Original Article

Surveillance Mammography Among Female Department of Defense Beneficiaries

A Study by Race and Ethnicity

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BACKGROUND: Annual surveillance mammography is recommended after a diagnosis of breast cancer. Previous studies have suggested that surveillance mammography varies by demographics and initial tumor characteristics, which are related to an individual's access to health care. The Military Health System of the Department of Defense provides beneficiaries with equal access health care and thus offers an excellent opportunity to assess whether racial differences in surveillance mammography persist when access to care is equal. **METHODS:** Among female beneficiaries with a history of breast cancer, logistic regression was used to assess racial/ethnic variations in the use of surveillance mammography during 3 periods of 12 months each, beginning 1 year after diagnosis adjusting for demographic, tumor, and health characteristics. **RESULTS:** The rate of overall surveillance mammography decreased from 70% during the first year to 59% during the third year ($P<.01$). Although there was an overall tendency for surveillance mammography to be higher among minority women compared with non-Hispanic white women, after adjusting for covariates, the difference was found to be significant only during the first year among black women (odds ratio [OR], 1.46; 95% confidence interval [95% CI], 1.10-1.95) and the second year among Asian/Pacific Islander (OR, 2.29; 95%CI, 1.52-3.44) and Hispanic (OR, 1.92; 95%CI, 1.17-3.18) women. When stratified by age at diagnosis and type of breast cancer surgery performed, significant racial differences tended to be observed among younger women (aged <50 years) and only among women who had undergone mastectomies. **CONCLUSIONS:** Minority women were equally or more likely than non-Hispanic white women to receive surveillance mammography within the Military Health System. The racial disparities in surveillance mammography reported in other studies were not observed in a system with equal access to health care. ***Cancer* 2013;119:3531-38**. *© 2013 American Cancer Society.*

KEYWORDS: breast cancer; mammography; surveillance; survivor; epidemiology; health care access.

INTRODUCTION

Although female breast cancer is the most common cancer among women in the United States and the second most common cause of cancer death, the overall 5-year relative survival rate is high (89%).[1] Thus, there are more than 2.7 million women currently alive in the United States with a history of breast cancer,[2] all of whom are at risk for disease recurrence and an increased risk of developing new primary tumors and ultimately breast cancer mortality.[3-7]

Breast cancer mortality rates vary by race/ethnicity. It is interesting to note that overall age-adjusted mortality rates are higher among black women than white women, even though the reverse is true for overall age-adjusted incidence rates.[1] In addition, Asian/Pacific Islander (API) women and Hispanic women have lower mortality rates, as well as incidence rates, compared with non-Hispanic white women.[8] Racial/ethnic variations in mortality rates are likely due to multiple factors, possibly including differences in follow-up care.

Mammography is an effective screening tool used to diagnose breast cancer at early stages and its use is associated with lower breast cancer mortality rates.[9] Although the American Society of Clinical Oncology recommends annual

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surveillance mammography for all women with a history of breast cancer,[10] studies have indicated that a sizable percentage of these women do not receive adequate screening; that use decreases significantly with time since diagnosis; and that many factors, including demographics, tumor characteristics, and cancer treatment, affect use.[11-16] Some of these studies[13,15,16] have found lower use among minority women compared with white/non-Hispanic white women. However, differential access to care by race/ethnicity in these previous studies may have confounded the racial comparisons. In addition, many of these previous studies were conducted among Medicare beneficiaries[11,13,15] or at least among predominately postmenopausal women,[12] and therefore may not be generalizable to younger women.

The Military Healthcare System (MHS) of the Department of Defense (DoD) provides a unique environment in which to conduct disparities research given that all DoD beneficiaries are provided equal access to health care. In addition, because the MHS is not restricted to women of a certain age, conducting research among its beneficiaries may provide insights into the behaviors of young women after a diagnosis of breast cancer. The objectives of the current study were 2-fold: 1) to determine whether annual surveillance mammography varied by race/ethnicity after adjustment for covariates among female DoD beneficiaries of any age with a history of breast cancer; and 2) to describe how annual surveillance mammography varied with time since diagnosis.

MATERIALS AND METHODS

Linked data from the DoD's Central Cancer Registry and the MHS Data Repository (MDR), the DoD's medical claims database, were used for the current study. The Central Cancer Registry contains information for all DoD patients with cancer who are diagnosed or treated at military treatment facilities (MTFs), including active duty and retired military personnel and their dependents. Duplicate records pertaining to the same tumor were consolidated following the North America Association of Central Cancer Registries guidelines. The MDR includes administrative and medical claims information from the DoD heath care program (known as TRICARE) beneficiaries, including direct care received at MTFs or indirect care received at non-MTFs that is paid for by the DoD. The MDR database includes information regarding clinical diagnoses of all medical conditions (which are coded using the International Classification of Diseases-Ninth Revision [ICD-9]) and diagnostic and treatment procedures (which are coded using ICD-9, Current Procedural Terminology [CPT] or Healthcare Common Procedure Coding System [HCPCS] codes). The current study began in 2005 because radiology records, which were the primary source of mammography documentation, became available that year.

Women were eligible for the study if they had surgically treated, histologically confirmed, first primary, malignant breast cancer diagnosed between 2005 and 2007 (the most recent years of the linked data). The racial/ethnic groups compared were non-Hispanic white, non-Hispanic black ("black"), non-Hispanic API ("API"), and Hispanic (regardless of race). Annual surveillance mammography use was assessed by race/ethnicity for 3 periods of 12 months each that began 1 year after diagnosis. Analyses for each year were restricted to women who had complete follow-up data available for that year. Women were excluded if they left the MHS (year 1 n=17; year 2 n=455; year 3 n=595) or died (year 1 n=60; year 2 n=41; year 3 n=22) before or during each assessment year. Annual surveillance mammography is not recommended for women who have undergone bilateral mastectomies; therefore women were also excluded if there was an indication that they undergone bilateral mastectomies (concurrently or sequentially) before each assessment year (year 1 n= 133; year 2 n=22; year 3 n=12).

To minimize the possibility of counting diagnostic mammograms, a mammogram was considered to have been for surveillance if there was a recorded bilateral mammogram in the MDR among women who had undergone breast-conserving surgery (BCS) (CPT codes 76091, 76092, 77056, and 77057; HCPCS codes G0202 and G0203; and ICD-9 codes V76.10, V76.11, and V72.12) or a unilateral mammogram (CPT codes 76090 and 77055) among women who had undergone unilateral mastectomies and had no diagnosis of a breast mass or other breast symptoms (ICD-9 codes 611.72 and 611.79) within the preceding 2 months. In addition, the identified mammogram had to be conducted at least 6 months after a previous mammogram.

Hormone receptor status was considered positive if either estrogen receptor or progesterone receptor status was recorded as positive, negative if both estrogen receptor and progesterone receptor status was negative, and unknown if neither measure was recorded. Comorbidities were considered to be present if a diagnosis was recorded in the MDR during the 12 months before each assessment year. To minimize the possibility of false comorbidity diagnoses, codes had to be recorded in the outpatient data sets at least 3 times. The level of comorbidity present was categorized according to the Charlson Comorbidity

Index[17] and breast cancer diagnoses were excluded from the calculation.

Statistical Analysis

Chi-square tests were used to compare demographics, initial breast cancer tumor characteristics, and cancer treatments between women who did and women who did not undergo surveillance mammography during each assessment year and to compare annual surveillance mammography use across the 3 years. Variables assessed included age at diagnosis, year of diagnosis, active duty status, beneficiary type (TRICARE Prime: health maintenance organization component/TRICARE non-Prime/unknown), marital status (married/not married, never married, separated, or divorced/status unknown), service branch, sponsor's service rank, tumor characteristics of the initial breast cancer (tumor stage, tumor grade, and hormone receptor status), cancer treatments (surgery/radiotherapy and chemotherapy), and Charlson Comorbidity Index. Logistic regression was used to assess receipt of annual surveillance mammography by race/ethnicity after adjustment for potential confounding by variables that were found to be significant for any year during univariate analysis, separately for the 3 years. Effect modification by age (<50 years vs >50 years) and type of breast cancer surgery were assessed by creating stratified regression models. All statistical analyses were performed using SAS statistical software (version 9.3; SAS Institute Inc, Cary, NC) and the 2-sided significance level was set at $P<.05$.

This project was approved by the Institutional Review Boards of the Walter Reed National Military Medical Center, TRICARE Management Activity, and the National Institutes of Health Office of Human Subjects Research.

RESULTS

Overall annual surveillance mammography decreased from 70% during the first year to 59% during the third year ($P<.01$) (Table 1). When stratified by race/ethnicity, the largest temporal decrease (-15%; $P<.01$) was observed among black women and the smallest temporal decrease (-7%; $P>.05$) was observed among API women.

During all 3 years, there was a tendency for annual surveillance mammography to be higher among minority women compared with non-Hispanic white women. During the first year, the receipt of annual surveillance mammography was found to be significantly higher among black women compared with non-Hispanic white women (odds ratio [OR], 1.46; 95% confidence interval [95% CI], 1.10-1.95) (Table 2). During the second year, the receipt of annual surveillance mammography was found to be significantly higher only among API women (OR, 2.29; 95% CI, 1.52-3.44) and Hispanic women (OR, 1.92; 95% CI, 1.17-3.18) in comparison with non-Hispanic white women. During the third year, no significant racial/ethnic differences were observed.

In addition to the observed racial/ethnic variations, annual surveillance mammography varied by covariates (Table 2). The receipt of surveillance mammography tended to increase with age. In comparison with women aged 40 years to 49 years at the time of diagnosis, older women were more likely to have received annual surveillance mammography, with the highest levels appearing to be obtained by those who were aged 70 years to 79 years at the time of diagnosis. In comparison with patients who had an enlisted sponsor, those who had sponsors of "other/unknown" rank were less likely to receive annual surveillance mammography (OR, range 0.23-0.36). The combination of surgery type and radiotherapy appeared to be associated with receipt of annual surveillance mammography. For example, during the first assessment year, women who underwent BCS without radiotherapy and unilateral mastectomies with or without radiotherapy were less likely (OR, range 0.40–0.58) to receive annual surveillance mammography compared with women who had received BCS with radiotherapy. Finally, depending on the assessment year, there were indications that receipt of annual surveillance mammography varied by sponsor's duty status and beneficiary plan.

Effect modification of the relationship between race-ethnicity and surveillance mammography was assessed by age and type of breast cancer surgery (Table 3). When stratified by age, racial/ethnic variations tended to be observed among young women (aged <50 years). During the first year, young black and API women (OR, 2.20 and 3.11, respectively) were more likely than their non-Hispanic white counterparts to undergo a surveillance mammography. During the second year, young API and Hispanic women (OR, 5.31 and 2.44, respectively) were also more likely than their non-Hispanic white counterparts to undergo a surveillance mammography. An increased likelihood of surveillance mammography among older API women (OR, 1.61) in comparison with older non-Hispanic white women also was observed. When stratified by type of breast cancer surgery, significant racial/ethnic variations were observed only among women who underwent mastectomies and the tendency was for minority women to be more likely to receive surveillance mammography than non-Hispanic white women.

TABLE 1. Comparison of Characteristics by Receipt of Annual Mammography During 3 Consecutive Years That Started 12 Months After Cancer Diagnosis Among Women Diagnosed With Breast Cancer Between 2005 and 2007 in the Military Health System

		Year 1 (n = 1951)					Year 2 (n = 1433)					Year 3 (n = 823)				
		Mammography					Mammography					Mammography				
		No		Yes			No		Yes			No		Yes		
Characteristic[a]		No.	%	No.	%	P^b	No.	%	No.	%	P^b	No.	%	No.	%	P^b
All		589	30%	1362	70%		464	32%	969	68%		334	41%	489	59%	
Race/ethnicity	Non-Hispanic white	385	32%	834	68%	.27	311	35%	582	65%	<.01	213	41%	304	59%	.62
	Non-Hispanic black	94	27%	258	73%		94	35%	176	65%		65	42%	88	58%	
	Non-Hispanic API	68	28%	177	72%		35	20%	139	80%		35	35%	66	65%	
	Hispanic	42	31%	93	69%		24	25%	72	75%		21	40%	31	60%	
Age, y	19-39	66	40%	98	60%	<.01	50	40%	74	60%	<.01	34	45%	41	55%	.01
	40-49	171	35%	311	65%		138	38%	223	62%		99	47%	110	53%	
	50-59	161	30%	378	70%		118	30%	278	70%		81	35%	149	65%	
	60-69	112	23%	365	77%		103	29%	253	71%		83	40%	126	60%	
	70-79	56	27%	155	73%		37	25%	109	75%		21	29%	51	71%	
	80-96	23	29%	55	71%		18	36%	32	64%		16	57%	12	43%	
Marital status	Married	476	30%	1112	70%	.37	365	31%	800	69%	.20	270	39%	416	61%	.27
	Not married	103	30%	237	70%		95	37%	161	63%		61	47%	69	53%	
	Unknown	10	43%	13	57%		4	33%	8	67%		3	43%	4	57%	
Duty status[c]	Nonactive duty	545	29%	1308	71%	<.01	431	32%	930	68%	.01	317	41%	462	59%	.79
	Active duty	44	45%	54	55%		33	46%	39	54%		17	39%	27	61%	
Rank[c]	Enlisted	394	29%	948	71%	<.01	320	32%	684	68%	.01	229	40%	347	60%	.03
	Officer	174	30%	405	70%		130	32%	276	68%		94	41%	138	59%	
	Other/unknown	21	70%	9	30%		14	61%	9	39%		11	73%	4	27%	
Service branch	Army	246	32%	520	68%	.15	185	34%	367	66%	.65	111	38%	181	62%	.56
	Air Force	178	30%	406	70%		144	34%	283	66%		108	42%	152	58%	
	Navy	97	25%	290	75%		82	29%	201	71%		67	40%	101	60%	
	Other	59	31%	130	69%		46	32%	100	68%		44	48%	48	52%	
	Unknown	9	36%	16	64%		7	28%	18	72%		4	36%	7	64%	
Beneficiary plan	TRICARE Prime "HMO"	444	30%	1028	70%	<.01	349	32%	741	68%	.54	259	41%	366	59%	.65
	Not TRICARE Prime	123	28%	317	72%		104	33%	213	67%		68	38%	113	62%	
	Unknown	22	56%	17	44%		11	42%	15	58%		7	41%	10	59%	
Year of diagnosis	2005	199	28%	511	72%	.26	215	32%	464	68%	.84	267	40%	393	60%	.88
	2006	198	32%	420	68%		194	33%	397	67%		67	41%	96	59%	
	2007	192	31%	431	69%		55	34%	108	66%		0	0%	0	0%	
Tumor stage American Joint Committee on Cancer (*AJCC*)	I	272	27%	729	73%	<.01	224	30%	526	70%	.10	166	40%	253	60%	.82
	IIA	152	30%	351	70%		122	33%	248	67%		89	40%	132	60%	
	IIB	74	36%	129	64%		54	37%	92	63%		40	45%	49	55%	
	III	91	37%	153	63%		64	38%	103	62%		39	41%	55	59%	
Tumor grade	1	128	28%	322	72%	.45	103	30%	235	70%	.79	81	41%	119	60%	.90
	2	225	29%	544	71%		181	32%	377	68%		127	39%	197	61%	
	3-4	207	33%	429	67%		157	34%	307	66%		108	42%	149	58%	
	Unknown	29	30%	67	70%		23	32%	50	68%		18	43%	24	57%	
Hormone receptor status	ER+ and/or PR+	424	29%	1035	71%	.17	335	31%	736	69%	.13	252	41%	362	59%	.85
	ER− and PR−	141	33%	282	67%		106	34%	203	66%		71	39%	112	61%	
	Unknown	24	35%	45	65%		23	43%	30	57%		11	42%	15	58%	
Surgery/radiotherapy	BCS	30	31%	68	69%	<.01	29	45%	36	55%	<.01	17	44%	22	56%	<.01
	BCS plus radiotherapy	204	22%	737	78%		192	27%	531	73%		145	35%	264	65%	
	Mastectomy	233	40%	352	60%		158	39%	247	61%		116	49%	119	51%	
	Mastectomy plus radiotherapy	122	37%	205	63%		85	35%	155	65%		56	40%	84	60%	
Chemotherapy	Yes	388	33%	795	67%	<.01	300	34%	570	66%	.03	205	53%	181	47%	.64
	No	201	26%	567	74%		164	29%	399	71%		129	30%	308	70%	
Charlson Comorbidity Index[d]	0	398	30%	928	70%	.78	331	32%	699	68%	.41	233	40%	356	60%	.07
	1	121	32%	263	68%		81	31%	182	69%		54	38%	89	62%	
	>1	70	29%	171	71%		52	37%	88	63%		47	52%	44	48%	

Abbreviations: +, positive; −, negative; BCS, breast-conserving surgery; ER, estrogen receptor; HMO, health management organization; PR, progesterone receptor. API, Asian/Pacific Islander.

[a] At the time of diagnosis unless otherwise stated.

[b] Determined using the chi-square test.

[c] Sponsor's duty status and service rank, if the patient was a dependent.

[d] During the preceding 12 months.

DISCUSSION

In the current study, the rate of overall surveillance mammography decreased from 70% during the first year to 59% during the third year ($P < .01$). Although there was a tendency for surveillance mammography to be higher among minority women compared with non-Hispanic

TABLE 2. Adjusted Odds of Annual Surveillance Mammography During 3 Consecutive Years That Started 12 Months After Cancer Diagnosis Among Women Diagnosed With Breast Cancer Between 2005 and 2007 in the Military Health System

		Year 1		Year 2		Year 3	
Characteristic[a]		OR[b]	95% CI	OR[b]	95% CI	OR[b]	95% CI
Race/ethnicity	Non-Hispanic white	1.00	Reference	1.00	Reference	1.00	Reference
	Non-Hispanic black	**1.46**	**1.10-1.95**	1.18	0.87-1.60	0.91	0.62-1.35
	Non-Hispanic API	1.33	0.96-1.83	**2.29**	**1.52-3.44**	1.29	0.81-2.05
	Hispanic	1.19	0.79-1.78	**1.92**	**1.17-3.18**	1.05	0.57-1.92
Age, y	19-39	0.96	0.65-1.40	1.01	0.65-1.57	1.08	0.62-1.88
	40-49	1.00	Reference	1.00	Reference	1.00	
	50-59	1.28	0.97-1.68	**1.38**	**1.01-1.89**	**1.70**	**1.14-2.53**
	60-69	**1.93**	**1.39-2.67**	**1.78**	**1.23-2.57**	1.51	0.96-2.36
	70-79	**2.10**	**1.23-3.59**	**3.38**	**1.81-6.31**	**2.32**	**1.05-5.10**
	80-96	**2.00**	**1.01-3.96**	**2.48**	**1.12-5.48**	0.83	0.31-2.26
Duty status[c]	Nonactive duty	1.00	Reference	1.00	Reference	1.00	
	Active duty	**0.62**	**0.40-0.97**	0.71	0.43-1.19	1.32	0.67-2.59
Rank[c]	Enlisted	1.00	Reference	1.00	Reference	1.00	
	Officer	1.00	0.80-1.26	1.06	0.81-1.38	0.97	0.70-1.36
	Other/unknown	**0.23**	**0.10-0.54**	**0.36**	**0.14-0.90**	**0.23**	**0.07-0.77**
Beneficiary plan	TRICARE Prime "HMO"	1.00	Reference	1.00	Reference	1.00	
	Not TRICARE Prime	0.75	0.51-1.11	**0.57**	**0.37-0.87**	1.17	0.70-1.96
	Unknown	**0.37**	**0.18-0.77**	0.73	0.30-1.81	1.24	0.41-3.74
Tumor stage American Joint Committee on Cancer (*AJCC*)	I	1.00	Reference	1.00	Reference	1.00	
	IIA	1.06	0.81-1.39	0.99	0.73-1.35	1.00	0.68-1.47
	IIB	0.82	0.57-1.18	0.79	0.52-1.21	0.73	0.43-1.25
	III	0.82	0.55-1.21	0.71	0.45-1.13	0.73	0.41-1.31
Surgery/Radiotherapy[d]	BCS plus radiotherapy	1.00	Reference	1.00	Reference	1.00	
	BCS	**0.56**	**0.34-0.91**	**0.37**	**0.21-0.64**	0.71	0.34-1.45
	Mastectomy	**0.40**	**0.32-0.51**	**0.52**	**0.40-0.68**	**0.56**	**0.40-0.79**
	Mastectomy plus radiotherapy	**0.58**	**0.41-0.81**	0.84	0.57-1.24	0.95	0.59-1.54
Chemotherapy[d]	Yes	1.00	Reference	1.00	Reference	1.00	
	No	1.10	0.84-1.44	1.10	0.81-1.50	0.76	0.52-1.12

Abbreviations: 95% CI, 95% confidence interval; BCS, breast-conserving surgery; HMO, health management organization; OR, odds ratio. API, Asian/Pacific Islander. Bold font indicates which ORs are significant.
[a] At time of diagnosis unless otherwise stated.
[b] Adjusted for all variables listed.
[c] Sponsor's duty status and service rank, if the patient was a dependent.
[d] During the first year after diagnosis.

white women, after adjusting for covariates, the difference was found to be significant only during the first year among black women and during the second year among API and Hispanic women. Furthermore, variation in the receipt of annual surveillance mammography by race-ethnicity tended to be confined to young women (aged <50 years) and those who underwent mastectomies. Surveillance mammography also appeared to vary by sponsor's duty status, sponsor's service rank, and beneficiary plan.

In comparison with previous studies on surveillance mammography use based on medical claims data and/or abstraction of medical records, the overall rate of surveillance mammography that was observed in the current study was lower than that in some reports[12-15] but higher than that in others.[11,16] However, because of differences in study population characteristics, study calendar years, and the definition of surveillance mammography, it is difficult to know whether any of the differences observed among the studies are significant. For example, we excluded diagnostic mammograms in defining surveillance mammography. This may have resulted in lower estimates than previous studies that used less restrictive definitions of surveillance mammography. Therefore, caution should be taken when making comparisons with these previous studies. Caution should also be used when comparing the current findings with survey estimates[18] because surveys rely on participant self-report, which has been shown to overestimate actual mammography use.[19,20]

Contrary to previous studies,[13,15,16] we observed higher rather than lower surveillance mammography rates among minority women in comparison with non-Hispanic white women. Given that the MHS provides

TABLE 3. Racial/Ethnic Variation in Annual Surveillance Mammography by Age and Surgery Type Among Women Diagnosed With Breast Cancer Between 2005 and 2007 in the Military Health System

		Period					
Stratified Variable	Race	OR[a]	95% CI	OR[a]	95% CI	OR[a]	95% CI
Age, y							
<50	Non-Hispanic white	1.00	Reference	1.00	Reference	1.00	Reference
	Non-Hispanic black	**2.20**	**1.39-3.46**	1.08	0.68-1.72	0.87	0.47-1.62
	Non-Hispanic API	**3.11**	**1.67-5.79**	**5.31**	**2.26-12.50**	2.11	0.90-4.95
	Hispanic	1.19	0.65-2.20	**2.44**	**1.11-5.34**	0.80	0.29-2.19
≥50	Non-Hispanic white	1.00	Reference	1.00	Reference	1.00	Reference
	Non-Hispanic black	1.06	0.73-1.54	1.19	0.78-1.82	0.88	0.52-1.47
	Non-Hispanic API	0.89	0.61-1.29	**1.61**	**1.01-2.57**	1.04	0.60-1.81
	Hispanic	1.27	0.72-2.24	1.53	0.80-2.94	1.21	0.55-2.64
Surgery							
Mastectomy	Non-Hispanic white	1.00	Reference	1.00	Reference	1.00	Reference
	Non-Hispanic black	**1.93**	**1.28-2.89**	1.53	0.96-2.43	1.10	0.60-2.04
	Non-Hispanic API	1.52	1.00-2.29	**2.74**	**1.56-4.78**	**2.45**	**1.19-5.05**
	Hispanic	**1.94**	**1.10-3.42**	**2.35**	**1.20-4.60**	1.33	0.58-3.05
BCS	Non-Hispanic white	1.00	Reference	1.00	Reference	1.00	Reference
	Non-Hispanic black	1.06	0.70-1.59	0.86	0.57-1.29	0.77	0.46-1.28
	Non-Hispanic API	1.12	0.67-1.87	1.73	0.95-3.15	0.72	0.38-1.34
	Hispanic	0.72	0.41-1.28	1.55	0.72-3.31	0.85	0.35-2.09

95% CI, 95% confidence interval; BCS, breast-conserving surgery; OR, odds ratio. API, Asian/Pacific Islander. Bold font indicates which ORs are significant.
[a] Adjusted for age at the time of diagnosis, active duty status at the time of diagnosis, beneficiary plan type, rank of active duty member/sponsor, tumor stage, chemotherapy, and surgery/radiotherapy. Stratified variables were not included in stratified analysis.

equal access health care, it was hypothesized that surveillance mammography would be similar across racial/ethnic groups; instead, we observed that minority groups, particularly API women, tended to be more likely than non-Hispanic white women to undergo surveillance mammography. Previous studies have indicated that having no health insurance and thus limited access to health care may be a greater barrier to obtaining mammography among API women than other minority women;[21-23] therefore, equal access health care in the current study may have been able to overcome the major obstacle to mammography among API women. It is also possible that API women may have developed closer relationships with their health care providers during cancer treatment because there have been indications that they are more likely to experience adverse effects of chemotherapy,[24] which likely results in closer follow-up during treatment and possibly after treatment. Previous cancer screening is a strong predictor of future screening;[22] therefore, given that the women in the later assessment years were included in the previous year(s), the relatively consistent finding of higher rates among API women across all 3 years may be due to the same women continuing screening adherence.

Although it is possible that incomplete mammography data may have affected the findings of the current study, it appears unlikely that completeness was differential by race/ethnicity and thus an explanation of the current study findings. If beneficiaries have other health insurance and seek care that is not paid for by the DoD, then there would be no record of this care in the MDR. Albeit not always significant, this may partially explain the lower use of surveillance mammography noted among women who did not have TRICARE Prime coverage (health maintenance organization component), assuming that women who have TRICARE Prime coverage are less likely to have other health insurance and thus have more complete data in the MDR. However, under this same assumption, incompleteness of mammography data does not appear to explain the observed racial/ethnic differences; during sensitivity analyses that were restricted to TRICARE Prime beneficiaries, similar racial/ethnic differences were observed (data not shown).

As in previous studies, we found that surveillance mammography was associated with other demographic, tumor, and health characteristics. In agreement with Geller et al,[14] we observed higher surveillance mammography use among older women in comparison with women aged 40 years to 49 years. However, we observed the highest use among women aged 70 years to 79 years as opposed to those aged 60 years to 69 years and we did not observe a significant decrease among the eldest age group (those aged ≥80 years), which had also been observed by others.[11,13] Similar to previous findings,[11-15] we also observed differences by surgery/radiotherapy such that women who did not receive radiotherapy after BCS were less likely to undergo surveillance mammography, particularly during the first year. In contrast to previous

studies,[11-15] we did not observe an inverse relationship between the receipt of surveillance mammography and tumor stage at the time of diagnosis. As in previous studies,[11-13,15] we observed an indication that women with comorbidities were less likely to receive surveillance mammography, which may be, as others have hypothesized,[11,15] an indication that these women and their providers were more concerned with other health issues. Finally, in agreement with previous studies,[11-13,18] we observed that surveillance mammography declined with time since diagnosis.

The main strengths of the current study were that it allowed for the assessment of racial/ethnic disparities within an equal access health care system and allowed for the assessment of surveillance mammography across a wider age range than many previous studies. Another strength of this study was the ability to adjust for demographics, tumor characteristics, and comorbidities, which was made possible by combining cancer registry and medical administrative databases. Limitations of the study included those inherent to using medical administrative databases, which include coding inaccuracies. Another possible study limitation was the unavailability of data regarding possible confounders, including whether follow-up care was provided by a specialist (oncologist/radiologist), which has been associated with the increased use of surveillance mammography.[12,13,15,25] However, unless minority women in the MHS are more likely to be seen by specialists than non-Hispanic white women, this is an unlikely explanation for our observations by race/ethnicity. Finally, because we did not have data available regarding the reason why a mammogram was conducted, some diagnostic mammograms may have been counted as surveillance but our classification scheme should have minimized this possibility.

Among women with equal access health care, minority women were found to be equally or more likely than non-Hispanic white women to receive surveillance mammography. The reasons for these findings are not clear. However, even with equal access health care, it is apparent that a large percentage of breast cancer survivors do not receive the recommended level of surveillance, particularly as time passes after diagnosis. Efforts should be made to educate breast cancer survivors and their health care providers on the importance of continued surveillance.

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CONFLICT OF INTEREST DISCLOSURES

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