Cost Differential of Immuno-Oncology Therapy Delivered at Community Versus Hospital Clinics

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ABSTRACT

OBJECTIVES: The site of cancer care delivery has been shown to be associated with the total cost of care. The magnitude of this effect in patients receiving expensive immuno-oncology (I-O) therapies has not been evaluated. We evaluated cost differentials between community-based and hospital-based outpatient clinics among patients receiving I-O therapies.

STUDY DESIGN: This was a retrospective analysis utilizing Truven MarketScan Commercial and Supplemental Medicare claims databases.

METHODS: Cost data for 3135 patients with non–small cell lung cancer, squamous cell carcinoma of the head and neck, bladder cancer, renal cell carcinoma, or melanoma who received pembrolizumab, nivolumab, and/or ipilimumab between January 1, 2015, and February 14, 2017, were analyzed as cost per patient per month (PPPM). Patients treated within a community setting were matched 2:1 with those treated at a hospital clinic based on cancer type, specific I-O therapy, receipt of radiation therapy, evidence of metastatic disease, gender, age, and evidence of surgery in the preindex period.

RESULTS: Mean (SD) total (medical plus pharmacy) PPPM cost was significantly lower for patients treated in a community- versus hospital-based clinic ($22,685 [$16,205] vs $26,343 [$22,832]; *P* <.001). Lower PPPM medical cost in the community versus hospital setting ($21,382 [$15,667] vs $24,831 [$22,102]; *P* <.001) was the major driver of this cost differential. Lower total cost was seen regardless of cancer type or I-O therapy administered.

CONCLUSIONS: Treatment with I-O therapies in community practice is associated with a lower total cost of care compared with that in hospital-based outpatient practices. With the expanding indications of these agents, future research is needed.

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Oncology treatment advances continue to evolve at a rapid pace, with immuno-oncology (I-O) therapy at the forefront given its efficacy and tolerability across different tumor types. The last few years have seen fast-track approvals, promising clinical responses, and significant investment from both pharmaceutical companies and venture capital firms. Various forms of I-O therapy exist, including checkpoint inhibitors targeting the programmed cell death protein 1 receptor or its ligand (PD-1/PD-L1), cytotoxic T-lymphocyte–associated antigen 4, chimeric antigen receptor T-cell therapy, and vaccines. Much of the current research has focused on PD-L1 agents; recent forecasts indicate that combined sales of all current agents in this subclass of I-O therapy are estimated to reach $22 billion by 2025.[1] Comparing PD-1/PD-L1 agents with conventional chemotherapy, significant improvements in overall survival have been shown in several types of malignancies.[2] However, these advances are coupled with considerable treatment costs, which can reach more than $100,000 per patient per year.[3] With the expanding number of indications of these agents, cost is a major concern in an already tenuous climate, with a cost trajectory for cancer care that is estimated to surpass $170 billion in just 2 years.[4]

The site of cancer care delivery has been shown to be associated with differences in cost of care; a recent systematic literature review revealed that costs were substantially higher for patients treated in hospital-based versus community-based practices.[5] Further, a matched cohort analysis of patients with non–small cell lung cancer (NSCLC), breast cancer, and colorectal cancer revealed that the cost of cancer care was significantly higher in the hospital clinic setting versus the community clinic setting.[6] Although compelling, this previous analysis utilized a hospital data source with limited Medicare representation and evaluated patients receiving standard first-line chemotherapy agents, which did not include I-O agents. Given the increased costs associated with I-O therapy and the expansion of approved indications, we sought to examine cost differences associated with site of care delivery for patients receiving these agents; these data included a Medicare-enrolled population.

METHODS

Data Source

The Truven MarketScan Commercial and Supplemental Medicare claims databases were used to conduct this analysis (see **eAppendix** [available at **ajmc.com**]).

Sample Selection

Included patients were adults (≥18 years) who (1) had either NSCLC, squamous cell carcinoma of the head and neck (SCCHN), bladder cancer, renal cell carcinoma (RCC), or melanoma; and (2) received 1 of the I-O agents pembrolizumab, nivolumab, or ipilimumab between January 1, 2015, and February 14, 2017. Healthcare Common Procedure Coding System codes were used for identifying the I-O agents. Cancer diagnosis was identified using *International Classification of Diseases, Ninth Revision, Clinical Modification,* and *Tenth Revision, Clinical Modification* (*ICD-9-CM/ICD-10-CM*), using medical claims. The date of first I-O therapy administration was the index date. Patients were required to have continuous enrollment for the 6 months prior to the index date and at least 45 days post index date. Patients were followed until unenrollment or loss to follow-up for a maximum of 6 months post index date.

Patients were grouped into the community clinic (CC) cohort or the hospital–outpatient clinic (HC) cohort based on place of service codes for administered I-O therapy. The practices associated with the HC cohort were owned by the hospital, and claims (which included oncologist visits and other oncologist-related services) were submitted through the hospital billing system. Patients must have received all I-O therapy in either the CC or the HC setting; patients treated at both settings were excluded.

The costs represent the total dollars received by each provider of care, including the insurer payment, patient out-of-pocket payment (co-payment, coinsurance, and deductible), and any coordination of benefits. Total healthcare costs were captured from the index I-O therapy administration date and included both medical and pharmacy costs. Pharmacy costs included all costs associated with dispensing of outpatient prescriptions under patients' prescription drug plans; total medical costs included all costs (ie, inpatient, outpatient, emergency department, and physician visits; radiation therapy; and cost of I-O therapy) except those covered under pharmacy costs. The cost for I-O therapy was defined as the cost of the I-O agent plus any other costs incurred on the same day as the I-O therapy administration. Patients with more than one I-O therapy received on the index date were included but categorized separately. All costs were standardized to 2017 US dollars using the medical care component of the Consumer Price Index for all urban consumers and analyzed as cost per patient per month (PPPM) using the following method: Total days in the postindex period were calculated for each patient and were divided by 30.4 to obtain total months of follow-up; the total costs were summed for that entire period and then divided by the total number of months of follow-up. Healthcare costs were also calculated for patient subgroups based on type of cancer and the index I-O therapy received; however, due to very small sample sizes, healthcare costs were not reported separately for bladder cancer and RCC subgroups.

TAKEAWAY POINTS

- Cost data for 3135 patients treated with pembrolizumab, nivolumab, and/or ipilimumab were analyzed in a cohort matched 2:1 (patients treated in a community vs hospital clinic setting).
- Patients were matched based on gender, age, cancer type, immunotherapeutic agent, receipt of radiation, and evidence of metastatic disease and surgery history.
- Our analysis revealed that the mean (SD) total cost per patient per month was significantly lower for patients treated in a community- versus hospital-based clinic ($22,685 [$16,205] vs $26,343 [$22,832]; *P* <.001).
- With the expanding indications of these agents and newer agents becoming available, future research is needed.

Statistical Analysis

Patients in the CC cohort were matched 2:1 with replacement with those in the HC cohort based on cancer type (NSCLC vs SCCHN vs RCC vs bladder cancer vs melanoma); matched patients had only 1 of these diagnoses throughout the study period. Other characteristics used for matching included specific I-O therapy received, receipt of radiation therapy during follow-up, presence of metastatic disease (identified via diagnosis codes) (**eAppendix Table 1**), gender, age, and evidence of surgery (yes vs no) in the preindex period. Charlson Comorbidity Index (CCI) scores were computed to assess comorbidity burden between cohorts; mean CCI scores were similar in the 2 cohorts and not included in the match (**eAppendix Table 2**).

Categorical measures were presented as counts and percentages; continuous outcomes were presented as means and SDs. For testing the differences between the cohorts, the Wilcoxon signed rank sum test for continuous variables and McNemar's test for categorical variables were conducted using SAS version 9.2 (SAS Institute; Cary, North Carolina).

RESULTS

A total of 6568 patients received 1 or more I-O therapy of interest during the study period; of these, 4183 patients met all the inclusion and exclusion criteria and 3135 patients were matched 2:1 (CC cohort, n = 2090; HC cohort, n = 1045) based on the characteristics previously described (**eAppendix Figure**).

The demographic and clinical characteristics for matched patients are described in **Table 1**. The mean (SD) age in both of the cohorts was 65 (9) years; the majority (91%) in both cohorts had metastatic disease. The mean (SD) CCI score was similar between cohorts: 4.2 (2.2) in the CC cohort and 4.8 (2.4) in the HC cohort. Across cohorts, NSCLC (78%) made up the majority of cancer

TABLE 1. Patient and Disease-Related Characteristics, All Matched Patients (N = 3135)

Characteristic	Community Practice	Hospital-Based Practice	*P*
Total patients, n (%)	2090 (67)	1045 (33)	–
Female, n (%)	890 (43)	445 (43)	[a]
Age in years, mean (SD)	56 (9)	55 (9)	[a]
Age group in years, n (%)			[a]
35-44	16 (1)	8 (1)	
45-54	170 (8)	85 (8)	
55-64	1028 (49)	514 (49)	
65-74	536 (26)	268 (26)	
75-84	340 (16)	170 (16)	
Geographic region, n (%)			<.001
North Central	544 (26)	346 (33)	
Northeast	308 (15)	159 (15)	
South	953 (46)	432 (41)	
West	284 (14)	107 (10)	
Unknown	1 (0)	1 (0)	
Presence of metastatic condition, n (%)	1896 (91)	948 (91)	[a]
Surgery during preindex period, n (%)	24 (1)	12 (1)	[a]
Radiation treatment during preindex period, n (%)	401 (19)	246 (24)	<.001
Surgery during postindex period, n (%)	49 (2)	26 (2)	.838
Radiation treatment during postindex period, n (%)	178 (9)	89 (9)	.014
Charlson Comorbidity Index score, mean (SD)	4.2 (2.2)	4.8 (2.4)	<.001
Unique drugs prescribed at baseline, mean (SD)	16.1 (9.3)	15.4 (9.1)	.005
Eligible days at baseline, mean (SD)	180 (0)	180 (0)	[b]
Paid medical cost at baseline, mean (SD)	$11,826 ($11,178)	$13,483 ($11,935)	.102
Duration of therapy in days, mean (SD)	88 (59)	89 (61)	.763

[a]Variable was used for matching, so no statistical test was conducted. The Wilcoxon signed rank sum test was used for continuous variables and McNemar's test was used for categorical variables.

[b]No statistical test was conducted.

diagnoses, followed by SCCHN (12%) and melanoma (10%). There were no differences in baseline demographics when patients were separated by cancer type (**eAppendix Table 3**).

Utilization Patterns of Immunotherapy Agents

Among the 3135 matched patients, nivolumab was the most common I-O agent (CC cohort: 89.1%; HC cohort: 89.1%); 5.5% of patients from both cohorts received pembrolizumab and 4% received ipilimumab. Only 1% received a combination of nivolumab and ipilimumab. The mean (SD) duration of therapy in each cohort was similar (CC cohort: 88 [59] days; HC cohort: 89 [61] days). When categorized by cancer type, nivolumab was the most commonly used agent in those with NSCLC (99%) and SCCHN (100%), and pembrolizumab and ipilimumab were the most commonly utilized agents in melanoma (45% and 41%, respectively) (**eAppendix Table 4**).

Cost of Care

Across all tumor types, the mean (SD) total cost (ie, medical plus pharmacy costs) PPPM during the postindex period was $23,904 ($18,753). The mean (SD) total cost PPPM was significantly lower in patients in the CC cohort compared with those in the HC cohort ($22,685 [$16,205] vs $26,343 [$22,832], respectively; P <.001). This trend remained the same for the subgroups of patients with NSCLC and melanoma (NSCLC: $20,697 [$14,781] vs $23,153 [$19,044]; melanoma: $34,586 [$23,077] vs $49,017 [$37,244]; P <.001 for all analyses) (**Table 2**). Within the subgroup of patients with SCCHN, although the mean cost was lower in the CC cohort, the difference between the cohorts was not statistically significant.

Overall, the major driver of the cost differential between the CC and HC cohorts was lower mean (SD) PPPM medical costs in the CC cohort compared with the HC cohort ($21,382 [$15,667] vs $24,831 [$22,102], respectively; P <.001), although the mean (SD) pharmacy PPPM costs were also slightly lower in the CC cohort versus the HC cohort ($1303 [$4142] vs $1512 [$4403]; P = .003).

The costs were also compared by the I-O therapy that was received on the index date. For patients who received ipilimumab, the mean (SD) total cost PPPM was significantly lower in the CC cohort compared with the HC cohort ($45,038 [$25,940] vs $58,360 [$41,873]; P = .043). Similar trends were observed for patients who received the other I-O therapies: nivolumab ($21,328 [$14,687] vs $23,761 [$18,978]; P <.001); nivolumab plus ipilimumab ($43,378 [$15,943] vs $66,152 [$36,691]; P = .013); and pembrolizumab ($22,899 [$14,778] vs $34,587 [$27,326]; P <.001).

DISCUSSION

Our study results suggest that the cost of cancer care for patients treated with I-O therapy in the CC setting is significantly lower than that for patients treated in the HC setting and that this is irrespective of I-O agent utilized. Further, costs were lower regardless of evaluated tumor type.

Our data are consistent with previous reports of site of care being significantly associated with cost of care delivery. For example, a commercial claims database analysis demonstrated a 20% to 39% higher mean cost per member per month for patients treated at a hospital-based practice, which was irrespective of cancer type, geographic location, patient age, and number of chemotherapy sessions.[7] Further, a systematic literature review (n = 10 studies of Medicare or commercial claims) revealed that the average cost of cancer care was 38% higher for patients treated in hospital-based practices versus those treated at community-based practices.[5]

A previous matched cohort analysis by Gordan et al revealed that the cost of cancer care for patients with breast, lung, or colorectal cancer treated in the CC setting was approximately $8000 less PPPM than for patients treated in the hospital-based outpatient setting, and this cost differential was irrespective of chemotherapy regimen, branded versus generic agents used, or tumor type.[6] Our analysis expands on this previous work by evaluating the newer and costlier I-O agents and including Medicare enrollees, while still matching patients on specific tumor types, treatments, and other possible confounders, such as presence of metastatic disease, surgery, radiation, and geographic region.

It has been proposed that healthcare systems are shaped by their reimbursement design.[8] Until very recently in the United States, this has meant delivery of healthcare services defined by transactional payments (ie, a given service is identified by a Current Procedural Terminology code, which has an assigned value relative to a standard reference service, and a fee is paid for each service delivered).[8] This volume-based fee-for-service (FFS) system stimulated a wide array of sites of service in which oncology patients receive their care.[8] Services that are provided in an oncology physician's office have been repeatedly shown to be less costly than those delivered in a hospital setting.[5-8] However, the FFS system has not recognized many of the services that oncology practices provide, and historically, these services were covered through the margins on chemotherapy drugs.[8] In 2003, the marginal revenues from these agents were substantially reduced with the implementation of reimbursement based on average sales price, and there began a consistent trend in community oncology practice closures.[8,9] Notably, since 2008, community-based practice clinic closures have increased by 121%, and acquisition of community practices by hospitals has increased by 172%.[9]

The FFS system can no longer be sustained in an era of rising costs, specifically in oncology care, and in this time of healthcare reform, value-based payment systems have been aimed toward models that incentivize provision of care delivered more efficiently, at a higher quality, and for less cost to the healthcare system. It is imperative that these new payment models support the provision of care in lower-cost sites of service, such as community oncology practices, and promote innovation in practice structure and care delivery.[8]

In our analysis, cost was captured at the point of first I-O therapy administration, and the cost differential was noted despite the fact that the durations of therapy with the I-O agents were similar between the matched cohorts. This indicates that the difference in cost associated with I-O therapy treatment is not due to disproportionately shorter treatment in the CC cohort. In other words, for the same therapy, given for the same length of time and for the same indication, the reimbursement received was different (lower for the CC cohort) based on the site of care delivery. Further, although the cost differential is not as high as that reported in previous studies, it should be noted that further evaluation may be needed as these are relatively new agents with unique adverse effect profiles. As such, as comfort builds and indications expand with these I-O agents, further evaluation of contributors to increased cost with these already costly agents should be explored.

TABLE 2. Mean PPPM Medical Cost: All Matched Patients (N = 3135)

	Community Practice n = 2090		Hospital-Based Practice n = 1045		
Cost PPPM, $	**Mean**	**SD**	**Mean**	**SD**	***P***
All matched patients	n = 2090		n = 1045		
Total costs	$22,685	$16,205	$26,343	$22,832	<.001
By type of cancer					
NSCLC	n = 1628		n = 814		
Total costs	$20,697	$14,781	$23,153	$19,044	<.001
SCCHN	n = 242		n = 121		
Total costs	$25,837	$13,057	$28,148	$18,320	.130
Melanoma	n = 212		n = 106		
Total costs	$34,586	$23,077	$49,017	$37,244	<.001
By immunotherapy					
Ipilimumab	n = 86		n = 43		
Total costs	$45,038	$25,940	$58,360	$41,873	.043
Nivolumab	n = 1862		n = 931		
Total costs	$21,328	$14,687	$23,761	$18,978	<.001
Nivolumab + ipilimumab	n = 28		n = 14		
Total costs	$43,378	$15,943	$66,152	$36,691	.013
Pembrolizumab	n = 114		n = 57		
Total costs	$22,899	$14,778	$34,587	$27,326	<.001

NSCLC indicates non–small cell lung cancer; PPPM, per patient per month; SCCHN, squamous cell carcinoma of the head and neck.

Limitations

Limitations of this study include those inherent in any retrospective study. Despite the frequent use of *ICD-9-CM/ICD-10-CM* coding similar to our analyses to identify cancer and metastases in claims-based studies, the sensitivity and specificity associated with these methods[10] may have led to misclassification of patients; however, we would anticipate that this would affect the CC and HC cohorts equally. Further, in spite of robust matching for anticipated confounding factors, other potential confounders, such as socioeconomic data, were not available for any patient. In addition, there are certain aspects within general oncology care that are specific to the use of these agents (ie, biomarker testing, genetic testing/counseling, pain management consult services) that cannot be evaluated using these types of data. Also, indirect costs, such as inability to work or cost of travel, could not be captured from this database.

CONCLUSIONS

This study indicates that treatment with immunotherapies for cancer in the community practice setting is associated with a lower total cost of care compared with similar treatment in the hospital-based

outpatient practice setting. These data provide real-world insight to payers, the oncology workforce, policy makers, and other health-system stakeholders to examine contributors to total cost of cancer care in this turbulent time of innovative therapies that both improve outcomes and add to an increasing cost trajectory. Due to the time frame of these data and the expanding indications of these agents, future research is needed. ■

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Authorship Information: Concept and design (LG, MB, VS, DK, SW, ME); acquisition of data (LG); analysis and interpretation of data (LG, MB, VS, DK, SW, ME); drafting of the manuscript (LG, MB, VS, DK, SW, ME); critical revision of the manuscript for important intellectual content (LG, MB, VS, DK, SW, ME); statistical analysis (LG, VS); and supervision (LG).

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eAppendix

Truven MarketScan Commercial and Supplemental Medicare Claims databases contain the medical and pharmacy claims of enrollees sourced directly from health plans and large self-insured employers. The databases represent over 50 million commercially insured and 4.3 million Medicare lives. Medical claims are linked to outpatient prescription drug claims and person-level enrollment data through the use of unique patient or enrollee identifiers. All patient information in this database is encrypted and deidentified, and no patient contact was involved, so no informed consent or approval by an institutional review board was required (the data source is fully compliant with the Health Insurance Portability and Accountability Act of 1996).

Determination of metastatic disease

The presence of metastatic disease was determined based on International Classification of Diseases, 9th and 10th Revision, Clinical Modification (ICD-9-CM/10-CM) codes on medical claims during the pre-index and post-index period. See Table 1.

ICD-9-CM codes used to in determining the CCI score

The Charlson comorbidity index (CCI) was calculated for each patient using International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) codes on non-diagnostic medical claims during the pre-index period. The CCI was developed in 1987 based on 1-year mortality data from internal medicine patients and encompasses 19 medical conditions weighted 1 to 6 with total scores ranging from 0 to 37 (Charlson 1987).

Individual diagnosis codes are listed in Table 2, with the “x” serving as a wild card (ie, this allows for any value in that position).

eAppendix Table 1. ICD-9-CM and ICD-10-CM Codes Used to Identify Metastatic Disease[a]

Description	ICD-9-CM Code	ICD-10-CM Code
Secondary and unspecified malignant neoplasm of lymph nodes of head, face, and neck	196.0	C77.0
Secondary and unspecified malignant neoplasm of intrathoracic lymph nodes	196.1	C77.1
Secondary and unspecified malignant neoplasm of intra-abdominal lymph nodes	196.2	C77.2
Secondary and unspecified malignant neoplasm of lymph nodes of axilla and upper limb	196.3	C77.3
Secondary and unspecified malignant neoplasm of lymph nodes of inguinal region and lower limb	196.5	C77.4
Secondary and unspecified malignant neoplasm of intrapelvic lymph nodes	196.6	C77.5
Secondary and unspecified malignant neoplasm of lymph nodes of multiple sites	196.8	C77.8
Secondary and unspecified malignant neoplasm of lymph nodes, site unspecified	196.9	C77.9
Secondary malignant neoplasm of unspecified lung	197.0	C78.00
Secondary malignant neoplasm of mediastinum	197.1	C78.1
Secondary malignant neoplasm of pleura	197.2	C78.2
Secondary malignant neoplasm of other respiratory organs	197.3	C78.39
Secondary malignant neoplasm of small intestine including duodenum	197.4	C78.4
Secondary malignant neoplasm of large intestine and rectum	197.5	C78.5
Secondary malignant neoplasm of retroperitoneum and peritoneum	197.6	C78.6
Malignant neoplasm of liver, secondary	197.7	C78.7
Secondary malignant neoplasm of other digestive organs and spleen	197.8	C78.7, C78.89
Secondary malignant neoplasm of kidney	198.0	C79.00
Secondary malignant neoplasm of other urinary organs	198.1	C79.11, C79.19
Secondary malignant neoplasm of skin	198.2	C79.2
Secondary malignant neoplasm of brain and spinal cord	198.3	C79.31
Secondary malignant neoplasm of other parts of nervous system	198.4	C79.32, C79.49
Secondary malignant neoplasm of bone and bone marrow	198.5	C79.51, C79.52
Secondary malignant neoplasm of ovary	198.6	C79.60
Secondary malignant neoplasm of adrenal gland	198.7	C79.70
Secondary malignant neoplasm of other specified sites	198.8	C79.81, C79.82, C79.89

[a)] Whyte JL, Engel-Nitz NM, Teitelbaum A, Gomez Rey G, Kallich JD. An Evaluation of Algorithms for Identifying Metastatic Breast, Lung, or Colorectal Cancer in Administrative Claims Data. Med Care. 2015 Jul;53(7):e49-57

Key: ICD-9/10-CM – International Classification of Diseases, 9th/10th Revision, Clinical Modification.

eAppendix Table 2. ICD-9-CM Codes Utilized to Identify Comorbidities

Comorbidities[a]	ICD-9-CM
Myocardial infarction	410.x, 412.x
Congestive heart failure	398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 425.4–425.9, 428.x
Peripheral vascular disease	093.0, 437.3, 440.x, 441.x, 443.1–443.9, 447.1, 557.1, 557.9, V43.4
Cerebrovascular disease	362.34, 430.x–438.x
Dementia	290.x, 294.1, 331.2
Chronic pulmonary disease	416.8, 416.9, 490.x–505.x, 506.4, 508.1, 508.8
Rheumatic disease	446.5, 710.0–710.4, 714.0–714.2, 714.8, 725.x
Peptic ulcer disease	531.x–534.x
Mild liver disease	070.22, 070.23, 070.32, 070.33, 070.44, 070.54, 070.6, 070.9, 570.x, 571.x, 573.3, 573.4, 573.8, 573.9, V42.7
Diabetes without chronic complication	250.0–250.3, 250.8, 250.9
Diabetes with chronic complication	250.4–250.7
Hemiplegia or paraplegia	334.1, 342.x, 343.x, 344.0–344.6, 344.9
Renal disease	403.01, 403.11, 403.91, 404.02, 404.03, 404.12, 404.13, 404.92, 404.93, 582.x, 583.0–583.7, 585.x, 586.x, 588.0, V42.0, V45.1, V56.x
Any malignancy, including lymphoma and leukemia, except malignant neoplasm of skin	140.x–172.x, 174.x–195.8, 200.x–208.x, 238.6
Moderate or severe liver disease	456.0–456.2, 572.2–572.8
Metastatic solid tumor	196.x–199.x
HIV/AIDS	042.x–044.x

[a] Charlson ME, Pompei P, et al. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987;40:373-383.

eAppendix Table 3. Patient Baseline Characteristics by Cancer Type

A. NSCLC

Characteristic	Community	Hospital Practice
Total patients	N=1,628	N=814
Female gender, n (%)	806 (50)	403 (50)
Mean age, years (SD)	66 (9)	66 (9)
Age group, years (%)		
35–44	6 (0)	3 (0)
45–54	122 (7)	61 (7)
55–64	728 (45)	364 (45)
65–74	470 (29)	235 (29)
75–84	302 (19)	151 (19)
Geographic region, n (%)		
North Central	443 (27)	290 (36)
Northeast	286 (18)	119 (15)
South	727 (45)	326 (40)
West	172 (11)	78 (10)
Unknown	0 (0)	1 (0)
Presence of metastatic condition, n (%)	1,434 (88)	717 (88)
Surgery during pre-index period, n (%)	0 (0)	0 (0)
Radiation treatment during pre-index period, n (%)	328 (20)	209 (26)
Surgery during post-index period, n (%)	25 (2)	13 (2)
Radiation treatment during post-index period, n (%)	168 (10)	84 (10)
Required inpatient service, n (%)	593 (36)	303 (37)
Required emergency room service, n (%)	594 (36)	326 (40)
Mean Charlson comorbidity index, n (SD)	4.1 (2.1)	4.7 (2.4)
Mean unique drugs prescribed at baseline, n (SD)	16.9 (9.2)	16.2 (9.1)
Mean eligible days at baseline, n (SD)	180 (0)	180 (0)
Mean paid medical cost at baseline, n (SD)	$12,857 ($11,576)	$12,998 ($13,663)
Mean duration of therapy, days (SD)	86 (58)	88 (62)

Key: NSCLC – non-small cell lung cancer; PPPM – per patient per month; SD – standard deviation.

B. Head and Neck Cancer

Characteristic	Community	Hospital Practice
Total patients	N=242	N=121
Female gender, n (%)	42 (17)	21 (17)
Mean age, years (SD)	62 (8)	62 (8)
Age group, years (%)		
35–44	0 (0)	0 (0)
45–54	22 (9)	11 (9)
55–64	162 (67)	81 (67)
65–74	42 (17)	21 (17)
75–84	16 (7)	8 (7)
Geographic region, n (%)		
North Central	51 (21)	34 (28)
Northeast	11 (5)	18 (15)
South	120 (50)	60 (50)
West	59 (24)	9 (7)
Unknown	1 (0)	0 (0)
Presence of metastatic condition, n (%)	242 (100)	121 (100)
Surgery during pre-index period, n (%)	0 (0)	0 (0)
Radiation treatment during pre-index period, n (%)	27 (11)	23 (19)
Surgery during post-index period, n (%)	13 (5)	2 (2)
Radiation treatment during post-index period, n (%)	8 (3)	4 (3)
Required inpatient service, n (%)	107 (44)	48 (40)
Required emergency room service, n (%)	67 (28)	41 (34)
Mean Charlson comorbidity index, n (SD)	5 (2.5)	5.1 (2.5)
Mean unique drugs prescribed at baseline, n (SD)	16.6 (8.6)	15.2 (7.9)
Mean eligible days at baseline, n (SD)	180 (0)	180 (0)
Mean paid medical cost at baseline, n (SD)	$8,244 ($9,031)	$8,884 ($10,500)
Mean duration of therapy, days (SD)	107 (59)	99 (61)

Key: PPPM – per patient per month; SD – standard deviation.

C. Melanoma

Characteristic	Community	Hospital Practice
Total patients	N=212	N=106
Female gender, n (%)	42 (20)	21 (20)
Mean age, years (SD)	61 (9)	61 (9)
Age group, years (%)		
35–44	10 (5)	5 (5)
45–54	26 (12)	13 (12)
55–64	130 (61)	65 (61)
65–74	24 (11)	12 (11)
75–84	22 (10)	11 (10)
Geographic region, n (%)		
North Central	50 (24)	22 (21)
Northeast	11 (5)	21 (20)
South	104 (49)	45 (42)
West	47 (22)	18 (17)
Unknown	0 (0)	0 (0)
Presence of metastatic condition, n (%)	212 (100)	106 (100)
Surgery during pre-index period, n (%)	24 (11)	12 (11)
Radiation treatment during pre-index period, n (%)	44 (21)	14 (13)
Surgery during post-index period, n (%)	11 (5)	11 (10)
Radiation treatment during post-index period, n (%)	2 (1)	1 (1)
Required inpatient service, n (%)	80 (38)	32 (30)
Required emergency room service, n (%)	38 (18)	21 (20)
Mean Charlson comorbidity index, n (SD)	4.5 (2.3)	5 (2.3)
Mean unique drugs prescribed at baseline, n (SD)	9.3 (7.5)	9.6 (8.7)
Mean eligible days at baseline, n (SD)	180 (0)	180 (0)
Mean paid medical cost at baseline, n (SD)	$8,091 ($8,510)	$9,519 ($14,517)
Mean duration of therapy, days (SD)	90 (63)	90 (59)

Key: PPPM – per patient per month; SD – standard deviation.

eAppendix Table 4. Distribution of Patients by Immunotherapy

Immunotherapy	Community	Hospital Practice
Overall sample, n (%)		
Ipilimumab	86 (4.1)	43 (4.1)
Nivolumab	1,862 (89.1)	931 (89.1)
Nivolumab + ipilimumab	28 (1.3)	14 (1.3)
Pembrolizumab	114 (5.5)	57 (5.5)
NSCLC, n (%)		
Nivolumab	1,614 (99.1)	807 (99.1)
Pembrolizumab	14 (0.9)	7 (0.9)
Head and neck cancer, n (%)		
Nivolumab	242 (100)	121 (100)
Melanoma, n (%)		
Pembrolizumab	96 (45.3)	48 (45.3)
Ipilimumab	86 (40.6)	43 (40.6)
Nivolumab + ipilimumab	28 (13.2)	14 (13.2)
Nivolumab	2 (0.9)	1 (0.9)

Key: NSCLC – non-small cell lung cancer.

eAppendix Figure. Patient Attrition