Cancer Care Spending and Use by Site of Provider-Administered Chemotherapy in Medicare

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ABSTRACT

OBJECTIVES: To compare cancer care spending and utilization by site of provider-administered chemotherapy in Medicare.

STUDY DESIGN: A retrospective analysis using 2010-2013 Medicare claims.

METHODS: The study population was a random sample of Medicare fee-for-service beneficiaries with cancer who initiated provider-administered chemotherapy in a hospital outpatient department (HOPD) or physician office (PO). We assessed the following outcomes during the 6-month follow-up period: (1) spending on cancer-related outpatient services excluding chemotherapy, (2) spending on cancer-related inpatient services, (3) utilization of select cancer-related outpatient services (evaluation and management, commonly used expensive billing codes, and radiation therapy sessions), and (4) the number of cancer-related hospitalizations. We used regression analyses to adjust for patient health risk factors and market characteristics.

RESULTS: During the 6-month follow-up period, risk-adjusted spending on nonchemotherapy outpatient services was slightly lower among patients receiving chemotherapy in HOPDs than in POs ($12,183 [95% CI, $12,008-$12,358] vs $12,444 [95% CI, $12,313-$12,575]; *P* <.05). Risk-adjusted cancer-related inpatient spending was higher in the HOPD group than in the PO group ($3996 [95% CI, $3837-$4156] vs $3168 [95% CI, $3067-$3268]; *P* <.01). The HOPD group had fewer visits in all select outpatient services but had a higher number of hospitalizations than the PO group.

CONCLUSIONS: Differences in cancer care spending by site of chemotherapy (HOPDs vs POs) vary by service type. Those differences are partially driven by utilization differences. As the site of chemotherapy shifts from POs to HOPDs, spending and utilization patterns in both settings need to be monitored.

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Medicare shoulders a large burden of the costs for cancer care delivered in the United States. In 2014, cancer care costs exceeded $87 billion,[1] with costs projected to increase to more than $173 billion in 2020.[2] Medicare's share is roughly one-third.[1] A main treatment modality for cancer is chemotherapy,[3] which is mostly administered by providers.[4]

Provider-administered chemotherapy is usually covered by medical benefits. In Medicare, Part B (coverage for outpatient medical services) pays for provider-administered chemotherapy. In recent years, there has been a shift in the site of provider-administered chemotherapy from physician offices (POs) to hospital outpatient departments (HOPDs).[5-9] In 2016, nearly 50% of Part B chemotherapy administration claims occurred in HOPDs, a rise from less than 25% in 2008.[10] A concern has been raised that this trend may lead to increased cancer care spending because of potential differences in spending patterns between HOPDs and POs.

Spending differences by site of chemotherapy have been extensively studied among commercially insured patients.[11-14] Prior studies using commercial claims consistently found cancer-related spending on outpatient services among patients receiving chemotherapy in HOPDs to be substantially higher than that in POs.[11,13,14] However, patients receiving chemotherapy in HOPDs were found to have only a slightly smaller number of office visits and outpatient services than those in POs.[12] Thus, prior discussions of spending differentials in outpatient cancer spending by site of chemotherapy focused on differences in payments for outpatient cancer services between HOPDs and POs, especially in the commercially insured population.[6,11-15] However, in Medicare, differences in payments for outpatient chemotherapy services by site of care are not profound.[5,6,16] For example, Medicare pays the same for chemotherapy drugs between HOPDs and POs,[17] whereas among commercial insurers, the average cost per chemotherapy drug claim was more than $2000 higher in HOPDs than in POs ($3799 vs $1466) after controlling for different distributions of chemotherapy drugs between HOPDs and POs.[14] Thus, in Medicare, part of the difference in outpatient cancer care spending between HOPDs and POs may come from differences in utilization.

Two prior studies compared Medicare spending on provider-administered chemotherapy in HOPDs and POs and reached conflicting conclusions.[9,18] A report by The Moran Company found that average per-patient spending on chemotherapy drugs was higher in HOPDs than in POs.[9] However, Kalidindi et al found that spending per beneficiary was higher among patients receiving chemotherapy in POs, driven by higher chemotherapy utilization.[18] It is important to note that Kalidindi et al used more rigorous risk adjustments than The Moran Company. For example, Kalidindi et al accounted for differences in the distribution of cancer type between the 2 care settings, whereas The Moran Company did not. However, both studies were limited to analyzing chemotherapy claims only. Neither study considered other services used by patients receiving chemotherapy. Patients who visit physicians to receive provider-administered chemotherapy often use additional services (eg, radiation therapy, computed tomography scans). Thus, analyzing only chemotherapy costs paints an incomplete picture of cost differences by site of care.

One report attempted to examine total care spending by site of chemotherapy in Medicare. The Milliman group analyzed 2006-2009 claims and found that patients receiving chemotherapy in HOPDs had approximately $6500 higher total annual costs than those receiving chemotherapy in POs.[5] However, the Milliman study had the following limitations and did not allow us to identify sources of its main finding. First, the Milliman report calculated total costs by cancer type but did not adjust for other risk factors, such as metastasis or other chronic conditions. Second, it analyzed all care spending and not just the costs associated with chemotherapy and cancer care. Finally, it did not look at utilization differences between care settings. Thus, its estimates of cost differentials could result from (1) differences in Medicare payments for outpatient services between care settings, (2) differences in utilization of outpatient services, (3) differences in utilization of inpatient services, or (4) a combination of any of the aforementioned factors. Thus, drivers of cancer care cost differentials by site of chemotherapy in Medicare remain to be examined.

Our study fills this gap by expanding the study by Kalidindi et al of chemotherapy services to include other cancer services.[17] For outpatient cancer care, we complement their study by focusing on spending on services other than chemotherapy. We also compare utilization of select outpatient cancer services by care site to understand whether site-specific cancer care spending in Medicare is entirely driven by payment differences or partially due to utilization differences. Further, because differences in utilization could affect patient outcomes, which can lead to hospitalizations, we examine cancer-related inpatient care spending and use. These analyses are important because they help us identify drivers of differential cancer care spending by site of chemotherapy in Medicare and thereby offer implications for patient care.

TAKEAWAY POINTS

Our study examined risk-adjusted differences in cancer care spending and utilization for the 6-month follow-up period after initiation of provider-administered chemotherapy by site of chemotherapy in Medicare. We found that:

- Risk-adjusted spending on outpatient cancer services other than chemotherapy was slightly lower for patients who received chemotherapy in hospital outpatient departments (HOPDs) versus physician offices (POs).
- Risk-adjusted inpatient cancer care spending was higher for patients who received chemotherapy in HOPDs versus POs.
- Although utilization of select outpatient services was higher among patients who received chemotherapy in POs, the number of hospitalizations was higher in the HOPD group.

METHODS

Data

The study was conducted from the Medicare payer perspective. We used Medicare data including 2010-2013 MedPAR files (inpatient and skilled nursing facility claims), Carrier files (PO claims), Hospital Outpatient files (HOPD claims), and Medicare Master Beneficiary Summary files. We acquired these Medicare data from CMS. We also used publicly available American Community Survey data for zip code–level income, education, and unemployment rates.

Sample

The study population was a random sample of the national cohort of Medicare beneficiaries with cancer between 2010 and 2013, which was created as follows. CMS first identified all patients with cancer using 100% Medicare claims based on the standard algorithm used to create cancer indicators in the Medicare Chronic Condition Warehouse file: (1) having at least 1 inpatient or skilled nursing facility cancer claim or (2) having at least 2 Carrier or Outpatient cancer claims in a given year.[19] Then, CMS selected a 10% random sample and provided us with the data for that sample.

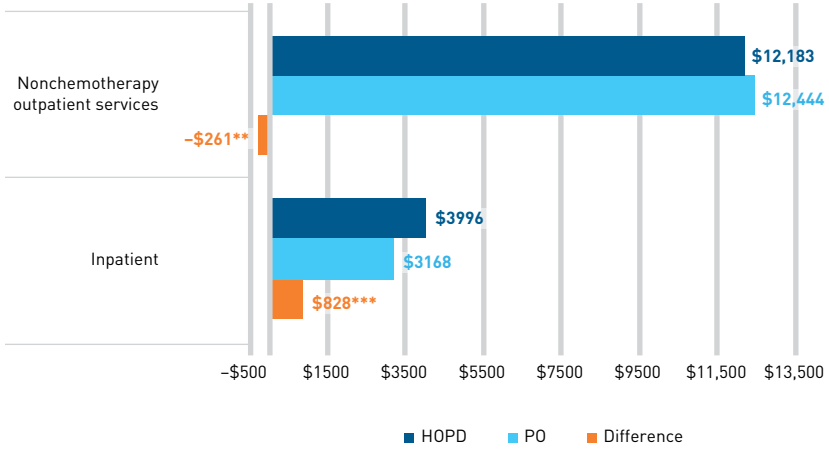
We selected beneficiaries who initiated provider-administered chemotherapy between January 1, 2010, and June 30, 2013, using the Healthcare Common Procedure Coding System Level II (J-code) in the Carrier or Outpatient file (**eAppendix Table 1** [eAppendix available at **ajmc.com**]). We used a 1-year washout to identify new chemotherapy users and designated the date of the first claim for chemotherapy after the washout as the index date.

Patients were required to have continuous Part A and Part B coverage for 12 months. We excluded those who died within 3 months of the index date and Medicare Advantage enrollees. Patients were categorized into 2 groups by the location of chemotherapy (HOPD vs PO). We excluded patients who used both settings. The eAppendix presents sample sizes associated with each exclusion.

Outcomes

We measured outcomes for a 6-month period following the index date. Spending measures were (1) spending on nonchemotherapy cancer-related outpatient services (these include all cancer-related

FIGURE 1. Risk-Adjusted Cancer-Related Care Spending per Beneficiary by Service Category Based on Site of Chemotherapy[a]



HOPD indicates hospital outpatient department; PO, physician office.
*P <.10; **P <.05; ***P <.01.

[a]For the estimation, we used generalized linear models with log-link function and gamma family distribution, controlling for patient and market characteristics and year-specific effects; standard errors are accounted for clustering within a market. All spending measures are adjusted to 2013 dollars. For risk-adjusted spending, we computed the predicted values in HOPD by setting the HOPD indicator to 1 and all the other covariates to their mean values. We computed the predicted values in PO by setting the HOPD indicator to 0.

outpatient services, such as supportive medications/premedications for chemotherapy, but they exclude chemotherapy services themselves) and (2) spending on cancer-related inpatient services (including chemotherapy services). We measured spending by Medicare allowed payments, which include both patient out-of-pocket spending and Medicare reimbursements. Spending was adjusted to 2013 dollars.

We measured 3 utilization outcomes for outpatient cancer-related services: (1) number of evaluation and management (E&M) visits, (2) number of most commonly used expensive billing codes, and (3) number of radiation therapy sessions. Additionally, we assessed the number of cancer-related hospitalizations. Further details of these measures are included in the eAppendix.

Statistical Approach

The key explanatory variable was a binary indicator of chemotherapy receipt in HOPDs. We adjusted for patient risks, including (1) 22 comorbidities that are common among Medicare beneficiaries (eAppendix)[19]; (2) cancer-specific risk factors, including cancer type, metastasis, and cancer-related service use and spending during the 6 months before chemotherapy initiation[18]; (3) patient demographics and market characteristics; and (4) year dummies. The eAppendix reports a list of adjusters and describes the methods in detail.

We used generalized linear models with log-link and gamma distribution to estimate spending measures,[12,14] and negative binomial models for utilization measures. We clustered standard errors by zip code.

Sensitivity Analysis

We performed the analysis separately by year to identify whether differences existed across years. We also conducted the analysis separately by cancer type (breast, colon, leukemia, lung, lymphoma, and prostate) to check whether the results were consistent across cancer types.

RESULTS

Sample Characteristics

A total of 61,993 patients were included in the analysis; 20,670 (33%) belonged to the HOPD group and 41,323 (67%) belonged to the PO group. The distribution of cancer types was different between the 2 groups: The proportion of patients with prostate cancer was lower in the HOPD group compared with the PO group (18% vs 45%), and the shares of patients with breast and lung cancer were higher in the HOPD group than the PO group (breast, 22% vs 15%; lung, 20% vs 14%, respectively) (**eAppendix Table 2**).

Spending and Utilization

Figure 1 and **Figure 2** illustrate the risk-adjusted results for spending and utilization measures, respectively. Risk-adjusted spending on outpatient cancer services other than chemotherapy was slightly lower among the HOPD group relative to the PO group ($12,183 vs $12,444; P <.05). Risk-adjusted spending on cancer-related inpatient services was higher among the HOPD group than the PO group ($3996 vs $3168; P <.01).

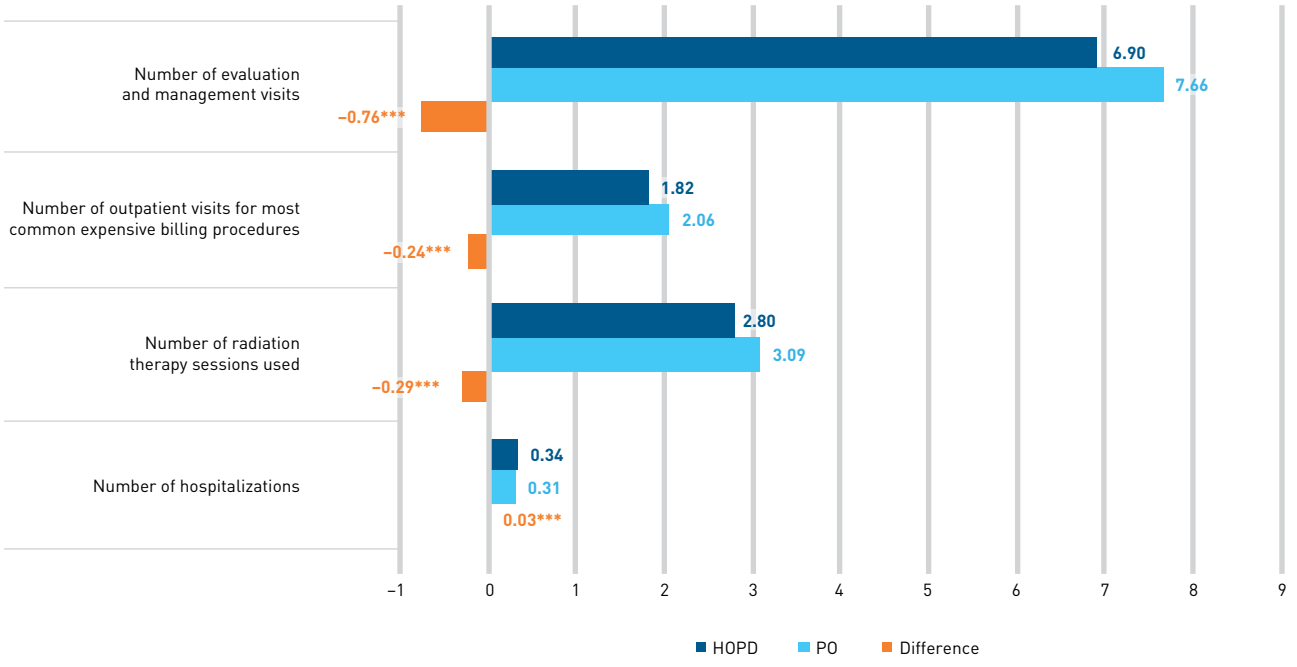
For risk-adjusted outpatient utilization, the HOPD group had lower numbers of cancer-related E&M visits (6.9 vs 7.7; P <.01), commonly used expensive billing codes (1.8 vs 2.1; P <.01), and radiation therapy sessions (2.8 vs 3.1; P <.01). However, the HOPD group had a higher number of cancer-related hospitalizations than the PO group (0.34 vs 0.31; P <.01).

All sensitivity analyses produced similar results to the primary findings except the analysis for breast and prostate cancer (**eAppendix Tables 3** and **4**).

DISCUSSION

Analyzing 2010-2013 Medicare claims, we examined cancer-related spending and utilization by site of provider-administered chemotherapy in Medicare. We found that patients receiving chemotherapy in HOPDs had slightly lower risk-adjusted spending on nonchemotherapy outpatient services than those in POs during the 6-month follow-up period. Although the difference in the spending was small, relatively low spending in the HOPD group is unexpected because payment rates for nonchemotherapy outpatient services are generally higher in HOPDs than in POs.[5,16] However, a lower level of utilization

FIGURE 2. Risk-Adjusted Cancer-Related Care Utilization per Beneficiary for Select Outpatient Services and Hospitalizations Based on Site of Chemotherapy[a]



HOPD indicates hospital outpatient department; PO, physician office.

*P <.10; **P <.05; ***P <.01.

[a]For the estimation, we used negative binomial regression models, controlling for patient and market characteristics and year-specific effects; standard errors are accounted for clustering within a market. For risk-adjusted utilization, we computed the predicted values in HOPD by setting the HOPD indicator to 1 and all the other covariates to their mean values. We computed the predicted values in PO by setting the HOPD indicator to 0.

(ie, fewer nonchemotherapy outpatient visits) in HOPDs compared with POs indicated that the difference in outpatient spending was driven by the difference in utilization in Medicare.

Our finding of low outpatient care use and spending in HOPDs is consistent with the study by Kalidindi et al, which reported spending on outpatient provider-administered chemotherapy services in Medicare was lower in the HOPD group than in the PO group due to lower utilization of chemotherapy services in HOPDs.[18] However, our finding differs from the results of previous studies of commercially insured patients.[6,11-14] This is probably because the differences in payments for outpatient cancer services between HOPDs and POs are much larger in the commercial setting than in Medicare.[5,6,16]

For cancer-related inpatient care, the HOPD group had higher spending than the PO group. This spending difference was also driven by utilization differences: The HOPD group had a higher number of hospitalizations than the PO group. Analyzing whether/how this finding is related to the difference in outpatient care utilization is important, but it was beyond the scope of our study. We leave it to future research.

Limitations

We note limitations of our study. First, we did not have information on cancer stage—a factor that may influence cancer-related use and spending. However, we controlled for a comprehensive set of health-risk factors, including comorbidities, cancer type, metastasis, and prior cancer-related utilization and spending. Second, we did not assess implications of different utilization by care setting for patient outcomes, except the analysis of hospitalizations. Finally, our results may not be generalizable to patients with other types of insurance.

CONCLUSIONS

Our analysis is the first to report differences in utilization and spending on cancer-related services by site of chemotherapy in Medicare. Our study results suggest that differences in cancer care spending by site of chemotherapy in Medicare vary by service type. Those differences are not entirely driven by payment differences between HOPDs and POs but partially reflect differences in care utilization. As the number of patients receiving chemotherapy in HOPDs increases in Medicare, it will be important to continue examining differences in care patterns by care site and their implications for patient care and outcomes. ■

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eAppendix

Variables used in the analysis:

Demographics:

For demographics, we used the following variables: age (in years), state buy-in status (whether beneficiary premium was paid by the state), dual eligibility (qualified for Medicare and Medicaid), gender (female indicator), and race (white indicator).

Chronic Conditions:

The 22 chronic conditions used in the analysis come from the Medicare Master Beneficiary Summary file (MBSF) and include: rheumatoid arthritis/osteoarthritis, dementia, atrial fibrillation, diabetes, hip/pelvic fracture, arthritis, chronic kidney disease, depression, hyperlipidemia, hyperplasia, hypertension, hypothyroidism, ischemic heart disease, stroke, myocardial infarction, anemia, asthma, cataract, heart failure, chronic obstructive pulmonary disease (COPD), and glaucoma. We also used the number of chronic conditions, and a metastasis indicator (codes are in eAppendix Table 1). Beneficiaries with metastatic cancer were identified as those who had at least two diagnosis codes indicating metastatic disease (International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) 196-199), separated by 30 days or more. The criterion of the two codes was used to exclude cases in which the metastatic disease is under evaluation.[1-3]

Cancer Type:

We used: breast, colon, leukemia, lung, lymphoma, and prostate. For our analysis, "other" cancer was used as the reference group. Diagnosis and claim codes used to identify patients with specific cancer diagnoses are in eAppendix Table 1.

Market Characteristics:

Market characteristics identified using the American Community Survey (ACS) include: Percent unemployed, median household income (in dollars), and percent college educated over 65.

Year:

Our study period was 2010 to 2013; year dummies were included to account for time-specific trends.

Selected non-chemotherapy outpatient services:

Healthcare Common Procedure Codes (HCPCS) Level II codes used for radiation therapy, evaluation and management (E&M), and most common used expensive billing codes are in eAppendix Table 1.

The most common expensive billing codes were selected based on prior studies examining outpatient service utilization among chemotherapy patients[4-8] Further, identification of these selected outpatient utilization measures was supported upon a descriptive analysis of the most common billing codes (identified using HCPCS Level II codes) among our study sample. Steps in identification of selected outpatient measures included: 1) selecting outpatient visits for the most commonly used billing codes using HCPCS Level II codes for the top 100 most common billing codes among the cohort after excluding radiation therapy, E&M, and chemotherapy and administration services and 2) identifying the billing codes with payments greater than $50.[9]

Treatment Setting:

A binary indicator set to 1 if the patient received chemotherapy in a hospital outpatient department (HOPD), and 0 if the patient received chemotherapy in a physician office (PO).

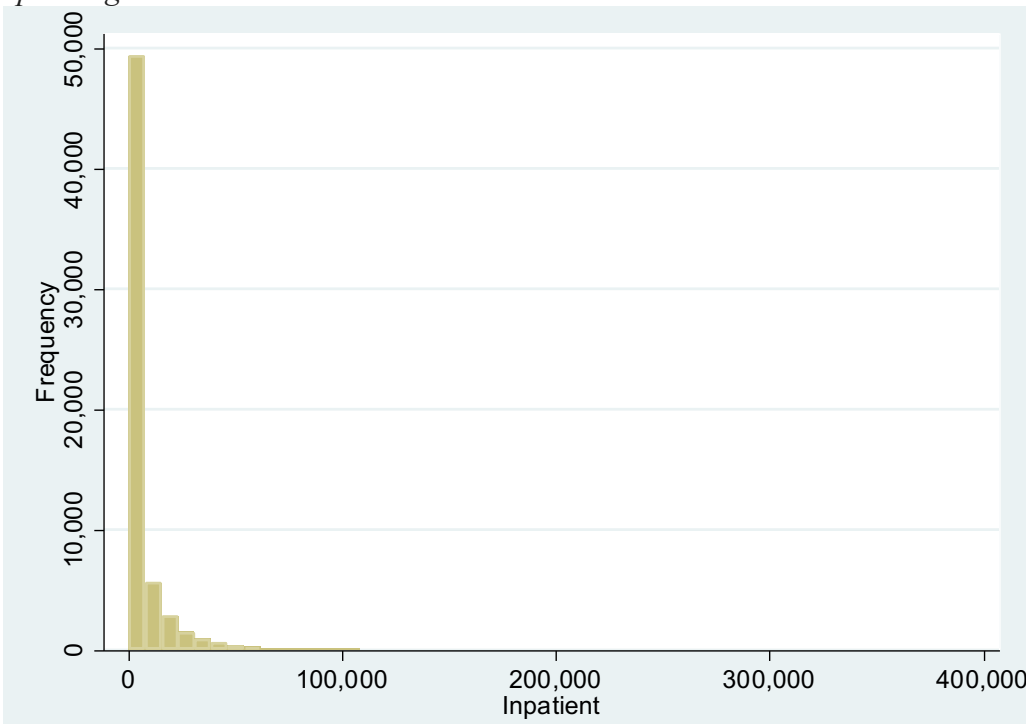
Statistical Approach:

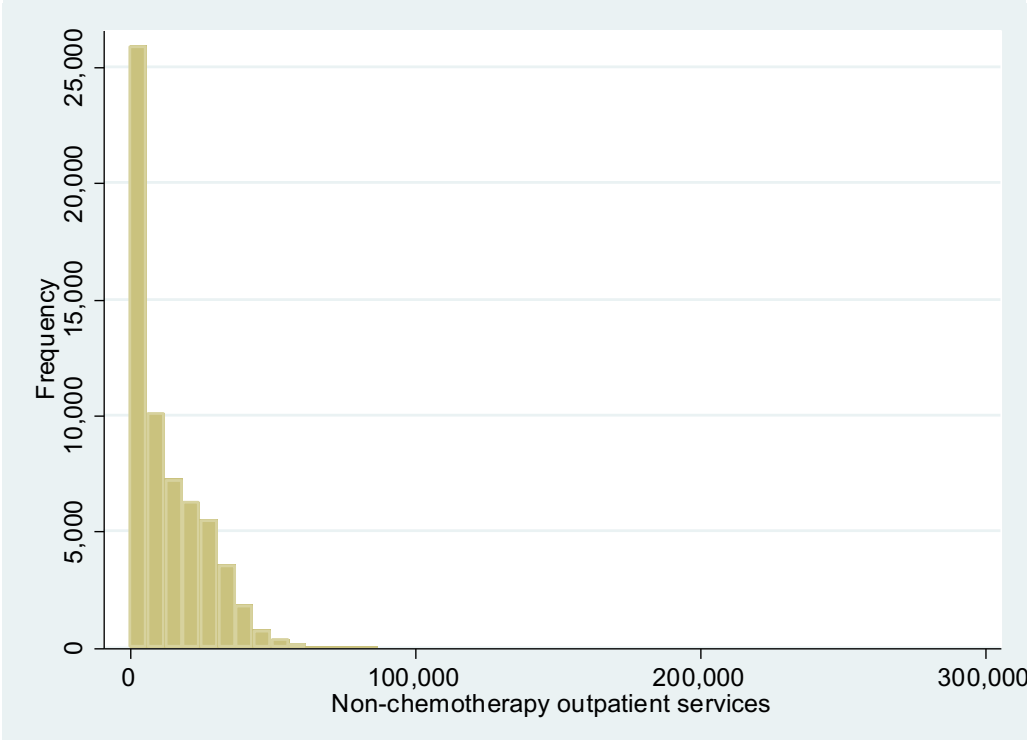
To obtain risk-adjusted values for spending and use, we computed predicted values first in the HOPD by setting the HOPD indicator to 1 and all the other covariates to their mean values. We repeated the steps to compute predicted values in the PO by setting the HOPD indicator to 0.

Handling of Duplicates:
Chemotherapy claims on the same day in both Carrier and Outpatient file were considered duplicates. We subsequently removed a claim from the Carrier file to avoid double counting. Claims in the Carrier file with place of service code indicating HOPD were considered HOPD claims and moved to the Outpatient file.

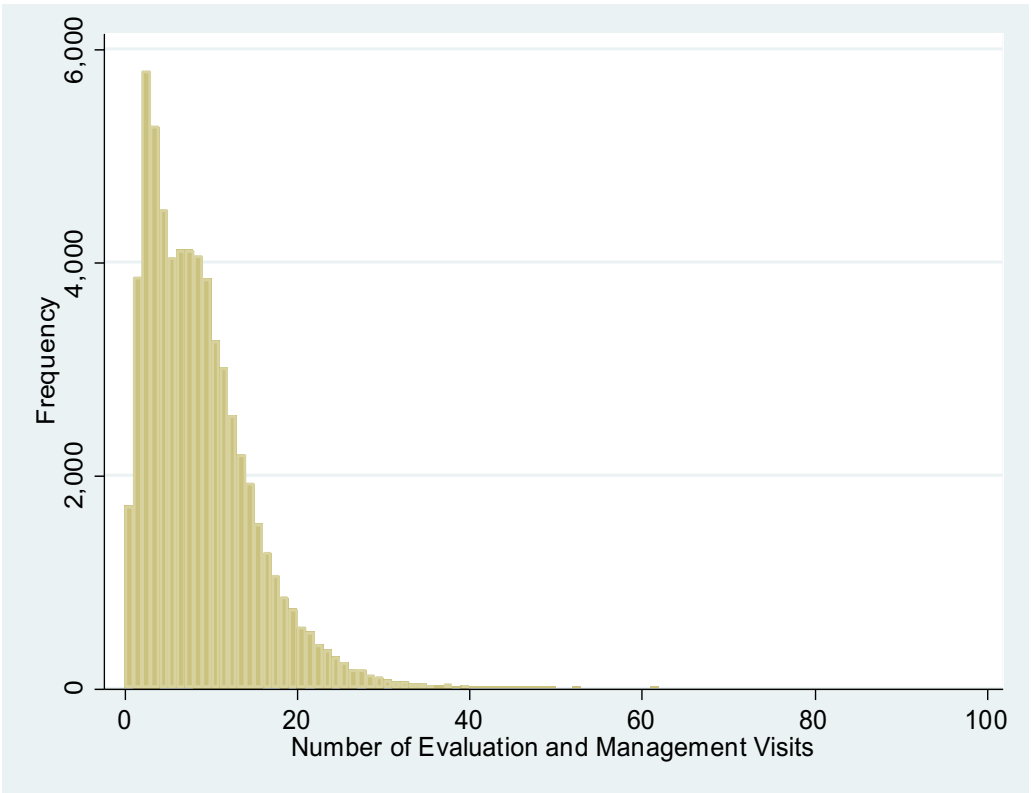
Exclusion Criteria:
There were 612,857 unique cancer patients in the 10% sample provided to us by CMS. Among those, 74,513 cancer patients newly initiated chemotherapy between January 1, 2010 and June 30, 2013. Restricting the sample to individuals who had continuous Part A and B coverage for 12 months and did not die within 3 months of initiation resulted in a sample of 66,192 patients. Lastly, removing patients who received chemotherapy in both settings and had complete information for all covariates resulted in a final sample of 61,993 patients.

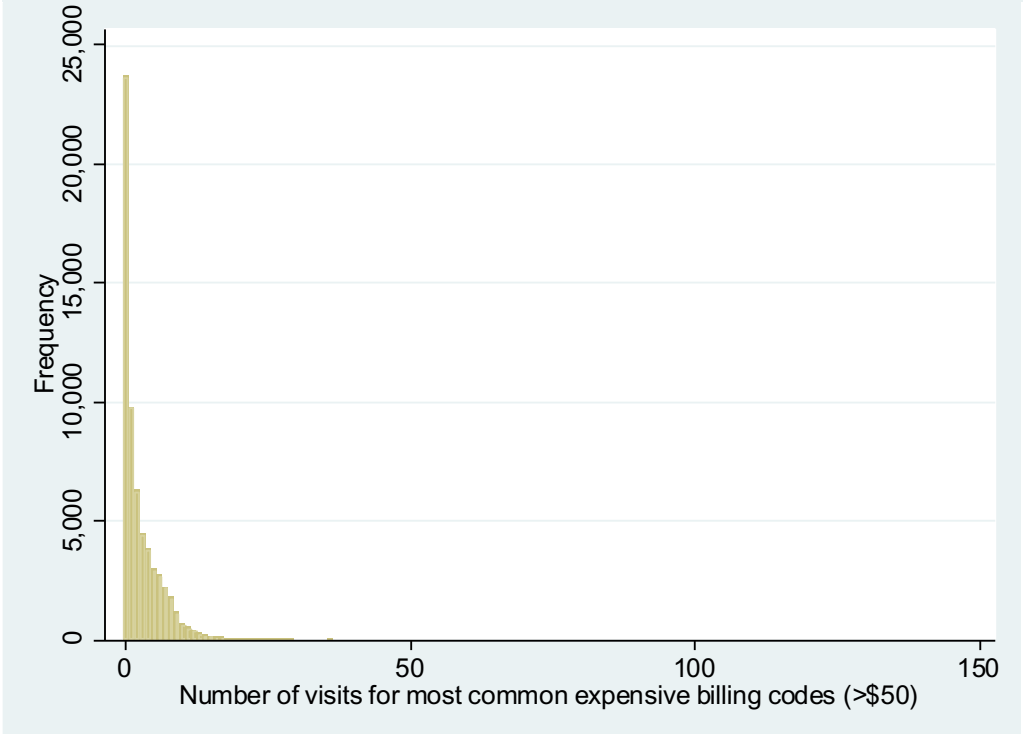
Distribution of Outcome Measures:
Spending:

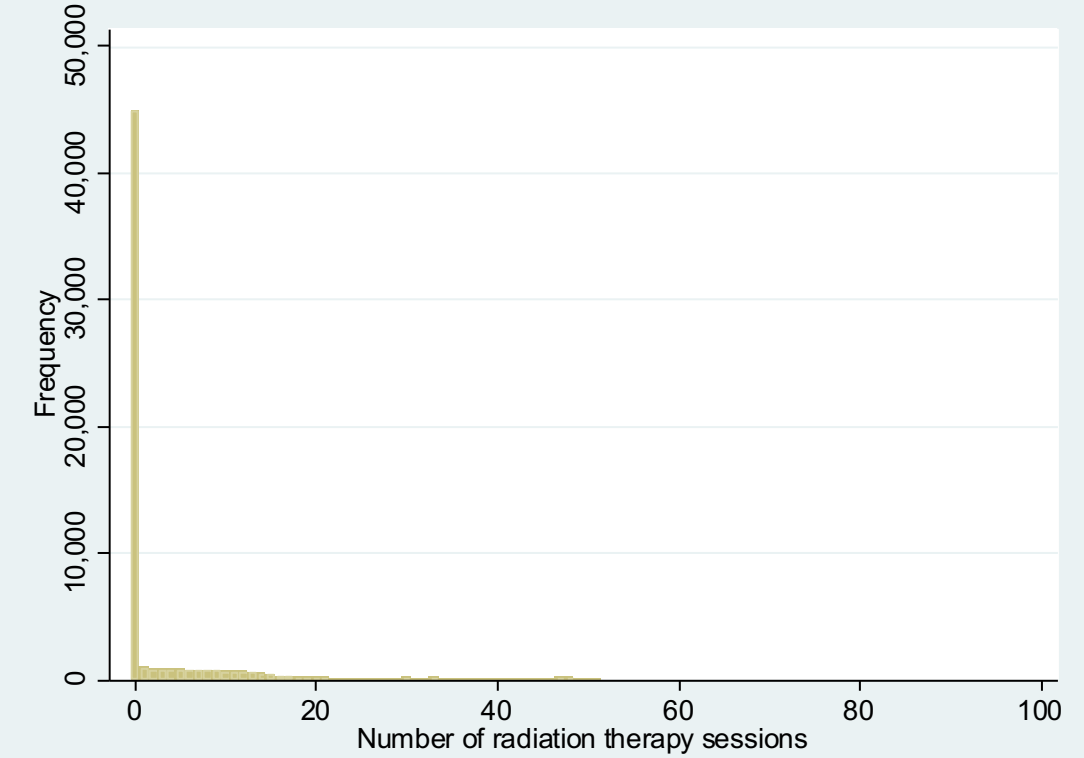


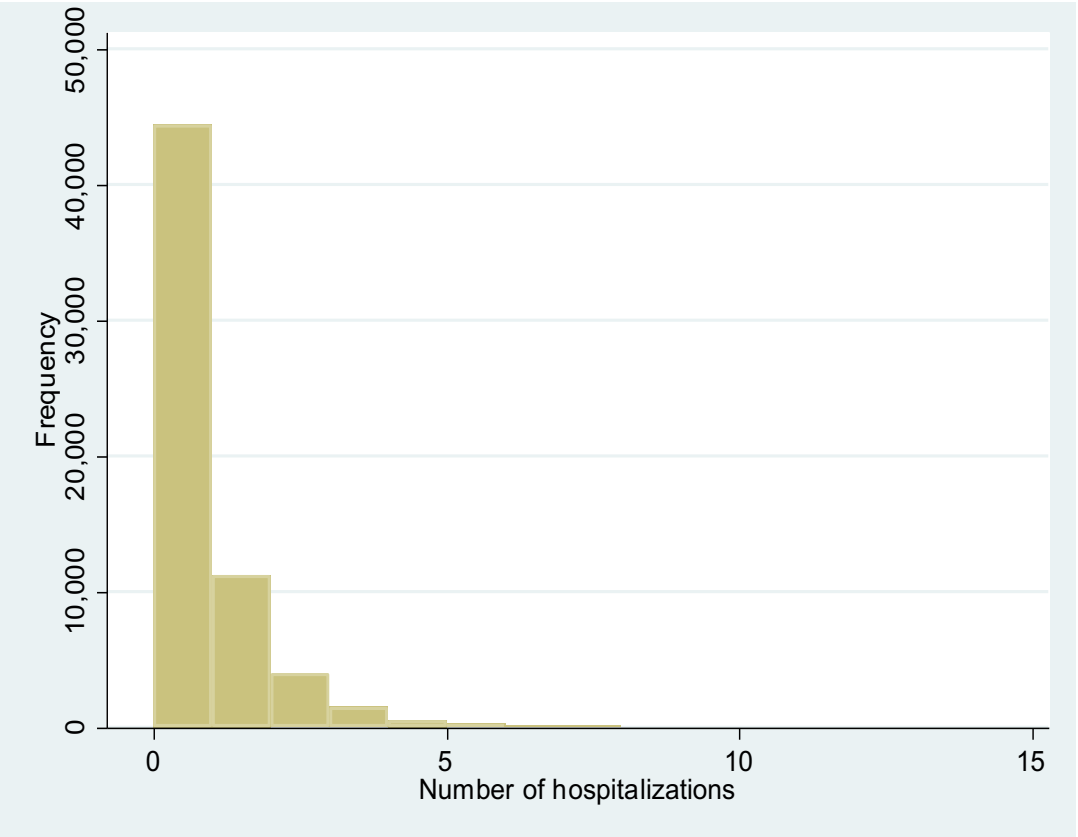


Utilization:






Frequency
0
10,000
20,000
30,000
40,000
50,000
0
20
40
60
80
100
Number of radiation therapy sessions


Frequency
0
10,000
20,000
30,000
40,000
50,000
0
5
10
15
Number of hospitalizations

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eAppendix Table 1. Diagnosis and claim codes used in the study

Cancer Diagnosis	*Claim/Procedure Codes*
Breast	174.0, 174.1, 174.2, 174.3, 174.4, 174.5, 174.6, 174.8, 174.9, 175.0, 175.9, 233.0, V10.3
Colon	153.0, 153.1, 153.2, 153.3, 153.4, 153.5, 153.6, 153.7, 153.8, 153.9, 154.0, 154.1, 230.3, 230.4, V10.05, V10.06
Prostate	185, 233.4, V10.46
Lung	162.2, 162.3, 162.4, 162.5, 162.8, 162.9, 231.2, V10.11
Leukemia	204, 205, 206, 207, 208, V10.60, V10.61, V10.62, V10.63, V10.69
Lymphoma	200, 202, V10.71, V10.79
Other	157, V10.09, 183, V10.43, 172, V10.82, 189.0, V10.52, 171
Chemotherapy Drugs (J-Codes)	J9000-J9999, J8521, J8560, J8520, and J8530
Chemotherapy Administration (HCPCS Level I Codes)	96xxxx
Radiation Therapy	77261,77262,77263,77280,77285,77290,77295,77299,77300,77301,77305,77306,77307,77310,77315,77321,77326, 77327,77328, 77331,77332,77333,77334,77336,77338,77370,77371,77372,77373,77399,77401,77402,77403,77404,77405,77406, 77407,77408,77409,77410,77411,77412,77413,77414,77415,77416,77417,77418,77421,77422,77423,77427,77430,77431,77432,77435,77469, 77470,77499,77520,77522,77523,77525,77750,77761,77762,77763,77776,77777,77778,77781,77782,77783,77784,77785,77786,77787,77789, 77790, 77799
Evaluation and Management (E&M)	99201, 99202, 99203, 99204, 99205, 99211, 99212, 99213, 99214, 99215
HCPCS for the most commonly billed expensive codes (>$50)	71260,96365, J2505,78815,74177,96360, J3487,78306, J1441,99285

eAppendix Table 2. Sample characteristics of patients who received provider-administered chemotherapy

Variable	Hospital Outpatient Department (HOPD)	Physician Office (PO)
	(n=20,670)	(n=41,323)
Demographics		
Age	72.32(9.0)	75.01(8.3)
State Buy-in [ł]	0.17(0.4)	0.12(0.3)
Dual-Eligible [łł]	0.15(0.4)	0.10(0.3)
Female	0.53(0.5)	0.36(0.5)
White	0.85(0.4)	0.87(0.3)
Chronic Conditions		
Rheumatoid Arthritis	0.02(0.1)	0.02(0.1)
Dementia	0.06(0.2)	0.08(0.3)
Atrial fibrillation	0.11(0.3)	0.12(0.3)
Diabetes	0.31(0.5)	0.32(0.5)
Hip/Pelvic Fracture	0.01(0.1)	0.01(0.1)
Arthritis	0.32(0.5)	0.32(0.5)
Chronic Kidney Disease	0.25(0.4)	0.24(0.4)
Depression	0.22(0.4)	0.15(0.4)
Hyperlipidemia	0.55(0.5)	0.57(0.5)
Hyperplasia	0.11(0.3)	0.19(0.4)
Hypertension	0.72(0.4)	0.72(0.5)
Hypothyroidism	0.17(0.4)	0.15(0.4)
Ischemic Heart Disease	0.39(0.5)	0.42(0.5)
Osteoporosis	0.08(0.3)	0.07(0.3)
Stroke	0.04(0.2)	0.05(0.2)
Acute Myocardial Infarction	0.01(0.1)	0.01(0.1)
Anemia	0.57(0.5)	0.51(0.5)
Asthma	0.08(0.3)	0.06(0.2)
Cataract	0.19(0.4)	0.21(0.4)
Heart failure	0.20(0.4)	0.20(0.4)
COPD[a]	0.26(0.4)	0.23(0.4)
Glaucoma	0.10(0.3)	0.12(0.3)
Number of Chronic Conditions	4.77(2.6)	4.73(2.6)
Metastasis	0.35(0.5)	0.21(0.4)
Cancer Type		
Breast	0.22(0.4)	0.15(0.4)
Colon	0.12(0.3)	0.08(0.3)
Leukemia	0.03(0.2)	0.02(0.1)
Lung	0.20(0.4)	0.14(0.3)
Lymphoma	0.15(0.4)	0.10(0.3)
Prostate	0.18(0.4)	0.45(0.5)
Other	0.11(0.3)	0.05(0.2)
6 month pre-index cancer-related spending		

Non-chemotherapy outpatient services ($)	6,206.71(6,106.83)	4,754.93(5,955.49)
Inpatient services ($)	8,534.48(17,536.80)	4,948.65(11,899.04)
6 month pre-index cancer-related utilization		
Number of E&M[b] visits	4.20(3.2)	3.15(2.7)
Number of Outpatient Visits for most common expensive billing codes	1.06(1.4)	0.83(1.1)
Number of Radiation Therapy Sessions used	0.75(2.9)	0.62(3.2)
Number of hospitalizations	0.53(0.8)	0.34(0.6)
Market Characteristics		
Percent Unemployed (%)	9.08(3.8)	9.04(3.7)
Median Household Income ($)	56,955.28(20,661.02)	57,355.12(20,292.26)
Percent College Educated over 65 (%)	19.81(12.0)	19.99(11.5)
Year		
2010	0.27(0.4)	0.35(0.5)
2011	0.28(0.5)	0.29(0.5)
2012	0.30(0.5)	0.24(0.4)
2013	0.15(0.4)	0.11(0.3)

Notes: Data presented as Mean (sd.) unless noted otherwise; [I] State buy-in status indicates whether beneficiary premium was paid by the state; [II] dual eligibility indicates whether an individual qualified for Medicare and Medicaid; [a] Chronic obstructive pulmonary disease; [b] Evaluation and Management

eAppendix Table 3. Sensitivity Analysis for risk-adjusted cancer-related care spending per beneficiary

	Coefficient estimates (95% Confidence Interval)					
	Non-chemotherapy outpatient services ($)			Inpatient services ($)		
By year	HOPD	PO	Difference	HOPD	PO	Difference
2010	10,389(10,078-10,700)	10,412(10,197-10,626)	-23	3,792(3,485-4,099)	3,044(2,873-3,214)	748***
2011	12,821(12,485-13,158)	13,255(13,009-13,500)	-433**	4,641(4,314-4,969)	3,383(3,203-3,564)	1,258***
2012	13,130(12,807-13,453)	13,589(13,328-13,850)	-459**	3,937(3,669-4,206)	3,539(3,323-3,756)	398**
2013	13,631(13,167-14,096)	13,476(1,098-13,855)	155	3,049(2,712-3,386)	2,067(1,851-2,283)	982***
By Cancer Type						
Breast	15,802(15,440-16,165)	15,363(15,084-15,641)	440*	3,521(3,265-3,777)	3,199(2,984-3,414)	322*
Colon	12,127(11,650-12,605)	13,637(13,248-14,025)	-1,509***	7,114(6,507-7,720)	6,196(5,790-6,603)	917**
Leukemia	9,066(8,290-9,843)	8,777(8,176-9,377)	290	5,587(4,381-6,793)	4,962(3,965-5,959)	625
Lung	17,186(16,802-17,569)	17,985(17,658-18,313)	-800***	7,560(7,110-8,011)	6,208(5,846-6,570)	1,352***
Lymphoma	12,582(12,163-13,001)	12,210(11,863-12,557)	372	6,395(5,779-7,011)	4,800(4,372-5,228)	1,595***
Prostate	8,995(8,583-9,407)	8,680(8,479-8,882)	315	1,878(1,643-2,114)	1,355(1,264-1,446)	524***

Notes: HOPD: Hospital Outpatient Department; PO: Physician Office All spending measures are adjusted to 2013 dollars; For the estimation, we used Generalized Linear Models with log-link function and gamma family distribution, controlling for patient and market characteristics, and year specific effects; standard errors are accounted for clustering within a market; For risk-adjusted spending, we computed the predicted values in HOPD by setting the HOPD indicator to 1 and all the other covariates to their mean values. We computed the predicted values in PO by setting the HOPD indicator to 0; $^{*}P < .10$, $^{**}P < .05$, $^{***}P < .01$

eAppendix Table 4. Sensitivity Analysis for risk-adjusted cancer-related care utilization per beneficiary

	Coefficient estimates (95% Confidence Interval)											
	Number of Evaluation and Management visits			Number of OP visits for commonly used expensive billing codes			Number of radiation therapy visits			Number of hospitalizations		
By year	HOPD	PO	Diff.	HOPD	PO	Diff.	HOPD	PO	Diff.	HOPD	PO	Diff.
2010	6.4 (6.3-6.5)	7.1 (7-7.2)	-0.7***	1.6 (1.6-1.7)	1.9 (1.8-1.9)	-0.3***	2.5 (2.3-2.8)	2.5 (2.4-2.6)	0.0	0.31 (0.30-0.33)	0.28 (0.27-0.29)	0.03***
2011	6.8 (6.7-6.9)	7.8 (7.7-7.9)	-0.9***	1.9 (1.8-1.9)	2.0 (2-2.1)	-0.2***	2.8 (2.6-3.0)	3.3 (3.1-3.4)	-0.5***	0.38 (0.36-0.40)	0.33 (0.32-0.35)	0.05***
2012	7.3 (7.2-7.4)	8.1 (7.9-8.2)	-0.8***	1.9 (1.9-2)	2.2 (2.2-2.3)	-0.3***	2.9 (2.7-3.1)	3.3 (3.1-3.5)	-0.4***	0.36 (0.34-0.38)	0.34 (0.32-0.35)	0.02**
2013	7.6 (7.4-7.7)	8.1 (8-8.3)	-0.5***	2 (1.9-2.1)	2.2 (2.1-2.4)	-0.3***	3.2 (2.8-3.5)	3.6 (3.3-3.9)	-0.4*	0.28 (0.25-0.30)	0.24 (0.22-0.25)	0.04***
By Cancer Type												
Breast	9.5 (9.4-9.7)	10.7 (10.6-10.9)	-1.2***	3.2 (3.1-3.3)	4.2 (4.1-4.3)	-1.0***	3.8 (3.6-4.1)	3.7 (3.5-3.9)	0.1	0.36 (0.33-0.37)	0.34 (0.33-0.36)	0.02
Colon	10.7 (10.4-11.0)	12.5 (12.3-12.8)	-1.8***	2.7 (2.6-2.8)	3.7 (3.6-3.9)	-1.0***	1.2 (1.0-1.4)	1.6 (1.4-1.8)	-0.4***	0.55 (0.52-0.59)	0.53 (0.50-0.56)	0.02
Leukemia	8.6 (8.1-9.1)	9.7 (9.3-10.2)	-1.1***	2.2 (1.9-2.6)	2.4 (2.2-2.7)	-0.2	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.0***	0.42 (0.36-0.48)	0.42 (0.36-0.48)	0.00
Lung	10.1 (10.0-10.3)	11.6 (11.4-11.8)	-1.5***	3.9 (3.8-4.0)	4.8 (4.7-4.9)	-0.9***	4.8 (4.5-5.1)	5.8 (5.5-6.0)	-1.0***	0.89 (0.76-1.01)	0.91 (0.79-1.02)	-0.02***
Lymphoma	8.3 (8.1-8.5)	9.3 (9.1-9.5)	-1.0***	3.7 (3.5-3.8)	4.2 (4.0-4.3)	-0.5***	0.9 (0.8-1.0)	0.9 (0.8-1.0)	0.0	0.51 (0.47-0.54)	0.45 (0.43-0.48)	0.06***
Prostate	4.0 (3.9-4.1)	4.0 (3.9-4.0)	0.0	0.6 (0.6-0.7)	0.5 (0.4-0.5)	0.2***	3.9 (3.6-4.3)	4.3 (4.2-4.5)	-0.4*	0.17 (0.16-0.18)	0.13 (0.13-0.14)	0.04***

Notes: HOPD: Hospital Outpatient Department; PO: Physician Office; Diff: Difference; OP: Outpatient. For the estimation, we used negative binomial regression models, controlling for patient and market characteristics, and year specific effects; standard errors are accounted for clustering within a market; For risk-adjusted utilization, we computed the predicted values in HOPD by setting the HOPD indicator to 1 and all the other covariates to their mean values. We computed the predicted values in PO by setting the HOPD indicator to 0; $^{*}P < .10$, $^{**}P < .05$, $^{***}P < .01$