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Racial/ethnic disparities in time to a breast cancer diagnosis: the mediating effects of healthcare facility factors

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Abstract

Background—Racial/ethnic disparities exist along the breast cancer continuum, including time to a diagnosis. Previous research has largely focused on patient-level factors, and less is known about the role that healthcare facilities may play in delayed breast cancer care.

Objectives—We examined racial/ethnic disparities in delayed diagnosis for breast cancer in the Breast Cancer Care in Chicago study and estimated the potential mediating effects of facility factors.

Research Design and Subjects—Breast cancer patients (N= 606) contributed interview and medical record data as part of a population-based study.

Measures—Race/ethnicity was self-reported at interview. Diagnostic delay was defined as an excess of 60 days between medical presentation and a definitive diagnosis. Facility factors included the facility of medical presentation with respect to: (1) accreditation through the National Consortium of Breast Centers; (2) certification as a Breast Imaging Center of Excellence through the American College of Radiology; and (3) status as a disproportionate share hospital through the state of Illinois as well as the number of facilities used between presentation and diagnosis.

Results—Relative to non-Hispanic Whites, minorities were more likely to experience a diagnostic delay, present at a non-accredited facility and at a disproportionate share hospital, and involve multiple facilities in their diagnosis. Together, facility factors accounted for 43% of the disparity in diagnostic delay ($p<.0001$).

Conclusions—Initial presentation of breast cancer at higher-resourced facilities can reduce diagnostic delays. Disparities in delay are partly due to a disproportionate presentation at lower resourced facilities by minorities.

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Keywords

breast cancer; disparities; between-facility effects; accreditation; multi-site care

Introduction

Racial/ethnic disparities span the breast cancer continuum [1, 2]. Despite lower incidence rates, non-Hispanic (nH) Black and Hispanic women are more likely to experience late stage diagnosis [2-4] and die of breast cancer [5, 6]. The disparate experiences women face in care partially contribute to poorer clinical presentation and survival. For example, nH Black and Hispanic women experience longer delays to confirmed diagnosis of breast cancer [7-9], which has been associated with late stage detection [10] and poorer survival [11]. Studies concerning diagnostic delays have largely focused on patient factors [12-19], including socioeconomic, healthcare access, and utilization.

Less is known about the role that healthcare facilities may play in delays. Minority and nH White patients differ in where they seek care: minority patients attend facilities with fewer resources and lower quality of care [20, 21], which in turn may influence delays and outcomes [22-24]. For example, nH White women are more likely than nH Black or Hispanic women to obtain mammograms at facilities with academic affiliation, dedicated breast radiologists, and digital mammography [25]. Facilities serving minorities and other vulnerable populations generally report longer periods of time to diagnostic resolution [22], potentially due to limited resources and scheduling delays. Taken together, these studies suggest that racial/ethnic differences in where patients initially present with breast cancer may help to explain observed disparities in diagnostic delay.

The current study examines three types of facility factors that may mediate racial/ethnic disparities in time to diagnostic resolution. The first characteristic is accreditation, measured by status as a member of the National Consortium of Breast Centers (NCBC) [26] and certification as an American College of Radiology's Breast Imaging Center of Excellence program (BICOE) [27]. Accrediting agencies assess facilities' quality control and assurance for staff and equipment in multiple breast cancer detection technologies (e.g., mammography, breast ultrasound, magnetic resonance imaging, stereotactic biopsy) for accreditation status. Recent work has indicated that accredited hospitals are more likely than non-accredited hospitals to meet national benchmarks for quality care (e.g., Mammography Quality Standards Act guidelines [28]). Given these resources, women receiving care from accredited facilities may be more likely to obtain a definitive diagnosis in less time. The second characteristic is facility disproportionate share hospital (DSH) status. DSH facilities are identified as serving high numbers of disadvantaged patients and providing more uncompensated care [29]. Because of limited resources, women receiving care from these facilities may experience longer time to a definitive breast cancer diagnosis. The final characteristic is coordination of care, measured by the number of facilities from medical presentation to diagnosis. Women receiving care from multiple facilities may experience longer time to a definitive diagnosis due to inadequate coordination of care [30].

Methods

Sample and procedures

Study details have been described previously [31,32]. Patients were eligible, if they were aged 30 to 79 years at diagnosis, resided in Chicago at the time of their diagnosis, were diagnosed with primary in situ or invasive breast cancer in 2005 and 2008; and reported their race/ethnicity as nH White, nH Black, or Hispanic. The final interview response rate was 56% (n = 989); 849 women provided authorization and written consent to medical record abstraction. Data on facility factors and documented date of a definitive diagnosis were available for 606 patients. Women in the analytic sample were more likely to identify as nH Black or Hispanic ($p = 0.01$) and were more likely to have screen-detected breast cancers ($p < 0.0001$). In addition, women in the analytic sample were less likely to have obtained care at more than one facility (32% vs. 47%; $p < 0.0001$). Women in the excluded and analytic samples did not significantly differ with regard to receipt of services at facilities with accreditation or DSH status ($ps = 0.45-0.70$). Participants in the analytic sample reported receipt of services from 115 unique facilities (Table 1).

Measures

Sociodemographic measures

Race/ethnicity was based on separate self-identifications of race and Hispanic ethnicity. Standard questions were administered for individual-level household income and education. The language used to complete the survey (English or Spanish) was also recorded. Data from the 2000 US Bureau of the Census were used to define two variables (concentrated disadvantage and concentrated affluence) based on census tract of residence [32]. Mode of detection was defined as the self-reported method of initial awareness of breast cancer (signs or symptoms vs. screening).

Access/utilization

Health insurance (no outpatient insurance, public insurance, private insurance), type of primary care (no regular provider or place, regular place, regular provider), number of mammograms in the past five years and recency of last clinical breast exam prior to diagnosis were reported.

Facility factors

The facility of medical presentation was defined with respect to certification as an NCBC facility [26], as an American College of Radiology BICOE facility [27], and designation as a DSH by the state of Illinois [29]. Sites that were non-hospital sites but that were public health facilities were defined as DSH for these analyses. Approximately 17% (N=19) of facilities had BICOE certification, 4% (N=5) had NCBC certification, and 23% (N=26) had DSH status. BICOE facilities were more likely to be NCBC facilities and vice versa (Table 1). There were no significant relationships between NCBC and BICOE certification to DSH status. The number of facilities involved from initial discovery to definitive diagnosis of their breast cancer was summed, and subsequently dichotomized as one vs. more than one facility. Women attending accredited facilities were less likely to obtain care at multiple

facilities, BICOE: 49% versus 13%, $p < 0.0001$; NCBC: 33% versus 18%, $p = 0.02$. There was no association between number of facilities and DSH status, $p = 0.91$.

Diagnostic delays

Diagnostic delay was defined as >60 days between self-reported date of first medical presentation and the date of a definitive diagnosis/biopsy found in the medical record. This definition has been previously used for research and program evaluation concerning diagnostic delays [33-36]. Also, previous evidence has linked 2-month delays to survival [12].

Statistical analysis

For patients (1%) with missing data, racial/ethnic-specific means of variables were used for imputation. We conducted chi-square tests for racial/ethnic differences in patient and facility factors, and for relationships of patient and facility factors with diagnostic delay. Next, we compared nested logistic regression models of diagnostic delay using Type 3 analyses. We conducted logistic regression with model-based standardization (predictive margins) to estimate what the disparity might be if we were able to equalize the distribution of the domains across racial/ethnic groups in the study. In addition, we compared rescaled coefficients using the method described by Karlson, Holm, and Breen (KHB) [37].

Results

Minorities exhibited less screening-based detection, lower socioeconomic status (all 4 indicators), less healthcare access (insurance, type of primary care), and were less likely to have obtained a clinical breast exam within one year of their breast cancer diagnosis (Table 2). Minorities were less likely to attend a BICOE accredited facility, but more likely to attend a DSH facility and multiple facilities (Table 2).

In all, 22% of women experienced a diagnostic delay (Table 3). Racial and ethnic minorities, as well as women with lower socioeconomic status and less healthcare insurance were more likely to experience delays (Table 3). Women who received care from a single facility and from facilities with BICOE and NCBC certification were less likely to experience delays, while those who received care from DSH facilities were more likely to experience delays. Healthcare utilization was not associated with diagnostic delay.

In Type 3 analysis of full and partial logistic regression models concerning diagnostic delays, the model which excluded facility factors had significantly poorer fit relative to full and other partial models (all $p < 0.001$). No other significant differences emerged between models ($p = 0.20-0.55$).

When examining differences between non-Hispanic White and minorities, adjustment for all variables pertaining to socioeconomic status reduced the disparity by half, and adjustment for access/utilization variables accounted for roughly one-fifth of the disparity (Table 4). Adjustment for facility factors accounted for 43% of the disparity, with BICOE certification emerging as the most important mediating factor (by itself accounting for 37% of the disparity). Simultaneous adjustment for all domains accounted for more than two-thirds of the disparity

in diagnostic delay. Similar patterns emerged for nH White-nH Black and nH White-Hispanic comparisons (Table 4).

Discussion

In line with previous work, we found racial/ethnic differences in where patients received care: nH Whites were more likely to obtain breast cancer care from accredited and non-DSH facilities and to obtain their care within a single facility relative to nH Black and Hispanic women. These factors were associated with reduced likelihood of diagnostic delays, which is in line with other work concerning between-facility effects on diagnostic delays and other cancer-related outcomes [20, 21, 23, 24, 38, 39]. Few studies, however, have directly examined the potential role of facility resources in mediating disparities in delay. One study we are aware of found that racial/ethnic disparities were attenuated when adjusting for between-facility variation in time to diagnostic resolution [17], but did not directly examine racial/ethnic differences in where women sought care nor which components of clinics contributed to variation in time to diagnostic resolution. Our work thus provides an important contribution to existing literature through the direct assessment of how between-facility effects may underlie racial/ethnic breast cancer disparities.

BICOE certification emerged as a particularly important mediating factor. Patients presenting either with symptoms or via screen-detection at a BICOE facility begin their breast cancer care at a high-resource facility with all the modalities needed to do a complete diagnostic workup, including multimodality imaging and image-guided biopsy. Although a patient may still choose to go elsewhere to complete diagnostic care, the reputation that comes with BICOE certification may provide an additional incentive for patients and their providers to complete diagnostic care at that facility. Racial/ethnic minorities were more likely to present at a non-BICOE facility, and presentation at a non-BICOE facility was associated with a greater likelihood of a diagnostic delay. As a result, the difference in presentation at BICOE facilities accounted for a substantial amount of the racial/ethnic disparity in diagnostic delay.

There were several limitations to the current study. Our study was set within a single, urban geographic region with unique and significant racial/ethnic inequities in women's health [40, 41]. Given this, future research is needed to confirm the generalizability of our results to other areas where healthcare resources may be distributed differently, including other urban areas. The current study did not use existing databases with a number of important facility factors, including the Medicare provider of service or Annual Survey of Hospitals survey. Future work is warranted to use these resources to further examine the role of facility factors in cancer disparities. Nonetheless, our study also has several strengths, including being population-based, relying on self-reported racial/ethnic data, including both patient- and neighborhood-level data, as well as examination of multiple facility factors.

Timeliness, coordination and quality of care are becoming an important part of how health care payment is being incentivized under the Patient Protection and Affordable Care Act. Research into understanding what drives timeliness can help to inform these and related policy decisions [42]. Our study specifically answers an important question regarding the

potential influence of facility characteristics on delayed breast cancer diagnosis and disparities. The role of facility factors in disparities may inform the development of national strategies for quality control and assurance [42-45], including increasing access to BICOE facilities through expanding referral networks (e.g., HB3673) and facilitating inter-organizational coordination of care [46] through efforts such as the Bundled Payments for Care Improvement Initiative and medical home models [47, 48]. Such efforts would facilitate women's access to existing facilities with BICOE certification. At the same time, our results may inform efforts to justify capacity building for under-resourced facilities, such as DSH facilities and community clinics, under the new reform, including the Capital Development-Building Capacity Grant Program. Such efforts may enable the resources necessary for these facilities to obtain BICOE certification.

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Table 1

Facility of medical presentation characteristics (N = 115)

		BICOE¹	NCBC²	DSH³
	N	%	%	%
BICOE¹				
No	96	---	1	21
Yes	19	---	21*	32
NCBC²				
No	110	14	---	23
Yes	5	80*	---	20
DSH³				
No	89	15	4	---
Yes	26	23	4	---

**p<0.001.

¹ American College of Radiology Breast Imaging Center of Excellence facility.² National Consortium of Breast Centers facility.³ Disproportionate share hospital facility. P-values are based on Fisher's exact test

* p<0.01

Table 2

Racial/ethnic differences in socio-demographic differences and study variables of interest (n = 606)

	nH ¹ White (n =263) N (%)	nH ¹ Black (n = 245) N (%)	Hispanic (n = 98)	p-value
Age ²				0.34
<50 years old	77 (29)	75 (31)	31 (32)	
50+ years old	186 (71)	170 (69)	67 (68)	
Mode of detection				0.04
Screening	170 (65)	134 (55)	55 (56)	
Symptom	91 (35)	110 (45)	44 (44)	
Language for Survey				<0.0001
English	263 (100)	244 (100)	40 (40)	
Spanish	0 (0)	0 (0)	59 (60)	
<u>Socioeconomic status</u>				
Income ²				<0.0001
<20,000	28 (11)	74 (30)	34 (34)	
20-<75K	93 (35)	143 (59)	52 (53)	
>=75K	142 (54)	27 (11)	13 (13)	
Education ²				<0.0001
<HS	8 (3)	43 (18)	41 (41)	
HS	35 (13)	61 (25)	23 (23)	
>HS	220 (84)	141 (58)	34 (35)	
Concentrated disadvantage				<0.0001
Tertile 1	162 (62)	7 (3)	32 (33)	
Tertile 2	91 (35)	62 (25)	47 (49)	
Tertile 3	10 (4)	176 (72)	17 (18)	
Concentrated affluence ²				<0.0001
Tertile 1	26 (10)	122 (50)	54 (55)	
Tertile 2	75 (29)	96 (40)	31 (32)	
Tertile 3	162 (62)	27 (11)	13 (13)	
<u>Access/utilization</u>				
Type of primary care				0.03
None	15 (6)	8 (3)	8 (8)	
Regular place	12 (5)	20 (8)	12 (12)	
Regular provider	236 (90)	217 (89)	78 (80)	
Insurance				<0.0001
No outpatient insurance	14 (5)	35 (14)	25 (26)	
Public	9 (3)	59 (24)	19 (19)	
Private	240 (91)	151 (62)	54 (55)	
Number of mammograms in 5 years				0.11
<2	63 (24)	70 (29)	34 (35)	
2	200 (76)	175 (71)	65 (65)	

	nH ¹ White (n =263) N (%)	nH ¹ Black (n = 245) N (%)	Hispanic (n = 98)	p-value
Prior clinical breast exam				0.05
1 year	188 (72)	150 (61)	63 (64)	
>1 year/Never	75 (29)	95 (39)	36 (36)	
Facility factors				
BICOE ³				<0.0001
Yes	205 (78)	103 (42)	31 (32)	
No	58 (22)	142 (58)	67 (68)	
NCBC ⁴				0.07
Yes	63 (24)	47 (19)	13 (13)	
No	200 (76)	198 (81)	85 (87)	
DSH ⁵				<0.0001
Yes	46 (18)	75 (31)	49 (50)	
No	217 (83)	170 (69)	49 (50)	
Number of facilities ⁶				<0.0001
1 facility	206 (78)	149 (61)	58 (59)	
>1 facility	57 (22)	96 (39)	41 (41)	

¹ non-Hispanic.

² Variable analyzed continuously in models.

³ American College of Radiology Breast Imaging Center of Excellence facility.

⁴ National Consortium of Breast Centers facility.

⁵ Disproportionate share hospital facility.

⁶ Number of facilities from medical presentation to a definitive cancer diagnosis.

Table 3

Diagnostic delays by race/ethnicity, socioeconomic status, access/utilization, and facility factors (n =606).

	>60 days		p-value
	N	%	
<u>Race/ethnicity</u>			<0.0001
nH ¹ White	263	13	
nH ¹ Black	245	28	
Hispanic	98	32	
<u>Socioeconomic status</u>			
Income ²			0.002
<20,000	136	28	
20-<75K	288	25	
>=75K	182	13	
Education			0.009
<HS	92	32	
HS	119	27	
>HS	395	19	
Concentrated disadvantage ²			0.003
Tertile 1	201	15	
Tertile 2	200	22	
Tertile 3	203	30	
Concentrated affluence ²			0.001
Tertile 1	202	28	
Tertile 2	202	25	
Tertile 3	202	13	
<u>Access/utilization</u>			
Type of primary care			0.39
None	31	26	
Regular place	44	30	
Regular provider	531	21	
Insurance			<0.0001
No outpatient insurance	74	39	
Public	87	31	
Private	445	18	
Mammograms in prior 5 years			0.08
2 or fewer	167	27	
>2	439	20	
Prior clinical breast exam			0.07
Within the prior year	401	20	
Longer ago or never	205	26	
<u>Facility factors</u>			<0.0001

	>60 days		p-value
	N	%	
BICOE ³			
Yes	339	13	
No	267	34	
NCBC ⁴			0.03
Yes	123	15	
No	483	24	
DSH ⁵			0.04
Yes	170	28	
No	436	20	
Number of facilities ⁶			<0.0001
1 facility	413	18	
>1 facility	193	32	
Total	606	22	

¹ non-Hispanic.

² Variable analyzed continuously in models.

³ American College of Radiology Breast Imaging Center of Excellence facility.

⁴ National Consortium of Breast Centers facility.

⁵ Disproportionate share hospital facility.

⁶ Number of facilities from medical presentation to a definitive cancer diagnosis.

Table 4

Evaluation of the potential mediation of ethnic disparity in diagnostic delay by different variable domains.

	nH White-Minority (n = 606)					nH White-nH Black (n = 508)					nH White-Hispanic (n = 361)					
	RD (95%CI) ¹	p-value ²	Proportion Mediated, ^{3,4}	p-value ⁵	RD (95%CI) ¹	p-value ²	Proportion Mediated, ^{3,4}	p-value ⁵	RD (95%CI) ¹	p-value ²	Proportion Mediated, ^{3,4}	p-value ⁵	RD (95%CI) ¹	p-value ²	Proportion Mediated, ^{3,4}	p-value ⁵
Unadjusted	0.16 (0.09, 0.22)	<0.0001			0.14 (0.07, 0.21)	<0.0001			0.18 (0.08, 0.28)	<0.0001			0.16 (0.07, 0.26)	0.001		
Baseline adjusted ⁶	0.15 (0.09, 0.21)	<0.0001			0.14 (0.06, 0.21)	<0.0001			0.16 (0.07, 0.26)	0.001			0.16 (0.07, 0.26)	0.001		
Socioeconomic status	0.08 (-0.02, 0.18)	0.11	<u>0.50</u>	0.02	0.07 (0.00, 0.18)	0.20	<u>0.47</u>	0.09	0.09 (0.00, 0.20)	0.15	<u>0.46</u>	0.07	0.09 (0.00, 0.20)	0.15	<u>0.46</u>	0.07
Income			0.13				0.14				0.13				0.13	
Education			0.09				0.17				0.17				0.00	
Concentrated disadvantage			0.21				0.07				0.07				0.33	
Concentrated affluence			0.06				0.04				0.04				0.11	
Access/utilization	0.12 (0.05, 0.19)	0.001	<u>0.19</u>	0.008	0.11 (0.04, 0.18)	0.004	<u>0.20</u>	0.02	0.13 (0.02, 0.23)	0.02	<u>0.20</u>	0.07	0.13 (0.02, 0.23)	0.02	<u>0.20</u>	0.07
Type of regular care			0.00				0.00				0.00				0.00	
Insurance status			0.19				0.17				0.17				0.19	
Mammograms prior 5 years			0.00				0.00				0.00				0.00	
Prior clinical breast exam			0.00				0.03				0.03				0.03	
Facility factors	0.09 (0.02, 0.15)	0.01	<u>0.43</u>	<0.0001	0.08 (0.01, 0.15)	0.02	<u>0.40</u>	0.001	0.12 (0.02, 0.22)	0.02	<u>0.23</u>	0.09	0.12 (0.02, 0.22)	0.02	<u>0.23</u>	0.09
BICOE ⁷			0.37				0.34				0.18				0.18	
NCBC ⁸			0.03				0.00				0.00				0.00	
DSH ⁹			0.00				0.00				0.00				0.02	
Number of facilities			0.03				0.07				0.04				0.04	
All three domains	0.04 (-0.06, 0.14)	0.45	<u>0.74</u>	0.001	0.03 (0.00, 0.14)	0.56	<u>0.77</u>	0.008	0.07 (0.00, 0.19)	0.30	<u>0.57</u>	0.03	0.07 (0.00, 0.19)	0.30	<u>0.57</u>	0.03
Socioeconomic status			0.26				0.34				0.32				0.32	
Access/utilization			0.09				0.01				0.11				0.11	
Facility factors			0.39				0.33				0.11				0.11	

¹ Risk differences corresponding to the ethnic disparity in diagnostic delay were estimated via model based standardization (predictive margins) from corresponding logistic regression models.

² p-value for the race/ethnicity coefficient from the logistic regression model.

³ Overall proportionate reduction (underlined) in the disparity in diagnostic delay comparing the baseline adjusted model to a model that includes the domain or domains of interest, using the method of Karlson, Holme, and Breene.

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- ⁴ Contribution of each covariate to the proportionate reduction in the disparity.
- ⁵ p-value for difference in rescaled race/ethnicity coefficient between full and reduced models using the method of Karlson, Holme, and Breene. Referent group in all models is nH White.
- ⁶ All models adjusted for age and mode of detection.
- ⁷ American College of Radiology Breast Imaging Center of Excellence facility.
- ⁸ National Consortium of Breast Centers facility.
- ⁹ Disproportionate share hospital facility.