Differences in Medicare Expenditures Between Appalachian and Nationally Representative Cohorts of Elderly Women With Breast Cancer: An Application of Decomposition Technique

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Abstract

Background: Differences in Medicare expenditures during the initial phase of cancer care among rural and medically underserved elderly women with breast cancer (BC) and those from a nationally representative cohort have not been reported. The objective of this study was to determine Medicare expenditures during the initial phase of care among women in West Virginia (WV) who were Medicare beneficiaries with BC and compare them with national estimates. The magnitude of differences in these expenditures was also determined by using a linear decomposition technique. **Methods:** A retrospective observational study was conducted using the WV Cancer Registry-Medicare database and the SEER-Medicare database. Our study cohorts consisted of elderly women aged ≥ 66 years diagnosed with incident BC in 2003 to 2006. Medicare expenditures during the initial year after BC diagnosis were derived from all of the Medicare files. Generalized linear regressions were performed to model expenditures, after controlling for predisposing factors, enabling resources, need, healthcare use, and external healthcare environmental factors. Blinder-Oaxaca decomposition was conducted to examine the proportion of the differences in the average expenditures explained by independent variables included in the model. **Results:** Average Medicare expenditures for the WV Medicare cohort during the initial phase of BC care were \$25,626 compared with \$29,502 for the SEER-Medicare cohort; a difference of \$3,876. In the multivariate regression, this difference decreased to \$708 and remained significant. Only 16% of the differences in the average expenditures between the cohorts were explained by the independent variables included in the model. Enabling resources (6.86%), healthcare use (7.55%), and external healthcare environmental factors (3.33%) constituted most of the explained portion of the differences in the average expenditures. **Conclusions:** The difference in average Medicare expenditures between the elderly beneficiaries with BC from a rural state (WV) and their national counterparts narrowed but remained significantly lower after multivariate adjustment. The explained portion of this difference was mainly driven by enabling and healthcare use factors, whereas 84% of this difference remained unexplained.

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Background

Female breast cancer (BC) constitutes the highest proportion of Medicare cancer spending and is projected to increase by an additional 32% in 2020, suggesting a higher economic burden on Medicare.¹ The initial phase of care (12 months) after BC diagnosis constituted 37% of BC Medicare spending, which is substantially higher due to surgery and adjuvant therapy.²⁻⁶ Additionally, elderly women aged ≥ 65 years have higher BC incidence compared with their younger counterparts,⁷ which may result in higher use of Medicare resources.

Several studies on Medicare expenditures during the initial phase of BC care used cancer case data only to 2003, from fewer cancer registries, or did not include all BC stages.^{1,2,6,8-10} A study that identified significant determinants of expenditures during the initial phase of BC care was conducted using Medicare beneficiaries in Virginia but is outdated.¹¹ Furthermore, there is a dearth of studies on expenditures associated with BC care among rural women and from non-SEER states.

Numerous rural areas in the United States are economically underdeveloped and medically underserved¹²—Appalachia is one such geographic region whose residents are designated as a special population of interest by the NCI.¹³ West Virginia (WV), the only state lying entirely in Appalachia, has all of the characteristics of rural areas in the United States, including high poverty, low levels of education, aging population, high rates of chronic diseases, poor health behaviors, and poor healthcare infrastructure.¹⁴⁻¹⁹ Although WV has lower BC incidence among its older women (372.8 per 100,000 vs 410.6 per 100,000), it has higher mortality (110.4 per 100,000 vs 98.6 per 100,000) compared with national estimates,²⁰ and higher rates of advanced BC.²¹⁻²⁴ Hence, it is highly likely that Medicare spending during the initial phase of care among WV women with BC may be higher than national averages. However, the estimates of Medicare expenditures during the initial phase of care among elderly women with BC from a rural and medically underserved state (WV) and how these vary from national averages, are not available.

Therefore, the objectives of the study were to (1) determine Medicare expenditures during the initial phase of care among elderly WV Medicare fee-for-service (FFS) female beneficiaries with BC and compare

them with national estimates derived from the SEER-Medicare data; and (2) determine the factors associated with expenditures. The post hoc objective of the study was to understand the extent to which differences in observed characteristics between WV Medicare FFS female beneficiaries with BC and national estimates explain the differences in expenditures between WV and the remainder of the United States.

Methods

Study Design

A retrospective observational cohort study was conducted from the Medicare perspective to assess direct medical expenditures paid by Medicare during the initial phase of care among WV Medicare FFS female beneficiaries with incident BC.

Data Source

WV Cancer Registry-Medicare Linked Data Set:

This study used data from the WV Cancer Registry (WVCR) to identify WV women with BC. Established by the WV Department of Health and Human Resources in 1993, the WVCR is a state-level cancer registry that provides information on cancer incidence and mortality in WV.²⁵ The WVCR was linked with Medicare claims files to derive Medicare utilization and expenditures. The details of the data set development and linkage processes with the WV Medicare database are described elsewhere.²⁶

SEER-Medicare Linked Data Set: This study used data from the SEER program that gathers data on clinical and enrollment status about cancer cases from 17 population-based tumor registries that in turn collect data from hospitals, outpatient visits, laboratories, private practitioners, hospices, autopsy reports, and death certificates; it represents 26% of the US population.²⁷ Approximately 94% of SEER cancer cases were matched to their Medicare claims from their eligibility through to death based on their name, social security number, sex, and date of birth.²⁸ The Medicare claims files were linked to the SEER cancer cases to identify a nationally representative cohort of elderly women with BC. Details of the SEER-Medicare data set and its linkage are described elsewhere.²⁷

The Area Resource File was linked to the WVCR-Medicare and SEER-Medicare data sets

using the state and county Federal Information Processing Standards codes for each beneficiary to identify the county level information on the availability of healthcare facilities, healthcare providers, and socioeconomic characteristics of the region's population.

Study Cohorts

The study cohorts consisted of women aged ≥ 66 years at the first primary incident BC (ICD-9 codes 174.xx, 233.0x, 238.3x, and 239.3x) during 2003 through 2006. Women who were continuously enrolled in Medicare Parts A and B at least 12 months before and up to the follow-up period of 12 months after BC diagnosis, who were not enrolled in health maintenance organizations at any time during this period, and had a reported stage at diagnosis were included in the study. Women diagnosed via death certificates/autopsy, who died within 12 months after diagnosis, and had zero total Medicare expenditures were excluded.

Of 2,814 women with BC from the WVCR-Medicare data set, 1,387 WV women were included based on the inclusion and exclusion criteria. In addition, of 112,719 women with BC from the SEER-Medicare data set, 39,525 were included to form a nationally representative population for comparison.

Measures

Initial Phase of Care: Because the prime objective was to evaluate Medicare expenditures during the clinically relevant treatment phase, and to be consistent with the previous studies, the initial phase of care was identified as the year after the date of BC diagnosis.^{1,2,4-6,11,29}

Medicare Expenditures: All Medicare files, including inpatient, hospital outpatient, carrier, hospice, skilled nursing facility, home health agency, and durable medical equipment (DME), were used to derive direct Medicare expenditures. Expenditures were defined as the amount reimbursed by Medicare. Reimbursements are calculated using reimbursement formulas that exhibit average healthcare use for the particular healthcare service.³⁰ Average Medicare expenditures and expenditures for specific services (inpatient services, outpatient services, physician services, and other services, such as DME, hospice care, and home health agency) were also calculated separately for both of the study cohorts. Even though

expenditures associated with chemotherapy covered under Medicare Part B physician services and DME were captured and included in the analyses, expenditures associated with chemotherapy and prescription drugs (Medicare Part D) were not included in the analyses because these were not covered by Medicare before 2007. Additionally, because prescription drug benefits were not available to Medicare beneficiaries during the study period, prescription drug expenditures were not included. All of the expenditures were adjusted with the previously used method⁶ and were reported in 2015 \$USD to control for variation over time.³¹

Independent Variables: The Andersen behavioral model of healthcare services utilization was used to determine the significant predictors of expenditures.^{32,33} This conceptual model has been used for decades to understand health services use in population-level studies. According to this model, healthcare utilization and expenditures are the function of the predisposition of individuals to use services, factors that enable or impede use, the need for care, healthcare use, and external healthcare environmental factors.

Predisposing factors consisted of age at BC diagnosis and race, and enabling factors included census tract median household income and percentage of people aged ≥ 25 years with ≥ 4 years of college education. Because person-level information on household income and education level are not available with both SEER-Medicare and WV Medicare cohorts, census tract information for these variables were used in the study. Need-related factors consisted of stage at diagnosis,³⁴ tumor grade, estrogen receptor status, and comorbidity^{35,36} and mental conditions (depression and/or anxiety) derived from co-occurring chronic conditions in the 12 months before BC diagnosis. Healthcare use comprised the number primary care physician (PCP) visits in the year following BC diagnosis,³⁷ categorized as high or low based on the median value; type of initial treatment in the year following BC diagnosis (definitive surgery only; nonsurgical treatment, such as chemotherapy or radiation therapy or both; definitive surgery + nonsurgical therapy; and no treatment); and inpatient use. External healthcare environmental factors comprised location of residence and number of hospitals offering oncology-related services in the area of residence, categorized as high or low based on the median value.

Statistical Analyses

Chi-square statistics were used to describe the significant differences between the study cohorts. Average Medicare expenditures and expenditures for specific services were statistically compared using *t* tests and ratio of means. Breusch-Pagan/Cook-Weisberg test and simplified White test were used to check for heteroscedasticity and kurtosis of log-scale residuals in the expenditures data.³⁸ Park tests indicated that generalized linear model (GLM) with log link function and gamma distribution should be used for these data.³⁹

Multivariable GLM regressions were separately conducted to model expenditures for both study cohorts. Also, GLM regression was conducted on average expenditures after controlling for setting (WV Medicare vs SEER-Medicare) and other independent variables, to determine significant differences in expenditures between the cohorts. Findings with $P < .05$ are discussed. All analyses were conducted within statistical analysis system software SAS 9.4 (SAS Institute Inc., Cary, NC) and Stata 13 (StataCorp 2013, College Station, TX).

Blinder-Oaxaca Decomposition Technique: A postregression Blinder-Oaxaca linear decomposition technique was used to estimate how much of the differences in average expenditures between the cohorts can be explained by differences in characteristics.^{40,41} This method has been widely used for decades to understand the disparities in healthcare utilization, and thereby expenditures, and access to care among vulnerable groups. For instance, a study by White-Means⁴² used this technique to evaluate the racial differences in the use of medical services among the disabled elderly US population. The Blinder-Oaxaca linear decomposition method uses the differences in means of independent variables and parameter estimates (betas) from the regressions to generate 2 components: the “explained” component, which provides differences in expenditures due to differences in observed characteristics between 2 cohorts, and the “unexplained” component, which provides differences in expenditures that could not be explained, either because of differences in the regression parameter estimates between the 2 cohorts or differences in unobservable/unmeasured independent variables (eg, provider level, organizational level variables). The explained portion was calculated by multiplying the differences in the

average characteristics between the cohorts using pooled regression weights. The pooled regression weights are the coefficients of the characteristics from the regression model, which included WV Medicare versus SEER-Medicare as one of the independent variables.

Results

Descriptive Characteristics

Most of the WV Medicare cohort (97.6%) was white compared with 89% from the SEER-Medicare cohort (Table 1). A higher proportion of the WV Medicare cohort had a household income $< \$35,000$ (91%) and resided in areas where $< 15\%$ of the population had some college education (51%) and with a lower number of hospitals with oncology services (60%). However, most of the SEER-Medicare cohort resided in metropolitan areas (84%), had household income $> \$35,000$ (75%), and resided in areas where $> 15\%$ of the population had some college education (70%), and with a lower number of hospitals with oncology services (55%).

Average Medicare Expenditures and Expenditures by Types of Services: Average expenditures for the WV Medicare cohort were \$25,626 compared with \$29,502 for the SEER-Medicare cohort; a difference of \$3,876 (Table 2). Average inpatient expenditures for the WV Medicare cohort (\$6,070) were also significantly lower than those for the SEER-Medicare cohort (\$6,775), with a ratio of means of 0.90. Average expenditures for physician services were significantly lower for the WV Medicare cohort (\$11,197) compared with the SEER-Medicare cohort (\$13,925), with a ratio of means of 0.80.

Factors Associated With Medicare Expenditures:

In the WV Medicare cohort, women who were diagnosed with regional and distant BC stage, had surgery with adjuvant therapy or adjuvant therapy only, had inpatient visits, had ≥ 2 comorbidities, and mental health conditions had significantly higher expenditures during the initial phase of BC care (Table 3). In the SEER-Medicare cohort, women who resided in areas with higher education level, were diagnosed at advanced BC stages, did not have a well-differentiated tumor grade, had negative estrogen receptor tumor status, had any kind of treatment in form of surgery or adjuvant therapy, had inpatient

Table 1. Patient Characteristics

Variables	WV Medicare (N=1,387)		SEER-Medicare (N=39,525)		Sig
	n	%	n	%	
Age at diagnosis, y					***
66–69	275	19.8	8,799	22.3	
70–74	384	27.7	9,868	25.0	
75–79	379	27.3	9,331	23.6	
≥80	349	25.2	11,527	29.2	
Race					***
White	1,354	97.6	34,992	88.5	
Other	33	2.4	4,533	11.5	
Location of residence					***
Metropolitan	761	54.9	32,989	83.5	
Nonmetropolitan	626	45.1	6,536	16.5	
Census tract household income					***
≤\$35,000	1,267	91.4	9,764	24.7	
>\$35,000	120	8.6	29,761	75.3	
Census tract education					***
<15% population with college education	703	50.7	12,056	30.5	
≥15% population with college education	684	49.3	27,469	69.5	
Stage at diagnosis					**
In situ	209	15.1	6,610	16.7	
Local	866	62.5	22,738	57.5	
Regional	273	19.7	8,985	22.7	
Distant	39	2.7	1,192	3.0	
Grade of tumor					***
Well differentiated	325	23.4	8,459	21.4	
Moderately differentiated	472	34.0	15,524	39.3	
Poorly differentiated	306	22.1	9,969	25.2	
Undifferentiated/Unknown	284	20.5	5,573	14.1	
Estrogen receptor status					***
Positive	627	45.2	27,260	69.0	
Negative	126	9.1	5,412	13.7	
Borderline/Unknown	634	45.7	6,853	17.3	
Initial treatment					**
Surgery only	560	40.4	14,478	36.6	
Surgery and adjuvant therapy	765	55.2	23,494	59.4	
Adjuvant therapy only	16	1.2	581	1.5	
No treatment	46	3.3	972	2.5	
Inpatient use					
Yes	681	49.1	18,621	47.1	
No	706	50.9	20,904	52.9	
Comorbidity					***
0	715	51.6	23,039	58.3	
1	416	30.0	10,629	26.9	
≥2	256	18.4	5,857	14.8	
Mental condition					***
Yes	134	9.7	2,411	6.1	
No	1,253	90.3	37,114	93.9	
Primary care physician visits					*
High	681	49.1	18,051	45.7	
Low	706	50.9	21,474	54.3	
Hospitals offering oncology services					***
High	551	39.7	17,613	44.6	
Low	836	60.3	21,912	55.4	

Based on 1,387 elderly WV Medicare women and 39,525 elderly SEER-Medicare women, aged ≥66 years diagnosed with primary incident breast cancer from 2003 to 2006, who had a positive direct Medicare expenditure. Asterisks represent statistically significant group differences based on chi-square tests: *** $P<.001$; ** $.001\leq P<.01$; * $.01\leq P<.05$. Abbreviations: Sig, significance; WV, West Virginia.

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Table 2. Average Medicare Expenditures and Expenditures by Specific Services

	WV Medicare (N=1,387)			SEER-Medicare (N=39,525)			Ratio-of-Means
	Average (\$USD)	SD	%	Average (\$USD)	SD	%	
Total***	25,626	23,202	100%	29,502	25,757	100%	0.87
Inpatient*	6,070	12,249	24%	6,775	15,153	23%	0.90
Outpatient	7,436	11,378	29%	7,486	8,672	25%	0.99
Physician services***	11,197	12,547	44%	13,925	14,630	47%	0.80
Other (HHA, HSP, DME)***	923	2,901	4%	1,316	4,149	4%	0.70

Based on 1,387 elderly WV Medicare women and 39,525 elderly SEER-Medicare women, aged ≥ 66 years diagnosed with primary incident breast cancer from 2003 to 2006, who had a positive Medicare expenditure.

Asterisks represent statistically significant group differences based on t-tests: *** $P < .001$; ** $.001 \leq P < .01$; * $.01 \leq P < .05$.

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

visits, high PCP visits, and had any comorbidity had significantly higher expenditures.

Differences in Average Expenditures Between Study Cohorts: Compared with the SEER-Medicare cohort, average expenditures during the initial phase of BC care were significantly lower for the WV Medicare cohort by \$708 in a multivariable regression (Table 4).

Factors Explaining Lower Average Expenditures in the WV Medicare Cohort: Using the pooled weights and logarithmic transformation of expenditures, there was a difference of -0.1678 in logarithmic terms. Of this difference, only -0.0266 or 15.85% of the difference in average Medicare expenditures between the cohorts was explained by the included beneficiary characteristics (Table 5). Enabling resources contributed 6.86%, healthcare use 7.55%, and external healthcare environmental factors 3.33% to the total explained portion. Detailed examination of the decomposition results revealed that type of initial treatment explained 12.25% of the differences in the average expenditures between the cohorts. This can be interpreted as follows: keeping all the other characteristics same, if the WV Medicare cohort had the same course of initial treatment as the SEER-Medicare cohort, then the WV Medicare cohort would result in lower expenditures. A total of 84.15% of the differences in average expenditures between the cohorts remained unexplained.

Discussion

To our knowledge, this study is first of its kind to determine Medicare spending during the initial phase

of care among elderly women (aged ≥ 66 years) with BC residing in a rural and medically underserved region of WV. As expected, the populations studied were statistically different in terms of most of their characteristics; contrary to the hypothesis, average Medicare expenditures and expenditures for inpatient services, physician services, and other services in elderly WV women with BC were significantly lower than those for the SEER-Medicare cohort.

These findings are surprising given the fact that elderly WV women with BC have a higher comorbidity burden and possibly greater proportion of negative health outcomes, which should increase the Medicare expenditures. Indeed, a previous study reported lower Medicare expenditures among rural elderly women with BC, although it focused on end-of-life care only.⁴³ In addition, some of the lower expenditures in the rural WV region compared with the SEER-Medicare regions may be due to the differences in Medicare spending across various geographic US regions.⁴⁴ However, no study examined the extent to which independent variables explain the differences in expenditures in rural regions versus nationally. The unique contribution of this study is that it provides an assessment of the extent to which the constructs included in the Andersen behavioral model explained the expenditure differences using a WVCR-Medicare database and a nationally representative population from the SEER-Medicare database using an advanced Blinder-Oaxaca linear decomposition technique.

Average Medicare expenditures during the initial phase of BC care among elderly WV women were significantly lower by \$3,876 compared with that for the SEER-Medicare cohort, which reduced

Table 3. Factors Associated With Average Medicare Expenditures Using Generalized Linear Model Regressions

Variables	WV Medicare (N=1,387)				SEER-Medicare (N=39,525)			
	Beta	Expenditures (\$USD)	SE	Sig	Beta	Expenditures (\$USD)	SE	Sig
Intercept (baseline expenditures)	8.8557	7,014	0.1342	***	8.8569	7,023	0.0252	***
Age at diagnosis, y								
66–69								
70–74	–0.0666	6,562	0.0503		–0.0349	6,782	0.0086	***
75–79	–0.1678	5,931	0.0507	***	–0.0836	6,459	0.0088	***
≥80	–0.1121	6,270	0.0538	*	–0.1376	6,120	0.0088	***
Race								
White								
Other	–0.0234	6,852	0.1120		–0.0096	6,956	0.0096	
Location of residence								
Metropolitan								
Nonmetropolitan	–0.0762	6,500	0.0440		–0.0814	6,474	0.0092	***
Census tract household income								
≤\$35,000								
>\$35,000	0.0208	7,162	0.0755		0.0150	7,129	0.0084	
Census tract education								
<15% population with college education								
≥15% population with college education	–0.0075	6,962	0.0477		0.0285	7,226	0.0076	***
Stage at diagnosis								
In situ								
Local	0.0940	7,706	0.0508		0.1625	8,262	0.0091	***
Regional	0.4257	10,736	0.0617	***	0.4081	10,562	0.0106	***
Distant	0.5909	12,663	0.1220	***	0.7389	14,703	0.0203	***
Grade of tumor								
Well differentiated								
Moderately differentiated	–0.0061	6,972	0.0462		0.0282	7,224	0.0080	***
Poorly differentiated	0.0118	7,098	0.0538		0.0977	7,743	0.0093	***
Undifferentiated/Unknown	–0.0503	6,670	0.0539		0.0365	7,284	0.0108	***
Estrogen receptor status								
Positive								
Negative	0.1061	7,799	0.0649		0.0976	7,743	0.0094	***
Borderline/Unknown	–0.0402	6,738	0.0369		0.0111	7,101	0.0087	
Initial treatment								
Surgery only	0.1165	7,881	0.1040		0.1843	8,444	0.0201	***
Surgery and adjuvant therapy	1.0200	19,452	0.1051	***	0.9223	17,663	0.0202	***
Adjuvant therapy only	0.7929	15,500	0.1867	***	0.7776	15,283	0.0317	***
No treatment								
Inpatient use								
Yes	0.7829	15,346	0.0370	***	0.7065	14,234	0.0065	***
No								
Comorbidity								
0								
1	0.0726	7,542	0.0395		0.0668	7,508	0.0070	***
≥2	0.1904	8,485	0.0478	***	0.2105	8,668	0.0090	***
Mental condition								
Yes	0.2480	8,988	0.0581	***	0.0841	7,639	0.0125	***
No								
Primary care physician visits								
High	0.0138	7,112	0.0353		0.0786	7,597	0.0062	***
Low								
Hospitals offering oncology services								
High	0.0654	7,488	0.0498		0.0738	7,561	0.0066	***
Low								

Based on average Medicare expenditures during initial phase of care among 1,387 elderly WV Medicare women and 39,525 elderly SEER-Medicare women, aged ≥66 years diagnosed with first primary incident breast cancer from 2003 to 2006, who had a positive Medicare expenditure. Asterisks represent statistically significant group differences based on generalized linear model with gamma distribution and log link function: *** $P<.001$; ** $.001\leq P<.01$; * $.01\leq P<.05$. Abbreviations: SE, standard error; Sig, significance; WV, West Virginia.

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Table 4. Differences in Average Medicare Expenditures Using Generalized Linear Model Regression

	Beta	(\$USD)	SE	Sig
Average Medicare expenditures ^a				
Intercept (baseline expenditures)	8.8602	7,046	0.0248	***
WV Medicare	-0.1059	6,338	0.0170	***
SEER-Medicare				

Based on average Medicare expenditures during initial phase of care among 1,387 elderly WV Medicare women and 39,525 elderly SEER-Medicare women, aged ≥66 years diagnosed with first primary incident breast cancer from 2003 to 2006, who had a positive Medicare expenditure.

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

Abbreviations: SE, standard error; Sig, significance; WV, West Virginia.
^aAdjusted for all the independent variables in the model.

to \$708 after a multivariate adjustment, thereby indicating disparities in cancer care. Even though \$708 appears a lower amount, it does not necessarily suggest a more efficient use of medical resources in WV. This study may have implications for Medicare for appropriately aligning its resources in WV given that WV has the third highest national proportion of the elderly at 17.3% of its population⁴⁵ and hence higher burden of cancer care. Again, because the data lack information about health outcomes, such as health status and disease progression, and given that BC has better 5-year survival rates, it may not be plausible to imply that lower Medicare expenditures during the initial phase of care among elderly WV women with BC compared with the national average may necessarily translate to better or worse health outcomes.

The Blinder-Oaxaca linear decomposition technique showed that 16% of the expenditure difference between cohorts was explained by the variables adjusted in the analyses. The enabling resources (household income and education) and healthcare use (PCP visits, type of initial treatment, uses of inpatient services) primarily explained 14% of these differences. These findings are consistent with those of previous studies reporting that the differences in healthcare spending are largely explained by different treatment patterns owing to the supply of physicians and hospital resources in the area, and also to household income and education.^{46–49} A noteworthy finding of this study is that 84% of the difference in Medicare expenditures between the cohorts remained unexplained. It is plausible that some

portion of this difference may be due to variables such as health status, severity of comorbid conditions, body mass index, patient preferences, and propensity to seek care that were not captured in the database.

Another portion of the “unexplained portion” was assumed to be due to external factors, which may include differences in the proportion of women covered by Medicare managed care, Medicaid, and Medicare supplemental insurance in WV and the rest of the United States. Due to the unavailability of individual level data, state-level data of Medicare managed care penetration, dual enrollment in Medicare/Medicaid, and Medicare supplemental coverage were identified for WV and compared with the US rates. In 2006, Medicare managed care penetration rate was lower in WV than the national average (9%⁵⁰ vs 16%⁵¹) and the percentage of Medicare beneficiaries with supplemental coverage was lower

Table 5. Factors Explaining Lower Expenditures Using Blinder-Oaxaca Linear Decomposition Analysis

Average log-transformed Medicare expenditures (West Virginia Medicare)	9.9843	
Average log-transformed Medicare expenditures (SEER-Medicare)	10.1520	
Difference	-0.1678	
Total “explained”	-0.0266	
Variables	% of “Explained” Difference in Average Expenditures	% Contribution to the “Explained” Portion
Predisposing characteristics (age, race)	-0.41%	-2.59%
Enabling resources (census tract annual household income and education)	6.86%	43.28%
Need-related variables (stage at diagnosis, grade of tumor, estrogen receptor status, comorbidity, mental conditions)	-1.48%	-9.34%
Healthcare use (primary care physician visits, type of initial treatment, inpatient use)	7.55%	47.64%
External healthcare environmental factors (location of residence, hospitals offering oncology services)	3.33%	21.01%
Total difference explained	15.85%	100.00%

Linear decomposition analysis based on average Medicare expenditures during initial phase of care among 1,387 elderly WV-Medicare women and 39,525 elderly SEER-Medicare women, aged ≥66 years diagnosed with first primary incident breast cancer from 2003 to 2006, who had a positive Medicare expenditure.

in WV compared with the United States (17% vs 23%).⁵² Therefore, it is speculated that these differences may not have contributed to lower expenditures in WV compared with the national average. In addition, the rates of Medicare/Medicaid dual enrollment were similar for WV and nationally.⁵³ Because Medicare is the primary payer for dually enrolled Medicare/Medicaid beneficiaries, it is again speculated that this may not have contributed to lower expenditures in WV compared with the national average. Furthermore, a portion of this difference may be due to lack of infrastructure owing to the mountainous topography of Appalachia, thereby amplifying problems such as lack of access to cancer care facilities. Insufficiently developed interstate and public transportation systems in Appalachia and cost of transportation¹⁸ may be leading to inequality in cancer care in the state, thereby affecting Medicare expenditures. Besides, before 2008, insufficient health information technology, such as broadband infrastructure that may have affected enhanced and timely communications between healthcare providers in WV,¹⁹ and hence continuity of care, may be contributing factor to the portion of unexplained difference in the Medicare expenditures. As reported, before 2008, 35% of the hospitals in WV had no or less than high-speed broadband connectivity, which may have impacted the use of patients' electronic health records among healthcare providers.¹⁹

In elderly WV women with BC, factors associated with higher expenditures during the initial phase of BC care were advanced stages of disease, surgery with adjuvant therapy or adjuvant therapy only, inpatient use, presence of ≥ 2 physical chronic conditions, and mental conditions. But older age was associated with lower expenditures in these women compared with those aged 66 to 69 years. These findings were consistent with those reported in the previous study on the Virginia population,¹¹ and highlight the importance of encouraging women to use preventive screenings to diagnose BC at earlier

stages and curb higher Medicare spending. Additionally, the findings emphasize the importance of better comanagement of physical and mental chronic conditions in elderly women with BC in order to lower overall expenditures to Medicare in WV.

Findings from this study raise important policy issues and have implications for payers (Medicare), providers, and patients. There is a geographic variation in Medicare spending among elderly women that indicates the Centers for Medicare & Medicaid Services to evaluate if lower expenditures among patients with BC in rural WV translates to similar, better, or worse health outcomes (eg, survival, quality of life) compared with national averages, and accordingly develop and/or modify reimbursement policies that can help bend the ever-increasing cancer spending curve.

Several study limitations are worth noting. Healthcare services obtained outside of Medicare settings may not be captured, thereby underestimating the expenditures. The Andersen model has some limitations when applied to claims data. For instance, data on enabling factors (supplemental coverage), need-related factors (severity of comorbidities, health status), personal health practice (body mass index, physical activity, smoking), and patient preferences, which may impact selection of treatment and hence Medicare expenditures, were not captured. Additionally, the study findings are generalizable to elderly patients with BC only covered by Medicare within WV.

Conclusions

The difference in the average Medicare expenditures during the initial phase of BC care between elderly WV women and their national counterparts remained significantly lower after multivariate adjustment. The explained portion of this difference was mainly driven by enabling and healthcare use factors, whereas 84% of it remained unexplained.

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