



Comparing Episode of Cancer Care Costs in Different Settings: An Actuarial Analysis of Patients Receiving Chemotherapy

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TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
BACKGROUND	3
FINDINGS	
Patient Characteristics	4
Cost Characteristics	6
CONSIDERATIONS FOR EMPLOYERS/PAYERS	15
APPENDIX A: DESCRIPTION OF KEY DATA SOURCES AND THEIR APPLICATION	17
APPENDIX B: METHODOLOGY	18
REFERENCES	22

EXECUTIVE SUMMARY

Cancer patients getting active treatment with chemotherapy (cytotoxic chemotherapy and biologics) account for 22% of cancer patients but incur 4 times the cost of cancer patients not receiving chemotherapy.¹ The cost of patients receiving chemotherapy has been reported to vary by site of service with costs higher when chemotherapy infusions are delivered in a hospital outpatient setting (HOP) versus a physician office (POV).^{2, 3} Recent reports indicate an increasing portion of chemotherapy is being delivered in HOP settings and less in POV settings, which can increase costs for payers/employers.⁴

This study provides new information by examining Truven MarketScan® commercial claims data (index years 2009 and 2010) to calculate the episode cost of chemotherapy delivered in the HOP versus POV settings for specific disease states. We limited our analysis to 6 cohorts: 3 major cancer types, non-small cell lung cancer (NSCLC), colorectal cancer (CRC) and breast cancer and further stratified each cancer cohort into those receiving adjuvant chemotherapy or chemotherapy for metastatic disease (see methodology). These 3 cancer cohorts account for 54% of cancer patients receiving chemotherapy.¹ We analyzed average episode costs, which included, for each cohort, all allowed costs from the first chemotherapy claim to 30 days after the last chemotherapy claim (chemotherapy claim with more than a 3 month gap since a previous chemotherapy claim triggered a new chemotherapy episode). Cost differences between HOP and POV cohorts were not attributable to observable differences in patient characteristics or treatments.

We compared HOP and POV episode costs for each of the 6 cohorts and identified significantly higher costs for HOP cancer patients in each of the 6 cohorts examined. HOP costs were 28% to 53% higher than the POV costs depending on the cancer and adjuvant or metastatic stage. In particular, we noted significantly higher per-episode cost for chemotherapy drugs, radiation oncology, imaging (CT, MRI and PET scans) and laboratory services in the HOP setting.

Comparison of Allowed Cost per Chemotherapy Episode

Cancer Type		POV	HOP	HOP/POV Episode Cost - Percent Higher in HOP	P Value
Metastatic	NSCLC	\$82,849	\$122,909	48.4%	< 0.001
	CRC	\$122,300	\$186,541	52.5%	< 0.001
	Breast	\$115,308	\$158,727	37.7%	< 0.001
Adjuvant	NSCLC	\$44,769	\$60,994	36.2%	< 0.01
	CRC	\$79,058	\$101,060	27.8%	< 0.001
	Breast	\$57,809	\$86,857	50.2%	< 0.001

Source: Milliman analysis of MarketScan® 2008-2011 Index Years: 2009 and 2010 combined. Allowed costs include payer costs and member cost sharing. Episode includes all costs from first chemotherapy session to 30 days after last chemotherapy session unless more than a 3 month gap occurs after a chemotherapy session. Chemotherapy includes cytotoxic chemotherapy and biologic infusions. NSCLC = Non Small Cell Lung Cancer, CRC = Colorectal Cancer, POV = Physician Office Visit, HOP = Hospital Outpatient

As more chemotherapy administration shifts to the HOP setting, more research is needed to better understand the drivers of this cost differential so that healthcare stakeholders, including payers and employers, can explore solutions that will promote cost and quality effective chemotherapy treatment delivery.

This report was commissioned by Genentech who manufactures oncology drug therapies. One of the authors, Bruce Pyenson, is a Member of the American Academy of Actuaries and meets its qualification standards for this communication. The findings reflect the research of the authors; Milliman does not

intend to endorse any product or organization. If this report is reproduced, we ask that it be reproduced in its entirety, as pieces taken out of context can be misleading. As with any economic or actuarial analysis, it is not possible to capture all factors that may be significant. Because we present national average data, the findings should be interpreted carefully before they are applied to any particular situation.

BACKGROUND

Cancer is an important cost issue for commercial payers and employers. The authors previously reported that cancer patients make up 0.68% of a commercially insured population, but account for 10% of healthcare costs, based on an analysis of 2007 dates of service.¹ Cancer patients receiving chemotherapy (approximately 22% of all commercially insured cancer patients) incur almost four times the per-person cost of cancer patients not receiving chemotherapy.¹

Reports have identified a recent shift in the site of chemotherapy administration—from physician offices to hospital outpatient (HOP) settings, which coincides with increased hospital ownership of oncology practices. Surveys of oncology practices showed a rapid increase in hospital ownership: 6% of responding practices were hospital-owned in 2009⁵; 10% in 2010⁵; and 14% in 2011.⁶ Inside Oncology reported that the percentage of oncology care delivered in HOP or in an integrated network setting has risen from 15% in 2006 to 29% in 2010, and predicts an increase to 42% by 2015.⁴

It is well established that costs are higher for services delivered in a HOP setting compared to a physician office setting (POV). Facility-related payments to HOPs are a significant driver of this cost difference. A 2011 RAND study reported HOP departments received 3.6 times more than the office-related portion of the Medicare physician fee schedule for services that could be provided in either setting. The RAND analysis showed that the differential payment greatly exceeded the differential costs. That is, the differences in payment were attributable to the payment system and did not reflect differences in the characteristics of the patient or the nature of the procedures. The RAND authors noted that the payment differences under Medicare create financial incentives to provide services in the HOP setting rather than POV setting. For example, a physician practice that is purchased by a hospital and then bills through the HOP is paid more for those services than when the services were billed through the POV.⁷ In the RAND study, the percentage of chemotherapy administration in HOP increased from 23% to 26% from 2007 to 2009. The authors noted that the Medicare reimbursement for the professional component of chemotherapy administration is 10% higher in the HOP setting.⁷

Several studies examined the difference in aggregate payer costs for chemotherapy treatment episodes delivered in a HOP setting versus a POV setting. The authors of this report previously analyzed cost and utilization differences for Medicare patients receiving chemotherapy in the HOP setting compared with POV setting and reported that per patient per month cost was higher for patients treated in the HOP setting; that this cost difference persisted even when inpatient hospital costs were excluded; and that the cost difference existed across age-gender categories.² Avalere Health studied differences in costs between HOP and POV based care in patients with cancer who were enrolled in a small sample of commercial and Medicare Advantage health plans. The study examined the total costs of care: it included total costs for the patients' episodes, not just those related to cancer care, and it included patient costs, such as deductibles and copays, as well as health plan costs. For risk adjustment, the study controlled for patient age, gender, and prior history of cancer. For patients receiving chemotherapy, care in the HOP setting, on average, was 24% higher than care in the POV setting. This was true despite the fact that the duration of chemotherapy was longer in the POV setting (3.8 months, compared with 3.3 months in HOP).³

An important limitation of both studies was that systematic differences in clinical severity and need for higher service intensity for patients treated in the different settings could not be assessed. In the present study, we attempted to address this limitation by examining patient cohorts who were receiving adjuvant chemotherapy or chemotherapy specific for metastatic disease. This stratification does not necessarily address the issue of the clinical severity of the patient populations within each cohort, for example the existence of co-morbidities. We analyzed the cost of chemotherapy administration in a commercially-insured population for HOP and POV sites of service. We limited our study to patients with non-small cell lung cancer (NSCLC), colorectal cancer (CRC), and breast cancer.

FINDINGS

Patient Characteristics

We used population stratification to control for major variables that could impact cost differences for patients receiving chemotherapy in HOP versus POV sites. In particular, the type of cancer and the stage of the cancer will influence the specific chemotherapy drugs, dosage and duration of the treatment. To control for these factors, we chose three cancers (NSCLC, CRC, breast) that account for approximately 54% of cancer patients receiving chemotherapy¹ and segmented each cohort into patients receiving metastatic or adjuvant chemotherapy.

We used Truven MarketScan 2009 and 2010 as index years to identify cancer patients starting chemotherapy (no chemotherapy in the 12 months before first chemotherapy during index year). We followed each patient for 24 months after index date or until loss of eligibility to identify an episode of chemotherapy. We categorized each chemotherapy episode into metastatic or adjuvant therapy and distinguished those receiving all of their chemotherapy in a HOP versus POV setting (see methodology section for details of the claims data logic). The sample size for each of the cohorts in each index year is presented in Table 1.

Table 1: Study Cohorts Sample Size

	Index Year 2009			Index Year 2010		
	NSCLC	CRC	Breast	NSCLC	CRC	Breast
POV Sample Size	1,031	1,267	2769	928	1,164	2544
Metastatic Sample Size	888	205	290	802	158	287
Adjuvant Sample Size	143	1062	2479	126	1006	2257
HOP Sample Size	240	233	623	292	229	646
Metastatic Sample Size	208	59	95	254	53	97
Adjuvant Sample Size	32	174	528	38	176	549

Source: Authors' analysis of MarketScan® 2008-2011. Index Years: 2009 and 2010.
 NSCLC = Non Small Cell Lung Cancer CRC = Colorectal Cancer POV = Physician Office HOP = Hospital Outpatient

The distribution of cancer patients receiving their chemotherapy in a POV versus HOP setting changed between the index years with more patients receiving chemotherapy in HOP settings during 2010 compared to 2009 shown in Table 2.

Table 2: Trend in Portion of Chemotherapy Delivered in Hospital Outpatient Setting

Cancer Type	2009 Percent of Chemotherapy delivery in HOP	2010 Percent of Chemotherapy delivery in HOP	Trend 2010/2009
NSCLC	18.9%	23.9%	26.8%
CRC	15.5%	16.4%	5.8%
Breast	18.7%	20.9%	11.6%

Source: Authors' analysis of MarketScan® 2008-2011. Index Years: 2009 and 2010.
 NSCLC = Non Small Cell Lung Cancer CRC = Colorectal Cancer. POV = Physician Office HOP = Hospital Outpatient
 Chemotherapy includes cytotoxic chemotherapy and biologic infusions

Other variables that can impact the difference in cost for patients receiving chemotherapy in a HOP versus POV setting are provided in Table 3. POV patients for NSCLC metastatic and CRC adjuvant cohorts were slightly older. Other variables that might explain the higher HOP costs include the number of episodes of chemotherapy/patient, the duration of an episode or the number of sessions/episode but these were not significantly different. Another variable that could explain the higher HOP costs is the number of unique chemotherapy products used per patient but the analysis showed a statistically significantly higher use of unique products in the POV setting for a few of the cohort comparisons although the difference was relatively minimal.

Table 3: Comparison of HOP and POV Demographics and Chemotherapy Episode Parameters

Cancer Type		POV	HOP	P Value	
NSCLC	Metastatic	Sample Size	1,690	462	
		Average Age	56.4	55.9	0.035
		Percent Female	45%	46%	0.369
		Average observation period (months)	11.1	11.6	0.071
		Average number chemo episodes per patient	1.2	1.2	0.160
		Average length of chemo episodes (months)	4.3	4.0	0.064
		Average number chemo sessions per episode	11.0	10.5	0.126
		Average number unique chemo products per episode	2.6	2.4	0.016
	Adjuvant	Sample Size	269	70	
		Average Age	55.7	54.9	0.170
		Percent Female	48%	51%	0.283
		Average observation period (months)	15.6	16.4	0.213
		Average number chemo episodes per patient	1.1	1.2	0.106
		Average length of chemo episodes (months)	2.6	2.5	0.285
Average number chemo sessions per episode		7.7	7.4	0.257	
Average number unique chemo products per episode		2.2	2.0	< 0.01	
CRC	Metastatic	Sample Size	363	112	
		Average Age	53.3	53.4	0.475
		Percent Female	41%	40%	0.435
		Average observation period (months)	14.7	15.2	0.288
		Average number chemo episodes per patient	1.3	1.3	0.446
		Average length of chemo episodes (months)	6.4	6.8	0.287
		Average number chemo sessions per episode	16.4	15.3	0.220
		Average number unique chemo products per episode	2.9	2.8	0.270
	Adjuvant	Sample Size	2,068	350	
		Average Age	53.1	52.3	0.032
		Percent Female	45%	43%	0.246
		Average observation period (months)	16.8	16.0	0.032
		Average number chemo episodes per patient	1.2	1.3	0.136
		Average length of chemo episodes (months)	4.9	4.2	< 0.001
Average number chemo sessions per episode		12.8	10.6	< 0.001	
Average number unique chemo products per episode		2.2	2.0	< 0.01	

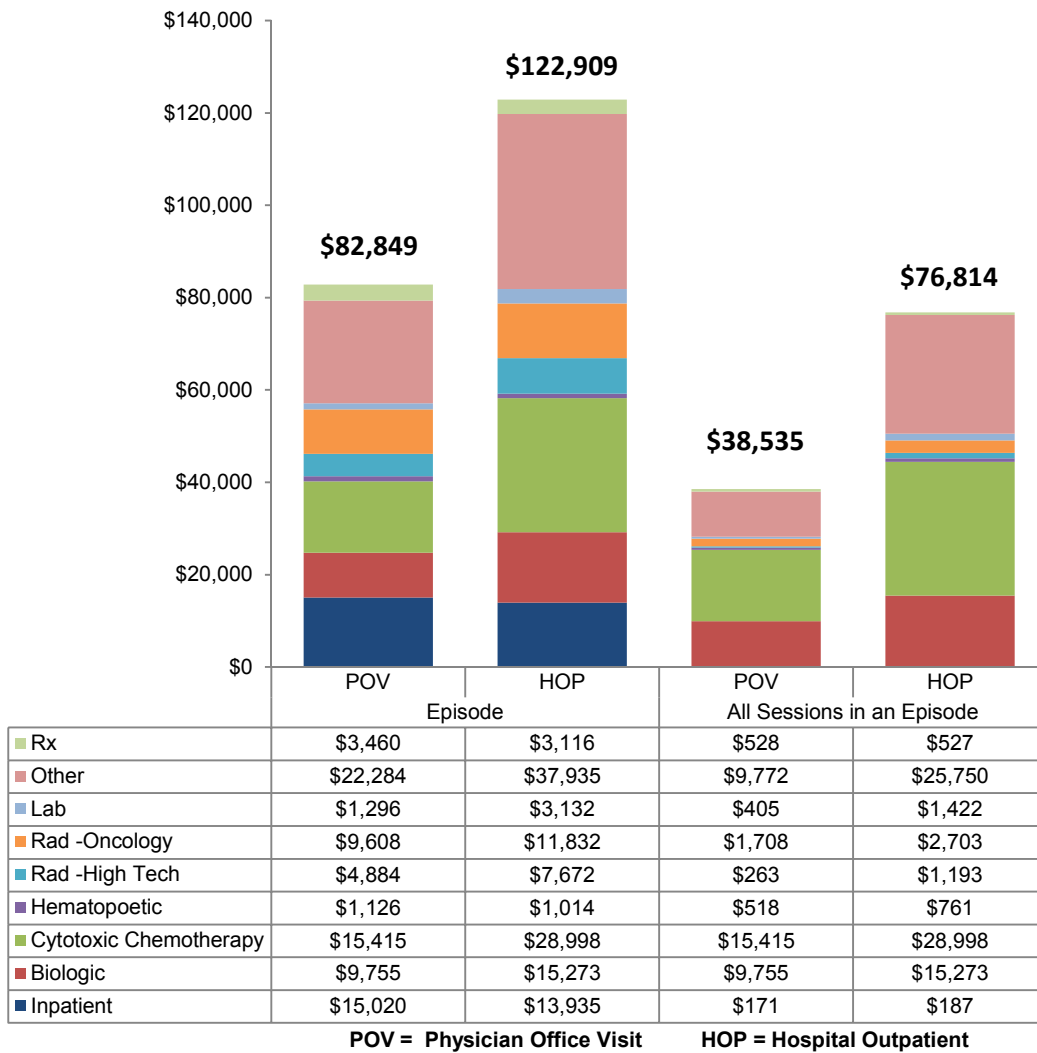
Cancer Type		POV	HOP	P Value	
Breast	Metastatic	Sample Size	577	192	
		Average Age	52.3	51.6	0.147
		Percent Female	100%	100%	n/a
		Average observation period (months)	14.3	14.6	0.281
		Average number chemo episodes per patient	1.2	1.2	0.378
		Average length of chemo episodes (months)	7.5	6.6	0.025
		Average number chemo sessions per episode	17.9	15.5	0.015
		Average number unique chemo products per episode	2.4	2.2	0.017
	Adjuvant	Sample Size	4,736	1,077	
		Average Age	50.7	50.5	0.292
		Percent Female	100%	100%	n/a
		Average observation period (months)	17.8	17.7	0.215
		Average number chemo episodes per patient	1.1	1.1	0.086
		Average length of chemo episodes (months)	4.7	4.9	0.044
		Average number chemo sessions per episode	10.2	10.7	0.042
	Average number unique chemo products per episode	2.7	2.7	0.045	

Source: Authors' analysis of MarketScan® 2008-2011. New chemotherapy cases beginning in 2009 or 2010
 NSCLC = Non Small Cell Lung Cancer, CRC = Colorectal Cancer, POV = Physician Office Visit, HOP = Hospital Outpatient
 Average Observation Period = First chemotherapy infusion through 24 months or end of eligibility
 Episode includes all costs from first chemotherapy session to 30 days after last chemotherapy session unless more than a 3 month gap occurs after a chemotherapy session. Chemotherapy includes cytotoxic chemotherapy and biologic infusions

Cost Characteristics

We compared HOP to POV allowed cost per episode and per session for each of the studied cancer types for metastatic and adjuvant treatments. The episode costs include all claims from first chemotherapy claim to 30 days after last chemotherapy claim (unless more than a 3 month gap in chemotherapy claims occurs after a chemotherapy claim). The session costs include all claims incurred on the day of chemotherapy. Significantly higher allowed cost for all HOP cohorts compared to POV cohorts was observed. Allowed costs include the amount paid by the insurer and the cost sharing paid by the member. The costs were higher by 28% to 53% in the HOP cohorts (all p values <0.01). In particular, the chemotherapy drug costs as well as the radiation oncology, radiation high tech imaging, laboratory services and “other” costs were higher for the HOP cohorts while the remaining components had similar costs for the two cohorts. See Charts 1-6 for details.

**Chart 1: NSCLC Metastatic Cancer Patients
Allowed Cost Per Chemotherapy Episode and Sessions**



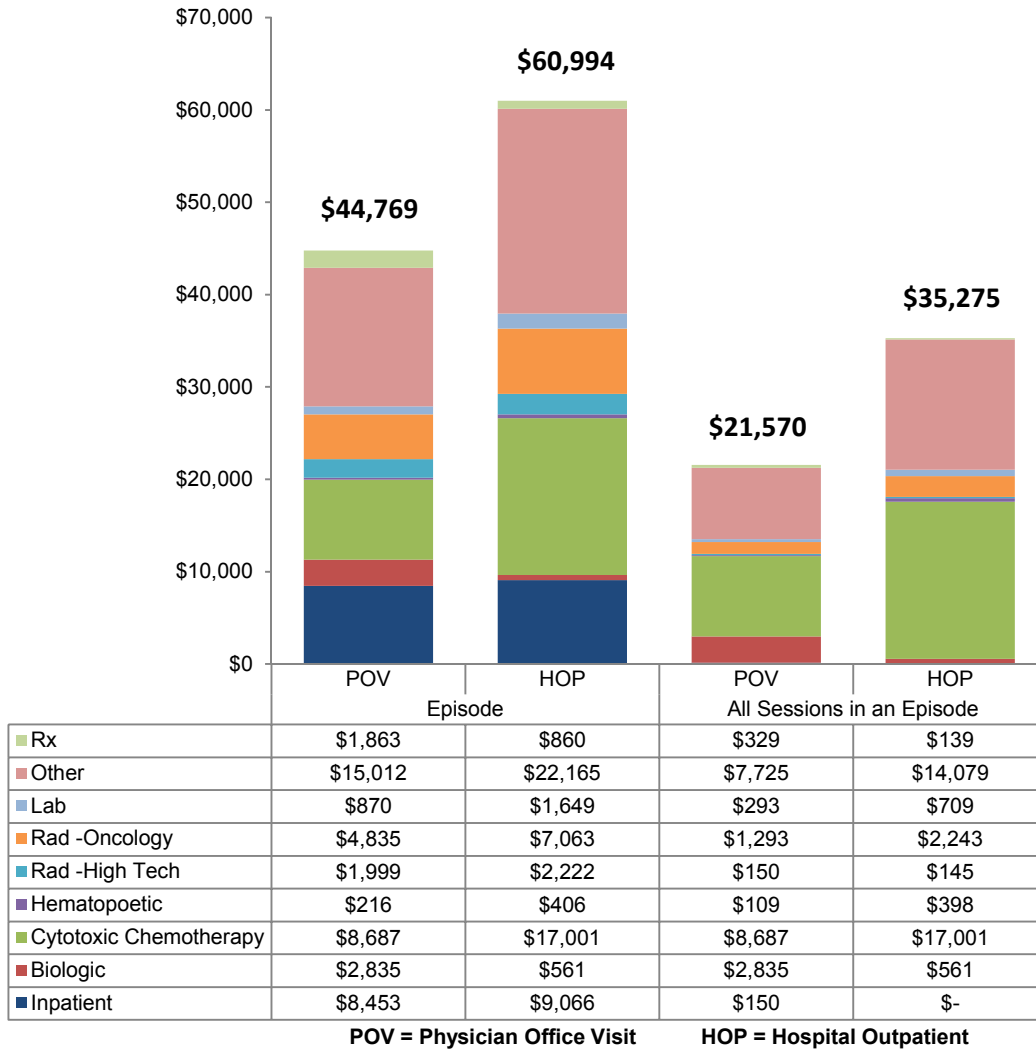
Source: Authors' analysis of MarketScan® 2008-2011. Index Years: 2009 and 2010 combined. Allowed costs include payer costs and member cost sharing.

Episode includes all costs from first chemotherapy session to 30 days after last chemotherapy session unless more than a 3 month gap occurs after a chemotherapy session. Session includes all costs on the day of a chemotherapy infusion.

NSCLC = Non-Small Cell Lung Cancer,

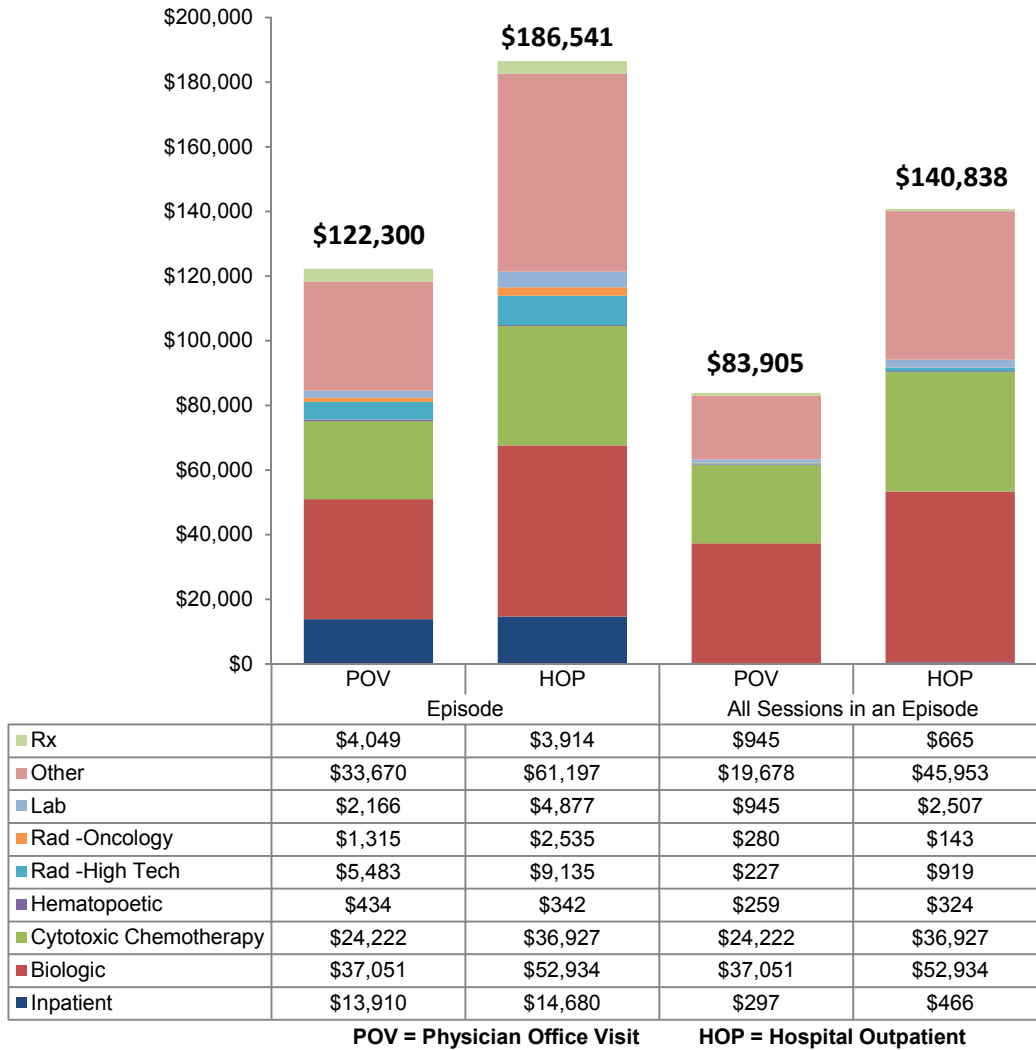
RX: oral prescription drugs including oral chemotherapy. Other includes SNF, Hospice, ER, Hormone therapy, Other Radiology, OP Surgery, Chemotherapy associated costs and all other professional and facility costs not captured in specified cost categories. Radiation – High Tech includes MRI, CT and PET scans. Hematopoetic drug therapies. Cytotoxic Chemotherapy and Biologic are infused drugs only.

**Chart 2: NSCLC Adjuvant Cancer Patients
Allowed Cost Per Chemotherapy Episode and Sessions**



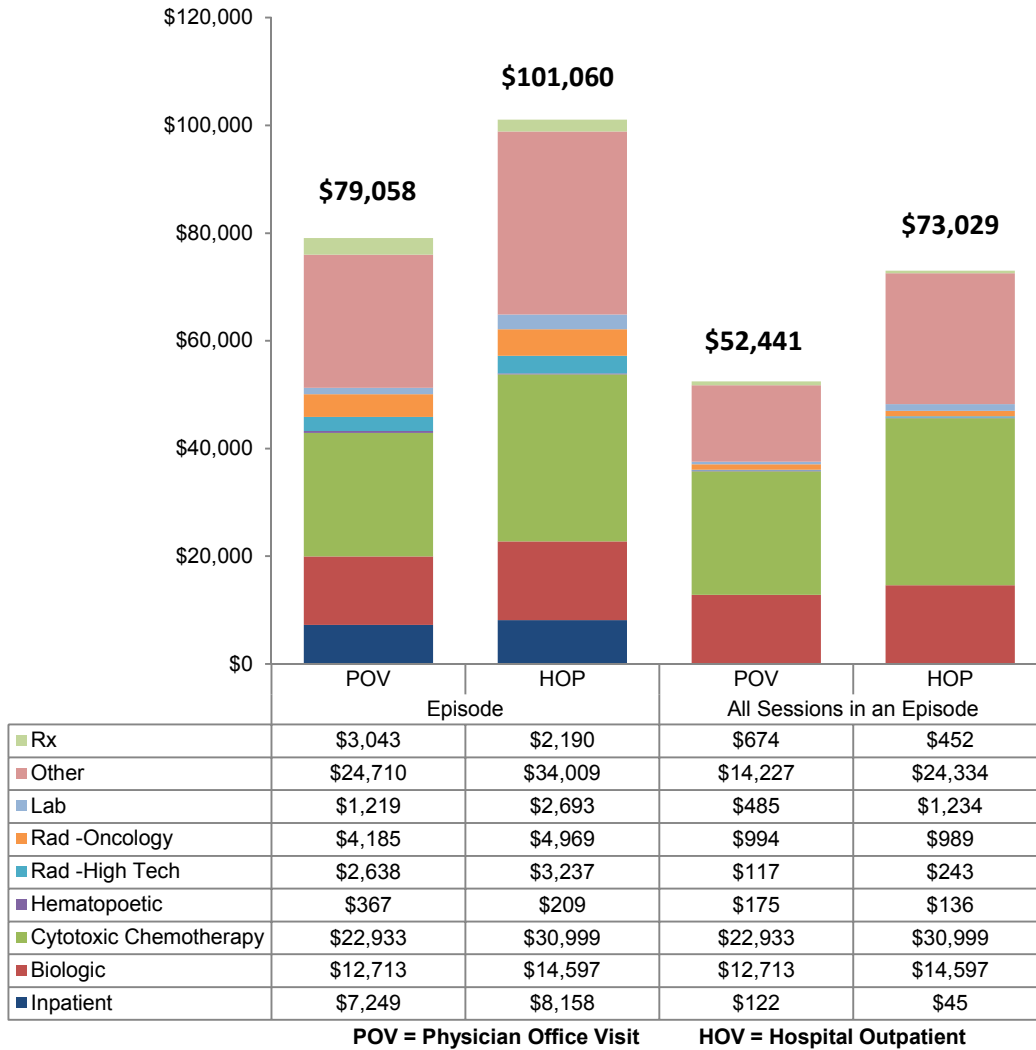
Source: Authors' analysis of MarketScan® 2008-2011. Index Years: 2009 and 2010 combined. Allowed costs include payer costs and member cost sharing. Episode includes all costs from first chemotherapy session to 30 days after last chemotherapy session unless more than a 3 month gap occurs after a chemotherapy session. Session includes all costs on the day of a chemotherapy infusion. NSCLC = Non-Small Cell Lung Cancer, RX: oral prescription drugs including oral chemotherapy. Other includes SNF, Hospice, ER, Hormone therapy, Other Radiology, OP Surgery, Chemotherapy associated costs and all other professional and facility costs not captured in specified cost categories. Radiation – High Tech includes MRI, CT and PET scans. Hematopoetic drug therapies. Cytotoxic Chemotherapy and Biologic are infused drugs only.

**Chart 3: CRC Mestatic Cancer Patients
Allowed Cost Per Chemotherapy Episode and Sessions**



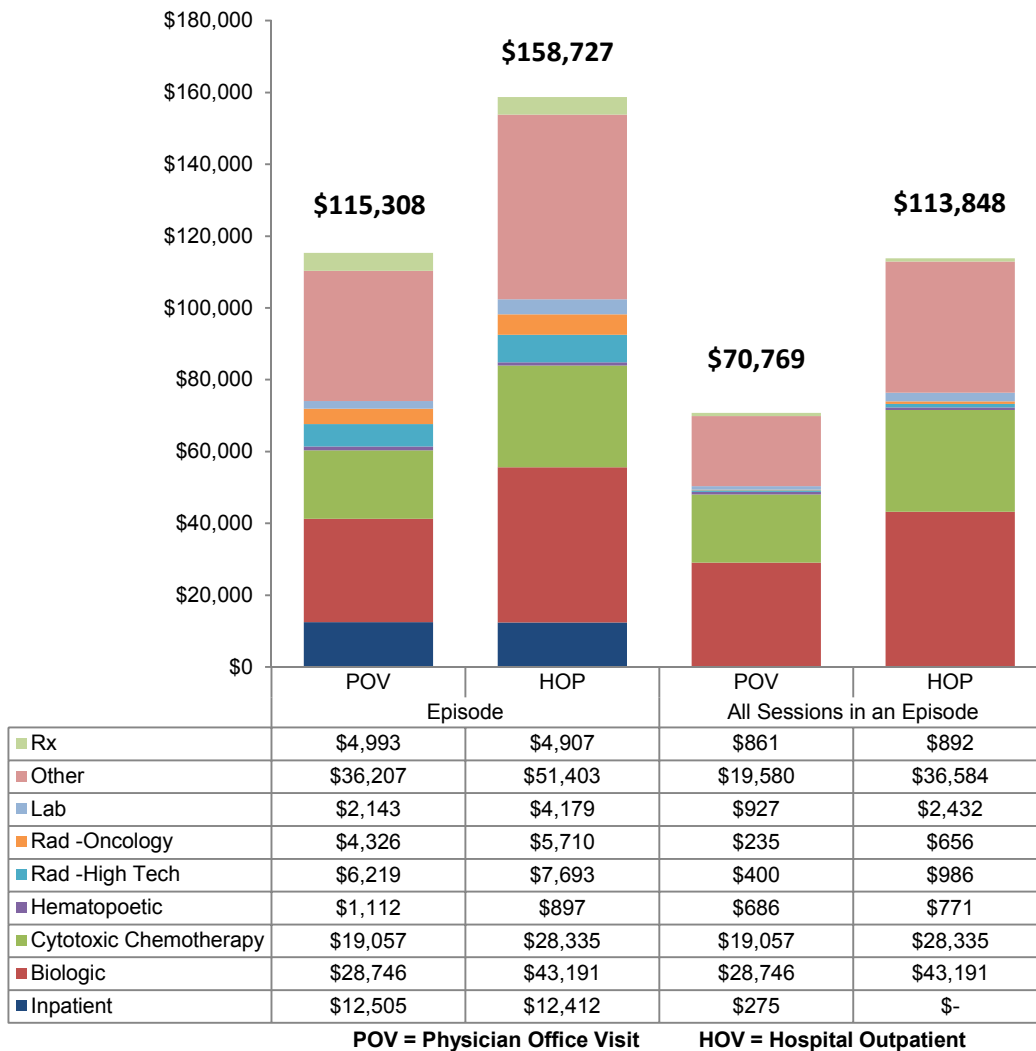
Source: Authors' analysis of MarketScan® 2008-2011. Index Years: 2009 and 2010 combined. Allowed costs include payer costs and member cost sharing.
 Episode includes all costs from first chemotherapy session to 30 days after last chemotherapy session unless more than a 3 month gap occurs after a chemotherapy session. Session includes all costs on the day of a chemotherapy infusion.
 CRC: Colorectal cancer
 RX: oral prescription drugs including oral chemotherapy. Other includes SNF, Hospice, ER, Hormone therapy, Other Radiology, OP Surgery, Chemotherapy associated costs and all other professional and facility costs not captured in specified cost categories. Radiation – High Tech includes MRI, CT and PET scans. Hematopoetic drug therapies. Cytotoxic Chemotherapy and Biologic are infused drugs only.

**Chart 4: CRC Adjuvant Cancer Patients
Allowed Cost Per Chemotherapy Episode and Sessions**



Source: Authors' analysis of MarketScan® 2008-2011. Index Years: 2009 and 2010 combined. Allowed costs include payer costs and member cost sharing. Episode includes all costs from first chemotherapy session to 30 days after last chemotherapy session unless more than a 3 month gap occurs after a chemotherapy session. Session includes all costs on the day of a chemotherapy infusion. Colorectal cancerRX: oral prescription drugs including oral chemotherapy. Other includes SNF, Hospice, ER, Hormone therapy, Other Radiology, OP Surgery, Chemotherapy associated costs and all other professional and facility costs not captured in specified cost categories. Radiation – High Tech includes MRI, CT and PET scans. Hematopoetic drug therapies. Cytotoxic Chemotherapy and Biologic are infused drugs only.

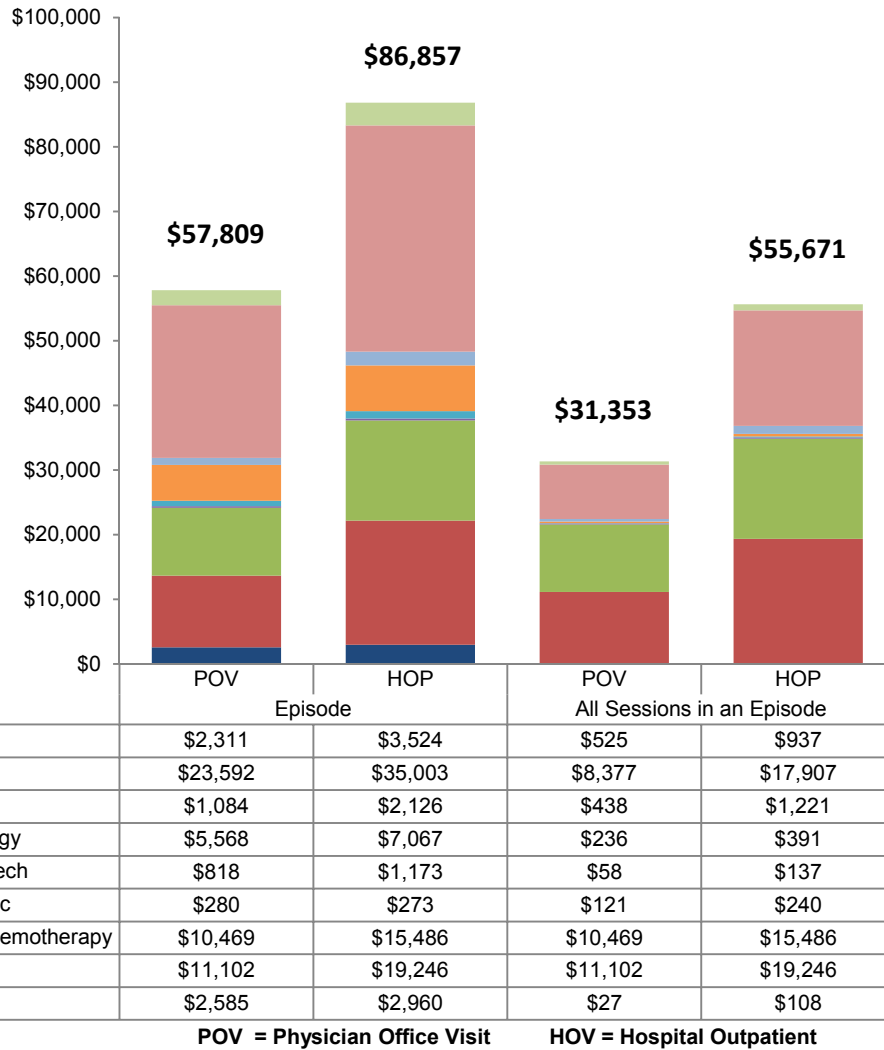
**Chart 5: Breast Metastatic Cancer Patients
Allowed Cost Per Chemotherapy Episode and Sessions**



Source: Authors' analysis of MarketScan® 2008-2011. Index Years: 2009 and 2010 combined. Allowed costs include payer costs and member cost sharing. Episode includes all costs from first chemotherapy session to 30 days after last chemotherapy session unless more than a 3 month gap occurs after a chemotherapy session. Session includes all costs on the day of a chemotherapy infusion.

RX: oral prescription drugs including oral chemotherapy. Other includes SNF, Hospice, ER, Hormone therapy, Other Radiology, OP Surgery, Chemotherapy associated costs and all other professional and facility costs not captured in specified cost categories. Radiation – High Tech includes MRI, CT and PET scans. Hematopoetic drug therapies. Cytotoxic Chemotherapy and Biologic are infused drugs only.

**Chart 6: Breast Adjuvant Cancer Patients
Allowed Cost Per Chemotherapy Episode and Sessions**



Source: Authors' analysis of MarketScan® 2008-2011. Index Years: 2009 and 2010 combined. Allowed costs include payer costs and member cost sharing.

Episode includes all costs from first chemotherapy session to 30 days after last chemotherapy session unless more than a 3 month gap occurs after a chemotherapy session. Session includes all costs on the day of a chemotherapy infusion.

RX: oral prescription drugs including oral chemotherapy. Other includes SNF, Hospice, ER, Hormone therapy, Other Radiology, OP Surgery, Chemotherapy associated costs and all other professional and facility costs not captured in specified cost categories. Radiation – High Tech includes MRI, CT and PET scans. Hematopoetic drug therapies. Cytotoxic Chemotherapy and Biologic are infused drugs only.

The session costs (costs incurred on the day of chemotherapy infusion) make up a significant portion of the episode costs, but other services could be incurred on non session days including inpatient admissions, ER visits, outpatient surgery, diagnostics, radiation oncology etc. We compared the total allowed costs incurred across all sessions in an episode and identified significantly higher costs for the chemotherapy session costs in HOP versus POV settings. Table 4 provides the site of service comparison for the episode costs and the session costs all which are significantly higher in the HOP setting.

Table 4: Total Average Chemotherapy Episode Costs and Chemotherapy Session Costs: Comparison by Site of Service

Cancer Type		Average Allowed Cost per Episode			Average Allowed Cost for all Sessions in an Episode		
		POV	HOP	P value	POV	HOP	P value
Metastatic	NSCLC	\$82,849	\$122,909	< 0.001	\$38,535	\$76,814	< 0.001
	CRC	\$122,300	\$186,541	< 0.001	\$83,905	\$140,838	< 0.001
	Breast	\$115,308	\$158,727	< 0.001	\$70,769	\$113,848	< 0.001
Adjuvant	NSCLC	\$44,769	\$60,994	< 0.01	\$21,570	\$35,275	< 0.01
	CRC	\$79,058	\$101,060	< 0.001	\$52,441	\$73,029	< 0.001
	Breast	\$57,809	\$86,857	< 0.001	\$31,353	\$55,671	< 0.001

Source: Authors' analysis of MarketScan® 2008-2011. Index Years: 2009 and 2010 combined. Allowed costs include payer costs and member cost sharing.

Episode includes all costs from first chemotherapy session to 30 days after last chemotherapy session unless more than a 3 month gap occurs after a chemotherapy session. Chemotherapy includes cytotoxic chemotherapy and biologic infusions

Session includes all costs on the day of a chemotherapy infusion

NSCLC = Non Small Cell Lung Cancer CRC = Colorectal Cancer POV = Physician Office Visit HOP = Hospital Outpatient

We also examined the average cost sharing for all claims in an episode of care and found a similar cost to the patient when comparing site of service: \$3695 average cost sharing for the POV cohort and \$3817 for the HOP cohort.

An important element of the cost difference between chemotherapy episodes in HOP versus POV settings are differences in the unit cost for chemotherapy products. Table 5 provides a comparison of the allowed costs for several of the same drugs and dosages in a HOP versus POV setting. In most cases, the unit reimbursement in the HOP setting is at least twice the amount in the POV setting.

Table 5: Allowed Cost per Claim for Same Chemotherapy Drug and Dosage

HCPCS	Description	Cancer	POV	HOP
J9035	Bevacizumab injection	NSCLC Metastatic	\$5,940	\$9,257
		CRC Metastatic	\$3,699	\$5,749
J9045	Carboplatin injection	NSCLC Metastatic	\$387	\$908
		Breast Metastatic	\$361	\$925
		Breast Adjuvant	\$590	\$831
J9055	Cetuximab injection	CRC Metastatic	\$3,338	\$7,363
J9171	Docetaxel injection	NSCLC Metastatic	\$1,571	\$4,955
		Breast Adjuvant	\$2,943	\$5,682
J9201	Gemcitabine hcl injection	NSCLC Metastatic	\$1,384	\$3,018
		Breast Metastatic	\$1,297	\$2,471
		Breast Adjuvant	\$1,235	\$3,521
J9265	Paclitaxel injection	NSCLC Metastatic	\$319	\$937
		NSCLC Adjuvant	\$271	\$474
		Breast Metastatic	\$334	\$998
		Breast Adjuvant	\$288	\$830
J9305	Pemetrexed injection	NSCLC Metastatic	\$5,083	\$9,750
J9355	Trastuzumab injection	Breast Metastatic	\$2,347	\$4,953
		Breast Adjuvant	\$2,546	\$4,424

Source: Authors' analysis of MarketScan® 2008-2011. Index Years: 2009 and 2010 combined.
 Allowed costs include payer costs and member cost sharing. Chemotherapy includes cytotoxic chemotherapy and biologic infusions
 NSCLC = Non Small Cell Lung Cancer CRC = Colorectal Cancer POV = Physician Office Visit HOP = Hospital Outpatient

CONSIDERATIONS

This paper provides information regarding the cost of cancer care in the HOP vs. POV setting. For adjuvant NSCLC, CRC and breast cancer, the cost of an episode of chemotherapy delivered in a HOP setting is 27.8% to 50.2% higher than an episode of chemotherapy delivered in a POV setting. For metastatic NSCLC, CRC and breast cancer, HOP costs 37.7% to 52.5% more. As shown in the findings section, the lower cost of POV is not associated with the use of fewer chemotherapy agents or fewer chemotherapy sessions. The unit cost of chemotherapy drugs and the cost of non-chemotherapy services including radiation oncology, radiation high tech imaging and laboratory services are higher in the HOP setting and drive some of this cost difference.

Payers and employers should be aware of increased costs they will likely incur if the trend for shifting more chemotherapy infusion delivery to the HOP setting from the POV setting continues. Our focus on only 3 cancers does not allow a comprehensive cost estimate for a shift away from POV to HOP. However, we developed a range for the cost increase by applying this report's low (\$16,000) and high (\$64,000) estimates of the per-episode cost differences to the approximately 0.15% of the commercial population that receives chemotherapy in a year.¹ A 25% shift from POV to HOP (for example from a hypothetical 75% POV to 50% POV), would increase commercial costs by 0.1% to 0.5%, given an average annual commercial per-member cost of \$5,000 (based on MarketScan 2010 \$410 PMPM for commercial lives). Future shifts from the POV setting to the HOP setting could be a noticeable contributor to future health benefits trends unless costs are controlled in the HOP setting. Alternatively, future shifts of patients from HOP to POV could help control costs.

We note that about 15% of adult cancers require specialized cancer care that is found in certain hospital-based academic medical centers or other Centers of Excellence, and most pediatric cancers are treated through children's hospitals.⁸ This analysis must not be seen as providing reasons to limit patient access to such specialized care for those who require it.

The health benefits landscape is changing rapidly with cost pressures and healthcare reform including Exchanges. Many of these changes are presented as ways to increase access to efficient care, which may facilitate the discussion of costs and outcomes associated with cancer care during benefit program planning and budgeting. Payers (including employers) may consider a variety of tools to address the higher cost of chemotherapy delivered in HOP setting including:

Benefit design—copays, coinsurance, and deductibles can create incentives or disincentives for patients to receive particular kinds of care or care from particular sites.

Medical management—processes such as prior authorization can help direct patients to appropriate types of care and less expensive sites of service or providers.

Network and contracting strategy—a carefully chosen network of providers can promote the most efficient providers with more favorable terms for the patient (lower cost sharing) and the provider (higher reimbursement or higher patient volume)

Patient education and support—better outcomes are possible when patients understand options and alternatives, have the support they need to comply with therapy, and have rapid access to professionals who can address emergent conditions.

Particular locales can have very different characteristics from the national average figures we present in this report. In particular, the portion of services provided by POV or HOP could vary significantly. Some locales may have very few oncologists who provide chemotherapy in their offices, while other locales may

have few hospitals that offer chemotherapy services. A starting point for payers is to analyze the current and future opportunities and risks for their own situation. Considerations for payers may include:

Historical Experience: Examine the current distribution of chemotherapy delivery by site of service. While this paper used sophisticated algorithms to identify particular types of adjuvant and metastatic therapies, the approach we used may not be practical for smaller organizations with limited data resources and small population sizes. We provide the claims data algorithm we used for chemotherapy site of service analysis in the Appendix.

Market: Assess the capacity and adequacy of the community oncology network for the members/employees. Discussions with business managers of oncology practices and hospitals can reveal their plans for expansion or acquisitions. Hospitals often publicize their intentions to develop new service lines, such as cancer centers. Oncology practices may have plans to remain independent, to join a national network of oncologists, or to become employees of a hospital system

Analysis: Based on the data and market analyses, the payer/employer can identify both the current distribution of chemotherapy services by site as well as the potential for future shifts in site of service - either toward HOP or toward POV.

Strategy:

For cases where there is still adequate availability of community oncology practices but it appears care is shifting to HOP settings,

- Benefit design can encourage POV chemotherapy infusion
- Contracting strategies can encourage community-based oncologists to remain independent

For cases where there is poor availability of community oncology practices and care has shifted to HOP, the payer may consider,

- Negotiation with hospitals for rates comparable to POV
- Implementation of medical management
- Contracting to encourage remaining independent oncologists to continue community based oncology practice

Much guidance on cancer care for employers is currently available.⁹ Payers with sufficient data resources may go beyond the cancers examined in this report and also analyze experience for Medicare Advantage lives. In addition, analyses can be constructed to simulate the impact on annual cost with various site of service shifts. Clinical studies can compare quality outcomes between the cohorts. The claim data we analyzed does not have clinical metrics or complete mortality data. We examined a limited number of claim based quality outcomes and did not identify statistically significant differences between these outcomes including rate of death in hospital or hospice enrollment rates.

High quality and effective cancer care involves many factors other than the site-of-service cost issues addressed in this paper and will require exploration of a variety of innovative solutions by healthcare stakeholders in the context of the rapidly changing benefits landscape.

APPENDIX A: DESCRIPTION OF KEY DATA SOURCES AND THEIR APPLICATION

Truven Healthcare MarketScan database® This dataset contains all paid claims generated by more than 40 million commercially-insured lives annually. Member identification codes are consistent from year to year and allow for multi-year longitudinal studies. Information includes diagnosis codes, procedure codes and DRG codes, NDC codes along with site of service information and the amounts paid by commercial insurers. For this study, we used MarketScan 2008-2011.

Milliman 2013 Health Cost Guidelines The Guidelines provide a flexible but consistent basis for the determination of health claims costs and premium rates for a wide variety of health plans. The Guidelines are developed as a result of Milliman's continuing research on healthcare costs. First developed in 1954, the Guidelines have been updated and expanded annually since that time. The Guidelines are continually monitored as they are used in measuring the experience or evaluating the rates of health plans, and as they are compared to other data sources

APPENDIX B: METHODOLOGY

Data source: MarketScan 2009 and 2010 were used as index years to identify each cancer cohort. Individuals were required to have eligibility for the full year prior to index year and at least 1 day during index year. We excluded plan contributors without pharmacy benefits and plans with capitation as the claims may not be complete.

Step 1: Select Cancer Patients. We identified all 18-64 year olds with 2 or more claims coded with an ICD-9 code specific to each cancer in any position of the claim at least 30 days apart

Cancer Type for Study	ICD-9 Codes
NSCLC	162.2-162.9, 163.xx, 231.2, 231.8, 231.9
CRC	153.xx, 154.0, 154.1x, 154.8x
Breast	174.xx, 233.0

Step 2: Select Chemotherapy Patients within Cancer Patients. We identified patients in each cohort with 2+ infused chemotherapy claims (excluded hormone only therapy without any non-hormone chemotherapy) in the index years and no infused chemotherapy claims in the 12 months prior to first 2009 or 2010 chemotherapy claim. Chemotherapy claims identified with:

Revenue codes for chemo: 331, 335
 Chemotherapy HCPCS codes: 9000-9999
 Hormone therapy chemotherapy: 9202, 9217, 9218, 9219, 9225, 9226, 9395

Step 3: Exclude Patients with Other Cancers. We excluded patients with two or more claims at least 15 days apart, in the 12 months prior to index chemotherapy date coded with ICD-9 codes in the table below. This excluded approximately 11% of chemotherapy patients.

Cancer Type for Study	ICD-9 Codes for Other Cancers to Exclude Patients
NSCLC	140.xx-161.xx, 164.xx-172.xx, 174.xx-195.xx, 199.xx-209.xx
CRC	140.xx-152.xx, 154.2x-154.3x, 155.xx-172.xx, 174.xx-195.xx, 199.xx-209.xx
Breast	140.xx-172.xx, 176.xx-195.xx, 199.xx-209.xx

Step 4: Split Cohorts into HOP and POV. We stratified patients using site of service codes on chemotherapy claims during an episode using the following codes.

HOP: Place of service code ='22'
POV: Place of service code ='11'

Patients were excluded if they had claims for both sites of service, which removed about 5% of patients remaining after step 3.

The table below shows the number of samples after each step. The pink cells are the number of excluded lives and the blue cells are the final sample size.

	Index Year =2009			Index Year = 2010		
	NSCLC	CRC	Breast	NSCLC	CRC	Breast
MarketScan population after meeting eligibility requirements	12.1 million			12.4 million		
Number of patients having 2+ chemotherapy sessions	2,643	3,497	9,146	2,480	3,340	9,059
Number of patients having 2+ chemotherapy sessions and all sessions were hormone therapy	5	6	766	5	5	789
Number of chemotherapy patients with chemotherapy claims in the prior year	976	1,503	3,323	871	1,490	3,296
Number of chemotherapy patients coded with other cancers in the year prior to index	326	344	253	314	312	291
Number of new chemotherapy patients without hormone-only therapy, without prior year chemotherapy and without other cancer claims in the year prior to index	1,336	1,644	4,804	1,290	1,533	4,683
All chemotherapy claims were POV during an episode	1,031	1,267	3,754	928	1,164	3,551
All chemotherapy claims were HOP during an episode	240	233	865	292	229	938
Chemotherapy claims occurred in both POV and HOP during an episode	65	144	185	70	140	194

Step 5: Split Adjuvant from Metastatic Patients. We used the following criteria to identify adjuvant and metastatic patients:

NSCLC Adjuvant chemotherapy cohort:

Patients having lung resection (lobectomy or pneumonectomy) 6 months prior to or within 3 months after index chemotherapy:

Lobectomy and pneumonectomy codes:

CPT codes: 32440-32488, 32503-32505, 32663, 32666, 32669-32671

ICD-9 procedure codes: 32.3, 32.39, 32.40, 32.41, 32.49, 32.50, 32.59

AND

Not having metastatic coding: At least 2 claims for secondary malignancy (ICD-9-CM 196.0x, 196.2x-196.9x, 197.4x-197.8x, 198.xx) in any position on the medical claim at least 15 days apart 12 months prior to or within 1 month after index chemotherapy claim.

NSCLC Metastatic chemotherapy cohort:

Does not meet adjuvant criteria

CRC Metastatic chemotherapy cohort:

At least 2 claims for secondary malignancy (ICD-9-CM 196.0x-196.1x, 196.3x-196.5x, 196.8x, 197.0x-197.3x, 197.7x, 198.xx) in any position on the medical claim at least 15 days apart 12 months prior to or within 1 month after index chemotherapy claim

CRC Adjuvant chemotherapy cohort:

Does not meet metastatic criteria

Breast cancer Adjuvant chemotherapy cohort:

- Claim for mastectomy or lumpectomy within 3 months prior to chemotherapy index date: claim coded with any of the following CPT or ICD9 procedure codes: CPT 19300-19307 or ICD-9 procedure codes 85.21-85.23, 85.41-85.48.

AND

- No claims coded with secondary malignant neoplasms: Two or more claims codes with ICD-9 196.0x-196.2x, 196.5x-196.9x, 197.xx, 198.xx in any position on the medical claim at least 15 days apart, in the 12 months prior to or within 1 month after index chemotherapy claim.

Breast cancer Metastatic chemotherapy cohort:

2 or more claims at least 15 days apart coded with secondary malignant neoplasm in the 12 months prior to or 1 month after index chemotherapy date: ICD-9 196.0x-196.2x, 196.5x-196.9

Approximately 21% of breast cancer patients meeting the criteria from the preceding steps were not assigned to either metastatic or adjuvant cohorts and were excluded from the analysis.

Step 6: Cost Tabulation. For both adjuvant and metastatic cohorts, patients were followed for 24 months or until the earlier of the date the patient lost eligibility or until there was a 3 month gap in chemotherapy. The episode ended 30 days after last chemotherapy claim before the 3 month gap. A new episode began for a patient if a chemotherapy claim appeared more than 3 months after a previous chemotherapy claim. Some episodes extended for over a year, and the costs attributed to 2009 include some services that were actually performed in 2011. Because of annual cost trend, services performed toward the end of an episode generally carry higher cost than if they were performed at the beginning of the episode. Because we are focused on the differences by site of service more than the cost levels, we made no adjustment for this “tail.”

We calculated average allowed costs (paid by payer and patient cost sharing) per chemotherapy episode and per chemotherapy session (day of chemotherapy) over an episode. We attribute costs for episodes to the year the episode began. We did not trend costs.

Step 7: Assignment of episode claims to cost categories. We grouped each claim with an allowed amount > \$0 during an episode into nine major service categories using a combination of site of service codes, ICD-9 procedure codes, HCPC codes, CPT codes, NDC codes and DRG codes. The categories include:

- Inpatient: includes facility and professional claims incurred during all inpatient stays
- Chemotherapy costs including:
 - Targeted Biologic claims: J code 9010, 9035, 9041, 9055, 9302, 9303, 9310, 9355
 - Chemotherapy claims: J code 9000-9999 except biologic (9010, 9035, 9041, 9055, 9302, 9303, 9310, 9355) and hormone (9201, 9217, 9218, 9219, 9225, 9226, 9395)
- Hematopoietic drug claims: J code 0880, 0881, 0882, 0885, 0886, 1440, 1441, 1642, 1644, 2355, 2505, 2997, 2820. Q code: 0136, 0137, 4054, 4055.
- Radiology-high tech: MRI, CT, PET – professional and facility claims
- Radiation Oncology: Revenue codes 333, CPT codes 77261-77799
- Lab: professional and facility claims for all lab and pathology claims
- RX: prescription drug claims
- Other: all other claims not grouped in above including SNF, ER, home care, hospice, hormone drugs, OP surgery, other radiology and all other professional and facility claims

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