ORIGINAL RESEARCH

Comparison of Treatment Costs for Breast Cancer, by Tumor Stage and Type of Service

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BACKGROUND: Diagnosis of breast cancer at early stages is associated with better clinical and survival outcomes. How the costs of care vary depending on the stage at which breast cancer was diagnosed has not been thoroughly examined.

OBJECTIVE: To quantify the stage-dependent average per capita cost of breast cancer treatment for a commercially insured population of women with newly diagnosed breast cancer.

METHODS: This retrospective analysis of claims data was based on a population selected from the Truven Healthcare MarketScan commercial claims database. The study comprised women aged 18 to 64 years with breast cancer who had ≥2 claims in 2010 that were ≥30 days apart and included an *International Classification of Diseases, Ninth Revision* diagnosis code for breast cancer (174.xx, 233.0) in any position of the claim. Two years of postdiagnosis claims data were analyzed by stage at diagnosis (ie, 0, I/II, III, and IV).

RESULTS: In total, 8360 women met the criteria for study inclusion (stage 0, N = 2300; stage I/II, N = 4425; stage III, N = 1134; and stage IV, N = 501). The costs were higher for patients whose cancer was more advanced at diagnosis, for all cumulative 6-month periods (months 0-6, 0-12, 0-18, and 0-24). The average costs per patient allowed by the insurance company in the year after diagnosis were $60,637, $82,121, $129,387, and $134,682 for disease stage 0, I/II, III, and IV, respectively. The average costs allowed per patient in the 24 months after the index diagnosis were $71,909, $97,066, $159,442, and $182,655 for disease stage 0, I/II, III, and IV, respectively. The cost difference based on the stage at diagnosis was largely driven by the cost of chemotherapy and noncancer treatments.

CONCLUSION: Treating advanced- versus early-stage breast cancer is associated with significant increases in incremental costs. Knowledge of the relevant stage-specific cost data provides support for strengthening programs, such as breast cancer screening, that are designed to shift breast cancer diagnosis to earlier disease stages.

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Breast cancer, the most common malignancy in women in the United States,[1] is a serious disease associated with substantial medical and economic burden. Nearly 3 million US women were living with breast cancer in 2012, and it is estimated that 231,840 women would be newly diagnosed with the disease in 2015.[1] Approximately 12.3% of women in the United States will receive a breast cancer diagnosis at some point in their life.[1]

In 2015, it is estimated that breast cancer claimed the lives of 40,290 women in the United States,[1] and it is second only to lung cancer as the leading cause of cancer-related death in women.[2] However, the 5-year survival rate after diagnosis of breast cancer has improved over time, increasing from 74.8% for women whose cancer was diagnosed in 1975-1977 to 90.7% for those diagnosed in 2004-2011.[3] Treatment of breast cancer at earlier (vs later) stages of the disease is associated with better survival outcomes: the 5-year relative survival rate is 98.6% if the cancer is diagnosed at the local stage, 84.9% if diagnosed at the regional stage, and 25.9% if diagnosed at the distant stage.[1]

The recent improvement in clinical and survival outcome is largely attributable to radiographic screening for breast cancer coupled with advances in treatment. Breast cancer screening guidelines were first published in 1989 in response to modeling based on studies conducted in the 1980s.[4] At present, approximately 70% of commercially insured women aged 50 to 74 years have had at least 1 screening mammogram in the previous 2 years.[5]

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KEY POINTS

- Few studies have analyzed the impact of breast cancer stage at diagnosis on the cost of treatment.
- This new retrospective analysis of claims data from 8360 women with breast cancer was focused on stage-related average per-person costs of treatment.
- In the first 12 months, surgery costs were more than 2-fold higher for those diagnosed with stage 0 ($16,909) than with stage IV ($7660), reflecting the curative nature of surgery for early-stage disease.
- Chemotherapy was responsible for the highest percentage of total costs for stage IV and the lowest for stage 0.
- In months 13 to 24 after diagnosis, chemotherapy costs were the largest contributor to treatment costs in every stage of the disease.
- In all, treatment costs were higher for patients whose cancer was more advanced at diagnosis.
- This information may help encourage initiatives aimed at strengthening breast cancer screening.

Early detection of breast cancer through screening is generally also associated with lower costs of treatment; however, the literature that supports this association predates the year 2009.[6] Some studies have analyzed therapy costs in Medicare (not commercially insured) populations.[7-9] Other cost studies have been performed in Europe and Canada,[10-12] but their health systems are publicly funded and, therefore, are different from the US commercially insured population. Few claims-based studies (discussed later) of breast cancer treatment costs in the US Medicare and commercially insured populations have examined how costs relate to the cancer stage at diagnosis.

The purpose of the current retrospective claims data analysis was to quantify the stage-dependent average per capita cost of breast cancer treatment for a commercially insured population of women with newly diagnosed breast cancer.

Methods

We conducted a retrospective claims data analysis, by cancer stage at diagnosis, to identify per capita allowed medical costs for women who were newly diagnosed with breast cancer in 2010 in the United States. The study population was selected from the Truven Healthcare MarketScan (MarketScan) commercial claims database using 2010 as the index year, 2009 as a look-back year, and 2011 and 2012 as the 24-month look-forward period.

The MarketScan database contains all annual paid claims generated by more than 50 million commercially insured individuals, and includes member identification codes that allow the longitudinal evaluation of members in the database. The database also includes standard codes for diagnosis, procedure, and diagnosis-related group, along with site-of-service information, amounts paid by commercial insurers, and cost-sharing amounts paid by members. Drugs are reported in the database using the National Drug Code, a unique, 3-segment number that serves as a universal drug identifier.[13]

Study Sample Identification

The study population comprised commercially insured US women aged 18 to 64 years who were newly diagnosed with breast cancer in 2010. Health insurance coverage was required for ≥1 months in 2010 and all of 2009 to perform a 12-month look-back analysis from the 2010 index diagnosis date. Claims data from 2011 and 2012 were used to calculate costs for the 24 months after the date of breast cancer diagnosis (ie, index date). For women who reached age 65 years in 2011 or 2012, claims continued to be included for the months in which commercial insurance was their primary coverage.

Monthly enrollment in the study was based on member eligibility criteria. Inclusion criteria included having ≥2 claims in 2010 that were ≥30 days apart and were coded with 1 of 2 breast cancer *International Classification of Diseases, Ninth Revision* (*ICD-9*) diagnosis codes (174.xx, 233.0) in any position of the claim. The index diagnosis date was defined as the date of the first claim in 2010 that contained an *ICD-9* diagnosis code for breast cancer.

We performed the 12-month look-back from the index diagnosis to identify women with newly diagnosed breast cancer and to exclude women who had other confounding cancers. Women who had ≥2 claims that were ≥15 days apart and were coded for any cancer other than nonmelanoma skin cancer (140.xx-172.xx, 174.xx-208.xx) were excluded from the study. Because a claim coded for metastatic cancer may have occurred before a claim coded for the primary cancer, women were not excluded if the look-back period contained only a claim coded for metastatic disease not related to breast cancer (ie, codes 196.0x-196.2x, 196.5x-196.9, 197.xx, or 198.xx).

Claim-Coding Methods for Cancer Staging

Women with newly diagnosed breast cancer were stratified based on the estimated cancer stage at diagnosis. *ICD-9* coding does not specify breast cancer stage; therefore, the stage was inferred based on identification of stage-specific treatments recommended in the National Comprehensive Cancer Network (NCCN) treatment guidelines.

We developed a claims-based algorithm for staging breast cancer using the system of the American Joint

Committee on Cancer (AJCC) and assigned a stage to each newly diagnosed case—stage 0, I/II, III, or IV. Stages I and II cases were combined, because the NCCN treatment recommendations are interchangeable for these stages, and, therefore, a distinct claims-based treatment identifier could not be used to differentiate them. The staging algorithm and codes are summarized in **Table 1**.

We performed a sensitivity analysis in which breast cancer stage was assigned using an alternative approach that identified the cancer as in situ, small tumor, large tumor, or metastatic. In situ and metastatic tumors were identified using the same logic as that of AJCC staging. Small tumors were designated as cases with partial mastectomy and no neoadjuvant chemotherapy or radiation therapy. Cases with an excisional breast procedure (*Current Procedural Terminology* [*CPT*] code 19120, 19125, or 19126, or *ICD-9* procedure code 85.21) and no additional claim for a partial (*CPT* code 19301 or 19302, or

Table 1 Staging Algorithm Steps for Breast Cancer

Steps for stage identification	Codes
Step 1. All cases meeting newly diagnosed breast cancer criteria were examined for stage IV metastatic identification criteria Women with ≥2 claims coded for breast cancer metastasis, ≥15 days apart, occurring from 1 month before to 6 months after the index diagnosis date were designated as having stage IV disease The *ICD-9* diagnosis code could be in any position on a claim	*ICD-9* diagnosis codes for breast cancer metastasis: 196.0x-196.2x, 196.5x-196.9, 197.xx, 198.xx
Step 2. Cases not meeting stage IV metastatic criteria were examined for evidence of active treatment with breast cancer surgery (inpatient or outpatient) The breast cancer surgery claim was required to be within 9 months of the index diagnosis date and contain a breast surgery *CPT* code or *ICD-9* procedure code in the primary position of the claim For women identified as having risk-reduction surgery, additional treatment indicating malignancy was required. Treatment for malignancy included radiation therapy, chemotherapy, and axillary node sampling	*CPT* codes for breast cancer surgery: 19120, 19125, 19126, 19301, 19302-19307 *ICD-9* procedure codes for breast cancer surgery: 85.21-85.23, 85.41-85.48 Risk-reduction surgery: *CPT* codes 19303, 19304; *CPT* procedure codes 85.41, 85.42 Axillary node sampling: *CPT* codes 38500, 38505, 38525, 38740, 38745; *ICD-9* procedure codes 40.23, 40.3, 40.51 [Codes for radiation therapy and chemotherapy are noted below]
Step 3. Women receiving neoadjuvant therapy and/or cases coded for axillary lymph node involvement were identified with stage III breast cancer Neoadjuvant therapy was indicated by ≥2 claims for radiation and/or chemotherapy after the index diagnosis date and before the breast surgery date Axillary lymph node involvement was indicated by ≥2 claims ≥15 days apart containing *ICD-9* code 196.3 in any position of the claim, occurring within 6 months of the index diagnosis date	Radiation HCPCS codes: 77261-77263, 77280-77299, 77300-77370, 77371-77399, 77401-77417, 77418, 77421, 77422-77423, 77427-77499, 77520-77525, 77600-77620, 77750-77799 Radiation revenue code: 333 Chemotherapy J codes: J9000-J9999, J8510, J8520, J8521, J8530, J8560, J8561, J8565, J8600, J8610, J8700, J8705, J8999 Oral chemotherapy NDCs were obtained from Medi-Span 2013; available upon request *ICD-9* diagnosis code for axillary lymph node involvement: 196.3
Step 4. Cases coded for in situ disease were identified with stage 0 breast cancer In situ disease was indicted by ≥2 claims ≥15 days apart containing *ICD-9* diagnosis code 233.0, occurring within 6 months of the index diagnosis date	*ICD-9* diagnosis code for in situ breast cancer: 233.0
Step 5: Remaining cases were designated as stage I/II disease	

CPT indicates *Current Procedural Terminology*; HCPCS, Healthcare Common Procedure Coding System; *ICD-9*, *International Classification of Diseases, Ninth Revision*; NDC, National Drug Code.
Source: Milliman's study protocol.

Table 2 Average per-Patient Allowed Costs, by Service Type[a]

Disease stage	Category of service	Average 0- to 12-month cost, by service per diagnosed patient: Average allowed cost, $	Average 0- to 12-month cost, by service per diagnosed patient: First 12-month total, %	Average 13- to 24-month cost, by service per diagnosed patient covered through 12 months after diagnosis: Average allowed cost, $	Average 13- to 24-month cost, by service per diagnosed patient covered through 12 months after diagnosis: Second 12-month total, %
0	Inpatient breast cancer surgery	4291	7	281	2
	Outpatient breast cancer surgery	12,618	21	405	3
	All costs on day of chemotherapy	4999	8	1147	8
	Oral chemotherapy	171	0	168	1
	Radiation therapy	14,454	24	361	3
	Prescription drugs	1717	3	1482	11
	Other inpatient	1708	3	1442	11
	Other outpatient	11,366	19	4579	34
	Other professional	9314	15	3658	27
	Total	**60,637**		**13,523**	
I/II	Inpatient breast cancer surgery	4722	6	213	1
	Outpatient breast cancer surgery	11,783	14	358	2
	All costs on day of chemotherapy	13,373	16	2554	14
	Oral chemotherapy	445	1	545	3
	Radiation therapy	14,910	18	377	2
	Prescription drugs	2581	3	1440	8
	Other inpatient	2873	3	2466	13
	Other outpatient	17,010	21	6271	34
	Other professional	14,425	18	4289	23
	Total	**82,121**		**18,514**	
III	Inpatient breast cancer surgery	6573	5	1033	3
	Outpatient breast cancer surgery	12,637	10	412	1
	All costs on day of chemotherapy	34,003	26	7315	20
	Oral chemotherapy	422	0	790	2
	Radiation therapy	21,133	16	1100	3
	Prescription drugs	3841	3	1525	4
	Other inpatient	4499	3	7225	20
	Other outpatient	25,913	20	9914	28
	Other professional	20,365	16	6486	18
	Total	**129,387**		**35,801**	
IV	Inpatient breast cancer surgery	3180	2	217	0
	Outpatient breast cancer surgery	4480	3	557	1
	All costs on day of chemotherapy	34,153	25	18,251	26
	Oral chemotherapy	1533	1	3749	5
	Radiation therapy	12,015	9	3592	5

Continued

Table 2 Average per-Patient Allowed Costs, by Service Type *(continued)*

Disease stage	Category of service	Average 0- to 12-month cost, by service per diagnosed patient: Average allowed cost, $	Average 0- to 12-month cost, by service per diagnosed patient: First 12-month total, %	Average 13- to 24-month cost, by service per diagnosed patient covered through 12 months after diagnosis: Average allowed cost, $	Average 13- to 24-month cost, by service per diagnosed patient covered through 12 months after diagnosis: Second 12-month total, %
IV	Prescription drugs	3316	2	2355	3
	Other inpatient	20,555	15	11,514	17
	Other outpatient	33,853	25	18,575	27
	Other professional	21,596	16	10,654	15
	Total	**134,682**		**69,464**	
All stages	Inpatient breast cancer surgery	4762	6	347	2
	Outpatient breast cancer surgery	11,691	14	389	2
	All costs on day of chemotherapy	15,113	18	3625	16
	Oral chemotherapy	432	1	636	3
	Radiation therapy	15,455	18	638	3
	Prescription drugs	2558	3	1510	7
	Other inpatient	3833	4	3306	15
	Other outpatient	17,674	21	6931	31
	Other professional	14,255	17	4743	21
	Total	**85,772**		**22,127**	

[a]Numbers were rounded so some totals do not add up exactly.
Source: Milliman's Analysis of Truven MarketScan commercial claims database for 2009-2012.

ICD-9 procedure code 85.22, 85.23) or complete mastectomy (*CPT* code 19305-19307 or *ICD-9* procedure code 85.43-85.48) were considered small tumors. Large tumors were designated as cases with complete mastectomy, with or without neoadjuvant chemotherapy or radiation therapy (treatment before surgery), as well as cases with partial mastectomy and neoadjuvant chemotherapy or radiation therapy. Analysis of data for this classification method showed results similar to those obtained using the AJCC staging. Because the AJCC staging is a standard method of assigning breast cancer stage, we present our results according to this approach.

Cost Calculation

Total medical costs were defined as all costs allowed by the insurance company for claims incurred from the index date (ie, diagnosis of breast cancer) through the subsequent 24 months. First-year costs reflected costs for all claims incurred during the 12 months after the index date, divided by the starting number of patients with index diagnosis. Second-year costs reflected costs for all claims incurred during months 13 to 24 after the index diagnosis, divided by the number of patients with index diagnosis and with continuing coverage in month 13.

The cost categories included inpatient breast cancer surgery, outpatient breast cancer surgery, all costs incurred on the day of infused chemotherapy, oral chemotherapy drugs, radiation therapy, other prescription drugs, and other medical costs (**Table 2**).

Costs related to inpatient breast surgery included professional and facility inpatient claims that contained a breast cancer surgery *ICD-9* procedure code in the primary position of the claim. Costs pertaining to outpatient breast surgery included all costs incurred on the day of an outpatient claim containing a breast cancer surgery *ICD-9* procedure code in the primary position of the claim.

Claims for oral chemotherapy were identified using National Drug Codes obtained from Medi-Span 2013 (a comprehensive drug database that contains information about over-the-counter and prescription drugs).[14] The Healthcare Common Procedure Coding System (HCPCS) codes were used to identify injectable drugs that generally cannot be self-administered, chemotherapy, immunosuppressive drugs, inhalation solutions, and some oral drugs.[15]

Claims for infused chemotherapy were also identified

by HCPCS codes. Costs for radiation therapy included all claims with radiation HCPCS codes or revenue codes. Other medical costs included costs for prescription drugs (excluding oral chemotherapy) and all other annual medical costs, all other medical care for patients with breast cancer, including, for example, imaging studies, inpatient stays not associated with breast surgery, and other services (eg, skilled nursing facility, hospice, laboratory).

The average medical cost in each study period was calculated based on the number of patients who remained covered at the beginning of the period. For each breast cancer stage cohort, average allowed costs were calculated for each service category, and the total allowed claims costs incurred during each cumulative 6-month interval were divided by the starting sample size. This calculation represents costs in a manner similar to an insurance reserve (ie, the expected cost of care for a given period can be estimated at the beginning of the period for a specific group of members, such as those with a known condition). Cost calculations were not adjusted for inflation or any other changes.

Results

We identified 15,761 women aged 18 to 64 years with newly diagnosed breast cancer who had ≥2 breast cancer claims and did not have a cancer diagnosis in the 1-year look-back period (**Table 3**). Of these, 8360 women met the criteria for study inclusion (stage 0, N = 2300 [27.5%]; stage I/II, N = 4425 [52.9%]; stage III, N = 1134 [13.6%], and stage IV, N = 501 [6.0%]). Approximately 81% of the women remained enrolled at the end of the first 12 months after the index diagnosis date, and 72% of the 8360 remained enrolled throughout the 24 months. The others either lost eligibility or died.

Table 3 Study Population and Inclusion Criteria

Study criteria	Population size, N
Women aged 18-64 years in noncapitated plans who satisfied continuous enrollment criteria	15,038,167
With ≥2 breast cancer claims ≥30 days apart	50,168
After excluding women with cancer diagnosis in 1-year look-back period	15,761
Meeting disease stage IV criteria	501
Not meeting stage IV criteria and having had breast cancer with surgery within 9 months of index date	6750
Not meeting stage IV criteria and having had breast cancer with risk-reduction surgery plus axillary node dissection, chemotherapy, or radiation therapy	1109
Breast cancer cases meeting criteria for assignment to stages 0-III	7859
Assignment to stage 0	2300
Assignment to stage I/II	4425
Assignment to stage III	1134
Total study population	8360

Source: Milliman's Analysis of Truven MarketScan commercial claims database for 2009-2012.

The costs were higher for women with more advanced cancer stage at diagnosis for all cumulative 6-month periods (ie, 0-6 months, 0-12 months, 0-18 months, and 0-24 months; **Table 4**).

The average allowed costs per patient by tumor stage in the 12 months after diagnosis were $60,637, $82,121, $129,387, and $134,682 for stages 0, I/II, III, and IV, respectively; the costs for months 13 to 24 after diagnosis were $13,523, $18,514, $35,801, and $69,464, respectively (**Table 5**).

The average allowed costs per patient in the 24 months after the index date were $71,909, $97,066, $159,442, and $182,655 for stages 0, I/II, III, and IV, respectively.

During the initial 12 months after breast cancer diagnosis, the per-patient increase in costs between each of the first 3 cancer stages was significant (P <.01), whereas the increase in cost between stages III and IV was not significant (P = .3). For months 13 to 24 after diagnosis, the average costs by cancer stage were lower than in the first year, and the difference in costs between each disease stage was significant (P <.01). The average per-patient medical costs declined in the second year after diagnosis (P <.01). The costs from year 1 to year 2 after diagnosis declined by more than 72% in all cohorts, with the exception of patients with stage IV disease, for whom the decline was approximately 48%.

In the first year after diagnosis, treatment-related costs for breast cancer accounted for 55% to 60% of the total medical costs for women with stage 0, I/II, or III breast cancer, but for only 41% of the total for women with stage IV breast cancer. In the second year after diagnosis, the treatment-related costs for breast cancer accounted for 17% to 38% of the total costs for each disease stage, and the proportion increased with the disease stage at diagnosis.

Among the treatment-related costs in the first 12 months after diagnosis, surgery was responsible for the highest share of the cost in stage 0 disease and for the lowest share of cost for stage IV disease. Surgery costs were more than 2-fold higher for stage 0 disease ($16,909) than for stage IV disease ($7660), a difference that reflects the curative nature of surgery in earlier stages of breast cancer. In the first 12 months after diagnosis, the costs for radiation therapy were highest for patients with

Table 4 Average per-Patient Allowed Costs, by Stage

Disease stage	Patients, N	Average allowed cost per patient			
		0-6 months postdiagnosis, $	0-12 months postdiagnosis, $	0-18 months postdiagnosis, $	0-24 months postdiagnosis, $
0	2300	48,477	60,637	67,450	71,909
I/II	4425	61,621	82,121	91,109	97,066
III	1134	84,481	129,387	147,470	159,442
IV	501	89,463	134,682	162,086	182,655
All patients	8360	62,774	85,772	96,499	103,735

Source: Milliman's Analysis of Truven MarketScan commercial claims database for 2009-2012.

Table 5 Average 12-Month per-Patient Allowed Costs, by Stage

Disease stage	First 12 months after diagnosis		Second 12 months after diagnosis	
	Patients at index diagnosis date, N	Average per-patient costs in initial 12 months, $	Patients with index diagnosis and coverage at start of second 12 months, N	Average per-patient costs in second 12 months, $
0	2300	60,637	1917	13,523
I/II	4425	82,121	3572	18,514
III	1134	129,387	952	35,801
IV	501	134,682	346	69,464
All patients	8360	85,772	6787	22,127

Source: Milliman's Analysis of Truven MarketScan commercial claims database for 2009-2012.

stage III breast cancer ($21,133) and similar for those with stage 0, I/II, or IV disease ($14,454, $14,910, and $12,015, respectively).

Chemotherapy contributed the highest percentage to the total claim costs for stage IV disease and the lowest for stage 0. The costs for chemotherapy (infused and oral therapy combined) in the first 12 months after the diagnosis were $5170, $13,818, $34,425, and $35,686 for stages 0, I/II, III, and IV, respectively. In months 13 to 24 after diagnosis, chemotherapy costs were the largest contributor to the treatment costs in every stage of the disease.

Discussion

We performed a retrospective claims data analysis, by stage at diagnosis, to identify the per capita allowed medical costs for commercially insured women aged 18 to 64 years who were newly diagnosed with breast cancer in 2010.

Our analysis showed that breast cancer treatment costs and other medical costs increased by disease stage at diagnosis (ie, lower stages were associated with lower treatment costs). Specifically, the average allowed cost per patient in the 12 months after diagnosis increased the most (58%) between disease stage I/II ($82,121) and stage III ($129,387), and was largely driven by differences in chemotherapy costs.

Economic analyses of the costs of breast cancer treatment are heterogeneous and not easily generalizable.[16] However, data from several published US cost-of-illness studies are consistent with our finding that the overall costs are higher for patients whose breast cancer is more advanced at the time of diagnosis. Two US studies, neither of which distinguished cost by breast cancer stage at diagnosis, warrant mention.[17,18]

In the first study, the total per-capita medical costs for patients with breast cancer in the 12 months after diagnosis were approximately $60,000 (in 2008 US dollars), including patients who were identified by diagnosis code but did not necessarily have breast surgery or subsequent breast cancer treatment.[17] The incremental medical cost associated with patients with breast cancer was reportedly $40,000, mostly incurred in an outpatient setting. In our analysis, the average first-year medical costs were $85,772 per patient with breast cancer (all stages of diagnosis), with $47,452 directly attributable to treatment services for breast cancer.[17]

The second study, in which costs were analyzed for a managed care population, demonstrated that breast cancer therapy was associated with a per-patient monthly cost of $2896 (in 2004 US dollars), with hospitalization responsible for most of the cost.[18] The projected annual medical costs in that study were $12,828 higher for women with breast cancer than for women without breast cancer.[18] The patients were actively treated, but the coding algorithm differed from ours, and new treatments have since become available.

Moreover, unlike our study, the costs in the period immediately after a newly diagnosed breast cancer were not examined. Although we found that the average cost of breast cancer treatment services in the first year after diagnosis was $47,452, the cost decreased significantly (to $5635) by the beginning of the second year after diagnosis.[18]

Although we found that the average cost of breast cancer treatment services in the first year after diagnosis was $47,452, the cost decreased significantly (to $5635) by the beginning of the second year after diagnosis.

In several recent European and Canadian studies, the cost of breast cancer treatment was analyzed by disease stage at diagnosis. For example, in a French study, researchers used claims data to analyze the cost trajectory of care for 57,552 patients with breast cancer.[10] Patients with the lowest costs (6957 Euros) were those with in situ carcinoma, and patients with the highest costs (26,139 Euros) were those hospitalized for palliative care.[10]

A retrospective incidence-based cost-of-illness analysis among 20,439 women with breast cancer in the Flanders region of Belgium showed that the average per-patient cost during a 6-year period was higher for those with more advanced stages of breast cancer, ranging from 19,827 Euros for patients with stage I disease to 35,201 Euros for patients with stage IV disease.[19]

In an analysis of patient-level routine health system data for 223 patients with breast cancer in the United Kingdom, clinical disease stage was found to be the most important predictor of the cost of hospital-based care, most of which was incurred during the first 6 months after diagnosis.[11]

An analysis of publicly funded healthcare costs for 39,655 Canadian patients with breast cancer showed that, during the first 2 years after diagnosis, the mean cost increased by stage (stage I, $29,938; II, $46,893; III, $65,369; IV, $66,627), and the main cost drivers were cancer clinic visits, physician billings, and hospitalizations.[12]

Limitations

This study has several limitations. First, we lacked sufficient clinical data to confirm the stage of breast cancer at diagnosis. Specifically, the algorithm we used to estimate disease stage at diagnosis provides an approximation based on claims representing treatment at various stages of breast cancer, as recommended by the NCCN guidelines. Therefore, cases grouped together based on treatment patterns and diagnosis codes may not have represented true clinical stages.

Second, using the index diagnosis date (as determined by our diagnosis coding algorithm) as the start of cancer treatment costs may have produced different results than if we had chosen a different starting point in the diagnosis and treatment course for breast cancer. However, we performed a sensitivity analysis using the biopsy date (when available) as the index date and examined the subsequent 24 months for each cohort. The cost pattern for each cohort was similar to that resulting from use of the diagnosis date as the index date.

In addition, our study population included women aged 18 through 64 years. Because it is possible that younger women (ie, those aged 18-39 years) may represent more complex or costly cases, we performed a sensitivity analysis in which the age range was limited to 40 to 64 years (ie, those eligible for routine screening within the commercially insured population); this showed that the cost trend observed (ie, increasing cost by disease stage) for the older patients did not differ from that of the overall study population.

Furthermore, our analysis of claims data represents a national average experience of a cross-section of patients with commercial insurance between 2010 and 2012. We acknowledge that regional variability may exist in terms of treatment costs, incidence of breast cancer, and distribution of stage at diagnosis, which could affect the results. Over time, revised guidelines for screening, diagnosis, and treatment, as well as the adoption of new technologies, could influence the results. In addition, our results may not reflect the cost experience of treating other populations of insured women with breast cancer, such as those with Medicare or Medicaid coverage.

Finally, the look-back period cannot capture breast cancer cases that might have been diagnosed at an earlier stage of the disease (before the 12-month look-back period). As a result, it is likely that not all metastatic cases were newly diagnosed breast cancer. Some metastatic cases might have been recurrent breast cancer that had been diagnosed and treated at an earlier disease stage (ie, >12 months before the index date in this study); this

might have resulted in an overestimation of de novo stage IV cases in our study.

Conclusion

Our analysis of the current costs of treating breast cancer in a commercially insured population shows that incremental costs are significantly higher for advanced-stage disease than for early-stage disease. Our disease stage–specific cost findings are consistent with the results of other studies, including those conducted in the US Medicare population and in populations with publicly funded insurance in other developed countries.

Our findings strongly suggest that the costs of treating breast cancer could be meaningfully reduced by earlier diagnosis and treatment.

Relevant data on medical costs, stratified by disease stage, may facilitate initiatives aimed at strengthening cancer management. Earlier detection of breast cancer by routine screening leads not only to reduced morbidity and mortality but also to lower costs for cancer treatment. Our findings strongly suggest that the costs of treating breast cancer could be meaningfully reduced by earlier diagnosis and treatment. Knowledge of the relevant stage-specific cost data provides support for strengthening programs such as breast cancer screening that are designed to shift breast cancer diagnosis to earlier stages. ■

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STAKEHOLDER PERSPECTIVE

An Ounce of Prevention Is Not a Choice a Patient Gets to Make for Late-Stage Cancer

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PAYERS: Understanding breast cancer treatment is an exercise is restraint. In their article, Blumen and colleagues attempt to show that an early diagnosis of breast cancer is associated with reduced costs to the healthcare system than a late-stage diagnosis.[1] Late-stage diagnosis, when surgery often is not possible, presumably leaves chemotherapy infusions as the patient's only option, often done with novel and expensive targeted therapies. On this basis, all stakeholders, and especially payers, should support prevention strategies, and in the case of breast cancer, mammograms, and promote early diagnosis as much as possible. There remains significant disagreement among experts about the value of mammograms for younger women. The article by Blumen and colleagues should contribute to this debate, at least from the perspective of the associated costs.

At some point, society will likely determine that we cannot afford all the new treatment options that are being developed and entering the marketplace.

But this argument is based more on a correlation than on a cause and effect. The high-cost treatment of late-stage breast cancer, which is typically associated with the use of new oncolytic drugs entering the market, is not a choice that can be contrasted with early diagnosis of the disease. Patients do not travel in time, and they cannot trade in a diagnosis of stage IV cancer for an earlier-stage diagnosis. Understanding the place and value of high-cost oncolytic drugs is the essence of an intellectual exercise in restraint.

PHYSICIANS: As the American Society of Clinical Oncology pioneers its initiative on the value framework for oncology physicians to take cost into account when choosing specific therapeutic options,[2] we are increasingly faced with a lack of appropriate evidence for the direct and indirect treatment costs, as well as the outcomes of the specific therapeutic choices that physicians make. A particular intervention may be more costly, but its impact on the patient's outcome may be justified through clinical trial data yet are difficult to measure when compared with other options not included in those trials.

The appropriate examination of a treatment's cost is to survey the options that are valid for that individual patient in the context of the outcomes that a specific treatment can deliver. There are legitimate questions about the prices of some drugs, and we increasingly need to justify those prices with real-world evidence and outcomes.

PATIENTS: The article by Blumen and colleagues is a helpful addition to the literature in terms of what it covers,[1] and timely support for continued prevention and diagnosis of cancer is key, as we debate the recommendations for when to start mammograms, and at what frequency they should be performed. The challenge is to avoid making too far of a leap by interpreting the high costs associated with late-stage treatments as an indictment. Patients with late-stage disease are difficult to treat because of the nature of the disease, their prognosis is worse, and their treatment costs are high.

POLICYMAKERS: Taking a population health perspective to cancer funding is the least helpful thing for an individual patient's health at diagnosis. At some point, society will likely determine that we cannot afford all the new treatment options that are being developed and entering the marketplace.

Blumen and colleagues suggest that if we were to maximize prevention strategies and apply treatment at an early stage of cancer, we would have more money for the treatment of patients with late-stage disease.[1] That is a helpful way to think about it, provided we do not use this limited evidence to justify complaints about cancer drug pricing. ■

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