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Impact of Chronic Conditions on the Cost of Cancer Care for Medicaid Beneficiaries

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Background: No study has assessed the cost of treating adult Medicaid cancer patients with preexisting chronic conditions. This information is essential for understanding the cost of cancer care to the Medicaid program above that expended for other chronic conditions, given the increasing prevalence of chronic conditions among cancer patients.

Research Design: We used administrative data from 3 state Medicaid programs' linked cancer registry data to estimate cost of care during the first 6 months following cancer diagnosis for beneficiaries with 4 preexisting chronic conditions: cardiac disease, respiratory diseases, diabetes, and mental health disorders. Our base cohort consisted of 6,212 Medicaid cancer patients aged 21 to 64 years (cancer diagnosed during 2001–2003) who were continuously enrolled in fee-for-service Medicaid for 6 months after diagnosis. A subset of these patients who did not die during the 6-month follow-up (n=4,628), were matched with 2 non-cancer patients each (n=8,536) to assess incremental cost of care.

Results: The average cost of care for cancer patients with the chronic conditions studied was higher than for cancer patients without any of these conditions. The increase in cancer treatment cost associated with the chronic conditions ranged from \$4,385 for cardiac disease to \$11,009 for mental health disorders.

Conclusions: Chronic conditions, especially the presence of multiple conditions, are associated with a higher cost of care among Medicaid cancer patients, and these increased costs should be reflected in projections of future Medicaid cancer care costs. The implementation of better care-management processes for cancer patients with preexisting chronic conditions may be one way to reduce these costs.

Keywords: chronic disease, healthcare costs, Medicaid

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Background

Medicaid is the nation's single largest source of health insurance for low-income people less than 65 years of age. In fiscal year 2009, federal and state Medicaid expenditures totaled \$366 billion, and more than 50 million people were enrolled in Medicaid (The Henry J. Kaiser Family Foundation-statehealthfacts.org, 2011). The Medicaid program plays a critical role in providing insurance coverage for many low-income beneficiaries with cancer. Following the implementation of the Breast and Cervical Cancer Prevention and Treatment Act (BCCPTA) of 2000, the Medicaid program began covering treatment for breast and cervical cancer to low-income women through the National Breast and Cervical Cancer Early Detection Program (NBCCEDP). Under the Affordable Care Act (ACA) of 2010, federal Medicaid funding will increase the maximum income threshold for Medicaid enrollment to 133% of the poverty level and this will increase program enrollment (The National Council for Community Behavioral Healthcare., 2011). The recent Supreme Court decision regarding the ACA, though, makes it more likely that not all states will increase their maximum income threshold for Medicaid enrollment to 133% of the federal poverty level.

Overall, about 45% of all cancers are diagnosed among those younger than 65 years, and the average length of survival following breast cancer diagnosis has been shown to be substantially lower among low-income people than among those with higher incomes, even in studies that controlled for cancer stage at the time of diagnosis (Tian, Wilson, & Zhan, 2011; Freeman, Ricardo, Campbell, Barrett, & Warnecke, 2011). About 60% of adult Medicaid enrollees have a chronic or disabling condition (Boyd et al., 2010). Highly prevalent chronic conditions such as mental disorders, respiratory diseases, diabetes, and cardiac conditions are key cost drivers for Medicaid, and people with these conditions have been targeted for participation in the Health Homes program, which was created by the ACA as a means of improving the coordination and management of patient care.

Although the Medicaid cost of treating cancer has been examined in previous studies, no study to date has assessed differences in Medicaid cost of treating cancer associated with specific chronic conditions (Subramanian et al., 2010, 2011). Some chronic conditions, such as diabetes, have been associated with an increased risk for complications during cancer treatment and with the treatment modalities selected for cancer patients (Srokowski, Fang, Hortobagyi, & Giordano, 2009). It is therefore important to understand the differential impact of these conditions on the cost of care. Prior analysis of Medicaid data has shown that the cost of care increases as the number of chronic conditions experienced by a patient increases (Kronick, Bella, Gilmer, & Somers, 2007). We expect this relationship between cost and multiple conditions to remain true for cancer patients; thus, we have primarily focused on analyzing the cost of four specific prevalent conditions individually. In this study we estimate the cost of cancer care for each of the selected conditions, controlling for the other conditions studied. We focused on four chronic

conditions, which include cardiac conditions, respiratory disorders, diabetes, and mental health disorders. We present the additional cost, in the first 6 months from diagnosis, compared to cancer patients without these comorbidities and also to non-cancer patients who have the same comorbidities. In addition, since more than one-third of cancer patients had more than one of the selected conditions, we also assessed cost by the number of chronic conditions to determine magnitude of cost increases due to the presence of multiple comorbidities.

In all assessments, we present cost by setting of care to help understand where additional costs are incurred: hospitalizations, physicians visits, prescription drugs, long-term care, or other costs. Accurate assessment of these costs is important for state Medicaid programs and for researchers to demonstrate the economic benefits of interventions to manage comorbid conditions experienced by cancer patients. This study will therefore foster the evidence base required to implement novel programs and targeted interventions, to reduce costs and potentially improve outcomes among Medicaid cancer patients with chronic conditions.

METHODS

Linking Medicaid and Cancer Registry Data

We linked 2000–2003 Medicaid administrative data from the Centers for Medicare & Medicaid Services with cancer registry data from Georgia, Maine, and Illinois. These states were selected based on the availability of high quality data for the analysis (including a large proportion of fee-for-service enrollees, and completeness and accuracy of social security numbers for linkage). The Institutional Review Board (IRB) at RTI International approved the research plan for this study and granted waivers of informed consent and of Health Insurance Portability and Accountability Act (HIPAA) authorization. The plan was also reviewed and approved by the IRBs at the health departments of all three states included in the study.

Using SAS[®] software, the three participating cancer registries linked all cancer cases diagnosed during 2000–2003 among Medicaid patients aged 21–64 years with Medicaid enrollment data on the basis of patients' social security number, date of birth, and sex. The Medicaid enrollment file contained beneficiary eligibility information, demographic characteristics, and indicators of monthly enrollment, while the claim files provided information on services (such as hospital admissions, ambulatory care services, prescription drugs, and long-term care) used and the payment associated with those services. Key variables used from the cancer registry data include date of cancer diagnosis and stage at diagnosis to differentiate between those cancers at *in situ*, localized, regional, and distant stages. To ensure that we had complete utilization data to estimate cost, we excluded patients enrolled in both Medicaid and Medicare from our study sample, because Medicare is the primary payer for these patients and Medicaid covers the services not provided by Medicare. Hence the Medicaid claims data alone do not include complete utilization information for the dually eligible population.

Additional Cost of Cancer Treatment due to Presence of Chronic Conditions

We estimated increases in costs associated with four classes of chronic conditions among adult Medicaid beneficiaries: cardiac conditions (ischemia, hypertension, and heart failure), respiratory diseases (asthma, chronic obstructive pulmonary disease, and emphysema), diabetes, and mental health disorders (including schizophrenic disorders, episodic mood disorders, delusional disorders, anxiety/personality disorders, and depressive disorders). We identified beneficiaries with these conditions on the basis of International Classification of Diseases, 9th Revision (ICD-9) codes in their Medicaid claims (World Health Organization, 1977). To ensure that we assessed only costs associated with preexisting conditions, we limited our analysis to patients with claims for these chronic conditions 3 months prior to the date of their cancer diagnosis. Some individuals had more than one of the selected chronic conditions and we control for this in the multivariate analysis described below.

We retained cancer cases with at least 3 months of fee-for-service enrollment prior to the cancer diagnosis and at least 6 months of continuous enrollment in fee-for-service Medicaid after diagnosis. About 20%, or 1,564 of those enrolled at the time of cancer diagnosis, were excluded due to discontinuous enrollment. Cancer costs are often defined in phases—treatment, continuing care, and terminal care—as they offer a natural clinical basis to study the cost of providing health care services, since it is not possible to follow all cancer patients from diagnosis to death (Brown, Riley, Schussler, & Etzioni, 2002; Warren et al., 2002). In this study, we focused on the treatment phase, which is generally defined as the initial 6-month period from diagnosis (Warren et al, 2002).

Since a large proportion of cancer patients can die within the 6-month follow-up period, we produced 6-month cost estimates for two separate cohorts: one that included deaths during the 6-month follow-up period (n=6, 212) and the other that excluded these deaths (n=4,628). Deaths were excluded from the second cohort to ensure that costs during the entire treatment phase were captured completely, since these individuals would not have costs truncated by death.

We compared the distribution of the following characteristics among cancer patients with chronic conditions: age at diagnosis (21–35; 36–50; 51–64 years), race (White, Black, Other), and cancer stage at diagnosis (*in situ*, localized, regional, distant, unknown) (Subramanian et al., 2010, 2011). We also report the most prevalent tumor sites and groupings based on site information in the cancer registry data. On the basis of expenditures incurred during the month of diagnosis and the next 5 months, we estimated 6-month costs related to each of the following services: hospital admissions, ambulatory care services, prescription drugs, and long-term care. We adjusted all cost estimates to 2003 dollars using the medical care services component of the Consumer Price Index.

We generated estimates of the additional 6-month costs attributable to chronic conditions using ordinary least square regressions that controlled for patients' age at diagnosis,

sex, race, state of residence, cancer stage at diagnosis, tumor site, and selected chronic conditions. Therefore, the cost of each of the four conditions is reported controlling for the other conditions (for individuals who may have more than one of the conditions studied). We did not control for other conditions, as we wanted to study the cost of an average person with these conditions, including the sequelae from other related conditions they may experience (for example, diabetic patients are also likely to have hypertension). We also ran additional regressions to assess the cost of multiple conditions and included the following instead of the four separate chronic conditions in the regressions: one condition, two conditions and three/four conditions (pooled together as there were very few patients with all four conditions). In some studies, researchers have used nonlinear two-part models of health care expenditures to account for people who do not use services and for skewness in the distribution of expenditures among service users (Manning & Mullahy, 2001). We also generated some nonlinear regression estimates to assess the extent to which estimates generated by the two methods differed, and found the results to be quite similar. We chose to use ordinary least square regression, because its results are easier to interpret and because it has been used to estimate medical costs in several previous studies (Ray et al., 2000; Powers, Meyer, Roebuck, & Vaziri, 2005; Pope et al., 2004; Warren et al., 2002).

Comparing Additional Costs of Treating Chronic Conditions in Beneficiaries with and without Cancer

We also used Medicaid claims information to select a comparison cohort of non-cancer patients enrolled during the same period, from 2000 to 2003, to assess the incremental cost of treating chronic conditions during the first 6 months of cancer treatment. This cohort, similar to the cancer cases, only included Medicaid beneficiaries between the ages of 21 and 64 years. Dual enrollees were excluded and only those with at least 6 months of continuous enrollment in fee-for-service Medicaid were retained. We excluded those who died during this period to ensure complete costs for the 6-month period. Each cancer patient who was continuously enrolled in fee-for-service for the 6 month follow-up period was matched by age, gender, race, and state with two Medicaid recipients who did not have cancer (n=8,536). Non-cancer patients were identified as those cases who were not present in the cancer registry data. When cancer patients matched with more than two comparison cases, two non-cancer cases were selected at random. This methodology was used in a previous analysis to select an unbiased comparison group of non-cancer enrollees (Subramanian et al., 2010, 2011). In addition, we also ensured that the follow-up period selected for the comparison case was the same (that is, the same months of enrollment) as the cancer case in order to ensure that seasonal differences in cost did not impact our cost estimates. To accomplish this, we assigned a “pseudo” diagnosis date for comparison cases that was the same month and year as that of the diagnosis date of the cancer patient. We created the same variables as the cancer cohort except for variables specifically related to cancer (for example, stage at diagnosis). We also generated univariate statistics to ensure that there was

an adequate sample of patients with the four chronic conditions selected for this study. Regressions controlled for patients' age at diagnosis, sex, race, and state of residence. Additional variables included a dichotomous variable to identify cancer versus non-cancer patients and interaction terms between the dichotomous variable and the four chronic conditions studied. The parameter estimate of the interaction terms provides the incremental cost of each chronic condition that is specifically related to cancer treatment. In additional regressions, the four separate chronic conditions were replaced with variables indicating the total number of conditions to assess incremental cost of patients with multiple chronic conditions.

RESULTS

As shown in Exhibit 1, the final cohorts analyzed were 6,121 cancer patients of whom 4,698 were continuously enrolled for the 6 month follow-up period. Among all patients, approximately 44 percent did not have any of the conditions studied. Overall, based on individuals with at least one condition, 58 percent had one condition, 29 percent had two conditions, and 13 percent had three or four conditions (2 percent had all four conditions).

Cancer patients with cardiac disease, respiratory disease, and diabetes were, on average, older than those with mental health disorders; percentages of diabetes and mental health conditions were higher among women than among men; and the prevalence of chronic conditions varied substantially by race. As we expected, the proportion of patients whose cancer was diagnosed at a distant stage was lower in the cohort of all living patients than in the cohort of living and deceased patients combined, because a disproportionate number of patients whose cancer was diagnosed at a distant stage died within 6 months of the diagnosis. Overall, the most common tumor sites were in the lung, breast, and digestive organs, although the distribution of tumor sites varied by category of comorbid chronic disease. The 6-month mortality rate was 25.6% overall and varied from 25.9% to 35.5% among the comorbidity groups. The overall unadjusted 6-month total medical costs were \$34,724 and \$33,067 for the average cancer patient, including and excluding those who died during the 6-month follow-up period, respectively. The costs were more than \$40,000 for the each of the comorbidities groups.

Exhibit 1 Distribution of selected characteristics among all Medicaid cancer patients and among those who survived at least 6 months

	All Medicaid Cancer Patients						Medicaid Cancer Patients Surviving at least 6 Months					
	Overall sample	None ²	Cardiac	Respiratory	Diabetes	Mental health ³	Overall sample	None ²	Cardiac	Respiratory	Diabetes	Mental health ³
Sample size (N) ⁴	6,212	2,714	1,867	1,174	1,596	920	4,628	2,155	1,271	759	1,182	661
Age groupings (%)												
21–35	9.3	16.7	1.6	2.9	2.9	4.6	11.1	19.0	1.9	3.4	3.3	5.3
36–50	31.0	37.2	21.0	24.9	23.3	35.7	32.6	38.4	22.4	28.5	24.1	39.5
51–65	59.7	46.1	77.4	72.2	73.8	59.7	56.3	42.6	75.7	68.1	72.6	55.2
Females (%)	59.4	60.4	55.8	55.1	65.6	66.2	64.5	65.4	60.3	61.5	69.0	69.7
Race Groupings (%)												
White	45.9	49.3	36.8	48.8	43.1	51.8	46.2	49.9	35.7	48.0	41.8	52.0
Black	43.4	41.1	53.2	42.3	43.0	36.6	42.3	40.1	53.8	41.8	43.3	33.9
Other	10.7	9.6	10.0	8.8	14.0	11.6	11.5	10.0	10.5	10.3	15.0	14.1
Stage Groupings (%)												
insitu	5.5	6.2	3.9	4.2	5.4	6.5	7.3	7.7	5.5	6.3	6.9	8.8
local	32.5	33.6	30.6	29.4	35.0	31.8	40.3	39.9	39.3	39.4	43.4	40.2
regional	26.3	28.0	24.8	23.9	24.0	24.0	29.2	30.6	27.6	27.8	26.1	27.5
distant	25.8	23.1	30.2	31.2	25.8	26.0	16.7	15.4	20.4	19.8	17.7	16.5
unknown	9.9	9.2	10.6	11.3	9.8	11.7	6.6	6.4	7.2	6.7	5.9	7.0
Tumor Sites (%)												
Breast	16.0	18.3	11.6	9.6	16.4	16.7	20.6	22.2	16.2	14.2	21.1	21.5
Lung	19.4	15.0	24.3	37.8	18.1	21.2	13.5	10.7	17.6	29.3	13.0	14.4
Digestive organs	18.5	16.7	22.7	15.7	21.4	17.7	16.2	14.5	19.8	16.1	18.1	15.9
Female genital organs	10.1	12.3	7.0	5.5	9.8	10.4	12.1	14.3	8.6	7.1	11.3	12.4
Male genital organs	5.6	5.5	5.7	4.3	5.5	4.2	7.3	6.8	8.2	6.5	7.3	5.6
Oropharynx	5.7	6.7	5.2	5.1	2.9	4.0	6.1	6.9	6.0	5.3	3.4	4.7
Thyroid/endocrine glands	2.0	2.4	1.1	1.2	2.6	2.1	2.5	2.9	1.4	1.7	3.3	2.7
Urinary tract	5.2	4.5	6.3	3.8	6.0	5.8	5.8	4.6	7.9	4.9	6.9	6.2
Other cancers	17.5	18.6	16.2	16.9	17.4	17.8	15.9	17.2	14.3	15.0	15.6	16.6
6-Month Mortality (%)	25.6	20.6	31.9	35.5	25.9	28.2	-	-	-	-	-	-
Unadjusted 6-month cost (\$)	34,724	30,580	40,248	41,488	40,058	42,223	33,067	28,033	40,432	43,511	39,917	43,553

¹Overall sample includes all cancer patients with 6 months of continuous enrollment and included those with and without chronic conditions. Individuals with the four chronic conditions are not mutually exclusive.

²Patients with none of the four conditions studied.

³Includes schizophrenic disorders, episodic mood disorders, delusional disorders, anxiety/personality disorders, and depressive disorders.

⁴The overall distribution of the sample across the states was the following: 52% from Illinois, 35% from Georgia and 13% from Maine.

Comparisons Between Cancer Patients With and Without Chronic Conditions

As shown in Exhibit 2, the increase in 6-month costs associated with each category of chronic condition ranged from \$3,418 to \$8,004 among all cancer patients and from \$4,385 to \$11,009 among those who survived at least 6 months. In both cohorts, cardiac conditions had the lowest increase, while mental health disorders had the highest increase. Hospitalizations accounted for more than 60 percent of the total additional cost of care among patients with chronic conditions, whereas prescription drug use, long-term care, and ambulatory care services accounted for much smaller proportions of the total additional cost. Compared with patients with no conditions, the cost of cancer patients who were continuously enrolled with multiple conditions was \$13,369 and \$25,739 for any two conditions and three or four conditions respectively. Cost of inpatient admissions were the largest cost category, but cancer patients with multiple comorbidities experienced higher costs across all the types of services. It is important to note that, overall, the cost of care does vary by Medicaid beneficiaries' state of residence; Maine and Illinois have significantly higher costs than Georgia (see Appendix exhibits for full model specification of the total cost regressions).

Comparisons Between Cancer Patients and Non-Cancer Patients

Exhibit 3 reports on the incremental 6-month costs per person for treating comorbid conditions experienced by cancer patients compared to non-cancer patients with the same chronic conditions. Although all the conditions resulted in higher total costs, diabetes (\$4,567) and mental health (\$4,299) were the two conditions with statistically significant increases. All conditions had significantly higher average per person hospitalization costs ranging from \$2,693 to \$4,235, but no consistent patterns were present in the costs for services at other settings.

The incremental 6-month cost for individuals with any one condition was not statistically significant, but those with multiple conditions were: \$6,869 when two conditions were present and \$12,191 when three or four conditions were present. Again, the key cost driver was very high hospitalization costs.

Exhibit 2. Additional 6-month cost of care among Medicaid cancer patients <65 years old with select comorbid conditions compared with cancer patients without these conditions¹

	Cardiac		Respiratory		Diabetes		Mental health ²		One Condition		Two Conditions		Three/Four Conditions	
	AC ³	P-value	AC	P-value	AC	P-value	AC	P-value	AC	P-value	AC	P-value	AC	P-value
Including those who died during the 6-month follow-up														
Hospital stays	\$2,732	0.028	\$4,618	0.001	\$4,678	0.000	\$4,979	0.000	\$1,824	0.142	\$7,000	<.0001	\$14,596	<.0001
Prescpt. drug	\$168	0.179	\$345	0.016	\$1,037	<.0001	\$546	0.000	\$373	0.003	\$967	<.0001	\$1,715	<.0001
Long-term care	\$362	0.038	-\$28	0.888	\$601	0.001	\$1,722	<.0001	\$335	0.054	\$861	<.0001	\$2,066	<.0001
Amb.care svcs.	\$156	0.622	\$105	0.771	\$1,167	0.000	\$756	0.045	\$646	0.040	\$976	0.013	\$1,787	0.001
Total	\$3,418	0.011	\$5,040	0.001	\$7,483	<.0001	\$8,004	<.0001	\$3,177	0.018	\$9,804	<.0001	\$20,165	<.0001
Excluding those who died during the 6-month follow-up (continuous follow-up for 6 months)														
Hospital stays	\$3,311	0.020	\$6,714	<.0001	\$5,112	0.000	\$6,883	0.000	\$2,727	0.046	\$9,891	<.0001	\$18,211	<.0001
Prescpt. drug	\$288	0.060	\$488	0.006	\$1,011	<.0001	\$715	<.0001	\$435	0.003	\$1,033	<.0001	\$2,199	<.0001
Long-term care	\$525	0.028	\$147	0.594	\$683	0.003	\$2,214	<.0001	\$416	0.070	\$1,126	0.000	\$2,933	<.0001
Amb.care svcs.	\$261	0.501	\$807	0.073	\$909	0.015	\$1,198	0.008	\$1,006	0.007	\$1,319	0.005	\$2,396	0.000
Total	\$4,385	0.005	\$8,155	<.0001	\$7,714	<.0001	\$11,009	<.0001	\$4,584	0.002	\$13,369	<.0001	\$25,739	<.0001

¹Regression analysis controlled for differences in age, sex, race, state, stage at diagnosis and cancer site. All measures reported are per person.

Medicaid cost is reported for the six month period after diagnosis in 2003 dollars.

²Includes schizophrenic disorders, episodic mood disorders, delusional disorders, anxiety/personality disorders, and depressive disorders.

³AC-Additional cost of chronic conditions among cancer patients; that is, increased cost of cancer care due to the presence of the comorbid condition.

Exhibit 3. Incremental 6-month cost of care for comorbid conditions experienced by cancer patients compared to non-cancer patients¹

	<u>By Specific Chronic Conditions</u>								<u>By Number of Chronic Conditions</u>					
	<u>Cardiac</u>		<u>Respiratory</u>		<u>Diabetes</u>		<u>Mental health²</u>		<u>One Condition</u>		<u>Two Conditions</u>		<u>Three/Four Conditions</u>	
	IC ³	P-value	IC ³	P-value	IC ³	P-value	IC ³	P-value	IC ⁴	P-value	IC ⁴	P-value	IC ⁴	P-value
Hospital stays	\$3,387	0.002	\$2,693	0.043	\$3,686	0.001	\$4,235	0.001	\$945	0.379	\$7,676	<.0001	\$12,392	<.0001
Prescription drug	-\$564	<.0001	\$91	0.611	\$97	0.525	-\$324	0.055	-\$428	0.003	-\$583	0.001	-\$351	0.156
Long-term care	\$452	0.076	-\$172	0.590	\$557	0.040	\$1,325	<.0001	\$339	0.189	\$481	0.125	\$1,929	<.0001
Ambulatory care services	-\$1,068	0.001	\$49	0.898	\$227	0.484	-\$937	0.009	-\$103	0.738	-\$705	0.060	-\$1,779	0.001
Total	\$2,207	0.067	\$2,661	0.077	\$4,567	0.000	\$4,299	0.002	\$753	0.535	\$6,869	<.0001	\$12,191	<.0001

¹Regression analysis controlled for differences in age, sex, race, and state. All measures reported are per person. Medicaid cost is reported for the six month period after diagnosis in 2003 dollars.

²Includes schizophrenic disorders, episodic mood disorders, delusional disorders, anxiety/personality disorders, and depressive disorders.

³IC—incremental cost of care for cancer versus non-cancer patients with the same chronic conditions; cost attributable to the specific chronic condition.

⁴IC—incremental cost of care for cancer versus non-cancer patients by number of chronic conditions.

DISCUSSION

In this study, we analyzed Medicaid claims linked with cancer registry data to estimate the cost of care for individuals diagnosed with cancer who had preexisting chronic conditions. Cancer patients with the comorbidities studied—cardiac conditions, respiratory diseases, diabetes, and mental health disorders—have higher average costs per person compared to cancer patients without these conditions. Cancer patient costs related to comorbid conditions ranged from \$4,385 for cardiac conditions to \$11,009 for mental health disorders during the 6-month treatment phase. Since cancer patients with chronic conditions have overall higher health care needs, we also assessed the incremental cost of treating chronic diseases by comparing cancer patients with comorbid conditions to non-cancer patients with the same conditions. The cost of treating patients with each of the four comorbid conditions was greater among those undergoing cancer treatment, with diabetes and mental health patients experiencing statistically significant cost increases of about \$5,000 per person during the 6-month treatment phase. Cancer patients with multiple chronic conditions were the ones who incurred the highest cost, and the cost of care increased as the number of comorbidities increased.

Although numerous studies have estimated the cost of care during the same 6-month treatment phase as in our study, we are aware of none that assessed the relationship between specific chronic conditions and costs among Medicaid patients (Subramanian et al., 2010, 2011; Brown, Riley, Schussler, & Etzioni, 2002). With the rapid growth rate of chronic conditions, even among the non-elderly U.S. population, such estimates become increasingly important as cancer patients will likely have more comorbid conditions that will need to be managed, while the patients undergo potentially intensive cancer combination therapy involving surgery, chemotherapy and radiation (Imai, Gregg, Cheng, & Zhang, 2006; Partnership to Fight Chronic Diseases, 2009; Boyle, Thompson, Gregg, Barker, & Williamson, 2010). The higher rate of cancer complications and exacerbations of comorbid conditions among individuals with underlying comorbidities may explain this increase in the cost during the treatment phase, which can add significantly to the overall increasing cost of care (Srokowski, Fang, Hortobagyi, & Giordano, 2009; Peters et al., 2011; Lee, Cheung, Atkinson, & Krzyzanowska, 2011). It is also possible that individuals with underlying comorbidities are receiving additional services, because they are in contact with providers more often due to their cancer diagnosis. The results from this study though do not show higher levels of cost related to ambulatory visits which are the likely health care delivery site for treatment of comorbid conditions. The treatment modalities selected for cancer patients with comorbidities could also differ and potentially result in the higher cost of care reported in this study. Overall, the higher additional cost during cancer treatment among patients with comorbidities should offer economic incentives to providers and payers to adopt care processes that can reduce complications and improve outcomes. The true current cost of care related to chronic conditions among Medicaid cancer patients may be even higher than

reported in this study, as the estimates are based on 2003 dollars and because claims data may underestimate the prevalence of comorbidities (Iezzoni et al., 1992). The high-cost prevalent conditions among Medicaid beneficiaries has not changed over the past decade (Kaiser Commission on the Medicaid and Uninsured, 2012) and therefore the estimates provided in this study offer a good starting point to initiate the discussion on better management of these conditions.

We found that mental health conditions were associated with substantial additional health care costs among cancer patients. Because Medicaid has a high proportion of enrollees with mental conditions, the management of these conditions among Medicaid cancer patients is an important issue, and improvements in care management processes may lead to better outcomes for these patients as well as a reduction in treatment cost to the Medicaid program (Thomas et al., 2005; Buck, Teich, & Miller, 2003). As state Medicaid programs plan for projected cost increases associated with the expansion of Medicaid when ACA is fully implemented, we believe that they should consider the impact that preexisting chronic conditions will have on the cost of cancer treatment (Sommers & Rosenbaum, 2011). Low-income, uninsured individuals who will be enrolling in Medicaid may have significant unmet needs and potential underlying chronic conditions, because of a lack of access to usual sources of care through which preventive healthcare services could have been provided (Pizer, Frakt, & Iezzoni, 2009; Adams et al., 2007).

Although claims data have been used extensively to assess the cost of cancer care, these data are collected for administrative purposes and have certain limitations when used for estimating treatment costs for specific diseases. First, because our analysis was based on data from only three states (with statistically significant differences in overall cost of care), the results may not be representative of all state Medicaid programs, which may have different policies and cost structures (Cohen & Marks, 2009). Second, the representativeness of our results may also have been affected by our decision to limit our study sample to cancer patients continuously enrolled in Medicaid for 3 months prior to—and 6 months after—their cancer diagnosis, and by our decision to exclude those enrolled in Medicare as well as Medicaid. This cohort could differ from the overall Medicaid population as there is significant turnover in enrollment, and claims data only contain limited information to control for differences between cohorts (Ramsey et al., 2008). Third, the accuracy of our cost estimates is dependent on the completeness of claims that providers submitted for their services; however, because cancer care is relatively expensive, we believe that most providers submitted complete claims and, thus, that any bias associated with missing claims information was likely minimal. Fourth, in this study we focused on specific chronic conditions and there may be other conditions that we did not study that can also impact the cost of the care provided. We selected the conditions that are most prevalent in the Medicaid population and, therefore, should have captured the conditions likely to have the most impact on the overall costs to the Medicaid program. Also, individuals with conditions such as diabetes are likely to have multiple other chronic conditions (such as hypertension) and, therefore, the

costs we have presented in this study include the costs of the key conditions and related comorbidities (Garis, Shara, Farmer, Horrell, & Arora, 2002). Fifth, we did not have adequate baseline data to include baseline costs for cancer and non-cancer patients in the cost comparisons. This approach would have allowed for the assessment of incremental costs of chronic conditions due to cancer, in relation to baseline costs incurred for chronic conditions prior to the diagnosis of cancer.

Despite these limitations, our findings showed that the 6-month post diagnosis costs for Medicaid cancer patients with chronic conditions were significantly higher than those for Medicaid cancer patients without these chronic conditions, and cancer patients with chronic conditions incurred higher costs of care than non-cancer patients after controlling for cancer related costs. Estimates of the future cost of care for Medicaid enrollees with cancer should reflect these higher costs for patients with chronic conditions, rather than simply extrapolating from previous estimates of average overall Medicaid costs. This is of particular importance, because the prevalence of these chronic conditions, including the presence of multiple conditions, among Medicaid patients with newly diagnosed cancer is projected to increase (Tu & Cohen, 2009). The projected increase in Medicaid costs for enrollees with chronic medical conditions may prompt better care-management processes for Medicaid cancer patients overall and specifically for those with preexisting chronic conditions.

Disclaimer

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Appendix**Exhibit A1. Factors impacting total 6 month cost of care of Medicaid cancer patients <65 years old—assessing costs related to specific chronic conditions**

	Including those who died		Excluding those who died	
	Cost Estimate	P-value	Cost Estimate	P-value
Age groupings				
21–35	(reference)		(reference)	
36–50	-\$1,889	0.3847	-\$521	0.8171
51–64	-\$4,312	0.0455	-\$3,474	0.1239
Gender				
Males	(reference)		(reference)	
Females	-\$2,421	0.0807	-\$5,706	0.0006
Race Groupings				
White	(reference)		(reference)	
Black	\$10,083	<.0001	\$8,214	<.0001
Other	\$10,559	0.047	\$5,017	0.3685
Stage Groupings				
In-situ	(reference)		(reference)	
Local	\$9,379	0.0004	\$8,950	0.0006
Regional	\$21,978	<.0001	\$21,384	<.0001
Distant	\$20,103	<.0001	\$24,874	<.0001
Other/unknown	\$8,363	0.0081	\$13,633	0.0001
Tumor Sites				
Other sites	(reference)		(reference)	
Breast	-\$20,122	<.0001	-\$17,026	<.0001
Lung	-\$8,214	<.0001	-\$7,143	0.0025
Digestive organs	-\$5,560	0.0033	-\$1,814	0.4117
Female genital organs	-\$16,665	<.0001	-\$14,255	<.0001
Male genital organs	-\$22,502	<.0001	-\$22,545	<.0001
Oropharynx	\$6,041	0.0315	\$7,528	0.0144
Urinary tract	-\$11,862	<.0001	-\$11,351	0.0002
State				
Georgia	(reference)		(reference)	
Maine	\$28,623	<.0001	\$25,062	<.0001
Illinois	\$10,347	<.0001	\$6,485	<.0001
Chronic Conditions				
None	(reference)		(reference)	
Cardiac	\$3,418	0.0113	\$4,385	0.005
Respiratory	\$5,040	0.0011	\$8,155	<.0001
Diabetes	\$7,483	<.0001	\$7,714	<.0001
Mental Health	\$8,004	<.0001	\$11,009	<.0001

SOURCE: Results from ordinary least squares regression with total cost as dependent variable.

Exhibit A2. Factors impacting total 6-month cost of care of Medicaid cancer patients <65 years old - Assessing costs by number of chronic conditions

	Including those who died		Excluding those who died	
	Estimate	P-value	Estimate	P-value
Age groupings				
21-35	(reference)		(reference)	
36-50	-\$1,374	0.528	-\$14	0.9949
51-64	-\$3,892	0.0716	-\$3,283	0.1467
Gender				
Males	(reference)		(reference)	
Females	-\$2,204	0.111	-\$5,597	0.0007
Race Groupings				
White	(reference)		(reference)	
Black	\$9,886	<.0001	\$7,748	<.0001
Other	\$10,271	0.0532	\$4,571	0.4123
Stage Groupings				
In-situ	(reference)		(reference)	
Local	\$9,315	0.0005	\$8,791	0.0007
Regional	\$21,969	<.0001	\$21,264	<.0001
Distant	\$20,080	<.0001	\$24,588	<.0001
Other/unknown	\$8,267	0.0089	\$13,495	0.0001
Tumor Sites				
Other sites	(reference)		(reference)	
Breast	-\$20,035	<.0001	-\$17,010	<.0001
Lung	-\$8,525	<.0001	-\$7,359	0.0016
Digestive organs	-\$5,627	0.0029	-\$2,011	0.3627
Female genital organs	-\$16,592	<.0001	-\$14,253	<.0001
Male genital organs	-\$22,223	<.0001	-\$22,373	<.0001
Oropharynx	\$5,845	0.0372	\$7,390	0.0162
Urinary tract	-\$11,742	<.0001	-\$11,473	0.0002
State				
Georgia	(reference)		(reference)	
Maine	\$29,004	<.0001	\$25,377	<.0001
Illinois	\$10,234	<.0001	\$6,416	<.0001
Number of Chronic Conditions				
None	(reference)		(reference)	
One condition	\$3,177	0.0181	\$4,584	0.0022
Two conditions	\$9,804	<.0001	\$13,369	<.0001
Three/Four conditions	\$20,165	<.0001	\$25,739	<.0001

SOURCE: Results from ordinary least squares regression with total cost as dependent variable.

Exhibit A3. Factors impacting total 6-month cost of care of Medicaid cancer patients compared to non-cancer patients

	<u>Specific Chronic Conditions</u>		<u>Multiple Chronic Conditions</u>	
	Cost Estimate	P-value	Cost Estimate	P-value
Age groupings				
21-35	(reference)		(reference)	
36-50	-\$919	0.29	-\$669	0.4417
51-64	-\$2,601	0.0027	-\$2,436	0.0049
Gender				
Males	(reference)		(reference)	
Females	-\$4,275	<.0001	-\$4,291	<.0001
Race Groupings				
White	(reference)		(reference)	
Black	\$3,080	<.0001	\$2,908	<.0001
Other	\$1,671	0.1084	\$1,699	0.1022
State				
Georgia	(reference)		(reference)	
Maine	\$8,622	<.0001	\$8,691	<.0001
Illinois	\$3,753	<.0001	\$3,747	<.0001
Cancer				
No	(reference)		(reference)	
Yes	\$26,891	<.0001	\$27,534	<.0001
Chronic Conditions				
None	(reference)		(reference)	
Cardiac	\$4,046	<.0001		
Respiratory	\$6,137	<.0001		
Diabetes	\$3,319	<.0001		
Mental Health	\$5,189	<.0001		
Number of Chronic Conditions				
None			(reference)	
One condition			\$3,562	<.0001
Two conditions			\$7,893	<.0001
Three/Four conditions			\$15,163	<.0001
Interaction terms				
Cancer*Cardiac	\$2,207	0.0665		
Cancer*Respiratory	\$2,661	0.0768		
Cancer*Diabetes	\$4,567	0.0004		
Cancer*Mental Health	\$4,299	0.0024		
Cancer*One Condition			\$753	0.5352
Cancer*Two Conditions			\$6,869	<.0001
Cancer*Three/Four Conditions			\$12,191	<.0001

SOURCE: Results from ordinary least squares regression with total cost as dependent variab

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