

# Healthcare Costs of Mental Health Conditions among Commercially Insured Cancer Survivors in the United States, 2012-2017

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## Research Article

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# Abstract

## Purpose

Only one-third of cancer survivors with a mental health condition receive mental health services for these conditions. Non-receipt of care may be associated, in part, with financial burden. This study compares the costs of all health care services received by cancer survivors with and without mental health conditions and examines the insurer and out-of-pocket (OOP) costs for mental health services among cancer survivors. We also examine variation in these costs by clinical, demographic, and socioeconomic factors.

## Methods

We used the MarketScan Commercial Claims and Encounters Database 2012–2017 to compute adjusted annual costs reported in 2019 US\$. Adjusted costs were estimated using the two-part model with age, sex, and number of comorbid conditions as independent variables.

## Results

Cancer survivors with mental health conditions incur an additional \$8,376 in total costs and \$287 in OOP costs for all health care services compared to those without. Cancer survivors had higher total costs for mental health services, especially prescription drugs, compared to those without cancer or other chronic conditions. Costs vary by type of mental health condition, cancer type, demographics, and socioeconomic characteristics of the area where the patient resides.

## Conclusions

Cancer survivors with mental health conditions incur higher healthcare costs than those without mental health conditions. These costs vary by demographic and socioeconomic factors. Targeting community and population specific interventions for cancer survivors with mental health conditions who are incurring the highest healthcare costs may help improve utilization of mental health services.

## Background

Among more than 17 million cancer survivors in the United States [1], approximately one-third have been diagnosed with at least one mental health condition.[2–4] Depression and anxiety are the most prevalent mental health conditions among cancer survivors.[2, 5–7] Cancer survivors are six times more likely to have any mental health condition and twice as likely to have disabling psychological conditions compared to adults without cancer.[8, 9] Comorbid mental health conditions may be associated with higher morbidity and mortality among cancer survivors due to multiple biochemical pathways.[10–12] Despite the significant burden of mental health conditions, only one third of cancer survivors received

mental health services for these conditions.[3, 13, 14] Considering the high economic burden faced by cancer survivors, the out-of-pocket (OOP) costs associated with receiving mental health care may be a financial barrier and a reason to forego mental health care services.[15] Demographic and socioeconomic factors are associated with disparities in access to mental health services.[16–18] Examining the costs of mental health services, especially the OOP costs paid by patients, stratified by demographic and socioeconomic factors, may provide insight into possible reasons for differences in utilization of mental health services among cancer survivors.

Several studies have examined the economic burden of mental health conditions among cancer survivors,[19–21] using either self-reported survey data or Medicare claims data.[19] Additionally, previous studies have either examined the healthcare costs of all health-related services among cancer survivors with and without mental health conditions or have examined the direct medical costs of mental health services, but not both.[19] Another gap in previous literature is the lack of estimates of OOP spending on mental health services.[19] In the current study, we use a large claims dataset that includes younger adults as well as older adults with Medicare supplemented with an employer-sponsored retiree plan. First, we compare the costs of all healthcare services received by cancer survivors, enrollees with chronic conditions, and non-cancer control groups with and without mental health conditions. Second, we examine the insurer and OOP costs for mental health services among the three groups. Third, we explore variation in these costs associated with patient-level and area-level demographic and socioeconomic factors. Understanding the healthcare costs (i.e., the direct medical costs and OOP costs) among cancer survivors with mental health conditions may highlight opportunities for strategies that address barriers to utilization of mental healthcare services.

## **Methods**

### **Data**

The data source for this study was the IBM MarketScan databases, which consist of the MarketScan Commercial Claims and Encounters database and the MarketScan Medicare Supplemental and Coordination of Benefits Database for the years 2012 to 2017. The MarketScan Commercial Claims and Encounters database contains data for several million individuals annually who are covered by employer-sponsored private health insurance in the United States.[22] There are nearly 300 contributing employers and 25 contributing health plans. The population covers employees, their spouses, and dependents. The MarketScan Medicare Supplemental and Coordination of Benefits Database includes data on Medicare enrollees with employer-sponsored retiree plans to supplement former employees' Medicare plan.[22] Plans and employers from all 50 states and Washington DC contribute to both databases used in this study. This analysis was based on commercially available administrative claims data and did not involve direct contact with patients; therefore, Institutional Review Board approval was not required.

### **Study Population**

We examined commercially insured adults older than 18 years of age and categorized them into the following cohorts: 1) Cancer survivors with and without mental health condition(s); 2) enrollees diagnosed with chronic conditions other than cancer with and without mental health condition(s); and 3) non-cancer and non-chronic condition controls with and without mental health condition(s). For the cancer survivor cohort, we included enrollees having at least one of the cancer diagnoses (including primary cancer or metastases and excluding in situ or benign cancers) defined in eTable1 during the study period (January 1, 2012 to December 31, 2017). Because this study used claims data, cancer survivors could be defined only by whether enrollees had a cancer diagnosis in the sample period, so there may be enrollees with cancer diagnoses prior to the sample period that are not defined as cancer survivors. Inclusion was limited to enrollees who were continuously enrolled in a contributing health plan for at least 365 days immediately prior to, and 365 days immediately after their first cancer diagnosis in the sample period (index date).

We then constructed two matched cohorts of enrollees, one with any chronic condition other than cancer and the other with neither cancer nor chronic conditions. Matching with the cancer survivor cohort was done based on age, sex, type of health plan, and whether they have a chronic condition. For matching, the age and health insurance plan type of each cancer survivor was set as December 31 of the year of the cancer diagnosis (index date). For the non-cancer chronic conditions cohort, henceforth referred to as 'chronic condition enrollees,' we included those that had at least one diagnosis for a chronic condition as specified in eTable2 during the sample period and did not have a cancer diagnosis during the study period. For the non-cancer controls without any chronic conditions' cohort, henceforth referred to as 'healthy enrollees,' we included those that did not have any cancer diagnosis or any chronic condition during the sample period, and that had at least one medical claim in the 365 days immediately before or after the index date of the cancer survivor with whom they were matched.

## Variables

The dependent variables examined are total costs and OOP costs for 1) all healthcare services and 2) mental health services. Total costs were computed as the sum of health plan costs and OOP costs. Health plan costs are the costs paid to the provider by the health plan or one or more health plans in case of Medicare supplemental coverage. The aggregate categories of mental health conditions and mental health services used in the analysis are presented in eTables3 and 4. OOP costs are the costs paid by the patient, computed as the sum of coinsurance, copayment, and deductible. Annual costs for each enrollee were calculated using the following formula:

$$\frac{\text{Total cost for enrollee in sample period}}{\text{Number of days enrolled in sample period}} * 365.25 \text{ days}$$

All reported costs are adjusted to 2019 US\$ using the Personal Health Care Deflator by the Centers for Medicare and Medicaid Services (CMS).[23]

Age was categorized as 18-39, 40-49, 50-64, 65-74, 75-84, and 85+. Health plan type was categorized into three groups: 1) Comprehensive/Major Medical Plans, Comprehensive Plans, and Preferred Provider Organization (PPO) Plans; 2) Health Maintenance Organization (HMO) Plans, Exclusive Provider Organization (EPO) Plans, and Point-of-Service (POS) Plans; 3) Consumer-Driven Health Plans (CDHP) and High-Deductible Health Plans (HDHP). Control variables used to generate adjusted costs include age, sex, and number of unique comorbid chronic conditions. Number of unique comorbid chronic conditions is a count of all chronic conditions except cancer, as listed in eTable2, that the enrollee was diagnosed with during the study period.

Other independent variables used to stratify the results include cancer type by system, cancer type by survival time, and timing of mental health condition diagnosis relative to cancer diagnosis at the enrollee-level. Area-level variables are defined at the Metropolitan Statistical Area (MSA) level. These include metropolitan status, region, poverty rate, population aged 65+, education, number of hospital beds, and number of psychiatrists. Details regarding operationalization of these variables are presented in eTable5.

## Statistical Analysis

Due to the skewness in the distribution of costs, we used a two-part model. First, we used logistic regression to estimate the probability of an enrollee having any expenditures for the applicable set of healthcare services. Second, using the subset of enrollees predicted to have positive costs for the applicable set of healthcare services, we used a generalized linear model with gamma distribution and log-link to estimate the annual costs of all healthcare services and mental health services. For each demographic and socioeconomic stratification, we calculated adjusted annual costs using the two-part model with the mental health condition indicator as well as age, sex, and number of unique comorbid chronic conditions as independent variables. If the dependent variable in a particular stratification had only positive costs, costs were estimated using only a generalized linear model. The adjusted costs are presented as predictive margins, which standardizes these estimates to the covariate distribution of the overall population. For any estimates calculated using the two-part model, standard errors (SEs) used to compute the confidence intervals (CIs) were calculated using the delta method.[24] Statistical significance was set at  $P \leq .05$ , using two-tailed tests. All analyses were conducted using SAS 9.4 (SAS Institute, Cary, North Carolina) and Stata 16 (StataCorp LLC).

## Results

The total number of enrollees in the dataset during the study period was 2,662,813. eTable6 presents the number of enrollees in the cancer survivors, chronic conditions, and healthy enrollee cohorts with and without mental health conditions. Within each cohort, number of enrollees stratified by patient and area characteristics are also presented.

Table 1 presents the average adjusted annual costs for all services among the three cohorts by presence and type of mental health condition. Across all three cohorts, those with any mental health condition had a higher total as well as OOP costs than those without. Cancer survivors with mental health conditions

(compared to cancer survivors without mental health conditions) incur an additional \$8,376 in total costs and \$287 in OOP costs for all healthcare services. Among cancer survivors, highest total costs were incurred by those with trauma/stress-related disorders followed by those with depressive disorders whereas among enrollees with chronic conditions and healthy enrollees, highest costs were incurred by those with depressive disorders. There was a 37% difference in total costs and 21% difference in OOP costs between cancer survivors with and without mental health conditions. The highest percent difference between those with and without mental health conditions were among healthy enrollees (66% for total costs and 54% for OOP costs).

Table 1

Adjusted annual costs for all healthcare services among those with and without mental health conditions in all three cohorts, MarketScan Commercial Claims Data 2012–2017

Mental Health Condition	Cancer Survivors		Chronic Condition Enrollees		Healthy Enrollees	
	Total (95% CI)	OOP (95% CI)	Total (95% CI)	OOP (95% CI)	Total (95% CI)	OOP (95% CI)
<b>Any Mental Health Condition</b>	31,347 (31,156, 31,538)	1,647 (1,641, 1,653)	14,894 (14,823, 14,964)	1,248 (1,245, 1,251)	4,314 (4,249, 4,378)	711 (706, 716)
Depressive Disorder	36,389 (36,098, 36,680)	1,860 (1,850, 1,870)	18,149 (18,052, 18,246)	1,433 (1,429, 1,437)	5,126 (5,025, 5,227)	838 (829, 848)
Anxiety Disorder	34,348 (34,091, 34,604)	1,811 (1,803, 1,820)	15,842 (15,758, 15,925)	1,366 (1,362, 1,369)	4,588 (4,471, 4,706)	785 (778, 793)
Substance-Related and Addictive Disorder	35,425 (35,103, 35,746)	1,761 (1,749, 1,773)	16,041 (15,932, 16,151)	1,321 (1,316, 1,326)	4,342 (4,250, 4,434)	696 (686, 706)
Trauma/Stress-Related Disorder	38,382 (37,904, 38,860)	1,854 (1,840, 1,867)	17,301 (17,133, 17,468)	1,380 (1,374, 1,386)	4,618 (4,496, 4,741)	778 (768, 789)
<b>No Mental Health Condition</b>	22,971 (22,834, 23,107)	1,360 (1,355, 1,365)	9,853 (9,812, 9,894)	952 (950, 954)	2,594 (2,571, 2,617)	461 (459, 463)
<b>\$ Difference between any mental health condition and no mental health condition</b>	8,376 (8,049, 8,704)	287 (276, 298)	5,041 (4,929, 5,152)	296 (291, 301)	1,720 (1,632, 1,807)	250 (243, 257)
<b>% Difference between any mental health condition and no mental health condition</b>	36.46%	21.10%	51.16%	31.09%	66.31%	54.23%
OOP: Out-of-pocket; CI: Confidence Interval						
All costs are reported in 2019 US\$						
Adjusted costs were estimated using the two-part model with the mental health condition indicator as well as age, sex, and number of unique comorbid chronic conditions as independent variables. When estimating costs for a mental health condition, the sample was limited to enrollees with no mental health condition and those with the mental health condition being estimated. Costs for enrollees with no mental health condition were estimated in the same model as those with any mental health condition.						
The adjusted costs are presented as predictive margins, which standardizes these estimates to the covariate distribution of the overall population. For any estimates calculated using the two-part model, standard errors (SEs) used to compute the CIs were calculated using the delta method.						

Table 2 presents the costs of all healthcare services among cancer survivors with mental health conditions by strata. Total costs were highest among those aged 50 to 64 years whereas OOP costs were highest among those aged 40 to 49 years. Total costs were higher among males, but OOP costs were higher among females. Total costs were highest among those with comprehensive and PPO plans, whereas OOP costs were highest among those with high deductible plans. Total costs were highest among those with upper gastrointestinal system cancers, whereas OOP costs were highest among those with neurological cancers. Total annual costs, as well as OOP costs for all healthcare services, were higher among those diagnosed with a cancer with short survival. Costs increased with increasing number of comorbid conditions and mental health conditions. Total costs were higher among those residing in metropolitan areas and those residing in the Northeast region, whereas OOP costs were higher among those not residing in metropolitans and those residing in the South. Total costs were lower among those areas that were at or above the 90th percentile of poverty rate and rate of persons aged 25 and over with less than high school education, while the reverse was true for OOP costs. Total costs were lower among areas that were at or above the 90th percentile of unemployment rate whereas there was no significant difference in OOP costs. Total and OOP costs were lower among areas with rate of persons aged 65 and over above the 90th percentile. Lastly, total costs increased, and OOP costs decreased with higher density of psychiatrists in the area.

Table 2

Adjusted annual costs for all healthcare services by patient and area characteristics among cancer survivors with and without mental health conditions, MarketScan Commercial Claims Data 2012–2017

Characteristics	With mental health conditions		Without mental health conditions	
	Total (95% CI)	OOP (95% CI)	Total (95% CI)	OOP (95% CI)
<b>Total</b>	31,693 (31,500, 31,886)	1,665 (1,659, 1,671)	23,225 (23,086, 23,362)	1,375 (1,370, 1,380)
<b>Age</b>				
18–39	29,211 (28,573, 29,849)	1,810 (1,790, 1,831)	19,516 (19,063, 19,969)	1,387 (1,370, 1,403)
40–49	30,474 (30,015, 30,933)	1,881 (1,865, 1,896)	21,264 (20,934, 21,595)	1,483 (1,471, 1,496)
50–64	32,582 (32,297, 32,867)	1,843 (1,833, 1,853)	23,043 (22,844, 23,241)	1,525 (1,518, 1,533)
65–74	31,536 (31,034, 32,038)	1,228 (1,217, 1,239)	25,602 (25,215, 25,988)	1,085 (1,077, 1,093)
75–84	31,318 (30,741, 31,895)	1,202 (1,189, 1,215)	27,039 (26,585, 27,492)	1,065 (1,054, 1,075)
85+	29,424 (28,284, 30,566)	1,106 (1,085, 1,127)	24,188 (23,384, 24,993)	966 (949, 983)
<b>Sex</b>				
Male	34,121 (33,769, 34,473)	1,595 (1,585, 1,605)	24,279 (24,057, 24,501)	1,340 (1,333, 1,347)
Female	29,888 (29,669, 30,108)	1,721 (1,713, 1,728)	22,398 (22,223, 22,572)	1,400 (1,394, 1,407)
<b>Health Insurance Plan Type</b>				
Comprehensive, PPO	32,467 (32,237, 32,697)	1,681 (1,674, 1,688)	24,128 (23,962, 24,295)	1,400 (1,395, 1,406)
HMO, EPO, POS	28,905 (28,512, 29,297)	1,340 (1,327, 1,351)	20,436 (20,161, 20,711)	1,037 (1,028, 1,046)
OOP: Out-of-pocket; CI: Confidence Interval				
All costs are reported in 2019 US\$				
Adjusted costs were estimated using the two-part model with the mental health condition indicator as well as age, sex, and number of unique comorbid chronic conditions as independent variables. When estimating costs for a given Enrollee Type and characteristic, the sample was limited to enrollees of that Enrollee Type and with that characteristic. The adjusted costs are presented as predictive margins, which standardizes these estimates to the covariate distribution of the overall population. For any estimates calculated using the two-part model, standard errors (SEs) used to compute the CIs were calculated using the delta method.				

	With mental health conditions		Without mental health conditions	
CDHP, HDHP	31,603 (30,814, 32,391)	2,505 (2,478, 2,533)	21,713 (21,204, 22,223)	2,060 (2,040, 2,081)
<b>Cancer Type by System</b>				
Colon and Rectum	39,315 (38,621, 40,011)	1,688 (1,669, 1,708)	30,335 (29,804, 30,865)	1,426 (1,409, 1,442)
Endocrine	21,071 (20,556, 21,585)	1,787 (1,762, 1,811)	15,158 (14,796, 15,518)	1,456 (1,437, 1,475)
Female Breast	29,896 (29,598, 30,194)	1,739 (1,728, 1,751)	23,654 (23,412, 23,897)	1,445 (1,435, 1,454)
Female Genital System	29,130 (28,512, 29,748)	1,674 (1,654, 1,695)	21,621 (21,144, 22,098)	1,390 (1,373, 1,406)
Head and Neck	37,025 (36,088, 37,963)	1,784 (1,749, 1,820)	26,298 (25,604, 26,994)	1,460 (1,429, 1,491)
Lung	58,008 (57,231, 58,787)	1,937 (1,916, 1,959)	56,065 (55,066, 57,064)	1,790 (1,762, 1,816)
Lymphoma and Leukemia	46,139 (45,254, 47,023)	1,820 (1,800, 1,840)	34,696 (34,026, 35,365)	1,490 (1,473, 1,507)
Melanoma	23,634 (22,925, 24,344)	1,470 (1,455, 1,486)	16,135 (15,721, 16,550)	1,187 (1,177, 1,198)
Neurological	49,486 (47,774, 51,199)	2,162 (2,126, 2,197)	41,208 (39,696, 42,719)	1,836 (1,798, 1,874)
Prostate	24,328 (23,934, 24,721)	1,429 (1,415, 1,442)	18,346 (18,108, 18,584)	1,226 (1,217, 1,234)
Upper Gastrointestinal System	65,237 (64,266, 66,210)	2,089 (2,060, 2,117)	55,627 (54,674, 56,581)	1,847 (1,819, 1,876)
Urinary System	34,510 (33,722, 35,296)	1,696 (1,671, 1,719)	27,361 (26,759, 27,962)	1,462 (1,441, 1,482)
<b>Cancer Survival Time Category</b>				

OOP: Out-of-pocket; CI: Confidence Interval

All costs are reported in 2019 US\$

Adjusted costs were estimated using the two-part model with the mental health condition indicator as well as age, sex, and number of unique comorbid chronic conditions as independent variables. When estimating costs for a given Enrollee Type and characteristic, the sample was limited to enrollees of that Enrollee Type and with that characteristic. The adjusted costs are presented as predictive margins, which standardizes these estimates to the covariate distribution of the overall population. For any estimates calculated using the two-part model, standard errors (SEs) used to compute the CIs were calculated using the delta method.

	With mental health conditions		Without mental health conditions	
Short	58,452 (57,803, 59,101)	1,973 (1,955, 1,990)	53,078 (52,343, 53,814)	1,787 (1,767, 1,807)
Medium	41,239 (40,859, 41,619)	1,794 (1,782, 1,805)	31,149 (30,853, 31,444)	1,483 (1,474, 1,492)
Long	26,640 (26,433, 26,847)	1,597 (1,590, 1,604)	19,858 (19,714, 20,002)	1,327 (1,322, 1,333)
<b>Number of Unique Comorbid Chronic Conditions</b>				
0	20,853 (20,404, 21,302)	1,360 (1,345, 1,376)	14,080 (13,866, 14,293)	1,074 (1,065, 1,083)
1	26,559 (26,307, 26,811)	1,657 (1,648, 1,666)	18,766 (18,605, 18,927)	1,335 (1,329, 1,342)
2	34,565 (34,188, 34,942)	1,748 (1,737, 1,760)	25,671 (25,391, 25,950)	1,479 (1,469, 1,489)
3	44,096 (43,492, 44,702)	1,817 (1,797, 1,836)	35,858 (35,302, 36,413)	1,608 (1,588, 1,627)
4 or more	64,414 (63,060, 65,769)	1,925 (1,904, 1,946)	60,956 (59,146, 62,764)	1,801 (1,772, 1,829)
<b>Number of Unique Mental Health Conditions</b>				
1	29,589 (29,351, 29,827)	1,577 (1,570, 1,585)	N/A	N/A
2	34,840 (34,476, 35,204)	1,802 (1,788, 1,816)	N/A	N/A
3	41,208 (40,614, 41,801)	2,039 (2,022, 2,057)	N/A	N/A
4 or more	44,983 (43,831, 46,137)	2,333 (2,304, 2,364)	N/A	N/A
<b>Region</b>				

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Adjusted costs were estimated using the two-part model with the mental health condition indicator as well as age, sex, and number of unique comorbid chronic conditions as independent variables. When estimating costs for a given Enrollee Type and characteristic, the sample was limited to enrollees of that Enrollee Type and with that characteristic. The adjusted costs are presented as predictive margins, which standardizes these estimates to the covariate distribution of the overall population. For any estimates calculated using the two-part model, standard errors (SEs) used to compute the CIs were calculated using the delta method.

	With mental health conditions		Without mental health conditions	
Northeast	37,533 (37,040, 38,025)	1,415 (1,405, 1,427)	26,511 (26,187, 26,836)	1,144 (1,136, 1,153)
Midwest	27,561 (27,254, 27,868)	1,581 (1,570, 1,591)	20,702 (20,462, 20,942)	1,362 (1,353, 1,371)
South	30,442 (30,149, 30,737)	1,872 (1,862, 1,883)	22,381 (22,166, 22,596)	1,561 (1,553, 1,569)
West	33,466 (32,867, 34,066)	1,693 (1,672, 1,714)	23,493 (23,110, 23,875)	1,337 (1,322, 1,352)
<b>Metropolitan Status</b>				
Metropolitan	32,083 (31,871, 32,297)	1,660 (1,654, 1,667)	23,355 (23,205, 23,506)	1,367 (1,362, 1,372)
Non-Metropolitan	29,385 (28,937, 29,833)	1,692 (1,677, 1,707)	22,398 (22,050, 22,746)	1,429 (1,415, 1,441)
<b>Poverty Rate</b>				
< 90th Percentile	31,875 (31,673, 32,078)	1,652 (1,646, 1,658)	23,317 (23,172, 23,461)	1,364 (1,359, 1,369)
≥ 90th Percentile	28,992 (28,340, 29,642)	1,875 (1,853, 1,899)	21,888 (21,392, 22,385)	1,570 (1,551, 1,590)
<b>Rate of Persons Age 25 + with Less than High School Diploma</b>				
< 90th Percentile	31,758 (31,557, 31,959)	1,662 (1,656, 1,668)	23,281 (23,138, 23,426)	1,375 (1,370, 1,380)
≥ 90th Percentile	30,599 (29,886, 31,312)	1,736 (1,713, 1,759)	22,312 (21,817, 22,806)	1,402 (1,384, 1,419)
<b>Rate of Population Age 65+</b>				
< 90th Percentile	31,838 (31,636, 32,038)	1,677 (1,671, 1,683)	23,278 (23,135, 23,422)	1,381 (1,376, 1,386)
≥ 90th Percentile	25,675 (24,924, 26,427)	1,525 (1,502, 1,547)	19,383 (18,804, 19,961)	1,315 (1,296, 1,335)

OOP: Out-of-pocket; CI: Confidence Interval

All costs are reported in 2019 US\$

Adjusted costs were estimated using the two-part model with the mental health condition indicator as well as age, sex, and number of unique comorbid chronic conditions as independent variables. When estimating costs for a given Enrollee Type and characteristic, the sample was limited to enrollees of that Enrollee Type and with that characteristic. The adjusted costs are presented as predictive margins, which standardizes these estimates to the covariate distribution of the overall population. For any estimates calculated using the two-part model, standard errors (SEs) used to compute the CIs were calculated using the delta method.

	With mental health conditions		Without mental health conditions	
<b>Unemployment Rate</b>				
< 90th Percentile	31,715 (31,519, 31,911)	1,668 (1,662, 1,674)	23,222 (23,081, 23,362)	1,379 (1,374, 1,384)
≥ 90th Percentile	29,939 (28,794, 31,083)	1,685 (1,650, 1,720)	22,356 (21,486, 23,227)	1,343 (1,314, 1,371)
<b>Number of Psychiatrists per 10,000 Persons</b>				
0 to Less than 1	30,011 (29,748, 30,273)	1,765 (1,756, 1,774)	22,312 (22,116, 22,508)	1,483 (1,475, 1,490)
1 to Less than 2	30,653 (30,340, 30,965)	1,607 (1,596, 1,616)	22,355 (22,131, 22,580)	1,343 (1,336, 1,351)
2 or More	38,312 (37,735, 38,890)	1,536 (1,522, 1,549)	26,762 (26,395, 27,129)	1,205 (1,195, 1,214)
OOP: Out-of-pocket; CI: Confidence Interval				
All costs are reported in 2019 US\$				
Adjusted costs were estimated using the two-part model with the mental health condition indicator as well as age, sex, and number of unique comorbid chronic conditions as independent variables. When estimating costs for a given Enrollee Type and characteristic, the sample was limited to enrollees of that Enrollee Type and with that characteristic. The adjusted costs are presented as predictive margins, which standardizes these estimates to the covariate distribution of the overall population. For any estimates calculated using the two-part model, standard errors (SEs) used to compute the CIs were calculated using the delta method.				

Table 3 presents the adjusted annual costs of mental health services by setting and mental health conditions among the three cohorts examined in this study. We do not present results for inpatient and emergency settings since these were infinitesimal. Cancer survivors and those with chronic conditions had higher total annual costs for mental health services as compared to healthy enrollees. Across all three cohorts and settings, those with stress/trauma related disorders and depressive disorders had the highest costs whereas those with substance-related and addiction disorders had the lowest costs. Cancer survivors and those with chronic conditions had higher costs for prescription drugs across all mental health conditions. Outpatient costs did not significantly vary across the cohorts. OOP costs were higher among healthy enrollees for any mental health condition, stress/trauma related disorders, and depressive disorders.

Table 3

Adjusted annual costs of mental health services by setting and mental health condition among all three cohorts, MarketScan Commercial Claims Data 2012–2017

	Any Mental Health Condition		Depressive Disorder		Anxiety Disorder		Substance-Related and Addictive Disorder		Stress/Trauma-Related Disorder	
	Total (95% CI)	OOP (95% CI)	Total (95% CI)	OOP (95% CI)	Total (95% CI)	OOP (95% CI)	Total (95% CI)	OOP (95% CI)	Total (95% CI)	OOP (95% CI)
<b>Cancer Survivors</b>										
<b>All Settings</b>	365 (360, 370)	69 (69, 70)	615 (605, 624)	109 (108, 111)	461 (454, 469)	87 (86, 88)	303 (295, 312)	51 (50, 52)	635 (621, 648)	126 (123, 128)
Outpatient	140 (136, 143)	32 (32, 33)	220 (215, 225)	49 (48, 50)	181 (177, 185)	41 (40, 42)	102 (98, 106)	20 (19, 21)	356 (347, 364)	84 (82, 86)
Prescription Drugs	217 (214, 221)	36 (35, 36)	380 (373, 386)	60 (60, 61)	271 (265, 276)	45 (44, 45)	185 (180, 191)	29 (29, 30)	265 (256, 274)	40 (39, 41)
<b>Chronic Condition Enrollees</b>										
<b>All Settings</b>	368 (365, 371)	71 (70, 71)	608 (602, 613)	109 (109, 110)	458 (454, 463)	88 (87, 88)	304 (299, 308)	51 (50, 52)	609 (601, 616)	125 (123, 126)

OOP: Out-of-pocket; CI: Confidence Interval

All costs are reported in 2019 US\$

We did not present the costs from inpatient and emergency department settings as they were nearly 0 for all cohorts and conditions.

Adjusted costs were estimated using the two-part model with age, sex, and number of unique comorbid chronic conditions as the independent variables.

When estimating costs for a given Enrollee Type, healthcare setting, and mental health condition, the sample was limited to enrollees of that Enrollee Type and with a diagnosis for that mental health condition in the sample period, and for services in that setting.

The adjusted costs are presented as predictive margins, which standardizes these estimates to the covariate distribution of the overall population. For any estimates calculated using the two-part model, standard errors (SEs) used to compute the CIs were calculated using the delta method.

	Any Mental Health Condition		Depressive Disorder		Anxiety Disorder		Substance-Related and Addictive Disorder		Stress/Trauma-Related Disorder	
Outpatient	127	30	199	44	163	38	93	18	328	82
	(126, 129)	(30, 31)	(196, 202)	(44, 45)	(161, 165)	(37, 38)	(91, 96)	(18, 19)	(323, 332)	(80, 83)
Prescription Drugs	234	39	396	64	287	49	197	31	268	42
	(232, 236)	(39, 39)	(392, 400)	(64, 65)	(284, 290)	(49, 50)	(193, 200)	(30, 31)	(263, 274)	(41, 42)
<b>Healthy Enrollees</b>										
<b>All Settings</b>	295	74	543	127	360	90	195	41	489	135
	(288, 301)	(73, 76)	(528, 557)	(124, 130)	(349, 370)	(88, 92)	(184, 206)	(39, 43)	(472, 507)	(131, 139)
Outpatient	136	41	232	67	166	50	86	21	334	105
	(132, 141)	(40, 42)	(222, 242)	(64, 69)	(159, 173)	(48, 52)	(79, 93)	(20, 22)	(322, 346)	(101, 108)
Prescription Drugs	155	31	302	60	188	40	97	18	151	29
	(151, 159)	(31, 32)	(292, 312)	(59, 61)	(181, 195)	(39, 40)	(91, 104)	(18, 19)	(141, 161)	(28, 31)
OOP: Out-of-pocket; CI: Confidence Interval										
All costs are reported in 2019 US\$										
We did not present the costs from inpatient and emergency department settings as they were nearly 0 for all cohorts and conditions.										
Adjusted costs were estimated using the two-part model with age, sex, and number of unique comorbid chronic conditions as the independent variables.										
When estimating costs for a given Enrollee Type, healthcare setting, and mental health condition, the sample was limited to enrollees of that Enrollee Type and with a diagnosis for that mental health condition in the sample period, and for services in that setting.										
The adjusted costs are presented as predictive margins, which standardizes these estimates to the covariate distribution of the overall population. For any estimates calculated using the two-part model, standard errors (SEs) used to compute the CIs were calculated using the delta method.										

Table 4 presents the costs of mental health services among cancer survivors by strata. Total costs and OOP costs were highest among younger cancer survivors (18 to 39 years and 40 to 49 years), females, and those with high deductible plans. Higher costs were reported by those diagnosed with endocrine cancers (compared to other organ systems) and those diagnosed with cancers with longer survival times

(compared to cancers with shorter survival times). Total and OOP costs were highest among those with one comorbid condition and decreased with increasing number of comorbid conditions. Total and OOP costs were higher for those with higher number of mental health conditions. Both costs were higher for those residing in metropolitan areas and in the Northeast region. Total costs and OOP costs were lower among those areas that were above the 90th percentile of poverty rate, unemployment rate, and rate of persons aged 25 and over with less than high school education. Total and OOP costs were lower among MSAs with proportion of persons aged 65 and over above the 90th percentile. Both total and OOP costs for mental health services increased with increased density of psychiatrists in the MSA.

Table 4

Adjusted annual costs of mental health services by patient and area characteristics among cancer survivors, MarketScan Commercial Claims Data 2012–2017

<b>Characteristics</b>	<b>Total (95% CI)</b>	<b>OOP (95% CI)</b>
<b>All</b>	365 (360, 370)	69 (69, 70)
<b>Age</b>		
<b>18–39</b>	428 (411, 443)	92 (89, 94)
<b>40–49</b>	424 (411, 436)	88 (86, 91)
<b>50–64</b>	395 (387, 402)	74 (73, 76)
<b>65–74</b>	287 (276, 298)	42 (41, 43)
<b>75–84</b>	209 (200, 218)	33 (32, 34)
<b>85+</b>	190 (177, 204)	31 (30, 33)
<b>Sex</b>		
<b>Male</b>	284 (277, 291)	52 (51, 53)
<b>Female</b>	417 (410, 424)	81 (80, 82)
<b>Health Insurance Plan Type</b>		
<b>Comprehensive, PPO</b>	371 (365, 376)	68 (68, 69)
<b>HMO, EPO, POS</b>	342 (333, 352)	64 (63, 66)
<b>CDHP, HDHP</b>	378 (358, 397)	97 (93, 101)
<b>Cancer Type by System</b>		
<b>Colon and Rectum</b>	296 (282, 310)	54 (52, 56)
<b>Endocrine</b>	426 (404, 447)	85 (81, 89)
<b>Female Breast</b>	411 (401, 422)	80 (79, 82)

OOP: Out-of-pocket; CI: Confidence Interval

All costs are reported in 2019 US\$

Adjusted costs were estimated using the two-part model with age, sex, and number of unique comorbid chronic conditions as the independent variables.

When estimating costs for a given Enrollee Type and characteristic, the sample was limited to enrollees of that Enrollee Type and with that characteristic.

The adjusted costs are presented as predictive margins, which standardizes these estimates to the covariate distribution of the overall population. For any estimates calculated using the two-part model, standard errors (SEs) used to compute the CIs were calculated using the delta method

<b>Characteristics</b>	<b>Total (95% CI)</b>	<b>OOP (95% CI)</b>
<b>Female Genital System</b>	406 (389, 424)	79 (76, 82)
<b>Head and Neck</b>	303 (283, 323)	57 (54, 60)
<b>Lung</b>	272 (259, 284)	47 (44, 48)
<b>Lymphoma and Leukemia</b>	419 (400, 436)	76 (73, 78)
<b>Melanoma</b>	390 (375, 406)	81 (78, 83)
<b>Neurological</b>	369 (348, 390)	65 (61, 68)
<b>Prostate</b>	276 (265, 287)	51 (49, 52)
<b>Upper Gastrointestinal System</b>	294 (280, 308)	52 (50, 55)
<b>Urinary System</b>	306 (292, 319)	54 (52, 56)
<b>Cancer Survival Time Category</b>		
<b>Short</b>	285 (275, 295)	50 (48, 51)
<b>Medium</b>	364 (356, 372)	67 (65, 68)
<b>Long</b>	369 (362, 375)	72 (71, 73)
<b>Number of Unique Comorbid Chronic Conditions</b>		
<b>0</b>	275 (264, 286)	68 (65, 70)
<b>1</b>	382 (375, 390)	80 (78, 81)
<b>2</b>	381 (371, 391)	66 (65, 68)
<b>3</b>	362 (349, 375)	55 (54, 57)
<b>4 or more</b>	351 (335, 367)	49 (47, 50)
<b>Number of Unique Mental Health Conditions</b>		
<b>1</b>	149 (146, 152)	33 (32, 33)

OOP: Out-of-pocket; CI: Confidence Interval

All costs are reported in 2019 US\$

Adjusted costs were estimated using the two-part model with age, sex, and number of unique comorbid chronic conditions as the independent variables.

When estimating costs for a given Enrollee Type and characteristic, the sample was limited to enrollees of that Enrollee Type and with that characteristic.

The adjusted costs are presented as predictive margins, which standardizes these estimates to the covariate distribution of the overall population. For any estimates calculated using the two-part model, standard errors (SEs) used to compute the CIs were calculated using the delta method

Characteristics	Total (95% CI)	OOP (95% CI)
2	407 (399, 417)	82 (80, 83)
3	743 (725, 761)	133 (130, 136)
4 or more	1,478 (1,432, 1,525)	222 (215, 230)
<b>Region</b>		
Northeast	471 (459, 484)	92 (90, 95)
Midwest	310 (302, 317)	56 (55, 57)
South	328 (320, 335)	62 (61, 63)
West	401 (387, 416)	79 (77, 82)
<b>Metropolitan Status</b>		
Metropolitan	382 (377, 388)	73 (72, 74)
Non-Metropolitan	264 (255, 273)	50 (49, 51)
<b>Poverty Rate</b>		
< 90th Percentile	372 (367, 377)	71 (70, 71)
≥ 90th Percentile	280 (266, 293)	56 (54, 58)
<b>Rate of Persons Age 25 + with Less than High School Diploma</b>		
< 90th Percentile	368 (363, 374)	70 (69, 71)
≥ 90th Percentile	331 (314, 347)	66 (63, 69)
<b>Rate of Population Age 65+</b>		
< 90th Percentile	371 (366, 376)	71 (70, 72)
≥ 90th Percentile	273 (258, 288)	48 (45, 50)
<b>Unemployment Rate</b>		

OOP: Out-of-pocket; CI: Confidence Interval

All costs are reported in 2019 US\$

Adjusted costs were estimated using the two-part model with age, sex, and number of unique comorbid chronic conditions as the independent variables.

When estimating costs for a given Enrollee Type and characteristic, the sample was limited to enrollees of that Enrollee Type and with that characteristic.

The adjusted costs are presented as predictive margins, which standardizes these estimates to the covariate distribution of the overall population. For any estimates calculated using the two-part model, standard errors (SEs) used to compute the CIs were calculated using the delta method

Characteristics	Total (95% CI)	OOP (95% CI)
< 90th Percentile	369 (364, 374)	70 (70, 71)
≥ 90th Percentile	262 (243, 281)	44 (41, 47)
<b>Number of Psychiatrists per 10,000 Persons</b>		
0 to Less than 1	304 (299, 310)	56 (56, 57)
1 to Less than 2	362 (354, 369)	68 (67, 69)
2 or More	541 (525, 557)	109 (106, 112)
OOP: Out-of-pocket; CI: Confidence Interval		
All costs are reported in 2019 US\$		
Adjusted costs were estimated using the two-part model with age, sex, and number of unique comorbid chronic conditions as the independent variables.		
When estimating costs for a given Enrollee Type and characteristic, the sample was limited to enrollees of that Enrollee Type and with that characteristic.		
The adjusted costs are presented as predictive margins, which standardizes these estimates to the covariate distribution of the overall population. For any estimates calculated using the two-part model, standard errors (SEs) used to compute the CIs were calculated using the delta method		

## Discussion

To our knowledge this is the first paper to use commercial claims data to examine the costs of mental health services among cancer survivors. We compared the costs of all healthcare services received by cancer survivors, non-cancer enrollees with chronic conditions, and enrollees with neither cancer nor chronic conditions, with and without mental health conditions. Next, we examined the insurer and OOP costs for mental health services among the three cohorts. Lastly, we examined variation in these costs associated with patient-level and the area-level demographic and socioeconomic factors. This study addresses several gaps identified in previous literature such as quantifying costs of mental health services for specific mental health conditions, examining OOP costs and costs by cancer type and survivorship duration.[19]

Across all three cohorts, those with any mental health condition had higher total as well as OOP costs than those without. Cancer survivors with any mental health condition (compared to those without a mental health condition) incurred an additional \$8,376 (2019 US\$) in total annual costs and \$287 (2019 US\$) in OOP costs. This is within the range found in previous literature.[19] The percent difference in OOP costs between those with and without mental health conditions were highest among healthy enrollees and lowest among cancer survivors. This may be because cancer survivors may have met their OOP maximum with OOP costs associated with their cancer-related treatment.[19] Among cancer survivors, highest total costs were incurred by those with trauma/stress-related disorders followed by those with

depressive disorders. While National Comprehensive Cancer Network, American Society for Clinical Oncology and Commission on Cancer all require accredited centers to integrate psychosocial distress screening as part of cancer care, only 50–65% of eligible cancer patients undergo screening.[25, 26] In addition, among cancer survivors who are diagnosed with distress, nearly three-quarters refuse treatment for distress. Prior research has shown that a hybrid approach involving screening, treatment referral, and emotional support by the clinical team may serve as a method for early diagnosis and management of distress among patients.[25] Additionally, screening for other mental health conditions such as depression and anxiety have been shown to reduce the clinical and economic burden of these conditions among cancer survivors.[27, 28] In addition, public health approaches such as destigmatize mental disorders/seeking treatment, providing tele-mental health and/or community-based, culturally-relevant treatment options may help increase utilization and can be examined in future research.

Total as well as OOP costs for all healthcare services and mental health services among cancer survivors with mental health conditions vary by cancer type, number and type of mental health condition and comorbid condition, and sociodemographic factors. Average annual total costs as well as OOP costs for all healthcare services were higher among those diagnosed with a cancer with short survival compared to those with a long survival, likely due to the lesser number of years in the denominator, higher likelihood of inpatient stay, and more complex treatments provided to those with aggressive cancers.[29] Across all three cohorts and settings, those with stress/trauma related disorders and depressive disorders had the highest costs whereas those with substance-related and addiction disorders had the lowest costs which is in line with previous literature.[30] Total and OOP costs were higher for those with a greater number of mental health conditions. Given that 18% of U.S. adults with mental illness also have a substance use disorder,[31] it may also be important to highlight the increase in costs proportionate to the number of mental health conditions. Total and OOP costs for mental health services were highest among those with one comorbid condition and decreased with increasing number of comorbid conditions (Table 4). These findings may lend support to previous research findings that suggest that holistic management of patients with chronic conditions and mental health conditions may help reduce clinical burden and subsequently healthcare costs.[32–34]

In terms of sociodemographic factors, total costs for all healthcare services as well as total costs and OOP costs for mental health services were higher for those residing in metropolitan areas and in the Northeast region which is consistent with previous findings.[35] OOP costs for all healthcare services were higher in the South. Individuals in the South are more likely than those in other regions to have multiple chronic illnesses, experience worse health outcomes, and be underinsured.[36] OOP costs for all healthcare services as well as mental health services were highest among high deductible plans, as seen in previous literature.[37] OOP costs for all healthcare services among cancer survivors with mental health conditions were higher in areas with higher rates of poverty, lack of education, and lower density of psychiatrists. Further research is needed to understand whether and how these differences compound any existing health inequities, and to target community and population specific interventions for communities and population groups with the highest clinical burden and healthcare costs.

## Study Limitations

This study has several limitations. First, MarketScan databases are based on a large convenience sample. Because the sample is not random, it may contain biases or fail to generalize well to other populations. Data come mostly from large employers; medium and small firms may be underrepresented, although the MarketScan Research Databases include a large amount of data contributed from health plans.[22] Second, this is a descriptive study and we do not consider the impact of any policy or other factors affecting time trends. Third, we only present outpatient and prescription drug costs and not inpatient and emergency department costs. Fourth, we only had data availability until 2017 so the analysis was restricted to 2017.

## Conclusions

Findings from this paper suggest that the cost for all healthcare services is higher among commercially insured cancer survivors with mental health conditions as compared to those without. Among the three cohorts, cancer survivors and those with chronic conditions incur higher annual total costs for mental health services compared to enrollees without cancer or chronic conditions. Studies have also shown that early detection and holistic management of mental health conditions among cancer survivors can reduce their overall utilization of health services and in turn, their associated healthcare costs.[19] Targeting community and population specific interventions for cancer survivors with mental health conditions who are incurring the highest healthcare costs may help improve utilization of mental health services.[18, 38, 39] Findings from this study can serve as inputs to understand potential healthcare costs averted that may result from early detection and treatment of mental health conditions among cancer survivors. Future research may be needed to examine the impact of increased uptake on tele-mental health services during the Covid-19 pandemic on utilization and costs of mental health services among commercially insured cancer survivors.

## Declarations

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The authors have no relevant financial or non-financial interests to disclose.

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Jaya Khushalani and Brandon Hesgrove. The first draft of the manuscript was written by Jaya Khushalani and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

This study uses secondary deidentified data and hence Ethical approval and IRB Approval were not needed.

## Data Availability Statement

Original de-identified data used in this analysis were obtained from and are the property of IBM MarketScan, and were accessed by the authors as part of a Data Use Agreement and thus cannot be shared publicly. Any researcher requiring access to the raw data that were used to generate the analytical files can access the data directly through IBM MarketScan at <https://www.ibm.com/products/marketscan-research-databases/databases>.

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