

# Healthcare Utilization and Costs During the Initial Phase of Care Among Elderly Women With Breast Cancer

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## Abstract

**Background:** Understanding the patterns of healthcare utilization and costs during the initial phase of care (12 months after breast cancer [BC] diagnosis) in older women (aged  $\geq 65$  years) is crucial in the allocation of Medicare resources. The objective of this study was to determine healthcare utilization and costs during the initial phase of care in older, female, Medicare fee-for-service beneficiaries diagnosed with BC, and to determine the factors associated with higher costs. **Methods:** A retrospective observational study using the SEER-Medicare linked database was conducted in 69,307 women aged  $\geq 66$  years diagnosed with primary incident BC in 2003–2009 to determine healthcare utilization, average costs, and costs for specific services during the initial phase of care. Generalized linear model regression was conducted to identify the factors associated with higher costs in a multivariate framework. **Results:** A total of 96% of women were treated with surgery during the initial phase of BC care, whereas 21% and 54% underwent chemotherapy and radiotherapy, respectively. Costs during the initial phase of care totalled \$28,075 in 2012 USD, comprising \$13,344 for physician services and \$7,456 for outpatient services. Factors associated with higher costs during the initial phase of care were younger age (66–69 years), African American race, higher household income, advanced stages of BC, initial BC treatment, higher number of primary care physician visits, and presence of comorbidities and/or a mental condition. **Conclusions:** The economic burden of BC is substantial during the initial phase of care. Physician and outpatient services accounted for the highest proportion of costs. Predisposing factors, need-related factors, healthcare use, and external environmental healthcare factors significantly predicted costs during the initial phase of care.

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Due to scientific advances in oncology, increased use of more expensive cancer treatments, and an aging population, the cost of cancer care is expected to increase enormously. In 2010, the national cost of cancer care was estimated to be \$124.6 billion USD in the SEER-Medicare

population, of which female breast cancer (BC) constituted the highest proportion at 13% (\$16.5 billion). Further, it is projected to increase by 32% in 2020, presenting a significant burden to Medicare.<sup>1</sup> Of the \$16.5 billion, the initial phase of care (12 months) following BC diagnosis

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represented 37% of the cost, the continuing phase of care 41%, and the last year of life accounted for 22%. BC costs are substantially higher for the initial phase of care due to surgery, radiotherapy (RT), and adjuvant therapy.<sup>2-6</sup> Regardless of these extensive costs to Medicare, there is insufficient up-to-date information on healthcare utilization and costs incurred by specific services, and factors significantly contributing to these costs in women aged  $\geq 65$  years. Because older women have higher BC incidence than their younger counterparts,<sup>7</sup> it is important to determine the economic burden of BC in planning for future healthcare resource allocation.

A descriptive review about the costs of cancer care in the United States reported that studies varied widely regarding settings, methodologies, cost perspectives, populations, measurements of costs, types of services included, time horizons, and data sources.<sup>8</sup> Another systematic review included outdated studies, which may not reflect changes in the patterns of care due to technological advances and innovations in BC treatment.<sup>3</sup> Furthermore, other studies used data from fewer cancer registries, and not for all BC stages.<sup>1,2,6,9,10</sup> Additionally, costs according to types of specific services have not been reported.<sup>6,10</sup> One study that determined costs during the initial phase of care for Medicare beneficiaries with BC in Virginia reported comorbidity, hospital stay, and type of treatment as the significant cost contributors.<sup>11</sup> Another study that used SEER-Medicare data reported higher healthcare utilization, although the study findings had limited generalizability due to inclusion of only 4 SEER geographic areas.<sup>9</sup> In fact, to date, no single comprehensive study focusing on both healthcare utilization and costs during the initial phase of care in older women with BC from all SEER areas has been published with the results stratified by specific services.

The purpose of this study was to determine the treatment approaches and healthcare utilization and costs during the initial phase of BC care among female Medicare fee-for-service beneficiaries using the SEER-Medicare data, and to determine factors associated with costs using a multivariate framework.

## Methods

### Study Design and Data Source

A retrospective observational cohort study was conducted from the Medicare perspective using data

from the SEER program, which routinely gathers data on socioeconomic and clinical factors about cancer cases from 17 population-based tumor registries that in turn collect data from hospitals, outpatient clinics, laboratories, private practitioners, hospices, autopsy reports, and death certificates; it represents 26% of the US population.<sup>12</sup> Approximately 94% of SEER cases were matched to their Medicare claims from the time of their eligibility until death based on name, social security number, sex, and date of birth.<sup>13</sup> This study used information from the Medicare claims files, which were linked to the SEER cancer cases.<sup>14</sup> More details of the SEER-Medicare data set are described elsewhere.<sup>12</sup> For this study, the Area Resource File was linked to the SEER-Medicare data set using the state and county Federal Information Processing Standards code for each beneficiary in order to obtain the county level information on income, education, healthcare providers, and hospitals offering oncology services.<sup>15</sup>

### Study Cohort

The study cohort comprised women aged  $\geq 66$  years with first primary incident BC (ICD-9-CM codes 174.xx, 233.0x, 238.3x, 239.3x) during 2003–2009. Among a total of 195,067 women identified, the following women were excluded: 11,031 who died within 12 months after BC diagnosis; 71,254 aged  $< 66$  years; 5,524 with any previous cancer diagnosis; 5 who were diagnosed with BC during death or autopsy; 2,072 with unknown or missing BC stage; 6,299 not continuously enrolled in Medicare Parts A and B in the 12 months before and after diagnosis; 29,195 who were members of a health maintenance organization at any time during the study period; and 380 who had zero Medicare costs. Therefore, 69,307 women met inclusion criteria.

### Measures

**Initial Phase of Care:** Based on the consensus from a group of clinical oncologists, the initial phase of care was defined as 12 months after BC diagnosis; initial courses of treatment including adjuvant therapy were usually completed within 1 year of cancer diagnosis; this definition is used for comparison purposes with previous literature.<sup>1,2,4-6,11,16</sup>

**Healthcare Utilization:** Healthcare utilization included inpatient visits, hospitalization days, outpa-

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tient visits, and emergency department (ED) visits derived from Medicare claims files. Additionally, the percentage of women who received surgery, RT, or chemotherapy was calculated. The average number of RT and chemotherapy visits were determined.

**Cost Estimates:** All of the Medicare files, including inpatient (Medicare Provider Analysis and Review [MedPAR]), hospital outpatient, carrier/National Claims History (NCH), hospice, home health agency (HHA), and durable medical equipment (DME) files, were used to obtain direct Medicare costs. Costs were defined as the amount reimbursed by Medicare. Reimbursement, used as a proxy for Medicare costs in previous cost studies,<sup>4,5,10</sup> are actual payments derived from reimbursement formulas reflecting the average resource utilization for each healthcare service.<sup>17</sup> Total costs, costs within the categories of care, such as inpatient services obtained from MedPAR file, outpatient services obtained from outpatient file, physician services obtained from NCH file, and other services (DME, hospice care, and HHA), were calculated to identify which Medicare component contributed substantially to total costs. All costs were adjusted using the previously used method<sup>6</sup> and were reported in 2012 \$USD to account for variation over time.<sup>18</sup>

**Independent Variables:** To identify the factors associated with costs, the Andersen behavioral model of healthcare services utilization was used.<sup>19,20</sup> According to this model, use of healthcare services is a function of people's predisposition to use services, factors that enable or impede use, need for care, and factors associated with healthcare use and external environmental healthcare-related factors. Predisposing factors included age at BC diagnosis and race; whereas enabling factors included marital status, census tract median household income, and census tract percentage of people aged  $\geq 25$  years with at least 4 years of college education. Need-related factors related to specific cancer care included stage at diagnosis,<sup>21</sup> grade of tumor, estrogen receptor (ER) status, comorbidity score,<sup>22,23</sup> and mental health conditions (ie, depression and/or anxiety) derived from co-occurring chronic conditions within 12 months before BC diagnosis. Factors associated with healthcare use were the number of primary care physician (PCP) visits in the year prior to BC diagnosis,<sup>24</sup> type of initial treatment in the year of BC diagnosis (ie,

definitive surgery only, nonsurgical treatment [chemotherapy, RT, or both], definitive surgery plus nonsurgical treatment, no treatment), and inpatient use. External environmental healthcare-related factors included location of residence, SEER region, and number of hospitals offering oncology-related services in the area of residence.

### Statistical Analyses

Descriptive statistics were used to describe the characteristics of the study cohort. Average healthcare utilization was calculated for each service, as well as for RT and chemotherapy. Percentages were determined of women who had surgery, chemotherapy, or RT, and those who had at least one inpatient, outpatient, or ED visit. To understand the trends in costs over time, average total costs and costs according to specific services during the initial phase of BC care were calculated and reported for each calendar year of diagnosis.

The Breusch-Pagan/Cook-Weisberg test and simplified White test were performed to report the heteroscedasticity and kurtosis of log-scale residuals in the cost data.<sup>25</sup> Due to distributional problems of cost data, Park tests<sup>26</sup> were conducted to determine the most appropriate regression model for data based on which generalized linear model (GLM) with log link function and gamma distribution was conducted to model costs and identify its predictors in a multivariate framework. From the regression, the regression estimates (betas) were exponentiated to yield average costs. The findings with  $P$  values  $\leq 0.05$  levels are discussed. All analyses were conducted using SAS version 9.4 (SAS Institute Inc., Cary, NC) and Stata version 13 (StataCorp LP, College Station, TX).

## Results

### Descriptive

Table 1 describes the study cohort along with the average costs during the initial phase of care within each group. Most patients were white (88%), resided in metropolitan areas (84%), were diagnosed with local-stage BC (58%), had ER-positive status (72%), and had no mental condition (94%) or comorbidity (57%). Average costs were higher among women who were black; resided in metropolitan areas; were diagnosed with distant, poorly differentiated, and

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Table 1. Description of Study Cohort (N=69,307)				
Variables	n	%	Average Costs (\$USD)	SD
Age at diagnosis, y				
66–69	15,789	22.8	\$31,656	\$25,398
70–74	17,605	25.4	\$29,971	\$24,847
75–79	15,901	22.9	\$27,582	\$23,117
≥80	20,012	28.9	\$23,975	\$22,006
Race				
White	61,122	88.2	\$27,848	\$23,341
Black	5,043	7.3	\$31,778	\$29,386
Other	3,142	4.5	\$26,567	\$25,945
Location of residence				
Metropolitan	57,894	83.5	\$28,648	\$24,317
Nonmetropolitan	11,413	16.5	\$25,170	\$21,949
Marital status				
Married/Partnered	30,502	44.0	\$28,239	\$22,573
Single/Divorced/Widowed	38,805	56.0	\$27,947	\$25,026
Census tract income				
≤\$25,000	4,712	6.8	\$28,439	\$25,927
\$25,001–\$50,000	33,856	48.8	\$27,547	\$24,115
\$50,001–\$75,000	20,654	29.8	\$28,530	\$23,716
>\$75,000	10,085	14.6	\$28,747	\$23,046
Census tract education				
0–13.33	17,341	25.0	\$28,388	\$25,244
13.34–22.98	17,339	25.0	\$27,916	\$24,280
22.99–38.79	17,301	25.0	\$28,125	\$23,957
≥38.80	17,326	25.0	\$27,873	\$22,335
Stage at diagnosis				
In situ	11,727	16.9	\$18,354	\$16,518
Localized	40,125	57.9	\$25,085	\$19,900
Regional	15,349	22.2	\$40,014	\$28,478
Distant	2,106	3.0	\$52,182	\$40,381
Tumor grade				
Well-differentiated	15,151	21.8	\$23,711	\$18,213
Moderately differentiated	27,841	40.2	\$27,488	\$22,873
Poorly differentiated	17,463	25.2	\$34,276	\$28,031
Undifferentiated/Unknown	8,852	12.8	\$25,160	\$24,906

Abbreviation: SD, standard deviation.

(continued on next page)

ER-negative tumors; had  $\geq 2$  comorbidities and reported any mental condition; and received nonsurgical treatment only during the initial phase.

### Healthcare Utilization

The upper part of Table 2 describes healthcare utilization wherein surgical intervention was reported for 96% of women. The mean number of chemotherapy visits was 2.5 (SD, 6.9), and 21% of the study cohort used this treatment at least once during the initial phase of care. The mean number of RT visits was 6.2 (SD, 8.0), and 54% used RT. Almost all patients (99.9%) reported at least one outpatient visit, with an average of 40.1 visits (SD, 20.3); 45% of the cohort reported at least one inpatient visit, with an average of 0.7 visits (SD, 1.1) and an average of 4.7 hospitalization days (SD, 14.8). Almost a quarter of the cohort (24%) reported  $\geq 1$  ED visit with an average of 0.4 visits (SD, 1.0).

### Average Costs and Associated Trends

The lower part of Table 2 describes average costs and costs by types of specific services. Average costs were \$28,075 (SD, \$23,978). Physician services contributed to the highest proportion (47.5%) of the costs (\$13,344; SD, \$13,773), whereas inpatient and outpatient services contributed to 21.5% and 26.6% of the costs, respectively, with corresponding amounts of \$6,046 (SD, \$13,905) and \$7,456 (SD, \$8,593), respectively.

Figure 1 describes trends in the average total costs and costs by types of specific services. From 2003 through 2009, there was an increase in average total costs (from \$26,361 to \$29,522, respectively), average costs due to outpatient services (from \$6,447 to \$8,730, respectively), and average costs due to physician services (from \$12,032 to \$13,946, respectively), whereas the average costs due to inpatient services declined (from \$6,620 to \$5,602, respectively).

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Table 1. Description of Study Cohort (N=69,307) (cont.)				
Variables	n	%	Average Costs (\$USD)	SD
Estrogen receptor status				
Positive	50,136	72.3	\$27,327	\$22,303
Negative	9,634	13.9	\$36,781	\$29,296
Borderline/Unknown	9,537	13.8	\$23,214	\$24,354
Initial treatment				
Surgery only	24,812	35.8	\$18,383	\$19,844
Surgery + adjuvant therapy	41,925	60.5	\$33,901	\$23,588
Nonsurgical treatment	1,015	1.5	\$41,245	\$36,653
No treatment	1,555	2.2	\$17,053	\$28,575
Inpatient use				
Yes	30,867	44.5	\$37,198	\$29,290
No	38,440	55.5	\$20,750	\$15,075
Comorbidity				
0	39,279	56.7	\$26,414	\$21,950
1	18,755	27.1	\$28,513	\$24,336
≥2	11,273	16.2	\$33,137	\$28,900
Mental condition				
Yes	4,412	6.4	\$31,611	\$27,499
No	64,895	93.6	\$27,835	\$23,701
Primary care physician visits				
0–1	16,017	23.1	\$27,592	\$24,473
2–4	21,771	31.4	\$26,757	\$22,386
5–7	15,302	22.1	\$27,483	\$22,686
≥8	16,217	23.4	\$30,882	\$26,392
Hospitals offering oncology services				
0–1	21,007	30.1	\$26,149	\$22,206
2–3	17,755	25.5	\$27,883	\$23,090
4–6	11,521	16.5	\$28,990	\$24,455
≥7	19,404	27.8	\$29,809	\$26,103
SEER region				
Northeast	14,620	21.1	\$30,196	\$24,676
South	17,316	25.0	\$26,340	\$22,852
North Central	8,705	12.6	\$27,283	\$22,786
West	28,666	41.3	\$28,283	\$24,537

Abbreviation: SD, standard deviation.

Costs were higher in the study cohort with advanced-stage versus early-stage BC: \$18,354 among those with in situ BC; \$25,085 for those with local-stage BC; \$40,014 for those with regional-stage BC; and \$52,182 for those with distant-stage BC (data not shown). Moreover, costs for specific services (inpatient and outpatient services, physician services, and other services) increased with advancing stage at diagnosis.

### Factors Associated With Average Costs

Table 3 summarizes results from the GLM regression on costs. Women who were diagnosed at advanced stages of BC, did not have a well-differentiated tumor grade, had ER-negative tumor status, had treatment in the form of surgery or adjuvant therapy, reported inpatient use, had higher PCP visits, and had any comorbidity and/or mental condition had significantly higher costs during the initial phase. Women who were black, resided in areas with at least 4 hospitals

offering oncology services, lived in the Northeast SEER region, and lived in areas where the household income was ≥\$50,000 had higher costs as well. In addition, women who were aged ≥70 years, were of “other” race, were married/partnered, and resided in nonmetropolitan areas and in the South and North Central SEER regions had significantly lower costs during the initial phase of care.

### Discussion

As costs of BC treatment constitute a substantial portion of overall national cancer costs and are projected to increase tremendously in the coming years,<sup>1</sup> estimating average costs and costs by types of specific services is critical for Medicare to identify cost drivers. This study is the first of its kind to use more recent SEER-Medicare data from 2003–2009 BC cases to estimate healthcare utilization, average costs, costs by types of specific services, and the sig-

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Table 2. Healthcare Utilization and Costs by Type of Specific Service	
Variables	% of Patients (N=69,307)
<b>Treatment</b>	
Surgery ± adjuvant therapy	96.3
Chemotherapy ± surgery	20.8
Radiation therapy ± surgery	54.4
<b>Other healthcare use</b>	
Inpatient visits	44.5
Outpatient visits	99.9
Emergency visits	23.7
<b>Average Visits (SD)</b>	
<b>Treatment</b>	
Chemotherapy visits	2.5 (6.9)
Radiation therapy visits	6.2 (8.0)
<b>Other healthcare use</b>	
Inpatient visits	0.7 (1.1)
Hospitalization days	4.7 (14.8)
Outpatient visits	40.1 (20.3)
Emergency visits	0.4 (1.0)
<b>Average Costs (\$D)</b>	
Total costs	\$28,075 (\$23,978)
Inpatient costs	\$6,046 (\$13,905)
Outpatient costs	\$7,456 (\$8,593)
Physician services costs	\$13,344 (\$13,773)
Other costs (HHA, HSP, DME)	\$1,230 (\$3,876)

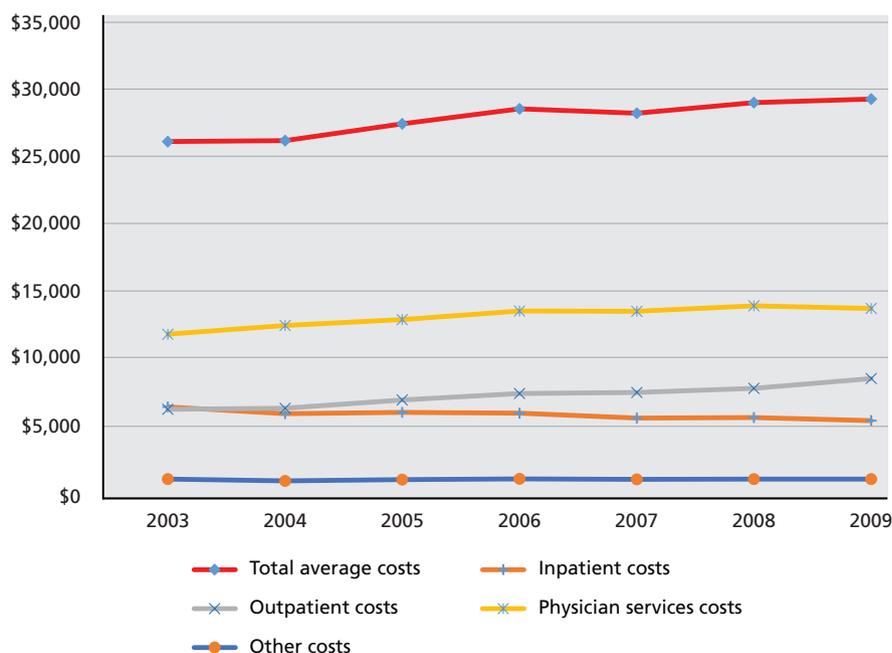
Abbreviations: DME, durable medical equipment; HHA, home health agency; HSP, hospice.

nificant predictors of costs during the initial phase of care.

The percentage of women who underwent surgery during the initial phase of care was significantly

higher than that reported in a previous study (96% vs 91%), whereas the percentages who underwent chemotherapy, RT, and hospitalization remained nearly consistent with the previously published data (21%, 54%, and 45%, respectively).<sup>10</sup> The average cost during the initial phase of care in older women with incident BC was \$28,075, which is significantly higher than the costs reported in previous studies.<sup>6,9,11</sup> Before and during our study period, several new BC drugs were approved by the FDA (eg, letrozole in 2001, fulvestrant in 2002, gemcitabine in 2004, nab-paclitaxel in 2005, lapatinib and ixabepilone in 2007),<sup>27</sup> which may be available at branded price during the study period, thereby suggesting increased Medicare expenditures.<sup>28</sup> In addition, use of more expensive radiation technology, such as brachytherapy and intensity-modulated RT,<sup>29</sup> may also cause higher Medicare expenditures.

In contrast to the literature,<sup>4,10</sup> our study found that physician services followed by outpatient services were the major contributors to the average total costs indicating an increased breast-conserving therapies<sup>30,31</sup> and new adjuvant therapies that require more frequent monitoring as reflected by higher adjusted costs associated with surgery and/or adjuvant therapy in Table 3. These findings likely represent several changes in treatment patterns, including in-



**Figure 1.** Trends in the average total costs and average costs by types of services during the initial phase of care among 69,307 elderly, female, SEER-Medicare fee-for-service beneficiaries aged  $\geq 66$  years diagnosed with first primary incident breast cancer from 2003–2009.

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**Table 3. Factors Associated With Costs Using Generalized Linear Model Regression**

Variables	Beta	Average Adjusted Costs, \$USD	SE	Sig
Intercept (baseline costs)	8.8409	\$6,911	0.0218	*
Age at diagnosis, y				
66–69				
70–74	–0.0437	\$6,616	0.0064	*
75–79	–0.0982	\$6,265	0.0066	*
≥80	–0.1540	\$5,925	0.0067	*
Race				
White				
Black	0.0363	\$7,167	0.0091	*
Other	–0.0883	\$6,327	0.0109	*
Location of residence				
Metropolitan				
Nonmetropolitan	–0.0555	\$6,538	0.0077	*
Marital status				
Married/Partnered	–0.0034	\$6,888	0.0047	
Single/Divorced/Widowed				
Census tract income				
≤\$25,000				
\$25,001–\$50,000	0.0138	\$7,007	0.0096	
\$50,001–\$75,000	0.0455	\$7,233	0.0111	*
>\$75,000	0.0765	\$7,461	0.0130	*
Census tract education				
0–13.33				
13.34–22.98	0.0093	\$6,976	0.0066	
22.99–38.79	0.0080	\$6,967	0.0073	
≥38.80	–0.0067	\$6,865	0.0087	
Stage at diagnosis				
In situ				
Localized	0.1827	\$8,297	0.0066	*
Regional	0.4033	\$10,344	0.0078	*
Distant	0.7162	\$14,145	0.0151	*
Tumor grade				
Well-differentiated				
Moderately differentiated	0.0446	\$7,226	0.0059	*
Poorly differentiated	0.1155	\$7,757	0.0069	*
Undifferentiated/Unknown	0.0420	\$7,208	0.0083	*

Abbreviations: SE, standard error; Sig, significance.

\* $P < .001$ : statistically significant group differences based on generalized linear model with gamma distribution and log link function.

(continued)

creased costs of multimodal treatments<sup>29–33</sup> and use of more expensive radiation technology, such as brachytherapy and intensity-modulated RT,<sup>29</sup> which may have increased costs associated with physician and outpatient services. Moreover, it highlights the trend toward more patients with cancer receiving chemotherapy and RT in the outpatient clinic setting<sup>34</sup> than the inpatient setting. Furthermore, several drugs that were FDA-approved during our study period may require use of physician services for drug administration and hence lead to higher costs in this category. Finally, costs from inpatient services contributed significantly less to the average costs than reported in the literature,<sup>6,9,10</sup> likely indicating the greater push by Medicare to decline inpatient status

**Table 3. Factors Associated With Costs Using Generalized Linear Model Regression (cont.)**

Variables	Beta	Average Adjusted Costs, \$USD	SE	Sig
Estrogen receptor status				
Positive				
Negative	0.1031	\$7,662	0.0069	*
Borderline/Unknown	–0.0081	\$6,855	0.0070	
Initial treatment				
Surgery only	0.1594	\$8,106	0.0156	*
Surgery + adjuvant therapy	0.8958	\$16,928	0.0157	*
Nonsurgical treatment	0.7589	\$14,762	0.0240	*
No treatment				
Inpatient use				
Yes	0.6848	\$13,708	0.0049	*
No				
Comorbidity				
0				
1	0.0563	\$7,311	0.0053	*
≥2	0.1768	\$8,248	0.0066	*
Mental condition				
Yes	0.0998	\$7,637	0.0092	*
No				
Primary care physician visits				
0–1				
2–4	0.0241	\$7,080	0.0061	*
5–7	0.0429	\$7,214	0.0067	*
≥8	0.1263	\$7,842	0.0068	*
Hospitals offering oncology services				
0–1				
2–3	0.0072	\$6,961	0.0071	
4–6	0.0306	\$7,126	0.0083	*
≥7	0.0916	\$7,574	0.0077	*
SEER region				
Northeast	0.0296	\$7,119	0.0068	*
South	–0.0259	\$6,735	0.0064	*
North Central	–0.0322	\$6,692	0.0073	*
West				

Abbreviations: SE, standard error; Sig, significance.

\* $P < .001$ : statistically significant group differences based on generalized linear model with gamma distribution and log link function.

and forcing observation care status for patients admitted after surgeries requiring hospital monitoring. This may also reflect a shift in Medicare reimbursement patterns. In addition, advancement in oncology and technology, varying demographics, and legislation may partly explain this shift.<sup>35</sup> Future research exploring the newer adjuvant BC treatments should be conducted to identify the most cost-effective strategies to reduce treatment-related costs while improving health outcomes (eg, survival).

Among predisposing factors, age and race were significant predictors of cost. Increasing age at diagnosis resulted in decreasing costs, a similar finding as reported in published literature,<sup>5</sup> perhaps because older women are less likely to receive aggressive

treatment after BC diagnosis, resulting in lower costs.<sup>16,36,37</sup> Additionally, consistent with a previous study,<sup>5</sup> higher costs were reported for African American women, perhaps because they have been shown to receive less preventive and diagnostic medical care<sup>38</sup> and hence are more likely to use inpatient services, resulting in higher costs.<sup>39</sup> Warren et al<sup>5</sup> suggested that African American women may receive different treatment compared with white women, and that certain unmeasured factors (eg, body mass index, health status) may affect differences in care, thereby affecting costs. Among enabling factors, living in areas with higher household income was independently associated with higher costs, a similar finding as reported in a previous study.<sup>11</sup>

With regard to need-related factors, advanced disease stage, moderately and poorly differentiated tumor grade, ER-negative tumor status, and presence of chronic physical and mental conditions were significantly associated with higher costs. These findings are consistent with those of previous studies reporting significant increases in costs associated with advancing disease stages<sup>4,5,11,16</sup> and the presence of comorbidities,<sup>11</sup> suggesting the importance of co-management of physical and mental chronic conditions<sup>40,41</sup> and improving access to preventive cancer screening services for older women. Emerging healthcare delivery models, such as “medical homes,” that emphasize care coordination for Medicare beneficiaries with multiple chronic conditions could be a step in the right direction to curb increasing costs associated with BC care. Among factors associated with

healthcare use, women with BC who had surgery and adjuvant therapy and those who had nonsurgical treatment had higher costs than those who did not have any BC treatment, as reported by Penberthy et al.<sup>11</sup> Furthermore, inpatient use and PCP visits were also significantly associated with higher costs. Older women with BC who resided in metropolitan areas and had access to a higher number of hospitals providing oncology services had higher costs in the initial phase of care, perhaps because of increased access to Medicare insurance.

Several limitations of this study are worth noting. Healthcare services not reimbursable by Medicare may not be captured, and healthcare utilization and costs of adjuvant therapy did not capture prescription drugs, potentially resulting in underestimation of cost. Data on variables such as health status, severity of comorbidities, and patient preferences, which may impact cancer prognosis and/or selection of BC treatment, were not available. Moreover, the study findings are generalizable to older patients with BC covered by Medicare.

## Conclusions

This population-based study suggests that BC represents a substantial economic burden during the initial phase of care. Physician and outpatient services accounted for the highest proportion of costs. Predisposing factors, need-related factors, healthcare use, and external environmental healthcare-related factors significantly predicted costs.

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