# Cost Drivers of Cancer Care: A Retrospective Analysis of Medicare and Commercially Insured Population Claim Data 2004-2014

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## EXECUTIVE SUMMARY

Nearly 14.5 million Americans with a history of cancer were alive in 2014[1] and that number is projected to increase to 18.1 million in 2020.[2] A number of factors will contribute to this increase, including the growth and aging of the U.S. population, an overall reduction in mortality, the earlier detection of cancer (lead time before death), and the increase in cancer survival. The projected increase for 2020 assumes continued past trends: the 5-year survival rate for all cancers diagnosed during 2005-2011 was 69%, up from 49% during 1975-1977,[1] and a 2012 study identified a 1.5% annual decline in cancer mortality for the decade examined.[3]

The increase in people living with cancer and the introduction of new therapies are associated with a rise in cancer care costs. Cancer care costs in the U.S. were estimated to be $124.57 billion in 2010, and are projected to increase to $158 to $173 billion by 2020, representing a 27% to 39% increase.[2] In addition to the impact of increased cancer survivorship and new therapies, a significant shift in the site of chemotherapy infusion delivery from less expensive physician office settings to more expensive hospital outpatient settings has driven some of the past increase[4,5,6,7,8] and may continue to contribute to cost increases.

The objective of this analysis was to identify trends in the overall and component costs of cancer care from 2004 to 2014 and to create comparisons to cost trends in the non-cancer population. We analyzed the prevalence and per-patient costs of actively treated cancer patients (those with claims for cancer surgery, radiation oncology, or chemotherapy) and non-actively treated cancer patients in each year from 2004 to 2014 using two data sources: the Medicare 5% sample claim database and the Truven MarketScan commercial claim database. Note that our analysis of the Medicare 5% sample claim database did not include pharmacy-dispensed drugs provided under the Part D benefit.

We identified the following key dynamics:

1. The percent increase in per-patient cost from 2004 to 2014 for actively treated Medicare fee-for-service (FFS) and commercially insured cancer patients has been similar to the corresponding increase for the respective non-cancer populations.

2. The per-patient cost of chemotherapy drugs is increasing at a much higher rate than other cost components of actively treated cancer patients, driven largely by biologics, but the chemotherapy drug increase has been offset by slower growth in other components.

3. The site of service for chemotherapy infusion has dramatically shifted from lower-cost physician office to higher-cost hospital outpatient settings.

We have important observations on trends in prevalence, cost, and site of service, summarized below:

- **The prevalence of people living with cancer increased from 2004 to 2014 but the prevalence of patients receiving active treatment has remained relatively stable**.

- **Over the entire 2004 to 2014 study period, the average annual increase in cost was essentially the same in the actively treated cancer population and the non-cancer population.**

- **Cancer prevalence increased from 2004 to 2014 more than the contribution of cancer patients' cost to the total population spend.**

- **For patients being actively treated, the portion of spending for cancer-directed pharmaceuticals increased from 2004 to 2014 while the portion of spending for inpatient care declined.**
  - In particular, the portion of spending for biologic chemotherapies increased from 3% to 9% in the Medicare population and from 2% to 7% in the commercial population.

- **The portion of chemotherapy infusions being performed in generally more expensive hospital outpatient settings increased by at least 30%, from 2004 to 2014 with a corresponding reduction in the generally less expensive physician office settings.**

- **As explained in the body of the report, if the chemotherapy infusion site-of-service distribution in 2014 had been maintained at 2004 levels, the estimated Medicare FFS cost per infused chemotherapy patient in 2014 would have been approximately:**
  - \$51,900 per actively treated Medicare FFS patient instead of the observed \$56,100 (7.5% lower)
  - \$89,900 per commercial patient instead of the \$95,400 observed (5.8% lower)

This analysis identifies several drivers influencing the rising cost of cancer care. We hope this material will encourage organizations to focus on feasible cost reduction opportunities.

This report was commissioned by Community Oncology Alliance, who received financial support from the following organizations: Bayer, Bristol-Myers Squibb, Eli Lilly and Company, Janssen Pharmaceuticals, Merck, Pfizer, Pharmaceutical Research and Manufacturers of America (PhRMA), and Takeda. 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. These results are based on analysis of Truven MarketScan commercial data and the Medicare 5% sample data from 2004 to 2014. Different data sets, time periods, and methodologies will produce different results. Bruce Pyenson is a member of the American Academy of Actuaries and meets the Qualification Standards of the American Academy of Actuaries for this report.

## BACKGROUND

The cost of cancer care has received significant attention in the last several years. Cancer care costs in the U.S. were estimated to be $124.57 billion in 2010 and are projected to increase to $158 to $173 billion by 2020.[2] A study examining cancer care costs across 1987-2005 identified a near doubling of cancer care costs, but the study concluded this increase was not dissimilar to overall trends in aggregate health spending.[9]

The rise in the number of people living with a history of cancer from nearly 14.5 million in 2014[1] to an expected 18.1 million in 2020[2] will be a major driver of the increase in cancer care costs. The growth in cancer cases is driven in part by the growth and aging of the U.S. population while another significant driver has been the improvement in cancer survival. Improvements in cancer survival contribute to the rise in cancer prevalence rates: the 5-year survival rate for all cancers diagnosed during 2005-2011 was 69%, up from 49% during 1975-1977.[1] Earlier detection of cancer associated with improvements in cancer screening as well as innovations in cancer treatment are responsible for the improved survival rates. Even without improved survival, earlier detection can increase the number of people living with cancer due to what is called "lead time," increasing the time between cancer diagnosis and mortality. Cancer drug therapies have contributed to the rise in the cost of cancer care. Over 70 new drugs and biologics have been approved for cancer indications within the study period from 2004 to 2014 (a full listing is provided in Appendix E). In each of the past three years, more than 20 therapies have either been approved to treat cancer or received new cancer indications.[10]

Another trend contributing to the increase in cancer care costs has been the shift in the site of chemotherapy infusion delivery from generally lower-cost physician office settings to generally higher-cost hospital outpatient settings. Two site of care analyses using Truven MarketScan commercial data identified a 20% to 39% and a 28% to 53% lower cost per person receiving chemotherapy infusion in a physician office versus a hospital outpatient setting.[7,8] An analysis of the Medicare FFS population identified a $6,500 lower cost for Medicare beneficiaries receiving chemotherapy infusion in a physician office versus hospital outpatient setting.[6]

Along with this site of service shift, there has also been substantial consolidation among outpatient oncology providers and hospitals or health systems going back to at least 2003 with a notable increase starting in 2011. A recent study demonstrated that this increased provider consolidation resulted in statistically significant increased inflation-adjusted spending on outpatient prescription drug-based cancer treatment.[11] One recent study reported that hospitals participating in the federal 340B drug pricing program receive over 50 percent higher Part B oncology drug reimbursement per-beneficiary per-day than community oncology practices.[5] The federal 340B drug pricing program allows hospitals to purchase drugs at greatly reduced prices; 340B was intended to support providers that furnish services to low-income people, allowing them to provide care to more patients using sometimes scarce federal resources.[12] However, providers can purchase drugs at these reduced prices for non-low-income patients, including those with Medicare or private insurance, and generate revenue if their reimbursement exceeds the price of the drug.[12]

Clinical progress is another potential driver of the cost of cancer care. For multiple myeloma, the 3-year survival was only 42% through the 1980s. In the 2000s, the introduction of thalidomide analogs and proteasome inhibitors increased that 3-year survival to approximately 66%, and novel therapies and therapeutic mechanisms continue to be explored.[13] Patients have also benefited from substantial progress in drug therapies treating colorectal cancer.[14] These novel therapies may be associated with increased costs.

The objective of this analysis was to identify trends in cancer care costs and the components of cancer care costs from 2004 to 2014 while comparing those trends to that of the total population and non-cancer population. We analyzed actively treated cancer patients (those with claims for cancer surgery, radiation therapy, or chemotherapy) in each year from 2004 to 2014 in both the Medicare 5% sample and the Truven MarketScan commercial claim database.

## FINDINGS

This section includes our detailed findings from 2004 to 2014 in the commercially insured and the Medicare FFS populations. There are three major sections to our findings:

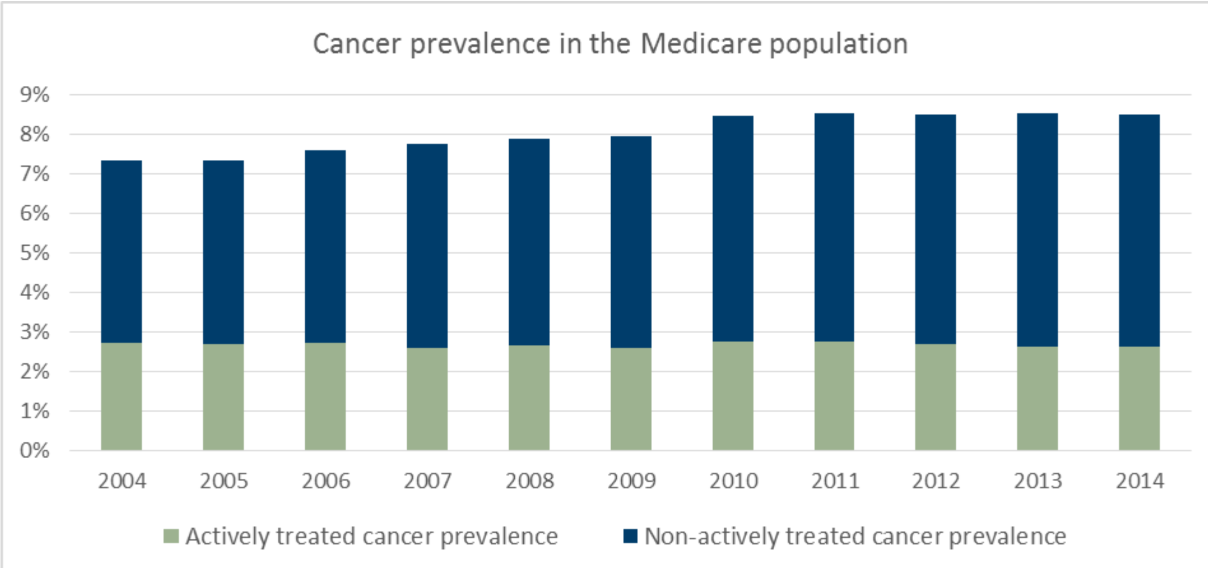
- Cancer population characteristics
- Spending on cancer
- Chemotherapy site of service

For more detail about our data sources and methodology please see the Appendices.

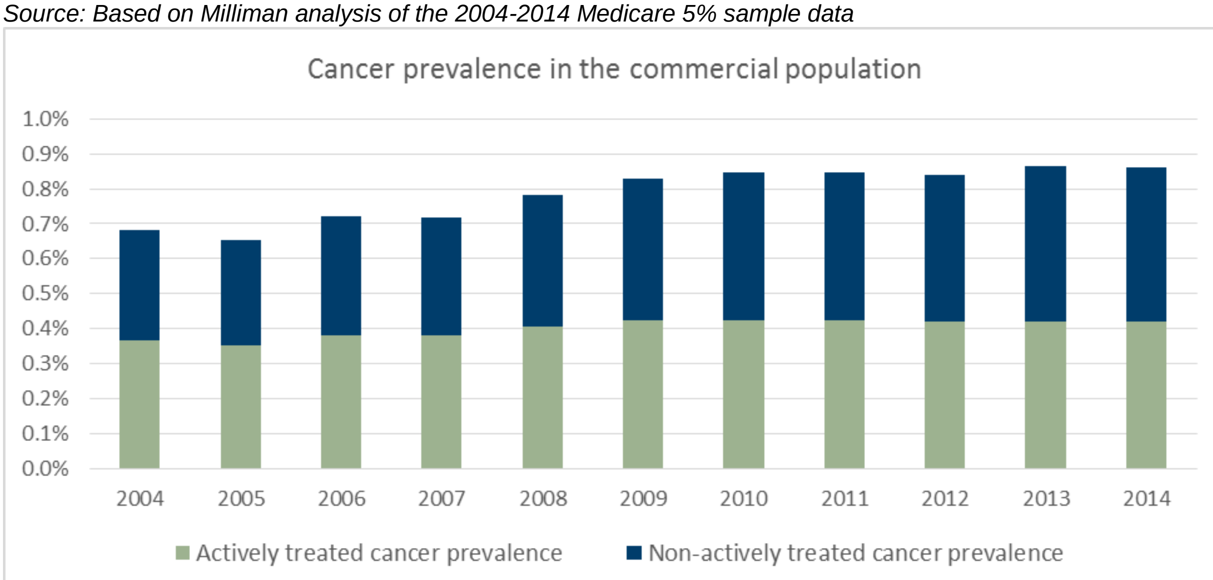
### CANCER POPULATION CHARACTERISTICS: 2004-2014

Figure 1 splits the annual prevalence of cancer between actively treated patients and non-actively treated patients for 2004 to 2014.

**Figure 1: Cancer prevalence in the Medicare FFS and commercially insured populations[a]**




*Source: Based on Milliman analysis of the 2004-2014 Medicare 5% sample data*




*Source: Based on Milliman analysis of the 2004-2014 Truven MarketScan data*

The prevalence of cancer increased between 2004 and 2014 from 7.3% to 8.5% (a 16% increase) in the Medicare FFS population and from 0.7% to 0.9% (a 26% increase) in the commercially insured population. However, the prevalence of actively treated cancer remained relatively stable for both populations: 2.7% in 2004 and 2.6% in 2014 for the Medicare FFS population and 0.4% in both 2004 and 2014 for the commercial population.

[a] Prevalence rates are measured as the number of patients with one or more specified claims coded with a cancer diagnosis in the given calendar year divided by the total database population. Actively treated cancer patients identified in each year include those with one or more claims for chemotherapy, radiation therapy or cancer surgery.

## SPENDING ON CANCER

We examined the proportion of total spending contributed by the non-cancer, the actively treated cancer, and the non-actively treated cancer populations for each year of the study period. Table 1 presents the proportion each sub-population contributes to total population spend.

**Table 1: Percent of total annual allowed costs by sub-population (actively treated cancer, non-actively treated cancer, and non-cancer)[b]**

| Medicare FFS Population | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Non-cancer | 80.5% | 80.7% | 80.5% | 80.5% | 80.4% | 80.6% | 80.0% | 79.4% | 79.2% | 79.3% | 79.2% |
| Cancer | 19.5% | 19.3% | 19.5% | 19.5% | 19.6% | 19.4% | 20.0% | 20.6% | 20.8% | 20.7% | 20.8% |
| *Actively treated* | *11.6%* | *11.3%* | *11.3%* | *10.4%* | *10.9%* | *10.7%* | *11.0%* | *11.3%* | *11.4%* | *11.1%* | *11.2%* |
| *Non-actively treated* | *7.9%* | *7.9%* | *8.2%* | *9.1%* | *8.7%* | *8.7%* | *9.1%* | *9.4%* | *9.3%* | *9.6%* | *9.5%* |

*Source: Based on Milliman analysis of the 2004-2014 Medicare 5% sample data*

| Commercially Insured Population | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Non-cancer | 90.6% | 90.5% | 90.3% | 90.0% | 89.7% | 89.7% | 89.4% | 89.3% | 89.2% | 89.1% | 89.3% |
| Cancer | 9.4% | 9.5% | 9.7% | 10.0% | 10.3% | 10.3% | 10.6% | 10.7% | 10.8% | 10.9% | 10.7% |
| *Actively treated* | *7.4%* | *7.3%* | *7.7%* | *7.9%* | *8.1%* | *8.1%* | *8.3%* | *8.4%* | *8.5%* | *8.5%* | *8.4%* |
| *Non-actively treated* | *2.0%* | *2.1%* | *2.0%* | *2.0%* | *2.2%* | *2.2%* | *2.3%* | *2.3%* | *2.3%* | *2.4%* | *2.3%* |

*Source: Based on Milliman analysis of the 2004-2014 Truven MarketScan data*

The percentage of total spending for cancer patients (both actively treated and non-actively treated) has increased slightly from 2004 to 2014 for both the Medicare and commercial populations. In the Medicare FFS population, the contribution to total population spend increased from 19.5% to 20.8% (6.7% increase), while in the commercial population, the contribution increased from 9.4% to 10.7% (13.8% increase).

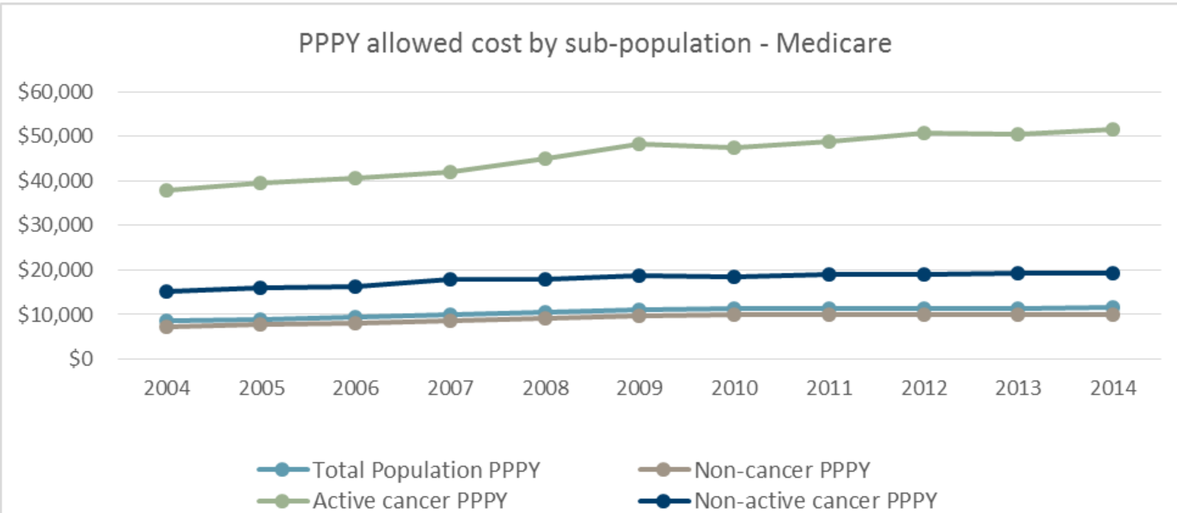
Over the same period, the prevalence of cancer (actively treated and non-actively treated) increased at a higher rate than the increase in the spending contribution: prevalence increased from 7.3% to 8.5% (16% increase) in the Medicare population and from 0.7% to 0.9% (26% increase) in the commercially insured population (Figure 1). Cancer prevalence is increasing at a faster rate than the portion that the cancer population contributes to total population spend.

[b] **Allowed cost**: all reimbursement from the payer plus member cost sharing. Note that for our Medicare analyses, pharmacy drugs covered under Part D are not included. For the commercial analysis, prescription drug costs are included and include oral chemotherapy drugs.
**Actively treated cancer**: members coded with cancer and having one or more claims for chemotherapy, radiation therapy or cancer surgery.
Non-actively treated cancer: members coded with cancer and not having one or more claims for chemotherapy, radiation therapy or cancer surgery.
**Non cancer**: members without claims coded with cancer.

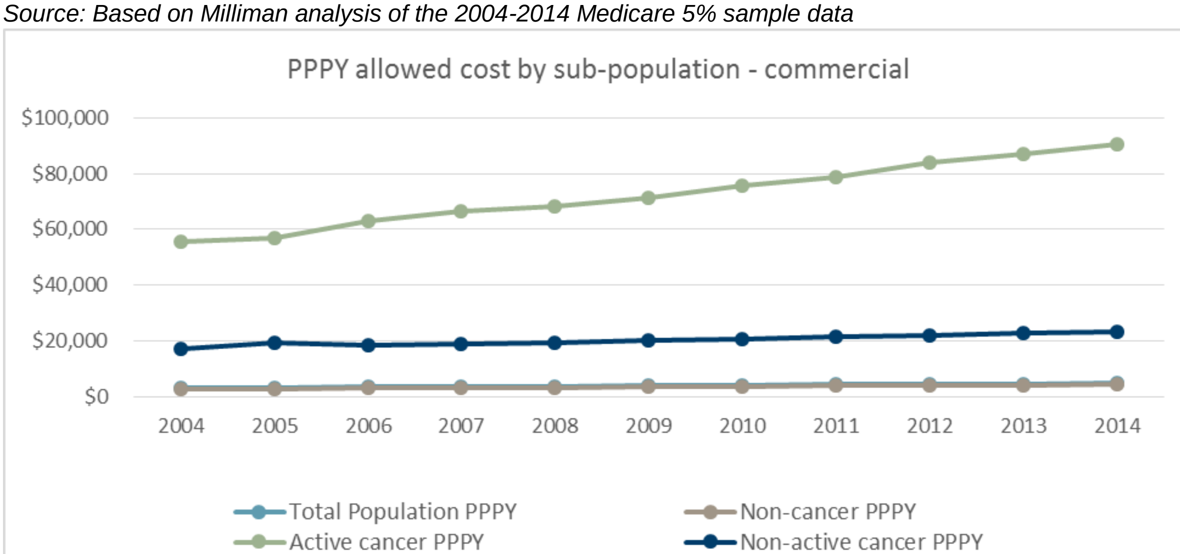
However, as shown in Figure 1, the increased prevalence reflects mostly an increase in patients who are not in active treatment.

Per-patient-per-year (PPPY) spending on actively treated cancer patients is higher than spending on non-actively treated patients and that spending is increasing (Figure 2).

**Figure 2: PPPY allowed cost by subpopulation[c]**




*Source: Based on Milliman analysis of the 2004-2014 Medicare 5% sample data*

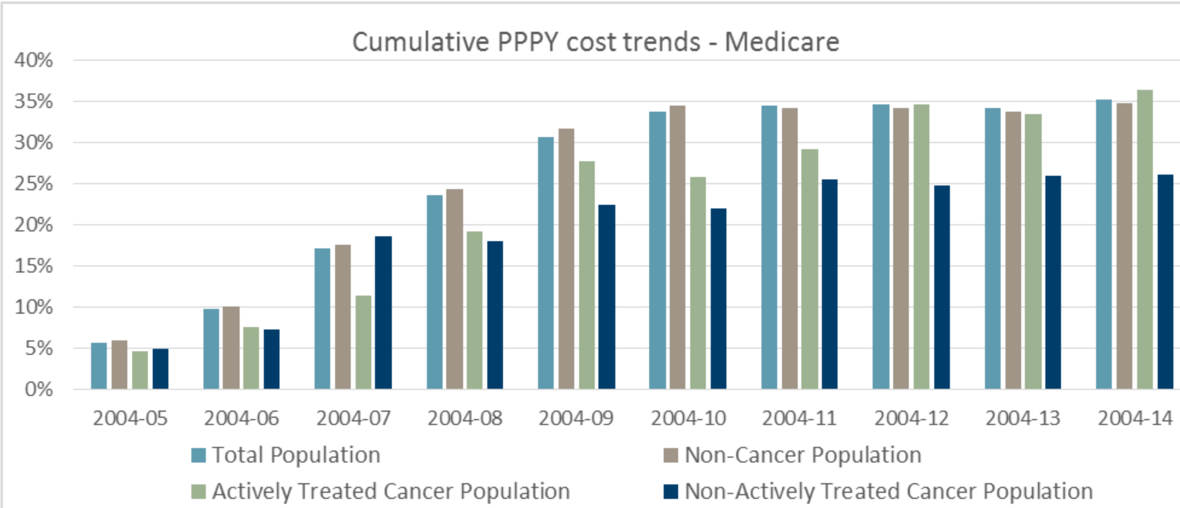



*Source: Based on Milliman analysis of the 2004-2014 Truven MarketScan data*

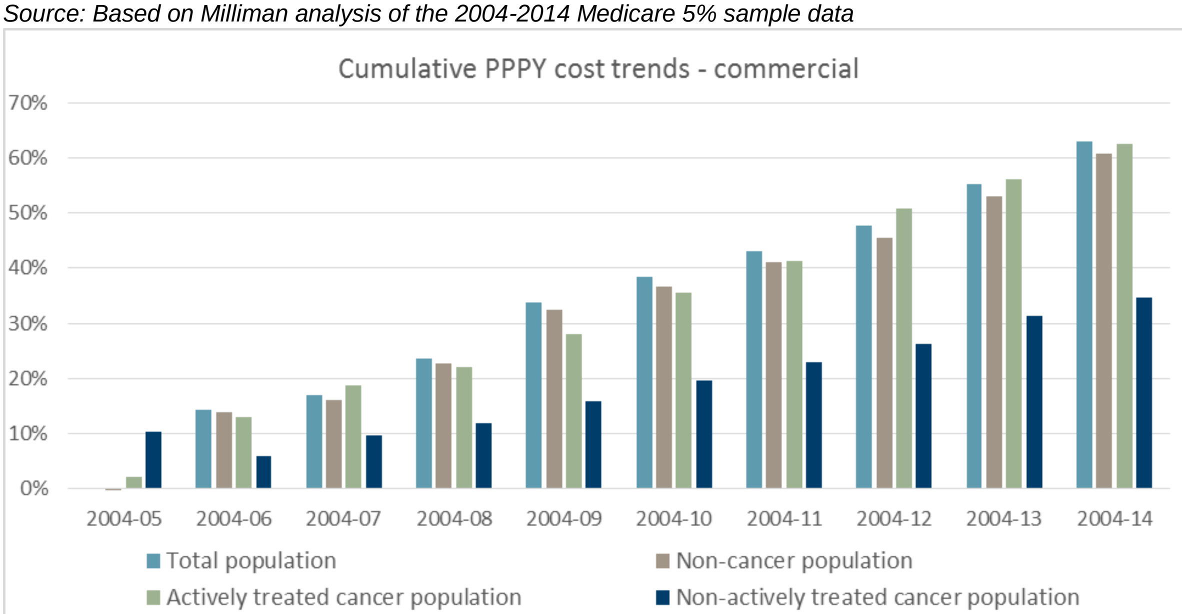
[c] **PPPY**: per patient per year.
**Allowed cost**: all reimbursement from the payer plus member cost sharing. Note that for our Medicare analyses, pharmacy drugs covered under Part D are not included. For the commercial analysis, prescription drug costs are included and include oral chemotherapy drugs.
**Total population**: all members.
**Non cancer**: all members without claims coded with cancer.
**Actively treated cancer**: members coded with cancer and having one or more claims for chemotherapy, radiation therapy or cancer surgery.
**Non-actively treated cancer**: members coded with cancer and not having one or more claims for chemotherapy, radiation therapy or cancer surgery.

While the higher PPPY cost for actively treated cancer patients is evident in Figure 2, the PPPY cost increased at a similar rate for all subpopulations. Figure 3 shows the cumulative trend in PPPY allowed cost for each subpopulation which is calculated as the trend from 2004 to each subsequent year.

**Figure 3: Cumulative trend in PPPY allowed cost across subpopulations**[d]




*Source: Based on Milliman analysis of the 2004-2014 Medicare 5% sample data*




*Source: Based on Milliman analysis of the 2004-2014 Truven MarketScan data*

[d] **PPPY**: per patient per year.
**Allowed cost**: all reimbursement from the payer plus member cost sharing. Note that for our Medicare analyses, pharmacy drugs covered under Part D are not included. For the commercial analysis, prescription drug costs are included and include oral chemotherapy drugs.
**Total population**: all members.
**Non cancer**: all members without claims coded with cancer.
**Actively treated cancer**: members coded with cancer and having one or more claims for chemotherapy, radiation therapy or cancer surgery.
**Non-actively treated cancer**: members coded with cancer and not having one or more claims for chemotherapy, radiation therapy or cancer surgery.

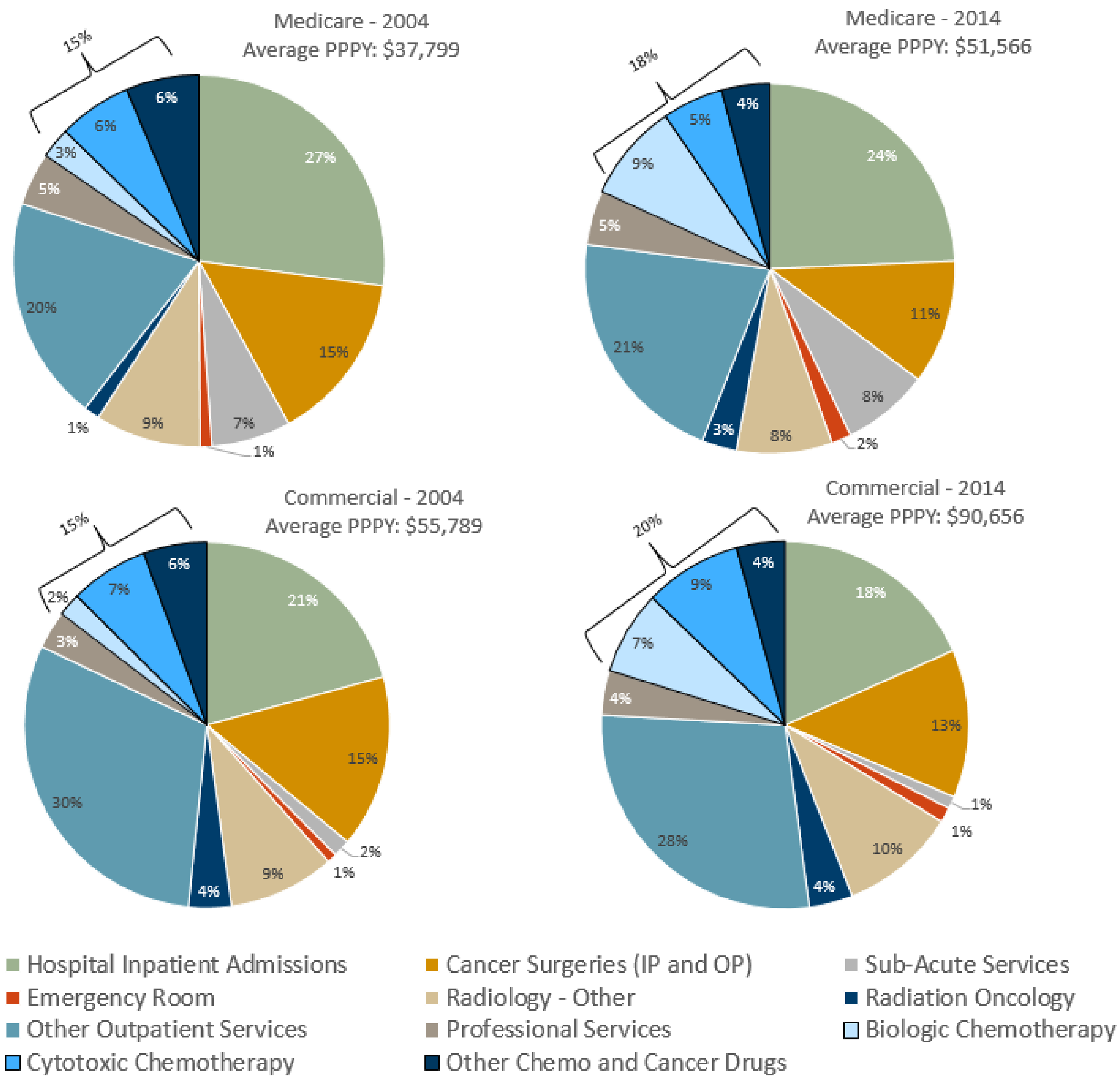
Figure 3 demonstrates that per-patient costs for the total population, for the actively treated cancer population, and for the non-cancer population were increasing at very similar rates throughout the study period; 35.2% versus 36.4% and 34.8% respectively for the Medicare population and 62.9% versus 62.5% and 60.8% respectively for the commercial population. The non-actively treated cancer population's 10-year cost trend was noticeably lower for both the Medicare and commercial populations; 26.0% and 34.7% respectively. We calculated confidence intervals for each cohort's trend line using an exponential curve to fit the series of PPPYs. The three cohorts 95% confidence intervals overlap and by this measure the 10 year cost trend between the total population, non-cancer population and actively treated cancer population are not statistically different.

### *Components of cancer care*

We split the PPPY cost for actively treated patients into cost categories to identify how specific components of cancer treatment have changed over the study period.

Figure 4 shows four pie charts, where per-patient annual allowed cost is split into eleven categories (described in Appendix B) for 2004 and 2014 for each of the Medicare and commercial populations.

### Figure 4: PPPY allowed cost by cost category in the actively treated cancer population, Medicare and commercial[e]




*Source: Based on Milliman analysis of the 2004-2014 Truven MarketScan data and Medicare 5% sample data*

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[e] **PPPY**: per patient per year.

**Allowed cost**: all reimbursement from the payer plus member cost sharing. Note that for our Medicare analyses, pharmacy drugs covered under Part D are not included. For the commercial analysis, prescription drug costs are included and include oral chemotherapy drugs.

For a full explanation of the service categories used, see Appendix B.

In Figure 4, the bracketed pie sections shows the subtotal for chemotherapy drugs (biologic chemotherapy, cytotoxic chemotherapy, and other chemotherapy and cancer drugs). The portion of PPPY spending has increased in actively treated cancer populations, from 15% to 18% in Medicare and from 15% to 20% in commercial. In particular, biologic chemotherapies have seen an increase from 3% to 9% in the Medicare population and from 2% to 7% in the commercial population. The contribution of cost from hospital inpatient admissions decreased, from 27% to 24% for Medicare and from 21% to 18% for commercial. A similar decline was seen for contribution of cost from cancer surgeries, decreasing from 15% to 11% for Medicare and from 15% to 13% for commercial. Radiation oncology cost contribution for the Medicare population increased from 1% to 3%, but the portion did not increase for commercial.

Table 2 shows the change in PPPY allowed costs from 2004 to 2014 for the Medicare and commercial populations.

**Table 2: 2004 to 2014 allowed cost trend by major service category for actively treated patients – Medicare and commercial[f]**

| Service Category | 2004-2014 PPPY Cost Trends | |
|---|---|---|
| | Medicare | Commercial |
| Hospital Inpatient Admissions | 22% | 44% |
| Cancer Surgeries (inpatient and outpatient) | 0%* | 39% |
| Sub-Acute Services | 51% | 15% |
| Emergency Room | 132% | 147% |
| Radiology – Other | 24% | 77% |
| Radiation Oncology | 204% | 66% |
| Other Outpatient Services | 48% | 49% |
| Professional Services | 40% | 90% |
| Biologic Chemotherapy | 335% | 485% |
| Cytotoxic Chemotherapy | 14% | 101% |
| Other Chemo and Cancer Drugs | -9% | 24% |
| **Total PPPY Cost Trend** | **36%** | **62%** |

*Source: Based on Milliman analysis of the 2004-2014 Truven MarketScan data and Medicare 5% sample data*

The PPPY trends vary considerably by service category, with some categories (such as hospital inpatient admissions and other chemo and cancer drugs) increasing less than the total PPPY cost trend, and others (such as biologic chemotherapy) trending at much higher rates than the total PPPY cost trend. PPPY Medicare trends are lower for all services compared to commercial trends except sub-acute services and radiation oncology.

[f] See methodology Appendix B for definition of cost categories.

**PPPY**: per patient per year.

**Allowed cost**: all reimbursement from the payer plus member cost sharing. Note that for our Medicare analyses, pharmacy drugs covered under Part D are not included. For the commercial analysis, prescription drug costs are included and include oral chemotherapy drugs.

* The difference in cost between 2004 and 2014 was $6

### *Cost characteristics for specific cancer types*

Table 3 shows the increase from 2004 to 2014 in annual per patient spending for specific types of cancer.

**Table 3: 2004 to 2014 trend in PPPY allowed cost for actively treated cancer patients, by cancer type[g]**

| Cancer Type | 2004-2014 PPPY Cost Trends | |
|---|---|---|
| | Medicare | Commercial |
| Blood | 53% | 73% |
| Breast | 36% | 71% |
| Colon | 28% | 65% |
| Lung | 21% | 59% |
| Non-Hodgkin's Lymphoma | 34% | 69% |
| Pancreatic | 25% | 54% |
| Prostate | 39% | 79% |
| Other | 22% | 58% |
| **Total: All Cancers** | **36%** | **62%** |

*Source: Based on Milliman analysis of the 2004-2014 Truven MarketScan data and Medicare 5% sample data.*

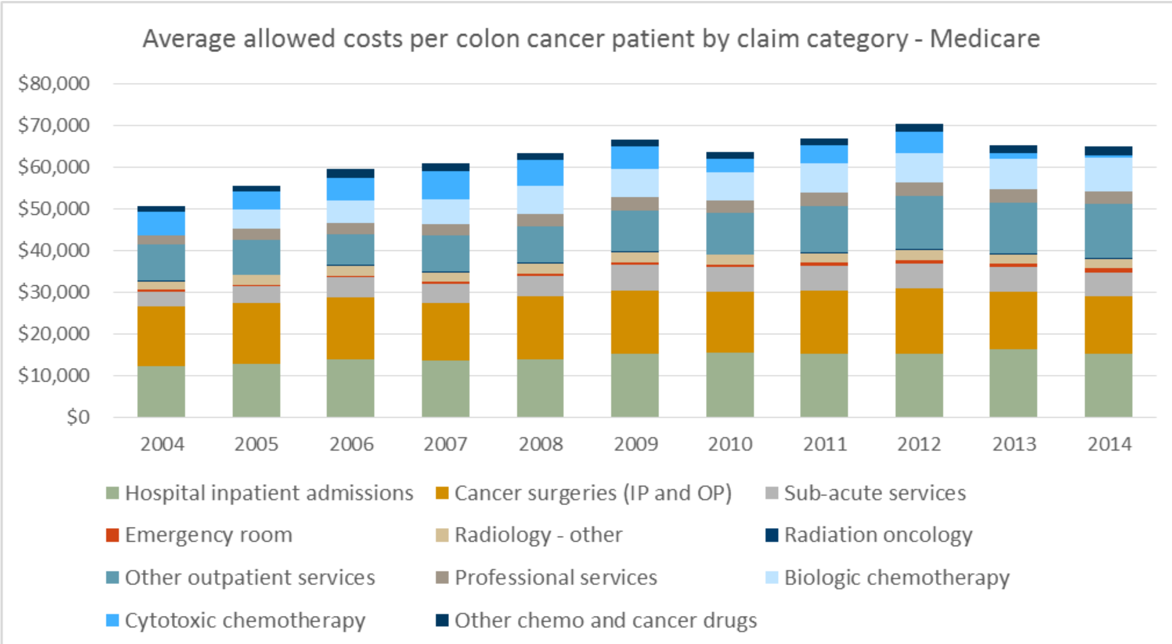
For the Medicare population, the 10-year trend in annual per-patient blood cancer and prostate cancer costs were higher than average, 53% and 39% respectively, while the 10-year trend in lung cancer, pancreatic cancer, and colon cancer costs were lower than average, 21%, 25% and 28% respectively. For the commercial population, the 10-year trend in colon cancer, blood cancer, breast cancer, and prostate cancer costs were higher than average, 65%, 73%, 71% and 79% respectively, while the 10-year trend in lung and pancreatic cancer costs were lower than average, 59% and 54% respectively.

Many factors can influence the change in costs, some of which involve shifts in treatment patterns for particular cancer types. The rise in costs for the blood cancer cohort during this period coincided with the introduction of FDA approved therapeutic options for patients with blood cancers such as myeloma and leukemia. In addition to improvements in survival, the use of new myeloma drugs led to a substantial increase in drug costs during this period.[13]

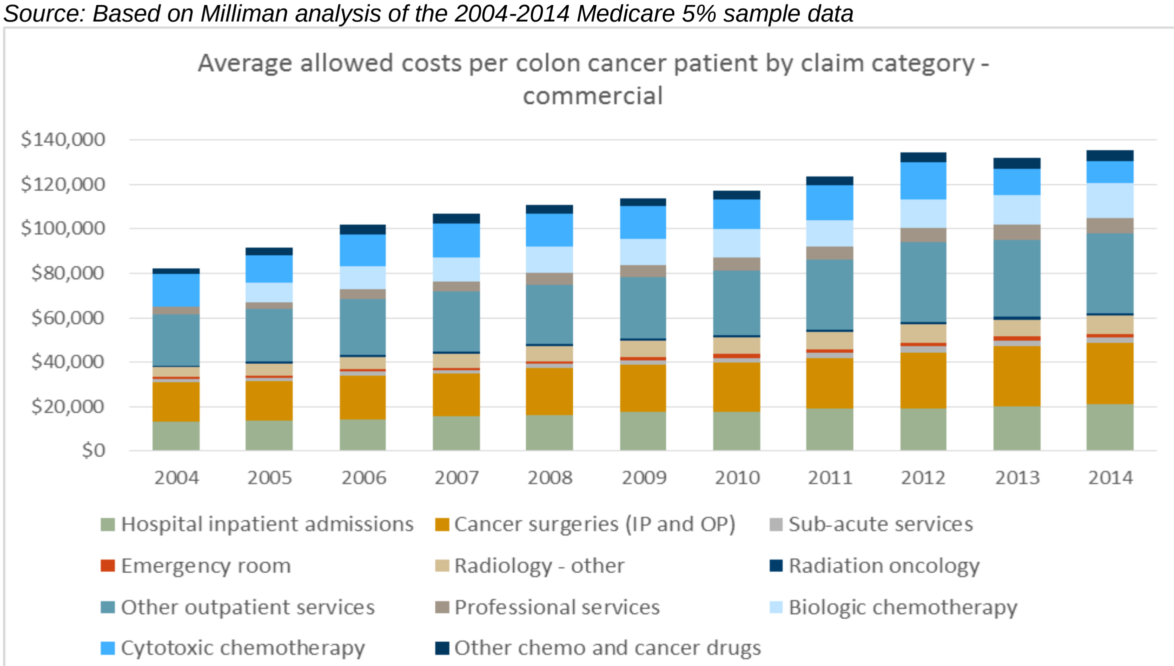
We examine colon cancer treatment costs in detail in Figure 5 to illustrate how therapeutic changes over the study period can influence costs. As seen in Table 3, the colon cancer population had lower than average cost trends for the Medicare population and higher than average cost trends for the commercial population. Figure 5 shows the components of annual per-patient cost for each year of the 11-year study period.

[g] **PPPY**: per patient per year.
**Allowed cost**: all reimbursement from the payer plus member cost sharing. Note that for our Medicare analyses, pharmacy drugs covered under Part D are not included. For the commercial analysis, prescription drug costs are included and include oral chemotherapy drugs.
See Appendix C for specific cancer identification criteria. Note that non-Hodgkin's lymphoma patients have been removed from the blood cancer category and are only included in the non-Hodgkin's lymphoma category.

**Figure 5: 2004-2014 average allowed costs per actively treated colon cancer patient by claim category[h]**




*Source: Based on Milliman analysis of the 2004-2014 Medicare 5% sample data*




*Source: Based on Milliman analysis of the 2004-2014 Truven MarketScan data*

[h] **Allowed cost**: all reimbursement from the payer plus member cost sharing. Note that for our Medicare analyses, pharmacy drugs covered under Part D are not included. For the commercial analysis, prescription drug costs are included and include oral chemotherapy drugs.
See methodology Appendix B for colon cancer identification criteria and a description of claim categories.

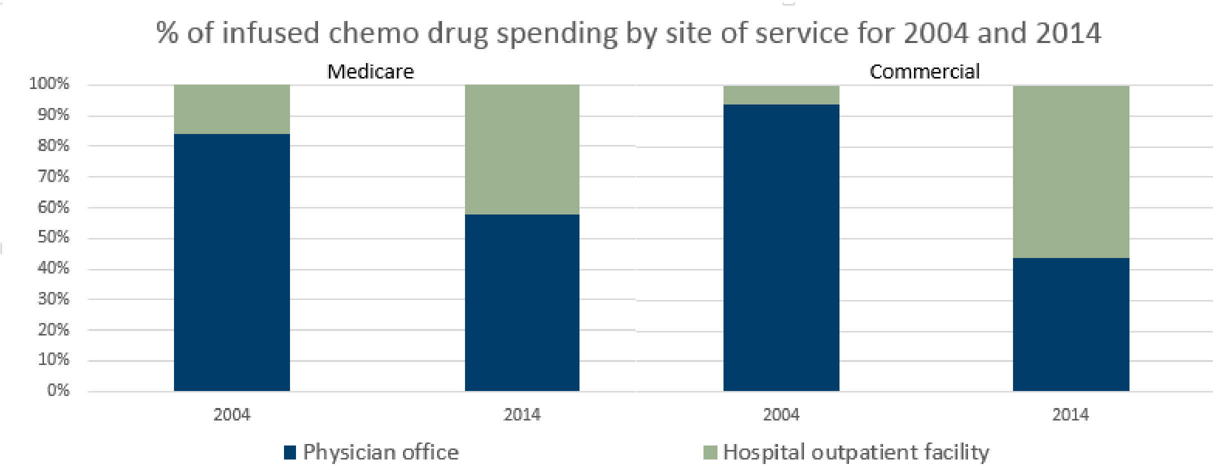
For the actively treated colon cancer population, there was almost no spending on biologic therapies in 2004, but spending on these therapies increased dramatically in 2005. The following changes in treating colon cancer occurred over the study period:[15]

- In 2004, cetuximab was approved for the treatment of metastatic colon cancer.
- Panitumumab followed in 2006 for the treatment of epidermal growth factor receptor (EGFr)-expressing metastatic colon cancer.
- In 2008, the ASCO annual meeting included five randomized controlled trials concluding that the presence of KRAS gene mutations in tumor tissue can predict the utility of these therapies, and the NCCN updated its guidelines in 2009.

## CHEMOTHERAPY SITE OF SERVICE

Most payers, including Medicare, pay less if a chemotherapy infusion is provided in a physician office setting as opposed to a hospital outpatient facility setting. We examined changes from 2004 to 2014 in both spending and volume of chemotherapy infusion drugs by site of service. Figure 6 shows a large shift in spending on chemotherapy drugs to the generally more expensive hospital outpatient settings from generally less expensive physician office setting.

**Figure 6: Infused chemotherapy drug spending by site of service**[i]

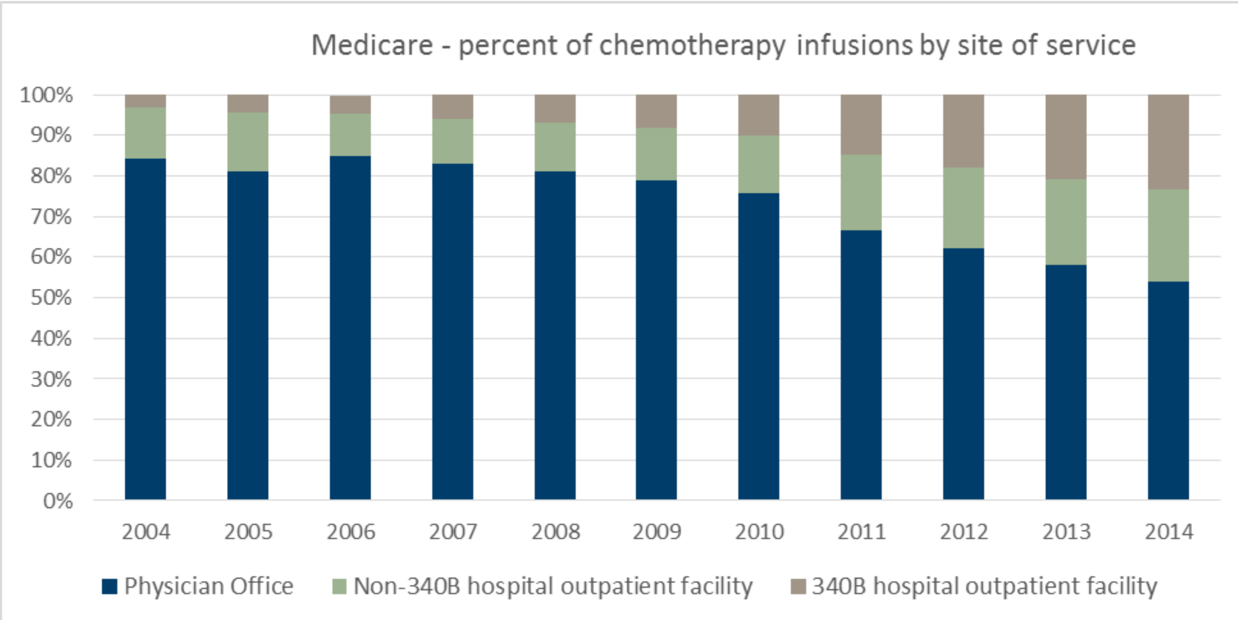



*Source: Based on Milliman analysis of the 2004-2014 Truven MarketScan data and Medicare 5% sample data*

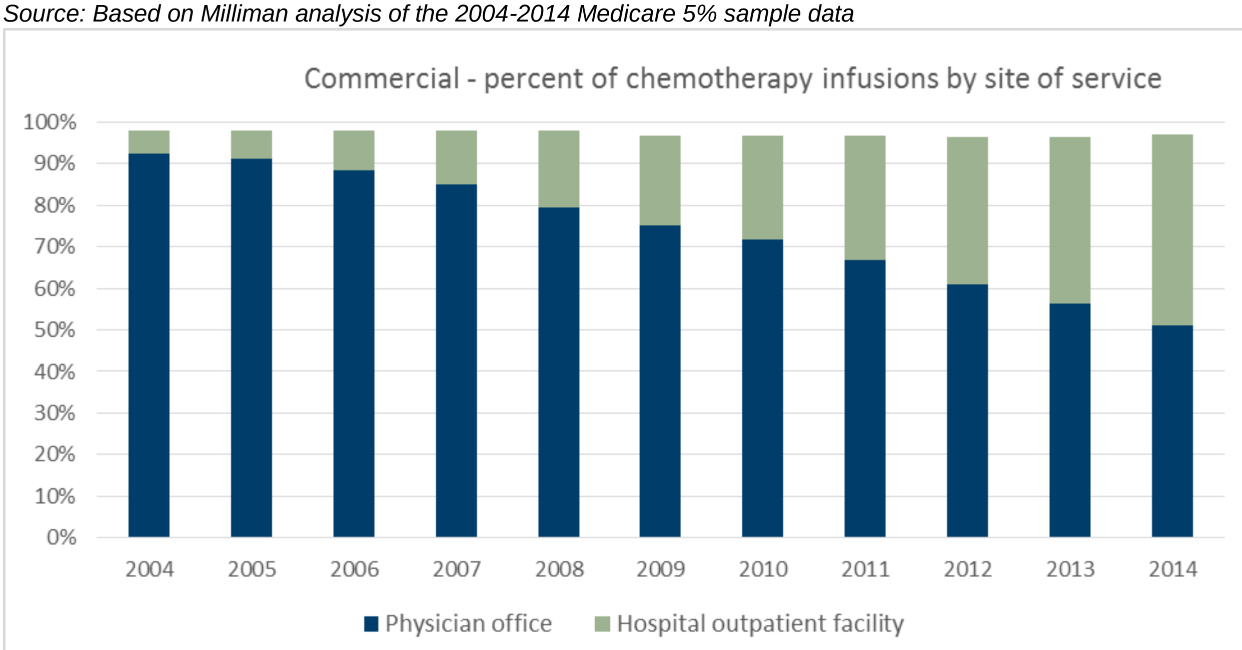
As shown in Figure 7, from 2004 to 2014 hospital outpatient settings saw an increase in the portion of chemotherapy infusions, and physician offices saw a corresponding decrease in the portion of chemotherapy infusions. In Figure 7, we also include a 340B hospital setting category to capture the percentage of hospital outpatient department-based chemotherapy infusions that are being administered in hospitals participating in the 340B drug purchasing program. We provide 340B information for Medicare only as our commercial data does not have facility identifiers.

[i] **PPPY**: per patient per year.
**Allowed cost**: all reimbursement from the payer plus member cost sharing. Note that for our Medicare analyses, pharmacy drugs covered under Part D are not included. For the commercial analysis, prescription drug costs are included and include oral chemotherapy drugs.
**Other**: site of service other than physician office and hospital outpatient includes SNF or home.

**Figure 7: Volume of chemotherapy infusion claims by site of service**




*Source: Based on Milliman analysis of the 2004-2014 Medicare 5% sample data*

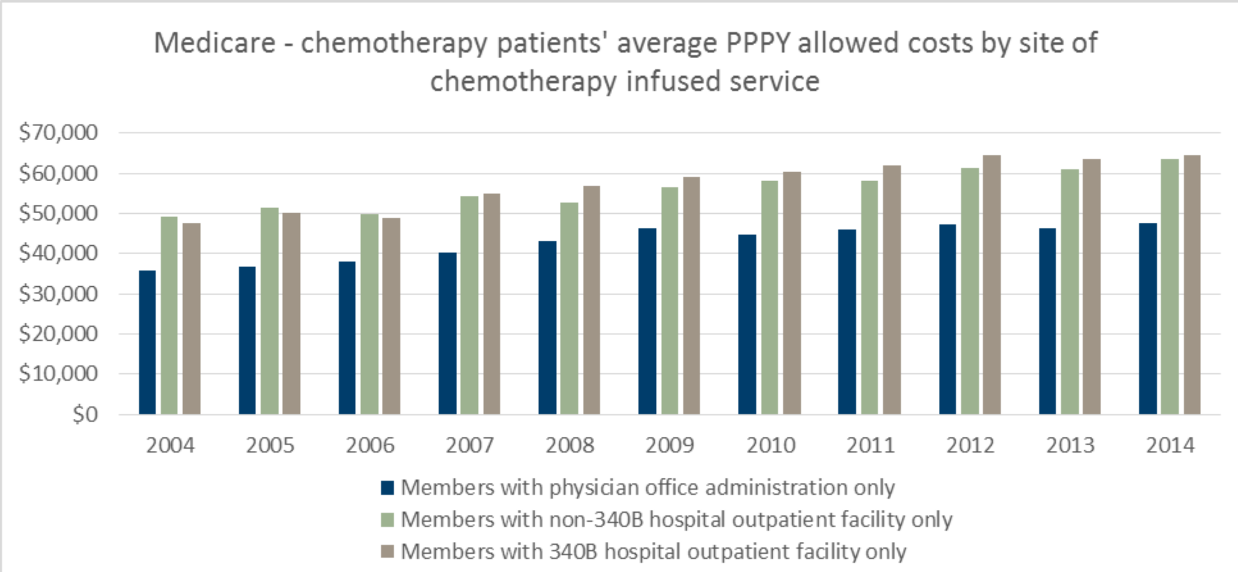



*Source: Based on Milliman analysis of the 2004-2014 Truven MarketScan data*

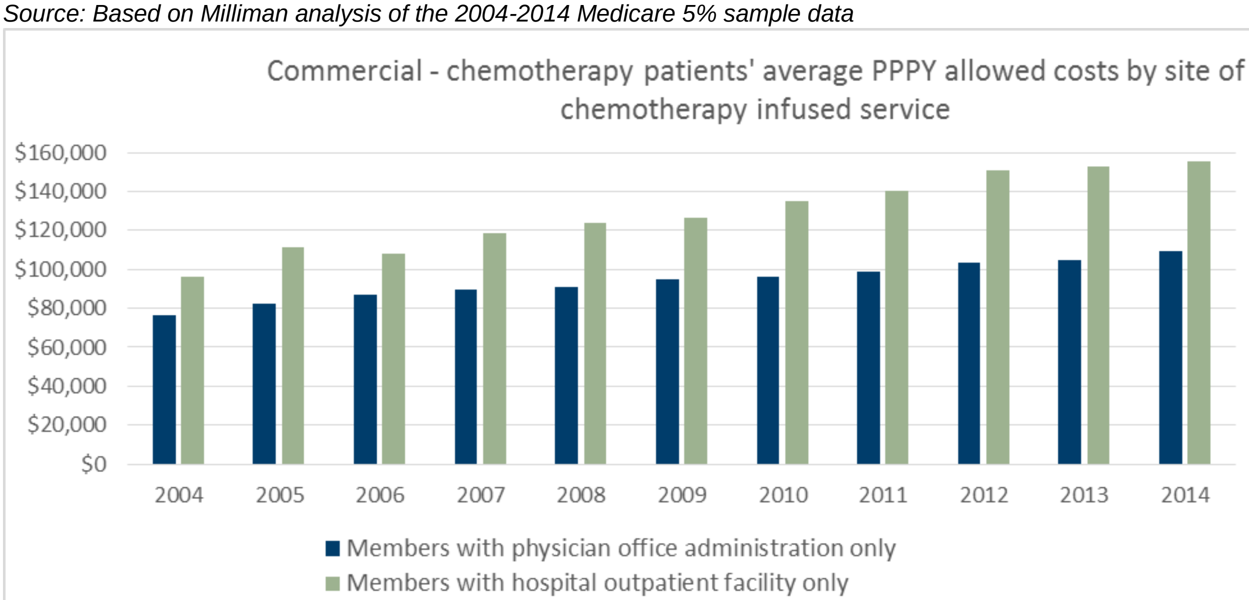
The portion of chemotherapy infusions delivered in hospital outpatient departments increased from 15.8% to 45.9% in the Medicare population and 5.8% to 45.9% in the commercial population. In the Medicare population, the portion of chemotherapy infusions administered in a 340B hospital outpatient department increased from 3.0% to 23.1%. In 2014, chemotherapy infusions in 340B hospitals accounted for 50.3% of all chemotherapy infusions in hospital outpatient departments.

Figure 8 shows the PPPY allowed costs of chemotherapy patients by the site of where they received all of their chemotherapy infusions. For Medicare patients, this could be in a physician office only, a non-340B hospital outpatient department only, or a 340B hospital outpatient department only. For commercial patients, this could be in a physician office only or a hospital outpatient department only. We excluded patients who received chemotherapy in both settings (~7%) and excluded pharmacy-based oral chemotherapy.

**Figure 8: PPPY costs for chemotherapy patients based on site of their infused chemotherapy service, 2004 to 2014**[j]




*Source: Based on Milliman analysis of the 2004-2014 Medicare 5% sample data*




*Source: Based on Milliman analysis of the 2004-2014 Truven MarketScan data*

Figure 8 demonstrates that the average annual PPPY allowed cost for infused chemotherapy patients was significantly higher when chemotherapy infusions were delivered entirely in a hospital outpatient setting versus a physician office setting. Compared to patients receiving all chemotherapy infusions in a physician office, those receiving all chemotherapy infusions in a hospital outpatient facility had a PPPY that was $13,167 (37%) higher in the 2004 Medicare

[j] **PPPY**: per patient per year.
**Allowed cost**: all reimbursement from the payer plus member cost sharing. Note that for our Medicare analyses, pharmacy drugs covered under Part D are not included. For the commercial analysis, prescription drug costs are included and include oral chemotherapy drugs.

FFS population, $16,208 (34%) higher in the 2014 Medicare FFS population, $19,475 (25%) higher in the 2004 commercially insured population, and $46,272 (42%) higher in the 2014 commercially insured population.

We note that the PPPYs for 340B hospitals and non-340B hospitals are similar. 340B hospitals receive the same payment for drugs from Medicare as non-340B hospitals but the purchase price from the drug manufacturer is at a mandated lower price than non-340B hospitals.

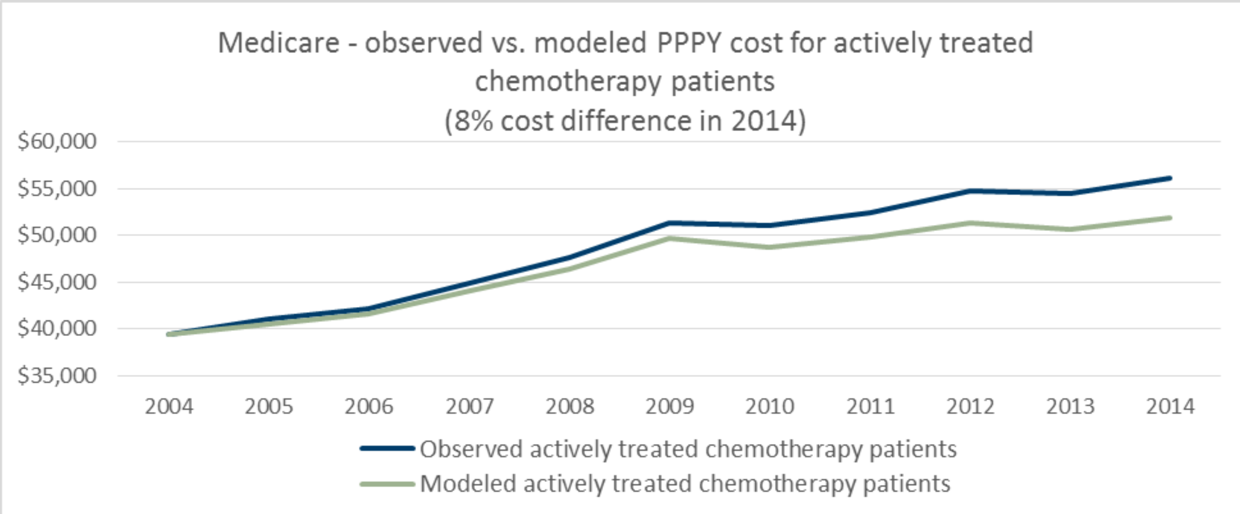
### *Modeling the cost implication of infused chemotherapy site of service shift*

The shift to higher cost hospital outpatient departments has contributed to the rise in PPPY costs for both the Medicare and commercial populations. By applying the two factors involved - the site of service and the cost differential by site of service - we use a relatively simple approach to estimate the extra cost associated with the observed site of service shift.

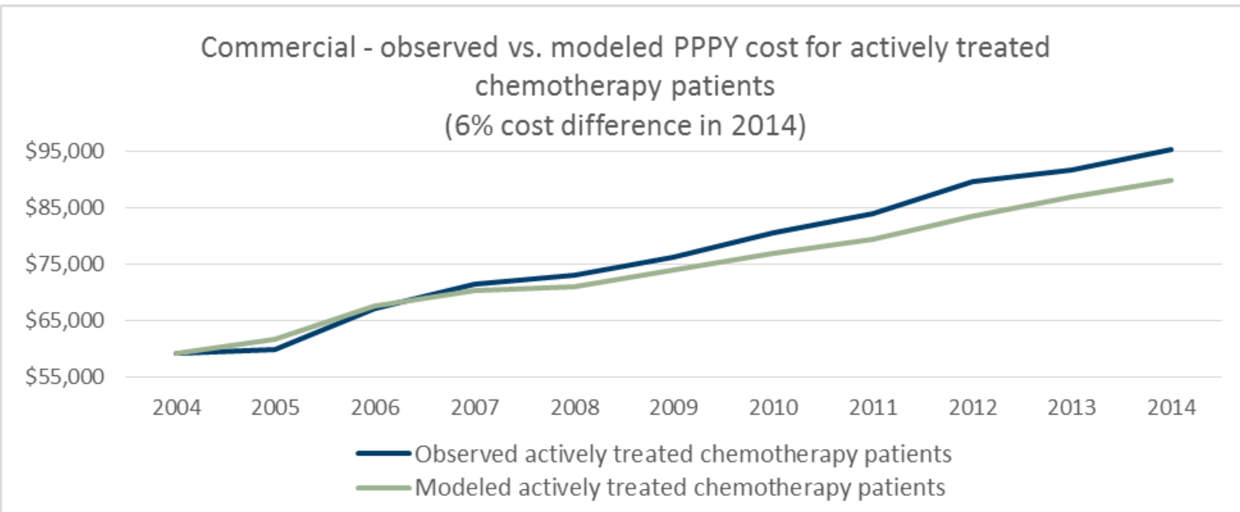
While we believe this simple approach reasonably captures the extra cost associated with chemotherapy infusion in hospital outpatient settings versus physician office settings, we note the uncertainty in reducing total payer spending. In particular, if hospital outpatient departments had not expanded chemotherapy services, they may have found other ways to generate desired revenue.

We assumed the 2004 distribution of patients by the site of chemotherapy infusion would be maintained for each subsequent year. We applied the annual cost trends observed for each site of service in each year. This model captures the observed cost trends while maintaining the distribution of patients receiving chemotherapy in the two settings at 2004 levels. Figure 9 shows the observed versus the modeled PPPY costs over the study period.

**Figure 9: Observed vs. modeled PPPY allowed costs for actively treated chemotherapy patients by chemotherapy infusion site of service[k]**




*Source: Based on Milliman analysis of the 2004-2014 Medicare 5% sample data*




*Source: Based on Milliman analysis of the 2004-2014 Truven MarketScan data*

If the site of service distribution was the same in 2014 as in 2004, the average PPPY cost in 2014 for actively treated chemotherapy patients would have been about $51,900 per Medicare beneficiary receiving infused chemotherapy instead of the $56,000 observed (7.5% lower cost) and $89,900 in the commercial population instead of the $95,400 observed (5.8% lower cost).

[k] **PPPY**: per patient per year.

**Allowed cost**: all reimbursement from the payer plus member cost sharing. Note that for our Medicare analyses, pharmacy drugs covered under Part D are not included. For the commercial analysis, prescription drug costs are included and include oral chemotherapy drugs.

**Observed cost**: PPPY cost of actively treated chemotherapy patients based on the actual distribution of chemotherapy infusion sites each year.

**Modeled cost**: PPPY cost of actively treated chemotherapy patients if the 2004 distribution of chemotherapy infusion sites was maintained.

For 2014, we estimate that Medicare spending would be about $2 billion lower if the infused chemotherapy site of service shift had not occurred. Table 4 shows results of scenarios if varying portions of the observed shift had not occurred.

**Table 4: Difference between observed and modeled Medicare FFS spending in 2014 for actively treated chemotherapy patients under site of service shifting scenarios**

| | Cost impact in billions in 2014 | | | |
|---|---|---|---|---|
| | Shift to 25% of 2004 observed levels | Shift to 50% of 2004 observed levels | Shift to 75% of 2004 observed levels | Shift to 100% of 2004 observed levels |
| Estimated Medicare FFS spending cost difference in 2014 if observed chemotherapy infusion site of service distribution was shifted toward 2004 site of service distribution | $0.5 | $1.0 | $1.5 | $2.0 |

*Source: Based on Milliman analysis of the 2004-2014 Medicare 5% sample data. See Appendix D for Medicare population and cost.*

In 2014, 64.6% of the Medicare actively treated cancer population was receiving infused chemotherapy. If the 2014 distribution of chemotherapy infusion site of service for these actively treated chemotherapy patients had been maintained at the 2004 levels for between 25% and 100% of these patients, the 2014 Medicare FFS spending would have been lower by between $500 million and $2 billion, respectively. Relative to 2014 Medicare spending, the $2 billion lower cost represents:

- 7.5% lower cost for the actively treated chemotherapy patients
- 5.2% lower cost for the total actively treated cancer population
- 0.59% lower cost for the total Medicare population spend

A number of factors could cause the modeled costs to be higher or lower than our estimate. We have assumed that the mix of patients receiving chemotherapy infusion in hospital outpatient facility settings and physician office settings were not substantially different. If the type of patients who shifted to receive their chemotherapy in a hospital outpatient facility setting were higher or lower need patients, the costs could vary from our modeled costs. However, differences in acuity for chemotherapy patients that shift from physician office to hospital outpatient to receive services is not substantiated in the literature. The modeled cost also does not consider regional variation in fee schedules for the commercial population or wage index, DSH or IME reimbursement differences for the Medicare population. If the shift occurred in regions with lower or higher reimbursement than the observed averages, the results could vary. The site of service estimated cost impact analysis does not account for the tendency for provider organizations to increase fees or utilization to meet revenue goals or the availability of alternate sites of service in all locales.

## DISCUSSION AND CONCLUSIONS

Healthcare spending is in the headlines, including spending on cancer care. The overall increase in healthcare costs is widely viewed as unsustainable. Increased spending on healthcare by employers reduces funds available for wages; for government programs, increased spending reduces funds available for infrastructure or other investments. For cancer, prominent individuals associated with academic medicine have criticized the high price of particular therapies that they argue bring little clinical advantage to patients.

This paper explores very large administrative databases to identify the components of total annual spending on cancer care. Instead of focusing on the cost of individual patients or even cancer types, we look at the big picture of average annual per-patient spending on patients receiving cancer care. Our analysis, which focuses mainly on actively treated cancer patients and compares their trends over 11 years to the total population trends, demonstrates the following in particular:

1. **The percent increase in cost from 2004-2014 for actively treated Medicare FFS and commercially insured cancer patients has been similar to the corresponding increase for the non-cancer Medicare FFS and commercially insured populations.**

   Our study finds that this increase is similar to the increase in overall population spending. While we observe that the prevalence of cancer has increased substantially in these populations over the study period, much of this increase is in the number of non-actively treated cancer patients.

2. **The cost of chemotherapy drugs is increasing at a rate significantly higher than other cost components of actively treated cancer patients, driven largely by biologics, but the chemotherapy drug increase has been offset by slower growth in other component costs.**

   When cancer costs are separated into components to understand cost drivers, we see that chemotherapy drug costs are increasing more quickly than other components. These increasing drug costs have been offset by slower growth in other costs categories, such as inpatient services and cancer surgeries.

3. **The site of service for chemotherapy infusion has dramatically shifted from physician office to hospital outpatient settings, which has contributed to the increase in cancer care cost.**

   The data demonstrates a consistent pattern of higher spending on patients receiving chemotherapy in hospital outpatient facilities than those receiving chemotherapy in physician office settings, and a trend toward the use of these higher cost hospital outpatient facility settings.

As healthcare spending continues to rise, insight into the drivers of cost in cancer care can enlighten strategies for meaningful change. Today’s movement for systematic change is often referred to as population health and will certainly involve cancer care. We hope our big picture approach will be useful to that effort.

## APPENDIX A: KEY DATA SOURCES

Medicare 5% Sample. The Medicare 5% sample is a limited data set containing all Medicare paid claims generated by a statistically-balanced sample of Medicare beneficiaries. Information includes county of residence, diagnosis codes, procedure codes, DRG codes, site of service information, beneficiary age, eligibility status and an indicator for HMO enrollment. Member identification codes are consistent from year to year and allow for multiyear longitudinal studies. The Medicare data does not include Part D prescription drug data. We used 2004-2014 data.

Truven Health Analytics MarketScan Commercial Claims Database. The Truven Health Analytics MarketScan Commercial Claims Database (MarketScan) contains all paid claims generated by 15-50 million commercially insured lives annually (depending on the year of data). The MarketScan database represents the inpatient and outpatient healthcare service use of individuals nationwide who are covered by the benefit plans of large employers, health plans, government, and public organizations. The data includes diagnosis codes, procedure codes, DRG codes, and NDC codes, along with site of service information and the amounts paid by commercial insurers. The MarketScan database links paid claims and encounter data to detailed patient information across sites and to types of providers. Patient identifiers are consistent over time, allowing for longitudinal studies. The annual medical database includes private sector health data from approximately 100 payers. We used the MarketScan data from 2004-2014.

## APPENDIX B: METHODOLOGY

Steps for our claim data analysis included the following:

1. **Identified all cancer patients in each year of analysis**

Patients must have at least one acute inpatient or two observation, nonacute inpatient, emergency department, or outpatient claims on different days that contain a cancer ICD-9 diagnosis code in any position of the claim. See Appendix C for code sets.

2. **Identified the subset of cancer patients being actively treated**

Active treatment includes chemotherapy or radiation therapy or cancer surgery.

Patients were considered to have active chemotherapy treatment if they had 1+ claim for a chemotherapy J-code or chemotherapy NDC codes (commercial analysis only).

- For the chemotherapy J codes, we used the entire J8500 and J9000 series. The specific codes may have changed over the study period but the range has been maintained.
- Note that our analysis of the Medicare 5% sample claim database did not include pharmacy-dispensed drugs provided under the Part D benefit.

Patients were considered to have active inpatient chemotherapy treatment if they had a claim for any of the inpatient chemotherapy MS-DRGs.

Patients were considered to have active radiation oncology treatment if they have a claim for at least one of the radiation therapy codes included in Appendix C or for revenue code 333.

Patients were considered to have active surgical treatment if they met one of the following criteria:

- Inpatient: Surgical MS-DRG that is coded with a Cancer ICD-9 code in the primary position of the claim

- Outpatient: Outpatient cancer surgery coded with a cancer procedure code and coded with a cancer ICD-9 code in the primary diagnosis of the claim

3. **Identified characteristics of the actively treated cancer patients in each annual cohort**

*Major cancer types*

- Specific cancers identified as cancer cases with at least two claims coded with the relevant ICD-9 diagnosis code for that cancer type in the primary position of the claim. For patients coded with more than one cancer type (approximately 1% of patients), we applied the following hierarchy:
    - Lung
    - Pancreatic
    - Blood
    - Non-Hodgkin's lymphoma

- Colon
- Breast
- Prostate
- Other

*Chemotherapy site of service*

- Percent of chemotherapy rendered in a hospital outpatient versus physician office setting
    - Place of service code 22 represents hospital outpatient departments, and 11 represents physician office
- Percent of hospital outpatient chemotherapy delivered in 340B hospitals
    - Note: the source for information about 340B status is the covered entities file, which is available for download at opanet.hrsa.gov and contains quarter-by-quarter 340B eligibility for all acute care hospitals in the country.

### 4. Characterized costs by major service categories

All annual claims for each actively treated cancer patient were grouped into cost model categories based on ICD-9 procedure codes, HCPCs codes, CPT codes, revenue codes, place of service codes, and DRGs.

Cost model categories include:

| Categories Used in Exhibits | Description |
|---|---|
| **Biologic chemotherapy drugs** | *Includes all biologic chemotherapy drugs; to identify, see infused chemotherapy codes and chemotherapy NDC codes lists; type of chemotherapy identified* |
| **Cancer surgeries (inpatient and outpatient)** | *Includes all surgical admissions (with a surgical DRG or MS-DRG) to inpatient acute care hospitals with a cancer diagnosis code as the primary ICD-9 diagnosis code and outpatient surgeries as identified on the outpatient cancer surgeries code list; must also have cancer ICD-9 diagnosis code as primary* |
| **Cytotoxic chemotherapy drugs** | *Includes all cytotoxic chemotherapy drugs; to identify, see infused chemotherapy codes and chemotherapy NDC codes lists; type of chemotherapy identified* |
| **Emergency room** | *Includes standalone emergency room visits (not resulting in an inpatient admission)* |
| **Hospital inpatient admissions** | *Includes all admissions to inpatient acute care hospitals with the exception of cancer surgeries, including medical admissions, non-cancer surgical admissions, rehabilitation and psychiatric admissions, and all associated professional services* |
| **Other chemo and cancer-related drugs** | *Includes all hormonal or other chemotherapy drugs (to identify, see infused chemotherapy codes and chemotherapy NDC codes lists; type of chemotherapy identified) as well as chemotherapy adjuncts (see* |

| | |
|---|---|
| | *chemotherapy adjuncts code list) and hematopoietic agents (see hematopoietic agent J-code list and hematopoietic agent NDC code list)* |
| **Other outpatient services** | *Includes all laboratory and pathology services and outpatient procedural care (such as port placement or non-chemotherapy infusion services), as well as any non-cancer drugs and administration services. Includes non-chemotherapy prescription drug costs for commercial population* |
| **Professional services (office visits, urgent care, and chemotherapy administration)** | *Includes all professional E/M charges, whether in office or hospital outpatient setting, as well as all chemotherapy administration services as identified chemotherapy administration list* |
| **Radiation oncology** | *See radiation oncology code list* |
| **Radiology - other** | *All radiology services, including those on the high tech imaging code list* |
| **Sub-acute services (home health, hospice, and SNF)** | *Includes all skilled nursing facility services, home health services, and hospice services* |

## APPENDIX C: CODE SET DETAIL

The following CPT and Revenue codes were used to identify claims as Acute Inpatient, Observation, Nonacute Inpatient, Emergency Department, or Outpatient site of service.

| Claim type | CPT code | Revenue codes |
|---|---|---|
| **Outpatient** | 99201-99205, 99211-99215, 99241-99245, 99341-99345, 99347-99350, 99381-99387, 99391-99397, 99401-99404, 99411, 99412, 99420, 99429, 99455, 99456, G0402, 0438,G0439,G0463,T1015 | 0510-0517,0519-0523, 0526-0529, 0982, 0983 |
| **Non-acute inpatient** | 99304-99310, 99315, 99316, 99318, 99324-99328, 99334-99337 | 0118, 0128, 0138, 0148, 0158, 0190-0194,0199, 0524, 0525, 0550-0552, 0559,0660-0663,0669 |
| **Acute inpatient** | 99221-99223, 99231-99233, 99238, 99239, 99251-99255, 99291, 99468, 99469, 99471, 99472, 99475-99480 | 010x, 0110-0115, 0117, 0119-0125, 0127, 0129-0135, 0137,0139-0145, 0147, 0149-0155, 0157,0159-0162, 0164, 0166-0175, 0179, 0200-0204, 0206-0214, 0219, 0720-0724, 0729, 0987 |
| **Observation** | 99217-99220 | |
| **Emergency department** | 99281-99285 | 0450-0452, 0456, 0459, 0981 |

### Cancer ICD-9 codes

| ICD-9 Diagnosis Code | Descriptor |
|---|---|
| 140.xx-172.xx | Primary malignant neoplasms, not lymphatic or hematopoietic |
| 174.xx-195.xx | Primary malignant neoplasms, not lymphatic or hematopoietic |
| 196.xx-198.xx | Secondary malignant neoplasms (i.e., metastatic) |
| 199.xx | Malignant neoplasms, unknown site |
| 200.xx-208.xx | Leukemias and lymphomas |
| 209.0x-209.3x | Neuroendocrine tumors |
| 230.xx-234.xx | Carcinoma in situ |

### Specific cancer type ICD-9 codes

| ICD-9 Diagnosis Code | Descriptor |
|---|---|
| 162.xx | Lung Cancer |
| 174.xx, 233.0 | Breast Cancer |
| 185.xx | Prostate Cancer |
| 157.xx | Pancreatic Cancer |
| 153.xx | Colon Cancer |
| 200.xx, 202.0x-202.2x, 202.7x-202.8x | Non-Hodgkin Lymphoma |
| 202.4x, 203.1x, 204.xx-208.xx | Blood Cancer |

### Chemotherapy DRGs and MS-DRGs

For discharges on or after 10/1/2007, used the MS-DRG list. For discharges before 10/1/2007, used the DRG list.

| MS-DRG | MS-DRG Title |
|---|---|
| 837 | CHEMO W ACUTE LEUKEMIA AS SDX OR W HIGH DOSE CHEMO AGENT W MCC |
| 838 | CHEMO W ACUTE LEUKEMIA AS SDX W CC OR HIGH DOSE CHEMO AGENT |
| 839 | CHEMO W ACUTE LEUKEMIA AS SDX W/O CC/MCC |
| 846 | CHEMOTHERAPY W/O ACUTE LEUKEMIA AS SECONDARY DIAGNOSIS W MCC |
| 847 | CHEMOTHERAPY W/O ACUTE LEUKEMIA AS SECONDARY DIAGNOSIS W CC |
| 848 | CHEMOTHERAPY W/O ACUTE LEUKEMIA AS SECONDARY DIAGNOSIS W/O CC/MCC |
| **DRG** | **DRG Title** |
| 410 | CHEMOTHERAPY W/O ACUTE LEUKEMIA AS SECONDARY DIAGNOSIS |
| 492 | CHEMOTHERAPY W ACUTE LEUKEMIA OR W USE OF HI DOSE CHEMOAGENT |

### Radiation therapy codes

| CPT code range | Description |
|---|---|
| 77261-77263 | Therapeutic Radiology: Treatment Planning |
| 77280-77299 | Radiation Therapy Simulation |
| 77300-77370 | Radiation Physics Services |
| 77371-77373 | Stereotactic Radiosurgery (SRS) Planning and Delivery |
| 77399 | Unlisted procedure, medical radiation physics, dosimetry and treatment devices, and special services |
| 77401-77417 | Radiation Treatment |
| 77418 | IMRT Delivery |
| 77421 | Stereoscopic Imaging Guidance |
| 77422-77423 | Neutron Therapy |
| 77427-77499 | Radiation Therapy Management |
| 77520-77525 | Proton Therapy |
| 77600-77620 | Hyperthermia Treatment |
| 77750-77799 | Brachytherapy |

### Chemotherapy J codes

| HCPCS | Description | Category |
|---|---|---|
| J8510 | Oral busulfan | Cytotoxic |
| J8520 | Capecitabine, oral, 150 mg | Cytotoxic |
| J8521 | Capecitabine, oral, 500 mg | Cytotoxic |
| J8530 | Cyclophosphamide oral 25 MG | Cytotoxic |
| J8560 | Etoposide oral 50 MG | Cytotoxic |
| J8561 | Oral everolimus | Cytotoxic |
| J8562 | Oral fludarabine phosphate | Cytotoxic |
| J8565 | Gefitinib oral | Cytotoxic |
| J8600 | Melphalan oral 2 MG | Cytotoxic |
| J8610 | Methotrexate oral 2.5 MG | Cytotoxic |
| J8700 | Temozolomide | Cytotoxic |
| J8705 | Topotecan oral | Cytotoxic |
| J8999 | Oral prescription drug chemo | Cytotoxic |

| | | |
|---|---|---|
| J9000 | Doxorubicin hcl injection | Cytotoxic |
| J9001 | Doxorubicin hcl liposome inj | Cytotoxic |
| J9002 | Doxil injection | Cytotoxic |
| J9010 | Alemtuzumab injection | Biologic |
| J9015 | Aldesleukin injection | Biologic |
| J9017 | Arsenic trioxide injection | Cytotoxic |
| J9019 | Erwinaze injection | Biologic |
| J9020 | Asparaginase, NOS | Biologic |
| J9025 | Azacitidine injection | Cytotoxic |
| J9027 | Clofarabine injection | Cytotoxic |
| J9031 | Bcg live intravesical vac | Biologic |
| J9033 | Bendamustine injection | Cytotoxic |
| J9035 | Bevacizumab injection | Biologic |
| J9040 | Bleomycin sulfate injection | Cytotoxic |
| J9041 | Bortezomib injection | Cytotoxic |
| J9042 | Brentuximab vedotin inj | Biologic |
| J9043 | Cabazitaxel injection | Cytotoxic |
| J9045 | Carboplatin injection | Cytotoxic |
| J9047 | Injection, carfilzomib, 1 mg | Cytotoxic |
| J9050 | Carmustine injection | Cytotoxic |
| J9055 | Cetuximab injection | Biologic |
| J9060 | Cisplatin 10 MG injection | Cytotoxic |
| J9062 | Cisplatin 50 MG injection | Cytotoxic |
| J9065 | Inj cladribine per 1 MG | Cytotoxic |
| J9070 | Cyclophosphamide 100 MG inj | Cytotoxic |
| J9080 | Cyclophosphamide 200 MG inj | Cytotoxic |
| J9090 | Cyclophosphamide 500 MG inj | Cytotoxic |
| J9091 | Cyclophosphamide 1.0 grm inj | Cytotoxic |
| J9092 | Cyclophosphamide 2.0 grm inj | Cytotoxic |
| J9093 | Cyclophosphamide lyophilized | Cytotoxic |
| J9094 | Cyclophosphamide lyophilized | Cytotoxic |
| J9095 | Cyclophosphamide lyophilized | Cytotoxic |
| J9096 | Cyclophosphamide lyophilized | Cytotoxic |
| J9097 | Cyclophosphamide lyophilized | Cytotoxic |
| J9098 | Cytarabine liposome inj | Cytotoxic |
| J9100 | Cytarabine hcl 100 MG inj | Cytotoxic |
| J9110 | Cytarabine hcl 500 MG inj | Cytotoxic |
| J9120 | Dactinomycin injection | Cytotoxic |
| J9130 | Dacarbazine 100 mg inj | Cytotoxic |
| J9140 | Dacarbazine 200 MG inj | Cytotoxic |
| J9150 | Daunorubicin injection | Cytotoxic |
| J9151 | Daunorubicin citrate inj | Cytotoxic |
| J9155 | Degarelix injection | Hormonal |
| J9160 | Denileukin diftitox inj | Biologic |
| J9165 | Diethylstilbestrol injection | Hormonal |
| J9170 | Docetaxel injection | Cytotoxic |
| J9171 | Docetaxel injection | Cytotoxic |
| J9175 | Elliotts b solution per ml | Not |
| J9178 | Inj, epirubicin hcl, 2 mg | Cytotoxic |
| J9179 | Eribulin mesylate injection | Cytotoxic |
| J9181 | Etoposide injection | Cytotoxic |
| J9182 | Etoposide injection | Cytotoxic |
| J9185 | Fludarabine phosphate inj | Cytotoxic |

| | | |
|---|---|---|
| J9190 | Fluorouracil injection | Cytotoxic |
| J9200 | Floxuridine injection | Cytotoxic |
| J9201 | Gemcitabine hcl injection | Cytotoxic |
| J9202 | Goserelin acetate implant | Hormonal |
| J9206 | Irinotecan injection | Cytotoxic |
| J9207 | Ixabepilone injection | Cytotoxic |
| J9208 | Ifosfamide injection | Cytotoxic |
| J9209 | Mesna injection | Not |
| J9211 | Idarubicin hcl injection | Cytotoxic |
| J9212 | Interferon alfacon-1 inj | Biologic |
| J9213 | Interferon alfa-2a inj | Biologic |
| J9214 | Interferon alfa-2b inj | Biologic |
| J9215 | Interferon alfa-n3 inj | Biologic |
| J9216 | Interferon gamma 1-b inj | Biologic |
| J9217 | Leuprolide acetate suspension | Hormonal |
| J9218 | Leuprolide acetate injection | Hormonal |
| J9219 | Leuprolide acetate implant | Hormonal |
| J9225 | Vantas implant | Hormonal |
| J9226 | Supprelin LA implant | Hormonal |
| J9228 | Ipilimumab injection | Biologic |
| J9230 | Mechlorethamine hcl inj | Cytotoxic |
| J9245 | Inj melphalan hydrochl 50 MG | Cytotoxic |
| J9250 | Methotrexate sodium inj | Cytotoxic |
| J9260 | Methotrexate sodium inj | Cytotoxic |
| J9261 | Nelarabine injection | Cytotoxic |
| J9262 | Inj, omacetaxine mep, 0.01mg | Cytotoxic |
| J9263 | Oxaliplatin | Cytotoxic |
| J9264 | Paclitaxel protein bound | Cytotoxic |
| J9265 | Paclitaxel injection | Cytotoxic |
| J9266 | Pegaspargase injection | Biologic |
| J9268 | Pentostatin injection | Cytotoxic |
| J9270 | Plicamycin (mithramycin) inj | Cytotoxic |
| J9280 | Mitomycin injection | Cytotoxic |
| J9290 | Mitomycin 20 MG inj | Cytotoxic |
| J9291 | Mitomycin 40 MG inj | Cytotoxic |
| J9293 | Mitoxantrone hydrochl / 5 MG | Cytotoxic |
| J9300 | Gemtuzumab ozogamicin inj | Biologic |
| J9302 | Ofatumumab injection | Biologic |
| J9303 | Panitumumab injection | Biologic |
| J9305 | Pemetrexed injection | Cytotoxic |
| J9306 | Injection, pertuzumab, 1 mg | Biologic |
| J9307 | Pralatrexate injection | Cytotoxic |
| J9310 | Rituximab injection | Biologic |
| J9315 | Romidepsin injection | Cytotoxic |
| J9320 | Streptozocin injection | Cytotoxic |
| J9328 | Temozolomide injection | Cytotoxic |
| J9330 | Temsirolimus injection | Cytotoxic |
| J9340 | Thiotepa injection | Cytotoxic |
| J9350 | Topotecan injection | Cytotoxic |
| J9351 | Topotecan injection | Cytotoxic |
| J9354 | Inj, ado-trastuzumab emt 1mg | Biologic |
| J9355 | Trastuzumab injection | Biologic |
| J9357 | Valrubicin injection | Cytotoxic |

| | | |
|---|---|---|
| J9360 | Vinblastine sulfate inj | Cytotoxic |
| J9370 | Vincristine sulfate 1 MG inj | Cytotoxic |
| J9371 | Inj, vincristine sul lip 1mg | Cytotoxic |
| J9375 | Vincristine sulfate 2 MG inj | Cytotoxic |
| J9380 | Vincristine sulfate 5 MG inj | Cytotoxic |
| J9390 | Vinorelbine tartrate inj | Cytotoxic |
| J9395 | Injection, Fulvestrant | Hormonal |
| J9400 | Inj, ziv-aflibercept, 1mg | Biologic |
| J9600 | Porfimer sodium injection | Other |
| J9999 | Chemotherapy drug | Cytotoxic |
| Q2043 | Provenge, 50 million autologous CD54+ cells | Biologic |
| Q2049 | Lipodox 10 mg | Cytotoxic |
| Q2050 | Doxil 10mg | Cytotoxic |
| Q0138 | Ferumoxytol | Not |

## Outpatient cancer surgeries

| Procedure code | Code description |
|---|---|
| 11600 | Exc tr-ext mal+marg 0.5 cm/< |
| 11601 | Exc tr-ext mal+marg 0.6-1 cm |
| 11602 | Exc tr-ext mal+marg 1.1-2 cm |
| 11603 | Exc tr-ext mal+marg 2.1-3 cm |
| 11604 | Exc tr-ext mal+marg 3.1-4 cm |
| 11606 | Exc tr-ext mal+marg >4 cm |
| 11620 | Exc h-f-nk-sp mal+marg 0.5/< |
| 11621 | Exc s/n/h/f/g mal+mrg 0.6-1 |
| 11622 | Exc s/n/h/f/g mal+mrg 1.1-2 |
| 11623 | Exc s/n/h/f/g mal+mrg 2.1-3 |
| 11624 | Exc s/n/h/f/g mal+mrg 3.1-4 |
| 11626 | Exc s/n/h/f/g mal+mrg >4 cm |
| 11640 | Exc f/e/e/n/l mal+mrg 0.5cm< |
| 11641 | Exc f/e/e/n/l mal+mrg 0.6-1 |
| 11642 | Exc f/e/e/n/l mal+mrg 1.1-2 |
| 11643 | Exc f/e/e/n/l mal+mrg 2.1-3 |
| 11644 | Exc f/e/e/n/l mal+mrg 3.1-4 |
| 11646 | Exc f/e/e/n/l mal+mrg >4 cm |
| 17304 | Mohs 1 stage |
| 17305 | Mohs 2 stage |
| 17306 | Mohs 3 stage |
| 17307 | Mohs addl stage |
| 17310 | Mohs addl specimen |
| 17311 | Mohs 1 stage h/n/hf/g |
| 17312 | Mohs addl stage |
| 17313 | Mohs 1 stage t/a/l |
| 17314 | Mohs addl stage t/a/l |
| 17315 | Mohs surg addl block |
| 19160 | Partial mastectomy |
| 19162 | P-mastectomy w/ln removal |
| 19200 | Mast radical |
| 19220 | Mast rad urban type |

| | |
|---|---|
| 19240 | Mast mod rad |
| 19301 | Partial mastectomy |
| 19302 | P-mastectomy w/ln removal |
| 19305 | Mast radical |
| 19306 | Mast rad urban type |
| 19307 | Mast mod rad |
| 45384 | Colonoscopy w/lesion removal |
| 45385 | Colonoscopy w/lesion removal |
| 44139 | Mobilization of colon |
| 44140 | Partial removal of colon |
| 44141 | Partial removal of colon |
| 44143 | Partial removal of colon |
| 44144 | Partial removal of colon |
| 44145 | Partial removal of colon |
| 44146 | Partial removal of colon |
| 44147 | Partial removal of colon |
| 44150 | Removal of colon |
| 44151 | Removal of colon/ileostomy |
| 44152 | Colectomy w/ileoanal anast |
| 44153 | Colectomy w/ileoanal anast |
| 44155 | Removal of colon/ileostomy |
| 44156 | Removal of colon/ileostomy |
| 44157 | Colectomy w/ileoanal anast |
| 44158 | Colectomy w/neo-rectum pouch |
| 44160 | Removal of colon |
| 44204 | Laparo partial colectomy |
| 44205 | Lap colectomy part w/ileum |
| 44206 | Lap part colectomy w/stoma |
| 44207 | L colectomy/coloproctostomy |
| 44208 | L colectomy/coloproctostomy |
| 44210 | Laparo total proctocolectomy |
| 44211 | Lap colectomy w/proctectomy |
| 44212 | Laparo total proctocolectomy |
| 44213 | Lap mobil splenic fl add-on |
| 58150 | Total hysterectomy |
| 58152 | Total hysterectomy |
| 58180 | Partial hysterectomy |
| 58200 | Extensive hysterectomy |
| 58210 | Extensive hysterectomy |
| 58240 | Removal of pelvis contents |
| 58260 | Vaginal hysterectomy |
| 58262 | Vag hyst including t/o |
| 58263 | Vag hyst w/t/o & vag repair |
| 58267 | Vag hyst w/urinary repair |
| 58270 | Vag hyst w/enterocele repair |
| 58275 | Hysterectomy/revise vagina |
| 58280 | Hysterectomy/revise vagina |
| 58285 | Extensive hysterectomy |
| 58290 | Vag hyst complex |
| 58291 | Vag hyst incl t/o complex |
| 58292 | Vag hyst t/o & repair compl |
| 58293 | Vag hyst w/uro repair compl |
| 58294 | Vag hyst w/enterocele compl |

## APPENDIX D: POPULATION SAMPLE SIZE AND COST

| Demographics | Commercial | | Medicare* | |
|---|---|---|---|---|
| | 2004 | 2014 | 2004 | 2014 |
| **Total population (number of members)** | 9,365,890 | 30,736,563 | 1,614,417 | 1,566,804 |
| **Cancer population** | | | | |
| Number of members | 63,935 | 264,204 | 118,089 | 133,225 |
| Percent of total population | 0.7% | 0.9% | 7.3% | 8.5% |
| **Actively treated cancer population** | | | | |
| Number of members | 34,329 | 129,507 | 44,139 | 41,098 |
| Percent of total population | 0.4% | 0.4% | 2.7% | 2.6% |
| Percent of cancer population | 53.7% | 49.0% | 37.4% | 30.8% |
| **Total chemotherapy population** | | | | |
| Number of members | 24,968 | 102,130 | 27,556 | 26,563 |
| Percent of actively treated cancer population | 72.7% | 78.9% | 62.4% | 64.6% |
| **Total infused chemotherapy population** | | | | |
| Infusions in physician's office only | | | | |
| Number of members | 10,778 | 23,708 | 22,295 | 14,854 |
| Percent of total chemotherapy population | 43.2% | 23.2% | 80.9% | 55.9% |
| Infusions in hospital outpatient facility only | | | | |
| Number of members | 817 | 20,258 | 3,622 | 10,047 |
| Percent of total chemotherapy population | 3.3% | 19.8% | 13.1% | 37.8% |
| Infusions in a combination of settings | | | | |
| Number of members | 1,773 | 7,525 | 1,639 | 1,662 |
| Percent of total chemotherapy population | 7.1% | 7.4% | 5.9% | 6.3% |
| **Spending** | | | | |
| **Total population (allowed cost)** | $24,379,270,607 | $129,785,018,754 | $13,446,397,168 | $17,670,384,548 |
| **Cancer population** | | | | |
| Total spending (allowed) | $2,281,981,711 | $13,908,337,950 | $2,619,153,436 | $3,672,799,298 |
| Percent of total population spend | 9.4% | 10.7% | 19.5% | 20.8% |
| **Actively treated cancer population** | | | | |
| Total spending (allowed) | $1,794,163,969 | $10,915,304,244 | $1,554,903,891 | $1,986,161,660 |
| Percent of total population spend | 7.4% | 8.4% | 11.6% | 11.2% |
| Percent of cancer population spend | 78.6% | 78.5% | 59.4% | 54.1% |
| **Total chemotherapy population** | | | | |
| Total spending (allowed) | $1,381,572,624 | $9,052,690,542 | $1,020,380,061 | $1,397,000,065 |
| Percent of total population spend | 5.7% | 7.0% | 7.6% | 7.9% |
| Percent of cancer population spend | 60.5% | 65.1% | 39.0% | 38.0% |
| Percent of actively treated population spend | 77.0% | 82.9% | 65.6% | 70.3% |
| **Total infused chemotherapy population** | | | | |
| Physician's office only | | | | |
| Total spending (allowed) | $758,511,113 | $2,361,766,202 | $753,370,260 | $668,629,519 |
| Spending as % of total pop. spend | 3.1% | 1.8% | 5.6% | 3.8% |
| Spending as % of cancer pop. spend | 33.2% | 17.0% | 28.8% | 18.2% |
| Spending as % of actively treated pop. spend | 42.3% | 21.6% | 48.5% | 33.7% |
| Spending as % chemotherapy pop. spend | 54.9% | 26.1% | 73.8% | 47.9% |
| Hospital outpatient facility only | | | | |
| Total spending (allowed) | $72,796,282 | $2,843,556,239 | $162,497,323 | $595,661,897 |
| Spending as % of total pop. spend | 0.3% | 2.2% | 1.2% | 3.4% |
| Spending as % of cancer pop. spend | 3.2% | 20.4% | 6.2% | 16.2% |
| Spending as % of actively treated pop. spend | 4.1% | 26.1% | 10.5% | 30.0% |
| Spending as % chemotherapy pop. spend | 5.3% | 31.4% | 15.9% | 42.6% |

*Source: Based on Milliman analysis of the 2004-2014 Truven MarketScan data and Medicare 5% sample data*

## APPENDIX E: NEW ONCOLOGY DRUG AND BIOLOGIC APPROVALS, 2004 – 2014

The table below lists all drugs approved with cancer indications between 2004 and 2014, as extracted from the *New Drug Approvals* documentation prepared annually by the Pharmaceutical Research and Manufacturers of America.

| Name (active ingredient) | Indication | FDA approval date |
|---|---|---|
| Alimta (pemetrexed) | Treatment of malignant pleural mesothelioma (asbestos-related cancer) | 2/4/2004 |
| Avastin (bevacizumab) | Treatment of first-line or previously untreated metastatic colorectal cancer | 2/26/2004 |
| Clolar (clofarabine) | Treatment of children with refractory or relapsed acute lymphoblastic leukemia | 12/28/2004 |
| Erbitux (cetuximab) | Treatment of metastatic colorectal cancer | 2/12/2004 |
| Human Secretin (for injection) | Stimulation of pancreatic secretions to aid in the diagnosis of pancreatic exocrine dysfunction, stimulation of gastrin secretion to aid in the diagnosis of gastrinoma, and stimulation of pancreatic secretion to facilitate the identification of the ampulla of Vater and accessory papilla during endoscopic retrograde cholangiopancreatography | 4/9/2004 |
| Sensipar (cinacalcet HCI) | Treatment of secondary hyperthyroidism in chronic kidney disease in patients on dialysis and for treatment of hypercalcemia in patients with parathyroid carcinoma | 3/8/2004 |
| Tarceva (erlotinib) | Treatment of advanced or metastatic non-small-cell lung cancer (NSCLC) | 11/18/2004 |
| Arranon (nelarabine) | Treatment of T-cell acute lymphoblastic leukemia and T-cell lymphoblastic lymphoma | 10/28/2005 |
| Nexavar (sorafenib) | Treatment of advanced renal cell carcinoma (kidney cancer) | 12/20/2005 |
| Sprycel (dasatinib) | Treatment of chronic myeloid leukemia and Philadelphia chromosome-positive acute lymphoblastic leukemia | 6/28/2006 |
| Sutent (sunitinib) | Treatment of advanced kidney cancer and gastrointestinal stromal tumors (GIST) | 1/26/2006 |
| Vectibix (panitumumab) | Treatment of epidermal growth factor receptor (EGFr)-expressing metastatic colorectal cancer | 9/27/2006 |
| Zolinza (vorinostate) | Treatment of cutaneous manifestations in cutaneous T-cell lymphoma | 10/6/2006 |
| Gardasil (quadrivalent human papillomavirus types 6,11,16, and 18 vaccine) | Vaccination in females 9-26 years of age for prevention of certain diseases caused by human papillomavirus (HPV) types 6, 11, 16, and 18 | 6/8/2006 |
| Ixempra (iabepilone) | monotherapy of metastatic or locally advanced breast cancer | 10/16/2007 |
| Tasigna (nilotinib) | Treatment of Philadelphia chromosome-positive chronic myeloid leukemia | 10/29/2007 |
| Torisel (temsirolimus) | Treatment of advanced renal cell carcinoma | 5/30/2007 |
| Tykerb (lapatinib) | Once-daily treatment of advanced or metastatic breast cancer in combination with Xeloda® | 3/13/2007 |
| Degarelix (for injection) | Treatment of advanced prostate cancer | 12/24/2008 |
| Mozobil (plerixafor) | To mobilize stem cells for autologous transplantation in non-Hodgkin's lymphoma and multiple myeloma | 12/15/2008 |
| Treanda (bendamustine) | Treatment of chronic lymphocytic leukemia | 3/20/2008 |
| Afinitor (everolimus) | Treatment of advanced renal cell carcinoma | 3/30/2009 |
| Arzerra (ofatumumab) | Treatment of refractory chronic lymphocytic leukemia (CLL) | 10/26/2009 |
| Folotyn (pralatrexate) | Treatment of relapsed or refractory peripheral T-cell lymphoma | 9/24/2009 |
| Istodax (romidepsin) | Treatment of cutaneous T-cell lymphoma (CTCL) | 11/5/2009 |
| Votrient (pazopanib) | Treatment of advanced renal cell carcinoma | 10/19/2009 |
| Halaven (eribulin mesylate injection) | Treatment of late-stage metastatic breast cancer | 11/15/2010 |
| Jevtana (cabazitaxel injection) | Treatment of metastatic hormone-refractory prostate cancer | 6/17/2010 |
| Provenge (sipuleucel-T) | Treatment of metastatic hormone-refractory prostate cancer | 4/29/2010 |
| Adcetris (brentuximab vedotin) | Hodgkin lymphoma, systemic anaplastic large-cell lymphoma | 8/19/2011 |
| Caprelsa (vandetanib tablets) | Medullary thyroid cancer | 4/6/2011 |

| | | |
|---|---|---|
| Erwinaze (asparginase) | Acute lymphoblastic leukemia (ALL) | 11/18/2011 |
| Jakafi (ruxolitinib tablets) | myelofibrosis | 11/16/2011 |
| Xalkori (crizotinib) | Non-small-cell lung cancer | 8/26/2011 |
| Yervoy (ipilimumab injection for intravenous infusion) | Metastatic melanoma | 3/25/2011 |
| Zelboraf (vemurafenib tablets) | Metastatic melanoma | 8/17/2011 |
| Zytiga (abiraterone acetate tablets) | Metastatic prostate cancer | 4/28/2011 |
| Bosulif (bosutinib) | Treatment of previously treated Philadelphia chromosome-positive (Ph+) chronic myelogenous leukemia (CML) (chronic, accelerated or blast phase) | 9/4/2012 |
| Choline C 11 injection | PET imaging for detection of recurrent prostate cancer | 9/12/2012 |
| Cometriq (cabozantinib) | Treatment of metastatic medullary thyroid cancer | 11/29/2012 |
| Erivedge (vismodegib) | Treatment of advanced basal cell carcinoma | 1/30/2012 |
| Iclusig (ponatinib) | Treatment of CML and Philadelphia chromosome-positive acute lymphoblastic leukemia (Ph+ALL) | 12/14/2012 |
| Inlyta (axitinib) | Treatment of advanced renal cell carcinoma | 1/27/2012 |
| Kyprolis (carfilzomib) | Treatment of multiple myeloma | 7/20/2012 |
| Perjeta (pertuzumab) | Treatment of HER2-positive metastatic breast cancer | 6/8/2012 |
| Picato (ingenol mebutate) | Treatment of actinic keratosis | 1/23/2012 |
| Stivarga (regorafenib) | Treatment of advanced colorectal cancer | 9/27/2012 |
| Synribo (omacetaxine mepesuccinate) | Treatment of CML (chronic or accelerated phase) | 10/26/2012 |
| Tbo-filgrastim | Treatment of chemotherapy-induced neutropenia | 8/29/2012 |
| Voraxaze (glucarpidase) | Treatment of toxic levels of methotrexate in blood due to kidney failure | 1/17/2012 |
| Xtandi (enzalutamide) | Treatment of advanced castration-resistant prostate cancer | 8/31/2012 |
| Zaltrap (ziv-aflibercept) | Treatment of previously treated metastatic colorectal cancer | 8/3/2012 |
| Gazyva (obinutuzumab) | Chronic lymphocytic leukemia | 11/1/2013 |
| Gilotrif (afatinib) | EGFR-positive non-small-cell lung cancer | 7/12/2013 |
| Imbruvica (ibrutinib) | Mantle cell lymphoma | 11/13/2013 |
| Kadcyla (ado-trastuzumab emtansine) | HER2-positive metastatic breast cancer | 2/22/2013 |
| Lymphoseek (technetium Tc99m tilmanocept) | lymphatic mapping in breast cancer and melanoma patients | 3/13/2013 |
| Mekinist (trametinib) | Unresectable or metastatic melanoma | 5/29/2013 |
| Pomalyst (pomalidomide) | Relapsed and refractory multiple myeloma | 2/8/2013 |
| Tafinlar (dabrafenib) | Unresectable or metastatic melanoma | 5/29/2013 |
| Xofigo (radium Ra 223 dichloride) | Castration-resistant prostate cancer | 5/15/2013 |
| Beleodaq (belinostst) | Treatment of relapsed or refractory peripheral T-cell lymphoma (PTCL) | 7/3/2014 |
| Blincyto (blinatumomab) | Treatment of Philadelphia chromosome-negative relapsed or refractory B-cell precursor acute lymphoblastic leukemia (Ph-ALL) | 12/3/2014 |
| Cyramza (ramucirumab) | Treatment of advanced gastric cancer or gastroesophageal junction adenocarcinoma | 4/21/2014 |
| Keytruda (pembrolizumab) | Treatment of unresectable or metastatic melanoma (second-line therapy) | 9/4/2014 |
| Lynparza (olaparib) | Treatement of advanced ovarian cancer in patients with germline BRCA-mutations | 12/19/2014 |
| Opdivo (nivolumab) | Treatment of unresectable or metastatic melanoma (second-line therapy) | 12/22/2014 |
| Zydelig (idelalisib) | Treatment of relapsed follicular B-cell non-Hodgkin lymphoma, relapsed small lymphocytic lymphoma | 7/23/2014 |
| Zydelig (idelalisib) | Treatment of relapsed chronic lymphocytic leukemia | 7/23/2014 |

| | | |
|---|---|---|
| Zykadia (ceritinib) | Treatment of metastatic anaplastic lymphoma kinase-positive (ALK+) metastatic non-small cell lung cancer (NSCLC) | 4/29/2014 |
| Gardasil ®9 (human papillomavirus 9-valent vaccine, recombinant) | For the prevention of cervical vulvar, vaginal and anal cancers caused by nine types of human papillomavirus (HPV) | 12/10/2014 |

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