The Military Health System: Minimizing Disparities in Breast Cancer Treatment

LCDR Jedson R. Liggett, MC, USN[*,‡]; LCDR Emily A. Norris, MC, USN*[*,‡]; Toni M. Rush*[†]; Nicholas M. Sicignano*[†]; CDR Christopher Oxner, MC, USN*[*]

ABSTRACT

Background:

The Military Health System (MHS) is a universal health care system, in which health care disparities are theoretically minimized. This study aimed to identify disparities and assess their impact on the initiation of timely treatment for breast cancer within a universally insured population.

Methods:

A retrospective cohort study was performed to evaluate the treatment of female breast cancer patients ≥18 years of age within the MHS from January 1, 2014, to December 31, 2018. Incident breast cancer was defined as ≥2 breast cancer diagnoses without a prior diagnosis of breast cancer during the three continuous years before index diagnosis. Time from index diagnosis to initial treatment was calculated and dichotomized as receiving treatment within a clinically acceptable time course. Poisson regression was used to estimate relative risk (RR) with 95% CIs.

Results:

Among the 30,761 female breast cancer patients identified in the MHS, only 6% of patients had a prolonged time to initial treatment. Time to initial treatment decreased during the study period from a mean (SD) of 63.2 (152.0) days in 2014 to 37.1 (28.8) days in 2018 ($P < 0.0001$). Age, region, and military characteristics remained significantly associated with receiving timely treatment even after the adjustment of confounders. Patients 70-79 years old were twice as likely as 18-39 years olds to receive timely treatment (RR: 2.0100, 95% CI, 1.52-2.6563, $P < 0.0001$). Senior officers and their dependents were more likely to receive timely initial treatment compared to junior enlisted patients and their dependents (RR: 1.5956, 95% CI, 1.2119-2.1005, $P = 0.004$).

Conclusions:

There have been significant improvements in the timely initiation of breast cancer treatment within the MHS. However, demographic and socioeconomic disparities can be identified that affect the timely initiation of therapy.

INTRODUCTION

Breast cancer is the most common cancer diagnosed among women in the United States, affecting one in eight women in their lifetime. The American Cancer Society projects that over 330,000 women will receive a new breast cancer diagnosis in 2022 with over 43,000 women estimated to die as a result of their diagnosis.[1] Rapid identification and initiation of treatment following a diagnosis of breast cancer are critical to improving outcomes, as delays in breast cancer treatment can have a significant effect on patient mortality.[2] The treatment of breast cancer can be unimodal or multimodal and can involve surgery, radiation, and/or chemotherapy, including immunotherapy and/or hormonal therapy. Although no consensus guidelines exist, the suggested intervals from diagnosis to treatment initiation are less than 90 days for surgery or less than 120 days for chemotherapy.[3] It is further recommended that radiation therapy be initiated within 365 days of receiving chemotherapy when administered in sequence with chemotherapy.[3]

Given the implications of delayed breast cancer diagnosis and initiation of treatment, identifying and addressing disparities is crucial. It has been well established that black women have an overall lower 5-year survival when compared to other racial groups.[4] Although this can be partially attributed to a higher prevalence of hormone receptor triple-negative (estrogen receptor, progesterone receptor, and human epidermal growth factor receptor 2 negative) tumors in this population,[1,5] racial disparities have also been implicated because of inadequate access to care/insurance status.[6] Moreover, an analysis of the Trial Assigning Individualized Options for Treatment determined that patients with a greater neighborhood deprivation index had a shorter survival regardless of race as did patients with Medicare compared to private insurance status.[7] Another analysis of this data set revealed that patients with associated depression and worse social and physical well-being were more likely to discontinue their recommended endocrine therapy.[8]

The Military Health System (MHS) is an employer-based universal health care system that has a large and

[*]Naval Medical Center Portsmouth, Portsmouth, VA 23708, USA

[†]Health ResearchTx, Trevose, PA 19053, USA

[‡]Authors contributed equally to this work.

This work was presented by the Military Health System Research Symposium, Kissimmee, Florida, Abstract No. MHSRS-22-07708.

doi:https://doi.org/10.1093/milmed/usad218

diverse beneficiary pool with a health information system linking the clinical environments of integrated care.[9] The MHS provides health care through means of direct care—completed within the military treatment facility—and/or purchased care—completed through eligibility for or referral to a civilian facility—and represents a universally insured population. Thus, disparities in the treatment of breast cancer should be highly minimized in this system given the theoretical equal access to care. However, an analysis of time to surgery for breast cancer patients within the MHS from the years 1998 to 2008 demonstrated that non-Hispanic black women had a longer time to surgery following breast cancer diagnosis than did other race/ethnic groups,[10] which is consistent with studies evaluating a non-MHS patient cohort.[11] It is currently unknown whether this disparity has remained within the MHS in more recent years and if additional disparities exist within this population, specifically when incorporating other initial treatment modalities.

In the present study, we performed a retrospective analysis of the MHS data repository from January 1, 2014 to December 31, 2018 using International Classification of Disease (ICD) codes to identify female patients with breast cancer during this time period. The objective of this study was to evaluate potential disparities related to the timely initiation of treatment within a universally insured population of adult, female breast cancer patients. We hypothesized that treatment disparities exist within the MHS and time to treatment initiation in these disparities may have been affected by the year of diagnosis.

METHODS

Data Source

Data from the US DoD MHS database was used in this study. The MHS is one of the largest health care systems in the United States and includes information on approximately 10 million active and retired military service members and their families (51% male; 49% female).[9,11]

Data used in this study were fully anonymized and used in compliance with all federal and state laws, including the Health Insurance Portability and Accountability Act of 1996. The study protocol was approved by the Naval Medical Center Portsmouth Institutional Review Board (IRB) (protocol number NMCP.2017.0007, approved March 2, 2017) in compliance with all applicable federal regulations governing the protection of human subjects and all data derived was subject to ongoing compliance and ethical review by the IRB.

Study Design

This retrospective, observational cohort study identified breast cancer patients in the DoD MHS database across a 5-year period covering January 1, 2014 to December 31, 2018. Patients were included in the study if they had ≥2 diagnosis codes for breast cancer (ICD-10 codes C.50.x and D.05.x; ICD-9 codes 174x, 175x, and 233.0) on separate dates, were ≥18 years of age as of the index date, and had greater than or equal to 1 year of continuous eligibility before the index date (enrollment gaps of ≤30 days were considered continuous). Patients were required to have incident breast cancer, defined as also having no prior diagnosis of breast cancer within the 3-year period before the index date, which was defined as the date of first breast cancer diagnosis encounter. Patients were excluded from either cohort if they had missing age or sex data. Patients were followed from the index date until the first occurrence of either death, disenrollment from the MHS, or end of the study period. Overall patient attrition is shown in Figure 1.

Outcome Assessment

Time to initial treatment (days) for breast cancer was the outcome of interest for this study. Time to treatment was assessed bivariately as a continuous variable and then dichotomized according to the timely initiation of treatment for further analyses. Using a clinically acceptable period for initiating treatment,[3] patients were then grouped into those who had received treatment within a clinically acceptable period and those patients who did not. The clinically acceptable time course from diagnosis to treatment initiation was dependent on the initial treatment each patient received and was defined as 90 days for patients who received surgery first, 120 days for patients who received chemotherapy first, and 120 days for patients who received radiation first.

Covariate Assessment

Patient demographics that were assessed at the index included age (18-39, 40-49, 50-59, 60-69, 70-79, and ≥80 years), geographic region (Supplementary Table S1), marital status (single/married), military service member rank (junior enlisted, senior enlisted, junior officer, senior officer, and warrant officer/other), DoD beneficiary status (active duty, dependent, retired, and other), military branch (Army, Air Force, Navy, Marines, and Coast Guard/other), and index year (2014-2018). Junior enlisted was defined as E1-E4, senior enlisted was defined as E5-E10, junior officer was defined as O1-O3, and senior officers defined as O4-O11. Race was assessed as a demographic of interest; however, it was excluded from the analysis because of an incomplete racial and ethnic documentation. Clinical characteristics were assessed over the 1-year baseline period before the index date. This included mammogram procedure (Y/N), a Charlson Comorbidity Index score calculated for each patient using relevant ICD-9/10 diagnosis codes outlined in the Quan coding method (≥3 and <3),[9] number of medical encounters, pre-index comorbidities (Y/N) included asthma, hypertension, diabetes, PTSD/anxiety, and depression. Comorbidities were defined

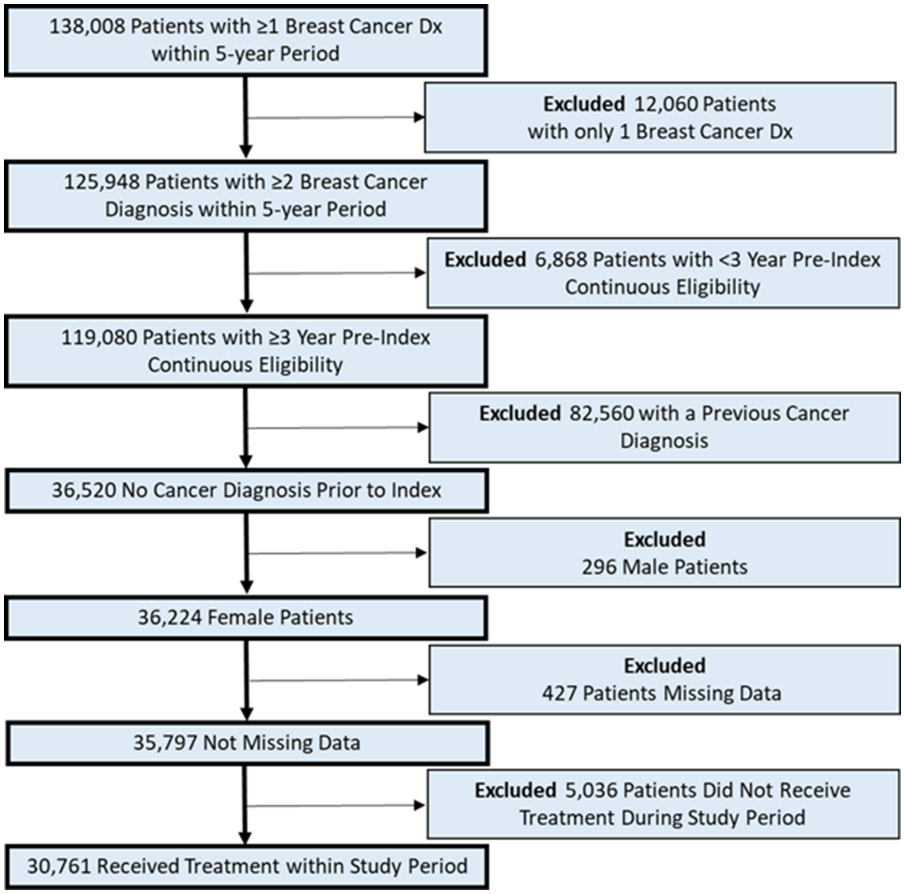

FIGURE 1. A study design with the inclusion and exclusion criteria. Of patients, 138,008 were initially identified, and 107,247 were subsequently excluded. The final study population was 30,761 patients.

as having at least one ICD 9/10 code for a corresponding condition within 1 year before index.

Statistical Analysis

To examine the relationship between time to initial treatment and the various categorical covariates, the least squared means were calculated. ANOVA tests were used to compare mean time to treatment by each categorical variable. A Spearman test was used to compare time to treatment to continuous variables. Time to initial treatment was dichotomized and further analyzed. Descriptive statistics were calculated with chi-squared tests comparing categorical variables and *t*-tests comparing continuous variables. Multicollinearity between covariates was assessed and only variables with a variance inflation factor of >4 or a tolerance level of <0.1 were added to the model. Variables that were significant at $P < 0.1$ from the bivariate analysis were included in the adjusted model. Poisson regression was performed to estimate the unadjusted and adjusted relative risk (RR) and 95% CI of receiving initial treatment for breast cancer in a clinically acceptable time course to assess disparities. Data were analyzed using SAS, version 9.4 for Windows (SAS Institute Inc., Cary, NC, USA).

REPORTING

This study is reported in compliance with the STROBE statement.[12]

RESULTS

Patient Characteristics and Time to Initiation Treatment

There were 30,761 women with breast cancer who received treatment identified in this study. Of these, the mean ± SD age at diagnosis was 64.6 ± 12.5 years of age, and the mean time of follow-up was 2.5 ± 1.4 years. Time to initial treatment was defined as the total time from index diagnosis to initiation of surgery, chemotherapy, or radiation therapy (Table I). Of the 30,761 women identified, 23,709 patients (77%) underwent surgical resection as the initial treatment with a mean time to the initial treatment of 42.5 ± 78.2 days. An additional 6,126 patients (20%) underwent chemotherapy as the initial treatment with a mean time initial treatment of 74.1 ± 151.6 days. Finally, 926 patients (3%) underwent radiation therapy as the initial treatment with a mean time to the initial treatment of 91.1 ± 138.5 days (Table I).

TABLE I. The Characteristic of Initial or Primary Treatment following a Breast Cancer Diagnosis and Median Time to Initial Treatment (TIT)

Initial or primary treatment regimens	*n*	%	Mean TIT (days)	SD	Median TIT (days)	SD
Surgery	23,709	77.0	42.5	78.2	30	20-44
Chemotherapy	6,126	20.0	74.1	151.6	34	21-58
Radiation	926	3.0	91.1	138.5	57	36-91

Bivariate Analysis of Patient Demographic Demonstrates Disparities in Time to Initial Treatment

We began our study utilizing a bivariate analysis to evaluate differences in the average time to treatment based on the demographic characteristics of our identified patient population (Table II). We found that age, geographic region, history of screening mammography within 1 year of a new breast cancer diagnosis, and a comorbid diagnosis of hypertension were highly significant ($P < 0.0001$) for differences in the average time to initial treatment. Of these groups, advanced patient age and a history of screening mammography within 1 year before diagnosis had a faster time to initial treatment. Patients in the older age groups (70-80 years old) had lower average times to initial treatment (43.6 ± 82.4 days) compared to those in the younger age groups (18-39 year old, 58.3 ± 123.2 days). Patients with a history of screening mammography underwent treatment initiation at a mean time of 42.8 ± 70.6 days as compared to 78.5 ± 168.6 for those who did not undergo screening mammography during that period. Moreover, treatment initiation within the Pacific (57.4 ± 105.4 days), Northeast (62.0 ± 130.2 days), or noncontiguous (69.6 ± 149.5 days) regions of the United States demonstrated delays in time to initial treatment as compared to the other demographic regions (range 42.4-49.5 days).

We further identified significant differences in the time to initial treatment based on associated military status among active duty military personnel ($P = .0267$). Among these patients, Junior enlisted personnel experienced the longest time to initial treatment with a mean of 60 ± 120.3 days. Additional differences were observed dependent on beneficiary status ($P = .0143$) and a comorbid diagnosis of depression ($P = .0396$).

Finally, we evaluated differences in time to initial treatment dependent based on the year of diagnosis. We identified significant differences between the years of index diagnosis and time to initial treatment during the study period. Time to initial treatment steadily improved from the initiation of the study period in 2014 to the termination of the study period in 2018, with mean time to initial treatment of 63.2 ± 152.0 to 37.1 ± 28.8 days, respectively ($P < .0001$).

Unadjusted Analysis of Patient Demographic Data Demonstrates Disparities in Time to Initial Treatment

Of the 30,761 women included in the study, 1,940 patients were classified as not receiving initial treatment within a clinically acceptable time period. Age, demographic region, marital status, military rank among active duty military personnel, previous mammography within 1 year, comorbidities of hypertension and depression, and index year were each associated with the initiation of treatment in a clinically acceptable time course. Furthermore, we appreciate that comorbidities of PTSD/anxiety ($P = .0173$), military branch ($P = .0268$), and number of 1-year pre-index treatment encounters ($P < .0001$) were also significantly associated with treatment initiation within a clinically acceptable time course before adjusting for confounding variables.

Adjustment of Variables Demonstrated Improvement in Disparities

We further conducted an adjusted analysis and controlled for variables to determine the RR and 95% CI for each patient's characteristic and initiating treatment in a clinically acceptable time course (Table III). Patients of age 70-79 years old were twice as likely as 18-39-year-old patients to initiate treatment in a clinically acceptable time course (RR: 2.00, 95% CI, 1.52, 2.63, $P < .0001$). Patients with a mammogram within 1 year before their index date of breast cancer were three times more likely to receive timely initial treatment compared to patients without a baseline mammogram (RR: 3.10, 95% CI, 2.8-3.43, $P < .0001$). Hypertension was also weakly independently associated with receiving treatment in a clinically acceptable time course (RR: 1.13, 95% CI, 1.01-1.26, $P = .0475$), whereas all other comorbidities and the number of index treatments were not significant.

Patients in the Southwest, Southeast, Midwest, and Rocky Mountain regions at index were all more likely to receive timely initial treatment for breast cancer compared to patients in the Pacific region at index ($P < .0001$). Military branch was borderline significant in regard to its association with receiving timely initial treatment ($P = .0475$) after adjusting for confounding. Furthermore, active duty military rank also retained significance when evaluated as an independent variable. It was found that senior officers and their dependents were more likely to initiate treatment in a clinically acceptable time course as compared to junior enlisted patients and their dependents (RR: 156, 95% CI, 1.19-2.05, $P = .004$). Finally, the index year of diagnosis remained significantly associated with the initiation of treatment in a clinically acceptable time course. Patients diagnosed in 2018 were twice as likely

TABLE II. The Mean Time to Treatment Initiation and Dichotomization of Treatment Initiation as Clinically Acceptable for Females Diagnosed with Breast Cancer by Clinical Characteristics

						Time to initial treatment in a clinically acceptable time course				
	Overall $n = 30,761$		Time to initial treatment			Yes $n = 28,915$		No $n = 1,940$		
Baseline characteristics	*n*	%	Mean (days)	SD	*P*-value*	*n*	%	*n*	%	*P*-value
Age groups (years)					**<.0001**					**<.0001**
18-39	1,011	3.3	58.3	123.2		912	90.2	99	9.8	
40-49	3,129	10.2	54.0	102.2		2,887	92.3	242	7.7	
50-59	5,444	17.7	52.8	100.8		5,027	92.3	417	7.7	
60-69	9,530	31.0	54.3	113.4		8,881	93.2	649	6.8	
70-79	8,147	26.5	43.6	82.4		7,791	95.6	356	4.4	
≥80	3,500	11.4	45.3	89.4		3,323	94.9	177	5.1	
Military rank					**.0267**					**<.0001**
Junior enlisted	774	2.5	60.0	120.3		702	90.7	72	9.3	
Senior enlisted	20,081	65.3	50.7	99.8		18,775	93.5	1,306	6.5	
Junior officer	902	2.9	50.3	95.9		844	93.6	58	6.4	
Senior officer	7,976	25.9	48.3	100.3		7,542	94.6	434	5.4	
Warrant officer/other	1,028	3.3	49.5	99.0		958	93.2	70	6.8	
Marital status					**.0220**					**.0345**
Single	7,886	25.6	48.0	1.1		7,428	94.2	458	5.8	
Married	22,875	74.4	51.0	0.7		21,393	93.5	1,482	6.5	
Region					**<.0001**					**<.0001**
Northeast	2,022	6.6	62.0	130.2		1,863	92.1	159	7.9	
Pacific	3,945	12.8	57.4	105.4		3,614	91.6	331	8.4	
Southeast	13,653	44.4	47.5	93.4		12,866	94.2	787	5.8	
Southwest	4,644	15.1	49.5	100.5		4,365	94.0	279	6.0	
Rocky Mountains	1,865	6.1	42.4	78.1		1,774	95.1	91	4.9	
Midwest	4,070	13.2	48.5	100.2		3,834	94.2	236	5.8	
Noncontiguous	562	1.8	69.6	149.5		505	89.9	57	10.1	
Beneficiary category					**.0002**					**<.0001**
Active duty	493	1.6	52.7	110.9		447	90.7	46	9.3	
Retiree	1,670	5.5	60.8	129.2		1,520	91.0	150	9.0	
Dependents	28,337	92.1	49.6	98.4		26,610	93.9	1,727	6.1	
Other	261	0.8	48.8	76.2		244	93.5	17	6.5	
Military branch category					.0692					**.0266**
Air Force	10,097	32.8	48.3	92.1		9,501	94.1	596	5.9	
Army	11,123	36.2	52.3	109.5		10,357	93.1	766	6.9	
Coast Guard/other	777	2.5	50.8	104.1		724	93.2	53	6.8	
Marines	1,638	5.3	49.9	92.8		1,538	93.9	100	6.1	
Navy	7,126	23.2	49.8	97.9		6,701	94.0	425	6.0	
Mammogram 1 year before diagnosis					**<.0001**					**<.0001**
No	6,410	20.8	78.5	168.6		5,594	87.3	816	12.7	
Yes	24,351	79.2	42.8	70.6		23,227	95.4	1,124	4.6	
Comorbidities										
Asthma	2,589	8.4	45.2	75.4	**.0069**	2,446	94.5	143	5.5	.0867
Hypertension	16,565	53.9	46.5	90.1	**<.0001**	15,693	94.7	872	5.3	**<.0001**
Diabetes	6,260	20.4	48.2	91.2	.0698	5,890	94.1	370	5.9	.1485
PTSD/anxiety	3,903	12.7	47.6	90.4	.0768	3,691	94.6	212	5.4	**.0161**
Depression	3,728	12.1	47.2	84.8	**.0492**	3,526	94.6	202	5.4	**.0173**
Index year					**<.0001**					**<.0001**
2014	6,451	21.0	63.2	152.0		5,944	92.1	507	7.9	
2015	6,324	20.6	56.2	121.3		5,872	92.9	452	7.1	
2016	6,308	20.5	49.3	85.2		5,883	93.3	425	6.7	
2017	6,334	20.6	43.2	48.9		5,954	94.0	380	6.0	
2018	5,344	17.4	37.1	28.8		5,168	96.7	176	3.3	

TABLE III. The Relative Risk with a 95% CI for Demographic Characteristics on Initiation of Treatment in a Clinically Acceptable Time Course

	Timely initial treatment[a]						
	Unadjusted				Adjusted		
Baseline characteristics	RR	95% CI		*P*-value	RR	95% CI		*P*-value
Age groups (years)				**<.0001**				**<.0001**
18-39	1.0	—	—		1.0	—	—	
40-49	1.30	1.01	1.66		0.97	0.75	1.26	
50-59	1.31	1.04	1.65		1.02	0.80	1.31	
60-69	1.49	1.19	1.86		1.25	0.98	1.61	
70-79	2.38	1.88	3.00		2.00	1.52	2.63	
≥80	2.04	1.58	2.63		1.86	1.35	2.58	
Rank group (SES proxy)				**<.0001**				**.0042**
Junior enlisted	1.0	—	—		1.0	—	—	
Senior enlisted	1.47	1.15	1.89		1.31	1.01	1.69	
Junior officer	1.49	1.04	2.14		1.39	0.96	2.02	
Senior officer	1.78	1.37	2.31		1.56	1.19	2.05	
Warrant officer/other	1.40	1.00	1.98		1.24	0.87	1.77	
Marital status				**.0346**				.7676
Single	1.0	—	—		1.0	—	—	
Married	0.89	0.799	0.992		0.98	0.87	1.11	
Region				**<.0001**				**<.0001**
Northeast	1.07	0.88	1.31		1.19	0.98	1.46	
Pacific	1.00	—	—		1.0	—	—	
Southeast	1.50	1.31	1.71		1.56	1.36	1.79	
Southwest	1.43	1.22	1.69		1.55	1.31	1.84	
Rocky Mountains	1.79	1.41	2.27		1.79	1.40	2.29	
Midwest	1.49	1.25	1.77		1.63	1.37	1.95	
Noncontiguous	0.81	0.60	1.09		1.02	0.75	1.38	
Beneficiary category				**<.0001**				**.0157**
Active duty	1.0	—	—		1.0	—	—	
Retiree	1.04	0.74	1.48		0.91	0.63	1.32	
Dependents	1.59	1.17	2.16		1.20	0.85	1.68	
Other	1.48	0.83	2.63		1.53	0.85	2.77	
Military branch category				**.0268**				**.0475**
Air Force	1.18	1.06	1.32		1.10	0.98	1.24	
Army	1.0	—	—		1.0	—	—	
Coast Guard/other	1.01	0.76	1.35		1.09	0.81	1.47	
Marines	1.14	0.92	1.41		1.17	0.94	1.46	
Navy	1.17	1.03	1.32		1.22	1.07	1.38	
Mammogram 1 year before diagnosis				**<.0001**				**<.0001**
No	1.0	—	—		1.0	—	—	
Yes	3.01	2.73	3.32		3.10	2.80	3.43	
Comorbidities (yes)								
Asthma	1.17	0.98	1.39	**.0870**	1.08	0.90	1.29	.4281
Hypertension	1.46	1.34	1.61	**<.0001**	1.13	1.01	1.26	**.0313**
Diabetes	1.09	0.97	1.23	.1486				
PTSD/anxiety	1.20	1.03	1.39	**.0163**	1.06	0.91	1.25	.4412
Depression	1.20	1.03	1.39	**.0175**	1.07	0.91	1.26	.4179
Index year				**<.0001**				**<.0001**
2014	1.0	—	—		1.0	—	—	
2015	1.11	0.97	1.26		1.10	0.97	1.26	
2016	1.18	1.03	1.35		1.13	0.99	1.29	
2017	1.34	1.16	1.53		1.33	1.15	1.53	
2018	2.50	2.10	2.99		2.38	1.99	2.84	
CCI score				**<.0001**				.3097
<4	1.0	—	—		1.0	—	—	
≥4	1.42	1.28	1.57		0.92	0.79	1.08	
1-year pre-index encounters				**<.0001**				.8666
<12	1.0	—	—		1.0	—	—	
≥12	1.30	1.18	1.42		0.99	0.89	1.10	

Abbreviation: CCI, Charlson Comorbidity Index.

[a]Reference is NOT receiving an initial treatment for breast cancer in a clinically acceptable time course.

than those diagnosed in 2014 to initiate treatment in a clinically acceptable time course (RR: 2.38, 95% CI, 1.99-2.84, $P < .0001$).

DISCUSSION

This study evaluated the MHS database from 2014 to 2018 to investigate disparities in the initiation of breast cancer treatment. Overall, we noted 94% of patients identified for our study underwent treatment initiation within a clinically appropriate time course and that there was a year-to-year decrease in time to treatment initiation from 2014 to 2018. These results demonstrate improvements in overall access to breast cancer treatment for patients within the MHS. However, of the 6% of patients, who did not have treatment initiated within a clinically acceptable time course, we identified that patients had statistically significant differences receiving timely initial treatment by the geographic region, age, and rank of the military service member.

Socioeconomic status (SES) has frequently been implicated as a leading cause of breast cancer disparity in both the United States and Europe, secondary to decreased access to care.[13–15] Within the military rank structure, military ranks can be utilized as a surrogate for SES.[16,17] In this regard, junior enlisted military personnel (defined as E1-E4 at the time of index diagnosis) represent the lowest ranks of military service, have the lowest household incomes, and are less likely to have completed educational levels greater than high school. In theory, socioeconomic disparities should not be present within universal health care systems, such as the MHS. Nonetheless, we found a significantly prolonged time to initial treatment among junior enlisted military personnel, independent of age, as compared to senior officers, whereas junior officers and senior enlisted personnel did not. Similar findings have been discovered regarding colorectal cancer screening[18] and screening mammography,[19] and a higher military rank of the patient and his/her dependents has been associated with improved health outcomes within the MHS.[20] However, to our knowledge, this is the first-time military rank has been associated with a disparity in breast cancer treatment. Taken together with previous studies, our data represents an area of further research into associated causes for delays in health care, the result of which could have significant implications for the improvement of care delivery within the MHS.

We further identified a significant difference in the time to initial treatment in women aged 18-39 years old as compared to women 40-70 years old. Breast cancer in young patients is more often attributable to hereditary genetic abnormalities and warrants BRCA1 and BRCA2 testing, as recommended by the National Comprehensive Cancer Network.[21] However, the BRCA testing was not uniformly recommended in patients less than 60 years old until 2011.[22] Although a direct correlation cannot be established within our data, delays resulting from more advanced workup and complex decision-making (to include fertility preservation) may offer some insight. However, a similar finding has also been noted regarding screening mammography[19] and surveillance mammography within the MHS, where women 40-49 years old were less likely to adhere to surveillance mammography guidance than older women.[23]

Finally, we demonstrated that patients diagnosed in the Southwest, Southeast, Midwest, and Rocky Mountain regions at index were all more likely to receive timely initial treatment for breast cancer compared to patients in the Pacific region. There also appeared to be a difference based on associated military branch, although this was only weakly significant. Interestingly, previous research has established a clear connection between the length of travel required to receive oncologic care to early diagnosis, appropriate treatment, and outcomes.[24] In this regard, a detailed investigation into the geospatial relationships of TRICARE beneficiaries within the Pacific Region and US Army and the distance traveled for breast cancer screening and care may provide valuable insight into this delayed time to initial treatment. Furthermore, the patient population investigated within this study includes patients who received treatment as a result of either TRICARE direct care or purchased care. It has been well established that surgical treatment volume within MTFs has been steadily declining. A recent study evaluating surgical volume at MTFs from 2015 to 2019 demonstrated a 25.6% decrease in surgical volume during the study period,[25] although it has been further demonstrated that the proportion of complex surgical procedures being completed for TRICARE beneficiaries more greatly reflected in the purchase care market.[26] To our knowledge, it is currently unknown if similar associations are being seen for oncological care. Further studies are warranted to investigate the roles of purchased care and direct care within the MHS in regard to increased access to the diagnosis and treatment of breast and other complex cancers among TRICARE beneficiaries.

LIMITATIONS

This is a retrospective review of the DoD MHS data repository, where data are generated and obtained using ICD codes from insurance claims data processed through TRICARE. As a result, reporting errors secondary to inadequate medical coding may exist within the MHS data repository and lead to inaccurate interpretation of the results. It is further important to recognize that MHS beneficiaries with additional health insurance may be missing health care claims in which a third-party insurer was utilized without TRICARE additionally covering a portion of that claim. Moreover, clinical and pathological staging data cannot be extracted from the MHS data repository using coding data. Although linked data regarding clinical and pathological staging are available through the DoD Central Cancer Registry, this is only applicable for patients who were diagnosed and treated within an MTF, whereas the dataset presented in this article represents

all patients who received care at civilian or military institutions. These data do not account for multidisciplinary care discussions, individualized treatment approaches, individual patient preferences, or fertility preservation, all of which may have affected the time to treatment initiation. Finally, although previous studies of breast cancer disparities within the MHS have demonstrated significant implications of race on treatment course[27] using Central Cancer Registry data, we found that our data set was largely incomplete regarding race and therefore race was excluded from subsequent analyses.

CONCLUSION

Significant improvements in time to breast cancer treatment initiation occurred during the time period of 2014-2018, with only 6% of all breast cancer patients within the MHS initiating treatment in a clinically unacceptable time course. These patients varied by the geographic region, age, and military rank, which suggests that these are the areas of remnant disparities within the MHS system. Our data provides insight into these disparities and demonstrate areas for further investigation to improve the delivery of care throughout this system.

SUPPLEMENT SPONSORSHIP

This article appears as part of the supplement "Proceedings of the 2022 Military Health System Research Symposium," sponsored by the Assistant Secretary of Defense for Health Affairs.

ACKNOWLEDGMENTS

The authors graciously thank Ms. Diana Sheldon for serving the critical role of research coordinator and providing administrative oversight for this project. The authors also wish to thank all medical providers within the MHS and worldwide who provide care for patients with breast cancer patients.

SUPPLEMENTARY MATERIAL

Supplementary material is available at *Military Medicine* online.

FUNDING

This research received no external funding.

CONFLICT OF INTEREST STATEMENT

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

INDIVIDUAL AUTHOR CONTRIBUTION STATEMENT

J.R.L. and E.A.N. contributed equally to this work in the critical interpretation of data and authorship. T.M.R. and N.M.S. were crucial in data acquisition, statistical methods, and statistical analysis. E.A.N. and C.O. were responsible for the study design. C.O. facilitated critical oversight of the project. All authors provided a critical review of the manuscript and approved the manuscript before submission.

REFERENCES

1. Siegel RL, Miller KD, Fuchs HE, Jemal A: Cancer statistics, 2022. CA Cancer J Clin 2022;72(1): 7–33. 10.3322/caac.21708.
2. Williams F: Assessment of breast cancer treatment delay impact on prognosis and survival: a look at the evidence from systematic analysis of the literature. J Cancer Biol Res 2015; 3(4): 1071. 10.47739/2373-9436/1071.
3. Bleicher RJ: Timing and delays in breast cancer evaluation and treatment. Ann Surg Oncol 2018;25(10): 2829–38. 10.1245/s10434-018-6615-2.
4. DeSantis CE, Ma J, Goding Sauer A, Newman LA, Jemal A: Breast cancer statistics, 2017, racial disparity in mortality by state. CA Cancer J Clin 2017;67(6): 439–48. 10.3322/caac.21412.
5. Cui Y, Deming-Halverson SL, Shrubsole MJ, et al: Associations of hormone-related factors with breast cancer risk according to hormone receptor status among white and African American women. Clin Breast Cancer 2014;14(6): 417–25. 10.1016/j.clbc.2014.04.003.
6. Ko NY, Hong S, Winn RA, Calip GS: Association of insurance status and racial disparities with the detection of early-stage breast cancer. JAMA Oncol 2020;6(3): 385–92. 10.1001/jamaoncol.2019.5672.
7. Sadigh G, Gray RJ, Sparano JA, et al: Assessment of racial disparity in survival outcomes for early hormone receptor-positive breast cancer after adjusting for insurance status and neighborhood deprivation: a post hoc analysis of a randomized clinical trial. JAMA Oncol 2022;8(4): 579–86. 10.1001/jamaoncol.2021.7656.
8. Yanez B, Gray RJ, Sparano JA, et al: Association of modifiable risk factors with early discontinuation of adjuvant endocrine therapy: a post hoc analysis of a randomized clinical trial. JAMA Oncol 2021;7(8): 1–7. 10.1001/jamaoncol.2021.1693.
9. Gimbel RW, Pangaro L, Barbour G: America's "undiscovered" laboratory for health services research. Med Care 2010;48(8): 751–6. 10.1097/MLR.0b013e3181e35be8.
10. Eaglehouse YL, Georg MW, Shriver CD, Zhu K: Racial differences in time to breast cancer surgery and overall survival in the US military health system. JAMA Surg 2019; 154(3): e185113. 10.1001/jamasurg.2018.5113.
11. Collin LJ, Ross-Driscoll K, Nash R, et al: Time to surgical treatment and facility characteristics as potential drivers of racial disparities in breast cancer mortality. Ann Surg Oncol 2022;29(8): 4728–4738. 10.1245/s10434-022-11720-z.
12. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative: The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol 2008;61(4): 344–9. 10.1016/j.jclinepi.2007.11.008.
13. Riba LA, Gruner RA, Alapati A, James TA: Association between socioeconomic factors and outcomes in breast cancer. Breast J 2019;25(3): 488–92. 10.1111/tbj.13250.
14. Dreyer MS, Nattinger AB, McGinley EL, Pezzin LE: Socioeconomic status and breast cancer treatment. Breast Cancer Res Treat 2018;167(1): 1–8. 10.1007/s10549-017-4490-3.
15. White A, Richardson LC, Krontiras H, Pisu M: Socioeconomic disparities in breast cancer treatment among older women. J Womens Health (Larchmt) 2014;23(4): 335–41. 10.1089/jwh.2013.4460.
16. Norton JM, Grunwald L, Banaag A, et al: Racial and socioeconomic disparities in CKD in the context of universal health care provided by the military health system. Kidney Med 2021;4(1): 100381. 10.1016/j.xkme.2021.08.015.
17. Young JD, Dee EC, Levine A, Sturgeon DJ, Koehlmoos TP, Schoenfeld AJ: Does universal insurance and access to care influence disparities in outcomes for pediatric patients with osteomyelitis? Clin Orthop Relat Res 2020;478(7): 1432–9. 10.1097/CORR.0000000000000994.
18. McEvoy CS, Shah NG, Roberts SE, et al: Universal healthcare coverage does not ensure adherence to initial colorectal cancer screening guidelines. Mil Med 2021;186(11–12): e1071–6. 10.1093/milmed/usaa319.
19. Bytnar JA, Byrne C, Olsen C, et al: The impact of mammography screening guideline changes among women serving in the U.S. military. Mil Med 2020;185(11–12): e2088–96. 10.1093/milmed/usaa176.

20. Blattner M, Price J, Holtkamp MD: Socioeconomic class and universal healthcare: analysis of stroke cost and outcomes in US military healthcare. J Neurol Sci 2018;386(15): 64–8. 10.1016/j.jns.2018.01.018.
21. Rosenberg SM, Ruddy KJ, Tamimi RM, et al: BRCA1 and BRCA2 mutation testing in young women with breast cancer. JAMA Oncol 2016;2(6): 730–6. 10.1001/jamaoncol.2015.5941.
22. Chun DS, Berse B, Venne VL, et al: BRCA testing within the Department of Veterans Affairs: concordance with clinical practice guidelines. Fam Cancer (2017);16(1): 41–9. 10.1007/s10689-016-9921-5.
23. Enewold L, McGlynn KA, Zahm SH, et al: Surveillance mammography among female Department of Defense beneficiaries: a study by race and ethnicity. Cancer 2013;119(19): 3531–8. 10.1002/cncr.28242.
24. Ambroggi M, Biasini C, Del Giovane C, Fornari F, Cavanna L: Distance as a barrier to cancer diagnosis and treatment: review of the literature. Oncologist 2015;20(12): 1378–85. 10.1634/theoncologist.2015-0110.
25. Dalton MK, Remick KN, Mathias M, et al: Analysis of surgical volume in military medical treatment facilities and clinical combat readiness of US military surgeons. JAMA Surg 2022; 157(1): 43–50. 10.1001/jamasurg.2021.5331.
26. Haag A, Cone EB, Wun J, et al: Trends in surgical volume in the military health system-a potential threat to mission readiness. Mil Med 2021;186(7–8): 646–50. 10.1093/milmed/usaa543.
27. Lovejoy LA, Eaglehouse YL, Hueman MT, Mostoller BJ, Shriver CD, Ellsworth RE: Evaluation of surgical disparities between African American and European American women treated for breast cancer within an equal-access military hospital. Ann Surg Oncol 2019;26(12): 3838–45. 10.1245/s10434-019-07706-z.