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Assessing equity of care across metastatic breast cancer treatment junctures: a multi-site retrospective cohort study

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Abstract

Background Although inequality in the prevalence and mortality of metastatic breast cancer (mBC) have been documented, the contribution of non-clinical predictors along the care continuum remains unclear. This study aimed to identify determinants of disparities along the continuum of care among patients with mBC.

Methods A retrospective cohort study of patients with mBC under the Medicare Oncology Care Model program was conducted with Texas Oncology Network data from July 2016 to June 2021 as well as the County Health Rankings and Roadmaps Data. Study outcomes were rates of completion and time to receipt of services across four key care junctures: (1) *Diagnosis and Evaluation*, (2) *Treatment Plan Design*, (3) *Treatment Implementation*, and (4) *End-of-life Care*. Race/ethnicity was the primary predictor variable and secondary predictors included sociodemographic and clinical characteristics (referred to as the Vulnerability Cluster). Bivariate analysis, multivariable logistic regression, and generalized linear models were employed.

Results Among 460 patients included, mean age was 72.7 years and 98.7% were female; 73.7% were white, followed by 10.7% Hispanic, and 7.6% Black. Over 90% received services across the first three junctures. At End-of-life Care, only 14 (3.04%) received palliative care referral and 34.1% were enrolled in hospice, with an average length of stay (LOS) of 32.0 days. Adjusted analyses revealed significant racial/ethnic disparities in the End-of-life Care juncture, especially in hospice utilization. Compared to whites, blacks and Hispanics had shorter days to hospice enrollment, by 13.2% (Incidence Rate Ratio [IRR] = 0.868, 95% CI = 0.845–0.891, $p < 0.001$) and 34.8% (IRR = 0.652, 95% CI = 0.635–0.671, $p < 0.001$), respectively, and shorter LOS by 24.6 (IRR = 0.754, 95% CI = 0.645–0.882, $p = 0.0004$) and 25.3% (IRR = 0.747, 95% CI = 0.632–0.882, $p = 0.0006$), respectively. Other vulnerability cluster variables were predictive across care junctures.

Conclusions The vulnerability cluster of variables, even in a Medicare population, were associated with the receipt and timeliness of care, especially at end-of-life among patients with mBC. More proactive and equitable care in mBC toward the end of their care journey is warranted.

Keywords Patients with metastatic breast cancer, Equitable care, Metastatic breast cancer care, End-of-life care

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Introduction

Breast cancer is the most commonly diagnosed cancer and the second leading cause of cancer-related death among women in the United States (US).¹ The incidence of female breast cancer in the US has been slowly but steadily increasing over the last two decades.¹ In 2024, it was projected that 310,720 metastatic cases will occur,² with approximately 6% of patients presenting with metastatic breast cancer (mBC) at diagnosis and 12% of those diagnosed with breast cancer developing mBC during the course of their lifetime.³ For patients with mBC, the main treatment goals are to prolong survival and improve quality of life (QoL).⁴ However, the overall survival rate of mBC has slightly improved but remains low,⁵ with a 5-year survival of approximately 30%,² while QoL may have worsened in the past decade.⁶

Disparities in cancer epidemiology in the US have been documented for decades⁷ and race, socioeconomic status and geography are key drivers of these disparities.^{8, 9, 10} Breast cancer mortality is higher among ethnic/racial minorities, including black, ^{11, 12, 13} Hispanic,^{11, 12, 13} and Native American women,^{12, 13} compared with white women. Minorities are also more likely to present with mBC^{11, 13, 14} and black women present with more aggressive tumors and experience poorer survival.¹⁴ Survival disparities (especially black-white disparities) persist even after accounting for possible confounders such as age, stage, and treatment, ^{11, 15} indicating that other non-clinical factors may contribute to inequalities.¹⁶

The purpose of this study was to identify determinants of disparities along the care continuum among patients with mBC, utilizing electronic medical records (EMR) and administrative claims data from a community oncology practice network. Most retrospective studies assessing breast cancer disparities have utilized the Surveillance, Epidemiology, and End Results (SEER) data, ¹⁷ and while valuable, they lack treatment variables such as distress screening and Advanced Care Planning (ACP) that are available from EMR data.

Study model

The conceptual framework was developed to represent primary junctures of the mBC care journey (Fig. 1). The model identifies four primary junctures – (1) *Diagnosis and Evaluation*, (2) *Treatment Plan Design*, (3) *Treatment Implementation*, and (4) *End-of-life Care* – as key phases of care which are hypothesized to be affected by a Vulnerability Cluster of variables. The model uses a multivariable approach in conceptualizing factors that drive inequities in the progression of mBC care and served as the guiding framework to examine the study aims. The aims were to understand the level of and time to receipt of recommended care across the four junctures and to

identify factors that are associated with not receiving necessary and/or timely care across these key phases.

Methods

Study design and data source

This multi-site retrospective cohort study utilized EMR and administrative claims data from the Texas Oncology Network (TxON). TxON is an independent, physician-led, community-based practice and the largest community oncology practice in the US. County Health Rankings and Roadmaps Data was used for county-level social and structural determinants of health.

Study population

Patients were included if they were diagnosed with mBC between July 1, 2016 and December 31, 2018 (the identification period) and received treatment under the Medicare Oncology Care Model (OCM) program. Each patient was followed from date of diagnosis until death or the end of the observation period set as June 30, 2021.

Outcomes and predictor variables

Study outcomes were receipt and timing of key services related to each of the four care junctures, following initial diagnosis (Fig. 1). Key services at each juncture included: (1) *Diagnosis and management*: oncology Evaluation and Monitoring (E&M) service; (2) *Treatment plan design*: anticancer treatment plan (anticancer therapy, radiation, or surgery) ordered and distress screening conducted; (3) *Treatment implementation*: anticancer therapy, radiation, or surgery received and advance care planning (ACP) visit made; and (4) *End-of-life care*: palliative care referral, hospice enrollment and length of stay (LOS), and use of chemotherapy in the last 14 days of life. Use of palliative care and chemotherapy in the last 14 days of life are the common indicators of quality of care in end-of-life cancer care.^{18, 19} For all outcomes except the last two services (i.e., hospice LOS and use of chemotherapy in the last 14 days of life), time to completion was measured as number of days from diagnosis date.

Race/ethnicity was the primary predictor variable and secondary predictors included other demographics (age, gender, marital status), clinical variables (number of metastatic sites), and county-level social and structural determinants of health (access to primary care, high school completion rate, mammography screening rate, median income, percentage of adults reporting fair or poor health, residential segregation index, unemployment rate, uninsured rate). Predictor variables are referred to as the “Vulnerability Cluster” in the study model (Fig. 1). We hypothesized that the vulnerability cluster variables were significantly related to the receipt and timing of key services at each of the four care junctures. Descriptions of

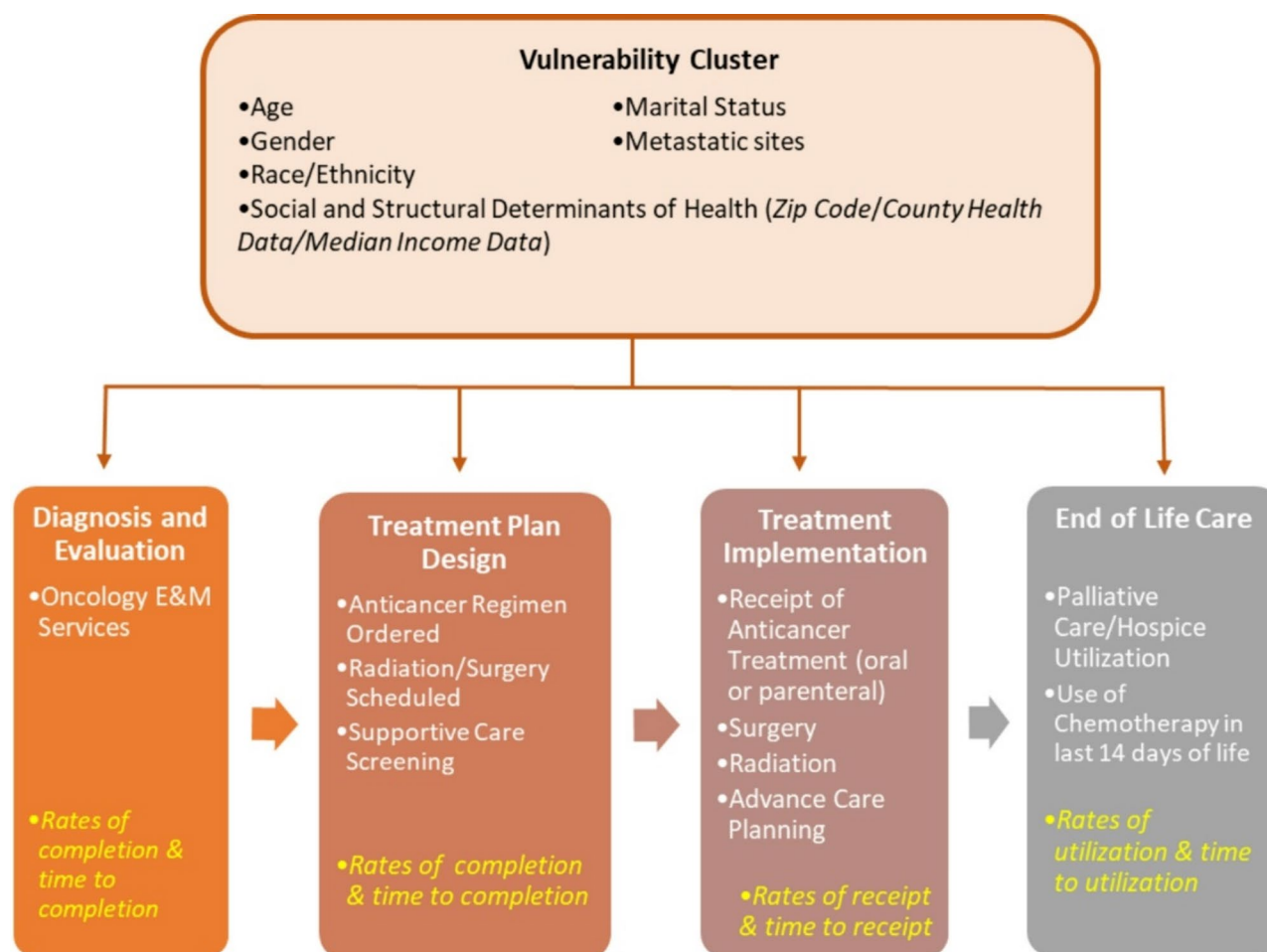


Fig. 1 Study conceptual model

outcomes and predictors are detailed in supplementary material (See Supplementary Table A1, Additional File 1).

Statistical analyses

Study outcomes and predictor variables were described as frequencies and percentages (categorical variables) or means and standard deviations and/or medians and ranges (continuous variables). Bivariate analyses compared outcomes across racial/ethnic groups. For these analyses, a chi-square test was used for the completion rates and one-way ANOVA test for time to completions (See Supplementary Table A2, Additional File 2). Multi-variable logistic regression and generalized linear models (GLM) identified predictors of outcomes with race/ethnicity as a primary predictor and all other vulnerability cluster variables as covariates. Modified Park test identified an appropriate link and family for each GLM analysis, and appropriate model diagnostics were used to assess multicollinearity between covariates. An a priori level of significance of $p < 0.05$ was assumed to determine

relevant covariates. Analyses were conducted using SAS 9.4 and STATA 17.

Results

Of the 460 patients with mBC identified, average age was 72.7 (± 9.7) years (range: 31.0–95.3) and almost all were female (98.7%). The majority was white (73.7%), followed by Hispanic (10.7%), and Black (7.6%). Less than half (40%) were married. They had a mean of 2.1 (± 1.3) metastatic sites, with 85.7% estrogen receptor positive, 69.6% progesterone receptor positive, and 16.3% human epidermal growth factor receptor 2 (HER2) positive. Overall, patients resided in counties with mostly good to average rankings on social and structural determinants of health (Table 1).

Rates of completion and time to receipt of services across four key care junctures

Descriptive results of key events across the four care junctures are shown in Table 2. At *Diagnosis and Evaluation*, all patients ($N=460$) received an E&M visit.

Table 1 Descriptive findings of the vulnerability cluster variables (predictor variables) of patients with mBC ($N=460$)

Variables	N (%)	Mean (SD)
Age		72.66 (9.65)
Gender		
Female	454 (98.70)	
Male	6 (1.30)	
Race/Ethnicity		
White	339 (73.70)	
Hispanic	49 (10.65)	
Black	35 (7.61)	
Asian	6 (1.30)	
Other	4 (0.87)	
Declined/Unknown	27 (5.87)	
Marital Status		
Married	184 (40.00)	
Widowed	123 (26.74)	
Single	65 (14.13)	
Unknown	36 (7.83)	
Number of Metastatic sites		2.07 (1.28)
Social and Structural Determinants of Health(County level)*		
Access to primary care ^a		2092.67 (1098.86)
Access to other primary care providers ^b		2050.30 (1267.42)
High school completion ^c		0.90 (0.05)
Mammography screening (Medicare patients) ^d		0.58 (0.06)
Median Income ^e		57,671.79 (14,168.33)
Poor or fair health ^f		0.18 (0.05)
Residential segregation index ^g		
Black/White		44.86 (9.26)
Nonwhite/White		29.29 (7.28)

Table 1 (continued)

Variables	N (%)	Mean (SD)
Unemployment ^h		0.04 (0.01)
Uninsured ⁱ		0.19 (0.04)

* As reported by County Health Rankings (except median income reported by the US Census Bureau)

a Ratio of population to primary care physicians

b Ratio of population to primary care providers other than physicians

c Percentage of adults ages 25 and over with a high school diploma

d Percentage of female Medicare enrollees ages 65–74 that received an annual mammography screening

e Median reported income for 2018 as reported by the US Census Bureau at the zip code level of the patient

f Percentage of adults reporting fair or poor health (age-adjusted)

g Residential segregation index for black/white and non-white/white

h Percentage of population aged ≥ 16 unemployed but seeking work

i Percentage of adults under the age of 65 who do not have health insurance

The average time to an E&M visit was 17.1 (± 18.2 ; Median = 11) days from mBC diagnosis. At *Treatment Plan Design*, a majority received a treatment plan (91.5%) and at least one distress screening (86.3%). The average times to receipt of a treatment plan and distress screening were 26.2 (± 41.4 ; Median = 17) and 820.2 (± 464.1) days from diagnosis, respectively. At *Treatment Implementation*, most patients received anticancer therapy (91.1%), starting an average of 39.4 (± 75.1 ; Median = 26) days from diagnosis. Fewer than 20% received radiation (17.8%) and surgery (11.1%). About one-third (33.04) had at least one ACP visit that occurred an average of 479.2 (± 628.6 ; Median = 98) days from diagnosis. At *End-of-life Care*, only 14 (3.0%) received palliative care referral and 34.1% enrolled in hospice. Among patients who died, 58.4% enrolled in hospice (data not shown in the table). Hospice enrollment occurred an average of 709.6 (± 465.1 ; Median = 611) days from diagnosis. Among those with a record of both hospice and death ($N=92$), the average hospice LOS was 32.0 (± 34.0 ; Median = 17.5) days. Among those with a record of death and receipt of chemotherapy within 14 days of death ($N=247$), less than 10% (8.5%) received chemotherapy during this time.

The association between vulnerability cluster variables and receipt and time to care across four key care junctures in mBC

Bivariate analyses of 423 patients ($n=37$ other or unknown race/ethnicity were excluded due to small sample size) showed no significant racial/ethnic variations in receipt or time to key services across the care junctures when unadjusted for other covariates (i.e., other vulnerability cluster variables) (See Supplementary Table A2, Additional File 2). For multivariable analysis, an additional 19 were excluded ($n=5$ male patients and $n=14$ for missing values), resulting in a total of 404 patients in the

Table 2 Descriptive findings across four key care junctures in mBC (N=460)

Care Juncture	Receipt of Service	Time to Receipt of Service (in Days)	
	N (%)	Mean (SD)	Median (Range)
Diagnosis and Evaluation			
Evaluation and Management (E&M) Visit	460 (100.0)	17.1 (18.2)	11.0 (0-211)
Treatment Plan Design			
Treatment Plan	421 (91.5)	26.2 (41.4)	17.0 (0-642)
Distress Screening	397 (86.3)	820.2 (464.1)	841.0 (0-2017)
Treatment Implementation			
Anticancer Therapy Start	419 (91.1)	39.4 (75.1)	26.0 (0-1022)
Radiation Start	82 (17.8)	51.6 (142.1)	22.0 (0-1201)
Surgery Start	51 (11.1)	398.4 (406.9)	223 (0-1491)
Advance Care Planning (ACP) Visit	152 (33.0)	479.2 (628.6)	98.0 (0-2107)
End of Life Care			
Palliative Care Referral	14 (3.0)	1362.9 (452.4)	1383.5 (6-1796)
Hospice Enrollment	157 (34.1)	709.6 (465.1)	611.0 (16-2030)
Hospice Length of Stay (LOS) ^a	N/A	32.0 (34.0)	17.5 (2-146)
Chemotherapy within 14 days of death ^b	21 (8.5)	N/A	N/A

aN=92 based on those who have a record of both 'hospice enrollment' and 'death,' (n = 146) and information about hospice length of stay (LOS)

bN=247 based on those who have a record of both 'death' (n=250) and information about whether or not they received chemotherapy within 14 days of death

cohort. Four factors from the County Health Rankings (poor or fair health, unemployment rate, median income, and uninsured rate) were excluded due to multicollinearity. Table 3 shows results of the multivariable models for each outcome, with all results adjusted for other model covariates.

At *Diagnosis and Evaluation*, compared to those who were married, those with unknown marital status had 58.9% more days between diagnosis and E&M visit (Rate Ratio [RR] = 1.589, 95% CI = 1.108–2.278, $p = 0.0119$). At *Treatment Plan Design*, a treatment plan was present for 373 out of 404 patients. Each additional metastatic site resulted in a 77.5% higher likelihood of having a treatment plan (Odds Ratio [OR] = 1.775, 95% CI = 1.118–2.817, $p = 0.0150$). Among those with treatment plans ($n = 373$), a one unit increase in the residential segregation index for black/white (i.e., greater residential segregation) was associated with 2.4% longer days from the diagnosis to date of treatment plan (RR = 1.024, 95% CI = 1.006–1.044, $p = 0.0102$). A one-year increase in age and unknown marital status (compared to married

status) were associated with a 3.9% (OR = 0.961, 95% CI = 0.927–0.997, $p = 0.0338$) and a 67.7% (OR = 0.323, 95% CI = 0.113–0.926, $p = 0.0354$) lower likelihood of having a distress screening, respectively.

At *Treatment Implementation*, a total of 372 of 404 patients started treatment. Each additional metastatic site was associated with a 68.6% higher likelihood of starting anticancer therapy (OR = 1.686, 95% CI = 1.088–2.613, $p = 0.0195$). While none of the covariates were associated with the likelihood of receiving radiation therapy, older patients were less likely to undergo surgery (OR = 0.957, 95% CI = 0.922–0.994, $p = 0.0238$). Due to small sample sizes, multivariable analysis could not be performed for “days to radiation” and “days to surgery” outcomes. Among those who had an ACP visit ($n = 136$), a one unit increase in access to primary care providers other than physicians was associated with 0.07% fewer days from diagnosis to ACP visit (RR = 0.9993, 95% CI = 0.9988–0.9998, $p = 0.0095$).

At *End-of-life Care*, only 14 of 404 patients received a palliative care referral. A one-year increase in age was associated with a 9.4% lower likelihood of receiving a referral (OR = 0.906, 95% CI = 0.840–0.977, $p = 0.0101$). “Days to palliative care referral” could not be assessed due to the limited sample size. Among those with a death record ($n = 217$; data not shown), a total of 128 (59.0%) were enrolled in hospice. None of the vulnerability cluster variables was associated with enrollment. However, regarding days from diagnosis to hospice enrollment, compared to white patients, black and Hispanic patients had shorter days, by 13.2% (Incidence Rate Ratio [IRR] = 0.868, 95% CI = 0.845–0.891, $p < 0.001$) and 34.8% (IRR = 0.652, 95% CI = 0.635–0.671, $p < 0.001$), respectively. Among other person-level covariates, older age, all marital statuses other than being married, and more metastatic sites were associated with shorter days from diagnosis to enrollment. Among neighborhood-level covariates, longer days between diagnosis and enrollment were associated with higher access to primary care physicians, higher high school completion, and a higher residential segregation index for black/white. However, higher access to primary care providers other than physicians and a higher residential segregation index for white/non-white were associated with shorter days from diagnosis to enrollment. Note that these results must be carefully interpreted considering results pertaining to patient mortality data.

In addition, characteristics of deaths were examined to address any potential bias regarding survival. Additional analysis showed similar tendencies with those from hospice enrollment: black and Hispanic patients experienced shorter diagnosis to death periods of 18.6% (IRR = 0.814, 95% CI = 0.800–0.829, $p < 0.001$) and 17.8% (IRR = 0.822, 95% CI = 0.807–0.837, $p < 0.001$), respectively, than white

Table 3 Multivariable associations between vulnerability cluster variables and receipt and time to care across four key care junctures in mBC (N=418)

Care Juncture	Outcome	Analysis used	N	Significant Factors at $p < 0.05$	β /OR/RR/IRR	95% CI lower	95% CI upper	p-value
Diagnosis and Evaluation	E&M visit^a	N/A ^a	418	-	-	-	-	-
	Days to E&M visit	GLM-Gamma	404 (missing $n = 14$)	Marital status Unknown (vs. Married)	1.589	1.108	2.278	0.0119
Treatment Plan Design	Treatment Plan	Logistic	Y = 373 , N = 31	Number of metastatic sites	1.775	1.118	2.817	0.0150
	Days to Treatment Plan date	GLM-Gamma	373	Residential segregation index for black/white ^b	1.024	1.006	1.044	0.0102
Treatment Implementation	Distress Screening	Logistic	Y = 353 , N = 51	Age at diagnosis Marital status Unknown (vs. Married)	0.961 0.323	0.927 0.113	0.997 0.926	0.0338 0.0354
	Days to Dis- tress Screen- ing date	GLM-normal	353	Age at diagnosis	0.0000056	0.000000025	0.001	< 0.001
	Anticancer Therapy Start	Logistic	Y = 372 , N = 32	Number of metastatic sites	1.686	1.088	2.613	0.0195
	Days to Anticancer Therapy date	GLM-Gamma	368 ^c	None	-	-	-	-
	Radiation Start	Logistic	Y = 76 , N = 328	None	-	-	-	-
	Days to Radiation date ^d	N/A ^d	76	-	-	-	-	-
	Surgery Start	Logistic	Y = 43 , N = 361	Age at diagnosis	0.957	0.922	0.994	0.0238
	Days to Surgery date ^d	N/A ^d	43	-	-	-	-	-
	ACP visit	Logistic	Y = 136 , N = 268	None	-	-	-	-
	Days to ACP date	GLM-Gamma	136	Access to other primary care providers	0.9993	0.9988	0.9998	0.0095

Table 3 (continued)

End of Life Care	Palliative Care	Logistic	Y = 14 , N = 390	Age at diagnosis	0.906	0.840	0.977	0.0101
	Days to Palliative Care referral ^d	N/A ^d	14	-	-	-	-	-
	Hospice Enrollment	Logistic	Y = 128 , N = 89	None	-	-	-	-
	Days to Hospice Enrollment date	GLM-Poisson	128	Race/ethnicity–Black (vs. White)	0.868	0.845	0.891	<0.0001
				Race/ethnicity–Hispanic (vs. White)	0.652	0.635	0.671	<0.0001
				Age at diagnosis	0.971	0.970	0.972	<0.0001
				Marital – Divorced (vs. married)	0.723	0.704	0.743	<0.0001
				Marital – Single (vs. married)	0.741	0.725	0.758	<0.0001
				Marital – Widowed (vs. married)	0.935	0.919	0.952	<0.0001
				Marital – Unknown (vs. married)	0.606	0.582	0.630	<0.0001
				No. of metastatic sites	0.991	0.986	0.996	0.0003
				Access to primary care	1.0001	1.0001	1.0001	<0.0001
				High school completion	1.416	1.129	1.775	0.0026
				Access to other primary care providers	0.9999	0.9999	0.9999	<0.0001
				Residential segregation index for black/white	1.0086	1.0077	1.0094	<0.0001
				Residential segregation index for white/non-white	0.982	0.981	0.983	<0.0001
	Chemotherapy within 14 days of death ^d	N/A ^d	18	-	-	-	-	-
	Hospice Length of Stay (LOS)	GLM-Poisson	82 ^e	Race/ethnicity – Black (vs. White)	0.754	0.645	0.882	0.0004
				Race/ethnicity – Hispanic (vs. White)	0.747	0.632	0.882	0.0006
				Age at diagnosis	1.010	1.006	1.015	<0.0001
				Marital – Divorced (vs. married)	2.094	1.855	2.364	<0.0001
				Marital – Widowed (vs. married)	0.833	0.734	0.946	0.0048
				No. of metastatic sites	0.871	0.842	0.901	<0.0001
				Access to primary care	1.0001	1.000	1.0001	0.015
				High school completion	6.346	1.794	22.457	0.0042
				Access to other primary care providers	0.9999	0.9998	1.0000	0.0014
				Residential segregation index for black/white	1.027	1.021	1.033	<0.0001

ACP= Advance Care Planning; E&M= Evaluation and Management; GLM= Generalized Linear Model; IRR= incidence rate ratio;

OR= odds ratio; RR= rate ratio

a 100% of the 418 patients had a record of the Diagnosis and Evaluation juncture E&M visit

b The residential segregation index ranges from 0 (complete integration) to 100 (complete segregation)

c Four patients whose days between the mBC diagnosis and the date of treatment start were greater than 365 days were removed from the analysis

d Sample size is too small to conduct multivariable analysis

e Among patients who have a record of both 'hospice enrollment' and 'death'

patients. Because only 18 patients had a record of chemotherapy within 14 days of death, multivariable analysis could not be conducted.

Lastly, among those with records of hospice LOS and both 'hospice enrollment' and 'death' ($n=82$), black and Hispanic patients had shorter hospice LOS, compared to whites, by 24.6% (IRR=0.754, 95% CI=0.645–0.882, $p=0.0004$) and 25.3% (IRR=0.747, 95% CI=0.632–0.882, $p=0.0006$), respectively. Among other person-level covariates, older and divorced patients (compared to those who were married) had longer hospice LOS, respectively, whereas widowed status (compared to being married) and having more metastatic sites were associated with shorter hospice LOS, respectively. Among neighborhood-level covariates, longer hospice LOS were linked to higher access to primary care physicians, higher high school completion, and higher residential segregation index for black/white, whereas higher access to primary care providers other than physicians was associated with shorter hospice LOS.

Discussion

To better understand ethnic and racial disparities in mBC, we sought to examine the care journey of patients with mBC, from the point of diagnosis to end-of-life, which was represented as four primary junctures – *Diagnosis and Evaluation, Treatment Plan Design, Treatment Implementation, and End-of-life Care*. Overall, a majority of patients received key services across the first three care junctures. However, significantly fewer patients received care at the End-of-life juncture. Several variables that make patients vulnerable to inequitable care, referred to as the *Vulnerability Cluster*, were predictive of receipt and timely care at various care junctures, though racial and ethnic inequities were especially pronounced at end-of-life care.

While receipt of care in earlier junctures were high, with the exception of ACP visits which occurred among only a third of patients, the timeliness of some services was problematic. ACP visits and distress screenings occurred over 1 year and 2 years after metastatic diagnosis, respectively. ACP conversations regarding patient values and goals of care have been shown to take place less often than expected and to be inadequate,²⁰ and implementation of ACP is now recommended when patients have a life expectancy of months to years.²¹ Although racial/ethnic disparities in cancer treatment have been well established,^{22, 23} no racial/ethnic disparities were evident in these earlier care junctures in our study. However, other person-level vulnerability cluster variables illustrated some disparities. Older age and marital status (other than married) made patients vulnerable to not receiving distress screening assessments at all or in a timely manner. Prior research is equivocal on the

importance of demographic factors in receipt of distress screening.^{24, 25} Regardless, attention to distress should be given to all patients with mBC, and this may be particularly needed in patients who are older and not married because of potential deficiencies in social support. On the other hand, as might be expected, more metastatic sites were associated with higher probabilities of planning and starting anticancer therapy.

The American Society of Clinical Oncology (ASCO) guidelines recommend palliative care along with usual oncology care as the standard of care for patients with advanced cancer.²⁶ However, consistent with literature,^{27, 28} a significantly small proportion of patients with mBC received palliative care and hospice services, represented at the End-of-life care juncture. And, when they occurred, they did so very late in the patient's care journey. As a consequence, hospice LOS was short (Median=17.5 days), though slightly shorter than the median of 20 days found in breast cancer²⁹ and longer than the 14.5 days found in cancer overall.³⁰ Nevertheless, this finding further supports the need for earlier access to palliative care and hospice for patients with mBC.

Our findings also show important inequities in utilization of end-of-life care, which is supported by a longstanding body of research that demonstrates disparities in the use of palliative care across disease states, socioeconomic status and geography.^{31, 32} There were significant racial/ethnic disparities in access to hospice and the time spent in it. While Blacks and Hispanics enrolled in hospice quicker than Whites, their LOS was shorter since they died earlier, which has been attributed to a complex set of issues involving clinical (e.g., tumor biology) and socioeconomic factors as well as access to timely and effective care.^{33, 34} Although similar person-level vulnerability variables that were significant in earlier junctures were also predictive in hospice use, some county-level vulnerability variables illuminated disparities in end-of-life care. These "neighborhood" characteristics may reflect the contribution of structural inequalities to poor health and the concomitant unequal distribution of wealth and other societal resources.³⁵ A recent national study employed a neighborhood-level measure of segregation to assess "racialized economic segregation" and its association with treatment and survival among patients with mBC.²² The findings revealed that patients from less privileged (lower income) areas were disproportionately Black or Latinx and experienced delayed treatment initiation and shorter survival compared to patients from more privileged neighborhoods (higher income). In another study, patients with metastatic cancer receiving care at primarily minority-serving hospitals were 33% less likely to receive palliative care than those at primarily non-minority-serving

hospitals.³⁶ In our study, some indicators of more affluent counties (e.g., access to primary care doctors) were associated with later hospice enrollment but longer LOS, while other county indicators (e.g., white/nonwhite residential segregation) predicted the opposite. While these were proxies for individual circumstances, it has been established that ethnic/racial disparities in access to palliative care and hospice are often rooted in historical mistrust and discrimination, and cultural and socioeconomic factors as well.³⁷

Our findings of county-level disparities may reflect unmeasured sociocultural determinants (e.g., spiritual issues, cultural norms) of hospice utilization. These findings also point to the importance of ACP and access to comprehensive palliative care to improve quality of cancer care for all patients, but especially for black and Hispanic patients who disproportionately experience poor access to end-of-life care.

To the authors' knowledge, this is the first study that conducted systematic analyses of disparities in the care continuum delivered in community-based mBC care. Utilizing real-world data from routine practice care and treatment in a Medicare insured population from the largest community oncology practice network in the US, this study mapped out the clinical experience of patients with mBC, pinpointing disparities that exist from point of diagnosis to end-of-life. The findings uncovered characteristics that put patients at risk for inequity of care or experiencing delays in care. They also facilitate a better understanding of inequities in access to care among patients with mBC with different vulnerabilities. Our results indicate opportunities for enhancing care of patients with mBC: (1) Increase ACP conversations and palliative care referrals and engage patients earlier in their care journeys; (2) Identify and help mitigate barriers to hospice utilization; and (3) Recognize that racial/ethnic minority patients may have unique issues (e.g., spiritual, cultural) that hinder end-of-life care, particularly hospice utilization. This study's findings support the need to improve palliative care and hospice utilization among patients with mBC and to help them navigate the healthcare system throughout their care journeys.

Limitations

The results should be interpreted within some limitations. First, the study population received care under the Medicare OCM program at the TxON practice sites, so results may not be generalizable to those who are uninsured, covered under non-Medicare insurance, or obtain treatment outside of TxON. Second, documentation of key services not associated with payment claims may underestimate the receipt of care. Third, the county-level data served as proxies for an individual patient's social and structural determinants of health. Fourth, due

to small sample sizes, Asian and male patients were not included in the multivariable analyses.

Conclusions

Most patients with mBC received services during the earlier care junctures – Diagnosis and Evaluation, Treatment Plan Design, and Treatment Implementation – albeit not always timely, especially regarding ACP visits and distress screening. However, we found that only a small proportion of patients received services near the end of their care journey, such as palliative care, with hospice enrollment at more moderate utilization levels. Moreover, while black and Hispanic patients enrolled in hospice sooner, they had shorter LOS which is likely related to their shorter life span after diagnosis, compared to white patients. Race/ethnicity and county-level social and structural determinants, even in an insured Medicare population, were associated with the receipt and timeliness of care, especially at end-of-life. Patients with mBC require targeted and more proactive and systematic care toward the end of their care journey since palliative care including hospice has a strong connection to the quality of life of patients and their families.

Abbreviations

ACP	Advanced care planning
E&M	Evaluation and Monitoring
EMR	Electronic medical records
GLM	Generalized linear models
LOS	Length of stay
mBC	Metastatic breast cancer
OCM	Oncology care model
QoL	Quality of life
TxON	Texas oncology network

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

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Author contributions

CB conceptualized and designed the study, secured funding, interpreted the data, and drafted and revised the manuscript. HK analyzed and interpreted the data, and drafted the manuscript. MJ designed the study, analyzed and interpreted the data. JT contributed to data acquisition, interpretation of data, and manuscript revision. GD contributed to data acquisition, interpretation of data, and manuscript revision. SB contributed to data acquisition, interpretation of data, and manuscript revision. CO contributed to study design. All authors read and approved the final manuscript.

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Data availability

The data that support the findings of this study are available from the Texas Oncology Network, but restrictions apply to the availability of these data, which were used under a data use agreement for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the Texas Oncology Network.

Declarations

Ethics approval and consent to participate

The study was approved by the University of Texas at Austin Institutional Review Board (IRB) (ID: STUDY00002132). The IRB determined that the proposed activity is not research involving human subjects as defined by U.S. Department of Health and Human Services (DHHS) and Food and Drug Administration (FDA) regulations. The activity was determined to be Non-Human Subjects Research. The need for informed consent to participate was waived by the University of Texas at Austin IRB.

Consent for publication

Not applicable. Only aggregated data and/or results are shown in this manuscript.

Competing interests

The authors declare no competing interests. At the time of the study, Dr. Broussard was an employee of Texas Oncology Network and Dr. Orji was a doctoral student at the University of Texas at Austin.

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