

Patterns of Care in Early-Stage Breast Cancer Survivors in the First Year After Cessation of Active Treatment

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A B S T R A C T

Purpose

Patterns of health care use have not been well described for breast cancer survivors. The purpose of this study was to describe the health service use in a survivor cohort.

Patients and Methods

Women with stage I or II breast cancer were recruited (n = 558) after primary treatment for a multicenter, randomized trial of psychoeducational interventions for facilitating transition to survivorship; 418 women completed the study. Participants completed calendar diaries detailing health care use for 1 year after treatment. Services were coded using Current Procedural Terminology–Fourth Edition codes; costs were estimated using year 2000 Medicare reimbursements.

Results

Health care use diary data were available for 391 women (70% of the sample). On average, these survivors reported 30 episodes of health service use in the year after treatment. Total annual costs of care averaged more than \$1,800 per survivor; medical office visits were the major component of costs. Type of cancer treatment, depression, and physical function and comorbid illness were independent predictors of the costs of services. There were geographic variations in initial local treatment patterns and in post-treatment costs. Notably, all women should have received surveillance mammography in the time period, but only 61.9% did so; the odds of mammogram receipt were higher for women who had a lumpectomy (v mastectomy) and women who were white (v nonwhite).

Conclusion

Use of health services is frequent and intensive in the first year after treatment for breast cancer. Despite frequent contact with the health care system, there is room for improvement in providing guideline-suggested surveillance mammography for survivors.

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INTRODUCTION

Breast cancer is the most commonly diagnosed non-skin cancer in women, with more than 200,000 new patients diagnosed in 2004.¹ When diagnosed in early stages and even in women with disease involvement of the local lymph nodes, breast cancer has a high 5-year survival rate. Because more than 90% of detected breast cancers are in the local or regional stages,² many women are survivors of breast cancer. As the population ages and early diagnosis and improved therapies continue to improve survival rates, the absolute number of breast cancer survivors will increase even further.

Despite the large number of women in the United States who have been diagnosed with, been treated for, and survived breast cancer, the patterns of health care use in this population have not been well studied. Women with breast cancer do have higher

health care costs than age-matched controls.^{3,4} Although the greatest increase in costs tends to be around the time of diagnosis and treatment, ongoing costs of care also tend to be higher than the costs for age-matched women without breast cancer. However, the specific patterns of care for women surviving breast cancer have not been well described.

A necessary element of understanding resource use in survivors is to understand the specific components of the care received. Breast cancer surveillance is an important component of resource use in breast cancer survivors. The goals of post-treatment surveillance include detection of local recurrence or second primary cancer, reassurance that the cancer remains in remission, and identification of early and late adverse effects of the primary treatment.⁵ A large randomized trial of surveillance after early breast cancer⁶ demonstrated a lack of benefit for routine surveillance testing other than interval history and

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physical examination plus annual mammography. Currently, the American Society of Clinical Oncology (ASCO) recommends physical examination and mammography surveillance for breast cancer survivors but recommends against other laboratory or radiology evaluation unless symptoms or physical signs suggest a directed evaluation.⁷ Current research would suggest that not all survivors receive recommended mammography surveillance.^{5,8,9}

In a clinical trial aimed at facilitating the transition from treatment to survivorship in women with recently treated breast cancer,¹⁰ we had the opportunity to track the health care use of the women in the cohort for a year after treatment as part of a plan to evaluate the cost effectiveness of the interventions used in the clinical trial. We had several goals for the health care use substudy presented in this report. The first goal was to describe patterns of care and health care use in women who were recently diagnosed and treated for cancer, which is an important and growing population. The second goal was to understand the determinants of the observed use. Finally, we evaluated determinants of surveillance mammography during the period of observation.

PATIENTS AND METHODS

Participants and Measures

Women in this study were participants of a multicenter, randomized trial of psychoeducational interventions for facilitating transition to survivorship for women recently diagnosed with and treated for breast cancer. Participants were recruited from the following three sites: Los Angeles, California; Washington, DC; and Lawrence/Kansas City, Kansas. The study is described in detail elsewhere.^{10,11} Briefly, women were eligible for registration for the study if they had definitive primary surgery within 30 days of the eligibility assessment and had stage I or II invasive breast cancer and were not planning to have neoadjuvant chemotherapy or high-dose chemotherapy with stem-cell transplantation. After completion of primary treatment (radiation therapy or chemotherapy), participants were enrolled and consented to the psychosocial intervention trial.^{10,11} Participants were included in the economic substudy if they had enrolled onto the intervention trial and had continued to participate in the full 12-month follow-up program after random assignment (whether or not they completed their assigned intervention) because patients who dropped out had incomplete use information. Women were excluded from the clinical trial if they had noninvasive breast cancer; metastatic disease at the time of diagnosis; inflammatory breast cancer; planned use of neoadjuvant chemotherapy; planned use of high-dose chemotherapy with bone marrow or stem-cell rescue; protracted reconstructive surgery or complications related to surgery; severe physical, cognitive, or psychiatric illness; or an inability to read and write in English. Informed consent was obtained for all participants.

Eligible participants completed a baseline survey within 8 weeks after completion of their primary treatment. This survey included demographic information, information about cancer treatment, a brief survey on comorbid illness, and a series of health and psychological status surveys (see Ganz et al¹⁰ for details). Starting at the baseline and continuing for 12 months, participants were asked to fill out a calendar of health services that they used. On this calendar, participants were requested to mark any day they had significant contacts with a health care provider. In a space below the calendar, they were asked to identify the type of contact (office visit, emergency department visit, phone call, hospitalization, or other), the provider, and the reason for the visit. We did not ask the participants to make judgments about the reason for the specific tests (eg, for routine surveillance or for symptom evaluation). In preliminary work for this study, one of the study investigators (A.L.S.) found more than 88% agreement between these self-reports of use and medical record data in breast cancer patients.¹² Participants were mailed calendars every 3 months and asked to return them when completed. Participants who did not return calendars were reminded by mail and by phone to return them.

Coding and Costs of Services

All episodes of use were coded using Current Procedural Terminology–Fourth Edition codes.¹³ Coding for a specific episode was reviewed by two independent coders (W.F.L. and J.C.). Any disagreements were discussed and resolved by consensus. When episodes of use were not described specifically enough to assign a unique Current Procedural Terminology–Fourth Edition code, a standardized code was used (eg, a routine office visit to a medical provider was coded as 99213 or an intermediate-level office visit for an established patient, unless data were available to suggest another code). Coders were blinded to the study treatment status of the participants.

Data were also categorized to examine specific types of services. To examine use of potential surveillance services, we tracked all mammograms (unilateral or bilateral). We also tracked bone scans, computed tomography of the chest and abdomen, and chest x-rays. We did not examine potential blood tests that might be considered surveillance testing because these tests were usually not reported with sufficient specificity (eg, it was common to report getting a blood test). Office visit data were categorized by whether the provider was primarily a medical provider (eg, primary care doctor, surgeon, or oncologist) or a provider of psychological or psychiatric services (eg, psychiatrist, psychologist, social worker, or counselor).

Reports of services were excluded from coding and analysis if they were not specifically dealing with a health care provider (eg, a trip to an informational conference on breast cancer), if they were part of the research study or another research study (eg, traveling to a hospital for a study interview for another study), or if there was insufficient information on the nature of the service to code it (eg, no information was given other than an unspecified service happened or the only information on the service was “test”). Only 5.6% of reported services were excluded for these reasons.

Data were analyzed for specific services, for specific categories of services, and for overall use. The estimated cost of care was used as a proxy for overall health care resource use, with the cost of a service representing the intensity of use of that service; this is a standard approach used in cost and cost-effectiveness analyses.¹⁴ Costs of outpatient and laboratory services were calculated using the average year 2000 Medicare reimbursement for services from public use data files. Costs for surgical procedures (eg, reconstruction surgery) were determined by the average Medicare reimbursement for the procedure; costs for hospitalizations for general care for a specific condition (eg, pneumonia) were estimated using an average daily cost of hospitalization for women in the study age range, as determined by the 2000 Health Cost and Utilization Project,¹⁵ multiplied by the number of days the participant was hospitalized. Costs of phone calls to providers, which represent use but are not reimbursed by Medicare (for brief, routine calls), were estimated based on 5 minutes of a provider's time multiplied by an average hourly wage as estimated in prior work.¹⁶ All costs are in year 2000 dollars.

Statistical Analysis

Univariate analyses were performed using one-way analysis of variance (ANOVA) to determine variations in service use by geographic region (Los Angeles, Kansas, and Washington, DC). Similarly, demographic factors were compared across regions and were formally tested using ANOVA for continuous variables and χ^2 analysis for categorical variables. Fisher's exact tests were used for categorical variables with cell sizes of less than 5. Cost of care was evaluated across study site for general categories of use (including office visits, psychological service visits, telephone calls, emergency department visits, hospitalizations, and laboratory/radiology services) using ANOVA testing. Multivariate analysis was performed using linear regression to predict overall costs of care. Covariates in the multivariate analyses included study site, age, race, household income level, educational status, marital status, number of comorbid conditions, type of surgical treatment received for breast cancer, whether axillary node dissection was performed, whether radiation therapy was used for breast cancer treatment, and whether chemotherapy was used. We used a natural log transformation of costs for multivariate analysis to generate a normal distribution of the outcomes from the skewed, untransformed cost distribution.

This study did not have cancer-free controls with which to evaluate differences in use for women with breast cancer versus women without breast cancer. To allow for some comparison, we used the 2000 Medical Expenditure Panel Survey to evaluate comparable services for women in the

Patterns of Care in Breast Cancer Survivors

Table 1. Demographic Characteristics of Early-Stage Breast Cancer Survivors by Geographic Site*

Characteristic	Overall Sample		Los Angeles (n = 226)		Kansas (n = 79)		Washington, DC (n = 86)		P
	No. of Patients	%	No. of Patients	%	No. of Patients	%	No. of Patients	%	
Age, years									
Mean	58.2		58.3		57.8		58.4		.92
Standard deviation	11.2		11.5		11.7		9.9		
Range	27-89		27-89		34-81		33-84		
Race									
White	338	86.7	180	79.7	77	98.7	81	94.2	< .0001
Black	23	5.9	20	8.9	1	1.3	2	2.3	
Other	29	7.4	26	11.5	0	0	3	3.5	
Marital status									
Married/committed	266	68.0	139	61.5	66	83.5	61	70.9	.0012
Unmarried	125	32.0	87	38.5	13	16.5	25	29.1	
Income									
≤ \$30,000	60	15.4	40	17.7	16	20.3	4	4.7	.054
\$30,001-\$60,000	104	26.6	62	27.4	21	26.6	21	24.4	
\$60,001-\$100,000	109	27.9	61	27.0	21	26.6	27	31.4	
> \$100,000	118	30.2	63	27.9	21	26.6	34	39.5	
Education									
≤ High school	50	12.8	25	11.1	15	19.0	10	11.6	.026
Some college/AA	96	24.6	68	30.1	16	20.3	12	14.0	
College graduate	104	26.6	55	24.3	24	30.4	25	29.1	
Postcollege	141	36.1	78	34.5	24	30.4	39	45.4	
Employment									
Employed	212	54.2	122	54.0	41	51.9	49	57.0	.80
Not working	179	45.8	104	46.0	38	48.1	37	43.0	
Comorbidity									
No conditions	87	22.3	53	23.4	20	25.3	14	16.3	.30
≥ 1 condition	304	77.8	173	76.6	59	74.7	72	83.7	
Treatment†									
BCS	22	5.6	16	7.1	3	3.8	3	3.5	.0007
BCS + RT	243	62.2	140	62.0	37	46.8	66	76.7	
MST	126	32.2	70	31.0	39	49.4	17	13.5	
Reconstruction, yes	57	14.6	32	14.2	18	22.8	7	8.1	.028
Adjuvant therapy									
Tamoxifen	222	56.8	124	54.9	49	62.0	49	57.0	.54
Chemotherapy	184	47.1	111	49.1	36	45.6	37	43.0	.60
Both	88	22.5	51	22.6	17	21.5	20	23.3	.96
Neither	73	20.2	42	18.6	11	13.9	20	15.1	.31
Post-treatment surveillance mammogram									
Yes	242	61.9	133	58.9	43	54.4	66	76.7	.005
No	149	38.1	93	41.2	36	45.6	20	23.3	

Abbreviations: BCS, lumpectomy, breast-conserving surgery; RT, radiation therapy; MST, mastectomy; AA, Associate in Arts.

*All women were diagnosed with stage I or II breast cancer. There were 396 women in the sample, but five had missing data on treatment and were excluded from subsequent analyses.

†Fisher's exact P value is reported for this comparison because more than 20% of cell sizes had more than five observations.

general population.¹⁷ The most directly comparable services between this survey and the study cohort were visits to providers. Thus, we compared visits to various provider types for women in the general population in the same age range as the participants in our study cohort with visits by our sample of survivors. Analysis of the provider visits data for the Medical Expenditure Panel Survey included incorporation of sampling weights and adjustment of variances for the complex sample design of the survey.

RESULTS

Of 558 women who participated in the randomized trial, 418 women completed the study.¹¹ Mean follow-up time for women

completing the study was 11.1 months (standard deviation [SD], 1.3 years). The 418 women who completed follow-up differed from the 141 women who did not in terms of age (58.2 v 53.6, respectively), employment status (47% v 35% unemployed, respectively), and current tamoxifen use (58% v 45%, respectively), but the two groups were similar in race, income, education, marital status, and use of chemotherapy and radiation.^{10,11} For the present analysis, an additional 22 women were excluded for not returning at least half of their calendars, and five women were excluded for missing data on treatment, resulting in a final study sample for the economic health care use substudy of 391 women (70% of the original cohort). There were no differences between the final

economic study cohort and the 27 women who were excluded for this analysis.

There were some differences in the sociodemographic characteristics of the economic use cohort by region; women from Washington, DC, had significantly higher incomes than other women, and there were more nonwhite women enrolled from Los Angeles than from the other areas (Table 1). There were geographic variations in local, but not adjuvant, treatment patterns. For example, women residing in Kansas had higher rates of mastectomy (49.4%) than women in Los Angeles (31%); and women in Washington, DC, had the lowest mastectomy rates (13.5%; $P = .0007$). Although reconstruction only occurred in approximately half of women having mastectomy (57 of 126 women), rates of reconstruction were higher in Kansas, which was the

area with the highest mastectomy rates. Radiation was only omitted after lumpectomy in 9% of the total sample, but omission of radiation did not vary by region.

Use of services in the 1 year after treatment included an average of 14.4 visits to medical providers (typically primary care physicians or oncologists; Table 2). Women also reported an average of 1.7 to 2.5 visits for psychological services, either through psychiatrists, psychologists, or social workers. However, these rates represent frequent visits for a small percentage of women; overall, only 18.1% of women had a psychological visit. Physical and occupational therapy visits were also common, with an average of 2.9 visits per woman overall. Interestingly, acupuncture was relatively commonly reported. To put the office visits listed in Table 2 in perspective, women in the general

Table 2. Use of Health Services Among Early-Stage Breast Cancer Survivors in the 1 Year After Completion of Active Treatment by Selected Characteristics (N = 391)

Characteristic	No. of Office Visits										No. of Nonoffice Services							
	Type of Visit										Type of Service							
	All*		Medical		Psych		OT/PT		Accup		Hospital		ER		Mam		Phone/E-mail	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age, years																		
< 50	31	21	13	7	4	12	3	8	0.8	4	0.9	2	0.1	0.4	0.8	0.9	2	5
50-64	29	18	14	9	2	6	3	7	0.8	4	0.5	1	0.2	0.6	1.0	1	2	4
65+	30	22	16	12	0.6	3	4	13	0.3	2	0.7	2	0.1	0.4	1.0	3	1.0	3
Race																		
White	30	20	15	10	2	8	3	9	0.7	4	0.6	2	0.1	0.5	0.6	0.5	2	4
Black	24	19	12	7	0	0	3	14	0.1	0.6	0.3	0.7	0	0	0.5	5	1.4	5
Other	27	14	15	9	0.6	2	3	6	0.03	0.2	0.6	1.2	0.2	0.6	0.5	0.5	2.3	4
Married																		
Yes	29	18	14	9	2	6	3	8	0.8	4	0.6	1.6	0.1	0.4	0.6	0.5	1.8	4
No	31	23	17	11	2	10	3	11	0.3	2	0.6	1.5	0.2	0.6	0.6	0.5	2.0	4
Employed																		
Yes	29	18	14	10	2.4	9	2.3	5	0.9	4	0.6	1.3	0.2	0.6	0.6	0.6	1.9	4
No	31	22	15	10	1.5	5	4.0	12	0.4	3	0.7	2	0.1	0.4	0.6	0.5	1.8	4
Comorbidity																		
None	24	13	11	6	1.5	5	2.2	5	0.2	1.3	0.5	1.2	0.05	0.2	0.6	0.5	1.6	4
≥ 1	31	21	15	11	2.1	8	3.3	10	0.8	4	0.6	1.7	0.2	0.5	0.6	0.5	1.9	4
Treatment																		
BCS	29	31	12	8	1.2	5	6.2	19	0.5	2.3	0.41	0.9	0.04	0.2	0.68	0.5	1.5	4
BCS + RT	28	18	14	9	2.3	8	2.6	7	0.6	3.3	0.3	0.9	0.11	0.5	0.73	0.4	1.5	4
MST	33	21	16	11	1.6	5	3.5	8	0.75	5	1.3	2.4	0.19	0.5	0.39	0.5	2.6	5
Reconstruction																		
Yes	36	24	18	11	1.5	6	4.5	10	1.3	7	1.6	2	0.2	0.5	0.35	0.5	3.2	6
No	28	19	14	10	2.1	8	2.9	9	0.5	3	0.5	1.5	0.1	0.5	0.66	0.5	1.6	4
Adjuvant therapy																		
Chemotherapy	28	16	14	9	1.6	5	2.6	6	0.67	3	0.76	1.8	0.15	0.5	0.61	0.5	1.8	4
Tamoxifen	29	20	15	10	2.0	7	3.0	9	0.73	4	0.56	1.6	0.14	0.5	0.62	0.5	1.8	4
Both	29	17	14	10	1.9	7	2.6	6	1.1	5	0.67	1.6	0.17	0.5	0.63	0.5	1.8	4
Neither	33	24	16	11	2.9	12	3.9	12	0.96	6	0.52	1.1	0.12	0.4	0.64	0.5	1.8	4
Geographic region																		
Washington, DC	33	24	16	11	3.9	12	2.8	11	1.4	7	0.49	1.2	0.20	0.6	0.77	0.4	2.0	4
Los Angeles	29	20	15	10	1.7	6	3.2	9	0.54	3	0.65	1.8	0.14	0.5	0.59	0.5	1.9	4
Kansas	26	15	12	8	0.8	3	3.0	7	0.14	1	0.68	1.5	0.06	0.3	0.54	0.5	1.4	4
Total	29.5	19.9	14.4	9.9	2.0	7.4	3.1	8.8	0.66	3.7	0.62	1.6	0.14	0.49	0.62	0.49	1.8	4

NOTE. All women were diagnosed with stage I or II breast cancer. Bolded values represent statistically significant differences in mean values of row categories for a given column ($P < .05$).

Abbreviations: Psych, psychological services; OT, occupational therapy; PT, physical therapy; Accup, acupuncture; ER, emergency room; Mam, mammography; SD, standard deviation; BCS, breast-conserving surgery; RT, radiation therapy; MST, mastectomy.

*Total visits may be higher than the sum of average visits across the subcategories of services since some care fell outside of these categories or could not be easily classified into a group.

population in the same age range as the study cohort had, on average, 4.6 office visits to a physician (SD, 5.3 visits); 0.2 visits to a physical therapist, occupational therapist, or chiropractor (SD, 2.0 visits); and 0.9 visits to another provider (SD, 4.8 visits).¹⁷

There were a few notable differences in service use by participant characteristics (Table 2). For example, women 65 years and older reported significantly fewer visits for psychological services than women less than age 50 years, and black women reported significantly fewer overall medical and psychological services than white women. There were minor geographic differences in reported use of care, with women in Kansas reporting fewer psychological services than women in Los Angeles or Washington, DC.

Of note, only 61.9% of the cohort received at least one mammogram in the time after entry onto the study. The key predictors of receipt of a surveillance mammogram in the 12 months after the end of active treatment were having had a lumpectomy compared with a mastectomy and being white versus nonwhite (Table 3).

Women reported other tests that are sometimes used for surveillance although not currently recommended by ASCO for surveillance in women without signs or symptoms. The proportion of women receiving chest and abdominal computed tomography scanning or chest x-rays was reasonably small (3.6%). Approximately 9% of women received bone scans, but as with all of the tests, we were unable to assess whether the bone scan was performed for routine surveillance or for evaluation of symptoms such as pain. More than 8% of women reported having pelvic ultrasounds, but this rate did not vary by whether women were on tamoxifen or not (a cause of the potential adverse effects of dysfunctional uterine bleeding and endometrial cancer).

Overall costs of care (Table 4) averaged more than \$1,800 per woman, with the highest costs among women receiving mastectomy and adjuvant chemotherapy (\$2,797). Outpatient office visits accounted for slightly more than half of the overall costs of services reported in the 1 year after completion of primary treatment.

The key independent predictor of log costs was the presence or absence of comorbid illnesses (Table 5). In addition, depression and overall physical functioning were significant predictors of log costs

($P = .03$ and $P = .01$, respectively). Of note, whites were independently more likely to have higher costs (and use) than nonwhites. Regional differences remained significant, with costs higher in Washington, DC, and lower in Kansas compared with Los Angeles.

DISCUSSION

The increasing incidence of breast cancer in the United States and the declining mortality rates and the aging of the US population are contributing to growing numbers of women living with breast cancer, with an estimated 815 of every 100,000 women alive today being breast cancer survivors.² Patterns of care of this large and growing population can have a substantial impact on health care use in the United States. In this study, we have examined patterns of health care use in a sample of breast cancer survivors enrolled onto a multisite behavioral trial, all of whom had completed primary breast cancer treatment at study entry. Health care use in the following year was surprisingly high, considering that most cancer-directed therapy had been completed.

Other studies in the United States have found that the cost of initial diagnosis and treatment of women with breast cancer is high^{3,4,18} and that, even after initial treatment, women with breast cancer continue to have significantly higher health care use than women without cancer.^{3,4} Similar results have been noted for long-term breast cancer survivors in other countries as well, even after considering comorbid illnesses.¹⁹ Women in our cohort had much higher rates of medical office visits than average women in the general population (14.4 v 4.6 visits, respectively).¹⁷ These office visits also comprised the main component of overall costs per woman in this cohort. These excess office visits among breast cancer survivors suggest the possibility of follow-up with multiple oncology specialists as well as primary care physicians. If true, this could be a potential target for interventions to better coordinate post-treatment care and obtain cost efficiencies.

In one recent case series of breast cancer survivors aged 21 to 65 years old with stage 0 to IV disease who had completed treatment 2 or more years previously, Oleske et al²⁰ noted that women reported an average of 14 provider visits each year. In addition, 25% of survivors were hospitalized for any reason compared with national rates for the same age group of 12%.²¹ This finding suggests that the elevated health care use we observed persists beyond the initial year after treatment. Similar to our finding that higher depression scores were a predictor of overall health care costs, in the case series by Oleske et al,²⁰ hospitalizations were more common among survivors who were depressed or had treatment-related side effects, suggesting modifiable targets for future interventions to reduce unmet needs.^{20,22}

Compared with women receiving a mastectomy, women receiving lumpectomy had lower costs of care, controlling for covariates in the 1-year post-treatment completion, including use of reconstruction. These costs represent both breast cancer- and nonbreast cancer-related care. This finding is similar to the finding of Polsky et al,¹⁸ who calculated the costs after treatment in a cohort of women aged 67 years and older with stage I and II disease. Reconstruction was only used by half of the women who underwent mastectomy, or 14.5% of the overall sample, so these costs were not a significant determinate of overall costs for this group of survivors. However, the increased costs

Table 3. Adjusted Odds of Receipt of a Surveillance Mammography (v no mammogram) Among Breast Cancer Survivors With Early-Stage Disease Within the 12 Months After Completion of Active Treatment (n = 390)*†

Variable	Odds Ratio	95% CI	P
Geographic region			
Washington, DC v Los Angeles, CA	1.83	1.02 to 3.41	.123
Kansas v Los Angeles, CA	0.99	0.56 to 1.76	
Age, years	0.999	0.978 to 1.02	.92
Race, white v other	2.03	1.06 to 3.90	.034
Local treatment			
Lumpectomy + RT v MST	3.92	2.21 to 6.98	< .0001
Lumpectomy v MST	2.95	1.04 to 8.31	
Reconstruction, yes v no	0.829	0.391 to 1.76	.625
Comorbidity, ≥ 1 condition v none	1.30	0.754 to 2.23	.348
C statistic	0.716		

Abbreviations: RT, radiation therapy; MST, mastectomy.

*One patient was not included in model because of missing information on race.

†All women were diagnosed with stage I or II breast cancer.

Table 4. Average Costs of Health Care Use for Early-Stage Breast Cancer Survivors in 1 Year of Post-Treatment Follow-Up by Type of Local Treatment (N = 391)*

Service Category	Overall (\$)	BCS + RT (n = 243)		BCS Alone (n = 22)		MST (n = 126)	
		Chemo (\$)	No Chemo (\$)	Chemo (\$)	No Chemo (\$)	Chemo (\$)	No Chemo (\$)
Office visit							
Mean	984	829	1,008	815	1,039	1,077	1,068
SD	848	453	1,403	679	917	722	984
Median	754.1	827.9	548	627	796.9	996	707
IQ range	424-1,264	518-1,037	141-881	424-1,043	427-1,292	471-1,508	471-1,224
Telephone							
Mean	14	1.54	19.9	11.4	11.3	19.5	19.9
SD	31	3.2	37.7	29.4	26.1	37.8	36.8
Median	0	0	7.7	0	0	0	0
IQ range	0-8	0-0	0-19.2	0-8	0-8	0-23	0-23
ER visit							
Mean	14	0	8.2	11.4	11.9	22.5	14.3
SD	50	0	28.3	46	51.9	65	40
Median	0	0	0	0	0	0	0
IQ range	0-0	0-0	0-0	0-0	0-0	0-0	0-0
Hospitalization†							
Mean	418	129	10.3	143	244	1,129	605
SD	2,313	306	35.6	802	984	3,763	3,949
Median	0	0	0	0	0	0	0
IQ range	0-0	0-157	0-0	0-0	0-0	0-0	0-0
Reconstruction							
Mean	992	979	1,108	1,031	995	967.8	919
SD	269	286	216	257	269	276	280
Median	1,201	1,201	1,201	1,201	1,201	1,201	646
IQ range	646-1,201	646-1,201	1,201-1,201	646-1,201	646-1,201	646-1,201	646-1,201
Lab/radiology							
Mean	226	289	240.2	241	220	253.6	161
SD	253	393	224	261	201	323	228
Median	169	180.8	194.8	168.9	168.9	104.2	84.4
IQ range	69-314	0-315	42-377	84.4-338	84-305	20-389	0-222
Total cost							
Mean	1,841	1,253	1,291	1,343	1,801	2,797	1,872
SD	3,115	815	1,507	1,711	2,790	4,312	4,249
Median	1,074	1,103.8	882.1	975.8	1,060.4	1,298	1,068
IQ range	600-1,795	823-1,665	341-1,258	600-1,517	651-1,946	722-2,123	549-1,748

NOTE. All women were diagnosed with stage I or II breast cancer. Bolded values represent significantly different mean costs by chemotherapy use (yes v no) within each treatment group (BCS, BCS+RT, and MST).

Abbreviations: BCS, breast-conserving surgery; RT, radiation therapy; MST, mastectomy; Chemo, chemotherapy; SD, standard deviation; IQ, interquartile (25th to 75th percentile); ER, emergency room; Lab, laboratory.

*Costs are presented as cost per woman.

†Excludes costs of hospitalizations for late or delayed breast reconstruction.

of care for the mastectomy patients may reflect other medical characteristics of this group (eg, number of positive nodes, hormone receptor status, or human epidermal growth factor receptor 2 [HER2] status) that were not accounted for in these analyses.

We also noted some regional differences in types of local breast cancer treatment received by our study sample as well as post-treatment health care costs. This effect persisted after considering other factors and mirrors previously reported geographic variations in initial treatment of breast cancer and reimbursement for services.^{23,24} However, the largest predictor of post-treatment health care use and costs was pre-existing comorbid illness. This result suggests that breast cancer acts as another chronic disease and perhaps interacts with other illnesses in producing the observed patterns of use.^{25,26} Unfortunately, we do not have sufficiently detailed data on all types and severity of the other chronic diseases to test potential interactions between treatment

and specific comorbidities and health care costs. This will be an important area for future research on the growing population of breast cancer survivors.

On the basis of the GIVIO study⁶ and current ASCO⁷ and National Comprehensive Cancer Network²⁷ recommendations, we would expect to see 100% of women receiving surveillance mammograms in the 1 year after completion of treatment. However, we found that 38% of women did not receive a mammogram within the timeframe of the study. This is surprising given the large number of health care provider visits that were reported. Mammography use in the year after treatment was significantly lower in nonwhite women (v white women) and women who had received a mastectomy (v lumpectomy). It is unlikely that the latter finding would be confounded by bilateral mastectomy. Rather, it is more likely that women with a conserved breast have more motivation for mammography

Patterns of Care in Breast Cancer Survivors

Table 5. Generalized Linear Model* Predicting Health Service Use Intensity (log costs†) for Early-Stage Breast Cancer Survivors in 1 Year of Post-Treatment Follow-Up (n = 389)‡

Covariate	β Coefficient	95% CI	P
Time since last surgery, days	0.0011	-0.0009 to 0.0031	.30
Geographic region			
Washington, DC v Los Angeles, CA	0.164	-0.0845 to 0.4126	.033
Kansas v Los Angeles, CA	-0.251	-0.5226 to 0.0208	
Age, years	-0.0005	-0.0111 to 0.0101	.93
Race, white v other	0.305	0.0069 to 0.6028	.045
Education			
Postcollege v \leq high school	0.335	0.0024 to 0.6675	.21
College graduate v \leq high school	0.192	-0.1482 to 0.5324	
Some college/AA v \leq high school	0.285	-0.0537 to 0.6235	
Income			
> \$100,000 v \leq \$30,000	0.079	-0.2806 to 0.4379	.47
\$60,001-\$100,000 v \leq \$30,000	0.195	-0.1425 to 0.5322	
\$30,001-\$60,000 v \leq \$30,000	0.208	-0.1116 to 0.5272	
Marital status, married v not married	0.038	-0.1907 to 0.2676	.74
Comorbidity, \geq 1 condition v none	0.296	0.0495 to 0.5421	.019
Physical function, per unit increase on SF-36 PCS	-0.013	-0.0237 to -0.0029	.012
Depression, per unit increase on CES-D	0.014	0.0017 to 0.0258	.026
Treatment			
BCS + RT v MST	-0.164	-0.4393 to 0.1110	.18
BCS v MST	-0.432	-0.9037 to 0.0405	
Reconstruction, yes v no	0.165	-0.1825 to 0.5133	.35
Adjuvant			
Chemotherapy and tamoxifen v neither	-0.126	-0.5421 to 0.2907	.89
Chemotherapy alone v neither	-0.071	-0.4743 to 0.3334	
Tamoxifen alone v neither	0.029	-0.2561 to 0.3137	

NOTE. Two women were not included because of missing data. All women were diagnosed with stage I or II breast cancer. Abbreviations: AA, Associate in Arts; SF-36, Short Form-36; PCS, physical component summary; CES-D, Center for Epidemiologic Studies Depression Scale; BCS, breast-conserving surgery; RT, radiation therapy; MST, mastectomy.
 *Generalized linear modeling is used to model log costs as an indicator of use intensity.
 †Log costs are modeled because costs are non-normally distributed.
 ‡Log likelihood (goodness of fit) = -531.95; *df* = 367.

surveillance because of the retained breast and a greater fear of recurrence, whereas women who have received mastectomy may not recognize the need for continued surveillance of the contralateral breast.

Also, on the basis of current clinical guidelines,^{7,27} tests, such as chest x-rays, bone scans, and computed tomography scans, are not indicated for routine surveillance in the absence of findings suggesting a possible recurrence. Although only a small percentage of women had computed tomography scans or chest x-rays, more than 9% of women had bone scans. However, we are unable to assess whether these scans represent appropriate use for evaluation of signs or symptoms or whether they represent inappropriate use for routine surveillance. Evaluation of current routine surveillance practices after diagnosis and treatment may be warranted, but this would require extensive chart review to determine whether or not such testing was prompted by clinical symptoms or was driven by a surveillance strategy. Even under the best of circumstances, the chart might reveal limited documentation of the reason for the test. In addition, some testing might have been ordered by nononcology clinicians. These providers may be less familiar with current guidelines and may have inappropriate concerns about recurrence when patients report post-treatment symptoms.¹⁰ All of this speaks to the need for oncology specialists to better communicate with patients and their primary health care providers at the end of cancer treatment regarding the need for any

follow-up testing. Current policy recommendations focused on improving the coordination of care for cancer survivors may improve this situation.²⁸

These results should be considered in the context of several limitations. First, we focus on services. We do not have information on goods, such as prescription medications or durable medical goods, travel, or patient time costs. Second, the cohort has a limited time period of follow-up. The follow-up period occurs in the first year after the primary treatment for breast cancer and is likely to be associated with more intense use of services. We are not able to comment on what happens to use in the longer term in this cohort, although other studies would suggest that use remains greater than women without cancer.^{3,4} It will be important to conduct additional research in the future to compare use and costs of breast cancer survivors of different stages and disease severity with the use and costs of controls without cancer or controls with other chronic diseases. Third, although all women in the study had early-stage disease (stage I or II), we did not have detailed data on tumor markers or other prognostic factors that may affect costs and service use. However, we were able to use chemotherapy receipt as a proxy for poorer prognosis disease. Fourth, this study was limited to three geographic regions and may not be generalizable to a population-based sample of all breast cancer survivors in the United States. The survivors in our study were also volunteers for a

clinical trial, which may also limit the generalizability of the findings. However, because volunteers for research studies tend to be healthier than the average population from which they are drawn,²⁹ this bias is likely to underestimate the overall service use and costs among breast cancer survivors.

Some women may have obtained surveillance mammograms after the last reporting period. However, a recent chart review study of cancer surveillance in a large medical group demonstrated that only 71% of the breast cancer patients sampled had received a mammogram within 18 months, which is consistent with our findings at 1 year.³⁰ We are also limited by self-report of service use, which may result in underreporting of services, including mammography. We did not have data on insurance coverage, which can affect health care use, but results were not sensitive to education or income level, which are proxies for access to care. In addition, we

were limited to self-report because of the numerous sources of care for this cohort.

Despite these limitations, we found that health care resource use is high in the year after diagnosis of and treatment for early breast cancer. The major component of this use is generated by visits to medical providers. Having a mastectomy compared with a lumpectomy, the presence of comorbid illnesses, depression, and lower physical function were all significant predictors of higher overall use as measured by the costs of care. Finally, although these survivors have frequent contact with a wide range of health care providers, there seems to be room for improvement in the recommended use of surveillance mammography. Future research should focus on ensuring that breast cancer survivors obtain recommended post-treatment surveillance and management of post-treatment symptoms that may contribute to excess use.

REFERENCES

- Jemal A, Tiwari RC, Murray T, et al: Cancer statistics, 2004. *CA Cancer J Clin* 54:8-29, 2004
- Ries LAG, Eisner MP, Kosary CL, et al: SEER Cancer Statistics Review, 1975-2000. Bethesda, MD, National Cancer Institute, 2003
- Fireman BH, Quesenberry CP, Somkin CP, et al: Cost of care for cancer in a health maintenance organization. *Health Care Financ Rev* 18:51-76, 1997
- Warren JL, Brown ML, Fay MP, et al: Costs of treatment for elderly women with early-stage breast cancer in fee-for-service settings. *J Clin Oncol* 20:307-316, 2002
- Lash TL, Silliman RA: Medical surveillance after breast cancer diagnosis. *Med Care* 39:945-955, 2001
- The GIVIO Investigators: Impact of follow-up testing on survival and health-related quality of life in breast cancer patients: A multicenter randomized controlled trial. *JAMA* 271:1587-1592, 1994
- Smith TJ, Davidson NE, Schapira DV, et al: American Society of Clinical Oncology 1998 update of recommended breast cancer surveillance guidelines. *J Clin Oncol* 17:1080-1082, 1999
- Schapira MM, McAuliffe TL, Nattinger AB: Underutilization of mammography in older breast cancer survivors. *Med Care* 38:281-289, 2000
- Andersen MR, Urban N: The use of mammography by survivors of breast cancer. *Am J Public Health* 88:1713-1714, 1998
- Ganz P, Kwan L, Stanton AL, et al: Quality of life at the end of primary treatment of breast cancer: First results from the Moving Beyond Cancer randomized trial. *J Natl Cancer Inst* 96:376-387, 2004
- Stanton AL, Ganz PA, Kwan L, et al: Outcomes from the Moving Beyond Cancer psychoeducational randomized, controlled trial with breast cancer patients. *J Clin Oncol* 23:6009-6018, 2005
- Stanton AL, Danoff-Burg S, Sworowski LA, et al: Randomized, controlled trial of written emotional expression and benefit-finding in breast cancer patients. *J Clin Oncol* 20:4160-4168, 2002
- American Medical Association: Current Procedural Terminology (CPT) Code Book, 2004. Chicago, IL, American Medical Association, 2004
- Gold MR, Siegel JE, Russell LB, et al (eds): *Cost-Effectiveness in Health and Medicine*. New York, NY, Oxford University Press, 1996
- Agency for Healthcare Research and Quality: HCUPnet: Healthcare Cost and Utilization Project. <http://hcup.ahrq.gov/Hcupnet.asp>
- Lawrence WF, Pehskin BN, Liang W, et al: Cost of genetic counseling and testing for BRCA1 and BRCA2 breast cancer susceptibility mutations. *Cancer Epidemiol Biomarkers Prev* 10:475-481, 2001
- Agency for Healthcare Research and Quality: Medical Expenditure Panel Survey. <http://www.meps.ahrq.gov/>
- Polsky D, Mandelblatt JS, Weeks JC, et al: Economic evaluation of breast cancer treatment: The value of patient choice. *J Clin Oncol* 21:1139-1146, 2003
- Nord C, Mykletun A, Thorsen L, et al: Self-reported health and use of services in long-term cancer survivors. *Int J Cancer* 114:307-316, 2005
- Oleske DM, Cobleigh MA, Phillips M, et al: Determination of factors associated with hospitalization in breast cancer survivors. *Oncol Nurs Forum* 31:1081-1088, 2004
- Graves EJ, Owings MF: Summary: National Hospital Discharge Survey (volume 301). Hyattsville, MD, National Center for Health Statistics, 2004
- Hewitt M, Rowland JH, Yancik R: Cancer survivors in the United States: Age, health, and disability. *J Gerontol A Biol Sci Med Sci* 58:82-91, 2003
- Nattinger AB, Gottlieb MS, Veum J, et al: Geographic variation in the use of breast-conserving treatment for breast cancer. *N Engl J Med* 326:1102-1107, 1992
- Hadley J, Mitchell J, Mandelblatt J: Medicare fees and small area variations in breast-conserving surgery among elderly women. *Med Care Res Rev* 58:334-360, 2001
- Yancik R, Wesley MN, Rues LA, et al: Effect of age and comorbidity in post-menopausal breast cancer patients aged 55 years and older. *JAMA* 285:885-892, 2001
- Satariano WA, Ragland DR: The effect of comorbidity on 3-year survival of women with primary breast cancer. *Ann Intern Med* 120:104-110, 1994
- National Comprehensive Cancer Network: Clinical Practice Guidelines in Oncology. v.1.2006. http://www.nccn.org/professionals/physician_gls/PDF/breast.pdf
- Hewitt M, Greenfield S, Stovall E: *From Cancer Patient to Cancer Survivor: Lost in Transition*. Washington, DC, Institute of Medicine, National Academy Press, 2006
- Goodwin JS, Hunt WC, Humble CG, et al: Cancer treatment protocols: Who gets chosen? *Arch Intern Med* 148:2258-2260, 1988
- Lafata JE, Simpkins J, Schultz L, et al: Routine surveillance care after cancer treatment with curative intent. *Med Care* 43:592-599, 2005

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