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Medical costs of treating breast cancer among younger Medicaid beneficiaries by stage at diagnosis

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Abstract

Background—Younger women (aged 18–44 years) diagnosed with breast cancer often face more aggressive tumors, higher treatment intensity, and lower survival rates than older women. In this study, we estimated incident breast cancer costs by stage at diagnosis and by race for younger women enrolled in Medicaid.

Methods—We analyzed cancer registry data linked to Medicaid claims in North Carolina from 2003 to 2008. We used Surveillance, Epidemiology, and End Results (SEER) Summary 2000 definitions for cancer stage. We split breast cancer patients into two cohorts: a younger and older group aged 18–44 and 45–64 years, respectively. We conducted a many-to-one match between patients with and without breast cancer using age, county, race, and Charlson Comorbidity Index. We calculated mean excess total cost of care between breast cancer and non-breast cancer patients.

Results—At diagnosis, younger women had a higher proportion of regional cancers than older women (49 vs. 42%) and lower proportions of localized cancers (44 vs. 50%) and distant cancers (7 vs. 9%). The excess costs of breast cancer (all stages) for younger and older women at 6 months after diagnosis were $37,114 [95% confidence interval (CI) = $35,769–38,459] and $28,026 (95% CI = $27,223–28,829), respectively. In the 6 months after diagnosis, the estimated excess cost was significantly higher to treat localized and regional cancer among younger women than among older women. There were no statistically significant differences in excess costs of breast cancer by race, but differences in treatment modality were present among younger Medicaid beneficiaries.

Conclusions—Younger breast cancer patients not only had a higher prevalence of late-stage cancer than older women, but also had higher within-stage excess costs.

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Conflict of interest Dr. Trogdon declares that he has no conflict of interest. Dr. Ekwueme declares that he has no conflict of interest. Ms. Poehler declares that she has no conflict of interest. Ms. Thomas declares that he has no conflict of interest. Mr. Allaire declares that he has no conflict of interest.

Ethical approval The study was reviewed by the UNC Institutional Review Board and deemed to not involve human subjects research.

Keywords

Breast cancer; Medical care costs; Medicaid; Younger women

Introduction

Over 22,000 women younger than 45 years of age (henceforth ‘‘younger women’’) were diagnosed with breast cancer in 2013 in the United States, approximately 11% of new breast cancer cases [1]. Breast cancer in younger women typically has higher risk biologic features, is diagnosed at a more advanced stage, and has poorer survival rates compared to breast cancer among older women [2, 3]. As a result of these differences in tumor types between younger and older women, younger women may also have more intense or aggressive treatments and have distinct and more prevalent side effects from treatment than older women [2, 4–6]. These side effects can include quality of life impacts, fertility problems, depression [6–9], and generate substantial productivity losses [10–12].

Health and economic outcomes may be worse among younger women of color and younger women enrolled in Medicaid. Medicaid beneficiaries and minorities of all ages are more likely to present with advanced stage cancers [2, 13–19], and are less likely to receive recommended treatments [20, 21], Even within Medicaid, racial/ethnic disparities exist in screening [22], incidence [23], and quality of care [20, 24]. Because Medicaid status is associated with health disparities for breast cancer patients, the Medicaid population could be an important group to assess potential differences between younger and older women with breast cancer.

Few studies have examined the costs of breast cancer treatment in a Medicaid population [18, 25–29]. One study of the costs of breast cancer treatment among younger women in Medicaid used a cross-sectional, prevalence-based design [11]. Prevalent or annual costs provide a view of costs for a cross-section of women across the spectrum of the treatment continuum. A different approach would involve using incident costs, which provide cost estimates from the onset of disease until the end of the disease or for a specific period of time, typically a year [30]. For cancer, incident cost estimates provide more information about the value of preventing disease. We are not aware of any studies that report incident medical costs of breast cancer treatment by stage at diagnosis among younger women insured by Medicaid.

Our study fills this gap by estimating incident breast cancer treatment costs by age at diagnosis and by race/ethnicity for women under age 45 years versus those 45–64 years enrolled in Medicaid in North Carolina. We also investigated whether the treatment costs are associated with a later stage of diagnosis. Providing estimates by stage is critical because in postmenopausal women, stage at diagnosis has been shown to substantially influence treatment costs [31].

Methods

Data

We analyzed 2003–2008 North Carolina Central Cancer Registry data linked to Medicaid enrollment files for the same time period, the most recent linked data available at the time of the analysis. The data were maintained by the Integrated Cancer Information and Surveillance System at the University of North Carolina and covered 100% of the North Carolina Medicaid population [31, 32]. The Institutional Review Boards at RTI International and University of North Carolina approved the research plan for this study.

The cancer registry file contains demographic characteristics including race; county; primary cancer site; cancer staging using the Surveillance, Epidemiology, and End Results (SEER) Summary 2000 definitions; date of diagnosis; and date of death. The Medicaid data include the following data files: enrollment, inpatient hospital, long-term care, other non-institutional, and prescription drug. The enrollment data file contains monthly indicators of Medicaid enrollment status, demographics, and the cancer registry link identifier.

Cost Estimation

We included women who were diagnosed with invasive primary breast cancer in the North Carolina Central Cancer Registry between ages 18 and 64 years (Table 1). We excluded those with benign tumors, those not enrolled in Medicaid at diagnosis, and those who died within 9 months of diagnosis so we could observe a minimum of 3 months of cancer claims data while allowing for a 6-month buffer for end-of-life costs.

We included breast cancer patients in our analysis only if the patients were continuously enrolled in each of the follow-up periods analyzed (3, 6, and 12 months), known as the initial phase of care (Table 1) [33]. We defined continuous enrollment separately for each time period as having either a fee-for-service only (FFS) or a primary case management only (PCCM) plan in Medicaid in consecutive months. We included women with FFS because we could obtain all medical costs associated with a patient’s treatment since providers are paid by service provided, as opposed to a managed care plan where Medicaid pays a monthly capitation payment for each enrollee [34]. We further included women with PCCM plans because during our analysis time period, providers of PCCM patients were paid on a fee-for-service model [35]. In addition to our younger cohort of women with breast cancer, we also estimated costs at 6 months for a cohort of women aged 45–64 years. We followed all the same sample restrictions as for the younger women with breast cancer. These women were analyzed to provide a comparison to younger women with breast cancer.

We calculated costs for two groups of breast cancer patients (aged 18–44 years and aged 45–64 years) and two comparison groups of female, non-breast cancer patients aged 18–44 years and aged 45–64 years who were enrolled for at least 1 month in a FFS only or PCCM only plan in Medicaid between 2003 and 2008. Due to sample size limitations, we did not require the non-breast cancer population to be continuously enrolled. We excluded all patients in the non-breast cancer population who died while enrolled in Medicaid and who had inconsistent birth date information across enrollment years.

We conducted a coarsened exact match between the breast cancer patients and patients without breast cancer using categorical 5-year birth year groups (1960–1964, 1965–1969, 1970–1974, 1975–1979, 1980–1984, 1985–1989), county, race (white, black, other), and a Charlson Comorbidity Index (CCI; zero, greater than [36]. We estimated the CCI using data from the 3 months after breast cancer diagnosis because requiring cancer patients to be continuously enrolled pre-diagnosis greatly reduced sample sizes. We excluded cancer from the [37]. We retained all matches and used weights to control for the varying number of non-breast cancer patients cancer case [38].

We first estimated average monthly total Medicaid insurance medical payments for three follow-up periods 6, and 12 months from diagnosis) using linear regression. For each follow-up period, we estimated separate regressions for younger women of all races and by race younger women. Each regression included indicators SEER stage at diagnosis, number of months enrolled, year indicators. We then estimated the total Medicaid insurance medical payments for each follow-up period multiplying the number of months in the follow-up period by the estimated per-month payment for that follow-up period. In addition, we estimated monthly and total for one follow-up period (6 months from diagnosis) older women with and without breast cancer. We calculated excess costs as the difference in mean total payments between the patients with and without breast cancer stage. We also calculated 95% confidence intervals All costs were adjusted to 2014 dollars using a domestic product deflator [39].

Treatment prevalence

Using the same analytic sample as in the cost estimation, we calculated the prevalence of the following treatments age group, race (white and black), and follow-up period and 12 months): surgery (mastectomy or breast conserving), reconstruction, chemotherapy, and radiotherapy. defined the treatment categories following the method KE Reeder-Hayes, AM Meyer, SB Dusetzina, H Liu SB Wheeler [40]. All estimates were generated using 13.1 (College Station, TX).

Results

Table 2 compares the age categories, CCI, cancer stages, and race of younger compared to older breast cancer patients. Due to the coarsened exact matching, the cancer and non-cancer samples for younger and older women match exactly on the variables in Table 2. On average, younger breast cancer patients were diagnosed at age 39 years, whereas older patients were diagnosed at age 55 years. Overall, 89 and 79% of younger and older women, respectively, had a CCI of zero in the 3 months after their cancer diagnosis, excluding their cancer. For younger women, at 6 months, regional cancer was the most common stage at diagnosis (49%), followed by localized cancer (44%). On the other hand, older women had a higher percentage of localized cancer (50%) and lower percentage of regional (42%).

Medicaid costs were significantly higher among younger women with breast cancer than those without breast cancer for all stages and follow-up periods (Table 3). The excess costs, relative to no cancer, at 6 months after diagnosis were $37,114 [confidence interval (CI) = $35,769–38,459]. Excess costs at 6 months increased with cancer stage for localized,

regional, and distant cancer stages at 6 months, respectively. There were no statistically significant differences in excess costs of breast cancer by race among younger Medicaid beneficiaries.

In the older population, the estimated excess cost of $28,026 (CI = $27,223–28,829) at 6 months was significantly higher among older women with breast cancer compared to those without breast cancer. Similar to the younger women, the excess costs of breast cancer increased with each stage. In the 6 months after diagnosis, the estimated excess cost was significantly higher to treat localized and regional cancer among younger women with breast cancer compared to older women.

Table 4 presents the prevalence of the following treatment categories by age at diagnosis and race: surgery, reconstruction, chemotherapy, and radiotherapy. For the full sample, the prevalence of all treatment categories except radiotherapy at 6 months was higher for younger women than for older women. The same pattern was also evident for white women. Among black women, the rates of chemotherapy treatment were higher among younger women. In addition, the rates of surgery and reconstruction were higher for white women compared to black women, especially among younger women.

Figure 1 presents mean monthly medical costs incurred by breast cancer patients for each stage at diagnosis. The overall pattern in average monthly costs is similar among each stage: highest costs during the first 6 months and then a downward trend that tapers off around 12 months. Generally, costs that occur after the first 12 months of care are known as ‘‘continuing’’ phase of care [41]. Breast cancer patients with distant stage maintain a consistently higher average monthly cost than patients with localized or regional breast cancer. Monthly costs from distant stage are highest at 4 months after diagnosis at around $12,000. Monthly costs from localized or regional stage converge closely 3–4 months after diagnosis at $6000 but diverge as monthly costs from regional stage continue to increase while monthly costs from localized stage begin to decrease.

Discussion

Our study has four main findings. First, younger breast cancer patients had a higher prevalence of late-stage breast cancer than older women in Medicaid. Second, younger breast cancer patients in Medicaid had higher total breast cancer attributable costs than older Medicaid beneficiaries with breast cancer. Third, younger women had higher within-stage breast cancer costs. Fourth, we did not find statistically significant differences in excess costs by race, but black women with breast cancer were less likely to receive surgery or reconstruction in the first 12 months after diagnosis.

The first three findings suggest that the excess cost of breast cancer in younger women is not solely due to later stage diagnosis. The difference in breast cancer treatment costs by stage at diagnosis has been reported in prior studies; [18, 31, 42] however, these costs have not been estimated for younger women. For example, Subramanian et al. [18] conducted a study on treatment cost for breast cancer patients enrolled in Medicaid in North Carolina and estimated that the incremental costs at 24 months after diagnosis were $22,343, $41,005, and

$117,033 for those with localized, regional, and distant breast cancers, respectively [18]. Khanna et al. [27] found that for a woman with breast cancer in the 2005 West Virginia Medicaid population, fee-for-service all-cause healthcare costs were $3321 significantly higher than women without breast cancer [43].

One of the key strengths of this study is the linkage of administrative and cancer registry data to estimate costs for younger and older women diagnosed with breast cancer in a Medicaid population. We were able to capture incident breast cancer costs occurring from the date of diagnosis, as opposed to either a reliance on an algorithm to detect the stage at diagnosis [31] or prevalence-based costs [10, 11]. Another strength of using cancer registry data by stage at diagnosis is the ability to examine whether costs for younger women were higher as a result of a late stage at diagnosis. Finally, we leveraged the size of our claims data to construct two separate comparisons for younger women: a sample of women without breast cancer used to estimate the attributable costs; and a sample of older women diagnosed with breast cancer used to compare costs.

Our results showed no significant differences in incident costs by race among younger Medicaid beneficiaries. However, this does not imply that black and white women received similar treatments. In fact, black women were less likely to receive surgery and reconstruction. It may be that black women are more likely to receive less expensive procedures (e.g., mastectomy without reconstruction) but be more likely to have costly treatment complications, making the total cost equivalent.

In comparison, an earlier study found significant racial/ethnic differences in prevalent costs nationally among younger Medicaid beneficiaries [11]. Differences in excess breast cancer costs could be caused by differences in access to quality survivorship care, coordination of care, or in patient characteristics including health status and socioeconomic differences [44, 45] It is possible that our continuous enrollment exclusions hid underlying racial/ethnic differences in incident costs. However, we did not detect differences in incident costs across races/ethnicities at any of the continuous enrollment periods analyzed (3, 6, and 12 months). This study’s results suggest that differences in observed racial/ethnic disparities across the two studies may not be attributable to initial treatment costs.

This study has several limitations. First, we only analyzed data from Medicaid in one state; therefore, the findings reported here may not be reflective of the treatments or resources used in other settings. Second, we could not account for unobserved differences between the cohorts. The encounter data may not have captured all diagnoses included in the CCI, which had to be calculated after breast cancer diagnosis. There is also substantial heterogeneity in tumor biology within the SEER cancer stages used in the analysis. Third, although our cost measure included all Medicaid payments, including those from adverse events following treatment [46], other facets of the economic burden of breast cancer for younger Medicaid beneficiaries were not included. These include the time cost of seeking care, lost productivity, and changes to health-related quality of life [11]. Fourth, our analysis was focused on Medicaid fee-for-service; Medicaid managed care was excluded. Fifth, sample sizes prevented us from extending the follow-up period past 12 months, which limited our ability to detect treatments occurring later such as reconstruction following radio-therapy.

Therefore, the estimated treatment costs may be underreported. Despite these limitations, this study offers an important contribution to the literature on the incidence-based cost of breast cancer treatment for younger Medicaid beneficiaries by stage at diagnosis. Incidence-based cost estimates provide information about the treatment phase for cancer, where prevalence-based costing provides a cross-section of patients along the treatment spectrum. Incidence-based costs are also critical for future research as inputs into cost-effectiveness analyses for decision making [30].

Clinical care for breast cancer has continued to evolve since the years included in this analysis. Costs for cancer care in general have increased faster than overall inflation. New cellular targets have been identified in breast cancer, and novel targeted therapies have contributed significantly to rising treatment costs. If, as with the treatments studied here, oncologists use these new treatments more intensively among younger women, it could increase the estimated gap between costs across the age groups.

The findings from this study have several implications. Women whose breast cancer was detected through the National Breast and Cervical Cancer Early Detection Program (NBCCEDP) can enroll in Medicaid to cover their treatment. Studies have shown that women using the NBCCEDP have an earlier stage at detection, shorter treatment delays, and survival benefits compared to similar women who do not receive services through NBCCEDP. [47] CDC conducts educational campaigns to help younger women understand their risk for breast cancer and catch cancers at earlier stages, as part of initiatives funded through the Education and Awareness Requires Learning Young (EARLY) Act [48]. For example, digital media campaigns such as *Bring Your Brave* inspire young women who may be at high risk to learn their own risk for breast cancer and talk with their health care provider about their risk. Bring Your Brave has an opportunity to reach all women, regardless of socioeconomic status or race, to increase awareness about risk.

As the Medicaid program continues to evolve, the treatment cost estimates reported in this paper could inform decisions for treating invasive breast cancer in the Medicaid population. Further, these treatment cost estimates could be used in modeling interventions to estimate the cost-effectiveness of invasive breast cancer treatment in women enrolled in Medicaid. The estimates may also be helpful for economic evaluations of multifaceted prevention strategies among younger women.

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Appendix

See Table 5.

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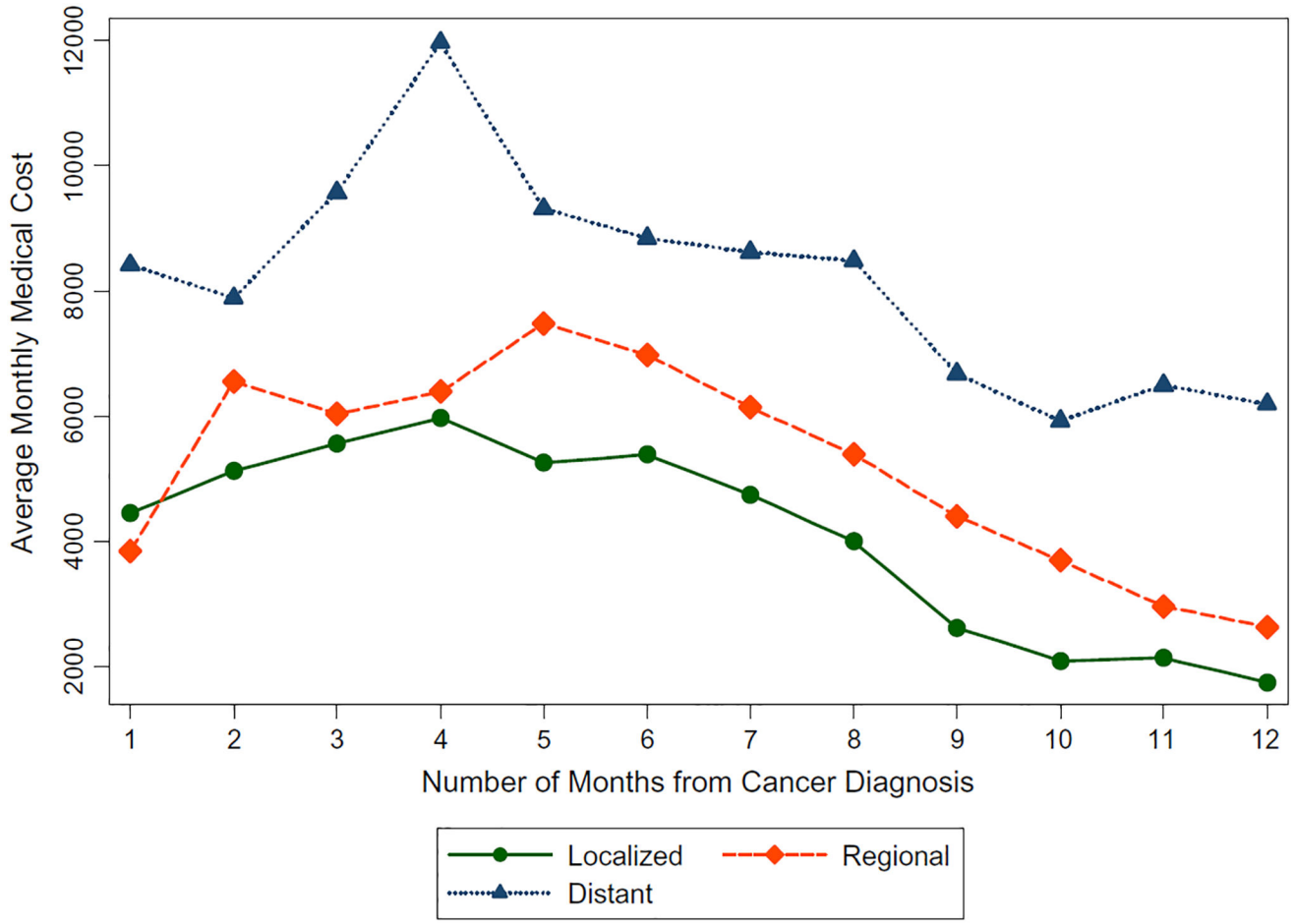

Fig. 1.

Adjusted average monthly cost per person from month of diagnosis to 12 months for Medicaid beneficiaries aged 18–44 years by SEER stage of diagnosis

Table 1

Sample selection criteria by age at diagnosis

	Younger women (aged 18–44)		Older women (aged 45–64)	
Inclusion criteria	**Sample size**	**Number dropped**	**Sample size**	**Number dropped**
Women diagnosed with breast cancer in age category	1135		2717	
Non-benign tumor	1019	116	2337	380
Enrolled in Medicaid at diagnosis	877	142	2028	309
Survived at least 9 months post-diagnosis	844	33	1898	130
Continuously enrolled at least 3 months post-diagnosis	520	324	-	-
Continuously enrolled at least 6 months post-diagnosis	456	64	1264	634
Continuously enrolled at least 12 months post-diagnosis	337	119	-	-

Table 2

Characteristics of women diagnosed with breast cancer by age at diagnosis

Variable	Women aged 18–44 years at diagnosis			Women aged 45–64 years at diagnosis
	Continuously enrolled 3 months from diagnosis (*N* = 520)	Continuously enrolled 6 months from diagnosis (*N* = 456)	Continuously enrolled 12 months from diagnosis (*N* = 337)	Continuously enrolled 6 months from diagnosis (*N* = 1177)
Age (year)[a]	38.54	38.48	38.39	54.62
Birth year				
1955–1959	1%	1%	1%	
1960–1964	38%	39%	43%	-
1965–1969	35%	34%	31%	-
1970–1974	18%	17%	16%	-
1975–1979	6%	6%	6%	-
1980–1984	2%	2%	2%	-
1985–1989	0.4%	0.4%	0.6%	-
Charlson comorbidity index (CCI)				
CCI score = 0	89%	90%	89%	79%
CCI score >0	11%	10%	11%	21%
Surveillance, epidemiology, and end results (seer) stage at diagnosis				
Localized	44%	44%	45%	50%
Regional	48%	49%	48%	42%
Distant	8%	7%	7%	9%
Race				
White	48%	48%	46%	49%
Black	46%	46%	47%	40%
Other	7%	6%	7%	10%
No. of matched comparisons	211,022	190,211	158,945	121,106

[a]We matched using birth year intervals; however, we present age in this table for further information

Table 3

6-month excess costs for Medicaid beneficiaries with breast cancer, by SEER stage, age at diagnosis and race

	Aged 18–44 years	Aged 45–64 years
Full sample		
All stages	$37,114[a]	$28,026[a,b]
	($35,769; $38,459; *N* = 456)	($27,223; $28,829; *N* = 1,117)
Localized	$30,036[a]	$18,055[a,b]
	($28,504; $31,568; *N* = 200)	($17,269; $18,842; *N* = 586)
Regional	$36,533[a]	$27,107[a,b]
	($35,207; $37,860; *N* = 222)	($26,110; $28,105; *N* = 489)
Distant	$44,659[a]	$38,872[a]
	($40,653; $48,664; *N* = 34)	($36,418; $41,326; *N* = 102)
White women		
All stages	$36,905[a]	$29,620[a,b]
	($35,034; $38,755; *N* = 217)	($28,452; $30,787; *N* = 579)
Localized	$29,100[a]	$17,978[a,b]
	($27,186; $31,013; *N* = 102)	($16,843; $19,114; *N* = 301)
Regional	$34,226[a]	$28,923[a,b]
	($32,245; $36,207; *N* = 99)	($27,445; $30,401; *N* = 228)
Distant	$47,292[a]	$41,748[a]
	($41,410; $53,174; *N* = 16)	($38,149; $45,347; *N* = 50)
Black women		
All stages	$36,873[a]	$27,292[a,b]
	($34,863; $38,883; *N* = 210)	($26,146; $28,438; *N* = 476)
Localized	$30,847[a]	$18,667[a,b]
	($34,903; $38,535; *N* = 83)	($17,448; $19,887; *N* = 227)
Regional	$36,719[a]	$26,384[a,b]
	($34,903; $38,535; *N* = 111)	($25,062; $27,706; *N* = 206)
Distant	$42,642[a]	$36,900[a]
	($36,749; $48,535; *N* = 16)	($33,284; $40,515; *N* = 43)

[a] Excess cost is significantly different among breast cancer and comparison samples at the 1% level 95% confidence intervals in parentheses

[b] Significantly different from women aged 18–44 years at the 1% level

Table 4

Treatment prevalence among Medicaid beneficiaries with breast cancer, by age at diagnosis and race

	Aged 18–44 years		Aged 45–64 years	
	6 months	12 months	6 months	12 months
	%	%	%	%
Surgery: mastectomy or breast conserving	62.5	77.4	55.1[a]	68.0[a]
Reconstruction (among women with surgery)	6.8 (10.9)	9.2 (11.9)	2.5[a] (4.2)	3.3[a] (4.7[a])
Chemotherapy	45.6	53.4	28.9[a]	37.2[a]
Radiotherapy	9.0	55.2	11.6	43.3[a]
White women				
Surgery: mastectomy or breast conserving	68.7	81.9	57.9[a]	70.1[a]
Reconstruction (among women with surgery)	11.1 (16.1)	16.1 (19.7)	2.9[a] (4.8[a])	4.1[a] (5.5[a])
Chemotherapy	45.6	52.3	30.7[a]	38.8[a]
Radiotherapy	9.2	58.7	13.6	45.9[a]
Black women				
Surgery: mastectomy or breast conserving	55.2	70.9	51.9	66.1
Reconstruction (among women with surgery)	3.3 (6.0)	3.8 (5.4)	1.7 (3.2)	2.5 (3.7)
Chemotherapy	45.2	54.4	28.6[a]	37.2[a]
Radiotherapy	9.0	51.3	9.5	41.4

[a]Significantly different from women aged 18–44 years at the 1% level

Table 5

Twelve-month excess costs for Medicaid beneficiaries with breast cancer, by SEER stage, and age at diagnosis

	Aged 18–44 years	Aged 45–64 years
Full sample		
	(*N* = 337)	(*N* = 868)
All stages	$66,596[a]	$45,914[a,b]
	($63,551; $69,641)	($44,231; $47,598)
Localized	$46,616[a]	$28,674[a,b]
	($43,394; $49,837)	($27,122; $30,226)
Regional	$59,431[a]	$45,288[a,b]
	($56,603; $62,260)	($43,265; $47,311)
Distant	$93,471[a]	$62,868[a,b]
	($83,203; $103,39)	($57,464; $68,271)

[a]Excess cost is significantly different among breast cancer and comparison samples at the 1% level 95% confidence intervals in parentheses

[b]Significantly different from women aged 18–44 years at the 1% level