachusetts BCCEDP participants diagnosed with breast cancer. The free treatment program was not administered by the BCCEDP. However, case managers assisted women to apply for free treatment or enroll in alternative treatment programs if they were not eligible for free treatment. After women enrolled in a treatment program, no further follow-up was provided by the BCCEDP case manager. Details of whether a woman enrolled in the free treatment program were not available in the data used for this study.

STUDY POPULATION

Women with an abnormal mammogram (BI-RADS 4 or 5) during the period July 1, 1998, through March 31, 2007, were eligible for the study. Screening mammograms were defined by *Current Procedural Terminology*[17] (*CPT*) code 76092 (bilateral) or *Healthcare Common Procedure Coding System*[18] (HCPCS) code G0202 (direct digital image, bilateral). Diagnostic mammograms were identified by *CPT* codes 76090 (unilateral) and 76091 (bilateral) or HCPCS codes G0204 (direct digital image, bilateral) and G0206 (direct digital image, unilateral). For each woman, we selected the first abnormal mammogram in the study period for inclusion in the study. To ensure that changes in contractors did not account for changes in times to events, we limited inclusion to contractors engaged with the Women's Health Network during all 3 study periods (pre–case management, July 1, 1998, through June 30, 2001; post–case management, July 1, 2001, through December 31, 2003; and post–treatment funding, January 1, 2004, through March 31, 2007). Only women with self-reported race and ethnicity as non-Hispanic white, non-Hispanic black, non-Hispanic Asian, or Hispanic were included in the sample because other individual racial or ethnic groups did not have sufficient numbers to make meaningful contributions to the analysis.

MEASURES

Two outcome measures of delay were assessed: diagnostic delay[18] and treatment delay[19] (**Figure**). Diagnostic delay was based on the Centers for Disease Control and Prevention clinical guidelines recommending resolution of a diagnostic evaluation within 60 days after an abnormal mammogram.[18] Diagnostic resolution was defined as either a biopsy-confirmed diagnosis of breast cancer or a finding that breast cancer was ruled out through diagnostic ultrasonography, biopsy, or diagnostic mammogram (BI-RADS 1, 2, or 3).[15] Treatment delay was computed only for women diagnosed with breast cancer and was based on literature suggesting that initiation of treatment more than 90 days after an abnormal mammogram might be associated with decreased breast cancer survival.[19]

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Table 1. Massachusetts BCCEDP Participants With Abnormal Mammograms[a]

Characteristic	Study Participants, No. (%)[b] Pre–Case Management 7/1/1998-6/30/2001 (n=832)	Post–Case Management 7/1/2001-12/31/2003 (n=536)	Post–Free Treatment 1/1/2004-3/31/2007 (n=884)	*P* Value[c]
Age, y				
<40	86 (10)	61 (11)	105 (12)	.50
40-49	352 (42)	244 (46)	386 (44)	
50-64	361 (43)	219 (41)	366 (41)	
≥65	33 (4)	12 (2)	27 (3)	
Race/ethnicity				
Non-Hispanic white	544 (65)	305 (57)	509 (58)	<.001
Non-Hispanic black	85 (10)	56 (10)	73 (8)	
Hispanic	192 (23)	166 (31)	272 (31)	
Non-Hispanic Asian	11 (1)	9 (2)	30 (3)	
Education				
Less than high school	230 (28)	149 (28)	195 (22)	<.001
High school or equivalent	286 (34)	168 (31)	324 (37)	
Some college and/or associate's degree	161 (19)	117 (22)	155 (18)	
Bachelor's degree or higher	120 (14)	58 (11)	121 (14)	
Unknown	35 (4)	44 (8)	89 (10)	
Primary language				
English	552 (66)	298 (56)	488 (55)	<.001
Spanish	140 (17)	116 (22)	175 (20)	
Portuguese	75 (9)	62 (12)	113 (13)	
Other	60 (7)	52 (10)	79 (9)	
Unknown	5 (1)	8 (1)	29 (3)	
Index abnormal mammogram				
Screening	436 (52)	114 (21)	65 (7)	<.001
Diagnostic	396 (48)	422 (79)	819 (93)	
Abnormal clinical breast examination finding				
Yes	121 (15)	117 (22)	209 (24)	<.001
No	711 (85)	419 (78)	675 (76)	
Prior mammogram				
Yes	292 (35)	292 (54)	521 (59)	<.001
No	540 (65)	244 (46)	363 (41)	
Breast cancer				
Diagnosed	139 (17)	105 (20)	198 (22)	.051
Ruled out	628 (75)	389 (73)	613 (69)	
No resolution	65 (8)	42 (8)	73 (8)	

Abbreviations: BCCEDP, Breast and Cervical Cancer Early Detection Program; BI-RADS, Breast Imaging Reporting and Data System.

[a] Abnormal mammograms associated with ratings of BI-RADS 4 (suspect abnormality) or 5 (highly suggestive of malignant neoplasm) that occurred from July 1, 1998, through March 31, 2007.

[b] Percentages may not total 100% owing to rounding.

[c] χ^2 Test.

Demographic characteristics obtained for analyses included age at the time of the abnormal mammogram, education, and primary language. We also measured whether an abnormal finding on clinical breast examination (CBE) was reported on the same date or within 6 months before the abnormal mammogram and whether a woman underwent mammography through the Massachusetts BCCEDP prior to the abnormal mammogram.

STATISTICAL ANALYSIS

The Cochran-Armitage test for trend and χ^2 test were used, as appropriate, to examine bivariate associations between demographic and clinical variables, study periods, and outcome measures of delay. The unadjusted median number of days and interquartile range from the abnormal mammogram to diagnostic resolution and initiation of treatment were assessed with Kaplan-Meier survival estimates. We included observations through June 30, 2007, to allow a minimum of 90 days for a follow-up event. Observations without a follow-up event were censored, and June 30, 2007, was assigned as the event date.

Because our interest was to evaluate the reduction in delay associated with case management and free treatment policies based on a clinically relevant number of days,[6,19] we estimated the adjusted relative risk (RR) of diagnostic and treatment delay by Poisson regression instead of survival analysis. Adjusted models controlled for race, ethnicity, education, primary language, age centered around the mean for the sample, abnormal CBE findings, completion of prior mammography, type of index mammogram (screening or diagnostic), and the effect of the other study period because these characteristics changed over time in our study, and/or the literature suggests that they are associated with timely follow-up. Models that examined adjusted RR of diagnostic delay also included a dummy variable for each contractor to control for differences in program implementation or changes in contractor characteristics associated with the outcomes. The small number of cancer cases precluded us from including the contractor dummy variables in the model that examined adjusted RR

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Table 2. Timing of Clinical Care After an Abnormal Mammogram[a] for Massachusetts BCCEDP Participants

Characteristic	Participants, No. (N=2252)	Days to Diagnostic Resolution, Median (Interquartile Range), No.[b]	*P* Value[c]
All Participants (N=2252)			
Study period			
Pre–case management, July 1, 1998, through June 30, 2001	832	40 (21-84)	<.001
Post–case management, July 1, 2001, through December 31, 2003	536	32 (17-57)	
Post–free treatment, January 1, 2004, through June 30, 2007	884	28 (15-54)	
Race or ethnicity			
Non-Hispanic white	1358	29 (15-57)	<.001
Non-Hispanic black	214	37 (21-67)	
Hispanic	630	38 (22-71)	
Non-Hispanic Asian	50	30 (12-159)	

Characteristic	Participants, No. (n=442)	Days to Initiation of Treatment, Median (Interquartile Range), No.[b]	*P* Value
Breast Cancer Cases (n=442)			
Study period			
Pre–case management, July 1, 1998, through June 30, 2001	139	57 (34-90)	.001
Post–case management, July 1, 2001, through December 31, 2003	105	45 (28-70)	
Post–free treatment, January 1, 2004, through June 30, 2007	198	42 (30-60)	
Race/ethnicity			
Non-Hispanic white	320	45 (30-74)	.21
Non-Hispanic black	37	36 (28-66)	
Hispanic	79	51 (35-79)	
Non-Hispanic Asian	6	40 (17-54)	

Abbreviations: BCCEDP, Breast and Cervical Cancer Early Detection Program; BI-RADS, Breast Imaging Reporting and Data System.
[a] Abnormal mammograms associated with ratings of BI-RADS 4 (suspect abnormality) or 5 (highly suggestive of malignant neoplasm) that occurred from July 1, 1998, through March 31, 2007.
[b] Kaplan-Meier estimates.
[c] Wilcoxon test for equality over strata.

of treatment delay. We also assessed whether the policies had a differential effect on outcomes by race and ethnicity by including interaction terms for "race/ethnicity by study period" in the adjusted Poisson regression models. To account for the clustering of women within contractors, we used generalized estimating equations in these adjusted models.[20]

All *P* values were 2-tailed, and $P<.05$ was set as the threshold for statistical significance. We used SAS software, version 9.1 (SAS Institute Inc, Cary, North Carolina) for all analyses.

RESULTS

STUDY COHORT

A total of 2821 women from 45 contracting organizations were eligible for case management from July 1, 1998, through March 31, 2007. We excluded 186 owing to race or ethnicity other than white, black Asian, or Hispanic (7%); 12 owing to missing date of birth or age greater than 100 years (<1%); and 371 because the abnormal mammogram came from a contractor who had a gap in program participation (13%). The final sample consisted of 2252 women, aged 19 to 84 years, from 26 contracting organizations. We censored 197 observations because a diagnostic resolution (n=180, 8%) or initiation of treatment (n=17, <1%) did not occur within the observation period. The percentage of censored observations did not vary over time by diagnostic resolution ($P=.93$) or initiation of treatment ($P=.50$).

The distribution of several characteristics changed over the study periods. Racial and ethnic diversity of women was greater in the case management and free treatment periods compared with before these policies were implemented. Index abnormal mammograms were more likely to be diagnostic studies and associated with abnormal CBE findings, prior mammogram, or diagnosis of breast cancer during the case management and free treatment periods relative to the period before case management was implemented (**Table 1**).

TIMING OF CLINICAL CARE

The median time from an abnormal mammogram to diagnostic resolution decreased by 8 days from before to after the case management period, and by an additional 4 days from the post–case management period to the post–free treatment period. We also observed improvements in time to initiation of treatment across study periods. The median time from an abnormal mammogram to initiation of treatment decreased by 12 days from the before to after the case management period, and by 3 additional days from the post–case management period to the post–free treatment period (**Table 2**).

Among all study subjects, white and Asian women had the shortest median number of days to diagnostic resolution (29 days and 30 days, respectively). Among women diagnosed with breast cancer, black women had the shortest median number of days to initiation of treatment (36

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Table 3. Unadjusted Delays in Clinical Care After an Abnormal Mammogram[a] for Massachusetts BCCEDP Participants

Participants	Pre–Case Management, July 1, 1998, Through June 30, 2001	Post–Case Management, July 1, 2001, Through December 31, 2003	Post–Free Treatment, January 1, 2004, Through June 30, 2007	*P* Value[b]
		All Participants (N=2252)		
Total, No.	832	536	884	NA
Experienced diagnostic delay, No. (%)[c]	274 (33)	121 (23)	180 (20)	<.001
		Participants Diagnosed With Breast Cancer (n=442)		
Total, No.	139	105	198	NA
Experienced treatment delay, No. (%)[d]	34 (24)	15 (14)	22 (11)	.001

Abbreviations: BCCEDP, Breast and Cervical Cancer Early Detection Program; BI-RADS, Breast Imaging Reporting and Data System; NA, not applicable.
[a] Abnormal mammograms associated with ratings of BI-RADS 4 (suspect abnormality) or 5 (highly suggestive of malignant neoplasm) that occurred from July 1, 1998, through March 31, 2007.
[b] Cochran-Armitage test.
[c] Diagnostic delay was defined as more than 60 days from the index abnormal mammogram to diagnostic resolution.
[d] Treatment delay was defined as more than 90 days from the index abnormal mammogram to initiation of treatment.

Table 4. Adjusted[a] Relative Risks (95% Confidence Intervals) of Delays in Clinical Care After an Abnormal Mammogram[b] for Massachusetts BCCEDP Participants

Delay	Post–Case Management, July 1, 2001, through December 31, 2003[c]	Post–Free Treatment, January 1, 2004, Through June 30, 2007[d]
	All Participants (N=2252)	
Diagnostic[e]	0.65 (0.53-0.79)	0.93 (0.80-1.10)
	Participants Diagnosed With Breast Cancer (n=442)	
Treatment[f]	0.61 (0.33-1.14)	0.77 (0.43-1.38)

Abbreviations: BCCEDP, Breast and Cervical Cancer Early Detection Program; BI-RADS, Breast Imaging Reporting and Data System; NA, not applicable.
[a] Adjusted for age, education, primary language, race/ethnicity, abnormal clinical breast examination, mammogram history, type of index mammogram, and effect of other study period. The effect of contractors was held constant for estimates of relative risk of diagnostic delay.
[b] Abnormal mammograms associated with ratings of BI-RADS 4 (suspect abnormality) or 5 (highly suggestive of malignant neoplasm) that occurred from July 1, 1998, through March 31, 2007.
[c] Relative to pre–case management, July 1, 1998, through June 30, 2001.
[d] Relative to post–case management, July 1, 2001, through December 31, 2003.
[e] Diagnostic delay was defined as more than 60 days from the index abnormal mammogram to diagnostic resolution.
[f] Treatment delay was defined as more than 90 days from the index abnormal mammogram to initiation of treatment.

days), and Hispanic women had the longest median time to treatment (51 days) (Table 2).

UNADJUSTED TRENDS IN THE DELAY OF CLINICAL CARE

The proportion of women with diagnostic delay decreased by 10 percentage points following implementation of case management, and by an additional 3 percentage points following implementation of free treatment ($P<.001$). There was also a decreasing trend in the proportion of women who experienced treatment delay across study periods ($P=.001$), with a decrease of 10 percentage points after implementation of case management and an additional decrease of 3 percentage points after implementation of free treatment (**Table 3**).

ADJUSTED RELATIVE RISK OF CLINICAL DELAYS

We observed a 35% reduction in the adjusted risk of diagnostic delay during the case management period. An additional 7% decrease in the adjusted risk of diagnostic delay followed the implementation of free treatment, but the decrease in risk was not statistically significant. Similarly, the decreases in the adjusted risk of treatment delay after the implementation of case management and free treatment (39% and 23%, respectively) were not statistically significant (**Table 4**).

The risk of diagnostic delay was greater among Asian women than among white women (RR, 1.61; 95% confidence interval [CI], 1.17-2.20) and lower among women with an abnormal CBE finding than among those with no abnormality (RR, 0.73; 95% CI, 0.59-0.89). The risk of treatment delay was also lower among women who had a diagnostic mammogram as an index event compared with those who had a screening mammogram (RR, 0.54; 95% CI, 0.38-0.79) and was greater among women who completed an earlier mammogram through the program than among those who did not (RR, 1.62; 95% CI, 1.13-2.33). The associations of case management with diagnostic delay did not differ for non-Hispanic black ($P=.32$), Hispanic ($P=.48$), or Asian women ($P=.86$) compared with non-Hispanic white women.

COMMENT

To our knowledge this is the first time-to-event analysis with before-after comparisons to examine associations

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between implementation of case management and free treatment for BCCEDP participants and diagnostic and treatment delays. In this empirical evaluation of Massachusetts BCCEDP data, we found that implementation of case management was associated with improved timely diagnostic resolution after an abnormal mammogram. Notably, the association between case management and diagnostic delay did not differ by race or ethnicity. Case management was not associated with changes in time to treatment in our study. We also found no association between the implementation of free treatment and delays in diagnosis or treatment beyond improvements associated with case management.

Our finding that case management improved time to diagnosis is consistent with evidence from smaller observational studies and randomized trials that demonstrated patient navigation services successfully improved timely diagnosis for low-income minority women.[9-14] Randomized trials found that women who received patient navigation experienced a lower mean time to diagnostic resolution than those who received usual care (25 days vs 43 days)[12] and were more likely to receive a timely diagnosis (77% vs 57%).[11] We attribute similarities between our findings and earlier research to comparable activities performed by the Massachusetts BCCEDP case managers and patient navigators. These services likely removed barriers to diagnosis through psychosocial support and navigation of the health system. Unfortunately, we are not able to compare the level of delay or change in delay in our study to earlier research owing to differences in criteria for inclusion of BI-RADS categories, definitions of timely follow-up, methods for censoring missing events, and choice of statistics.

We found only 1 study of patient navigation that examined time to treatment.[11] This trial showed that a greater percentage of the patient navigation group initiated treatment within 90 days of an abnormal mammogram (80%, n=5) compared with patients undergoing usual care (50%, n=10).[11] The low number of women diagnosed with breast cancer precluded statistical testing of this difference. We experienced similar power issues in our adjusted analysis of treatment delay. With approximately 550 women enrolled in the pre–case management and post–case management periods, we had only 45% power to detect the 10% change in treatment delay at an alpha level of .05. However, when testing for unadjusted trends across all 3 study periods, we found a significant decrease in treatment delay.

The free treatment policy was not associated with timeliness of diagnostic resolution or initiation of treatment beyond improvements observed after implementation of case management. We attribute this finding to 2 factors. First, barriers to timely resolution of an abnormal mammogram are primarily due to health system factors[21-25] and patient factors[21-23] that were addressed through case management. Second, given the size of our sample, the probability of a false-negative finding was high at an alpha level of .05. We had only 22% power to detect the 3% change in diagnostic delay, and 10% power to detect the 3% change in treatment delay after implementation of free treatment. Moreover, the greatest benefits of free treatment may be found in outcomes not measured in this study, such as improved receipt of treatment sessions, reduced anxiety, and mitigation of the financial burden of cancer treatment.[3]

The greater RR of diagnostic delay among Asian women should be interpreted carefully because this estimate is strongly influenced by outlier values for time to resolution. Median days to diagnosis, a measure insensitive to outliers, showed that 50% of Asian women received diagnostic resolution within the same number of days as white women (30 days and 29 days, respectively). We found no other associations by race or ethnicity, and the relationship between case management and relative risk of diagnostic delay did not differ by race or ethnicity. This result implies that policies enacted to address barriers to care for low-income women, in addition to providing coverage for services, may improve the quality of care for all women served.

The observed lower risk of diagnostic delay among women with an abnormal CBE finding and among women with an index diagnostic mammogram are consistent with earlier research that suggests women with the greatest clinical need receive more timely follow-up.[26] The observed association between mammogram use and treatment delay is similar to an earlier study that found women who completed previous mammograms had longer time from abnormal mammogram to initiation of treatment.[27] Research is needed to inform our understanding of how earlier experiences with mammography may influence timely follow-up for subsequent tests.

Our ability to describe client participation in case management and free treatment was limited by lack of data on the type and frequency of services provided to women. More detailed information on program participation is kept in local records by contractors but is not summarized in a data source at the Massachusetts BCCEDP. Our study also did not have measures for history of breast cancer, use of hormone replacement therapy, or prior screening outside the program, all of which may have influenced timely follow-up if these characteristics changed over time. However, we did control for patient and clinical characteristics most likely to be associated with diagnostic and treatment delays to account for temporal changes in the race or ethnicity, educational level, primary language, type of index mammogram, breast symptoms, and prior mammogram use of program participants. Temporal change in these factors not related to the program under study but associated with the outcome is of greatest concern in before-after intervention studies that lack a comparison group. We are not aware of broader regional or statewide initiatives to improve follow-up of abnormal mammograms during the period when case management was implemented.

Several studies have demonstrated improved time to diagnostic resolution after implementation of patient navigation. However, gaps remain in knowledge on why this service is effective and whether the benefits outweigh the costs of maintaining the service. Future research can assess more detailed information on the costs and types of services and interactions between patients and navigators. Also, measuring more proximal outcomes of patient navigation may guide our ability to design effective programs by determining whether greater satisfaction with care or reduced anxiety over abnormal test results[12,16] improves timely follow-up.

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Our analysis was limited to 1 potential outcome of the free treatment policy. A more comprehensive evaluation is needed to examine the impact of free treatment on out-of-pocket costs and standards of care, given that income level, insurance status, and race are associated with these factors. Out-of-pocket costs for cancer care can force patients to incur debt, even when they are covered by private insurance.[28] In addition, standards of care for breast cancer are less likely to be followed for women who reside in impoverished areas, are uninsured, are enrolled in Medicaid, or of black race.[5,29-33]

The rate of timely follow-up after abnormal mammograms in this study was within the range reported in other studies. Earlier reports of diagnostic delays greater than 60 days have ranged from 18% to 29% (Massachusetts BCCEDP, 20%), and treatment delays greater than 90 days range from 5% to 22% (Massachusetts BCCEDP, 11%).[27,34-36] Results from our study may not be generalizable to other BCCEDP programs because the structure and implementation of case management services varies across sites. Nonetheless, our methods could readily be applied by other investigators to guide policy makers about the impact of BCCEDP programs in other states.

While improvement in rates of successful follow-up after abnormal findings are impressive for this public program, a reduction in disparities will also require a shift in social determinants of disease burden.[37] All women need insurance coverage for breast cancer screening and diagnostic services, particularly low-income women who are not able to pay for medical services out of pocket. However, limited funding for the BCCEDP means that services reach only about 13% of eligible women,[38] and breast cancer screening remains inaccessible for many low-income women.

Our study demonstrated that most women who participated in the Massachusetts BCCEDP received follow-up after an abnormal mammogram within the time recommended by clinical guidelines. Implementation of a case management policy through the Massachusetts BCCEDP was associated with improved time to resolution following an abnormal mammogram, and the benefits of this policy did not differ by race or ethnicity.

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