Specialty Payment Model Opportunities and Assessment

Oncology Model Design Report

A product of the **CMS Alliance to Modernize Healthcare (CAMH)**
Federally Funded Research and Development Center

Sponsored by the Centers for Medicare & Medicaid Services (CMS)

MITRE

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Published by the RAND Corporation, Santa Monica, Calif. and The MITRE Corporation, McLean, Va.

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Preface

In August 2013, the Centers for Medicare & Medicaid Services (CMS) issued a task order to The MITRE Corporation (MITRE), operator of the CMS Alliance to Modernize Healthcare (CAMH) Federally Funded Research and Development Center (FFRDC). The goal of this task order was to inform the development of alternative payment models for specialty health care services. Mary Kapp serves as the Government Task Lead (GTL) and Claire Schreiber serves as the CMS project manager for this work.

This report includes analyses of claims data to inform the development of a payment model related to oncology care. The research addressed in this report was conducted in RAND Health, a division of the RAND Corporation, under a subcontract to MITRE. A profile of RAND Health, abstracts of its publications, and ordering information can be found at http://www.rand.org/health.

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Summary

This report describes research related to the design of a payment model for specialty oncology services for possible testing by the Center for Medicare and Medicaid Innovation at the Centers for Medicare & Medicaid Services (CMS). Cancer is a common and costly condition. Episode-based payment, which aims to create incentives for high-quality, low-cost care, has been identified as a promising alternative payment model for oncology care (Bach, Mirkin, and Luke, 2011; McClellan et al., 2013a). Episode-based payment systems can provide flexibility to health care providers to select among the most effective and efficient treatment alternatives, including activities that are not currently reimbursed under Medicare payment policies (Bach, Mirkin, and Luke, 2011). However, the model design also needs to ensure that high-quality care is delivered and that beneficial treatments are not withheld from patients.

CMS asked The MITRE Corporation (MITRE), operator of the CMS Alliance to Modernize Healthcare (CAMH) Federally Funded Research and Development Center (FFRDC) and RAND to conduct analyses to inform design decisions related to an episode-based oncology model for Medicare beneficiaries undergoing chemotherapy treatment for cancer. In particular, this report focuses on analyses of Medicare claims data related to the definition of the initiation of an episode of chemotherapy, patterns of spending during and surrounding episodes of chemotherapy, and attribution of episodes of chemotherapy to physician practices. Chemotherapy and its administration accounts for approximately 20 percent of Medicare spending on oncology care (McClellan et al., 2013a).

The claims data analyses in this report provide one source of information for consideration in payment model design. Other sources of information provide important complementary insights. Claims data are useful for understanding patterns of utilization, but they include limited information about the clinical context or appropriateness of care. The oncology clinical evidence and associated practice guidelines provide this type of complementary information. Several other reports from this project also provide complementary sources of information related to model design. A previous report summarized a comprehensive environmental scan of oncology care payment reform options (McClellan et al., 2013a). The Brookings Institution and MITRE convened a technical expert panel to discuss these reform options and provide input on how to best design payment and delivery reform models (McClellan et al., 2013b).

Based on evidence from the environmental scan and feedback from both the stakeholder interviews and the technical expert panel, CMS chose to move forward with developing an episode-based oncology model that incorporates care within oncology practices. The model would be designed for testing in the traditional Medicare fee-for-service (FFS) program (Parts A and B). The details of the model have yet to be determined. The analyses in this report are intended to support decisionmaking related to model design.

Methods

The study population included Medicare beneficiaries receiving chemotherapy treatment for cancer. The primary study sample was drawn from a 100-percent sample of national Medicare FFS claims files. A supplementary sample was drawn from Surveillance, Epidemiology, and End Results-Medicare (SEER-Medicare) data files, which include information on cancer stage and diagnosis date, in addition to claims information.

Beneficiaries initiating chemotherapy treatment in 2010 were identified using 2009 and 2010 chemotherapy drug claims. Chemotherapy drugs were classified into two categories: "likely chemotherapy," including drugs that are nearly always used to treat cancer, and "possible chemotherapy," which includes chemotherapies with other clinical indications—for example, treatment of autoimmune diseases. Chemotherapy and related drugs can be physician-administered or self-administered. Depending on the drug, formulation, and Medicare payment provisions, claims for these drugs can appear in Carrier, Outpatient, Part D, or Durable Medical Equipment (DME) claims, all of which were included in these analyses. In order to describe patterns of health spending, we classified all Medicare claims for services provided to the study population using procedure codes and other information on the claims.

Definition of an Episode of Chemotherapy

We used claims data analysis to focus on two key parameters in model design for episodes of care for patients receiving chemotherapy treatment for cancer: episode initiation and termination. The date of first diagnosis of cancer, the date of first chemotherapy, and the dates of visits with physicians related to oncology care could all potentially be used to identify the initiation of an episode of care. We used SEER-Medicare data to measure the time between the first diagnosis of cancer and initiation of chemotherapy for all patients in the sample initiating chemotherapy in 2003–2009. We found that the time between the primary cancer diagnosis and chemotherapy initiation varied widely across patients, ranging from one day to over seven years, with a median of 2.4 months. A substantial number (16.2 percent) of beneficiaries with a primary cancer diagnosis on a claim did not have a claim for an ambulatory care visit for a cancer diagnosis or a claim for a chemotherapy drug (specifically, claims for "possible" or "likely" chemotherapy drugs, either in the Carrier, Part D, Outpatient, or DME claim files), an unexpected finding. Almost all patients with chemotherapy drug claims also had physician visits for cancer diagnoses within 14 days.

In subsequent analyses, we used the first chemotherapy drug claim in 2010 (with no prior claims within six months) as the marker of the initiation of an episode of care. We examined the types of chemotherapy drugs that marked episode initiation. Chemotherapy initiation was mostly concentrated within several types of chemotherapy drugs, but those drugs varied by type of cancer. For most types of cancer, a substantial proportion of initiations were for drugs classified

as "possible chemotherapy." For example, for breast cancer, 18 percent of episodes initiated with tamoxifen citrate. For lymphoma, 47 percent of episodes initiated with rituximab. A chemotherapy payment model will need to include provisions to ensure that patients receiving "possible chemotherapy" drugs are actually cancer patients that are eligible for the model.

Considering the termination of an episode, the simplest approach would be a fixed period of time following initiation. However, several events that occur frequently during episodes could also potentially be considered as markers to signal the end of an episode. We examined several potential markers of this type, including a period of time without chemotherapy utilization (as indicated by claims for either chemotherapy drugs or administration), mortality, hospice, and loss of Medicare Part A and Part B enrollment (e.g., due to enrollment in Medicare Advantage).

We found that there is considerable variability in the length of time beneficiaries receive chemotherapy treatment. The length of uninterrupted chemotherapy treatment was greatest for people with breast cancer: The mean time from chemotherapy initiation to a two-month period with no chemotherapy treatment was five months (standard deviation [SD], five months). The length of uninterrupted chemotherapy treatment was shortest for people with pancreatic cancer: The mean time from chemotherapy initiation to a two-month period with no chemotherapy treatment was four months (standard deviation [SD], four months).

We found that repeating periods of chemotherapy were common. For example, among patients with chemotherapy treatment for breast cancer (excluding decedents), 72 percent had a gap in chemotherapy with duration *g* of at least one month that was followed by reinitiation of chemotherapy. These repeating periods could be part of a planned therapeutic strategy and considered as continuations of the same episode of care, or they could reflect new courses of treatment that could be considered new episodes of care. It is impossible to distinguish between these scenarios using claims data analysis. The payment model could be designed so that each repeating period is treated as a separate episode, or it could be designed to recognize longer periods of treatment, including active chemotherapy and gaps of several months, which would lead to substantially longer periods of eligibility for the model.

As expected, we found that mortality occurs frequently among Medicare beneficiaries receiving chemotherapy treatment. Mortality within 12 months from the first date of chemotherapy ranged from 7 percent of patients (breast cancer) to 62 percent of patients (pancreatic cancer). These findings indicate that many patients will die during an episode of chemotherapy that makes them eligible for the payment model. Hospice use was also common among Medicare beneficiaries with cancer; the rate of hospice participation ranged from 5 percent (breast and prostate cancer) to 49 percent (pancreatic cancer). Disenrollment from Medicare Part A or B in the time period following chemotherapy initiation was very rare; 2–4 percent of the study population disenrolled for at least one month.

Spending Patterns

We found that Medicare payments escalate sharply in the four months prior to chemotherapy initiation, which may reflect diagnosis and treatment planning, and then peak in the first month of chemotherapy. Monthly spending falls at varying rates in the first six months after chemotherapy initiation and is relatively flat between months eight and 18 after chemotherapy initiation. We found that 16 to 25 percent of total spending in the 24-month window around chemotherapy initiation that we examined occurs in the six months prior to chemotherapy, representing the work-up prior to initiation (i.e., laboratory, imaging, and Evaluation and Management [E&M] payments) and hospitalizations. Between 52 and 71 percent of total spending occurs through the first six months of chemotherapy, and between 77 and 90 percent of spending occurs within the first year of chemotherapy.

The average level of total monthly payments varied considerably across cancers, with the highest spending peak of $9,972 for lymphoma, and peaks of $3,109 for breast cancer and $2,135 for prostate cancer. Monthly Medicare spending for beneficiaries with cancer who receive chemotherapy was substantial. The service categories forming the components of cancer care were numerous, and their relative importance varied across cancer types. Chemotherapy drug and administration (10 to 31 percent of total spending) and inpatient care (25 to 45 percent of total spending), however, were nearly always important contributors to overall spending and may represent important opportunities for improving the efficiency and coordination of care.

We also found that for each type of cancer, there exists great variation in the total costs of care across patients, with the top quartile of patients incurring substantially higher costs than the bottom three quartiles. In principle, this variation could reflect variability in the clinical severity of patients. In a subanalysis, however, we examined quartiles of total spending within patients with each type of cancer and the stage of cancer at diagnosis. The variability across quartiles within a stage and site is comparable to the variation in spending across quartiles not accounting for stage at diagnosis. While there may be other clinical characteristics driving service utilization, this evidence may suggest that differences in treatment patterns independent of severity contribute to variation in utilization and spending.

Attribution of Episodes to Practices

Attribution methodologies are needed to associate patients undergoing episodes of chemotherapy treatment with physician practices that could participate in a payment model. We explored two alternative approaches for attributing chemotherapy episodes to practices: a rule that attributed the episode to the practice responsible for the plurality of cancer-related visits for evaluation and management services, which entails a retrospective approach, and a prospective attribution rule that attributed episodes to the practice responsible for the trigger chemotherapy claim (i.e., the claim that is used to identify the initiation of the chemotherapy treatment episode).

The two rules produced the same results (i.e., attributed the episode to the same practice) for 78.7 percent of episodes. The prospective rule successfully attributed a higher percentage of episodes (99.6 percent vs. 97.4 percent). We then examined the percentage of episodes attributed to clinicians who were most likely to be characterized as "chemotherapy providers" by virtue of submitting Carrier or DME claims for chemotherapy. Using the results of our clinician attribution (which was conducted in parallel with our practice-level attribution), we found that a total of 87.0 percent of episodes were attributed to clinicians who provide physician-administered chemotherapy using the prospective rule, as compared with 80.4 percent of these episodes attributed to clinicians under the plurality rule.

Finally, we measured the percentage of payments per episode made to the attributed practice across a range of different payment categories. We focused on the sample of episodes that produced discordant attribution results. We found that the prospective attribution rule was more likely to attribute the episode to the practice that was primarily responsible for chemotherapy spending. In two other payment categories (all outpatient and total payments), the practice attributed under the prospective rule was responsible for a higher proportion of payments.

Characteristics of Practices with Attributed Oncology Episodes

Using the results from the prospective attribution method, we derived summaries of the practices that were attributed at least one episode. We found that the distribution of episodes per practice is extremely skewed, with 62.1 percent of practices attributed only one or two episodes. A payment model that used a minimum annual episode volume of ten episodes would reduce the sample of practices participating in the program by 79 percent in our study population. However, because chemotherapy episodes are clustered primarily in high-volume practices, the ten-episode minimum entails a loss of only 9 percent of episodes from the analysis. Practices with at least ten attributed episodes had a mean of 3.0 affiliated oncologists and 6.5 total physicians with at least one attributed episode. The number of episodes attributed to each practice and the number of physicians and oncologists with attributed episodes per practice each increase as the overall practice volume minimum is raised. The low volume of episodes attributed to many practices will likely present a challenge to the measurement of performance for episodes of care.

We also examined mean payments, by type of cancer, for the subset of practices that were attributed 40 or more episodes (we selected a cutoff of 40 episodes for these analyses to provide a profile of the practices most likely to participate in the payment model). Mean 12-month episode costs ranged from $58,392 for episodes of leukemia to $19,591 for prostate cancer. Six-month episode costs followed similar patterns.

Conclusion

The results of this study provide one source of information for consideration in the design of an oncology payment model. The analyses in this report describe the initiation and termination of episodes of chemotherapy, spending patterns for patients initiating chemotherapy, and the results of claims-based methods for attributing chemotherapy patients to oncology practices. In future analyses, we will simulate the potential effects of oncology payment models and identify key design considerations.

Acknowledgments

We thank Mireille Jacobson of the University of California, Irvine, and Paul Ginsburg of the University of Southern California, whose thoughtful reviews and comments greatly improved this report.

We also appreciate feedback on our analysis from Kavita Patel and Mark McClellan at the Brookings Institution and Claire Schreiber, Mary Kapp, and other members of the Patient Care Models Group at CMS. We are grateful to our colleagues at MITRE, particularly Heidi Giles, Ren Resch, Dan Speece, and Ken Hoffman, for their guidance and counsel. We thank Shawna Beck-Sullivan and Susan Lovejoy at RAND for project support.

Abbreviations

Acronym	Definition
ATC	Anatomical Therapeutic Chemical
BCG	Bacillus Calmette-Guerin
BETOS	Berenson-Eggers Type of Service
CCW	Chronic Conditions Warehouse
CMS	Centers for Medicare & Medicaid Services
DME	durable medical equipment
E&M	Evaluation and Management
ESRD	end-stage renal disease
FDA	U.S. Food and Drug Administration
FFS	fee-for-service
HCPCS	Healthcare Common Procedure Coding System
HOPD	Hospital Outpatient Department
ICC	intraclass correlation
ICD	International Classification of Diseases
MD-PPAS	Medicare Data on Physician Practice and Specialty
MedPAR	Medicare Provider Analysis and Review
NCI	National Cancer Institute
NDC	National Drug Code
NPI	National Provider Identifier
PPS	prospective payment system

Acronym	Definition
SD	standard deviation
SEER	Surveillance, Epidemiology, and End Results
TIN	Tax Identification Number
XRT	radiation therapy

1. Background

This report describes research related to the design of a payment model for specialty oncology services for possible testing by the Center for Medicare and Medicaid Innovation at the Centers for Medicare & Medicaid Services (CMS). Cancer is a common and costly condition; due to increases in the costs and extent of available therapies, treatment costs are projected to nearly double between 2006 and 2020 (Mariotto et al., 2011; McClellan et al., 2013a; Smith and Hillner, 2011). However, the predominant payment methods for oncology care have not changed substantially since the 1970s (Newcomer, 2012).

Episode-based payment, which aims to create incentives for high-quality, low-cost care, has been identified as a promising alternative payment model (Bach, Mirkin, and Luke, 2011; McClellan et al., 2013a). Episode-based payment systems can provide flexibility to health care providers to select among the most effective and efficient treatment alternatives, including activities that are not currently reimbursed under Medicare payment policies (Bach, Mirkin, and Luke, 2011). In addition, episode-based payment reduces incentives to provide unnecessary services by reducing or removing the additional or "marginal" payment Medicare pays health care providers for each additional service. For example, the prospective payment system for outpatient dialysis, phased in by CMS starting in 2011, was meant to lead to more judicious use of injectable drugs administered during dialysis that were billed separately prior to payment reform (Iglehart, 2011; Medicare Payment Advisory Commission, 2011). However, reductions in marginal payments also create an incentive to "stint," or underprovide care; thus, the model design also needs to ensure that high-quality care is delivered and that beneficial treatments are not denied to patients. Bach, Mirkin, and Luke (2011) note that the existence of regularly updated treatment guidelines in oncology facilitates quality monitoring. Finally, any new payment model will create incentives that can change care patterns at the margin (Jacobson, Earle, and Newhouse, 2011). It is important to identify potential responses during the design process to better align the incentives in the model with clinical guidelines and best practices.

CMS asked The MITRE Corporation (MITRE), operator of the CMS Alliance to Modernize Healthcare (CAMH) Federally Funded Research and Development Center (FFRDC) and RAND to conduct analyses to inform design decisions related to an episode-based oncology model for Medicare beneficiaries undergoing chemotherapy treatment for cancer. In particular, this report focuses on analyses of Medicare claims data related to the definition of the initiation of an episode of chemotherapy, patterns of spending during and surrounding episodes of chemotherapy, and attribution of episodes of chemotherapy to physician practices. Chemotherapy and its administration accounts for approximately 20 percent of Medicare spending on oncology care (McClellan et al., 2013a). The remaining 80 percent of spending includes surgery, radiation therapy, and ongoing management and surveillance; spending in these areas was also studied as part of our analyses.

The claims data analyses in this report provide one source of information for consideration in payment model design. Other sources of information provide important complementary insights for oncology payment model design. Claims data are useful for understanding patterns of utilization, but they include limited information about the clinical context or appropriateness of care. The oncology clinical evidence and associated practice guidelines provide one type of complementary information.

Our analyses take certain general payment model design features as given, based on findings from other reports from this project and input from CMS. A previous report summarized a comprehensive environmental scan of oncology care payment reform options (McClellan et al., 2013a). The environmental scan involved both a review of the literature and interviews with 31 key stakeholders, including academic researchers, oncology providers, patient advocates, and payers. The scan sought to identify and describe potential alternative oncology payment models, garner stakeholder feedback on the benefits and challenges for each identified model, and describe models that commercial or public payers are testing.

The stakeholders advocated for a range of options for new payment models, and not all agreed on the most effective approach to reform. However, there was consensus that any new model should link quality metrics to performance, include incentives to control costs, reform the payment system to provide more support for valuable services not currently reimbursed, and curb the highly variable spending currently associated with the fee-for-service (FFS) payment model (McClellan et al., 2013a; McClellan et al., 2013b). There was also general agreement among stakeholders that opportunity for payment reform in oncology should center on payment for episodes of care that are managed by a medical oncologist. Based on the literature and stakeholder interviews, the report identified four predominant models for cancer care payment reform consideration: (1) payment for adherence to clinical pathways, (2) patient-centered oncology medical homes, (3) bundled payments, and (4) oncology accountable care organizations.

In conjunction with the environmental scan, the Brookings Institution and MITRE convened a technical expert panel to discuss these reform options and provide input on how to best design payment and delivery reform models (McClellan et al., 2013b). The technical expert panel considered each model in light of care delivery structure (such as practice size, organization, and geographic location), payment structure, requirements for provider groups, and potential undesirable consequences. The goal of the technical expert panel was not to reach consensus on what model to move forward but rather to provide guidance to CMS as they weighed the relative advantages and challenges associated with each of the four predominant models.

Based on evidence from the environmental scan and feedback from both the stakeholder interviews and the technical expert panel, CMS chose to move forward with developing an episode-based oncology model that incorporates care within oncology practices. The model

would be designed for testing in the traditional Medicare program (Parts A and B). The details of the model have yet to be determined. The analyses in this report are intended to support decisionmaking related to model design. A forthcoming report by MITRE and RAND will include findings from a simulation of possible effects of an oncology payment model.

This report is organized as follows. In Chapter 2, we present methods used to identify the study population of Medicare beneficiaries receiving chemotherapy through claims data and to classify their health care spending for analysis. In Chapter 3, we present the results of claims data analyses related to the initiation of episodes of chemotherapy treatment. In Chapter 4, we present the results of claims data analyses of spending patterns during episodes of chemotherapy and discuss implications for opportunities for savings in a CMS Center for Medicare and Medicaid Innovation payment model. In Chapter 5, we discuss methods for attributing episodes of chemotherapy to physician practices using claims data and the characteristics of practices with attributed episodes.

2. Methods

Data Sources

The primary data source was Medicare claims data from the Chronic Conditions Warehouse (CCW) for 100 percent of Medicare FFS beneficiaries in 2009–2012. We used claims data for all types of Medicare covered services, including the Carrier,[1] Medicare Provider Analysis and Review (MedPAR), Outpatient, Durable Medical Equipment (DME), Home Health, Hospice, and Part D files. We also used the Master Beneficiary Summary File as a source of beneficiary demographics and information on Medicare eligibility. While the CCW claims data provide a thorough record of Medicare's payments for services, the clinical information available from claims is limited.

To address this limitation, we supplemented these data with Surveillance, Epidemiology, and End Results-Medicare (SEER-Medicare) claims files for 2003–2010. The SEER-Medicare data come from cancer registries and include detailed information on date of diagnosis, staging (at diagnosis), and other epidemiological information. This information permits more accurate identification of the types and stages of cancer. These data included claims from the Carrier, MedPAR, Outpatient, DME, Hospice, and Part D files (Part D data were available for 2008–2010 only). We used the Patient Entitlement and Diagnosis Summary File (PEDSF) as a source of beneficiary characteristics, including demographics and eligibility, as well as data not available from the CCW, including date of cancer diagnosis, cancer site, and stage of cancer at diagnosis. The SEER-Medicare data are only available for a selected set of 12 states that Jacobson et al. (2011) find are not representative of changes in chemotherapy treatment nationwide.

In these analyses, we excluded denied claims using the Carrier Claim Payment Denial Code not equal to "0" or "D" (Carrier and DME files) and Claim Medicare Non-Payment Reason Code not blank (institutional files). We excluded denied claim lines using the Line Processing Indicator Code equal to "A" Allowed or "R" Reprocessed/"S" Secondary payer and the Line Allowed Charge Amount greater than $0 (Carrier and DME files) and Revenue Center Non-Covered Charge Amount not equal to Revenue Center Total Charge Amount (institutional files).

[1] The Carrier file comprises claims for services rendered by physicians.

Population

The CCW study sample included eligible Medicare FFS beneficiaries receiving chemotherapy treatment for cancer in 2010. First, we identified Medicare FFS beneficiaries with cancer by extracting all 2010 claims with any primary or secondary diagnosis code for cancer (Table 2.1). We assigned each beneficiary to a primary cancer type equal to the cancer type from Table 2.1 with the plurality of claims in 2010. We identified eight types of cancer (breast, colorectal, leukemia, lung, lymphoma, ovarian, pancreatic, and prostate) that are prevalent and for which we had access to SEER-Medicare data (with the exception of prostate cancer, which was included due to prevalence, despite the lack of SEER-Medicare data available to us); all other types of cancers were combined into an "other" category for purposes of these analyses.

Table 2.1. Diagnosis Codes Used to Identify and Classify Medicare Beneficiaries with Cancer in the Chronic Conditions Warehouse Sample

Cancer Type	Primary Invasive Cancer ICD-9 Diagnosis Codes	In Situ ICD-9 Diagnosis Codes
Breast	174.x, 175.x	233.0
Colorectal	153.x, 154.x	230.3, 230.4, 230.5, 230.6
Leukemia	204.xx, 205.xx, 206.xx, 207.xx, 208.xx	N/A
Lung	162.3–162.9	231.2
Lymphoma	200.xx, 201.xx, 202.xx	N/A
Ovarian	183.x	N/A
Pancreatic	157.x	230.9
Prostate	185	233.4
Other		
Head and neck	140.x–149.x, 160.x, 161.x	230.0, 231.0
Esophagus	150.x	230.1
Stomach	151.x	230.2
Small intestine	152.x	230.3

Cancer Type	Primary Invasive Cancer ICD-9 Diagnosis Codes	In Situ ICD-9 Diagnosis Codes
Liver	155.0	N/A
Gallbladder, bile ducts	155.1, 156.0–156.9	230.8
Peritoneum and retroperitoneum	158.x	N/A
Spleen	159.1	230.9
Digestive ill-defined	159.8–159.9	N/A
Trachea and main bronchus	162.0, 162.2	231.1
Pleura	163.0–163.8	N/A
Thymus	164.0	N/A
Mediastinum	164.2–164.8	N/A
Respiratory ill-defined	165.x	N/A
Bone and joint	170.x	N/A
Soft tissue and heart	171.x, 164.1	N/A
Melanoma	172.x	N/A
Other malignant skin cancers	173.x	232.x
Kaposi sarcoma	176.x	N/A
Uterine cervix	180.x	233.1
Uterine body	182.x	233.2
Uterus non-specified	179.x	233.2
Placenta	181.x	N/A
Other female genital neoplasms	184.x	233.3
Testis	186.x	N/A

Cancer Type	Primary Invasive Cancer ICD-9 Diagnosis Codes	In Situ ICD-9 Diagnosis Codes
Other male genital neoplasms	187.0–187.8	233.5, 233.6
Bladder	188.x	233.7
Kidney	189.0, 189.1	N/A
Ureter and other urinary organs	189.2, 189.3	233.9
Genito-urinary unspecified	189.9	N/A
Eye	190.x	234.0
Brain and other nervous system	191.x, 192.x	N/A
Thyroid	193.x	N/A
Other endocrine	194.x, 209.x	N/A
Myeloma	203.0, 203.1	N/A
Malignant unspecified site	199.x	N/A

Note: ICD = International Classification of Diseases.
Source: Authors' analysis.

We then identified the subset of patients with any chemotherapy claim in 2010. The working definition of "chemotherapy" for purposes of this report is discussed further below. To focus on patients *initiating* an episode of chemotherapy in 2010, we identified the first 2010 chemotherapy claim and then excluded beneficiaries that had used chemotherapy in 2009 within the six months prior to their initial use in 2010.

The CCW data included 859,253 Medicare beneficiaries with cancer and chemotherapy treatment in 2010. We excluded beneficiaries who were not eligible for both Medicare Parts A and B or enrolled in Medicare Advantage in the month of chemotherapy initiation (30,359), beneficiaries with date of death recorded before the date of chemotherapy initiation (2), and beneficiaries who received chemotherapy in the six-month period preceding the first chemotherapy in 2010 (in order to focus on patients initiating an episode of chemotherapy in 2010; 323,382 beneficiaries). After exclusions, the final CCW study sample included 505,510 unique beneficiaries who initiated chemotherapy in 2010; the most common cancer types were breast and prostate (16 percent and 21 percent, respectively, as shown in Table 2.2). For some

analyses (as noted with each data table or figure), we omitted the "other" cancer category for the purpose of analytic simplicity because of the heterogeneity of cancers included in this category. There is no reason that cancer types in the "other" category could not be included in an oncology payment model, however.

The SEER-Medicare data included 808,699 Medicare beneficiaries with breast, colorectal, leukemia, lung, lymphoma, ovarian, or pancreatic as their primary cancer site at diagnosis in 2003–2009. We excluded any beneficiaries that (1) lacked Medicare Part A or B entitlement in the month of cancer diagnosis, (2) were enrolled in Medicare Advantage in the month of cancer diagnosis, or (3) had died prior to the date of cancer diagnosis. We classified each beneficiary by cancer type using the primary site of cancer at diagnosis. The final eligible SEER-Medicare study sample included 485,429 beneficiaries. Of this population, the most common cancer types were lung (29 percent), breast (29 percent), and colorectal (20 percent) (Table 2.2).

Table 2.2. Number of Individuals with Cancer and Chemotherapy Treatment in 2010 in the CCW and SEER-Medicare Study Samples, by Type of Cancer

Cancer Type	CCW Study Sample	CCW Study Sample	SEER-Medicare Study Sample	SEER-Medicare Study Sample
	Frequency	Percentage of Study Sample	Frequency	Percentage of Study Sample
Prostate	104,972	21	0	0
Breast	80,229	16	47,639	29
Lung	51,961	10	47,924	29
Lymphoma	30,699	6	18,919	11
Colorectal	30,297	6	32,681	20
Leukemia	13,906	3	5,530	3
Ovarian	10,247	2	4,935	3
Pancreatic	9,332	2	8,734	5
Other	173,867	34	0	0
Total	**505,510**	**100**	**166,362**	**100**

Source: Authors' analysis of 2010 CCW Medicare claims data.

The CCW study sample population was 79–88 percent white, 6–13 percent black, and 4–6 percent Hispanic across cancer types (Appendix Table A.1). Some Medicare beneficiaries in the sample were younger than 65, ranging from 3 percent of beneficiaries with prostate cancer to 16 percent of beneficiaries with breast cancer. Between 4 and 15 percent of beneficiaries were eligible for Medicare due to disability, and 12–22 percent were eligible for both Medicare and Medicaid (dual eligibles) across cancer types.

The SEER-Medicare study sample was 78–83 percent white, 7–11 percent black, 3–6 percent Hispanic, and 4–5 percent other race/ethnicity across cancer types (Appendix Table A.2). Between 6 and 8 percent of beneficiaries were under 65 years old. Among beneficiaries diagnosed with colorectal, leukemia, lung, lymphoma, and pancreatic cancer, 46–55 percent were female. Across all cancer types, 6–8 percent were eligible for Medicare through disability (16 percent had a disability based on the original reason for Medicare entitlement; data not shown), and 19–24 percent were covered by Medicaid.

In the SEER-Medicare study sample, across cancer types, 90–98 percent of beneficiaries had one cancer site listed in the SEER-Medicare registry data, 2–9 percent had two sites, and the remaining beneficiaries had three to six sites (Table 2.3). Cancer stages in the registry were grouped as Stages 0, I, II, III, and IV, with the remainder being either Stage Occult, unknown, or not applicable (for example, for leukemia), (using the variable "dajccstg1"). The distributions of stages varied by cancer type. The majority of beneficiaries with breast cancer were listed as Stages I and II. Colorectal cancer and lymphoma diagnoses were distributed fairly evenly across stages. Lung and ovarian cancer cases tended to be listed as Stages III and IV. Beneficiaries with pancreatic cancer tended to be diagnosed at Stage IV or the stage was missing/occult/unknown. Leukemia was not categorized by stages.

Table 2.3. Cancer Characteristics of the SEER-Medicare Study Sample, by Cancer Type

	Number of Beneficiaries (%)													
	Breast		**Colorectal**		**Leukemia**		**Lung**		**Lymphoma**		**Ovarian**		**Pancreatic**	
Number of cancer sites														
1	108,419	(91)	98,050	(90)	22,228	(94)	146,251	(96)	36,569	(93)	11,696	(96)	27,957	(98)
2	10,292	(9)	9,956	(9)	1,405	(6)	6,396	(4)	2,626	(7)	518	(4)	507	(2)
3	657	(1)	924	(1)	92	(0)	392	(0)	207	(1)	28	(0)	19	(0)
4	55	(0)	93	(0)	10	(0)	39	(0)	20	(0)	2	(0)	1	(0)
5	6	(0)	7	(0)	2	(0)	3	(0)	1	(0)	0	(0)	0	(0)
6	0	(0)	0	(0)	0	(0)	0	(0)	1	(0)	0	(0)	0	(0)
Total	119,429	(100)	109,030	(100)	23,737	(100)	153,081	(100)	39,424	(100)	12,244	(100)	28,484	(100)
Stage at diagnosis														
0	19,568	(16)	8,690	(8)	0	(0)	107	(0)	0	(0)	5	(0)	87	(0)
I	46,495	(39)	22,901	(21)	0	(0)	26,039	(17)	8,852	(22)	1,282	(10)	1,629	(6)
II	29,221	(24)	26,144	(24)	0	(0)	5,722	(4)	4,985	(13)	718	(6)	4,634	(16)
III	9,412	(8)	22,572	(21)	0	(0)	35,743	(23)	5,252	(13)	3,786	(31)	1,624	(6)

	Number of Beneficiaries (%)													
	Breast		**Colorectal**		**Leukemia**		**Lung**		**Lymphoma**		**Ovarian**		**Pancreatic**	
IV	5,762	(5)	16,682	(15)	0	(0)	59,300	(39)	11,221	(28)	3,855	(31)	10,736	(38)
NA/Occult/unk	8,971	(8)	12,041	(11)	23,737	(100)	26,170	(17)	9,114	(23)	2,598	(21)	9,774	(34)
Total	119,429	(100)	109,030	(100)	23,737	(100)	153,081	(100)	39,424	(100)	12,244	(100)	28,484	(100)

Source: Authors' analysis of 2003–2009 SEER-Medicare data.

Definition of Chemotherapy and Related Drug Categories

We use the term "chemotherapy" to refer to pharmaceuticals that are used to treat cancer, specifically those drugs with a U.S. Food and Drug Administration–approved (FDA-approved) cancer treatment indication or guideline-concordant "off-label" cancer treatment use. While some chemotherapy drugs are exclusively used to treat cancer, others are used to treat both cancer and other diseases. Based on a clinical review of each chemotherapy drug by RAND and CMS, we separated chemotherapies into two categories for the purposes of reporting descriptive statistics, checking episode trigger conditions, and modeling. The "likely chemotherapy" category includes drugs that are always or nearly always used to treat cancer. The second "possible chemotherapy" category includes chemotherapies with other clinical indications—for example, treatment of autoimmune diseases.

We identified three categories of drugs that are not antineoplastic but are often administered with chemotherapy for distinct purposes. Changes in chemotherapy utilization should shift the utilization and spending of these related drugs. For example, an increase in chemotherapy rates should be associated with increases in drugs that are typically prescribed alongside chemotherapy or drugs that are used to treat the side effects of chemotherapy. The three specific categories are

1.) **Drugs coadministered with chemotherapy**—e.g., adjuvants that have few other uses besides being prescribed in conjunction with chemotherapy. In some cases the coadministered drug is most often used with a specific class of chemotherapeutic agents (e.g., amifostine with alkylating agents)

2.) **Antiemetics** used to treat nausea related to chemotherapy

3.) **Drugs used to treat other side effects of chemotherapy—**e.g., anemia and neutropenia. These primarily biologic drugs are expensive and may be important to identify in our modeling.

We include a separate antiemetics category because these drugs are subject to special Medicare payment policy. Our overall approach involves the five categories of drugs listed in the middle column of Table 2.4.

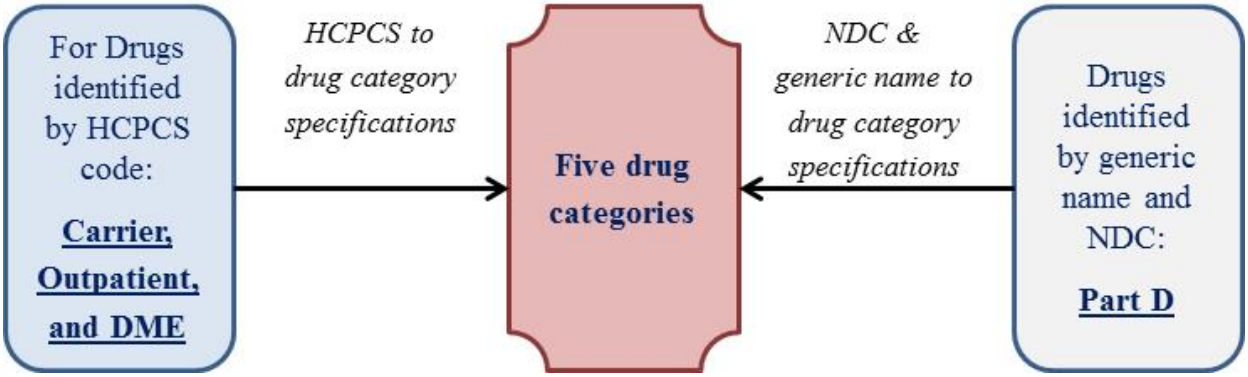
Table 2.4. Drug Categories

	Drug Category	Note
Chemotherapy	1.) Likely chemotherapy	Includes drugs that are (a) chemotherapy from a pharmacological perspective, and (b) chemo-like drugs (e.g., some monoclonal antibodies) that are used primarily to treat cancer
	2.) Possible chemotherapy	Chemo or chemo-like drugs used to treat cancer but also other conditions (e.g., interferons)
Drugs related to chemotherapy	3.) Drugs coadministered with chemotherapy	Includes adjuvants and other coadministered drugs with protective or enhancing effects related to chemotherapy
	4.) Antiemetics	Antiemetics are used to treat a common side effect of chemotherapy (nausea) and are subject to special Medicare coverage and payment provisions.
	5.) Possible side-effect management	Other drugs sometimes used to treat symptoms related to chemotherapy

Source: Authors' analysis.

Chemotherapy and related drugs can be physician-administered or self-administered. Depending on the drug, formulation, and Medicare payment provisions, claims for these drugs can appear in Carrier, Outpatient, Part D, or DME claims. We identify drugs by Healthcare Common Procedure Coding System (HCPCS) code or by National Drug Code (NDC), depending on the claims data source. As a result, we need two sets of crosswalk specifications to translate the HCPCS codes and NDCs that appear in the claims data into the four drug categories of interest (Figure 2.1).

Figure 2.1. Methods for Classifying Drugs into Five Categories



The following tables list complete HCPCS to drug category specifications and NDC and generic name to drug category specifications for four of the five chemotherapy categories (Table 2.5). For the fifth category, drugs to treat chemotherapy side effects, we include only those active ingredients that were included in the list of cancer-related drugs provided by CMS. Some common drugs to treat chemotherapy side effects—for example, epoetin alfa to treat anemia related to chemotherapy—are flagged as a drug used to treat side effects in our data. There is a wide range of potential chemotherapy side effects and a long list of other drugs that could be used to treat these side effects. RAND and CMS mutually agreed that the benefit from a more complete list would not justify the cost involved in its construction. We therefore view this category as "incomplete" in the sense that there may be other drugs that are used to treat chemotherapy side effects. Still, we believe there is value in separately identifying the side effect drugs in our specifications, particularly for the purpose of reporting separate spending trends.

Table 2.5. Drug Categories for Chemotherapy and Related Drugs

	Drug Category	HCPCS Specifications	Generic Name and NDC Specifications
Chemotherapy	1.) Likely chemotherapy	Included, Table A.4	Included, Table A.10
	2.) Possible chemotherapy	Included, Table A.5	Included, Table A.11
Drugs related to chemotherapy	3.) Drugs coadministered with chemotherapy	Included, Table A.6	Included, Table A.12
	4.) Antiemetics	Included, Table A.7	Included, Table A.13
	5.) Possible side-effect management	Partial, Table A.8	Partial, Table A.14

Source: Authors' analysis.

Methods and Specifications: HCPCS

Physicians bill for physician-administered drugs using HCPCS "J" codes. CMS provided a list of HCPCS codes labeled "chemotherapy." The list includes 204 HCPCS codes, some of which fit into each of the five categories listed above. RAND matched this list to 2013 Berenson-Eggers Type of Service (BETOS) codes. We used this list as a starting point to construct a HCPCS-to-drug category crosswalk following these steps:

1.) All HCPCS provided by CMS that are associated with BETOS code O1D (chemotherapy) are classified as likely chemotherapy.

2.) All HCPCS codes for chemotherapy prodrugs listed in the Medicare Claims Processing Manual, Chapter 17, §80.1.1, are classified as likely chemotherapy.

3.) All HCPCS oral antiemetic Q-codes listed in the Medicare Claims Processing Manual, Chapter 17, §80.2.1, are classified as antiemetics.

4.) All "WW" prodrug HCPCS codes are classified as likely chemotherapy.

5.) All remaining O1E (other drug) HCPCS codes on the CMS list are categorized based on feedback from a clinician or CMS.

6.) All codes categorized as likely chemotherapy are reviewed and transferred to possible chemotherapy where applicable based on feedback from a clinician or CMS.

7.) Other codes that may be missing from the CMS list are reviewed.

Additional HCPCS codes were added to our lists in steps 2, 3, 4, and 7. The HCPCS categories are listed in Appendix Tables A.4–A.9. Table A.9 lists three active ingredients—Bacillus Calmette-Guerin (BCG) live vaccine, dexamethasone, and methylprednisolone—that are used to treat cancer in some contexts but are used to treat side effects or as adjuvants in other contexts. These drugs are challenging to categorize. Drug HCPCS codes that are not listed in Tables A.4–A.9 are grouped in an "all other drug" category for the purpose of reporting cost trends and modeling.

Methods and Specifications: NDC

We developed separate NDC crosswalks to assign drugs reported by NDC in the Part D data to one of the five drug classes. While the DME data occasionally reports NDC in addition to HCPCS on the same claim line, we used HCPCS because the DME HCPCS field, unlike the NDC field, is consistently populated. While the Part D data lists 11-digit "package" level NDCs, the nine-digit "product" NDCs are sufficient for our purposes because each product NDC is assigned to a single active ingredient. Several 11-digit package-level NDC codes can be nested in a single nine-digit product-level NDC code. While the appendix tables present nine-digit NDC codes for brevity, our actual crosswalks employ 11-digit NDCs.

We identified chemotherapy and chemotherapy-related NDCs by assembling lists of drug active ingredients for each of the five drug categories and then identifying all NDCs associated with the active ingredients on our lists. For likely and possible chemotherapy, we used a list of chemotherapy active ingredients associated with our cancers of interest from the National Cancer Institute (NCI) website (National Cancer Institute, 2014). We used the NCI lists rather than anticancer drug compendia because the NCI lists are freely and publicly available. These active ingredient names were separated into our category 1 (likely chemotherapy) and category 2 (possible chemotherapy) based on a RAND clinical review of their approved indications and on input from CMS. We reclassified a handful of the NCI active ingredients into the "coadministered" and "treat side effects" categories on a case-by-case basis.

We used Anatomical Therapeutic Chemical (ATC) categories from the World Health Organization Collaborating Centre for Drug Statistics Methodology (2014) to identify active ingredients that are coadministered with chemotherapy or antiemetics. While other pharmaceutical classification systems are available to researchers, the ATC system has the advantages of being comprehensive and publicly available. We used ATC code V03AF, "detoxifying agents for antineoplastic treatment," to identify drugs coadministered with chemotherapy. We used ATC code A04, "antiemetics and antinauseants," to identify antiemetics (category 4). ATC code A04 includes the subheadings "serotonin (5HT3) antagonists" and "other antiemetics." A04 does not include antihistamines and dopamine antagonists that are sometimes used as antiemetics. We excluded these drug classes because they have significant other clinical uses.

We then used the FDA's NDC database to flag 11-digit NDCs associated with each of the active ingredients in our list. Tables A.10–A.14 report the resulting nine-digit NDC to drug category crosswalks. NDCs or active ingredients that are not listed in Tables A.10–A.14 are grouped in an "all other drug" category for the purpose of reporting cost trends and modeling.

Categorization of Health Care Services

We classified claims into service categories for analyses of Medicare payments by type of service. Claims were classified using HCPCS codes, BETOS categories based on HCPCS codes, place of service codes, revenue center codes, and MedPAR codes for type of institutional providers. In addition, drug claims were classified using NDC codes and generic names, as described above. The payment categories are listed in Table 2.6. More details on the codes used to define each category of service are listed in Appendix Table A.15. We used "other" categories to capture unclassified claims so that the analyses include all Medicare payments for each beneficiary.

Table 2.6. Aggregate Payment Categories

Aggregate Category	Component Categories from Appendix Table A.15
Non–Part D chemotherapy payments	Unambiguous chemotherapy—office
	Possible chemotherapy—office
	Drugs coadministered w/chemotherapy—office
	Antiemetics—office
	Chemotherapy administration—office
	Unambiguous chemotherapy—outpatient hospital
	Possible chemotherapy—outpatient hospital
	Drugs coadministered w/chemotherapy—outpatient hospital
	Antiemetics—outpatient hospital
	Chemotherapy administration—outpatient hospital
	Unambiguous chemotherapy—DME
	Possible chemotherapy—DME
	Drugs coadministered w/chemotherapy—DME
	Antiemetics—DME
Part D chemotherapy payments	Unambiguous chemotherapy—Part D
	Possible chemotherapy—Part D
	Drugs coadministered w/chemotherapy—Part D
	Antiemetics—Part D
All evaluation and management payments	Evaluation and management—office
	Evaluation and management—outpatient hospital
All laboratory payments	Laboratory—office
	Laboratory—outpatient hospital
All radiation therapy payments	Radiation therapy services—office
	Radiation therapy services—outpatient hospital
All Imaging payments	Imaging—office
	Imaging—outpatient hospital

Aggregate Category	Component Categories from Appendix Table A.15
Skilled nursing facility and home health services	All services—skilled nursing facility All services—home health
Total payments	Sum of all payment categories in Appendix Table A.3
Inpatient	All services—inpatient hospital
Emergency department	All services—emergency department (note: when patient not admitted)
Hospice	All services—hospice

Source: Authors' analysis.

3. Definition of an Episode of Chemotherapy

Oncology care entails a full range of health care services, provided by many clinicians in a variety of settings, over a potentially long period of time. Defining an "episode" of care requires careful consideration of each of these dimensions.

An episode of care can be defined mainly by three parameters: the initiation of the episode, the termination of the episode, and the rules for sorting health care services that occur during this time period into those attributed to the episode and those that are independent of it. The oncology provider would directly provide some of these services and would also be accountable for other services that beneficiaries under the oncology provider's care receive from other providers. For these analyses, we did not attempt to distinguish between these categories of services during episodes. We provide descriptive claims data analyses of all services provided in the time period surrounding episode initiation. In this chapter, we use claims data analyses to focus on two other key parameters in model design for episodes of care: episode initiation and termination.

Initiation of an Episode

An oncology payment model could be designed to incorporate episodes of care that initiate with a cancer diagnosis, surgery, radiation therapy, chemotherapy treatment, or some other event. As noted in the introduction, as directed by CMS, for this analysis we focus on episodes of chemotherapy treatment for cancer.

Episodes of chemotherapy treatment may initiate at different times in the course of oncology treatment. For example, chemotherapy may be initiated following a period of watchful waiting. We used SEER-Medicare data to measure the time between the first diagnosis of cancer and initiation of chemotherapy for all patients in the sample initiating chemotherapy in 2003–2009. We used chemotherapy drug claims to identify the first date on which a patient received chemotherapy. The date of first diagnosis of cancer is reported to SEER-Medicare cancer registries. We found that the time between the primary cancer diagnosis and chemotherapy initiation varied widely across patients (Table 3.1). For approximately 5 percent of patients, the date of chemotherapy initiation measured using claims was prior to the date of cancer diagnosis recorded in the registry; for leukemia, this was more common (the 10^{th} percentile patient had a date of chemotherapy 6.6 months preceding the date of diagnosis). The median time between first diagnosis of cancer and chemotherapy initiation was 2.4 months, and among patients for whom diagnosis preceded chemotherapy initiation, the time period ranged from one day to over seven years.

Table 3.1. Time Between Primary Cancer Diagnosis and Chemotherapy Initiation Among Medicare Beneficiaries with Cancer, 2003–2009

Percentile of the Patient Population	Months from Primary Diagnosis to Chemotherapy Initiation							
	Breast	Colorectal	Leukemia	Lung	Lymphoma	Ovarian	Pancreatic	All Cancer Types
10	1.6	1.0	-6.6	0.6	0.7	0.8	0.6	0.8
20	2.2	1.5	0.7	1.0	1.1	1.2	0.9	1.3
30	2.8	1.9	1.3	1.3	1.3	1.4	1.2	1.6
40	3.5	2.2	2.0	1.5	1.5	1.6	1.4	2.0
50	4.6	2.5	3.5	1.8	1.8	1.9	1.7	2.4
60	7.0	2.9	7.0	2.1	2.1	2.1	2.1	3.0
70	12.9	3.6	13.8	2.6	2.5	2.5	2.5	4.2
80	24.0	5.5	24.0	3.7	3.7	3.2	3.3	8.2
90	38.4	17.5	39.4	8.4	12.4	8.5	5.2	23.4

Source: Authors' analysis of SEER-Medicare claims for patients with seven cancer types and chemotherapy initiation.

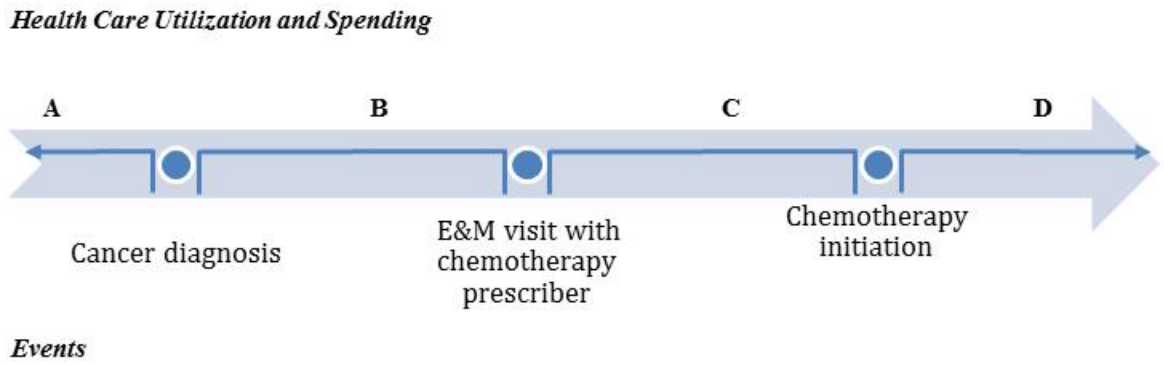
Evaluation and management (E&M) visits for cancer diagnoses (as identified in claims data) can also provide information related to when an episode of chemotherapy treatment begins. In Figure 3.1, points A, B, C, and D along the top of the timeline represent the health care utilization and spending experienced by a patient. One possibility would be to identify episode initiation using a cancer diagnosis code on a claim and a chemotherapy drug. Episode initiation would be defined as the later of the two dates (which will almost always be the chemotherapy date); care provided in D onward would be included in the episode and the care provided in A, B, and C would be excluded from the episode.

Another option would be to define episode initiation as the date that the patient met with a physician to discuss treatment options; however, this would need to be identified retrospectively, looking at claims history preceding chemotherapy initiation (a "best guess" from the claims data). In this case, the episode would include care provided in C and D and exclude care provided in A and B. Although it is assumed that most patients would have a visit with a physician to discuss treatment options, this is not always identified in claims (discussed in more detail below).

A third option would be to define episode initiation as the cancer diagnosis date, which would include B, C, and D, and exclude A. The cancer diagnosis date could be identified using registry

(as in Table 3.1) or possibly claims data. The reliability of the dates of these events in claims and registry dates is unknown; therefore, empirically defined episodes of care identified through retrospective data analysis are not necessarily indicative of actual clinical practice.

Figure 3.1. Three Events That Could Be Used to Define Episode Initiation



Using the SEER-Medicare study sample, we examined the proportion of the population with potential episode initiation events from Figure 3.1. All of the beneficiaries in this population had a primary cancer diagnosis date recorded in a cancer registry. In Table 3.2, we present data on the frequency of two other potential episode initiation events measured using claims data: (1) E&M visits with a cancer diagnosis occurring in an ambulatory care setting; (2) chemotherapy initiation (including "likely" and "possible" chemotherapy drug categories on Carrier, Part D, or DME claims with a cancer diagnosis code). Among cancer patients, 16.2 percent did not have either an ambulatory E&M visit or chemotherapy identified in claims data. While some of these patients may have been treated exclusively in inpatient settings, this frequency is higher than expected because outpatient follow-up visits are considered typical care. A higher percentage of patients had a claim for an ambulatory E&M visit with a cancer diagnosis but no chemotherapy drug claim (49.3 percent) than had both an E&M visit and a chemotherapy drug claim (34.2 percent). A very small percentage of people received chemotherapy with no ambulatory E&M visit (0.3 percent).

Table 3.2. Frequency of Chemotherapy Initiation and E&M Visits Among Medicare Beneficiaries with Cancer, 2003–2009

	Breast	Colorectal	Leukemia	Lung	Lymphoma	Ovarian	Pancreatic	All Cancer Types
No ambulatory E&M visits for cancer; no chemotherapy drugs	5,830 (4.9)	19,242 (17.8)	4,925 (20.9)	33,349 (22.0)	4,527 (11.5)	2,648 (21.7)	7,665 (27.1)	78,186 (16.2)
Ambulatory E&M visit for cancer; no chemotherapy drugs	65,602 (55.1)	56,474 (52.1)	13,147 (55.7)	70,554 (46.5)	15,769 (40.2)	4,620 (37.9)	11,899 (42.1)	238,065 (49.3)
Ambulatory E&M visit for cancer and chemotherapy drug claim within 14 days of the visit date	47,221 (39.7)	32,408 (29.9)	5,425 (23.0)	47,521 (31.3)	18,803 (48.0)	4,894 (40.1)	8,655 (30.6)	164,927 (34.2)
Chemotherapy drug only; no ambulatory E&M code for cancer	418 (0.4)	273 (0.3)	105 (0.4)	403 (0.3)	116 (0.3)	41 (0.3)	79 (0.3)	1,435 (0.3)
Total	119,071 (100.0)	108,397 (100.0)	23,602 (100.0)	151,827 (100.0)	39,215 (100.0)	12,203 (100.0)	28,298 (100.0)	482,613 (100.0)

Source: Authors' analysis of 2003–2009 SEER-Medicare data for patients with seven cancer types and at least one Carrier claim.

Types of Chemotherapy Initiation

Many possible chemotherapy treatment regimens exist for different types of cancer. For each cancer type, the FDA has approved some chemotherapy drugs for treatment of that cancer, while other drugs are used in clinical practice but are not FDA-approved for that specific cancer.

In Table 3.3, we present data on the frequency of each type of chemotherapy drug initiating episodes of chemotherapy in the CCW study sample with no prior chemotherapy within six months of first chemotherapy in 2010. Chemotherapy initiation was mostly concentrated within several types of chemotherapy drugs, but those drugs varied by type of cancer. For most types of cancer, a substantial proportion of initiations were for drugs classified as "possible chemotherapy." For example, for breast cancer, 18 percent of episodes initiated with tamoxifen citrate. For lymphoma, 47 percent of episodes initiated with rituximab. A chemotherapy payment model will need to include provisions to ensure that patients receiving "possible chemotherapy" drugs are actually cancer patients that are eligible for the model. Chemotherapy drugs that are not FDA approved for a specific cancer type are indicated by the cells without gray shading in Table 3.3. These represented a small but non-negligible number of episodes.

Table 3.3. Frequency of Chemotherapy Drugs Initiating Episodes of Chemotherapy, by Type of Cancer

	Frequency (%) of Chemotherapy Initiations																	
Active Ingredient	**Breast**		**Colorectal**		**Leukemia**		**Lung**		**Lymphoma**		**Ovarian**		**Pancreatic**		**Prostate**		**Other**	
Likely chemotherapy																		
anastrozole	534,192	(28)	2,088	(0)	1,056	(0)	3,120	(0)	1,608	(0)	2,040	(1)	264	(0)	1,728	(0)	42,696	(1)
azacitidine	576	(0)	312	(0)	26,352	(8)	480	(0)	1,776	(0)	48	(0)	48	(0)	264	(0)	75,504	(2)
bortezomib	192	(0)	168	(0)	528	(0)	240	(0)	9,480	(1)	24	(0)	0	(0)	240	(0)	177,792	(4)
capecitabine	26,400	(1)	131,400	(18)	48	(0)	912	(0)	120	(0)	288	(0)	14,688	(7)	264	(0)	42,312	(1)
carboplatin	28,896	(2)	2,448	(0)	288	(0)	339,360	(27)	1,728	(0)	76,752	(31)	912	(0)	1,968	(0)	176,472	(4)
cetuximab	96	(0)	11,832	(2)	24	(0)	2,976	(0)	24	(0)	0	(0)	48	(0)	24	(0)	67,920	(2)
cisplatin	1,368	(0)	2,736	(0)	192	(0)	81,216	(7)	1,272	(0)	3,624	(1)	2,904	(1)	480	(0)	184,704	(4)
cyclophosphamide	142,776	(7)	624	(0)	24,696	(7)	1,968	(0)	106,632	(14)	1,536	(1)	168	(0)	1,968	(0)	26,424	(1)
cytarabine	216	(0)	24	(0)	5,136	(2)	48	(0)	2,352	(0)	24	(0)	0	(0)	0	(0)	696	(0)
decitabine	120	(0)	144	(0)	19,992	(6)	240	(0)	960	(0)	0	(0)	48	(0)	120	(0)	25,896	(1)
degarelix	0	(0)	264	(0)	96	(0)	336	(0)	72	(0)	0	(0)	72	(0)	70,584	(3)	3,192	(0)
docetaxel	108,624	(6)	264	(0)	144	(0)	55,560	(4)	144	(0)	11,784	(5)	1,800	(1)	41,952	(2)	43,656	(1)

	Frequency (%) of Chemotherapy Initiations																	
Active Ingredient	**Breast**		**Colorectal**		**Leukemia**		**Lung**		**Lymphoma**		**Ovarian**		**Pancreatic**		**Prostate**		**Other**	
doxorubicin HCl	50,160	(3)	480	(0)	696	(0)	984	(0)	49,488	(7)	18,672	(8)	264	(0)	408	(0)	57,552	(1)
erlotinib HCl	432	(0)	120	(0)	24	(0)	51,552	(4)	96	(0)	48	(0)	4,200	(2)	24	(0)	4,920	(0)
etoposide	624	(0)	1,008	(0)	480	(0)	127,776	(10)	6,024	(1)	1,464	(1)	432	(0)	888	(0)	25,680	(1)
exemestane	50,280	(3)	48	(0)	120	(0)	192	(0)	96	(0)	120	(0)	48	(0)	72	(0)	4,848	(0)
fludarabine phosphate	144	(0)	48	(0)	33,072	(10)	240	(0)	13,320	(2)	0	(0)	0	(0)	264	(0)	888	(0)
fluorouracil	43,800	(2)	260,736	(36)	15,312	(5)	16,080	(1)	18,168	(2)	2,280	(1)	19,224	(9)	80,616	(3)	1,513,728	(36)
fulvestrant	66,600	(3)	24	(0)	24	(0)	288	(0)	120	(0)	48	(0)	24	(0)	24	(0)	6,096	(0)
gemcitabine HCl	16,584	(1)	1,128	(0)	312	(0)	64,344	(5)	7,080	(1)	17,136	(7)	162,648	(73)	744	(0)	142,584	(3)
goserelin acetate	2,016	(0)	384	(0)	192	(0)	792	(0)	264	(0)	24	(0)	24	(0)	89,568	(4)	5,112	(0)
imatinib mesylate	240	(0)	456	(0)	27,768	(8)	120	(0)	528	(0)	24	(0)	72	(0)	216	(0)	17,136	(0)
irinotecan HCl	288	(0)	60,840	(8)	24	(0)	10,200	(1)	72	(0)	288	(0)	936	(0)	72	(0)	19,368	(0)
letrozole	272,928	(14)	1,104	(0)	456	(0)	2,016	(0)	744	(0)	1,368	(1)	168	(0)	360	(0)	20,448	(0)
leuprolide acetate	2,880	(0)	10,632	(1)	4,080	(1)	14,616	(1)	5,880	(1)	336	(0)	1,776	(1)	1,792,752	(71)	122,832	(3)
mitomycin	336	(0)	7,536	(1)	144	(0)	984	(0)	432	(0)	24	(0)	96	(0)	1,440	(0)	127,080	(3)

	Frequency (%) of Chemotherapy Initiations																	
Active Ingredient	**Breast**		**Colorectal**		**Leukemia**		**Lung**		**Lymphoma**		**Ovarian**		**Pancreatic**		**Prostate**		**Other**	
oxaliplatin	384	(0)	179,400	(25)	96	(0)	336	(0)	1,032	(0)	168	(0)	7,248	(3)	120	(0)	34,992	(1)
paclitaxel	71,256	(4)	1,320	(0)	144	(0)	212,304	(17)	456	(0)	85,320	(35)	1,752	(1)	1,704	(0)	162,144	(4)
pemetrexed disodium	672	(0)	240	(0)	120	(0)	176,136	(14)	168	(0)	984	(0)	0	(0)	240	(0)	23,568	(1)
pentostatin	264	(0)	10,800	(1)	2,688	(1)	744	(0)	1,896	(0)	0	(0)	192	(0)	1,296	(0)	106,920	(3)
temozolomide	96	(0)	72	(0)	72	(0)	912	(0)	864	(0)	0	(0)	336	(0)	0	(0)	80,808	(2)
trastuzumab	81,696	(4)	24	(0)	24	(0)	48	(0)	0	(0)	48	(0)	0	(0)	0	(0)	2,832	(0)
vantas implant (histrelin)	0	(0)	1,272	(0)	264	(0)	1,632	(0)	384	(0)	0	(0)	120	(0)	131,184	(5)	13,560	(0)
vincristine sulfate	384	(0)	168	(0)	8,304	(2)	624	(0)	93,000	(13)	24	(0)	24	(0)	408	(0)	3,168	(0)
vinorelbine tartrate	9,960	(1)	0	(0)	0	(0)	29,136	(2)	1,320	(0)	768	(0)	24	(0)	408	(0)	4,392	(0)
Possible chemotherapy																		
bevacizumab	4,056	(0)	11,544	(2)	48	(0)	7,104	(1)	96	(0)	4,488	(2)	96	(0)	96	(0)	26,688	(1)
bicalutamide	48	(0)	1,272	(0)	408	(0)	1,968	(0)	768	(0)	0	(0)	240	(0)	261,864	(10)	17,088	(0)
chlorambucil	240	(0)	120	(0)	21,480	(6)	168	(0)	6,456	(1)	72	(0)	0	(0)	120	(0)	1,800	(0)
lenalidomide	336	(0)	216	(0)	1,536	(0)	144	(0)	1,776	(0)	24	(0)	24	(0)	168	(0)	87,192	(2)

	Frequency (%) of Chemotherapy Initiations																	
Active Ingredient	**Breast**		**Colorectal**		**Leukemia**		**Lung**		**Lymphoma**		**Ovarian**		**Pancreatic**		**Prostate**		**Other**	
methotrexate	34,776	(2)	10,536	(1)	7,920	(2)	15,888	(1)	17,184	(2)	2,424	(1)	1,080	(0)	21,456	(1)	389,328	(9)
methotrexate sodium	5,208	(0)	1,752	(0)	672	(0)	1,992	(0)	1,872	(0)	360	(0)	264	(0)	3,384	(0)	63,024	(2)
rituximab	3,168	(0)	1,584	(0)	104,880	(31)	2,544	(0)	346,680	(47)	144	(0)	216	(0)	1,992	(0)	22,032	(1)
tamoxifen citrate	348,024	(18)	2,088	(0)	792	(0)	2,904	(0)	1,104	(0)	4,200	(2)	288	(0)	696	(0)	39,528	(1)
Total	**1,925,496**		**727,128**		**333,744**		**1,247,064**		**736,776**		**245,928**		**223,608**		**2,519,328**		**4,172,808**	

Note: Includes only drugs that account for at least 2 percent of triggers for at least one cancer type; full list in Appendix Table A.15. Italic type indicates endocrine therapy. Gray shading indicates on-label use—i.e., drugs listed by the NCI as FDA-approved for each cancer.
Source: Authors' analysis of 2009–2012 CCW Medicare claims data for patients with cancer and chemotherapy initiation in 2010.

Termination of an Episode

The simplest definition of episode termination would be a fixed period of time following initiation. However, several events that occur frequently during episodes could also potentially be considered as markers to signal the end of an episode. We examined several potential such markers, including a period of time without chemotherapy utilization (as indicated by claims for either chemotherapy drugs or administration), mortality, hospice, and loss of Medicare Part A and Part B enrollment (e.g., due to enrollment in Medicare Advantage).

Gaps in Chemotherapy Utilization

Beneficiaries who are not actively receiving chemotherapy treatment (as identified in claims data) could possibly be removed as active participants in the payment model. Chemotherapy regimens vary widely in length, and there may be treatment interruptions for a number of reasons. One approach to accounting for this heterogeneity in treatment length in the payment model would be to identify gaps in treatment empirically, as a period of a defined length between chemotherapy claims. However, chemotherapy treatment commonly includes gaps between courses and lines of therapy. Empirically defined gaps in chemotherapy could signify different events in patterns of treatment, varying by type and stage of cancer. The definition of a gap in chemotherapy could therefore have important implications for the payment model if it were used to signify the termination of an episode of eligibility for the model.

We used the CCW study sample to measure the length of time, *t,* between initiation of chemotherapy and a subsequent gap occurring before the end of the observation period in 2012 (Table 3.4). We defined gaps with several different durations, *g*, equal to one, two, four, and six months. The mean time *t* between chemotherapy initiation and a gap in chemotherapy with duration *g* of at least one month ranged from *t*=one month (people with prostate cancer) to four months (people with breast, colorectal, and ovarian cancer). There was considerable variation in the length of chemotherapy treatment before reaching a gap. Depending on cancer type, between 0 percent and 5 percent of people in our sample reached the end of the observation period without experiencing a gap with duration *g* of at least one month in chemotherapy.

The time between chemotherapy initiation and a gap increased as the duration of the gap *g* increased, indicating that some of the shorter gaps observed were pauses between periods of chemotherapy treatment. The length of uninterrupted chemotherapy treatment was greatest for people with breast cancer; the mean time *t* from chemotherapy initiation to a gap was five months (SD, five months) for a two-month gap, *t*=nine months (SD, six months) for a four-month gap, and *t*=ten months (SD, six months) for a six-month gap. The length of uninterrupted chemotherapy treatment was shortest for people with pancreatic cancer: *t*=four months (SD, four months) for a two-month gap, *t*=five months (SD, four months) for a four-month gap, and *t*=five months (SD, four months) for a six-month gap. For all types of cancers and all gap lengths, there

was substantial variation across beneficiaries, with standard deviations of *t* typically equal to or greater than the mean.

Reinitiation of chemotherapy following a gap was common (Table 3.4). Among patients with chemotherapy treatment for breast cancer (excluding decedents), 72 percent had a gap in chemotherapy with duration *g* of at least one month that was followed by reinitiation of chemotherapy. Reinitiation of chemotherapy following longer gaps was less frequent, but still common. For patients receiving chemotherapy treatment for breast cancer, 18 percent reinitiated chemotherapy following a gap of at least four months (mean length of gap between chemotherapy treatments, seven months); following a gap of at least six months, 8 percent reinitiated chemotherapy. For some other types of cancer, reinitiation of chemotherapy following a gap was somewhat less common. Reinitiation was least common for people with pancreatic cancer; following a gap of at least four months in chemotherapy, 10 percent of people reinitiated chemotherapy.

Table 3.4. Duration of Periods of Chemotherapy Treatment by Type of Cancer

Chemotherapy Gap Duration *(g)*	**Time *(t)* from Chemotherapy Initiation (Months) to Gap of at Least *g* Months**		**Percentage of Episodes with a Gap of at Least *g* Months**	**Percentage of Episodes with a Gap of at Least *g* Months and Followed by Chemotherapy Reinitiation**
	Mean	**SD**		
Breast				
1 month	4	4	95	72
2 months	5	5	87	51
4 months	9	6	78	18
6 months	10	6	75	8
Colorectal				
1 month	4	3	97	54
2 months	4	4	93	38
4 months	6	5	88	19
6 months	6	5	85	9
Leukemia				

Chemotherapy Gap Duration *(g)*	Time *(t)* from Chemotherapy Initiation (Months) to Gap of at Least *g* Months		Percentage of Episodes with a Gap of at Least *g* Months	Percentage of Episodes with a Gap of at Least *g* Months and Followed by Chemotherapy Reinitiation
	Mean	SD		
1 month	2	3	99	61
2 months	4	4	95	44
4 months	5	5	91	26
6 months	6	5	89	15
Lung				
1 month	3	3	98	48
2 months	4	4	96	33
4 months	5	4	94	17
6 months	6	5	92	8
Lymphoma				
1 month	3	2	100	41
2 months	3	3	97	48
4 months	5	5	92	28
6 months	6	5	89	13
Ovarian				
1 month	4	3	98	65
2 months	5	4	93	48
4 months	6	5	85	26
6 months	7	5	80	14
Pancreatic				
1 month	3	3	98	35
2 months	4	4	96	22

Chemotherapy Gap Duration *(g)*	Time *(t)* from Chemotherapy Initiation (Months) to Gap of at Least *g* Months		Percentage of Episodes with a Gap of at Least *g* Months	Percentage of Episodes with a Gap of at Least *g* Months and Followed by Chemotherapy Reinitiation
	Mean	SD		
4 months	5	4	94	10
6 months	5	4	93	4
Prostate				
1 month	1	2	99	81
2 months	2	3	98	76
4 months	6	6	93	40
6 months	8	7	88	18

Source: Authors' analysis of 2009–2012 CCW claims data for patients with eight cancer types and chemotherapy initiation in 2010.

We used the SEER-Medicare sample of beneficiaries receiving chemotherapy in 2003–2009 in a stratified analysis by stage of cancer at diagnosis (Table 3.5), as stage of cancer is not available in the CCW data. As the length of periods of chemotherapy varied between types of cancer, there was also variation between patients at different stages of cancer at diagnosis for a given cancer type. For breast cancer and lymphoma patients, there was little difference in the mean time between chemotherapy initiation and a gap of at least two months across people at different stages of cancer at diagnosis. For colorectal patients, chemotherapy treatment periods were longer for people diagnosed at Stage IV relative to other stages. For lung, ovarian, and pancreatic cancer patients, treatment periods were shorter for people diagnosed at Stage 0.

Table 3.5. Duration of Periods of Chemotherapy Treatment by Type and Stage of Cancer

Cancer Type	Mean Count (Standard Deviation) of *t*, Months Between Chemotherapy Initiation and a Gap of at Least Two Months in Chemotherapy					
Stage	**0**	**I**	**II**	**III**	**IV**	**NA**
Breast	7 (9)	8 (10)	7 (8)	7 (7)	8 (10)	8 (9)
Colorectal	4 (6)	3 (5)	4 (4)	5 (4)	7 (7)	4 (6)

Cancer Type	Mean Count (Standard Deviation) of *t,* Months Between Chemotherapy Initiation and a Gap of at Least Two Months in Chemotherapy					
Stage	**0**	**I**	**II**	**III**	**IV**	**NA**
Leukemia	N/a	N/a	N/a	N/a	N/a	4 (6)
Lung	2 (2)	4 (4)	3 (3)	4 (4)	4 (5)	4 (4)
Lymphoma	N/a	4 (4)	4 (4)	4 (4)	4 (4)	4 (4)
Ovarian	2 (N/a)	4 (5)	5 (5)	6 (5)	6 (5)	5 (5)
Pancreatic	2 (2)	4 (5)	5 (5)	5 (5)	4 (5)	4 (5)

Source: Authors' analysis of 2003–2009 SEER-Medicare data for patients with seven cancer types and chemotherapy initiation.

There are several main findings from these analyses with implications for design of the payment model. First, there is considerable variability in the length of time beneficiaries receive chemotherapy treatment. Second, as the claims data show, chemotherapy treatment is characterized by repeating periods of chemotherapy. These repeating periods could be part of a planned therapeutic strategy and considered as continuations of the same episode of care, or they could reflect new courses of treatment that could be considered new episodes of care. It is impossible to distinguish between these scenarios using claims data analysis. The payment model could be designed so that each repeating period is treated as a separate episode, or it could be designed to recognize longer periods of treatment including active chemotherapy and gaps of several months, which would lead to substantially longer periods of eligibility for the model.

Mortality

Mortality occurs frequently among Medicare beneficiaries receiving chemotherapy treatment (Table 3.6). Mortality rates vary by type of cancer. Mortality within 12 months from the first date of chemotherapy ranged from 7 percent of patients (breast cancer) to 62 percent of patients (pancreatic cancer). Among patients who died, the mean amount of time between chemotherapy initiation and mortality ranged from five months (pancreatic cancer) to seven months (prostate cancer). These findings indicate that a nontrivial percentage of patients will die during an episode of chemotherapy that makes them eligible for the payment model, assuming the payment episode is at least five to seven months.

Hospice

Hospice use was common among Medicare beneficiaries with cancer (Tables 3.6 and 3.7). Medicare beneficiaries are eligible to elect to be in hospice if two physicians certify them as terminal (life expectancy of six months or less). Once enrolled, all care related to the terminal illness is reimbursed through the hospice benefit. High-cost treatments may exceed the hospice benefit payment rate and could serve as a deterrent to enrolling patients into hospice. Alternatively, financial incentives could decrease the use of certain costly treatments for hospice patients (Carlson et al., 2012). Among Medicare beneficiaries in the CCW sample, the rate of hospice participation before the end of the observation period ranged from 5 percent (breast and prostate cancer) to 49 percent (pancreatic cancer).

Among Medicare beneficiaries in the SEER-Medicare sample initiating chemotherapy in 2003–2009, the percentage of patients entering hospice increased with stage of cancer (Table 3.7). The mean amount of time between chemotherapy initiation and hospice initiation within 12 months of first chemotherapy ranged from five to six months (Table 3.6). However, for most types and stages of cancer, patients experience a gap in chemotherapy of at least two months before utilization of hospice (Table 3.8).

Loss of Medicare Part A and Part B Enrollment

Disenrollment from Medicare Parts A and B due to enrollment in Medicare Advantage or other reasons could be a challenge for administration of the model. However, this is likely to have limited impact on model design due to the low frequency of disenrollment. Among beneficiaries in the CCW study sample, 2 to 4 percent disenrolled from Part A or B for at least one month before the end of the observation period (Table 3.6).

Table 3.6. Time Until Mortality, Hospice, or Loss of Medicare Eligibility for Chemotherapy Patients, by Type of Cancer

Terminating Event*	Time from Chemotherapy Initiation (Months) to Event		Percentage of Episodes
	Mean	SD	
Breast			
Mortality within 12 months after first chemo	6	3	7
Hospice within 12 months after first chemo	6	3	5
Loss of Medicare A or B eligibility of one month	9	5	4

Terminating Event*	Time from Chemotherapy Initiation (Months) to Event		Percentage of Episodes
	Mean	SD	
Colorectal			
Mortality within 12 months after first chemo	6	3	22
Hospice within 12 months after first chemo	6	3	16
Loss of Medicare A or B eligibility of one month	8	5	4
Leukemia			
Mortality within 12 months after first chemo	5	3	24
Hospice within 12 months after first chemo	5	3	12
Loss of Medicare A or B eligibility of one month	9	5	3
Lung			
Mortality within 12 months after first chemo	6	3	48
Hospice within 12 months after first chemo	6	3	34
Loss of Medicare A or B eligibility of one month	7	5	2
Lymphoma			
Mortality within 12 months after first chemo	6	3	18
Hospice within 12 months after first chemo	6	3	10
Loss of Medicare A or B eligibility of one month	9	5	3
Ovarian			
Mortality within 12 months after first chemo	6	3	19
Hospice within 12 months after first chemo	6	3	16

Terminating Event*	Time from Chemotherapy Initiation (Months) to Event		Percentage of Episodes
	Mean	SD	
Loss of Medicare A or B eligibility of one month	9	5	3
Pancreatic			
Mortality within 12 months after first chemo	5	3	62
Hospice within 12 months after first chemo	5	3	49
Loss of Medicare A or B eligibility of one month	6	4	2
Prostate			
Mortality within 12 months after first chemo	7	3	8
Hospice within 12 months after first chemo	6	3	5
Loss of Medicare A or B eligibility of one month	9	5	4

* These terminating events are not mutually exclusive—i.e., beneficiaries may be counted in more than one of the events.
Source: Authors' analysis of 2009–2012 CCW Medicare claims data for patients with eight cancer types and chemotherapy initiation in 2010.

Table 3.7. Chemotherapy Patients Using Hospice at Any Time and Before a Two-Month Gap in Chemotherapy, by Cancer Type and Stage

	Percentage of Patients with Hospice Following Chemotherapy Initiation						Percentage of Patients with Hospice Following Chemotherapy Initiation and Before a Two-Month Gap in Chemotherapy					
	0	**I**	**II**	**III**	**IV**	**N/A**	**0**	**I**	**II**	**III**	**IV**	**N/A**
Breast	8.10	6.09	10.54	21.75	38.90	23.29	0.13	0.05	0.06	0.20	0.53	0.33
Colorectal	18.99	19.82	19.80	24.16	52.79	32.89	0.35	0.06	0.07	0.03	0.39	0.17
Leukemia	N/A	N/A	N/A	N/A	N/A	26.31	N/A	N/A	N/A	N/A	N/A	0.29
Lung	30.00	34.87	38.45	45.26	53.99	48.16	0.00	0.23	0.21	0.25	0.79	0.30
Lymphoma	N/A	16.33	18.96	21.01	22.90	22.53	N/A	0.13	0.11	0.32	0.19	0.12
Ovarian	0.00	16.48	23.46	43.69	47.20	52.90	0.00	0.00	0.29	0.15	0.20	0.78
Pancreatic	15.38	57.72	58.91	65.33	68.04	47.61	0.00	0.85	0.28	1.25	2.28	0.61

Source: Authors' analysis of 2003–2009 SEER-Medicare data for patients with seven cancer types and chemotherapy.

4. Spending Patterns for Chemotherapy Treatment and Implications for Savings Opportunities

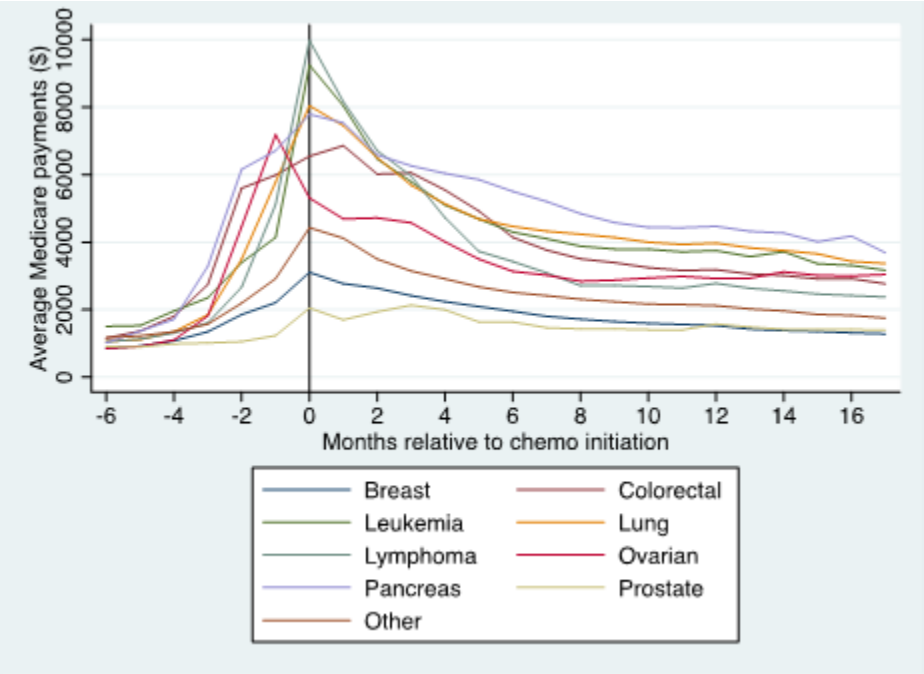
Spending by Type of Service Preceding and Following Initiation of Episodes of Chemotherapy

In this section, we examine Medicare payments for various service categories to inform the design of an episode of care, the length of an episode, and services to be included in an episode. These results are based on analysis of average Medicare payments occurring in each month relative to the initiation of chemotherapy. For most analyses, we used the CCW study sample of patients with cancer and chemotherapy initiation in 2010; where indicated, we used the SEER-Medicare study sample to allow for analysis by cancer stage. We dropped beneficiary-months that occurred after the month of death or with either incomplete Part A or B coverage or with Medicare Advantage coverage. Using this beneficiary/month sample, we computed average Medicare payments in each month relative to chemotherapy initiation separately by cancer type.

Trends in Total Spending Over Time for Beneficiaries Initiating Chemotherapy

Figure 4.1 plots total Medicare spending patterns by site for the six months prior to chemotherapy initiation and the 18 months following initiation. For each patient with each type of cancer, Medicare payments escalate sharply in the four months prior to initiation, which may reflect diagnosis and treatment planning, and then peak in the first month of chemotherapy. This pattern differs slightly for ovarian and prostate cancer; the peak precedes the month of initiation for ovarian cancer, and prostate cancer exhibits less change in payments over time during the episode. Monthly costs fall at varying rates in the first six months after chemotherapy initiation and are relatively flat between months eight and 18 after chemotherapy initiation. The average level of total monthly payments varies considerably across cancers, with the highest spending peak of $9,972 for lymphoma, and peaks of $3,109 for breast cancer and $2,135 for prostate cancer. This evidence implies that the intensity of services varies considerably across cancer types, and that opportunities for improved efficiency and the design of a payment model may vary across cancer types.

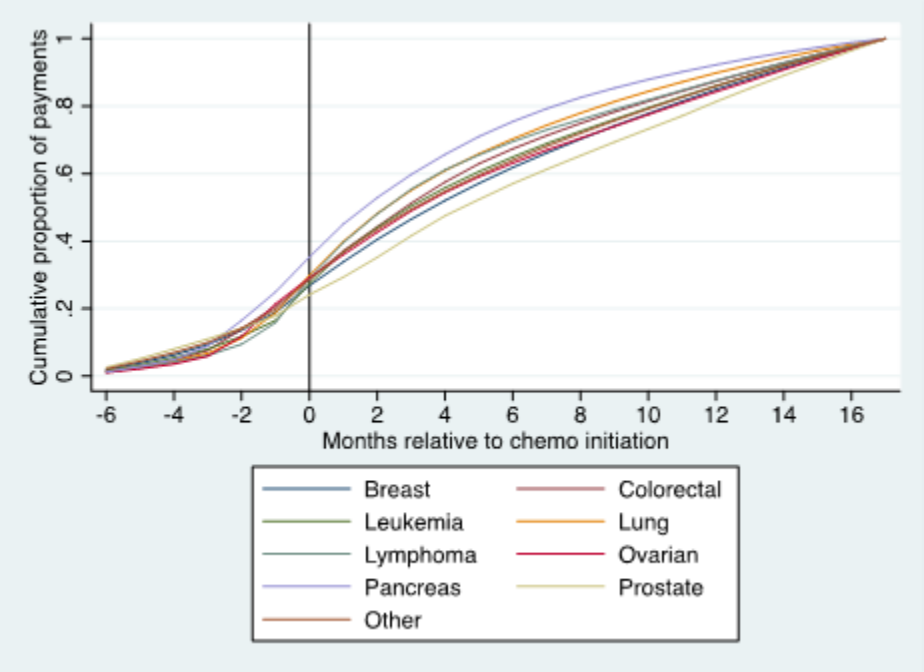
Figure 4.1. Average Monthly Total Medicare Payments for Beneficiaries Initiating Chemotherapy in 2010



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Figure 4.2 plots the cumulative proportion of total Medicare payments occurring over the 24-month window. Across cancer types, between 16 and 25 percent of spending occurs *prior* to the first month of chemotherapy. In the postchemotherapy initiation period, the proportion of spending captured in each month increases at a decreasing rate. Between 52 and 71 percent of total spending occurs through the first six months of chemotherapy, and between 77 and 90 percent of spending occurs within the first year of chemotherapy. We examine the composition of this utilization in subsequent analyses.

Figure 4.2. Cumulative Proportion of Total 24-Month Medicare Payments Occurring in Each Month Relative to Chemotherapy Initiation



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapyinitiation in 2010.

Table 4.1 shows the proportion of total Medicare spending attributable to different service categories in the period from six months prior to chemotherapy initiation through the first 18 months of chemotherapy. The largest category is inpatient spending, which represents 25 to 45 percent of total spending. The next largest category is physician administered and DME chemotherapy, which includes payments for likely chemotherapy, possible chemotherapy, antiemetics, drugs administered with chemotherapy, and chemotherapy administration, and ranges from 10 to 31 percent of total spending. Chemotherapy on Part D claims, in contrast, only comprises 1 to 9 percent of total Medicare spending. Other drugs, skilled nursing facility and home health payments, imaging, laboratory, radiation therapy (XRT), and hospice payments comprise smaller, but not insignificant, proportions of total Medicare spending. The relative importance of chemotherapy, XRT, and other drugs varies considerably across cancer types, while E&M and laboratory services are more similar across cancer types.

Table 4.1. Share of Total Medicare Spending by Service Category for Beneficiaries with 2010 Chemotherapy Initiation

	Proportion of Total Spending for the Period Six Months Prior to 18 Months Following Chemotherapy Initiation								
Service Category	**Breast**	**Colorectal**	**Leukemia**	**Lung**	**Lymphoma**	**Ovarian**	**Pancreatic**	**Prostate**	**Other**
Non–Part D Chemotherapy	19	29	21	19	31	24	19	10	12
Part D Chemotherapy	4	1	9	3	1	0	2	1	5
Evaluation and Management	5	3	3	3	3	4	3	5	4
Laboratory	3	2	5	2	3	3	2	3	3
Radiation Therapy	7	3	0	7	2	1	4	12	4
Imaging	5	4	2	6	5	5	4	5	4
Skilled Nursing Facility/Home Health	8	6	5	6	6	7	5	12	8
Inpatient	25	38	41	37	34	40	45	33	37
Hospice	2	2	1	4	1	3	5	2	2
Other Drugs	10	4	5	4	4	4	4	7	9
Other	10	7	9	8	11	10	6	9	9

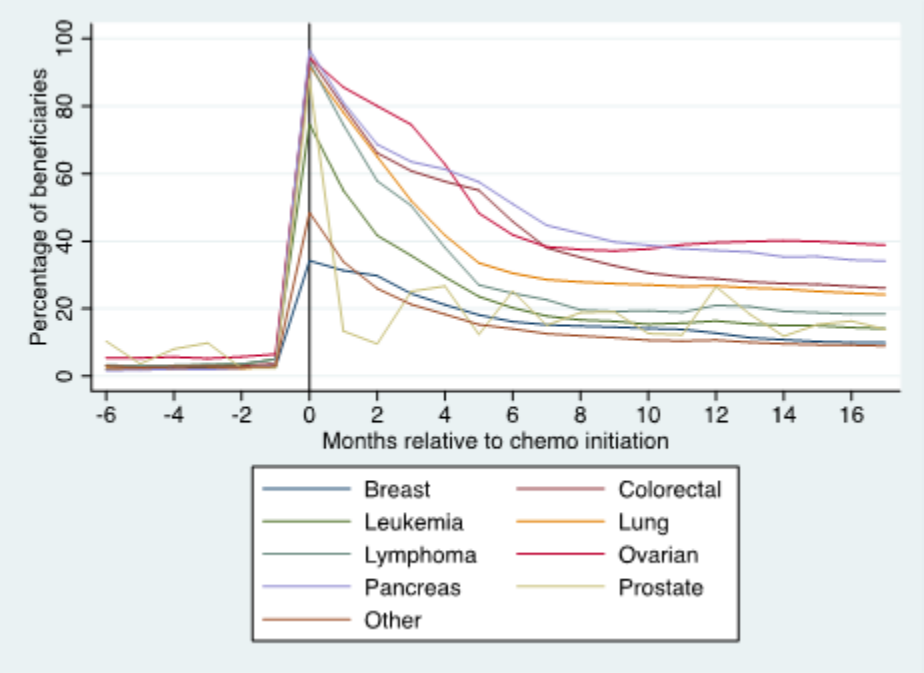
Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table 4.1 demonstrates that many types of service utilization underlie total health care payments over the course of an episode of oncology care, and thus need to be accounted for when designing a new payment model. Next, we examine the timing of utilization relative to the initiation of chemotherapy. In the following sections, for each service category, we present charts that show (1) the probability of use of that service category, measured as the proportion of patients with any Medicare payments for that service category in each month; and (2) the average Medicare spending for the service category for all patients in the study sample in each month, including those with zero payments in the month.

Patterns in Chemotherapy Use

We start by investigating the probability of use and Medicare spending on chemotherapy over chemotherapy episodes. Figure 4.3 exhibits the fraction of beneficiaries with positive physician-administered or DME chemotherapy in each month relative to chemotherapy initiation. By construction, there is a spike in use in the month of initiation; the percentage of beneficiaries with positive payments in the first month is less than 100 because some beneficiaries initiate chemotherapy under Part D. The percentage of beneficiaries with non–Part D chemotherapy in the first month of chemotherapy ranges from 34 for breast cancer to 97 for pancreatic cancer. The percentage of beneficiaries with physician-administered or DME chemotherapy then falls in the first eight months of chemotherapy (with variation in the extent of decline across cancer types) and is relatively constant thereafter.

Figure 4.3. Percentage of Beneficiaries with Positive Physician-Administered or DME Chemotherapy Payments per Month Relative to Chemotherapy Initiation

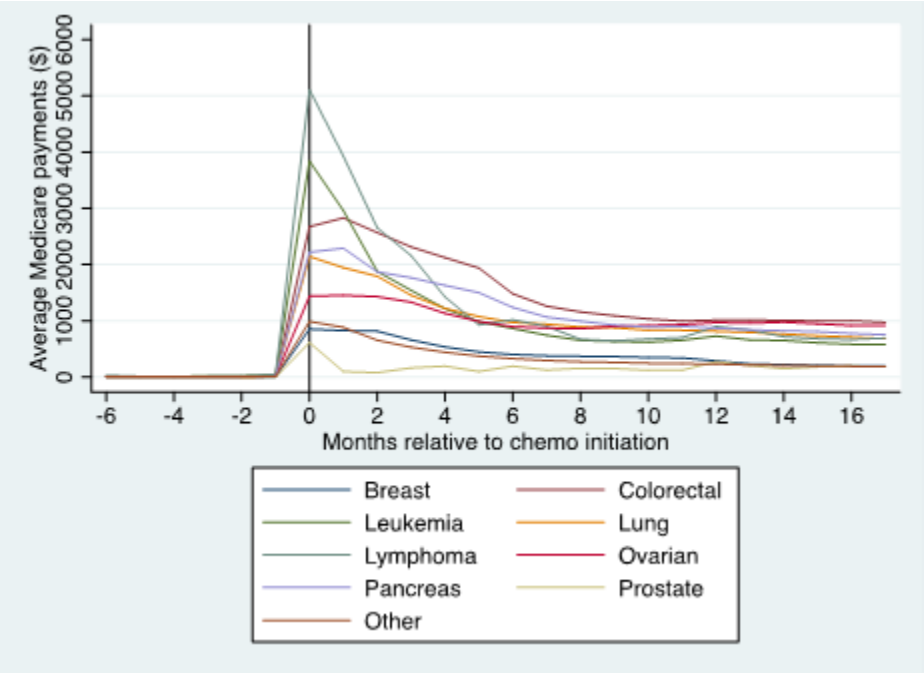


Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

In Figure 4.4, we display average payments (including beneficiaries with zero monthly payments) for physician-administered and DME chemotherapy in the months prior to and following chemotherapy initiation. Similar to the measures of incidence, we observe a large spike in payments in the first month following chemotherapy initiation. The level of spending, however, varies considerably across cancer categories, reflecting variations in the price and duration of different chemotherapy treatment regimens. The largest spike is for lymphoma

(nearly $5,108 in the month of initiation), followed by leukemia and colorectal cancer ($3,841 and $2,676, respectively). In contrast, average payments in the month of initiation are only $855 for breast and $615 for prostate cancer. These differences reflect both differences in overall use and payments per use.

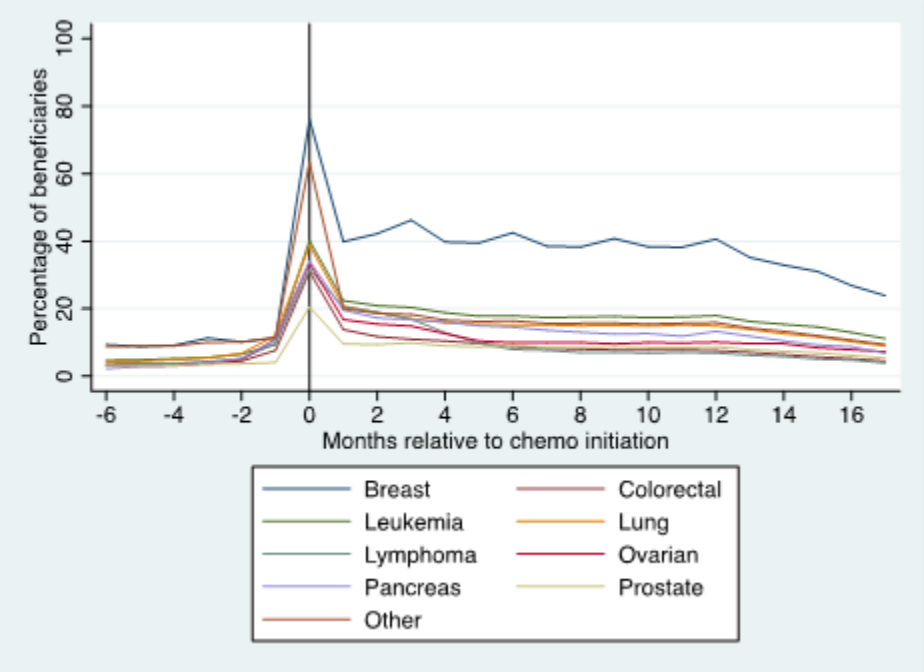
Figure 4.4. Average Payments for Physician-Administered and DME Chemotherapy per Month Relative to Chemotherapy Initiation



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Figure 4.5 displays the percentage of beneficiaries with Part D chemotherapy in each month. The percentage with Part D chemotherapy in the month of initiation ranges from 20 to 76 percent, but then falls dramatically for most cancer types.

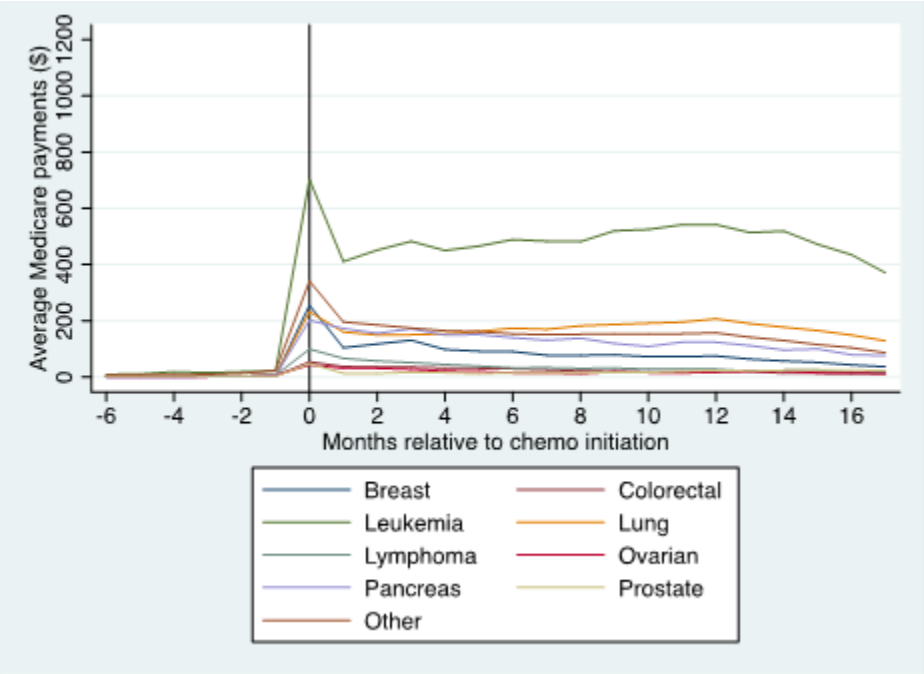
Figure 4.5. Percentage of Beneficiaries with Positive Part D Chemotherapy Payments per Month Relative to Chemotherapy Initiation



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Figure 4.6 shows average Part D chemotherapy payments occurring in each month. The level of payment is considerably lower for Part D compared to physician-administered and DME chemotherapy. Part D chemotherapy payments are highest for patients with leukemia, reaching $703 per month at the time of initiation. Despite the high fraction of breast cancer patients using Part D chemotherapy, average payments (including patients with zero payments) are only $256 per month, implying that costs conditional on use are lower for Part D chemotherapy drugs for breast cancer relative to other cancer types.

Figure 4.6. Average Payments for Part D Chemotherapy per Month Relative to Chemotherapy Initiation



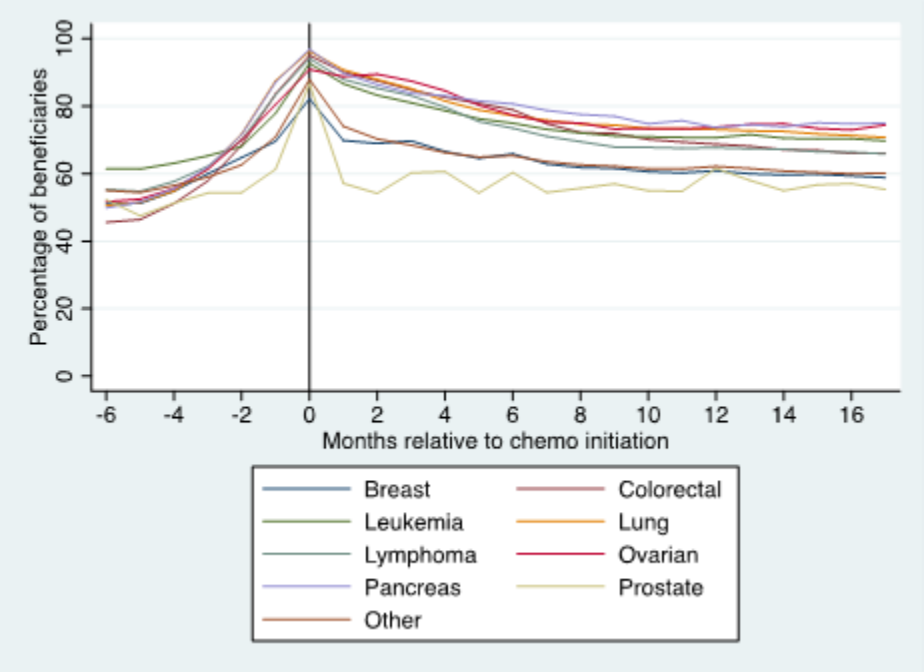
Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Figures 4.3 through 4.6 imply that types of chemotherapy, the patterns of use, and the level of spending vary considerably across cancer types, which may be important to incorporate into an oncology payment model.

Patterns in Evaluation and Management, Imaging, and Laboratory Service Use

Next, we investigate the timing and level of payments for evaluation and diagnostic services. Figure 4.7 displays the percentage of beneficiaries with positive evaluation and management visit payments in each month, combining visits in physician office and outpatient hospital settings. Across cancer types, we observe an increase in the percentage of beneficiaries with visits in the four months prior to chemotherapy initiation, which then falls in the months following initiation. The percentage with any E&M visit ranges from 82 for breast cancer to 97 for pancreatic cancer in the month of chemotherapy initiation.

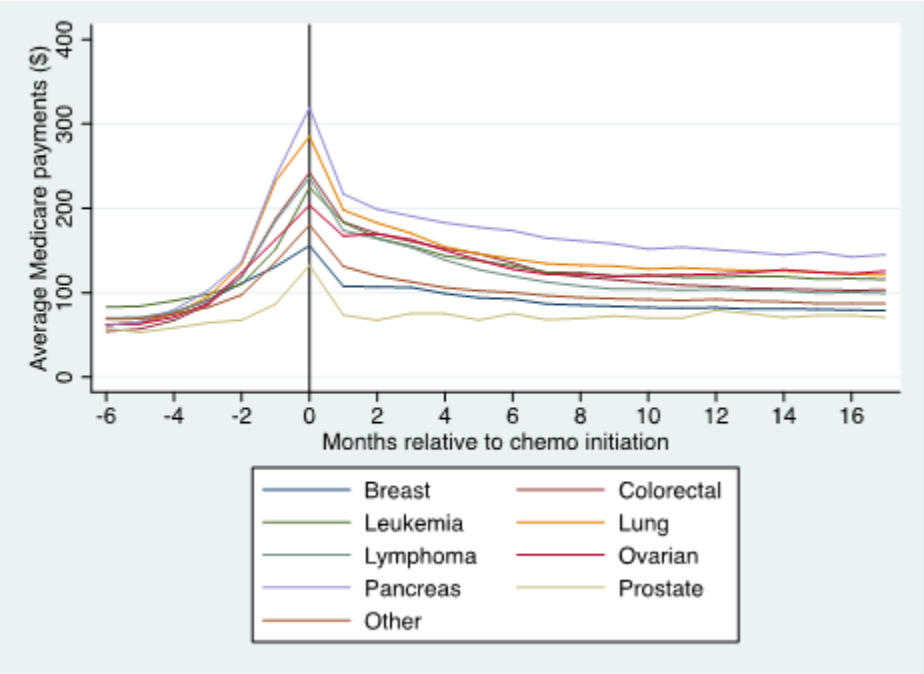
Figure 4.7. Percentage of Beneficiaries with Positive E&M Payments per Month Relative to Chemotherapy Initiation



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Figure 4.8 displays average evaluation and management payments occurring in each month. We observe a similar pattern of spending across cancer types, but the levels of payments differ substantially across sites, ranging from $133 for prostate to $319 for pancreatic cancer in the first month of chemotherapy. Figures 4.8 and 4.9 both imply that a nontrivial portion of evaluation and management spending occurs prior to the start of the chemotherapy initiation.

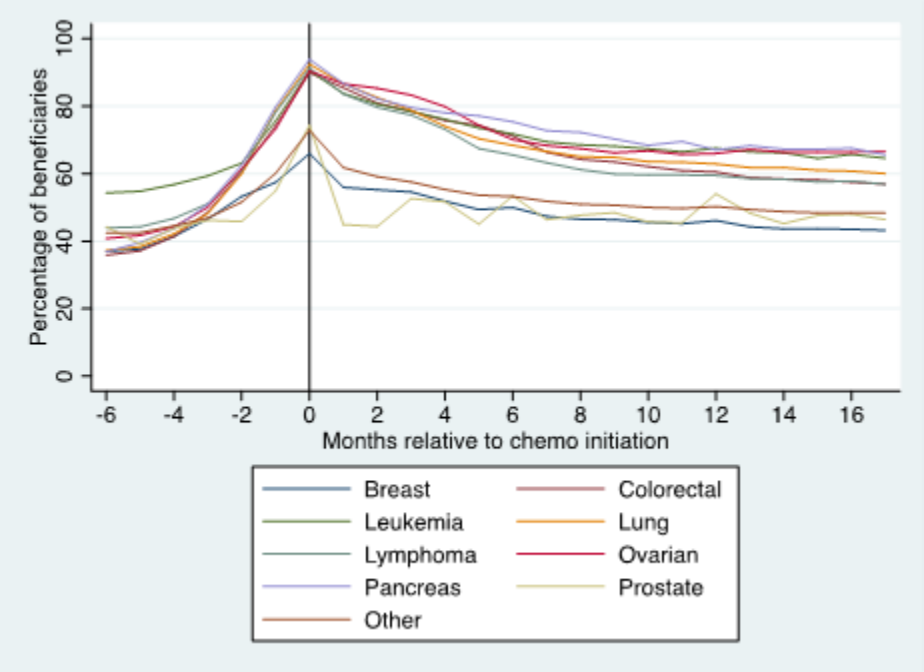
Figure 4.8. Average E&M Payments per Month Relative to Chemotherapy Initiation



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Figure 4.9 shows the percentage of patients with laboratory payments in each month relative to chemotherapy initiation. We find a positive trend in use that peaks at approximately 90 percent in the month prior to initiation and then falls in subsequent months. The pattern and levels of use are nearly identical for colorectal cancer, leukemia, lung cancer, lymphoma, ovarian, and pancreatic cancer, with lower levels for breast, prostate, and other cancers.

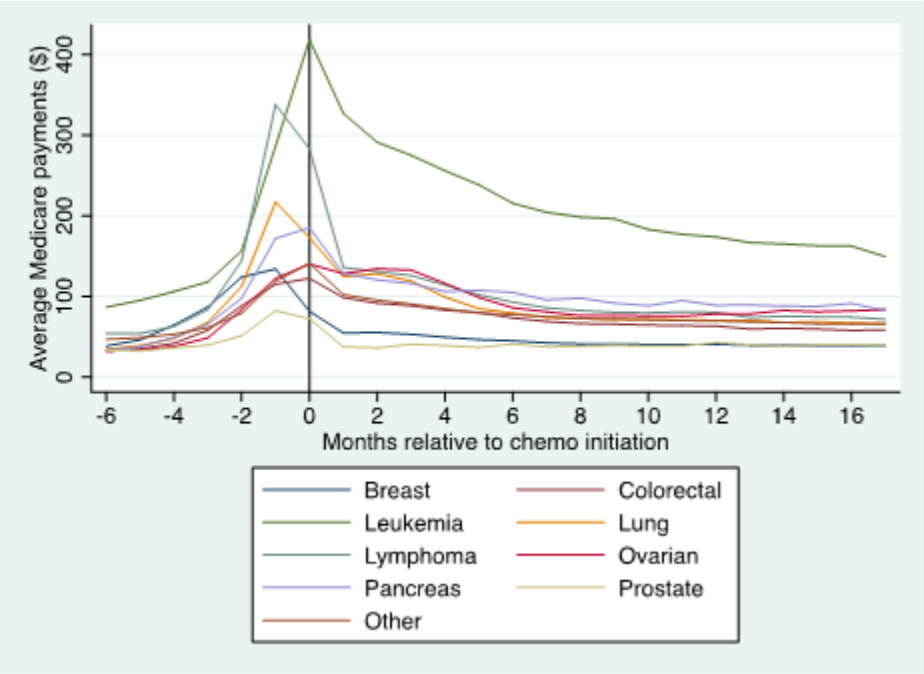
Figure 4.9. Percentage of Beneficiaries with Positive Laboratory Payments per Month Relative to Chemotherapy Initiation



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Figure 4.10 shows laboratory payments in each month by cancer type. The level of payment varies considerably across cancer types and is highest for leukemia and lymphoma. The highest payments occur prior to chemotherapy initiation for many cancers, likely reflecting the patient work-up occurring prior to the initiation of chemotherapy.

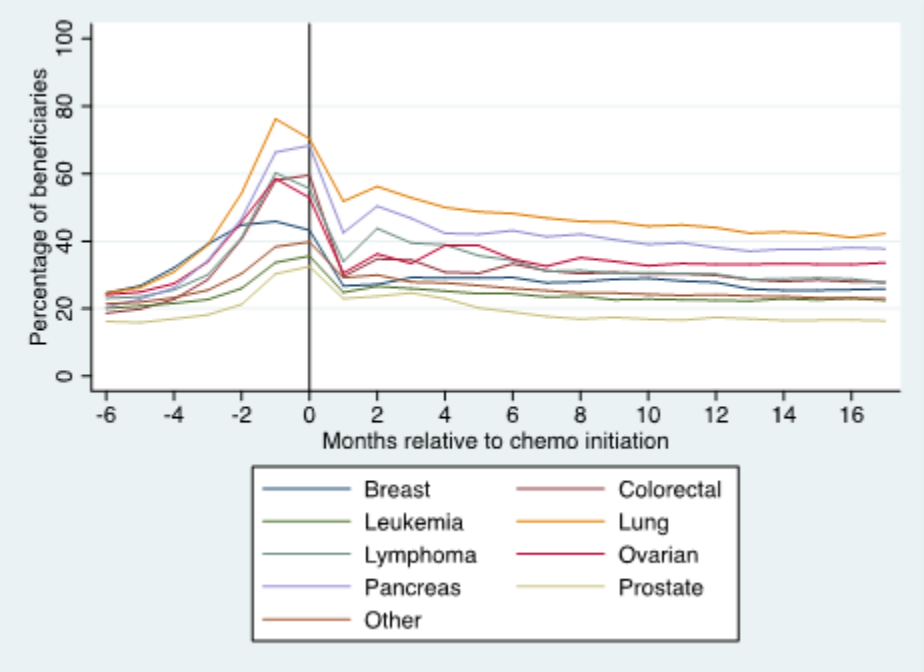
Figure 4.10. Average Laboratory Payments per Month Relative to Chemotherapy Initiation



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Next we examine imaging payments. Figure 4.11 shows a rise in the percentage of beneficiaries with positive imaging payments in the months immediately preceding the initiation of chemotherapy. Patients with lung and pancreatic cancer are most likely to use imaging.

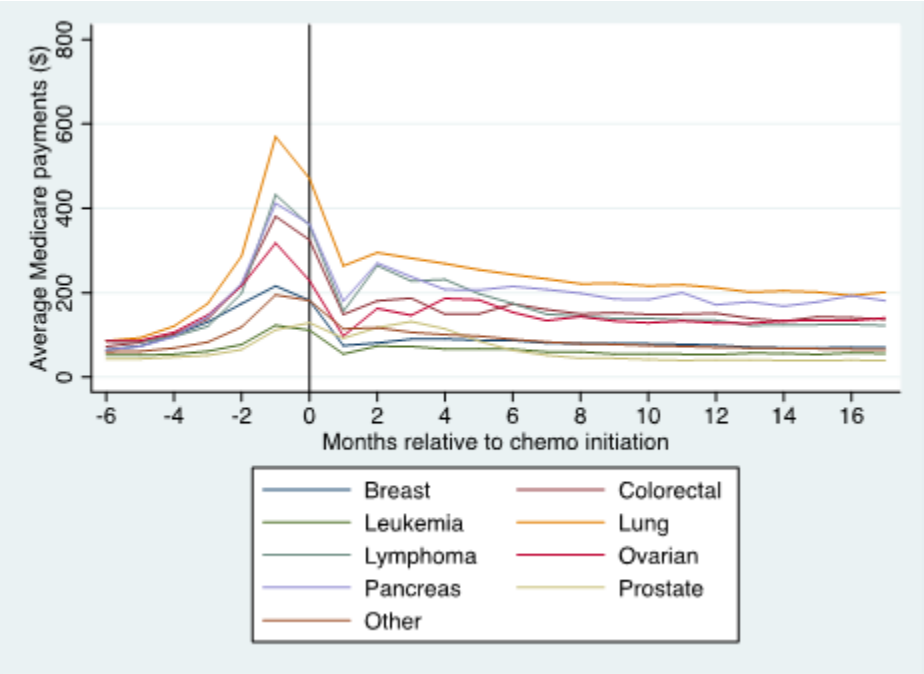
Figure 4.11. Percentage of Beneficiaries with Positive Imaging Payments per Month Relative to Chemotherapy Initiation



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Figure 4.12 shows average imaging payments in each month and also shows high levels of payment in the months immediately preceding chemotherapy initiation. The payments vary considerably across cancer types, ranging from a maximum of $112 for prostate cancer to $570 for lung cancer.

Figure 4.12. Average Imaging Payments per Month Relative to Chemotherapy Initiation

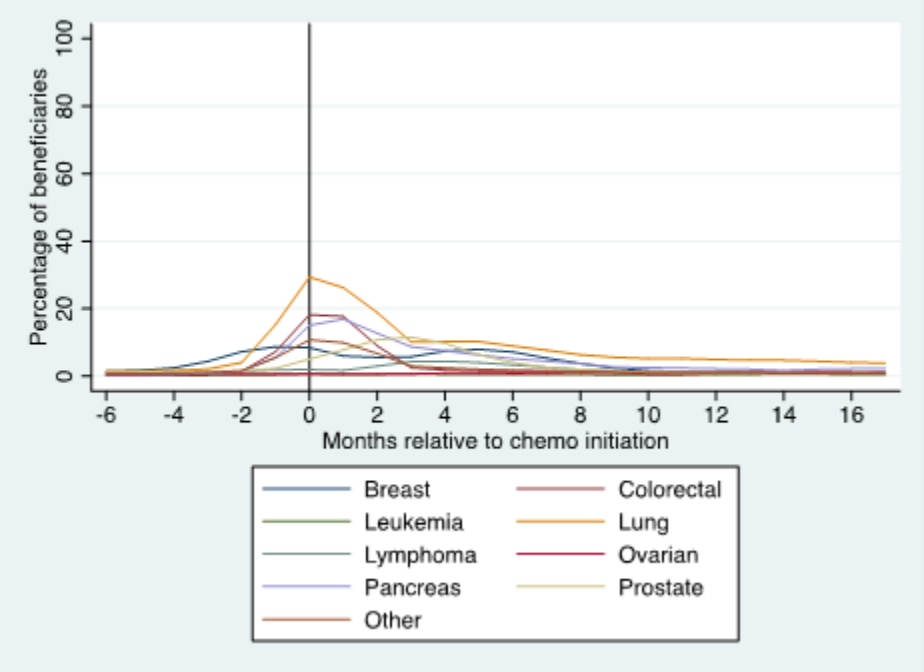


Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Patterns in Radiation Therapy, Inpatient, and Hospice Service Use

Next, we examine utilization and payments for other treatment types across cancer types. Figure 4.13 displays the percentage of patients with positive radiation therapy payments in each month relative to the initiation of chemotherapy. Overall, a minority of patients receives radiation therapy services in each month, with the highest percentage occurring for lung cancer patients and the highest use occurring in the month of chemotherapy initiation or soon thereafter.

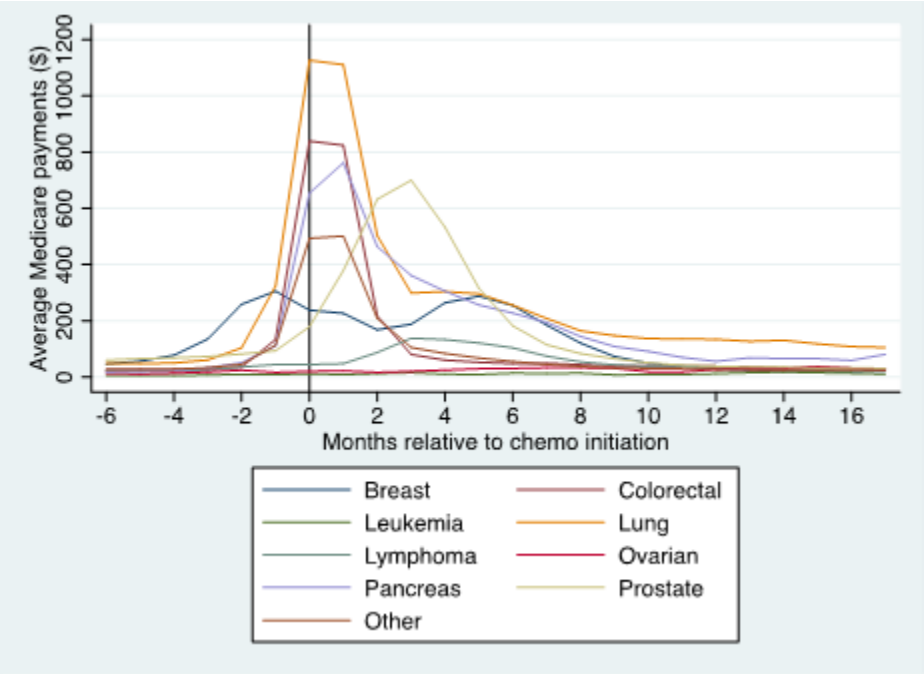
Figure 4.13. Percentage of Beneficiaries with Positive Radiation Therapy Payments per Month Relative to Chemotherapy Initiation



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Figure 4.14 displays the level of radiation therapy payments occurring in each month relative to chemotherapy initiation across cancer types. Despite the low percentage of patients using radiation therapy services, monthly payments are substantial relative to other utilization categories for certain cancer types. In particular, the highest payments occur for lung cancer, followed by colorectal cancer.

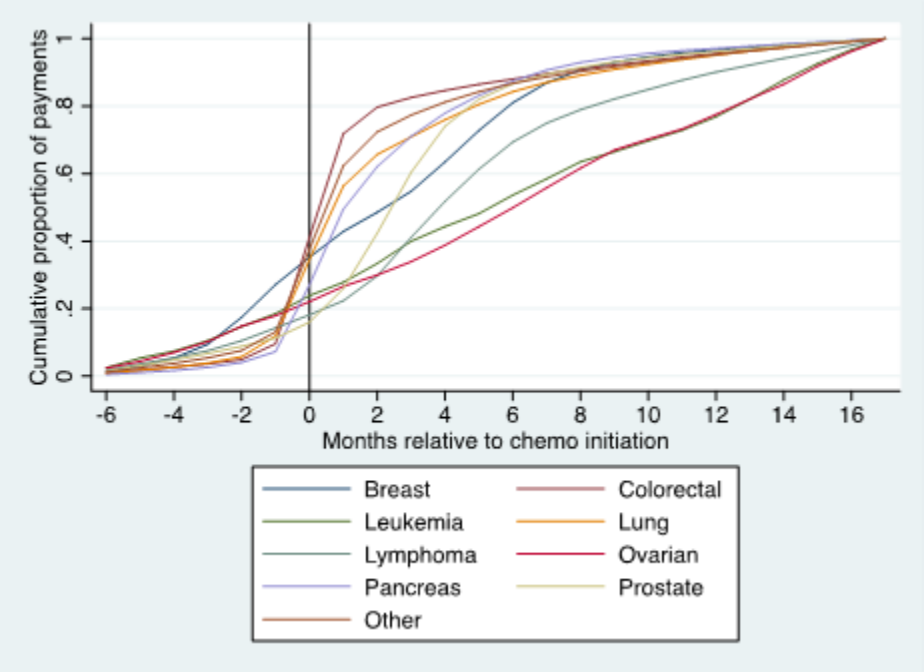
Figure 4.14. Average Radiation Therapy Payments per Month Relative to Chemotherapy Initiation



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

In Figure 4.15, we examine the cumulative proportion of XRT payments occurring by each month. For colorectal, lung, and other cancers, the majority of XRT spending occurs by the first or second month following chemotherapy initiation. For ovarian cancer, lymphoma, leukemia, and prostate cancer, spending occurs more evenly over the sample period.

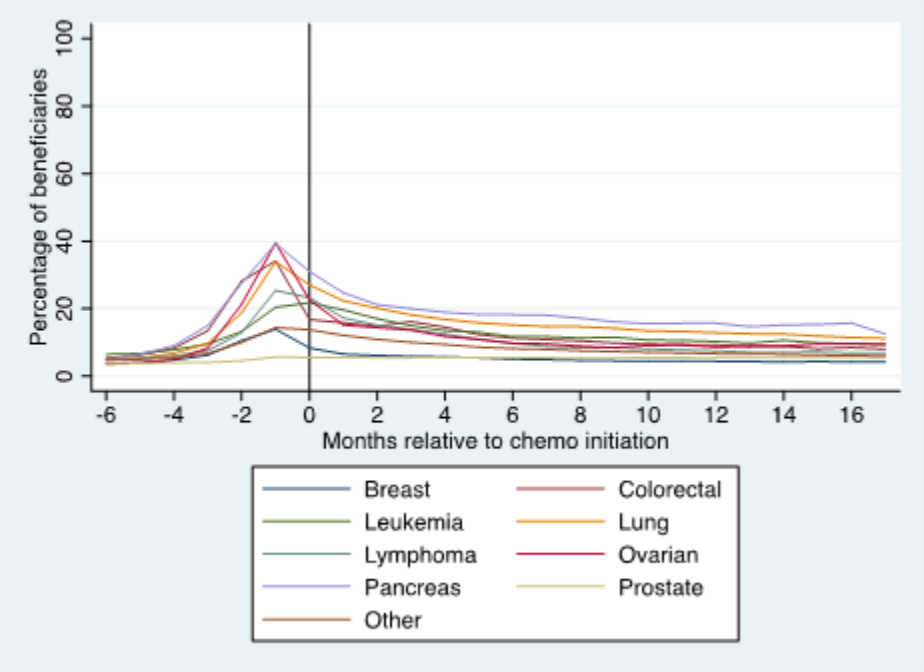
Figure 4.15. Cumulative Proportion of Radiation Therapy Payments per Month Relative to Chemotherapy Initiation



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Next, we examine inpatient utilization (long-term-care hospitals, inpatient rehabilitation facilities, Prospective Payment System–eligible (PPS-eligible) short stay hospitals, and non-PPS short stay hospitals). Figure 4.16 shows that there is a spike in inpatient facility use in the months prior to chemotherapy initiation for most cancer types besides prostate; however, the spike in use varies considerably across cancer types, from 14 percent for breast cancer to 39 percent of ovarian and pancreatic cancer episodes.

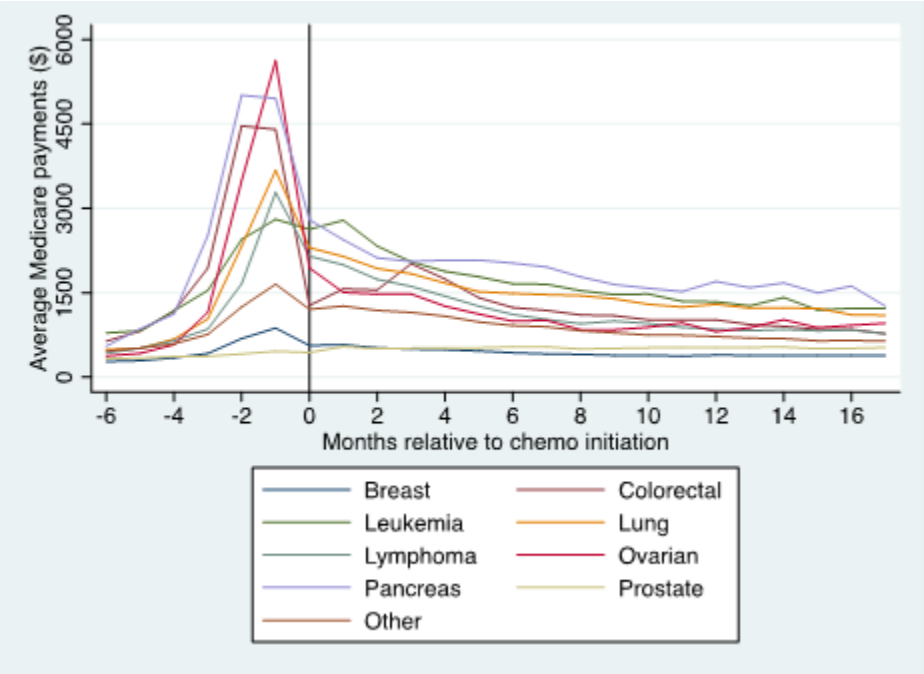
Figure 4.16. Percentage of Beneficiaries with Positive Inpatient Payments per Month Relative to Chemotherapy Initiation



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Figure 4.17 shows that inpatient utilization leads to substantial Medicare spending in each month, although this also varies across cancer types. The highest spending is for ovarian and pancreatic cancer, with much lower spending for breast and prostate cancer.

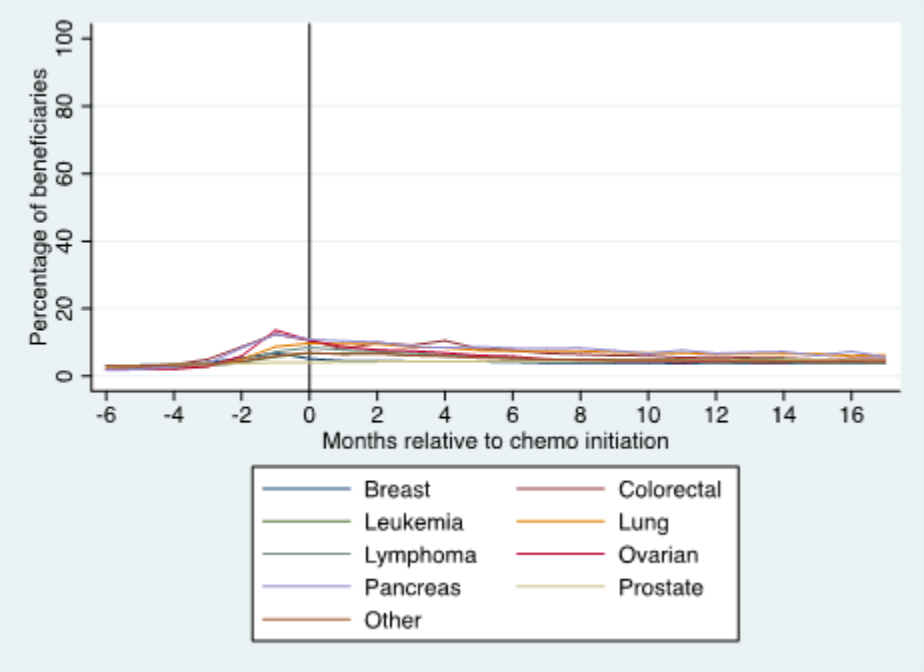
Figure 4.17. Average Inpatient Payments per Month Relative to Chemotherapy Initiation



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

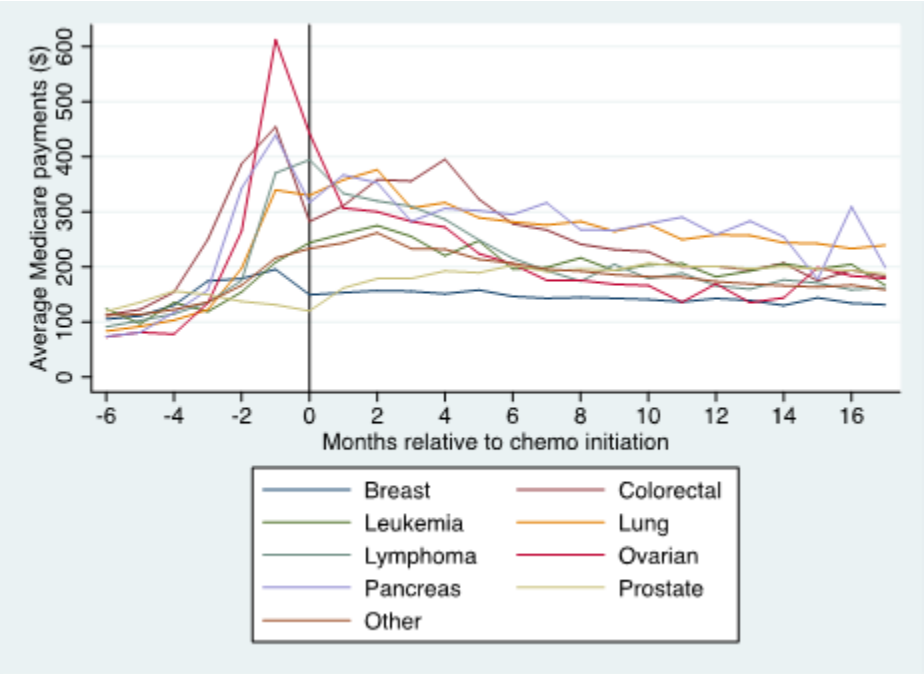
Figures 4.18 and 4.19 display the percentage of patients with any home health or skilled nursing facility payments, and average home health and skilled nursing facility payments in each month. While the percentage is low over the sample period, average payments are comparable to average payments in other categories with higher frequency of use, such as E&M visits.

Figure 4.18. Percentage of Beneficiaries with Positive Skilled Nursing Facility or Home Health Payments per Month Relative to Chemotherapy Initiation



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

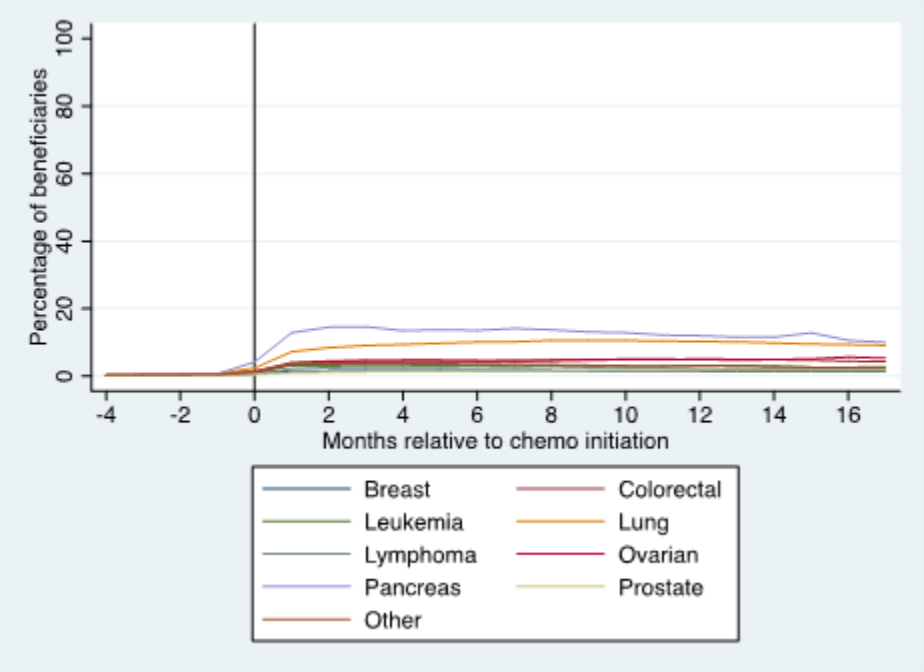
Figure 4.19. Average Skilled Nursing Facility and Home Health Payments per Month Relative to Chemotherapy Initiation



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Finally, we examine hospice use by patients across cancer types. Patients with pancreatic and lung cancer are the most likely to use hospice services, but the overall percentage is less than 20 percent in any given month.

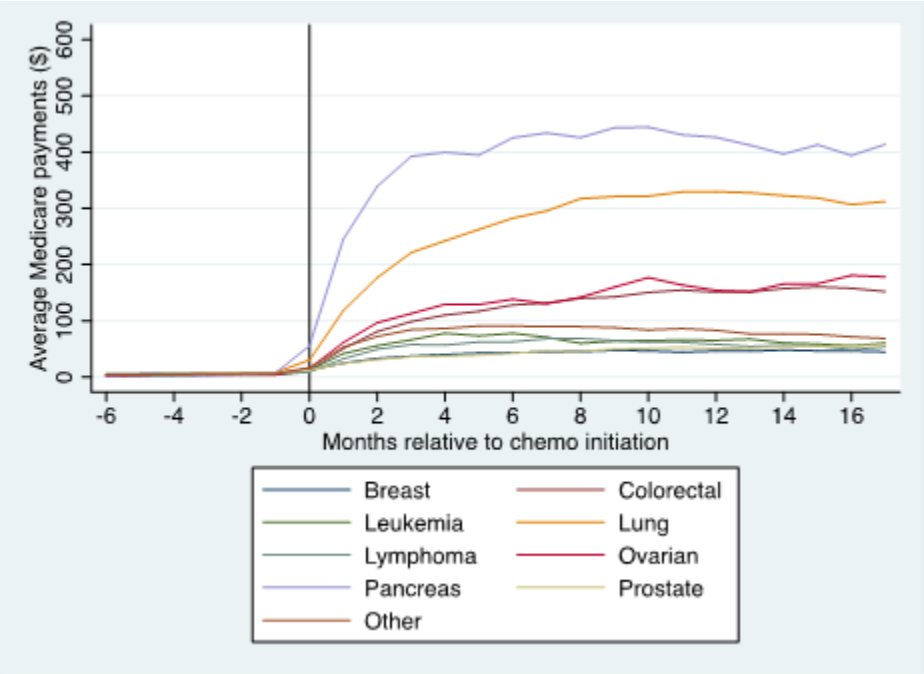
Figure 4.20. Percentage of Beneficiaries with Positive Hospice Payments per Month Relative to Chemotherapy Initiation



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Figure 4.21 shows average payments for hospice services across cancer types. Similar to the percentage of beneficiaries with positive hospice service use, patients with lung and pancreatic cancer have the highest payments for hospice services.

Figure 4.21. Average Hospice Payments per Month Relative to Chemotherapy Initiation

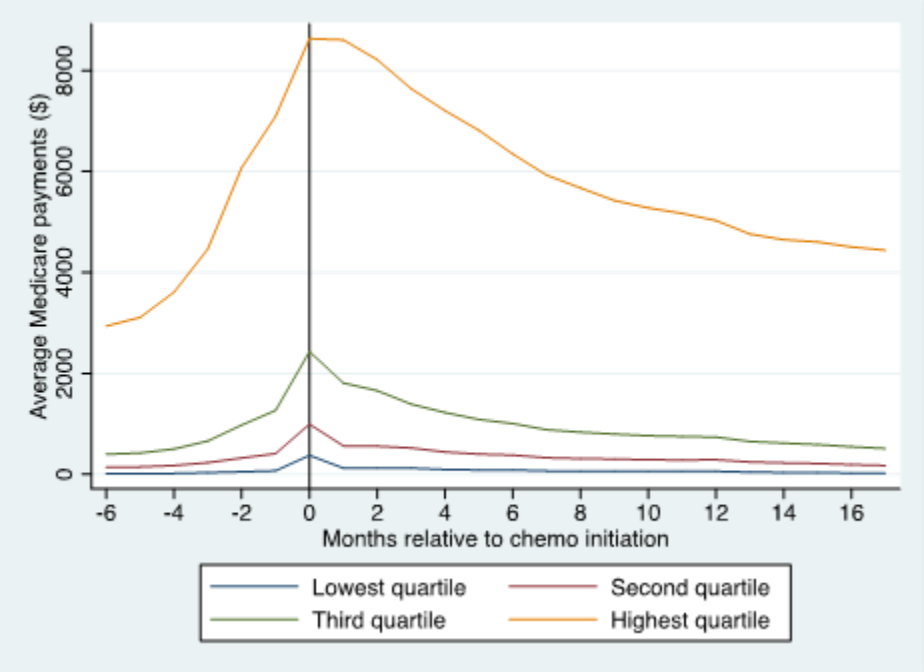


Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Variation in Medicare Payments

Next, we examine variation in total Medicare payments across patients and cancer type. Figure 4.22 (parts a through h) displays average payments for each quartile of total Medicare spending in each month. Figure 4.22a plots quartiles of total Medicare spending for breast cancer in each month relative to chemotherapy initiation. The top quartile of spending in each month is considerably higher, with spending peaking at over $8,000 per month in the months immediately preceding and following chemotherapy initiation. In contrast, the bottom three quartiles each represent less than half the per-beneficiary spending of the top quartile and are grouped closely together.

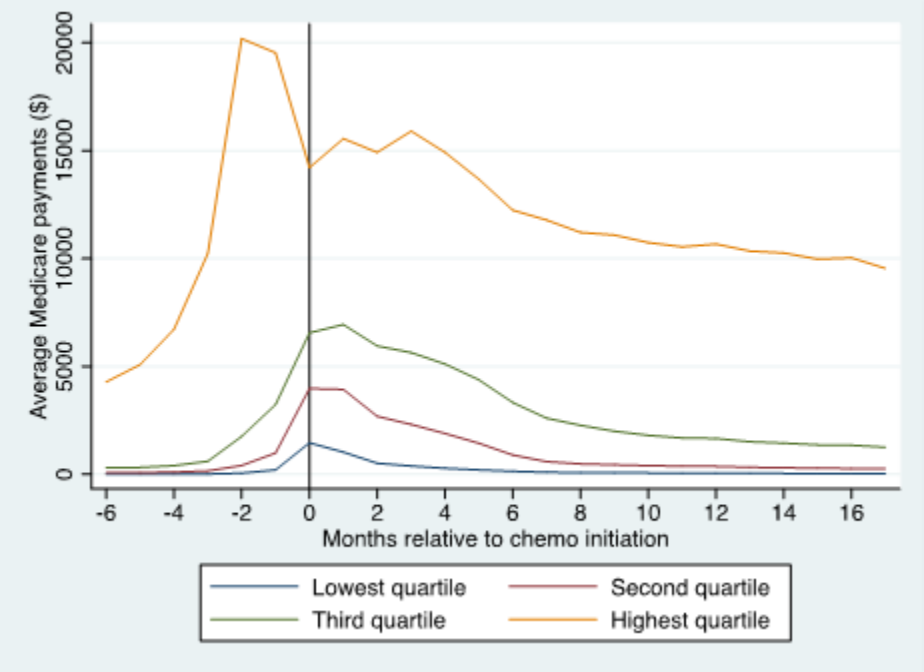
Figure 4.22a. Average Total Medicare Spending per Month Relative to Chemotherapy Initiation, by Cancer Type and Quartile of Average Monthly Medicare Spending: Breast Cancer



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Figure 4.22b plots quartiles of total Medicare spending for colorectal cancer. The pattern of total spending over time differs with a peak in spending prior to chemotherapy initiation, and the level of spending is higher than breast cancer, but the top quartile again represents much higher spending than the bottom three quartiles.

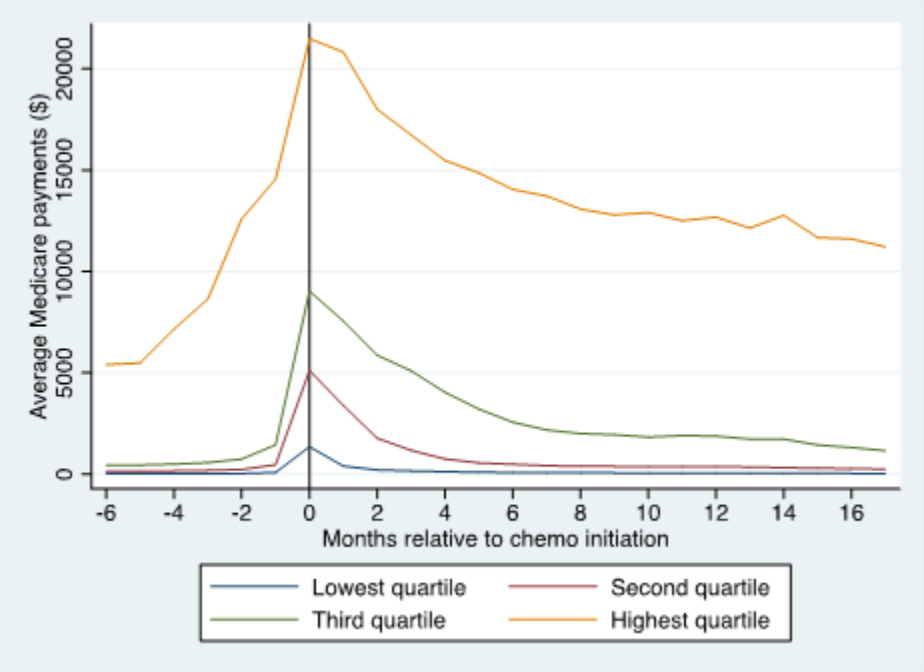
Figure 4.22b. Average Total Medicare Spending per Month Relative to Chemotherapy Initiation, by Cancer Type and Quartile of Average Monthly Medicare Spending: Colorectal Cancer



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

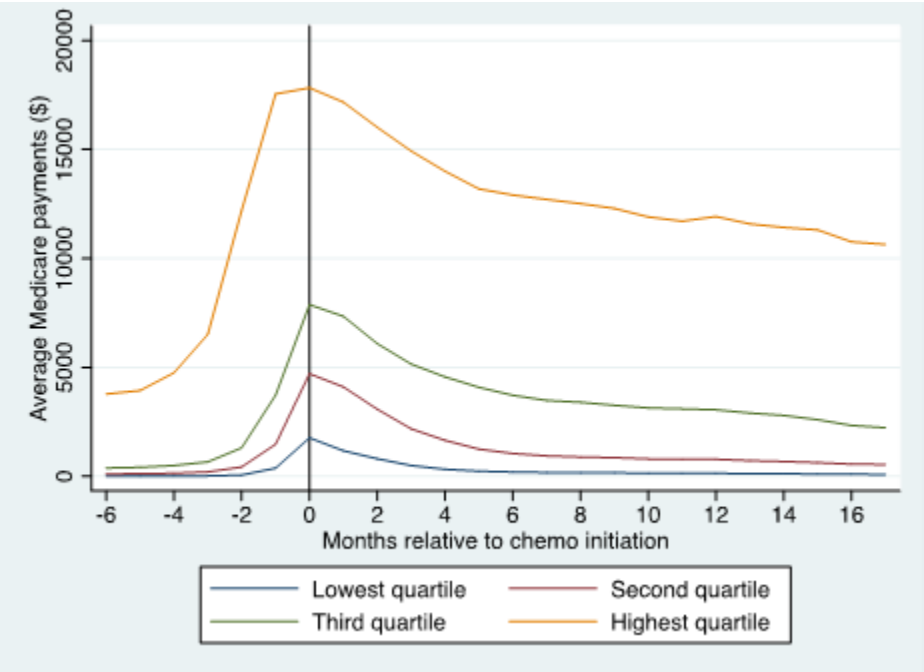
Figures 4.22c through 4.22h also show considerably higher total Medicare spending for the top quartile relative to the bottom three quartiles of spending in the months prior to and following chemotherapy initiation for leukemia, lung cancer, lymphoma, ovarian cancer, pancreatic cancer, and prostate cancer.

Figure 4.22c. Average Total Medicare Spending per Month Relative to Chemotherapy Initiation, by Cancer Type and Quartile of Average Monthly Medicare Spending: Leukemia



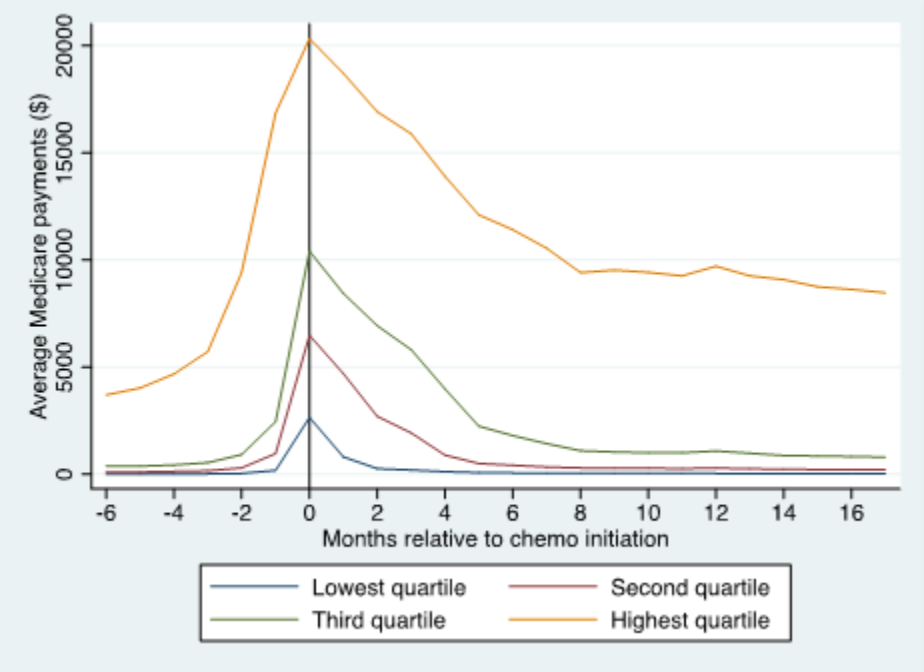
Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Figure 4.22d. Average Total Medicare Spending per Month Relative to Chemotherapy Initiation, by Cancer Type and Quartile of Average Monthly Medicare Spending: Lung Cancer



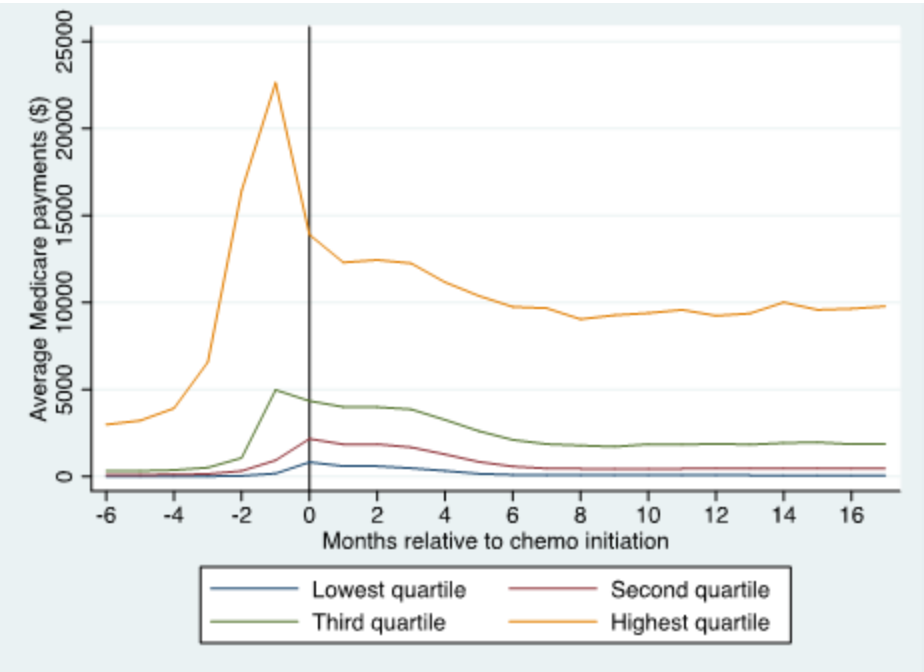
Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Figure 4.22e. Average Total Medicare Spending per Month Relative to Chemotherapy Initiation, by Cancer Type and Quartile of Average Monthly Medicare Spending: Lymphoma



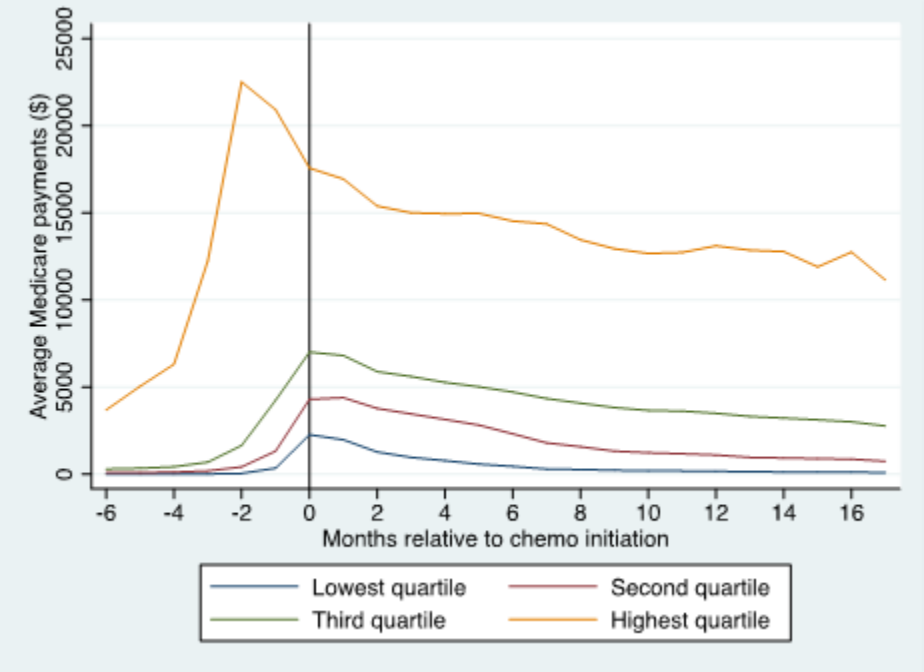
Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Figure 4.22f. Average Total Medicare Spending per Month Relative to Chemotherapy Initiation, by Cancer Type and Quartile of Average Monthly Medicare Spending: Ovarian Cancer



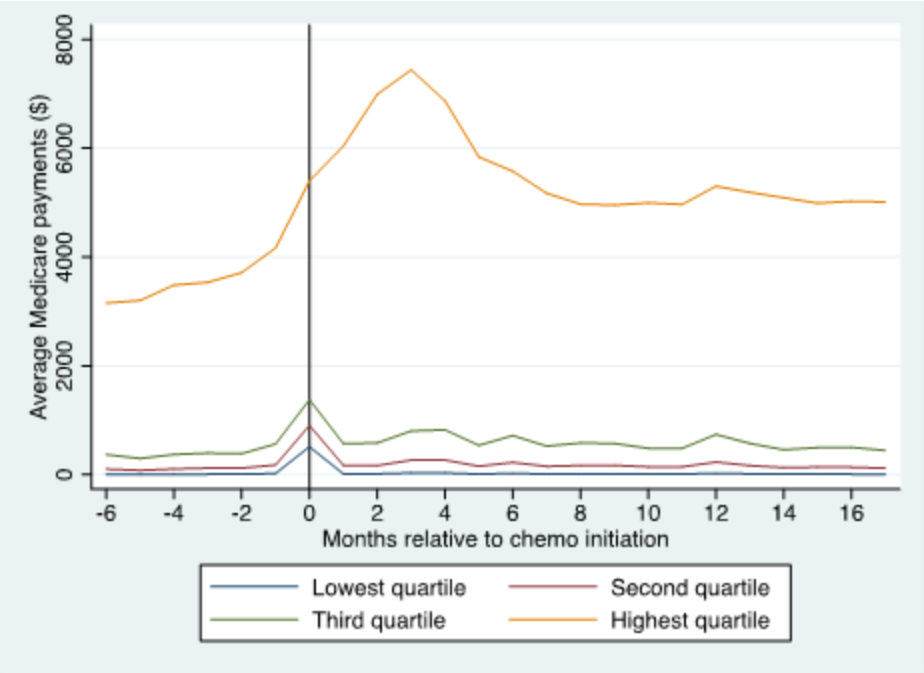
Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Figure 4.22g. Average Total Medicare Spending per Month Relative to Chemotherapy Initiation, by Cancer Type and Quartile of Average Monthly Medicare Spending: Pancreatic Cancer



Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Figure 4.22h. Average Total Medicare Spending per Month Relative to Chemotherapy Initiation, by Cancer Type and Quartile of Average Monthly Medicare Spending: Prostate Cancer

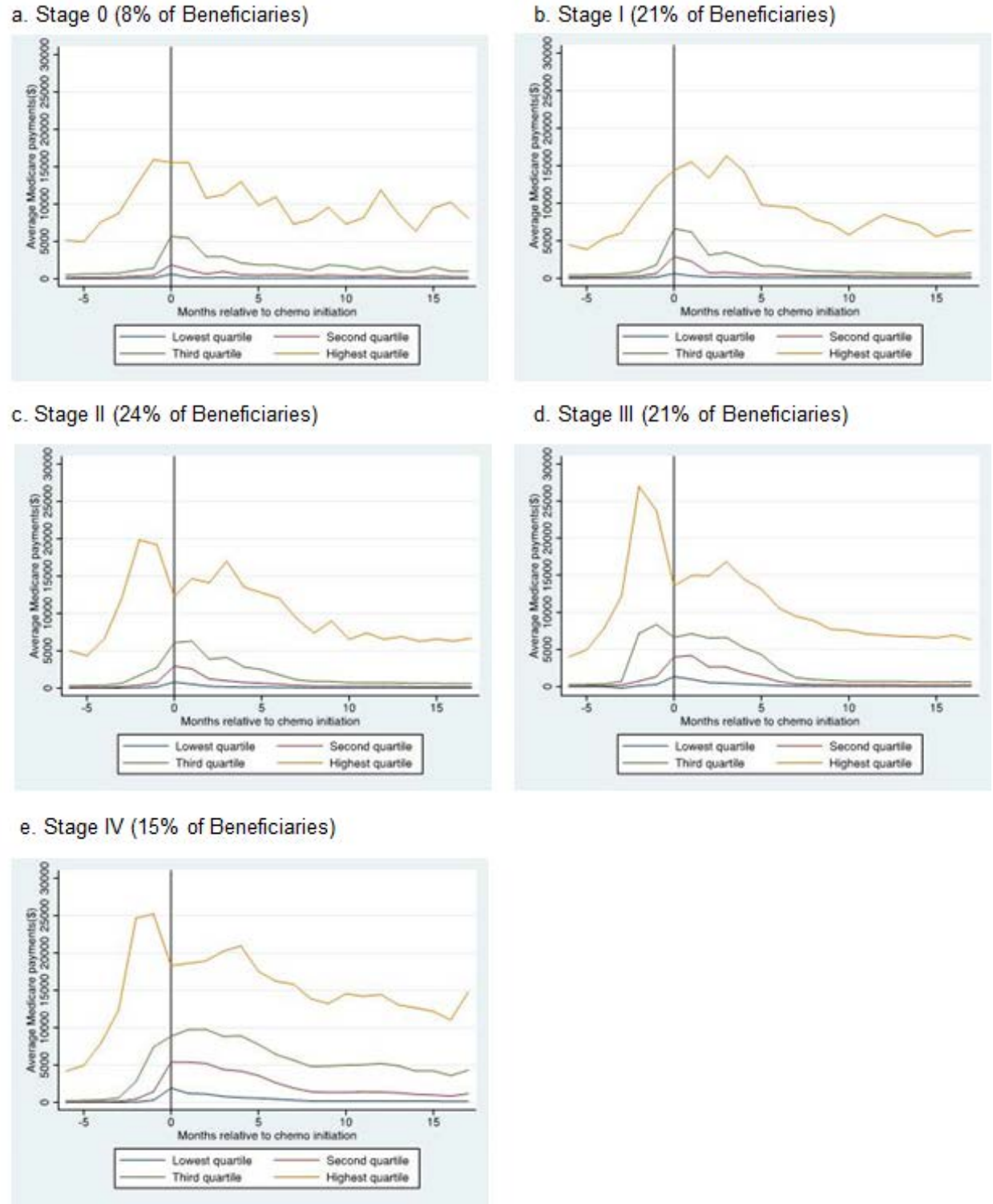


Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Figure 4.22 shows that there is significant variation in spending among patients using chemotherapy within types of cancer. Such variation could be driven by both differences in practice patterns or differential severity of patients within cancer types. In Figures 4.23 through 4.25, we examine the distribution of total payments in the months preceding and following chemotherapy initiation separately based on the stage of cancer at the time of diagnosis. While such information is not available in claims data, we are able to observe the stage of cancer at diagnosis in SEER-Medicare cancer registry data linked with claims data. In each case, we examine similar average spending measures as those in Figure 4.22, except we further stratify the sample by stage at diagnosis. Here, we only show colorectal cancer, lung cancer, and lymphoma. However, we find qualitatively similar patterns for other cancer types.

Figure 4.23 shows total Medicare spending by total spending quartile in the months before and after chemotherapy initiation, separately by stage at diagnosis, for colorectal cancer. The peaks of spending generally increase with the stage. For example, the peaks for Stages III and IV are higher than Stages 0–II. However, substantial variation exists in spending patterns within patients with a common stage at diagnosis.

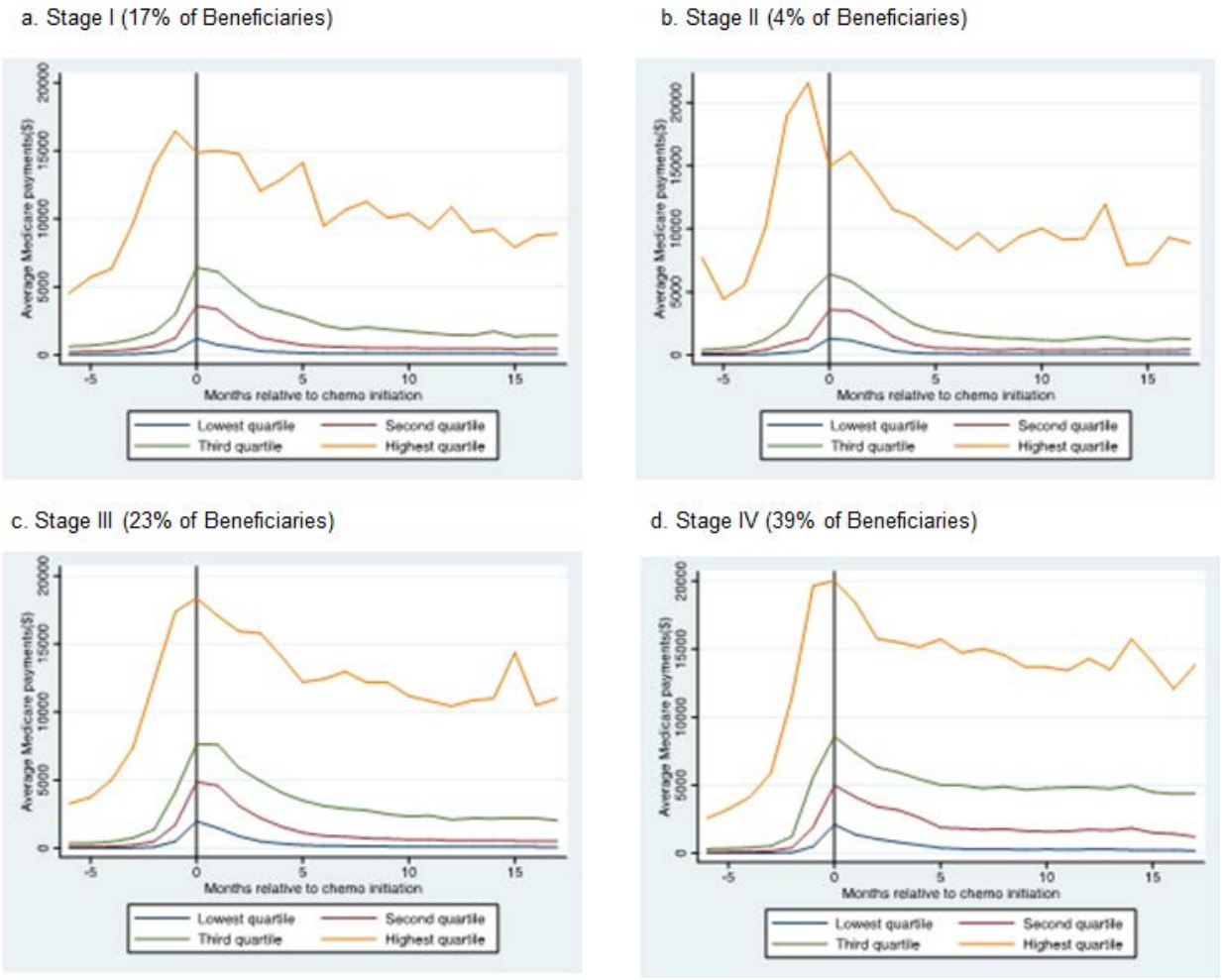
Figure 4.23. Average Total Medicare Payments per Month Relative to Chemotherapy Initiation, Beneficiaries with Colorectal Cancer, by Stage at Diagnosis



Source: Authors' analysis of 2003–2009 SEER-Medicare Medicare claims for patients with seven cancer types and chemotherapy initiation in 2003–2009.

Figure 4.24 displays within-stage quartiles of total Medicare spending in each month for lung cancer and exhibits a similar pattern; total Medicare spending increases with the stage of diagnosis, but the within-stage variation is comparable to the across-stage variation.

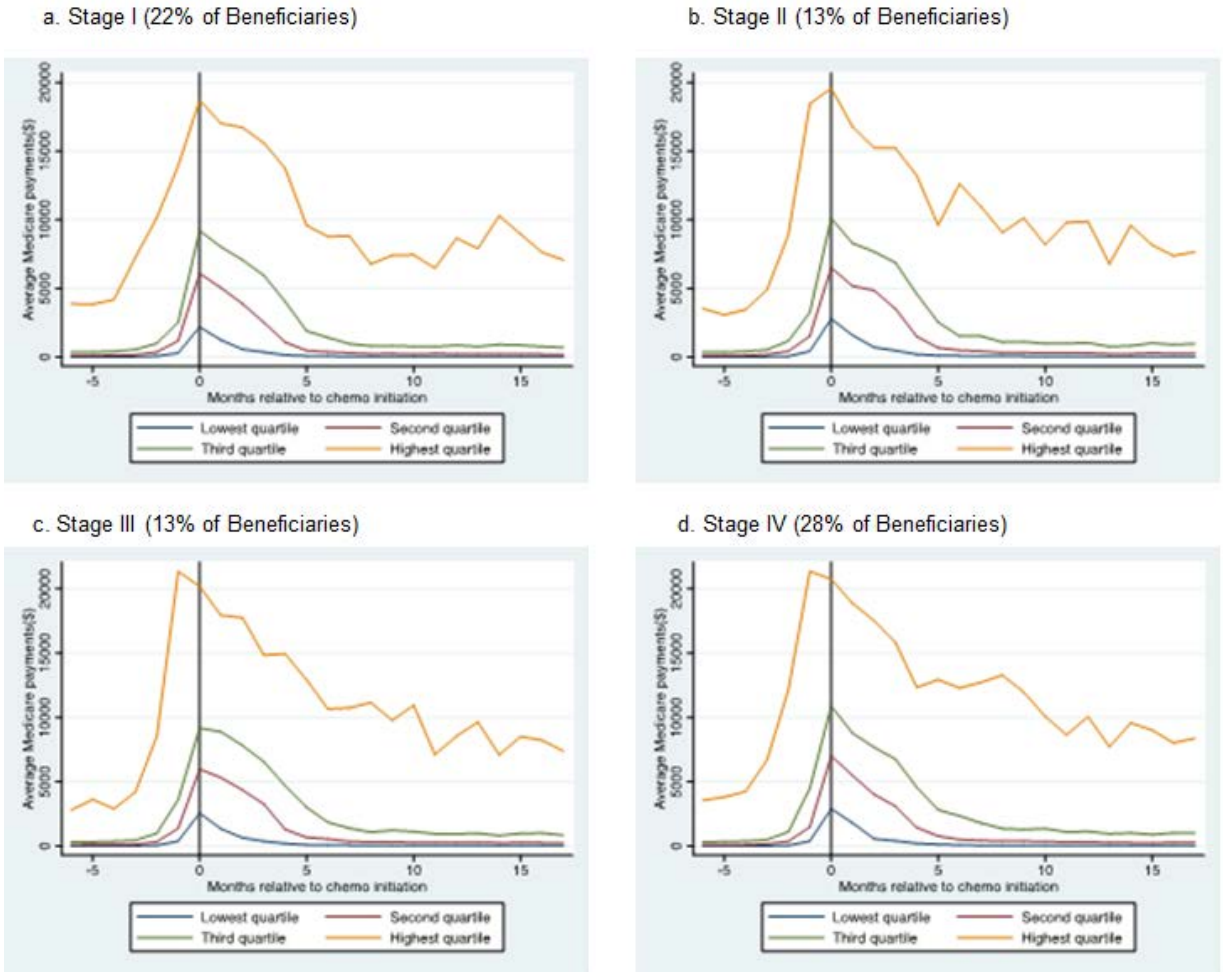
Figure 4.24. Average Total Medicare Payments per Month Relative to Chemotherapy Initiation, Beneficiaries with Lung Cancer, by Stage at Diagnosis



Source: Authors' analysis of 2003–2009 SEER-Medicare Medicare claims for patients with seven cancer types and chemotherapy initiation in 2003–2009.

Figure 4.25 shows total costs for lymphoma by stage at diagnosis. The levels of spending for each quartile are nearly identical across stages, but the variation across quartiles is substantial. This evidence suggests that variation in treatment patterns is occurring to some degree independently of the stage of cancer at diagnosis.

Figure 4.25. Average Total Medicare Payments per Month Relative to Chemotherapy Initiation, Beneficiaries with Lymphoma, by Stage at Diagnosis



Source: Authors' analysis of 2003–2009 SEER-Medicare Medicare claims for patients with seven cancer types and chemotherapy initiation in 2003–2009.

Implications for Medicare Savings Opportunities

In this section, we showed that monthly Medicare spending for beneficiaries with cancer who receive chemotherapy is substantial. The results of our descriptive analyses help highlight important features to consider in designing a payment model for oncology and identify potential opportunities for savings.

First, the level and timing of spending vary considerably depending on the cancer type. The service categories forming the components of cancer care are numerous and their relative importance varies across cancer types. Chemotherapy drug and administration and inpatient spending, however, are nearly always important contributors to overall spending, and may represent important opportunities for improving the efficiency and coordination of care.

Second, 15 to 25 percent of total spending in the 24-month window around chemotherapy initiation that we examined occurs in the six months prior to chemotherapy, representing the work-up prior to initiation (i.e., laboratory, imaging, and E&M payments) and hospitalizations.

We also find that within cancer type, great variation exists in the total costs of care across patients, with the top quartile of patients incurring substantially higher costs than the bottom three quartiles. In principle, this variation could reflect variability in the clinical severity of patients. In a subanalysis, however, we examined quartiles of total spending within cancer type and the stage of cancer at diagnosis. The variability across quartiles within a stage and site is comparable to the variation in spending across quartiles not accounting for stage at diagnosis. While there may be other clinical characteristics driving service utilization, this evidence may suggest that differences in treatment patterns independent of severity contribute to variation in utilization and spending.

5. Attribution of Episodes to Practices

Attribution methodologies are needed to associate patients undergoing episodes of chemotherapy treatment with physician practices that could participate in a payment model. There is no single attribution methodology recognized as the "gold standard," and prior studies have shown that alternative rules typically produce different results (Mehrotra et al., 2010). In this section, we describe two claims data–based attribution rules that RAND developed and tested for the oncology payment model. We then compare the rates at which the two rules successfully attribute episodes to practices and the concordance between the results from the two rules. Next, we describe four criteria we used to select a "preferred" attribution rule and then display characteristics of practices that were attributed episodes using the selected attribution rule. These claims data analyses provide the basis for an attribution methodology CMS might consider using for the oncology payment model and provide a profile of the type of practices that are most likely to participate in such a program—based on an analysis of the eight major cancer sites.

Development of Attribution Rules

RAND explored two alternative approaches for attributing chemotherapy episodes to practices: (1) a rule that attributed the episode to the practice responsible for the plurality of cancer-related visits for E&M services, which entails a retrospective approach, and (2) a prospective attribution rule that attributed episodes to the practice responsible for the trigger chemotherapy claim (i.e., the claim that is used to identify the initiation of the chemotherapy treatment episode).

We used Tax Identification Numbers (TINs) to identify practices—an approach commonly used in health services research for analyses using claims data. One disadvantage of TINs is the extreme heterogeneity in how they relate to practices. TINs might represent either individual brick-and-mortar practices or practices that operate in multiple settings that share a financial relationship. However, while TINs may change over time due to consolidations and mergers, they are likely to be sufficiently stable over the timeframe of a six- or 12-month attribution period to support their use for the payment model.

To test the performance of each attribution rule, we used a cohort of 331,643 beneficiaries from the CCW cohort who met the following criteria: (1) had a chemotherapy claim in 2010, (2) had a six-month "clean" period in which the beneficiary had no chemotherapy claims in the six months preceding the first chemotherapy claim in 2010, and (3) had one of the eight cancer types defined earlier in this report. The first chemotherapy claim in 2010 that met these criteria is referred to as a "trigger" claim since the claim initiates a chemotherapy episode. Only a beneficiary's first trigger claim is eligible for the analysis.

Plurality Visit Attribution Rule

The first attribution rule retrospectively examines all claims for cancer-related visits during a defined time window and attributes the episode to the practice responsible for the plurality of those visits. Hereafter we refer to this rule simply as the "plurality rule." The key features of the plurality rule include:

- *Counts of cancer-related visits.* Cancer-related visits were defined as any visit during which a claim for an E&M service (HCPCS code in the range 99201–99499) was billed in the Carrier file and for which a cancer diagnosis (ICD-9 code in the range 140.xx–239.xx or one of 12 ICD-9 V-codes) was present in either the primary diagnosis field or any of the 12 secondary diagnosis fields. We initially considered two other definitions of cancer-related visits that required a cancer diagnosis in the primary diagnosis field (a more restrictive definition) and one that dropped the cancer diagnosis requirement altogether (a looser definition). RAND and CMS agreed to use the definition that fell between these two extremes.
- *90-day time period.* We used a 90-day period over which we counted cancer-related visits billed by each practice—beginning 30 days before each trigger claim through 60 days following the trigger claim. The only deviation from this rule is noted below.
- *Tie-breaking rules.* In cases where more than one practice billed the same number of E&M visits for the same patient during the 90-day period, we extended the measurement period an additional 90 days (i.e., until 150 days after the trigger claim). If the additional E&M visits billed during the expanded period failed to break the tie, we attributed the episode to the practice billing for the visit that was most proximate to the trigger chemotherapy date.
- *Practice identifiers.* TINs are reported on all Carrier file claims, making it straightforward to associate cancer-related visits to individual practices.

Prospective Attribution Rule

The second attribution rule primarily assigns episodes to the practice that is responsible for the trigger chemotherapy claim. Deviations from this approach are limited to chemotherapy episodes initiated in hospital outpatient department (HOPD) settings and episodes for which TINs are not available on the trigger claim or cannot be crosswalked from other data sources. Trigger chemotherapy claims are found in four data files, representing different types of chemotherapy: Carrier, Part D, DME, and HOPD. The specific steps we took for each of the four categories of triggers are as follows:

Carrier triggers. For Carrier file triggers, we attributed the episode to the TIN of the rendering clinician that is reported on each Carrier claim.

Part D triggers. Attributing Part D triggers to practices is complicated by the fact that TINs are not present on Part D claims. While there is a single field available to identify the prescribing

physician, this field is not consistently populated with National Provider Identifiers (NPIs). When NPIs were available, we crosswalked them to TINs using the Medicare Data on Physician Practice and Specialty (MD-PPAS) database.[2] When we could not successfully crosswalk a prescribing provider's NPI to a TIN, or when NPIs were not available, we attributed the episode based on the results of the plurality rule described above.

DME triggers. For DME triggers, we first identified the NPI of the referring provider (as opposed to the supplying provider) on the trigger claim. We then crosswalked the referring provider's NPI to a TIN as reported in the MD-PPAS database. When we could not successfully crosswalk a prescribing provider's NPI to a TIN, we attributed the episode to a TIN based on the results of the plurality rule.

HOPD triggers. One concern regarding chemotherapy episodes that are initiated in HOPDs is that the HOPD attending physician may not be the provider or practice that is ultimately responsible for a patient's ongoing cancer care. In fact, many attending physicians may not even be oncologists. This concern led to a more refined approach for HOPD triggers that sought to attribute episodes based on E&M services rather than simply the practice in which the patient received his or her first course of chemotherapy. We therefore attributed episodes with HOPD triggers after assessing the presence of the following services:

- *E&M claim on the same day as the HOPD trigger.* Practices that billed for a cancer-related E&M service (using the same definition that we used for the plurality rule) on the same day as the trigger claim were assumed to play a key role in the care of the patient and were attributed the episode.
- *E&M claim on the same day as a subsequent chemotherapy drug claim.* In the event that a patient did not receive an E&M service on the same day as the trigger claim (or if a patient had multiple E&M services on the trigger date), we extended our measurement period to the 90-day period following the trigger date and assigned the episode to the practice billing for the greatest number of E&M visits *on the same day as a claim for a chemotherapy drug*. Similar to the tie-breaking procedures we used in our plurality attribution rule described above, if more than one practice billed the same number of E&M visits, we extended the measurement window to 180 days to

[2] The MD-PPAS database was developed to provide a standardized approach for assigning physicians to medical practices. This assignment is made to the TIN of the physician that accounts for the plurality of the physician's charges for evaluation and management visits, procedures, and imaging services. We used this database to crosswalk NPIs to TINs in cases where an NPI was reported on a claim but a TIN was not. We compiled five years of the MD-PPAS dataset to maximize our chances of crosswalking NPIs to TINs. The crosswalk was not complete because MD-PPAS is not comprehensive. It does not include nonphysicians; clinicians who do not have a record in the Provider Enrollment, Chain and Ownership System; and physicians practicing in Puerto Rico.

attempt to break the tie, and, if necessary, we broke the tie by attributing the episode to the practice that billed for the E&M service (on the same day as a chemotherapy drug claim) that was most proximate to the trigger date.

If the episode was not successfully attributed using the rules described above, we attributed the episode to the HOPD attending provider. Because TINs are not reported on HOPD claims, we crosswalked the attending physician's NPI to a TIN using the MD-PPAS database. When a TIN could not be crosswalked, we attributed the episode based on the results of the plurality attribution rule.

Comparison of Attribution Rules

Attribution Success

Table 5.1 shows the disposition of the 331,643 episodes in our sample. All but 8,543 episodes (2.6 percent) were successfully attributed using the plurality rule, while all but 996 episodes (0.3 percent) were attributed to practices under the prospective rule. Because the plurality rule attribution results were used to supplement the prospective rule results whenever TINs were not available on trigger claims, the only types of episodes that were not successfully attributed under the prospective rule were those that were also not attributed under the plurality rule.

We identified a number of possible reasons that might explain why episodes failed to be attributed under the plurality rule. However, given the low rate of nonattributed episodes, we did not conduct additional analyses to explore these hypotheses.

- *Off-label use of chemotherapy.* These beneficiaries might have E&M visits during the 90-day period, but these claims may not be associated with a cancer diagnosis. This implies that at least some percentage of episodes that are not attributed under the plurality rule, which requires an ICD-9 cancer diagnosis on the claim, may involve beneficiaries who are receiving chemotherapy for off-label uses.
- *Cancer-related visits may be included within a global surgical payment*. For some inpatient and outpatient procedures, postoperative E&M visits are included in a global surgical package (and are not reimbursed separately) and are therefore not included in the plurality rule analysis. While some physicians might submit claims for these services, we believe that the vast majority do not.
- *Death, loss of eligibility, or enrollment in Medicare Advantage*. Beneficiaries might have died, lost Medicare Part A/B eligibility, or enrolled in Medicare Advantage after the trigger claim, and thus we observed no additional E&M claims after the trigger.
- *Beneficiaries are enrolled in hospice*. Hospice providers are reimbursed using a prospective payment methodology. Claims for services rendered by hospice providers would appear in the hospice file and not as E&M visits in the carrier file.

- *Beneficiaries are receiving care at Federally Qualified Health Centers or Rural Health Clinics*. Visits to Federally Qualified Health Centers and Rural Health Clinics are captured in the Outpatient file and not in the Carrier file.

Table 5.1. Disposition of Episodes Following Application of Attribution Rule, by Rule

Attribution Rule	N (Percentage)
Plurality Attribution Rule	
Attributed using 90-day window	235,888 (71.1)
Attributed using 180-day window	57,358 (17.3)
Attributed based on E&M visit closest to trigger date	29,854 (9.0)
Not attributed	8,543 (2.6)
Prospective Attribution Rule	
Carrier trigger	177,501 (53.5)
Part D trigger, NPI present, TIN available through crosswalk	62,611 (18.9)
Part D trigger, NPI present, TIN not available through crosswalk*	4,950 (1.5)
Part D trigger, NPI not present*	14,080 (4.3)
DME trigger	8,886 (2.7)
DME trigger, NPI present, TIN not available through crosswalk*	462 (0.1)
HOPD trigger, attributed to practice billing for same-day E&M visit	26,634 (8.0)
HOPD trigger, attributed to practice billing for plurality of E&M visits with concomitant chemo claims (90-day window)	17,808 (5.4)
HOPD trigger, attributed to practice billing for plurality of E&M visits with concomitant chemo claims (180-day window)	2,386 (0.7)
HOPD trigger, attributed to HOPD attending, TIN available through crosswalk	14,982 (4.5)
HOPD trigger, attributed to HOPD attending, TIN not available through crosswalk*	347 (0.1)
Not attributed	996 (0.3)

Note: The cohort comprised 331,643 beneficiaries.
* The plurality rule was implemented for these triggers.
Source: Authors' analysis of 2010–2011 CCW Medicare claims data for patients with eight cancer types and chemotherapy initiation in 2010.

Concordance of Attribution Results Between Rules

A high degree of concordance between the attribution results from both rules would provide some reassurance that aspects of the model design would not be overly sensitive to the selection of the attribution rule. To examine concordance between the rules, we restricted our analysis to the sample of episodes that were successfully attributed under both attribution rules (323,100 episodes, or 97.4 percent of all episodes). Table 5.2 shows that the two rules produce fairly consistent results overall, although there is considerable heterogeneity in concordance across episodes with different trigger types.

Table 5.2. Concordance Between Plurality and Prospective Attribution Rules Among Episodes Successfully Attributed by Both Attribution Rules, by Trigger Type and Overall

Trigger Type	Number of Episodes Attributed Under Both Rules	Percentage of Concordance
Carrier trigger	173,502	87.1
Part D trigger, NPI present, TIN available through crosswalk	60,307	64.4
Part D trigger, NPI present, TIN not available through crosswalk*	4,950	100.0
Part D trigger, NPI not present*	14,080	100.0
DME trigger	8,813	82.5
DME trigger, NPI present, TIN not available through crosswalk*	462	100.0
HOPD trigger, attributed to practice billing for same-day E&M visit	26,634	92.3
HOPD trigger, attributed to practice billing for plurality of E&M visits with concomitant chemo claims (90-day window)	17,788	88.6
HOPD trigger, attributed to practice billing for plurality of E&M visits with concomitant chemo claims (180-day window)	2,373	75.4
HOPD trigger, attributed to HOPD attending, TIN available through crosswalk	13,844	70.5
HOPD trigger, attributed to HOPD attending, TIN not available through crosswalk*	347	100.0
Overall	323,100	83.2

* The plurality rule was implemented for these triggers.
Source: Authors' analysis of 2010–2011 CCW Medicare claims data for patients with eight cancer types and chemotherapy initiation in 2010.

The episodes for which we observed the lowest levels of concordance involve Part D triggers. Patients receiving oral chemotherapy may be used for different indications than infused therapies, and these conditions may be associated with different utilization patterns—such as E&M visits to a broader set of providers—which could introduce differences between the two attribution rules. While we were initially concerned that patients who began chemotherapy in HOPD settings might seek ongoing care elsewhere—leading to large differences between the results of the two attribution rules—the results in Table 5.2 suggest that this may not be a major problem. In particular, among episodes that are attributed to the practice of the HOPD attending physician, 71 percent of those episodes were also attributed to the same practice based on the plurality rule. Overall, 83 percent of episodes that were attributed under both rules were attributed to the same practice.[3]

Selection of a Preferred Attribution Rule

We developed four quantitative measures to guide the selection of a preferred attribution rule: (1) the percentage of episodes successfully attributed to a practice, (2) the percentage of episodes under the plurality rule that are decided by a tie-breaking rule, (3) the percentage of episodes attributed to clinicians who provide physician-administered chemo, and (4) the mean percentage of total episode payments billed by the attributed practice. An assessment of these criteria led us to select the prospective attribution rule for the remaining analyses. We describe the results that supported the decision below.

As indicated in Table 5.1, the prospective rule successfully attributed a higher percentage of episodes (99.7 percent vs. 97.4 percent). While a high rate of ties between practices for cancer-related visits might cast some doubt on the validity of the plurality attribution rule, we found that only 9 percent of episodes attributed by the plurality rule were done so with the use of a tie-breaking rule that assigned the episode to the practice with the visit that occurred most proximate to the trigger chemotherapy claim. Because previous reports of attribution analyses typically do not include information on ties, we have few benchmarks against which to compare this rate. Nevertheless, we believe this rate is not high enough to be concerning.

We then examined the percentage of episodes attributed to clinicians who were most likely to be characterized as "chemotherapy providers" by virtue of submitting Carrier or DME claims for chemotherapy. Using the results of our clinician attribution (which was conducted in parallel with our practice-level attribution), we found that a total of 75.9 percent of episodes were

[3] If the four trigger types in which plurality rule results were used (indicated by asterisks in Table 5.2) were excluded from this calculation, the two rules would produce results that were 77-percent concordant.

attributed to clinicians who provide physician-administered chemotherapy using the prospective rule, as compared with 69.0 percent of clinicians attributed episodes under the plurality rule.

Finally, we measured the percentage of payments per episode made to the attributed practice across a range of different payment categories (Table 5.3). We focused on the sample of episodes that produced discordant attribution results. Among this sample of 54,147 episodes (16.3 percent of the sample), we found that the prospective attribution rule was more likely to attribute the episode to the practice that was primarily responsible for chemotherapy spending. In two other payment categories (all outpatient and total payments), the practice attributed under the prospective rule was responsible for a higher proportion of payments.

Table 5.3. Mean Percentage of Episode Payments to the Attributed Practice, by Attribution Rule and Payment Category

	Among Episodes Attributed by Both Methods and Producing Discordant Results (n=54,147 episodes)		Among Episodes Attributed By Both Methods (n=323,100 episodes)	
	Plurality Attribution Rule	**Prospective Attribution Rule**	**Plurality Attribution Rule**	**Prospective Attribution Rule**
Chemotherapy payments	16.7	75.0	86.3	91.6
E & M payments	32.7	25.5	57.3	56.2
Other Outpatient payments	26.5	23.4	38.5	38.1
All Outpatient payments	21.6	44.8	66.9	69.6
Total payments	13.6	23.4	45.8	47.3

Notes**: Chemotherapy payments** included likely chemotherapy, possible chemotherapy, drugs coadministered with chemotherapy, and antiemetics (rendered in office or outpatient hospital settings or billed on DME or Part D claims), as well as payments for chemotherapy administration performed in office or outpatient hospital settings. **E&M payments** included spending in office and outpatient hospital settings. **Other outpatient payments** included imaging, laboratory, and radiation therapy services rendered in office or outpatient hospital settings. **All outpatient payments** included everything except payments for inpatient, skilled nursing facility, hospice, and home health services. Episode payments were measured over a six-month period that includes the month of the trigger claim and the subsequent five months. The analysis included only episodes that were successfully attributed under both rules. Source: Authors' analysis of 2010–2011 CCW Medicare claims data for patients with eight cancer types and chemotherapy initiation in 2010.

Based on this evidence, we recommend that the prospective attribution rule be used for the subsequent modeling portion of the oncology analyses.

Characteristics of Practices with Attributed Oncology Episodes

Using the results from the prospective attribution method, we derived summaries of the practices that were attributed at least one episode. Figures 5.1 through 5.5 display practices' episode volume, number of physicians with attributed episodes, and number of oncologists with attributed episodes. We display these results using four possible episode volume cutoffs—recognizing that CMS might consider implementing a minimum episode volume criterion for participation in the payment model to focus the program on practices that are most likely to undertake practice redesign and other quality improvement strategies in pursuit of savings.

Of note, the distribution of episodes per practice is extremely skewed, with 62.1 percent of practices attributed only one or two episodes. Using a cutoff of ten episodes (across the eight cancer types) would reduce the sample of practices participating in the program by 79 percent. However, because chemotherapy episodes are clustered primarily in high-volume practices, the ten-episode cutoff entails a loss of only 9 percent of episodes from the analysis (Figure 5.2). The number of episodes attributed to each practice and number of physicians and oncologists with attributed episodes per practice each increase as the overall practice volume cutoff is raised.

Figure 5.1. Number of Practices Potentially Eligible for Participation in an Oncology Payment Model Under Different Minimum Episode Volume Cutoffs

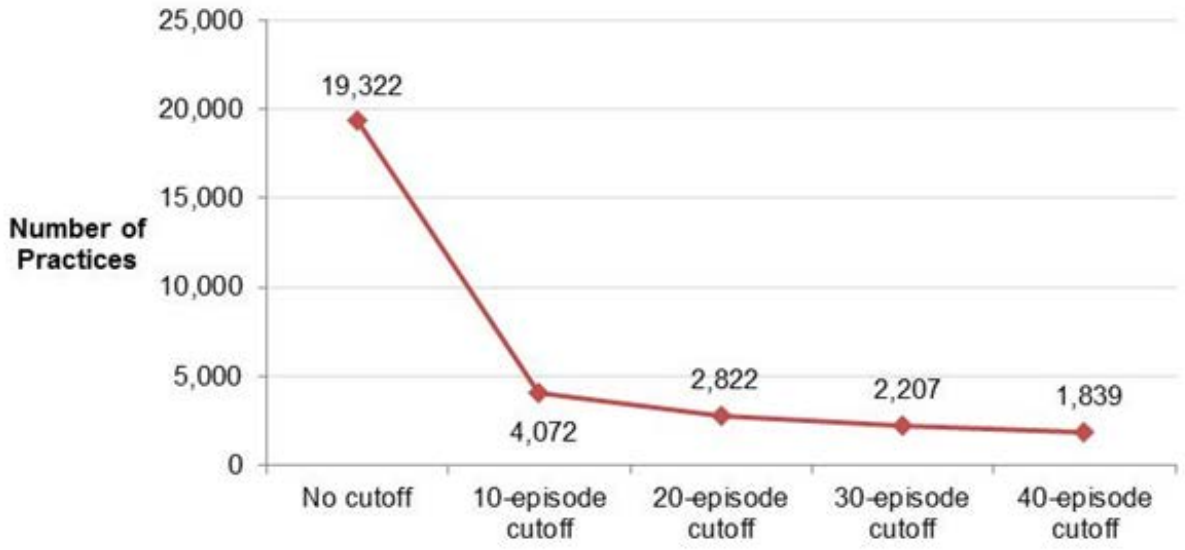


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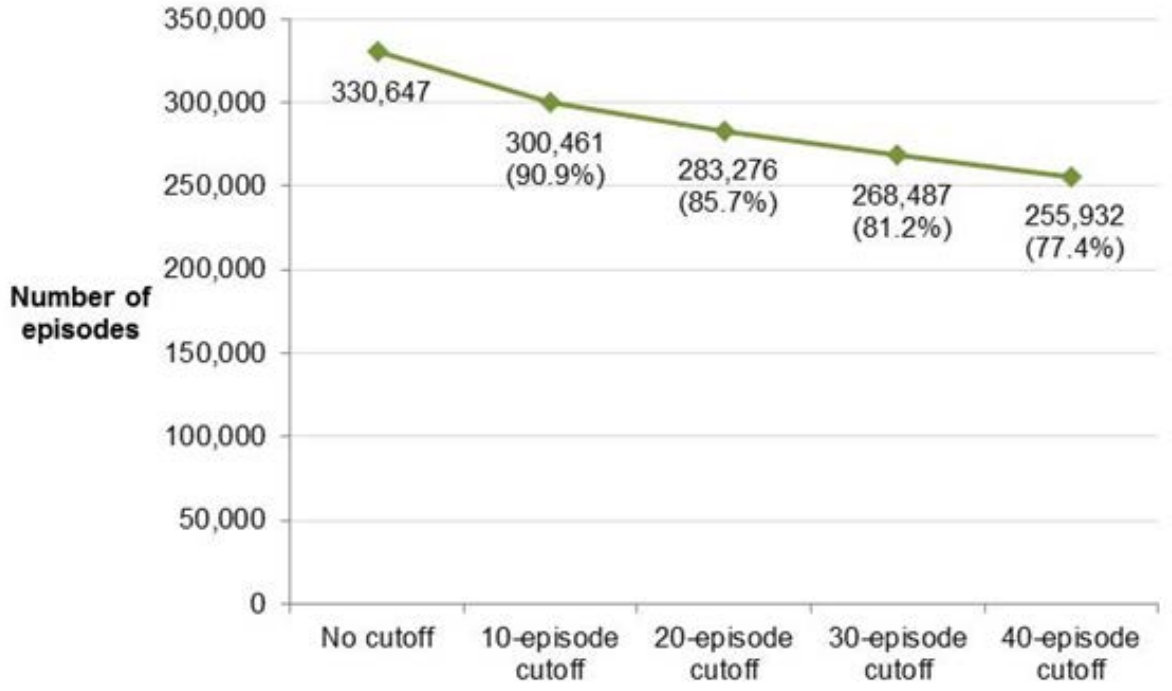
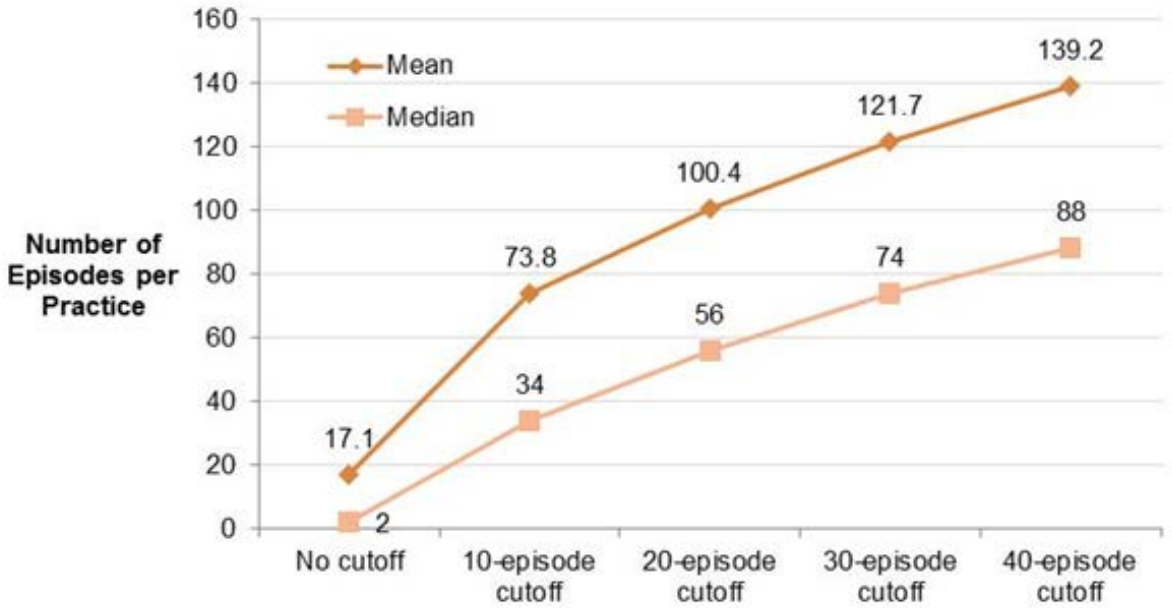
Figure 5.2. Number of Episodes Attributed to Practices Under Different Minimum Episode Volume Cutoffs



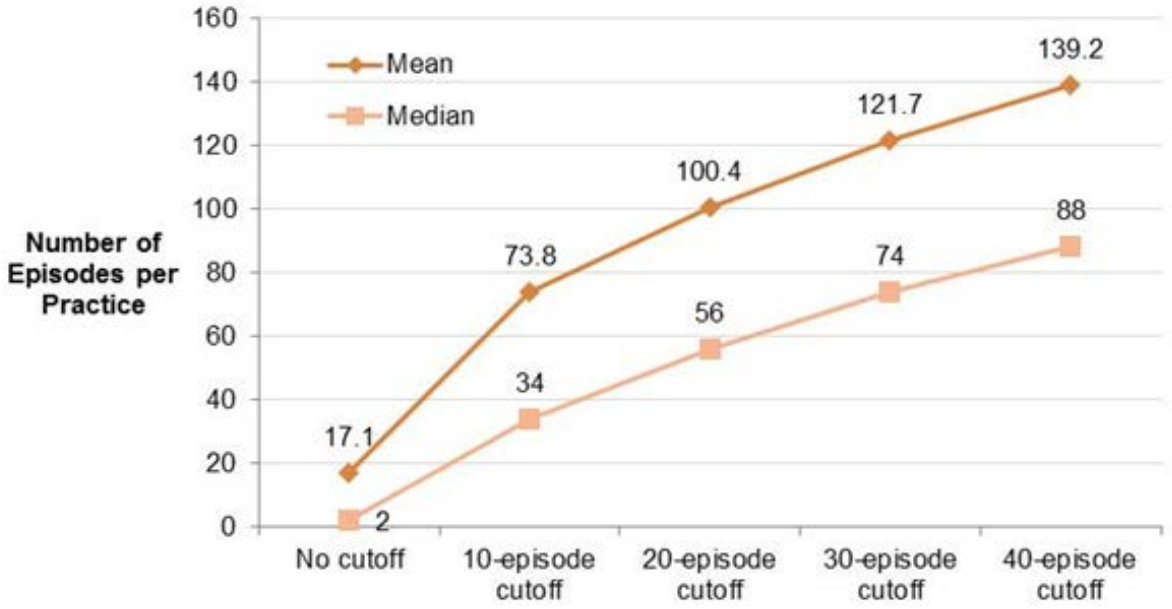
Source: Authors' analysis of 2010–2011 CCW Medicare claims data for patients with eight cancer types and chemotherapy initiation in 2010.

Figure 5.3. Number of Episodes Attributed per Practice Under Different Minimum Episode Volume Cutoffs



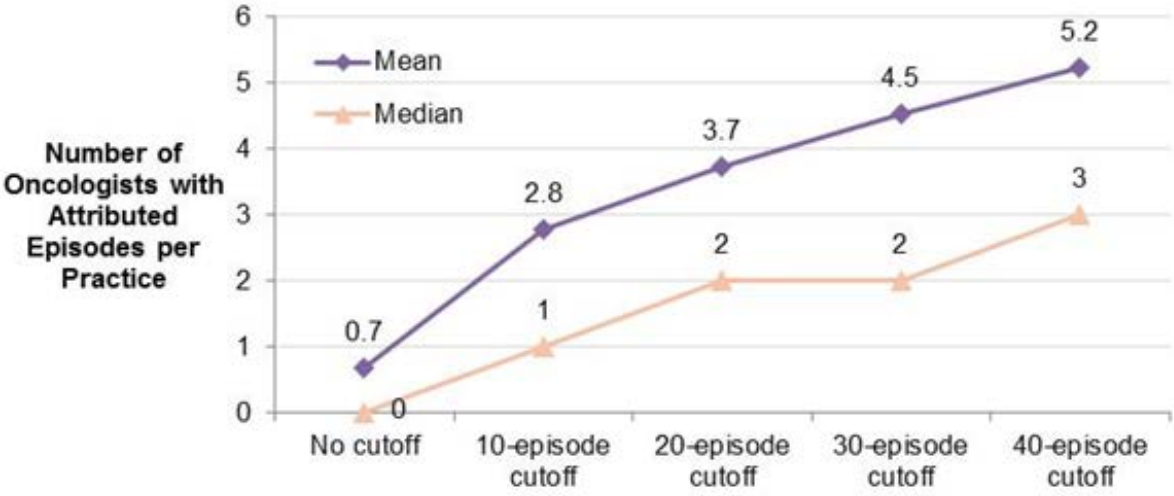
Source: Authors' analysis of 2010–2011 CCW Medicare claims data for patients with eight cancer types and chemotherapy initiation in 2010.

Figure 5.4. Number of Physicians per Practice Who Are Attributed at Least One Episode, by Episode Volume Cutoff



Source: Authors' analysis of 2010–2011 CCW Medicare claims data for patients with eight cancer types and chemotherapy initiation in 2010.

Figure 5.5. Number of Oncologists per Practice Who Are Attributed at Least One Episode, by Episode Volume Cutoff



Source: Authors' analysis of 2010–2011 CCW Medicare claims data for patients with eight cancer types and chemotherapy initiation in 2010.

CMS may assess the performance of practices participating in the program using quality or cost measures that are specific to cancer types. Thus, we examined the volume of episodes for individual cancer types that were attributed to each practice. In Table 5.4, we display the median episode volume for episodes of specific cancer types among the subset of practices attributed at least 40 episodes. We selected a cutoff of 40 episodes for these analyses to provide a profile of the practices most likely to participate in the payment model. We recognize that CMS might reasonably decide to lower this cutoff to enable a larger pool of practices to participate in the program. However, practices that provide chemotherapy infrequently might be less interested in participating and might be less likely to comply with the participation requirements (such as reporting performance on quality measures).

Overall, the median practice was attributed fewer than ten episodes for most of the eight cancer types. While most practices have a substantial volume of breast cancer cases, some of the more rare cancers, including ovarian and pancreatic cancers, are disproportionately attributed to larger practices. These site-specific volumes may have implications for the reliability of cancer-site-specific performance measures if these measures were to be used in an oncology payment model.

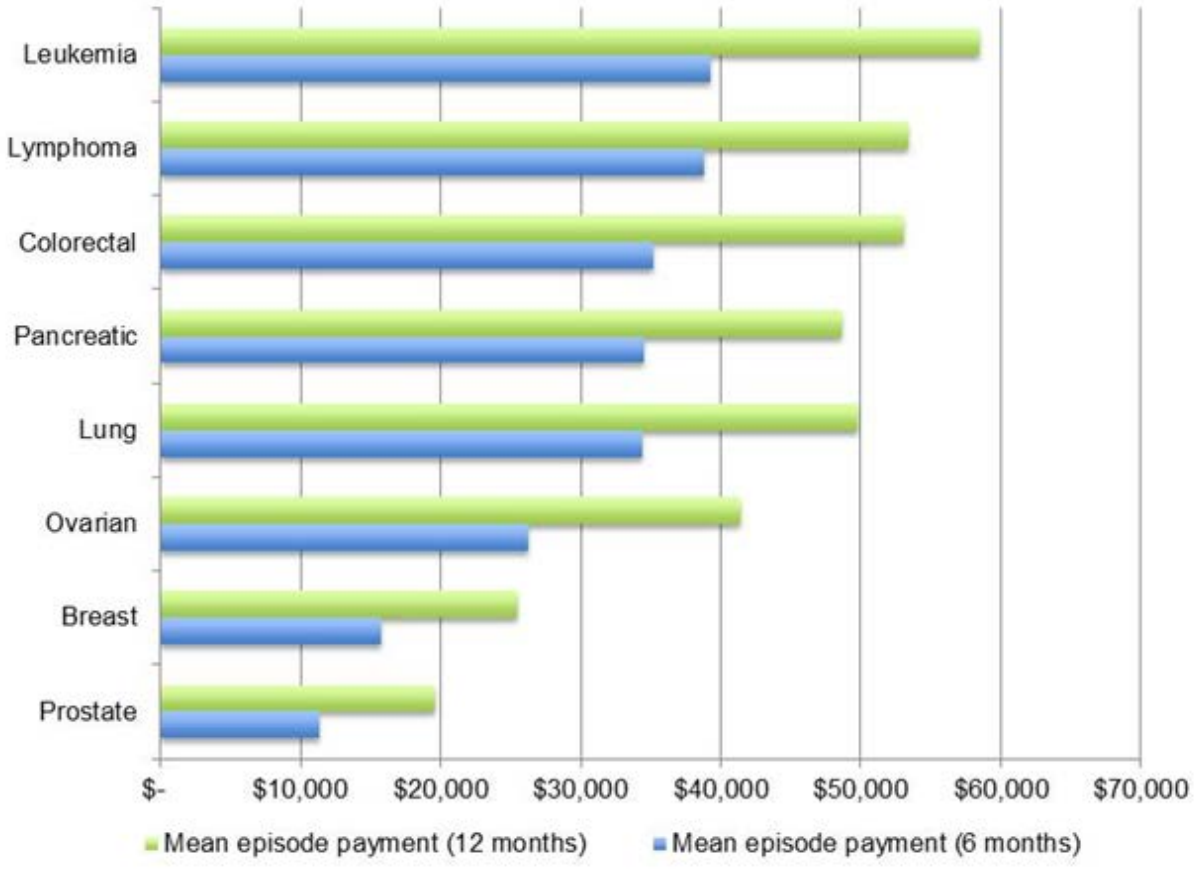
Table 5.4. Median Number of Episodes Attributed to Each Practice, by Cancer Type, Among Practices Attributed at Least 40 Episodes Overall

Overall Practice Size (episodes)	Number of Practices	Cancer Type							
		Ovarian	Pancreatic	Leukemia	Lymphoma	Colorectal	Prostate	Lung	Breast
40–59	511	0	0	1	3	3	7	6	10
60–79	293	1	1	2	6	7	8	12	17
80–99	253	1	1	3	8	8	12	16	22
100–149	309	3	3	5	12	14	9	23	34
150–199	150	5	5	8	21	18	12	32	48
200–299	167	7	8	12	28	26	19	48	68
>=300	156	13	16	20	49	46	60	82	109
All practices	1839	2	2	3	8	9	13	15	21

Source: Authors' analysis of 2010–2011 CCW Medicare claims data for patients with eight cancer types and chemotherapy initiation in 2010.

Figure 5.6 reports mean payments, by cancer type, for the subset of practices that were attributed 40 or more episodes. Mean 12-month episode payments ranged from $58,481 for episodes of leukemia to $19,568 for prostate cancer. Six-month episode payments tracked 12-month episode payments with no obvious differences across cancer sites. The site-specific volume and cost estimates for practices most likely to participate in an oncology payment model can help CMS begin to understand the opportunities for cost savings under the model.

Figure 5.6. Mean Episode Payment for Practices Attributed at Least 40 Episodes



Source: Authors' analysis of 2010–2011 CCW Medicare claims data for patients with eight cancer types and chemotherapy initiation in 2010.

In Table 5.5, we report intraclass correlations (ICCs) for total episode payments, by cancer site, for the set of practices attributed at least 40 episodes. The ICC is defined as the ratio of the between-practice variance in total episode payments to total variance (where total variance is defined as the sum of the between-practice variance and the within-practice variance). This statistic provides a useful summary of the magnitude of the practice-to-practice variability in episode payments and therefore an indicator of the likely reliability of practice-level cost

estimates. These analyses suggest that the between-practice differences in payments for prostate cancer and lung cancer episodes are larger than those of other cancer sites. This could mean that practices treat these cancers very differently (which increases the ICC numerator). These results could also mean that practices deliver a relatively homogenous set of services to patients with these cancers (which reduces the ICC denominator). Because low reliability of performance measures has become a contentious issue in the past few years, we recommend that CMS carefully consider the reliability of any performance measures used in the payment model.

Table 5.5. Intraclass Correlations for Total Episode Payments by Cancer Site Among Practices Attributed at Least 40 Episodes

Cancer Site	Number of Practices with at Least 40 Total Episodes and at Least One Cancer-Site-Specific Episode	Intraclass Correlation of Episode Payments (6 months)	Intraclass Correlation of Episode Payments (12 months)
Breast	1,414	0.02	0.02
Colorectal	1,529	0.08	0.06
Leukemia	1,394	0.00	0.01
Lung	1,602	0.15	0.11
Lymphoma	1,473	0.09	0.06
Ovarian	1,168	0.05	0.06
Pancreatic	1,256	0.11	0.05
Prostate	1,749	0.19	0.20

Source: Authors' analysis of 2010–2011 CCW Medicare claims data for patients with eight cancer types and chemotherapy initiation in 2010.

Summary of Attribution Analyses

Attributing practices to episodes of care is complex and all attribution rules have shortcomings. In the case of the prospective attribution rule, the attribution method differs depending on the setting of the initial chemotherapy, which may pose logistical difficulties and inconsistent qualification for the model across settings. In particular, because of low rates of attribution for Part D triggers and outpatient hospital episodes without accompanying E&M visits, the prospective rule logic used in these analyses actually uses a plurality attribution algorithm in some instances. The validity of the prospective attribution rule could potentially be improved if both NPI and TIN information were consistently reported on claims—particularly Part D claims. Meanwhile, the plurality rule failed to attribute nearly 3 percent of episodes and may include many practices that do not typically initiate chemotherapy. Nevertheless, the attribution results are highly concordant across the two methods. In cases where the results differed, the practices attributed by the prospective attribution rule were responsible for a higher percentage of spending. Using the prospective attribution rule, we observed considerable variation in episode volumes and payments overall and across cancer types. These volumes may have implications for performance assessment under the payment model.

Conclusion

The results of this study provide one source of information for consideration in the design of an oncology payment model. The analyses in this report describe the initiation and termination of episodes of chemotherapy, spending patterns for patients initiating chemotherapy, and the results of claims-based methods for attributing chemotherapy patients to oncology practices. In future analyses, we will simulate the potential effects of an oncology payment models and identify key design considerations.

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Appendix

Table A.1. Characteristics of Medicare Beneficiaries with Cancer and Chemotherapy Treatment in the CCW Study Sample

	Number of Beneficiaries (%)																	
	Breast		**Colorectal**		**Leukemia**		**Lung**		**Lymphoma**		**Ovarian**		**Pancreatic**		**Prostate**		**Other**		**All Cancers**	
Race																				
Black	8,301	(10)	3,185	(11)	1,029	(7)	4,494	(9)	1,497	(5)	656	(6)	914	(10)	13,793	(13)	9,875	(6)	43,744	(9)
Hispanic	3,998	(5)	1,740	(6)	505	(4)	1,515	(3)	1,489	(5)	475	(5)	419	(4)	5,208	(5)	6,462	(4)	21,811	(4)
White	65,672	(82)	24,297	(80)	12,098	(87)	44,536	(86)	26,939	(88)	8,800	(86)	7,703	(83)	83,330	(79)	153,678	(88)	427,053	(84)
Other	2,111	(3)	1,014	(3)	257	(2)	1,356	(3)	729	(2)	295	(3)	284	(3)	2,494	(2)	3,558	(2)	12,098	(2)
Unknown	147	(0)	61	(0)	17	(0)	60	(0)	45	(0)	21	(0)	12	(0)	147	(0)	294	(0)	804	(0)
Age at chemotherapy initiation																				
< 65	11,069	(14)	4,050	(13)	1,581	(11)	5,698	(11)	2,876	(9)	1,398	(14)	751	(8)	2,723	(3)	17,799	(10)	47,945	(9)
65–74	39,261	(49)	14,054	(46)	5,389	(39)	26,097	(50)	12,243	(40)	4,946	(48)	4,618	(49)	33,334	(32)	74,780	(43)	214,722	(42)
75–84	22,383	(28)	9,598	(32)	5,083	(37)	17,390	(33)	11,371	(37)	3,153	(31)	3,326	(36)	43,436	(41)	59,300	(34)	175,040	(35)
≥ 85	7,516	(9)	2,595	(9)	1,853	(13)	2,776	(5)	4,209	(14)	750	(7)	637	(7)	25,479	(24)	21,988	(13)	67,803	(13)
Gender: female	79,446	(99)	14,126	(47)	5,881	(42)	24,309	(47)	14,854	(48)	10,246	(100)	4,603	(49)	19	(0)	79,337	(46)	232,821	(46)

	Number of Beneficiaries (%)																			
	Breast		**Colorectal**		**Leukemia**		**Lung**		**Lymphoma**		**Ovarian**		**Pancreatic**		**Prostate**		**Other**		**All Cancers**	
Disability* (current)	12,288	(15)	4,554	(15)	1,822	(13)	6,807	(13)	3,285	(11)	1,536	(15)	857	(9)	3,815	(4)	20,092	(12)	55,056	(11)
Disability* (original)	16,695	(21)	6,418	(21)	2,719	(20)	11,446	(22)	5,138	(17)	1,951	(19)	1,420	(15)	11,140	(11)	31,039	(18)	87,966	(17)
Dual eligibility**	11,520	(14)	3,874	(13)	1,448	(10)	6,889	(13)	3,016	(10)	986	(10)	850	(9)	9,516	(9)	20,819	(12)	58,918	(12)
Total	80,229	(100)	30,297	(100)	13,906	(100)	51,961	(100)	30,699	(100)	10,247	(100)	9,332	(100)	104,972	(100)	173,867	(100)	505,510	(100)

Source: Authors' analysis of 2009–2012 CCW Medicare claims data for beneficiaries with cancer and chemotherapy initiation in 2010.
* Based on current or original reason for entitlement; includes disability/end-stage renal disease (ESRD).
** Dual eligibility status based on state buy-in status anytime from 2010–2012.

Table A.2. Characteristics of Medicare FFS Beneficiaries in the SEER-Medicare Study Sample

	Number of Beneficiaries (%)															
	Breast		**Colorectal**		**Leukemia**		**Lung**		**Lymphoma**		**Ovarian**		**Pancreas**		**All Cancers**	
Race																
Black	4,738	(10)	2,844	(9)	275	(5)	3,548	(7)	746	(4)	253	(5)	720	(8)	13,124	(8)
Hispanic	2,632	(6)	1,903	(6)	265	(5)	1,664	(3)	1,032	(5)	271	(5)	456	(5)	8,223	(5)
White	38,099	(80)	26,214	(80)	4,757	(86)	40,772	(85)	16,297	(86)	4,241	(86)	7,111	(81)	137,491	(83)
Other	2,170	(5)	1,720	(5)	233	(4)	1,940	(4)	844	(4)	170	(3)	447	(5)	7,524	(5)
Age at diagnosis																
< 65	4,930	(10)	2,508	(8)	396	(7)	4,016	(8)	1,235	(7)	282	(6)	525	(6)	13,892	(8)
65–74	24,775	(52)	15,900	(49)	2,311	(42)	25,328	(53)	7,961	(42)	2,434	(49)	4,326	(50)	83,035	(50)
75–84	14,528	(30)	11,902	(36)	2,242	(41)	16,559	(35)	7,621	(40)	1,867	(38)	3,345	(38)	58,064	(35)
≥ 85	3,406	(7)	2,371	(7)	581	(11)	2,021	(4)	2,102	(11)	352	(7)	538	(6)	11,371	(7)
Gender: female	47,280	(99)	15,865	(49)	2,311	(42)	22,535	(47)	9,563	(51)	4,935	(100)	4,439	(51)	106,928	(64)
Disability*	4,891	(10)	2,506	(8)	402	(7)	3,996	(8)	1,221	(6)	284	(6)	522	(6)	13,822	(8)
Medicaid dual eligibility**	12,661	(27)	6,866	(21)	948	(17)	9,582	(20)	2,942	(16)	820	(17)	1,270	(15)	35,089	(21)
Total	47,639	(100)	32,681	(100)	5,530	(100)	47,924	(100)	18,919	(100)	4,935	(100)	8,734	(100)	166,362	(100)

Source: Authors' analysis of 2003–2009 SEER-Medicare data for beneficiaries with seven cancer types and chemotherapy claim.
* Based on current reason for entitlement; includes disability/ESRD.
** Dual eligibility status based on state buy-in status anytime from 2003–2009.

Table A.3. Definitions of Categories of Health Care Services

Category	Definition
Services Provided in Physician Offices	
Likely chemotherapy—office	Carrier claim lines for "unambiguous chemotherapy" (defined above) and place of service = "office"
Possible chemotherapy—office	Carrier claim lines for "possible chemotherapy" (defined above) and place of service = "office"
Drugs coadministered with chemotherapy—office	Carrier claim lines for "drugs coadministered with chemotherapy" (defined above) and place of service = "office"
Antiemetics—office	Carrier claim lines for "antiemetics" (defined above) and place of service = "office"
Chemotherapy administration—office	Carrier claims lines for chemotherapy administration (HCPCS = 96400–96549, Q0083–Q0085) and place of service = "office"
Evaluation and management—office	Carrier claim lines for evaluation and management (HCPCS = 99201–99499) and place of service = "office"
Imaging—office	Carrier claim lines for imaging services (BETOS = I1A-D, I2A-D, I3A-F, I4A-B) and place of service = "office"
Laboratory—office	Carrier claim lines for laboratory services (BETOS = T1A-H, T2A-D) and place of service = "office"
Radiation therapy services—office	Carrier claims lines for radiation therapy services (BETOS = P7A) and place of service = "office"

Category	Definition
Services Provided in Hospital Outpatient Departments	
Likely chemotherapy—outpatient hospital	Carrier claim lines for "unambiguous chemotherapy" (defined above) and place of service = "outpatient hospital"; Outpatient claim lines for "unambiguous chemotherapy" (defined above) and revenue center code not observation unit or emergency department (0760, 0762, 0450–0459, 0981)
Possible chemotherapy—outpatient hospital	Carrier claim lines for "possible chemotherapy" (defined above) and place of service = "outpatient hospital"; Outpatient claim lines for "possible chemotherapy" (defined above) and revenue center code not observation unit or emergency department (0760, 0762, 0450–0459, 0981)
Drugs coadministered with chemotherapy—outpatient hospital	Carrier claim lines for "drugs coadministered with chemotherapy" (defined above) and place of service = "outpatient hospital"; Outpatient claim lines for "drugs coadministered with chemotherapy" (defined above) and revenue center code not observation unit or emergency department (0760, 0762, 0450–0459, 0981)
Antiemetics—outpatient hospital	Carrier claim lines for "antiemetics" (defined above) and place of service = "outpatient hospital"; Outpatient claim lines for "antiemetics" (defined above) and revenue center code not observation unit or emergency department (0760, 0762, 0450–0459, 0981)
Chemotherapy administration—outpatient hospital	Carrier claim lines for chemotherapy administration (HCPCS = 96400–96549, Q0083–Q0085) and place of service = "outpatient hospital"; Outpatient claim lines for chemotherapy administration (HCPCS = 96400–96549, Q0083–Q0085) and revenue center code not observation unit or emergency department (0760, 0762, 0450–0459, 0981)
Evaluation and management—outpatient hospital	Carrier claim lines for evaluation and management (HCPCS = 99201–99499) and place of service = "outpatient hospital"
Imaging—outpatient hospital	Carrier claim lines for imaging services (BETOS = I1A-D, I2A-D, I3A-F, I4A-B) and place of service = "outpatient hospital"; Outpatient claim lines for imaging services (BETOS = I1A-D, I2A-D, I3A-F, I4A-B) and revenue center code not observation unit or emergency department (0760, 0762, 0450–0459, 0981)

Category	Definition
Laboratory—outpatient hospital	Carrier claim lines for laboratory services (BETOS = T1A-H, T2A-D) and place of service = "outpatient hospital"; Outpatient claim lines for laboratory services (BETOS = T1A-H, T2A-D) and revenue center code not observation unit or emergency department (0760, 0762, 0450–0459, 0981)
Radiation therapy services—outpatient hospital	Carrier claim lines for radiation therapy services (BETOS = P7A) and place of service = "outpatient hospital"; Outpatient claim lines for radiation therapy services (BETOS = P7A) and revenue center code not observation unit or emergency department (0760, 0762, 0450–0459, 0981)
All services—emergency department	Carrier claim lines with place of service = emergency department; Outpatient claim lines with revenue center code = emergency department (0450–0459, 0981)
Other outpatient hospital	Outpatient claim lines otherwise unclassified, including observation units
Inpatient Services	
All services—inpatient hospital	Carrier claim lines with place of service = "inpatient hospital"; MedPAR claims with short stay/long stay/skilled nursing facility indicator code = "short stay or long stay hospital"
All services—skilled nursing facility	Carrier claim lines with place of service = "skilled nursing facility"; MedPAR claims with short stay/long stay/skilled nursing facility indicator code = "skilled nursing facility"
All services—hospice	Carrier claim lines with place of service = "hospice"; all Hospice file claims
Part D Services	
Likely chemotherapy—Part D	Part D claims for "unambiguous chemotherapy" (defined above)
Possible chemotherapy—Part D	Part D claims for "possible chemotherapy" (defined above)
Drugs coadministered with chemotherapy—Part D	Part D claims for "drugs coadministered with

Category	Definition
	chemotherapy" (defined above)
Antiemetics—Part D	Part D claims for "antiemetics" (defined above)
Other drugs—Part D	Part D claims otherwise unclassified
DME Services	
Likely chemotherapy—DME	DME claims for "unambiguous chemotherapy" (defined above)
Possible chemotherapy—DME	DME claims for "possible chemotherapy" (defined above)
Drugs coadministered with chemotherapy—DME	DME claims for "drugs coadministered with chemotherapy" (defined above)
Antiemetics—DME	DME claims for "antiemetics" (defined above)
Other DME—DME	DME claims otherwise unclassified
Other Professional Services	
Professional services otherwise unclassified	Carrier claim lines otherwise unclassified
Home Health Services	
Payments to home health agencies	All Home Health file claims

Source: Authors' analysis.

Table A.4. HCPCS Codes for Likely Chemotherapy

Active Ingredient	HCPCS
Aldesleukin	J9015
Alemtuzumab	J9010
antineoplastic drugs, not otherwise classified	J9999
arsenic trioxide	J9017
asparaginase, not otherwise specified	J9020
Azacitidine	J9025
Bendamustine	J9033
Bleomycin	J9040
Bortezomib	J9041
Busulfan	J8510; WW020; J0594
Cabazitaxel	J9043
Capecitabine	J8520; J8521; WW089; WW090; WW091; WW093; WW094; WW096
Carboplatin	J9045
Carmustine	J9050
Cetuximab	J9055
Cisplatin	J9060; J9062
Cladribine	J9065
Clofarabine	J9027
Cyclophosphamide	J8530; J9070; J9080; J9090; J9091; J9092; J9093; J9094; J9095; J9096; J9097; WW010; WW011; WW013; WW014; WW015; WW016; WW017

Active Ingredient	HCPCS
Cytarabine	J9100; J9110; J9098
Dacarbazine	J9130; J9140
Dactinomycin	J9120
Daunorubicin	J9150; J9151
Decitabine	J0894
Degarelix	J9155
denileukin diftitox	J9160
diethylstilbestrol diphosphate	J9165
Docetaxel	J9170; J9171
doxorubicin HCl	J9000; J9001
epirubicin HCl	J9178
eribulin mesylate	J9179
Etoposide	J8560; J9181; WW030; WW031; WW032; J9182
Floxuridine	J9200
Fludarabine	J9185
Fluorouracil	J9190
Fulvestrant	J9395
Gefitinib	J8565
Gemcitabine	J9201
Gemtuzumab	J9300
Goserelin	J9202

Active Ingredient	HCPCS
Idarubicin	J9211
Ifosfamide	J9208
Ipilimumab	J9228
Irinotecan	J9206
Ixabepilone	J9207
leuprolide acetate	J9217; J9218; J9219; J1950
Mechlorethamine	J9230
Melphalan	J8600; J9245; WW080; WW081
Mitomycin	J9290; J9291
Nelarabine	J9261
Ofatumumab	J9302
Oxaliplatin	J9263
Paclitaxel	J9264; J9265
Panitumumab	J9303
Pegaspargase	J9266
Pemetrexed	J9305
Pentostatin	J9268; J9280
Plicamycin	J9270
porfimer sodium	J9600
Pralatrexate	J9307
prescription drug, oral, chemotherapeutic, not otherwise specified	J8999

Active Ingredient	HCPCS
Romidepsin	J9315
Streptozocin	J9320
supprelin implant (histrelin)	J9226
Temozolomide	J8700; J9328; WW002; WW003; WW004; WW005; WW006; WW007; WW008; WW009
Temsirolimus	J9330
Thiotepa	J9340
Topotecan	J8705; J9350; J9351
Trastuzumab	J9355
Valrubicin	J9357
vantas implant (histrelin)	J9225
Vinblastine	J9360
vincristine sulfate	J9370; J9375; J9380
vinorelbine tartrate	J9390

Source: Authors' analysis.

Table A.5. HCPCS Codes for Possible Chemotherapy

Active Ingredient	HCPCS
Bevacizumab	J9035
interferon alfa-2b	J9214
interferon alfacon-1	J9212
interferon, alfa-2a	J9213
interferon, alfa-n3	J9215

Active Ingredient	HCPCS
interferon, gamma 1-b	J9216
Methotrexate	J8610; J9250; J9260; WW034; WW040; WW044; WW052; WW053; WW054; WW060; WW064; WW068; WW075; WW076; WW100; WW101; WW102; WW103
mitoxantrone HCl	J9293
Rituximab	J9310

Source: Authors' analysis.

Table A.6. HCPCS Codes for Drugs Coadministered with Chemotherapy (with Few Other Uses)

Active Ingredient	HCPCS
Amifostine	J0207
Dexrazoxane	J1190
elliotts b solution	J9175
Leucovorin	J0640
Levoleucovorin	J0641
Mensa	J9209
Rasburicase	J2783

Source: Authors' analysis.

Table A.7. HCPCS Codes for Antiemetics

Active Ingredient	HCPCS
antiemetic drug, oral, not otherwise specified	J8597
antiemetic drug, rectal/suppository, not otherwise specified	J8498
Aprepitant	J8501
chlorpromazine HCl	Q0172
diphenhydramine HCl	Q0163
dolasetron mesylate	J1260
Dronabinol	Q0168
Fosaprepitant	J1453
granisetron HCl	Q0166
hydroxyzine pamoate	Q0178
Nabilone	J8650
ondansetron hydrochloride	J2405
Perphenazine	Q0176
prochlorperazine maleate	Q0165
promethazine HCl	J2550
thiethylperazine maleate	Q0174
trimethobenzamide HCl	Q0173
unspecified oral dosage form, antiemetic	Q0181

Source: Authors' analysis.

Table A.8. HCPCS Codes for Drugs Sometimes Used to Treat the Side Effects of Chemotherapy

Active Ingredient	HCPCS
darbepoetin alfa	J0881
epoetin alfa	J0885
Filgrastim	J1440; J1441
Pegfilgrastim	J2505
Sargramostim	J2820

Source: Authors' analysis.

Table A.9. Problematic Drugs—Often Chemotherapy in Some Cases, Support Drugs in Others

Active Ingredient	HCPCS	Note
BCG live vax	J9031	Chemo in some cases, adjuvant in others
Dexamethasone	J1100; J1094	Chemo, antiemetic, and support, depending on context
Methylprednisolone	J1020; J1030; J1040; J2920; J2930	Chemo, antiemetic, and support, depending on context

Source: Authors' analysis.

Table A.10. Generic Names and NDCs for Likely Chemotherapy

Active Ingredient	Product-Level NDC
abiraterone	57894-150
ado-trastuzumab emtansine	50242-087
ado-trastuzumab emtansine	50242-088
afatinib	0597-0137
afatinib	0597-0138
afatinib	0597-0141
aldesleukin	0078-0495
aldesleukin	65483-116
alemtuzumab	58468-0357
anastrozole	0054-0164
anastrozole	0093-7536
anastrozole	0179-0068
anastrozole	0310-0201
anastrozole	0378-6034
anastrozole	0781-5356
anastrozole	0904-6195
anastrozole	0904-6229
anastrozole	16571-421
anastrozole	16729-035
anastrozole	21695-990
anastrozole	42043-180
anastrozole	42254-161
anastrozole	43063-383
anastrozole	51079-323
anastrozole	51991-620
anastrozole	54868-5000
anastrozole	54868-6130
anastrozole	55111-647
anastrozole	60258-866
anastrozole	60429-286
anastrozole	60505-2985
anastrozole	62175-710
anastrozole	62756-250
anastrozole	63323-129

Active Ingredient	Product-Level NDC
anastrozole	63672-0015
anastrozole	65841-743
anastrozole	66336-533
anastrozole	66435-415
anastrozole	67877-171
anastrozole	68084-448
anastrozole	68382-209
arsenic trioxide	63459-600
asparaginase	57902-249
azacitidine	0781-3253
azacitidine	43598-305
azacitidine	59572-102
bendamustine HCl	63459-390
bendamustine HCl	63459-391
bleomycin sulfate	0703-3154
bleomycin sulfate	0703-3155
bleomycin sulfate	55390-005
bleomycin sulfate	55390-006
bleomycin sulfate	61703-323

Active Ingredient	Product-Level NDC
bleomycin sulfate	61703-332
bleomycin sulfate	63323-136
bleomycin sulfate	63323-137
bortezomib	63020-049
bosutinib monohydrate	0069-0135
bosutinib monohydrate	0069-0136
brentuximab vedotin	51144-050
busulfan	0173-0713
busulfan	59148-070
busulfan	76388-713
cabazitaxel	0024-5824
capecitabine	0004-1100
capecitabine	0004-1101
capecitabine	53808-0411
capecitabine	54868-4143
capecitabine	54868-5260
carboplatin	0703-3249
carboplatin	0703-4244
carboplatin	0703-4246

Active Ingredient	Product-Level NDC
carboplatin	0703-4248
carboplatin	25021-202
carboplatin	55390-150
carboplatin	55390-151
carboplatin	55390-152
carboplatin	55390-153
carboplatin	55390-154
carboplatin	55390-155
carboplatin	55390-156
carboplatin	61703-339
carboplatin	61703-360
carboplatin	63323-172
carboplatin	66758-047
carmustine	0015-3012
carmustine	23155-261
carmustine	24338-050
cetuximab	66733-948
cetuximab	66733-958
cisplatin	0015-3072

Active Ingredient	Product-Level NDC
cisplatin	0069-0081
cisplatin	0069-0084
cisplatin	0703-5747
cisplatin	0703-5748
cisplatin	44567-509
cisplatin	44567-510
cisplatin	55390-099
cisplatin	55390-112
cisplatin	55390-187
cisplatin	55390-414
cisplatin	61126-003
cisplatin	61126-004
cisplatin	63323-103
cladribine	0069-0086
cladribine	0069-0201
cladribine	47351-017
cladribine	55390-115
cladribine	55390-124
cladribine	59676-201

Active Ingredient	Product-Level NDC
cladribine	63323-140
clofarabine	0024-5860
clofarabine	58468-0100
crizotinib	0069-8140
crizotinib	0069-8141
cyclophosphamide	0054-0382
cyclophosphamide	0054-0383
cyclophosphamide	0054-4129
cyclophosphamide	0054-4130
cyclophosphamide	10019-955
cyclophosphamide	10019-956
cyclophosphamide	10019-957
cyclophosphamide	10019-988
cyclophosphamide	10019-989
cyclophosphamide	10019-990
cyclophosphamide	54868-5005
cyclophosphamide	54868-5218
cytarabine	0069-0152
cytarabine	0069-0153
cytarabine	0069-0154
cytarabine	0069-0155
cytarabine	55390-131
cytarabine	55390-132
cytarabine	55390-133
cytarabine	55390-134
cytarabine	55390-806
cytarabine	55390-807
cytarabine	55390-808
cytarabine	55390-809
cytarabine	57665-331
cytarabine	61703-303
cytarabine	61703-304
cytarabine	61703-305
cytarabine	61703-319
cytarabine	63323-120
dacarbazine	0703-5075
dacarbazine	55390-090
dacarbazine	55390-339

Active Ingredient	Product-Level NDC
dacarbazine	61703-327
dacarbazine	63323-127
dacarbazine	63323-128
dactinomycin	55292-811
dactinomycin	55390-337
dactinomycin	67386-811
dasatinib	0003-0524
dasatinib	0003-0527
dasatinib	0003-0528
dasatinib	0003-0852
dasatinib	0003-0855
dasatinib	0003-0857
dasatinib	54868-5759
daunorubicin HCl	0703-5233
daunorubicin HCl	10885-001
daunorubicin HCl	55390-108
daunorubicin HCl	55390-142
daunorubicin HCl	55390-281
daunorubicin HCl	55390-805

Active Ingredient	Product-Level NDC
degarelix	55566-8301
degarelix	55566-8303
degarelix	55566-8401
degarelix	55566-8403
denileukin diftitox	62856-603
docetaxel	0075-8001
docetaxel	0075-8003
docetaxel	0075-8004
docetaxel	0075-8005
docetaxel	0409-0201
docetaxel	0955-1020
docetaxel	0955-1021
docetaxel	16729-120
docetaxel	16729-228
docetaxel	16729-231
docetaxel	16729-267
docetaxel	25021-222
docetaxel	47335-285
docetaxel	47335-286

Active Ingredient	Product-Level NDC
docetaxel	66758-050
doxorubicin HCl	0069-0170
doxorubicin HCl	0069-0171
doxorubicin HCl	0069-3030
doxorubicin HCl	0069-3031
doxorubicin HCl	0069-3032
doxorubicin HCl	0069-3033
doxorubicin HCl	0069-3034
doxorubicin HCl	0069-4030
doxorubicin HCl	0069-4031
doxorubicin HCl	0069-4032
doxorubicin HCl	0069-4033
doxorubicin HCl	0069-4034
doxorubicin HCl	0703-5040
doxorubicin HCl	0703-5043
doxorubicin HCl	0703-5046
doxorubicin HCl	25021-207
doxorubicin HCl	47335-049
doxorubicin HCl	47335-050

Active Ingredient	Product-Level NDC
doxorubicin HCl	47335-082
doxorubicin HCl	47335-083
doxorubicin HCl	53150-314
doxorubicin HCl	53150-315
doxorubicin HCl	53150-317
doxorubicin HCl	53150-320
doxorubicin HCl	55390-231
doxorubicin HCl	55390-232
doxorubicin HCl	55390-233
doxorubicin HCl	55390-235
doxorubicin HCl	55390-236
doxorubicin HCl	55390-237
doxorubicin HCl	55390-238
doxorubicin HCl	55390-241
doxorubicin HCl	55390-242
doxorubicin HCl	55390-243
doxorubicin HCl	55390-245
doxorubicin HCl	55390-246
doxorubicin HCl	55390-247

Active Ingredient	Product-Level NDC
doxorubicin HCl	55390-248
doxorubicin HCl	59676-960
doxorubicin HCl	62756-826
doxorubicin HCl	62756-827
doxorubicin HCl	63323-101
doxorubicin HCl	63323-883
enzalutamide	0469-0125
epirubicin HCl	0009-5091
epirubicin HCl	0009-5093
epirubicin HCl	0703-3067
epirubicin HCl	0703-3069
epirubicin HCl	25021-203
epirubicin HCl	53104-0211
epirubicin HCl	53150-247
epirubicin HCl	53150-250
epirubicin HCl	55390-207
epirubicin HCl	55390-208
epirubicin HCl	59762-5091
epirubicin HCl	59762-5093

Active Ingredient	Product-Level NDC
epirubicin HCl	59923-701
epirubicin HCl	61703-347
epirubicin HCl	61703-348
epirubicin HCl	61703-359
epirubicin HCl	66758-042
eribulin mesylate	62856-389
erlotinib HCl	50242-062
erlotinib HCl	50242-063
erlotinib HCl	50242-064
erlotinib HCl	54868-5290
erlotinib HCl	54868-5447
erlotinib HCl	54868-5474
etoposide	0015-3404
etoposide	0378-3266
etoposide	0703-5653
etoposide	0703-5656
etoposide	0703-5657
etoposide	16729-114
etoposide	16729-262

Active Ingredient	Product-Level NDC
etoposide	55390-291
etoposide	55390-292
etoposide	55390-293
etoposide	55390-491
etoposide	55390-492
etoposide	55390-493
etoposide	63323-104
exemestane	0009-7663
exemestane	0054-0080
exemestane	54868-5261
exemestane	59762-2858
floxuridine	55390-135
floxuridine	63323-145
fludarabine phosphate	0024-5820
fludarabine phosphate	0069-9321
fludarabine phosphate	0703-4852
fludarabine phosphate	0703-5854
fludarabine phosphate	25021-205
fludarabine phosphate	61703-344

Active Ingredient	Product-Level NDC
fludarabine phosphate	63323-192
fludarabine phosphate	63323-196
fludarabine phosphate	66758-046
fludarabine phosphate	67457-238
fludarabine phosphate	67457-268
fluorouracil	0066-7150
fluorouracil	0069-0169
fluorouracil	0069-0173
fluorouracil	0069-0174
fluorouracil	0069-0176
fluorouracil	0187-3204
fluorouracil	0187-5200
fluorouracil	0378-4791
fluorouracil	0703-3015
fluorouracil	0703-3018
fluorouracil	0703-3019
fluorouracil	10139-063
fluorouracil	16110-812
fluorouracil	21695-829

Active Ingredient	Product-Level NDC
fluorouracil	43547-258
fluorouracil	43547-259
fluorouracil	51672-4062
fluorouracil	51672-4063
fluorouracil	51672-4118
fluorouracil	52549-4118
fluorouracil	54868-6293
fluorouracil	63323-117
fluorouracil	66530-249
fluorouracil	66758-044
fluorouracil	66758-054
fluorouracil	68682-004
fulvestrant	0310-0720
gefitinib	0310-0482
gemcitabine HCl	0002-7501
gemcitabine HCl	0002-7502
gemcitabine HCl	0069-3857
gemcitabine HCl	0069-3858
gemcitabine HCl	0069-3859

Active Ingredient	Product-Level NDC
gemcitabine HCl	0409-0181
gemcitabine HCl	0409-0182
gemcitabine HCl	0409-0183
gemcitabine HCl	0409-0185
gemcitabine HCl	0409-0186
gemcitabine HCl	0409-0187
gemcitabine HCl	0591-3562
gemcitabine HCl	0591-3563
gemcitabine HCl	0703-5775
gemcitabine HCl	0703-5778
gemcitabine HCl	0781-3282
gemcitabine HCl	0781-3283
gemcitabine HCl	16729-092
gemcitabine HCl	16729-117
gemcitabine HCl	16729-118
gemcitabine HCl	23155-213
gemcitabine HCl	23155-214
gemcitabine HCl	25021-208
gemcitabine HCl	25021-209

Active Ingredient	Product-Level NDC
gemcitabine HCl	42236-001
gemcitabine HCl	42236-002
gemcitabine HCl	47335-153
gemcitabine HCl	47335-154
gemcitabine HCl	55111-686
gemcitabine HCl	55111-687
gemcitabine HCl	55390-391
gemcitabine HCl	57884-4001
gemcitabine HCl	57884-4002
gemcitabine HCl	63323-102
gemcitabine HCl	63323-125
gemcitabine HCl	63323-126
gemtuzumab	0008-4510
goserelin acetate	0310-0950
goserelin acetate	0310-0951
ibritumomab tiuxetan	68152-103
ibrutinib	57962-140
idarubicin	0013-2576
idarubicin	0013-2586

Active Ingredient	Product-Level NDC
idarubicin	0013-2596
idarubicin	0703-4154
idarubicin	0703-4155
idarubicin	0703-4156
idarubicin	53150-336
idarubicin	53150-386
idarubicin	53150-411
idarubicin	63323-194
idarubicin	66758-055
ifosfamide	0069-4495
ifosfamide	0069-4496
ifosfamide	0338-3991
ifosfamide	0338-3993
ifosfamide	0703-3427
ifosfamide	0703-3429
ifosfamide	0703-4100
ifosfamide	0703-4106
ifosfamide	0703-4116
ifosfamide	10019-925

Active Ingredient	Product-Level NDC
ifosfamide	10019-926
ifosfamide	55390-047
ifosfamide	55390-048
ifosfamide	63323-142
ifosfamide	63323-174
imatinib mesylate	0078-0401
imatinib mesylate	0078-0438
imatinib mesylate	54868-5289
imatinib mesylate	54868-5427
imatinib mesylate	66828-0030
ipilimumab	0003-2327
ipilimumab	0003-2328
irinotecan HCl	0009-1111
irinotecan HCl	0009-7529
irinotecan HCl	0143-9701
irinotecan HCl	0143-9702
irinotecan HCl	0703-4432
irinotecan HCl	0703-4434
irinotecan HCl	23155-179

Active Ingredient	Product-Level NDC
irinotecan HCl	25021-214
irinotecan HCl	47335-937
irinotecan HCl	47335-953
irinotecan HCl	53104-0151
irinotecan HCl	57884-3001
irinotecan HCl	57884-3002
irinotecan HCl	59923-702
irinotecan HCl	61703-349
irinotecan HCl	63323-193
irinotecan HCl	66758-048
ixabepilone	0015-1910
ixabepilone	0015-1911
lapatinib ditosylate	0173-0752
letrozole	0054-0269
letrozole	0078-0249
letrozole	0093-7620
letrozole	0378-2071
letrozole	0603-4180
letrozole	16729-034

Active Ingredient	Product-Level NDC
letrozole	24724-030
letrozole	42254-243
letrozole	51991-759
letrozole	54868-4151
letrozole	54868-6252
letrozole	55111-646
letrozole	57884-2021
letrozole	60505-3255
letrozole	62175-888
letrozole	62756-511
letrozole	63323-772
letrozole	65841-744
letrozole	68382-363
leuprolide acetate	0024-0222
leuprolide acetate	0024-0605
leuprolide acetate	0024-0610
leuprolide acetate	0024-0793
leuprolide acetate	0074-1052
leuprolide acetate	0074-1053

Active Ingredient	Product-Level NDC
leuprolide acetate	0074-2108
leuprolide acetate	0074-2282
leuprolide acetate	0074-2440
leuprolide acetate	0074-3346
leuprolide acetate	0074-3473
leuprolide acetate	0074-3641
leuprolide acetate	0074-3642
leuprolide acetate	0074-3663
leuprolide acetate	0074-3683
leuprolide acetate	0074-3779
leuprolide acetate	0074-9694
leuprolide acetate	0185-7400
leuprolide acetate	0703-4014
leuprolide acetate	0781-4003
leuprolide acetate	41616-936
mechlorethamine	42427-002
mechlorethamine	55292-911
mechlorethamine	66215-016
melphalan	10139-321

Active Ingredient	Product-Level NDC
melphalan	52609-0001
melphalan	52609-3001
melphalan	67457-195
melphalan	67457-215
mitomycin	16729-108
mitomycin	16729-115
mitomycin	16729-116
mitomycin	16729-246
mitomycin	16729-247
mitomycin	16729-248
mitomycin	49771-002
mitomycin	55390-251
mitomycin	55390-252
mitomycin	55390-253
mitomycin	55390-451
mitomycin	55390-452
mitomycin	55390-453
nelarabine	0007-4401
obinutuzumab	50242-070

Active Ingredient	Product-Level NDC
ofatumumab	0173-0821
omacetaxine mepesuccinate	63459-177
oxaliplatin	0024-0590
oxaliplatin	0024-0591
oxaliplatin	0069-0067
oxaliplatin	0069-0070
oxaliplatin	0069-0074
oxaliplatin	0069-1010
oxaliplatin	0703-3985
oxaliplatin	0703-3986
oxaliplatin	0781-3315
oxaliplatin	0781-3317
oxaliplatin	12516-0592
oxaliplatin	25021-211
oxaliplatin	25021-212
oxaliplatin	47335-176
oxaliplatin	47335-178
oxaliplatin	61703-361
oxaliplatin	61703-362

Active Ingredient	Product-Level NDC
oxaliplatin	61703-363
oxaliplatin	63323-650
paclitaxel	0069-0076
paclitaxel	0069-0078
paclitaxel	0069-0079
paclitaxel	0703-4764
paclitaxel	0703-4766
paclitaxel	0703-4767
paclitaxel	0703-4768
paclitaxel	25021-213
paclitaxel	44567-504
paclitaxel	44567-505
paclitaxel	44567-506
paclitaxel	47351-009
paclitaxel	55390-114
paclitaxel	55390-304
paclitaxel	55390-314
paclitaxel	61703-342
paclitaxel	63323-763

Active Ingredient	Product-Level NDC
paclitaxel	66758-043
paclitaxel	68817-134
panitumumab	55513-954
panitumumab	55513-955
panitumumab	55513-956
pegaspargase	54482-301
pemetrexed disodium	0002-7623
pemetrexed disodium	0002-7640
pentostatin	0409-0801
pentostatin	55390-244
pertuzumab	50242-145
ponatinib hydrochloride	76189-534
ponatinib hydrochloride	76189-535
porfimer sodium	76128-155
pralatrexate	48818-001
procarbazine HCl	54482-053
regorafenib	50419-171
romidepsin	46026-983
romidepsin	59572-983

Active Ingredient	Product-Level NDC
sipuleucel-T	30237-8900
streptozocin	0703-4636
supprelin implant (histrelin)	67979-002
temozolomide	0085-1366
temozolomide	0085-1381
temozolomide	0085-1417
temozolomide	0085-1425
temozolomide	0085-1430
temozolomide	0085-1519
temozolomide	0085-3004
temozolomide	0093-7599
temozolomide	0093-7600
temozolomide	0093-7601
temozolomide	0093-7602
temozolomide	0093-7638
temozolomide	0093-7639
temozolomide	0781-2691
temozolomide	0781-2692
temozolomide	0781-2693

Active Ingredient	Product-Level NDC
temozolomide	0781-2694
temozolomide	0781-2695
temozolomide	0781-2696
temozolomide	54868-4142
temozolomide	54868-5348
temozolomide	54868-5350
temozolomide	54868-5354
temozolomide	54868-5980
temsirolimus	0008-1179
thiotepa	55390-030
topotecan HCl	0007-4201
topotecan HCl	0007-4205
topotecan HCl	0007-4207
topotecan HCl	0069-0075
topotecan HCl	0409-0302
topotecan HCl	0703-4714
topotecan HCl	16729-151
topotecan HCl	25021-206
topotecan HCl	25021-824

Active Ingredient	Product-Level NDC
topotecan HCl	55390-370
topotecan HCl	62756-023
topotecan HCl	63323-762
topotecan HCl	66435-410
topotecan HCl	66758-051
toremifene citrate	11399-005
toremifene citrate	42747-327
tositumomab	0007-3260
tositumomab	0007-3261
tositumomab	0007-3262
trastuzumab	50242-134
valrubicin	67979-001
vantas implant (histrelin)	67979-500
vinblastine sulfate	55390-091
vinblastine sulfate	63323-278
vincristine sulfate	0703-4402
vincristine sulfate	0703-4412
vincristine sulfate	20536-322
vincristine sulfate	61703-309
vinorelbine tartrate	0008-0045
vinorelbine tartrate	0069-0099
vinorelbine tartrate	0069-0103
vinorelbine tartrate	0069-0205
vinorelbine tartrate	0703-4182
vinorelbine tartrate	0703-4183
vinorelbine tartrate	25021-204
vinorelbine tartrate	55390-069
vinorelbine tartrate	55390-070
vinorelbine tartrate	57884-3003
vinorelbine tartrate	61703-341
vinorelbine tartrate	64370-210
vinorelbine tartrate	64370-250
vinorelbine tartrate	64370-532
vinorelbine tartrate	66758-045
vorinostat	0006-0568

Source: Authors' categorization of NCI active ingredients.

Table A.11. Generic Names and NDCs for Possible Chemotherapy

Active Ingredient	Product-Level NDC
bevacizumab	50242-060
bevacizumab	50242-061
bicalutamide	0093-0220
bicalutamide	0310-0705
bicalutamide	0378-7017
bicalutamide	0781-5409
bicalutamide	0904-6019
bicalutamide	16714-571
bicalutamide	16729-023
bicalutamide	41616-485
bicalutamide	51079-692
bicalutamide	51991-560
bicalutamide	52125-709
bicalutamide	54868-4503
bicalutamide	54868-6133
bicalutamide	60429-226
bicalutamide	60505-2642
bicalutamide	63672-0005

Active Ingredient	Product-Level NDC
bicalutamide	65841-613
bicalutamide	67253-191
bicalutamide	68084-374
bicalutamide	68084-612
bicalutamide	68382-224
chlorambucil	0173-0635
chlorambucil	76388-635
denosumab	55513-710
denosumab	55513-730
everolimus	0078-0414
everolimus	0078-0415
everolimus	0078-0417
everolimus	0078-0566
everolimus	0078-0567
everolimus	0078-0594
everolimus	0078-0620
everolimus	0078-0626
everolimus	0078-0627

Active Ingredient	Product-Level NDC
everolimus	0078-0628
interferon alfa-2b, recomb.	0085-0539
interferon alfa-2b, recomb.	0085-0571
interferon alfa-2b, recomb.	0085-1110
interferon alfa-2b, recomb.	0085-1133
interferon alfa-2b, recomb.	0085-1168
interferon alfa-2b, recomb.	0085-1235
interferon alfa-2b, recomb.	0085-1242
interferon alfa-2b, recomb.	0085-1254
interferon alfa-2b, recomb.	0085-1279
interferon alfa-2b, recomb.	0085-1287
interferon alfa-2b, recomb.	0085-1291
interferon alfa-2b, recomb.	0085-1297
interferon alfa-2b, recomb.	0085-1304
interferon alfa-2b, recomb.	0085-1312
interferon alfa-2b, recomb.	0085-1316
interferon alfa-2b, recomb.	0085-1323
interferon alfa-2b, recomb.	0085-1368
interferon alfa-2b, recomb.	0085-1370

Active Ingredient	Product-Level NDC
interferon alfa-2b, recomb.	0085-1388
interferon alfacon-1	66435-201
interferon alfacon-1	66435-202
interferon, alfa-2a	0004-0350
interferon, alfa-2a	0004-0357
interferon, alfa-2a	0004-0360
interferon, alfa-2a	0004-0365
interferon, gamma 1-b	42238-111
interferon, gamma 1-b	64116-011
lenalidomide	59572-402
lenalidomide	59572-405
lenalidomide	59572-410
lenalidomide	59572-415
lenalidomide	59572-420
lenalidomide	59572-425
megestrol acetate	0015-0508
megestrol acetate	0054-3542
megestrol acetate	0054-4603
megestrol acetate	0054-4604

Active Ingredient	Product-Level NDC
megestrol acetate	0054-8603
megestrol acetate	0054-8604
megestrol acetate	0121-4776
megestrol acetate	0555-0606
megestrol acetate	0555-0607
megestrol acetate	0615-3570
megestrol acetate	0904-3571
megestrol acetate	16590-254
megestrol acetate	16590-898
megestrol acetate	17856-0907
megestrol acetate	49884-289
megestrol acetate	49884-290
megestrol acetate	49884-907
megestrol acetate	49884-949
megestrol acetate	51079-434
megestrol acetate	51079-435
megestrol acetate	53808-0614
megestrol acetate	54868-1629
megestrol acetate	54868-5389

Active Ingredient	Product-Level NDC
megestrol acetate	54868-5572
megestrol acetate	55154-0734
megestrol acetate	55154-1579
megestrol acetate	55154-1582
megestrol acetate	55154-5390
megestrol acetate	55154-5516
megestrol acetate	55154-9440
megestrol acetate	60432-126
megestrol acetate	63739-165
megestrol acetate	63739-549
megestrol acetate	66689-020
megestrol acetate	68094-518
megestrol acetate	68094-528
mercaptopurine	0054-4581
mercaptopurine	0093-5510
mercaptopurine	0378-3547
mercaptopurine	49349-606
mercaptopurine	49884-922
mercaptopurine	54868-5282

Active Ingredient	Product-Level NDC
mercaptopurine	57844-522
mercaptopurine	68084-325
methotrexate	0069-0146
methotrexate	0069-0147
methotrexate	0069-0148
methotrexate	0069-0149
methotrexate	0069-0181
methotrexate	0378-0014
methotrexate	0555-0572
methotrexate	0904-6012
methotrexate	10139-062
methotrexate	42254-110
methotrexate	43063-439
methotrexate	51079-670
methotrexate	51285-366
methotrexate	51285-367
methotrexate	51285-368
methotrexate	51285-369
methotrexate	54436-010
methotrexate	54436-015
methotrexate	54436-020
methotrexate	54436-025
methotrexate	54868-0173
methotrexate	55289-924
methotrexate	55390-031
methotrexate	55390-032
methotrexate	55390-033
methotrexate	55390-034
methotrexate	55390-143
methotrexate	66336-338
methotrexate	67253-320
methotrexate	67253-580
methotrexate	67457-221
methotrexate sodium	0054-4550
methotrexate sodium	0054-8550
methotrexate sodium	0069-0204
methotrexate sodium	0703-3671
methotrexate sodium	0703-3673

Active Ingredient	Product-Level NDC
methotrexate sodium	0703-3675
methotrexate sodium	0703-3678
methotrexate sodium	21695-111
methotrexate sodium	49349-314
methotrexate sodium	49349-406
methotrexate sodium	54868-3826
methotrexate sodium	61703-350
methotrexate sodium	61703-408
methotrexate sodium	61703-411
methotrexate sodium	63323-122
methotrexate sodium	63323-123
methotrexate sodium	63629-1472
methotrexate sodium	66758-040
methotrexate sodium	66758-041
methotrexate sodium	75840-111
mitoxantrone HCl	0069-0080
mitoxantrone HCl	0703-4680
mitoxantrone HCl	0703-4685
mitoxantrone HCl	0703-4686
mitoxantrone HCl	55390-083
mitoxantrone HCl	55390-084
mitoxantrone HCl	55390-085
mitoxantrone HCl	61703-343
mitoxantrone HCl	63323-132
nilotinib hydrochloride	0078-0526
nilotinib hydrochloride	0078-0592
prednisone	0054-0017
prednisone	0054-0018
prednisone	0054-0019
prednisone	0054-3721
prednisone	0054-3722
prednisone	0054-4728
prednisone	0054-4741
prednisone	0054-4742
prednisone	0054-8722
prednisone	0054-8724
prednisone	0054-8739
prednisone	0054-8740

Active Ingredient	Product-Level NDC
prednisone	0143-1410
prednisone	0143-1425
prednisone	0143-1473
prednisone	0143-1475
prednisone	0143-1477
prednisone	0143-9738
prednisone	0143-9739
prednisone	0143-9740
prednisone	0143-9741
prednisone	0440-8165
prednisone	0440-8167
prednisone	0591-5052
prednisone	0591-5442
prednisone	0591-5443
prednisone	0603-5335
prednisone	0603-5336
prednisone	0603-5337
prednisone	0603-5338
prednisone	0603-5339

Active Ingredient	Product-Level NDC
prednisone	0615-0536
prednisone	0615-1542
prednisone	0615-2513
prednisone	0615-3593
prednisone	0615-6516
prednisone	10544-508
prednisone	10544-509
prednisone	10768-7085
prednisone	10768-7283
prednisone	10768-7733
prednisone	16590-326
prednisone	16590-365
prednisone	16590-373
prednisone	16590-624
prednisone	21695-305
prednisone	21695-306
prednisone	21695-307
prednisone	21695-580
prednisone	21695-764

Active Ingredient	Product-Level NDC
prednisone	21695-765
prednisone	24236-205
prednisone	24236-217
prednisone	24236-248
prednisone	24236-625
prednisone	35356-673
prednisone	35356-674
prednisone	35356-677
prednisone	35356-818
prednisone	35356-819
prednisone	42549-647
prednisone	43063-097
prednisone	43063-109
prednisone	43063-415
prednisone	43063-426
prednisone	43063-432
prednisone	43063-472
prednisone	43353-657
prednisone	45802-303

Active Ingredient	Product-Level NDC
prednisone	45802-733
prednisone	49349-059
prednisone	49349-550
prednisone	49349-607
prednisone	49349-717
prednisone	49349-725
prednisone	49349-783
prednisone	49349-856
prednisone	49349-997
prednisone	49999-008
prednisone	49999-028
prednisone	49999-110
prednisone	50436-4324
prednisone	50436-4325
prednisone	50436-4326
prednisone	52125-034
prednisone	52125-054
prednisone	52125-150
prednisone	52125-255

Active Ingredient	Product-Level NDC
prednisone	52125-366
prednisone	52125-522
prednisone	52125-555
prednisone	52125-775
prednisone	52959-126
prednisone	52959-127
prednisone	52959-220
prednisone	53808-0399
prednisone	53808-0540
prednisone	53808-0542
prednisone	53808-0543
prednisone	53808-0560
prednisone	54569-0330
prednisone	54569-0331
prednisone	54569-0332
prednisone	54569-0333
prednisone	54569-3043
prednisone	54569-3302
prednisone	54569-3413

Active Ingredient	Product-Level NDC
prednisone	54569-4026
prednisone	54569-5840
prednisone	54868-0258
prednisone	54868-0836
prednisone	54868-0908
prednisone	54868-1119
prednisone	54868-1183
prednisone	54868-4095
prednisone	54868-4096
prednisone	54868-5213
prednisone	54868-5230
prednisone	55154-4926
prednisone	55154-4938
prednisone	55154-4946
prednisone	55154-4949
prednisone	55154-4950
prednisone	55154-4954
prednisone	55154-4965
prednisone	55289-330

Active Ingredient	Product-Level NDC
prednisone	55289-352
prednisone	55289-373
prednisone	55289-438
prednisone	58118-0018
prednisone	58118-4728
prednisone	58118-5338
prednisone	58118-9738
prednisone	59115-139
prednisone	59115-140
prednisone	59115-141
prednisone	59746-171
prednisone	59746-172
prednisone	59746-173
prednisone	59746-175
prednisone	60429-130
prednisone	60429-131
prednisone	60429-132
prednisone	60760-629
prednisone	63629-1579

Active Ingredient	Product-Level NDC
prednisone	63629-1587
prednisone	63629-1605
prednisone	63629-4562
prednisone	63629-4658
prednisone	63739-518
prednisone	63739-519
prednisone	63739-520
prednisone	66116-485
prednisone	66336-058
prednisone	66336-094
prednisone	66336-219
prednisone	66336-428
prednisone	67296-0140
prednisone	67296-0600
prednisone	67296-0602
prednisone	68258-3013
prednisone	68387-240
prednisone	68387-241
prednisone	68788-1473

Active Ingredient	Product-Level NDC
prednisone	68788-9177
prednisone	68788-9178
prednisone	68788-9179
prednisone	75987-020
prednisone	75987-021
prednisone	75987-022
prednisone	76237-227
prednisone	76237-228
rituximab	50242-051
rituximab	50242-053
tamoxifen citrate	0093-0782
tamoxifen citrate	0093-0784
tamoxifen citrate	0378-0144
tamoxifen citrate	0378-0274
tamoxifen citrate	0591-2233
tamoxifen citrate	0591-2472
tamoxifen citrate	0591-2473
tamoxifen citrate	13632-123
tamoxifen citrate	54868-3004
tamoxifen citrate	54868-4287
tamoxifen citrate	63629-4413
tamoxifen citrate	63739-269
ziv-aflibercept	0024-5840
ziv-aflibercept	0024-5841

Source: Authors' categorization of National Cancer Institute active ingredients

Table A.12. Generic Names and NDCs for Drugs Coadministered with Chemotherapy (with Few Other Uses)

Active Ingredient	Product-Level NDC
Amifostine	47335-581
Amifostine	55390-308
Amifostine	62756-581
Dexrazoxane	0013-8717
Dexrazoxane	0013-8727
Dexrazoxane	38423-110
Dexrazoxane	55390-014
Dexrazoxane	55390-060
Dexrazoxane	67457-207
Dexrazoxane	67457-208
Elliotts B solution	55792-007
Elliotts B solution	67871-007
Glucarpidase	50633-210
leucovorin calcium	0054-4496
leucovorin calcium	0054-4497
leucovorin calcium	0054-4498
leucovorin calcium	0054-4499
leucovorin calcium	0054-8496
leucovorin calcium	0555-0484
leucovorin calcium	0555-0485
leucovorin calcium	0703-2793
leucovorin calcium	0703-2797
leucovorin calcium	0703-5140
leucovorin calcium	0703-5145
leucovorin calcium	25021-813
leucovorin calcium	25021-814
leucovorin calcium	25021-815
leucovorin calcium	25021-816
leucovorin calcium	51079-581
leucovorin calcium	51079-582
leucovorin calcium	52125-018
leucovorin calcium	52125-453
leucovorin calcium	54868-3310
leucovorin calcium	54868-5915
leucovorin calcium	55390-009
leucovorin calcium	55390-051

Active Ingredient	Product-Level NDC
leucovorin calcium	55390-052
leucovorin calcium	55390-053
leucovorin calcium	55390-054
leucovorin calcium	55390-818
leucovorin calcium	55390-824
leucovorin calcium	55390-825
leucovorin calcium	55390-826
leucovorin calcium	63323-710
leucovorin calcium	63323-711
leucovorin calcium	68152-101
leucovorin calcium	68152-102
mensa	0338-1305
mensa	0703-4805
mensa	10019-953
mensa	25021-201
mensa	55390-045
mensa	55390-347
mensa	63323-733
mensa	67108-3565
mensa	67457-148
palifermin	66658-112
plerixafor	0024-5862
plerixafor	58468-0140
rasburicase	0024-5150
rasburicase	0024-5151

Source: RAND categorization of NCI active ingredients and Anatomical Therapeutic Chemical (ATC) code V03A.

Table A.13. Generic Names and NDCs for Antiemetics

Active Ingredient	Product-Level NDC
Aprepitant	0006-0461
Aprepitant	0006-0462
Aprepitant	0006-0464
Aprepitant	0006-3862
Aprepitant	42254-160
Aprepitant	54868-5231
Aprepitant	54868-5325
chlorpromazine HCl	0615-1546
chlorpromazine HCl	0615-1547
chlorpromazine HCl	0615-1548
chlorpromazine HCl	0615-7683
chlorpromazine HCl	0615-7717
chlorpromazine HCl	0641-1397
chlorpromazine HCl	0641-1398
chlorpromazine HCl	0781-1715
chlorpromazine HCl	0781-1716
chlorpromazine HCl	0781-1717
chlorpromazine HCl	0781-1718
chlorpromazine HCl	0781-1719
chlorpromazine HCl	0781-5913
chlorpromazine HCl	0781-5914
chlorpromazine HCl	0781-5915
chlorpromazine HCl	0781-5916
chlorpromazine HCl	0781-5917
chlorpromazine HCl	0832-0300
chlorpromazine HCl	0832-0301
chlorpromazine HCl	0832-0302
chlorpromazine HCl	0832-0303
chlorpromazine HCl	0832-0304
chlorpromazine HCl	24236-258
chlorpromazine HCl	24236-323
chlorpromazine HCl	24236-581
chlorpromazine HCl	24236-830
chlorpromazine HCl	51079-130
chlorpromazine HCl	51079-516
chlorpromazine HCl	51079-517

Active Ingredient	Product-Level NDC
chlorpromazine HCl	51079-518
chlorpromazine HCl	51079-519
chlorpromazine HCl	52125-062
chlorpromazine HCl	52125-138
chlorpromazine HCl	52125-284
chlorpromazine HCl	53808-0924
chlorpromazine HCl	53808-0925
chlorpromazine HCl	53808-0928
chlorpromazine HCl	53808-0931
chlorpromazine HCl	54868-2464
chlorpromazine HCl	55154-5657
chlorpromazine HCl	62584-330
chlorpromazine HCl	62584-331
chlorpromazine HCl	67046-103
chlorpromazine HCl	67046-104
chlorpromazine HCl	68084-420
chlorpromazine HCl	68084-421
chlorpromazine HCl	68084-422
diphenhydramine HCl	0121-0489
diphenhydramine HCl	0409-2290
diphenhydramine HCl	0555-0059
diphenhydramine HCl	0641-0376
diphenhydramine HCl	42254-190
diphenhydramine HCl	49349-836
diphenhydramine HCl	51079-066
diphenhydramine HCl	52125-175
diphenhydramine HCl	52125-246
diphenhydramine HCl	52125-636
diphenhydramine HCl	52584-290
diphenhydramine HCl	52584-376
diphenhydramine HCl	53808-0238
diphenhydramine HCl	55045-3683
diphenhydramine HCl	55154-3193
diphenhydramine HCl	55154-5102
diphenhydramine HCl	55154-5530
diphenhydramine HCl	55154-9363
diphenhydramine HCl	55154-9409
diphenhydramine HCl	55154-9418

Active Ingredient	Product-Level NDC
diphenhydramine HCl	63323-664
diphenhydramine HCl	67046-127
diphenhydramine HCl	67457-124
diphenhydramine HCl	76045-102
dolasetron mesylate	0088-1202
dolasetron mesylate	0088-1203
dolasetron mesylate	0088-1206
dolasetron mesylate	0088-1208
dolasetron mesylate	0088-1209
Dronabinol	0051-0021
Dronabinol	0051-0022
Dronabinol	0051-0023
Dronabinol	0378-8170
Dronabinol	0378-8171
Dronabinol	0378-8172
Dronabinol	0591-3591
Dronabinol	0591-3592
Dronabinol	0591-3593
Dronabinol	49884-867

Active Ingredient	Product-Level NDC
Dronabinol	49884-868
Dronabinol	49884-869
Dronabinol	54868-3084
Dronabinol	54868-3189
Dronabinol	54868-5929
Dronabinol	68084-174
Dronabinol	68084-175
Fosaprepitant	0006-3884
Fosaprepitant	0006-3941
Granisetron	0054-0143
Granisetron	0093-7485
Granisetron	0143-9744
Granisetron	0143-9745
Granisetron	16714-221
Granisetron	17478-546
Granisetron	17478-547
Granisetron	25021-778
Granisetron	25021-779
Granisetron	25021-781

Active Ingredient	Product-Level NDC
Granisetron	42747-726
Granisetron	51079-472
Granisetron	51672-4138
Granisetron	51991-735
Granisetron	52547-801
Granisetron	54868-5985
Granisetron	55390-250
granisetron	55648-661
granisetron	55648-662
granisetron	63323-317
granisetron	63323-318
granisetron	63323-319
granisetron	64679-661
granisetron	64679-662
granisetron	64720-198
granisetron	66758-035
granisetron	66758-036
granisetron	67877-184
hydroxyzine pamoate	0049-5460
hydroxyzine pamoate	0069-5410
hydroxyzine pamoate	0069-5420
hydroxyzine pamoate	0093-5060
hydroxyzine pamoate	0093-5061
hydroxyzine pamoate	0093-5062
hydroxyzine pamoate	0179-0072
hydroxyzine pamoate	0179-0075
hydroxyzine pamoate	0185-0613
hydroxyzine pamoate	0185-0615
hydroxyzine pamoate	0378-2586
hydroxyzine pamoate	0378-2587
hydroxyzine pamoate	0378-2588
hydroxyzine pamoate	0440-1617
hydroxyzine pamoate	0517-4201
hydroxyzine pamoate	0517-5601
hydroxyzine pamoate	0517-5602
hydroxyzine pamoate	0517-5610
hydroxyzine pamoate	0555-0302
hydroxyzine pamoate	0555-0323

Active Ingredient	Product-Level NDC
hydroxyzine pamoate	0555-0324
hydroxyzine pamoate	0591-0800
hydroxyzine pamoate	0591-0801
hydroxyzine pamoate	0591-3423
hydroxyzine pamoate	0591-5522
hydroxyzine pamoate	0591-5523
hydroxyzine pamoate	0603-1310
hydroxyzine pamoate	0603-3967
hydroxyzine pamoate	0603-3968
hydroxyzine pamoate	0603-3969
hydroxyzine pamoate	0615-0331
hydroxyzine pamoate	0615-0332
hydroxyzine pamoate	0615-1525
hydroxyzine pamoate	0615-1526
hydroxyzine pamoate	0615-1527
hydroxyzine pamoate	0904-0357
hydroxyzine pamoate	0904-0358
hydroxyzine pamoate	0904-0359
hydroxyzine pamoate	10544-017

Active Ingredient	Product-Level NDC
hydroxyzine pamoate	10544-209
hydroxyzine pamoate	10544-210
hydroxyzine pamoate	10702-010
hydroxyzine pamoate	10702-011
hydroxyzine pamoate	10702-012
hydroxyzine pamoate	10702-052
hydroxyzine pamoate	16590-357
hydroxyzine pamoate	16590-737
hydroxyzine pamoate	16714-081
hydroxyzine pamoate	16714-082
hydroxyzine pamoate	16714-083
hydroxyzine pamoate	21695-208
hydroxyzine pamoate	21695-356
hydroxyzine pamoate	21695-378
hydroxyzine pamoate	21695-573
hydroxyzine pamoate	23155-105
hydroxyzine pamoate	23155-106
hydroxyzine pamoate	23155-107
hydroxyzine pamoate	24236-070

Active Ingredient	Product-Level NDC
hydroxyzine pamoate	24236-133
hydroxyzine pamoate	24236-341
hydroxyzine pamoate	35356-701
hydroxyzine pamoate	35356-938
hydroxyzine pamoate	35356-939
hydroxyzine pamoate	35356-942
hydroxyzine pamoate	42291-322
hydroxyzine pamoate	42291-323
hydroxyzine pamoate	42549-528
hydroxyzine pamoate	43063-095
hydroxyzine pamoate	43063-172
hydroxyzine pamoate	43063-251
hydroxyzine pamoate	43063-406
hydroxyzine pamoate	43063-435
hydroxyzine pamoate	49349-441
hydroxyzine pamoate	49349-480
hydroxyzine pamoate	49349-647
hydroxyzine pamoate	49349-648
hydroxyzine pamoate	49349-667

Active Ingredient	Product-Level NDC
hydroxyzine pamoate	49349-696
hydroxyzine pamoate	49999-024
hydroxyzine pamoate	49999-035
hydroxyzine pamoate	49999-701
hydroxyzine pamoate	50111-307
hydroxyzine pamoate	50111-309
hydroxyzine pamoate	50383-796
hydroxyzine pamoate	51079-077
hydroxyzine pamoate	51079-078
hydroxyzine pamoate	51079-413
hydroxyzine pamoate	51079-422
hydroxyzine pamoate	51079-430
hydroxyzine pamoate	51079-796
hydroxyzine pamoate	51079-806
hydroxyzine pamoate	51079-816
hydroxyzine pamoate	52125-001
hydroxyzine pamoate	52125-320
hydroxyzine pamoate	52125-356
hydroxyzine pamoate	52584-007

Active Ingredient	Product-Level NDC
hydroxyzine pamoate	52584-201
hydroxyzine pamoate	52584-601
hydroxyzine pamoate	52584-610
hydroxyzine pamoate	52959-074
hydroxyzine pamoate	52959-433
hydroxyzine pamoate	53808-0373
hydroxyzine pamoate	53808-0374
hydroxyzine pamoate	53808-0426
hydroxyzine pamoate	53808-0429
hydroxyzine pamoate	53808-0431
hydroxyzine pamoate	54569-0406
hydroxyzine pamoate	54569-0409
hydroxyzine pamoate	54569-0413
hydroxyzine pamoate	54569-1640
hydroxyzine pamoate	54569-2353
hydroxyzine pamoate	54569-2571
hydroxyzine pamoate	54838-502
hydroxyzine pamoate	54868-0063
hydroxyzine pamoate	54868-0229

Active Ingredient	Product-Level NDC
hydroxyzine pamoate	54868-1804
hydroxyzine pamoate	54868-2032
hydroxyzine pamoate	54868-2892
hydroxyzine pamoate	54868-4336
hydroxyzine pamoate	55154-2095
hydroxyzine pamoate	55154-5092
hydroxyzine pamoate	55154-5377
hydroxyzine pamoate	55154-5725
hydroxyzine pamoate	55154-5728
hydroxyzine pamoate	55289-138
hydroxyzine pamoate	55289-139
hydroxyzine pamoate	55289-226
hydroxyzine pamoate	55289-354
hydroxyzine pamoate	55289-912
hydroxyzine pamoate	57664-112
hydroxyzine pamoate	57664-113
hydroxyzine pamoate	57664-114
hydroxyzine pamoate	58118-0011
hydroxyzine pamoate	58118-0012

Active Ingredient	Product-Level NDC
hydroxyzine pamoate	60429-223
hydroxyzine pamoate	60429-224
hydroxyzine pamoate	60429-225
hydroxyzine pamoate	60432-150
hydroxyzine pamoate	62584-739
hydroxyzine pamoate	62584-741
hydroxyzine pamoate	63629-1533
hydroxyzine pamoate	63629-1751
hydroxyzine pamoate	63629-4929
hydroxyzine pamoate	63739-483
hydroxyzine pamoate	63739-486
hydroxyzine pamoate	64980-169
hydroxyzine pamoate	64980-170
hydroxyzine pamoate	66336-086
hydroxyzine pamoate	67046-281
hydroxyzine pamoate	67046-282
hydroxyzine pamoate	67296-0055
hydroxyzine pamoate	67296-0152
hydroxyzine pamoate	67296-0381
hydroxyzine pamoate	67296-0648
hydroxyzine pamoate	67405-575
hydroxyzine pamoate	67405-577
hydroxyzine pamoate	67405-671
hydroxyzine pamoate	68084-253
hydroxyzine pamoate	68084-254
hydroxyzine pamoate	68084-255
hydroxyzine pamoate	68462-360
hydroxyzine pamoate	68462-361
hydroxyzine pamoate	68462-362
hydroxyzine pamoate	68788-0323
hydroxyzine pamoate	68788-9129
hydroxyzine pamoate	68788-9197
hydroxyzine pamoate	68788-9696
hydroxyzine pamoate	68788-9737
hydroxyzine pamoate	68788-9776
hydroxyzine pamoate	75921-011
hydroxyzine pamoate	76237-186
nabilone	0037-1221

Active Ingredient	Product-Level NDC
nabilone	0187-1221
ondansetron	0069-1441
ondansetron	0143-2424
ondansetron	0143-9891
ondansetron	0378-0315
ondansetron	0378-0344
ondansetron	0378-0374
ondansetron	0378-7732
ondansetron	0378-7734
ondansetron	0641-6078
ondansetron	0641-6079
ondansetron	0641-6080
ondansetron	0703-7221
ondansetron	0703-7226
ondansetron	0781-3010
ondansetron	0781-5238
ondansetron	0781-5239
ondansetron	11819-365
ondansetron	16590-545

Active Ingredient	Product-Level NDC
ondansetron	17856-0691
ondansetron	17856-4091
ondansetron	21695-380
ondansetron	35356-197
ondansetron	35356-678
ondansetron	35356-755
ondansetron	35356-853
ondansetron	42254-077
ondansetron	42254-097
ondansetron	42254-212
ondansetron	42254-213
ondansetron	42549-657
ondansetron	43063-052
ondansetron	43063-247
ondansetron	43063-273
ondansetron	43288-104
ondansetron	43288-108
ondansetron	45963-538
ondansetron	45963-539

Active Ingredient	Product-Level NDC
ondansetron	50436-0133
ondansetron	51079-524
ondansetron	51079-525
ondansetron	52125-268
ondansetron	52125-561
ondansetron	52125-568
ondansetron	52125-569
ondansetron	52125-744
ondansetron	54868-5749
ondansetron	54868-5887
ondansetron	55045-3848
ondansetron	55154-2876
ondansetron	55154-2877
ondansetron	55154-3680
ondansetron	55154-3728
ondansetron	55154-4567
ondansetron	55154-5369
ondansetron	55154-5431
ondansetron	55154-6295

Active Ingredient	Product-Level NDC
ondansetron	55289-559
ondansetron	55390-307
ondansetron	58118-0240
ondansetron	58118-0356
ondansetron	58118-0458
ondansetron	58118-6666
ondansetron	62756-240
ondansetron	62756-356
ondansetron	63304-346
ondansetron	63304-347
ondansetron	63304-458
ondansetron	63304-459
ondansetron	63629-4014
ondansetron	63629-4306
ondansetron	65162-691
ondansetron	65862-390
ondansetron	65862-391
ondansetron	68258-7068
ondansetron	68462-105

Active Ingredient	Product-Level NDC
ondansetron	68462-106
ondansetron	68462-107
ondansetron	68462-157
ondansetron	68462-158
ondansetron	68788-9559
ondansetron	68788-9670
ondansetron	68788-9770
ondansetron	68788-9894
ondansetron	75921-459
ondansetron HCl	0054-0064
ondansetron HCl	0069-1340
ondansetron HCl	0093-0233
ondansetron HCl	0093-7236
ondansetron HCl	0143-2422
ondansetron HCl	0143-2423
ondansetron HCl	0143-9890
ondansetron HCl	0173-0442
ondansetron HCl	0173-0446
ondansetron HCl	0173-0447

Active Ingredient	Product-Level NDC
ondansetron HCl	0173-0489
ondansetron HCl	0173-0569
ondansetron HCl	0173-0570
ondansetron HCl	0179-0099
ondansetron HCl	0179-0100
ondansetron HCl	0409-1120
ondansetron HCl	0409-4755
ondansetron HCl	0409-4759
ondansetron HCl	0527-1726
ondansetron HCl	0781-1679
ondansetron HCl	0781-1681
ondansetron HCl	0781-1879
ondansetron HCl	0904-6208
ondansetron HCl	0904-6209
ondansetron HCl	10019-905
ondansetron HCl	10019-906
ondansetron HCl	16714-671
ondansetron HCl	21695-834
ondansetron HCl	21695-835

Active Ingredient	Product-Level NDC
ondansetron HCl	23155-168
ondansetron HCl	23155-196
ondansetron HCl	25021-777
ondansetron HCl	25021-782
ondansetron HCl	35356-445
ondansetron HCl	35356-652
ondansetron HCl	35356-679
ondansetron HCl	36000-012
ondansetron HCl	36000-013
ondansetron HCl	49349-714
ondansetron HCl	49349-810
ondansetron HCl	49349-858
ondansetron HCl	50436-0131
ondansetron HCl	50436-0132
ondansetron HCl	51672-4091
ondansetron HCl	51672-4108
ondansetron HCl	51672-4109
ondansetron HCl	51672-4110
ondansetron HCl	52125-334

Active Ingredient	Product-Level NDC
ondansetron HCl	52125-347
ondansetron HCl	52125-574
ondansetron HCl	52959-991
ondansetron HCl	54838-555
ondansetron HCl	54868-5738
ondansetron HCl	54868-5801
ondansetron HCl	54868-5888
ondansetron HCl	55045-3729
ondansetron HCl	55045-3817
ondansetron HCl	55111-153
ondansetron HCl	55111-154
ondansetron HCl	55111-156
ondansetron HCl	55150-125
ondansetron HCl	55150-126
ondansetron HCl	55154-1132
ondansetron HCl	55154-2872
ondansetron HCl	55154-2873
ondansetron HCl	55154-4731
ondansetron HCl	55154-6976

Active Ingredient	Product-Level NDC
ondansetron HCl	55390-121
ondansetron HCl	55648-726
ondansetron HCl	55648-727
ondansetron HCl	60505-0381
ondansetron HCl	62756-130
ondansetron HCl	62756-131
ondansetron HCl	62756-181
ondansetron HCl	62756-182
ondansetron HCl	63323-373
ondansetron HCl	63323-374
ondansetron HCl	63629-4023
ondansetron HCl	63629-4093
ondansetron HCl	64679-726
ondansetron HCl	64679-727
ondansetron HCl	65293-373
ondansetron HCl	65293-374
ondansetron HCl	65862-187
ondansetron HCl	65862-188
ondansetron HCl	65862-189

Active Ingredient	Product-Level NDC
ondansetron HCl	65862-208
ondansetron HCl	66116-604
ondansetron HCl	66336-793
ondansetron HCl	67877-169
ondansetron HCl	67877-170
ondansetron HCl	68084-220
ondansetron HCl	68084-221
ondansetron HCl	68094-325
ondansetron HCl	68788-9892
ondansetron HCl	68788-9893
ondansetron HCl	76045-103
palonosetron HCl	62856-797
palonosetron HCl	62856-798
perphenazine	0603-5060
perphenazine	0603-5061
perphenazine	0603-5062
perphenazine	0603-5063
perphenazine	0603-5090
perphenazine	0603-5091

Active Ingredient	Product-Level NDC
perphenazine	0603-5092
perphenazine	0603-5093
perphenazine	0615-3584
perphenazine	0615-3585
perphenazine	0615-4511
perphenazine	0781-1046
perphenazine	0781-1047
perphenazine	0781-1048
perphenazine	0781-1049
perphenazine	21695-141
perphenazine	21695-415
perphenazine	24236-484
perphenazine	24236-880
perphenazine	24236-887
perphenazine	24236-889
perphenazine	52125-102
perphenazine	52125-771
perphenazine	52959-940
perphenazine	53808-0395
perphenazine	53808-0664
perphenazine	53808-0665
perphenazine	53808-0760
perphenazine	53808-0761
perphenazine	53808-0762
perphenazine	55154-3526
perphenazine	67046-540
perphenazine	67046-541
perphenazine	68084-602
perphenazine	68084-607
prochlorperazine maleate	0093-9643
prochlorperazine maleate	0093-9652
prochlorperazine maleate	0378-5105
prochlorperazine maleate	0378-5110
prochlorperazine maleate	0440-8190
prochlorperazine maleate	0574-7226
prochlorperazine maleate	0615-2519
prochlorperazine maleate	0615-2520
prochlorperazine maleate	0641-0491

Active Ingredient	Product-Level NDC
prochlorperazine maleate	0713-0135
prochlorperazine maleate	0781-5020
prochlorperazine maleate	0781-5021
prochlorperazine maleate	16590-327
prochlorperazine maleate	21695-571
prochlorperazine maleate	21695-572
prochlorperazine maleate	23155-294
prochlorperazine maleate	35356-325
prochlorperazine maleate	35356-672
prochlorperazine maleate	43063-160
prochlorperazine maleate	43063-353
prochlorperazine maleate	49349-148
prochlorperazine maleate	49349-347
prochlorperazine maleate	51079-541
prochlorperazine maleate	51079-542
prochlorperazine maleate	52125-055
prochlorperazine maleate	52125-192
prochlorperazine maleate	52125-528
prochlorperazine maleate	52584-077

Active Ingredient	Product-Level NDC
prochlorperazine maleate	54569-0350
prochlorperazine maleate	54569-0355
prochlorperazine maleate	54868-0261
prochlorperazine maleate	54868-1082
prochlorperazine maleate	54868-3112
prochlorperazine maleate	54868-4721
prochlorperazine maleate	55154-0370
prochlorperazine maleate	55154-5094
prochlorperazine maleate	55154-5660
prochlorperazine maleate	55289-119
prochlorperazine maleate	55289-224
prochlorperazine maleate	55289-568
prochlorperazine maleate	55390-077
prochlorperazine maleate	59746-113
prochlorperazine maleate	59746-115
prochlorperazine maleate	63629-1335
prochlorperazine maleate	63629-1841
prochlorperazine maleate	66213-200
prochlorperazine maleate	66336-921

Active Ingredient	Product-Level NDC
prochlorperazine maleate	68788-0384
prochlorperazine maleate	68788-6766
prochlorperazine maleate	68788-9819
promethazine HCl	0115-1040
promethazine HCl	0115-1041
promethazine HCl	0115-1042
promethazine HCl	0143-9868
promethazine HCl	0143-9869
promethazine HCl	0378-7028
promethazine HCl	0378-7029
promethazine HCl	0378-7030
promethazine HCl	0409-2312
promethazine HCl	0440-8195
promethazine HCl	0574-7234
promethazine HCl	0574-7236
promethazine HCl	0591-2160
promethazine HCl	0591-2161
promethazine HCl	0591-5307
promethazine HCl	0591-5319

Active Ingredient	Product-Level NDC
promethazine HCl	0603-1584
promethazine HCl	0603-5437
promethazine HCl	0603-5438
promethazine HCl	0603-5439
promethazine HCl	0615-1539
promethazine HCl	0615-7668
promethazine HCl	0641-0928
promethazine HCl	0641-0929
promethazine HCl	0641-0948
promethazine HCl	0641-0949
promethazine HCl	0641-0955
promethazine HCl	0641-0956
promethazine HCl	0641-1495
promethazine HCl	0641-1496
promethazine HCl	0641-6082
promethazine HCl	0641-6083
promethazine HCl	0641-6084
promethazine HCl	0641-6085
promethazine HCl	0641-6099

Active Ingredient	Product-Level NDC
promethazine HCl	0703-2191
promethazine HCl	0703-2201
promethazine HCl	0713-0132
promethazine HCl	0713-0526
promethazine HCl	0713-0536
promethazine HCl	0781-1830
promethazine HCl	0781-1832
promethazine HCl	0904-5840
promethazine HCl	0904-6252
promethazine HCl	10019-097
promethazine HCl	10544-618
promethazine HCl	10702-002
promethazine HCl	10702-003
promethazine HCl	10702-004
promethazine HCl	16590-047
promethazine HCl	16590-191
promethazine HCl	17856-0608
promethazine HCl	21695-453
promethazine HCl	21695-589

Active Ingredient	Product-Level NDC
promethazine HCl	21695-649
promethazine HCl	21695-703
promethazine HCl	21695-885
promethazine HCl	21695-959
promethazine HCl	24236-110
promethazine HCl	27808-051
promethazine HCl	39822-5500
promethazine HCl	42254-045
promethazine HCl	42549-543
promethazine HCl	43063-049
promethazine HCl	43063-060
promethazine HCl	43063-405
promethazine HCl	43063-447
promethazine HCl	45802-758
promethazine HCl	45802-759
promethazine HCl	49349-878
promethazine HCl	49999-090
promethazine HCl	50383-801
promethazine HCl	50436-4379

Active Ingredient	Product-Level NDC
promethazine HCl	51079-895
promethazine HCl	52125-162
promethazine HCl	52125-308
promethazine HCl	52125-529
promethazine HCl	52125-566
promethazine HCl	52125-637
promethazine HCl	52125-639
promethazine HCl	52125-703
promethazine HCl	52584-495
promethazine HCl	52584-496
promethazine HCl	52959-534
promethazine HCl	52959-731
promethazine HCl	53808-0545
promethazine HCl	53808-0546
promethazine HCl	54569-1046
promethazine HCl	54569-1754
promethazine HCl	54569-4168
promethazine HCl	54868-0262
promethazine HCl	54868-0601

Active Ingredient	Product-Level NDC
promethazine HCl	54868-1323
promethazine HCl	54868-1613
promethazine HCl	54868-1867
promethazine HCl	54868-2088
promethazine HCl	54868-2844
promethazine HCl	54868-4021
promethazine HCl	54868-4794
promethazine HCl	54868-5121
promethazine HCl	55045-1643
promethazine HCl	55154-0455
promethazine HCl	55154-2535
promethazine HCl	55154-2860
promethazine HCl	55154-2861
promethazine HCl	55154-3278
promethazine HCl	55154-4775
promethazine HCl	55154-5112
promethazine HCl	55154-5127
promethazine HCl	55154-5423
promethazine HCl	55154-5697

Active Ingredient	Product-Level NDC
promethazine HCl	55289-464
promethazine HCl	55289-531
promethazine HCl	55289-928
promethazine HCl	55289-940
promethazine HCl	57664-107
promethazine HCl	57664-108
promethazine HCl	57664-109
promethazine HCl	57664-146
promethazine HCl	58118-0107
promethazine HCl	58118-5307
promethazine HCl	60429-149
promethazine HCl	60429-150
promethazine HCl	60429-151
promethazine HCl	60432-608
promethazine HCl	60977-001
promethazine HCl	60977-002
promethazine HCl	63629-1591
promethazine HCl	63629-1742
promethazine HCl	63739-213
promethazine HCl	63739-389
promethazine HCl	65162-521
promethazine HCl	65162-522
promethazine HCl	65162-678
promethazine HCl	65162-745
promethazine HCl	65841-040
promethazine HCl	65841-041
promethazine HCl	65841-042
promethazine HCl	66336-085
promethazine HCl	68084-154
promethazine HCl	68084-155
promethazine HCl	68258-3011
promethazine HCl	68258-3028
promethazine HCl	68382-040
promethazine HCl	68382-041
promethazine HCl	68382-042
promethazine HCl	68788-0353
promethazine HCl	68788-9183
promethazine HCl	68788-9543

Active Ingredient	Product-Level NDC
promethazine HCl	68788-9679
promethazine HCl	75921-438
promethazine HCl	76237-230
promethazine HCl	76237-273
scopolamine hydrobromide	0067-4345
scopolamine hydrobromide	10019-553
scopolamine hydrobromide	54868-2803
scopolamine hydrobromide	63323-268
trimethobenzamide HCl	21695-448
trimethobenzamide HCl	21695-853
trimethobenzamide HCl	35356-473
trimethobenzamide HCl	42023-118
trimethobenzamide HCl	42023-119
trimethobenzamide HCl	42023-142
trimethobenzamide HCl	42023-143
trimethobenzamide HCl	43386-660
trimethobenzamide HCl	49349-496
trimethobenzamide HCl	52125-143
trimethobenzamide HCl	52584-119
trimethobenzamide HCl	52584-952
trimethobenzamide HCl	53489-376
trimethobenzamide HCl	54868-5741
trimethobenzamide HCl	61570-079
trimethobenzamide HCl	63629-3685

Source: ATC code A04.

Table A.14. Drugs Sometimes Used to Treat the Side Effects of Chemotherapy

Active Ingredient	Product-Level NDC
darbepoetin alfa	54868-5428
darbepoetin alfa	54868-5429
darbepoetin alfa	54868-5867
darbepoetin alfa	55513-002
darbepoetin alfa	55513-003
darbepoetin alfa	55513-004
darbepoetin alfa	55513-005
darbepoetin alfa	55513-006
darbepoetin alfa	55513-021
darbepoetin alfa	55513-023
darbepoetin alfa	55513-025
darbepoetin alfa	55513-027
darbepoetin alfa	55513-028
darbepoetin alfa	55513-032
darbepoetin alfa	55513-053
darbepoetin alfa	55513-057
darbepoetin alfa	55513-110
darbepoetin alfa	55513-111
dexamethasone	0023-3348
dexamethasone	0054-3176
dexamethasone	0054-3177
dexamethasone	0054-4179
dexamethasone	0054-4180
dexamethasone	0054-4181
dexamethasone	0054-4182
dexamethasone	0054-4183
dexamethasone	0054-4184
dexamethasone	0054-4186
dexamethasone	0054-8174
dexamethasone	0054-8175
dexamethasone	0054-8176
dexamethasone	0054-8179
dexamethasone	0054-8180
dexamethasone	0054-8181

Active Ingredient	Product-Level NDC
dexamethasone	0054-8183
dexamethasone	0069-0177
dexamethasone	0069-0178
dexamethasone	0069-0179
dexamethasone	0069-0192
dexamethasone	0069-4541
dexamethasone	0069-4543
dexamethasone	0069-4545
dexamethasone	0069-4547
dexamethasone	0095-0086
dexamethasone	0095-0087
dexamethasone	0095-0088
dexamethasone	0095-0089
dexamethasone	0517-4901
dexamethasone	0517-4905
dexamethasone	0517-4930
dexamethasone	0603-1147
dexamethasone	0641-0367
dexamethasone	0904-3006

Active Ingredient	Product-Level NDC
dexamethasone	0998-0615
dexamethasone	11695-1411
dexamethasone	16590-068
dexamethasone	16590-269
dexamethasone	21695-290
dexamethasone	21695-382
dexamethasone	21695-728
dexamethasone	21695-745
dexamethasone	21695-847
dexamethasone	24208-720
dexamethasone	42254-088
dexamethasone	43063-266
dexamethasone	44183-507
dexamethasone	44183-508
dexamethasone	44183-509
dexamethasone	49349-841
dexamethasone	49349-917
dexamethasone	49884-084
dexamethasone	49884-085

Active Ingredient	Product-Level NDC
dexamethasone	49884-086
dexamethasone	49884-087
dexamethasone	49884-129
dexamethasone	49999-059
dexamethasone	52125-619
dexamethasone	52584-165
dexamethasone	52584-516
dexamethasone	52959-392
dexamethasone	52959-547
dexamethasone	54569-0322
dexamethasone	54569-0324
dexamethasone	54569-0336
dexamethasone	54569-5729
dexamethasone	54868-0218
dexamethasone	54868-0916
dexamethasone	54868-0927
dexamethasone	54868-1744
dexamethasone	54868-3129
dexamethasone	54868-3157

Active Ingredient	Product-Level NDC
dexamethasone	54868-5334
dexamethasone	54868-5903
dexamethasone	54868-6099
dexamethasone	54879-003
dexamethasone	55045-1755
dexamethasone	55154-2732
dexamethasone	55154-2733
dexamethasone	55154-3275
dexamethasone	55154-4901
dexamethasone	55154-4914
dexamethasone	55154-5118
dexamethasone	55154-5707
dexamethasone	55154-9364
dexamethasone	55154-9371
dexamethasone	55154-9387
dexamethasone	55289-582
dexamethasone	55289-903
dexamethasone	57319-065
dexamethasone	60432-466

Active Ingredient	Product-Level NDC
dexamethasone	61314-294
dexamethasone	63323-165
dexamethasone	63323-506
dexamethasone	63323-516
dexamethasone	63629-3742
dexamethasone	63629-4127
dexamethasone	63629-4129
dexamethasone	64679-810
dexamethasone	64980-509
dexamethasone	66336-479
dexamethasone	67457-420
dexamethasone	67457-421
dexamethasone	67457-422
dexamethasone	68788-9938
dexamethasone	68788-9939
dexamethasone	68850-001
dexrazoxane	67457-423
epoetin alfa	55513-126
epoetin alfa	55513-144
epoetin alfa	55513-148
epoetin alfa	55513-267
epoetin alfa	55513-283
epoetin alfa	55513-478
epoetin alfa	55513-823
filgrastim	54868-2522
filgrastim	54868-3050
filgrastim	54868-5020
filgrastim	55513-209
filgrastim	55513-530
filgrastim	55513-546
filgrastim	55513-924
filgrastim	63459-910
filgrastim	63459-912
pamidronate disodium	0069-0107
pamidronate disodium	0069-0109
pamidronate disodium	0069-0186
pamidronate disodium	0517-0745
pamidronate disodium	0517-0746

Active Ingredient	Product-Level NDC
pamidronate disodium	0703-4075
pamidronate disodium	0703-4085
pamidronate disodium	25021-802
pamidronate disodium	25021-803
pamidronate disodium	55390-127
pamidronate disodium	55390-129
pamidronate disodium	55390-157
pamidronate disodium	55390-159
pamidronate disodium	55390-204
pamidronate disodium	55390-604
pamidronate disodium	59923-601
pamidronate disodium	59923-602
pamidronate disodium	59923-603
pamidronate disodium	61703-324
pamidronate disodium	61703-325
pamidronate disodium	61703-326
pamidronate disodium	61703-356
pamidronate disodium	63323-734
pamidronate disodium	63323-735
pegfilgrastim	54868-5229
pegfilgrastim	55513-190
sargramostim	0024-5843
sargramostim	0024-5844
sargramostim	58468-0180
sargramostim	58468-0181
pamidronate disodium	0069-0109
pamidronate disodium	0069-0186

Source: Authors' and CMS review of drugs included on a CMS-provided list of chemotherapy and chemotherapy-related drugs.

Table A.15. Frequency of Chemotherapy Drugs Initiating Episodes of Chemotherapy, by Type of Cancer

	Frequency (%) of Chemotherapy Initiations								
Active Ingredient	**Breast**	**Colorectal**	**Leukemia**	**Lung**	**Lymphoma**	**Ovarian**	**Pancreatic**	**Prostate**	**Other**
Likely Chemotherapy									
aldesleukin	24 (0)	24 (0)	24 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	648 (0)
alemtuzumab	24 (0)	0 (0)	4,872 (1)	0 (0)	912 (0)	0 (0)	0 (0)	0 (0)	192 (0)
anastrozole	534,192 (28)	2,088 (0)	1,056 (0)	3,120 (0)	1,608 (0)	2,040 (1)	264 (0)	1,728 (0)	42,696 (1)
antineoplastic drugs, not otherwise classified	840 (0)	360 (0)	2,424 (1)	648 (0)	2,472 (0)	96 (0)	120 (0)	1,728 (0)	3,072 (0)
arsenic trioxide	0 (0)	0 (0)	2,112 (1)	0 (0)	48 (0)	0 (0)	0 (0)	0 (0)	72 (0)
asparaginase, not otherwise specified	0 (0)	0 (0)	192 (0)	0 (0)	24 (0)	0 (0)	0 (0)	0 (0)	0 (0)
azacitidine	576 (0)	312 (0)	26,352 (8)	480 (0)	1,776 (0)	48 (0)	48 (0)	264 (0)	75,504 (2)
bendamustine HCl	0 (0)	0 (0)	144 (0)	0 (0)	144 (0)	0 (0)	0 (0)	0 (0)	0 (0)
bleomycin sulfate	0 (0)	24 (0)	0 (0)	120 (0)	3,600 (0)	192 (0)	0 (0)	0 (0)	2,256 (0)
bortezomib	192 (0)	168 (0)	528 (0)	240 (0)	9,480 (1)	24 (0)	0 (0)	240 (0)	177,792 (4)
busulfan	24 (0)	0 (0)	240 (0)	0 (0)	24 (0)	0 (0)	0 (0)	0 (0)	792 (0)

	Frequency (%) of Chemotherapy Initiations								
Active Ingredient	**Breast**	**Colorectal**	**Leukemia**	**Lung**	**Lymphoma**	**Ovarian**	**Pancreatic**	**Prostate**	**Other**
cabazitaxel	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	24 (0)	0 (0)
capecitabine	26,400 (1)	131,400 (18)	48 (0)	912 (0)	120 (0)	288 (0)	14,688 (7)	264 (0)	42,312 (1)
carboplatin	28,896 (2)	2,448 (0)	288 (0)	339,360 (27)	1,728 (0)	76,752 (31)	912 (0)	1,968 (0)	176,472 (4)
carmustine	0 (0)	0 (0)	0 (0)	0 (0)	312 (0)	0 (0)	0 (0)	0 (0)	408 (0)
cetuximab	96 (0)	11,832 (2)	24 (0)	2,976 (0)	24 (0)	0 (0)	48 (0)	24 (0)	67,920 (2)
cisplatin	1,368 (0)	2,736 (0)	192 (0)	81,216 (7)	1,272 (0)	3,624 (1)	2,904 (1)	480 (0)	184,704 (4)
cladribine	24 (0)	24 (0)	480 (0)	24 (0)	4,848 (1)	0 (0)	24 (0)	48 (0)	504 (0)
clofarabine	0 (0)	0 (0)	432 (0)	0 (0)	24 (0)	0 (0)	0 (0)	24 (0)	24 (0)
cyclophosphamide	142,776 (7)	624 (0)	24,696 (7)	1,968 (0)	106,632 (14)	1,536 (1)	168 (0)	1,968 (0)	26,424 (1)
cytarabine	216 (0)	24 (0)	5,136 (2)	48 (0)	2,352 (0)	24 (0)	0 (0)	0 (0)	696 (0)
dacarbazine	24 (0)	72 (0)	48 (0)	72 (0)	4,824 (1)	0 (0)	72 (0)	0 (0)	9,216 (0)
dactinomycin	0 (0)	0 (0)	24 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	120 (0)
dasatinib	24 (0)	0 (0)	2,808 (1)	48 (0)	96 (0)	0 (0)	0 (0)	24 (0)	264 (0)
decitabine	120 (0)	144 (0)	19,992 (6)	240 (0)	960 (0)	0 (0)	48 (0)	120 (0)	25,896 (1)
degarelix	0 (0)	264 (0)	96 (0)	336 (0)	72 (0)	0 (0)	72 (0)	70,584 (3)	3,192 (0)

	Frequency (%) of Chemotherapy Initiations								
Active Ingredient	**Breast**	**Colorectal**	**Leukemia**	**Lung**	**Lymphoma**	**Ovarian**	**Pancreatic**	**Prostate**	**Other**
denileukin diftitox	0 (0)	24 (0)	24 (0)	0 (0)	720 (0)	0 (0)	0 (0)	0 (0)	48 (0)
docetaxel	108,624 (6)	264 (0)	144 (0)	55,560 (4)	144 (0)	11,784 (5)	1,800 (1)	41,952 (2)	43,656 (1)
doxorubicin HCl	50,160 (3)	480 (0)	696 (0)	984 (0)	49,488 (7)	18,672 (8)	264 (0)	408 (0)	57,552 (1)
epirubicin HCl	3,456 (0)	0 (0)	24 (0)	48 (0)	144 (0)	0 (0)	0 (0)	0 (0)	5,760 (0)
erlotinib HCl	432 (0)	120 (0)	24 (0)	51,552 (4)	96 (0)	48 (0)	4,200 (2)	24 (0)	4,920 (0)
etoposide	624 (0)	1,008 (0)	480 (0)	127,776 (10)	6,024 (1)	1,464 (1)	432 (0)	888 (0)	25,680 (1)
exemestane	50,280 (3)	48 (0)	120 (0)	192 (0)	96 (0)	120 (0)	48 (0)	72 (0)	4,848 (0)
floxuridine	0 (0)	336 (0)	0 (0)	0 (0)	0 (0)	0 (0)	24 (0)	0 (0)	384 (0)
fludarabine phosphate	144 (0)	48 (0)	33,072 (10)	240 (0)	13,320 (2)	0 (0)	0 (0)	264 (0)	888 (0)
fluorouracil	43,800 (2)	260,736 (36)	15,312 (5)	16,080 (1)	18,168 (2)	2,280 (1)	19,224 (9)	80,616 (3)	1,513,728 (36)
fulvestrant	66,600 (3)	24 (0)	24 (0)	288 (0)	120 (0)	48 (0)	24 (0)	24 (0)	6,096 (0)
gefitinib	0 (0)	0 (0)	0 (0)	96 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
gemcitabine HCl	16,584 (1)	1,128 (0)	312 (0)	64,344 (5)	7,080 (1)	17,136 (7)	162,648 (73)	744 (0)	142,584 (3)
gemtuzumab	24 (0)	0 (0)	1,344 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	96 (0)

	Frequency (%) of Chemotherapy Initiations								
Active Ingredient	**Breast**	**Colorectal**	**Leukemia**	**Lung**	**Lymphoma**	**Ovarian**	**Pancreatic**	**Prostate**	**Other**
goserelin acetate	2,016 (0)	384 (0)	192 (0)	792 (0)	264 (0)	24 (0)	24 (0)	89,568 (4)	5,112 (0)
ifosfamide	48 (0)	0 (0)	0 (0)	168 (0)	912 (0)	144 (0)	0 (0)	0 (0)	2,688 (0)
idarubicin	0 (0)	0 (0)	1,032 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
imatinib mesylate	240 (0)	456 (0)	27,768 (8)	120 (0)	528 (0)	24 (0)	72 (0)	216 (0)	17,136 (0)
irinotecan HCl	288 (0)	60,840 (8)	24 (0)	10,200 (1)	72 (0)	288 (0)	936 (0)	72 (0)	19,368 (0)
ixabepilone	4,632 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	96 (0)	408 (0)
lapatinib ditosylate	984 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	264 (0)
letrozole	272,928 (14)	1,104 (0)	456 (0)	2,016 (0)	744 (0)	1,368 (1)	168 (0)	360 (0)	20,448 (0)
leuprolide acetate	2,880 (0)	10,632 (1)	4,080 (1)	14,616 (1)	5,880 (1)	336 (0)	1,776 (1)	1,792,752 (71)	122,832 (3)
mechlorethamine	0 (0)	0 (0)	0 (0)	0 (0)	120 (0)	0 (0)	0 (0)	0 (0)	48 (0)
melphalan	120 (0)	24 (0)	120 (0)	24 (0)	192 (0)	120 (0)	0 (0)	48 (0)	24,456 (1)
mitomycin	336 (0)	7,536 (1)	144 (0)	984 (0)	432 (0)	24 (0)	96 (0)	1,440 (0)	127,080 (3)
nelarabine	0 (0)	0 (0)	72 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
oxaliplatin	384 (0)	179,400 (25)	96 (0)	336 (0)	1,032 (0)	168 (0)	7,248 (3)	120 (0)	34,992 (1)
paclitaxel	71,256 (4)	1,320 (0)	144 (0)	212,304 (17)	456 (0)	85,320 (35)	1,752 (1)	1,704 (0)	162,144 (4)

	Frequency (%) of Chemotherapy Initiations								
Active Ingredient	**Breast**	**Colorectal**	**Leukemia**	**Lung**	**Lymphoma**	**Ovarian**	**Pancreatic**	**Prostate**	**Other**
panitumumab	0 (0)	5,688 (1)	0 (0)	0 (0)	24 (0)	0 (0)	0 (0)	24 (0)	336 (0)
pegaspargase	0 (0)	0 (0)	72 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	24 (0)
pemetrexed disodium	672 (0)	240 (0)	120 (0)	176,136 (14)	168 (0)	984 (0)	0 (0)	240 (0)	23,568 (1)
pentostatin	264 (0)	10,800 (1)	2,688 (1)	744 (0)	1,896 (0)	0 (0)	192 (0)	1,296 (0)	106,920 (3)
pralatrexate	0 (0)	0 (0)	0 (0)	0 (0)	24 (0)	0 (0)	0 (0)	0 (0)	0 (0)
procarbazine HCl	0 (0)	0 (0)	0 (0)	0 (0)	2,232 (0)	24 (0)	0 (0)	0 (0)	0 (0)
porfimer sodium	0 (0)	0 (0)	0 (0)	216 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1,032 (0)
procarbazine HCl	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	216 (0)
streptozocin	0 (0)	0 (0)	0 (0)	0 (0)	24 (0)	0 (0)	168 (0)	0 (0)	384 (0)
supprelin implant (histrelin)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	72 (0)	0 (0)
temozolomide	96 (0)	72 (0)	72 (0)	912 (0)	864 (0)	0 (0)	336 (0)	0 (0)	80,808 (2)
temsirolimus	0 (0)	144 (0)	0 (0)	144 (0)	216 (0)	0 (0)	24 (0)	0 (0)	29,832 (1)
thiotepa	0 (0)	72 (0)	24 (0)	120 (0)	144 (0)	0 (0)	0 (0)	216 (0)	15,432 (0)
topotecan HCl	192 (0)	96 (0)	0 (0)	10,080 (1)	24 (0)	8,232 (3)	0 (0)	48 (0)	4,344 (0)
toremifene citrate	600 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	24 (0)	96 (0)

	Frequency (%) of Chemotherapy Initiations																	
Active Ingredient	**Breast**		**Colorectal**		**Leukemia**		**Lung**		**Lymphoma**		**Ovarian**		**Pancreatic**		**Prostate**		**Other**	
trastuzumab	81,696	(4)	24	(0)	24	(0)	48	(0)	0	(0)	48	(0)	0	(0)	0	(0)	2,832	(0)
valrubicin	0	(0)	0	(0)	24	(0)	72	(0)	0	(0)	0	(0)	0	(0)	72	(0)	8,184	(0)
vantas implant (histrelin)	0	(0)	1,272	(0)	264	(0)	1,632	(0)	384	(0)	0	(0)	120	(0)	131,184	(5)	13,560	(0)
vinblastine sulfate	48	(0)	48	(0)	48	(0)	504	(0)	8,328	(1)	0	(0)	0	(0)	144	(0)	1,608	(0)
vincristine sulfate	384	(0)	168	(0)	8,304	(2)	624	(0)	93,000	(13)	24	(0)	24	(0)	408	(0)	3,168	(0)
vinorelbine tartrate	9,960	(1)	0	(0)	0	(0)	29,136	(2)	1,320	(0)	768	(0)	24	(0)	408	(0)	4,392	(0)
vorinostat	0	(0)	0	(0)	0	(0)	0	(0)	648	(0)	0	(0)	24	(0)	24	(0)	72	(0)
WW140—topotecan	0	(0)	0	(0)	0	(0)	1,008	(0)	0	(0)	0	(0)	0	(0)	0	(0)	96	(0)
WW141—fludarabine phosphate	0	(0)	0	(0)	96	(0)	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	24	(0)
Possible Chemotherapy																		
bevacizumab	4,056	(0)	11,544	(2)	48	(0)	7,104	(1)	96	(0)	4,488	(2)	96	(0)	96	(0)	26,688	(1)
bicalutamide	48	(0)	1,272	(0)	408	(0)	1,968	(0)	768	(0)	0	(0)	240	(0)	261,864	(10)	17,088	(0)
chlorambucil	240	(0)	120	(0)	21,480	(6)	168	(0)	6,456	(1)	72	(0)	0	(0)	120	(0)	1,800	(0)

	Frequency (%) of Chemotherapy Initiations																	
Active Ingredient	**Breast**		**Colorectal**		**Leukemia**		**Lung**		**Lymphoma**		**Ovarian**		**Pancreatic**		**Prostate**		**Other**	
everolimus	72	(0)	24	(0)	0	(0)	48	(0)	24	(0)	0	(0)	144	(0)	0	(0)	10,488	(0)
interferon alfa-2b, recomb., or alfa-2a	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	5,688	(0)
interferon alfa-2b, recomb.	72	(0)	96	(0)	144	(0)	72	(0)	1,128	(0)	0	(0)	0	(0)	288	(0)	24	(0)
interferon alfacon-1	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	24	(0)
interferon, alfa-2a	0	(0)	24	(0)	0	(0)	24	(0)	96	(0)	0	(0)	24	(0)	0	(0)	624	(0)
lenalidomide	336	(0)	216	(0)	1,536	(0)	144	(0)	1,776	(0)	24	(0)	24	(0)	168	(0)	87,192	(2)
mercaptopurine	1,008	(0)	360	(0)	1,248	(0)	552	(0)	216	(0)	48	(0)	48	(0)	1,272	(0)	18,648	(0)
methotrexate	34,776	(2)	10,536	(1)	7,920	(2)	15,888	(1)	17,184	(2)	2,424	(1)	1,080	(0)	21,456	(1)	389,328	(9)
methotrexate sodium	5,208	(0)	1,752	(0)	672	(0)	1,992	(0)	1,872	(0)	360	(0)	264	(0)	3,384	(0)	63,024	(2)
mitoxantrone HCl	96	(0)	48	(0)	168	(0)	0	(0)	72	(0)	0	(0)	0	(0)	2,592	(0)	504	(0)
nilotinib HCl	24	(0)	0	(0)	4,152	(1)	24	(0)	72	(0)	0	(0)	0	(0)	0	(0)	624	(0)
prednisone	1,800	(0)	384	(0)	648	(0)	1,728	(0)	552	(0)	96	(0)	168	(0)	384	(0)	8,184	(0)
rituximab	3,168	(0)	1,584	(0)	104,880	(31)	2,544	(0)	346,680	(47)	144	(0)	216	(0)	1,992	(0)	22,032	(1)
tamoxifen citrate	348,024	(18)	2,088	(0)	792	(0)	2,904	(0)	1,104	(0)	4,200	(2)	288	(0)	696	(0)	39,528	(1)

	Frequency (%) of Chemotherapy Initiations								
Active Ingredient	**Breast**	**Colorectal**	**Leukemia**	**Lung**	**Lymphoma**	**Ovarian**	**Pancreatic**	**Prostate**	**Other**
Total	**1,925,496**	**727,128**	**333,744**	**1,247,064**	**736,776**	**245,928**	**223,608**	**2,519,328**	**4,172,808**

Note: Italic type indicates endocrine therapy. Gray shading indicates on-label use—i.e., drugs listed by NCI as FDA-approved for each cancer.
Source: Authors' analysis of 2009–2012 CCW Medicare claims data for patients with cancer and chemotherapy initiation in 2010.

Table A.16. Data for "Figure 4.1. Average Monthly Total Medicare Payments for Beneficiaries Initiating Chemotherapy in 2010"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	871	1,161	1,506	1,064	1,050	1,172	851	1,018	906
-5	921	1,370	1,527	1,115	1,129	1,228	909	1,370	894
-4	1,075	1,802	1,960	1,348	1,310	1,345	1,103	1,718	990
-3	1,347	2,749	2,355	1,849	1,610	1,577	1,815	3,289	1,014
-2	1,855	5,599	3,400	3,495	2,665	2,194	4,463	6,160	1,056
-1	2,210	5,989	4,140	5,781	5,114	2,920	7,178	6,710	1,232
0	3,109	6,548	9,244	8,044	9,972	4,428	5,307	7,790	2,050
1	2,775	6,860	8,039	7,452	8,164	4,117	4,691	7,537	1,698
2	2,638	6,016	6,467	6,500	6,708	3,499	4,722	6,585	1,937
3	2,418	6,056	5,791	5,688	5,959	3,147	4,573	6,263	2,135
4	2,240	5,547	5,099	5,134	4,727	2,912	4,010	6,040	1,998
5	2,096	4,925	4,684	4,687	3,731	2,675	3,502	5,850	1,635
6	1,954	4,147	4,300	4,468	3,428	2,517	3,138	5,502	1,636
7	1,801	3,765	4,100	4,327	3,093	2,417	3,024	5,203	1,465
8	1,720	3,506	3,882	4,239	2,711	2,306	2,840	4,847	1,433
9	1,647	3,396	3,799	4,141	2,723	2,238	2,876	4,582	1,428
10	1,597	3,250	3,790	3,997	2,685	2,168	2,940	4,441	1,407
11	1,564	3,163	3,712	3,933	2,643	2,154	2,985	4,428	1,400
12	1,528	3,187	3,752	3,972	2,779	2,118	2,923	4,469	1,573
13	1,424	3,058	3,573	3,831	2,632	2,020	2,936	4,323	1,485
14	1,382	3,013	3,719	3,751	2,557	1,962	3,123	4,269	1,421
15	1,358	2,916	3,362	3,659	2,462	1,862	3,021	4,013	1,408
16	1,316	2,920	3,312	3,434	2,423	1,830	3,003	4,182	1,417
17	1,286	2,770	3,167	3,373	2,374	1,754	3,042	3,690	1,394

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.17. Data for "Figure 4.2. Cumulative Proportion of Total 24-Month Medicare Payments Occurring in Each Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.03
-5	0.04	0.03	0.03	0.03	0.03	0.04	0.02	0.03	0.05
-4	0.06	0.05	0.05	0.04	0.04	0.07	0.04	0.05	0.08
-3	0.09	0.08	0.08	0.07	0.06	0.1	0.06	0.09	0.11
-2	0.14	0.14	0.12	0.11	0.09	0.14	0.12	0.17	0.14
-1	0.19	0.21	0.17	0.19	0.16	0.2	0.21	0.25	0.18
0	0.27	0.29	0.27	0.3	0.29	0.29	0.29	0.35	0.24
1	0.34	0.37	0.37	0.4	0.4	0.37	0.36	0.45	0.29
2	0.41	0.44	0.44	0.48	0.48	0.44	0.43	0.53	0.35
3	0.47	0.51	0.5	0.55	0.55	0.49	0.49	0.6	0.42
4	0.52	0.58	0.56	0.61	0.61	0.55	0.54	0.66	0.48
5	0.57	0.63	0.61	0.66	0.66	0.6	0.59	0.71	0.52
6	0.62	0.67	0.65	0.7	0.7	0.64	0.63	0.75	0.57
7	0.66	0.71	0.69	0.74	0.73	0.68	0.67	0.79	0.61
8	0.7	0.75	0.73	0.78	0.76	0.72	0.71	0.83	0.65
9	0.74	0.78	0.76	0.81	0.79	0.76	0.74	0.85	0.69
10	0.78	0.81	0.8	0.84	0.82	0.79	0.78	0.88	0.73
11	0.81	0.84	0.83	0.87	0.85	0.83	0.81	0.9	0.77
12	0.85	0.87	0.86	0.9	0.88	0.86	0.84	0.92	0.81
13	0.88	0.9	0.89	0.92	0.9	0.89	0.87	0.94	0.85
14	0.91	0.93	0.92	0.94	0.93	0.92	0.91	0.96	0.89
15	0.94	0.95	0.95	0.96	0.95	0.95	0.94	0.97	0.93
16	0.97	0.98	0.98	0.98	0.98	0.97	0.97	0.99	0.96
17	1	1	1	1	1	1	1	1	1

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.18. Data for "Figure 4.3. Percentage of Beneficiaries with Positive Physician-Administered or DME Chemotherapy Payments per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	2	3	3	2	3	3	5	2	10
-5	2	3	3	2	3	3	5	2	4
-4	2	3	3	2	3	3	6	2	8
-3	3	3	3	2	3	3	5	2	10
-2	3	3	3	2	4	3	6	2	2
-1	3	4	5	3	5	3	7	3	2
0	34	94	75	92	93	48	94	97	88
1	31	80	55	78	74	34	86	81	13
2	30	66	42	65	58	26	80	69	10
3	24	61	36	52	51	21	75	64	25
4	21	58	29	42	38	18	63	61	27
5	18	55	24	34	27	15	48	58	12
6	16	46	20	30	25	14	42	51	25
7	15	38	18	29	23	13	38	45	15
8	15	35	17	28	20	12	37	42	19
9	15	33	16	27	19	11	37	40	19
10	14	31	15	27	19	11	38	39	13
11	14	29	16	27	19	10	39	38	12
12	13	29	16	27	21	11	40	37	27
13	11	28	16	26	21	10	40	37	18
14	11	27	15	26	19	10	40	35	12
15	10	27	15	25	19	9	40	35	15
16	10	27	14	25	18	9	39	34	16
17	10	26	14	24	18	9	39	34	14

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.19. Data for "Figure 4.4. Average Payments for Physician-Administered and DME Chemotherapy per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	3	5	19	5	32	8	7	3	6
-5	3	4	14	5	13	8	8	3	3
-4	4	4	15	3	13	8	8	4	8
-3	3	4	20	4	17	9	8	4	6
-2	5	6	24	6	22	10	8	7	2
-1	7	10	44	15	53	14	13	12	3
0	855	2,676	3,841	2,148	5,109	992	1,441	2,222	615
1	830	2,833	2,962	1,948	3,929	886	1,456	2,295	102
2	816	2,569	1,881	1,797	2,653	660	1,433	1,873	83
3	662	2,315	1,542	1,455	2,159	535	1,334	1,766	166
4	537	2,126	1,220	1,222	1,427	444	1,133	1,635	197
5	451	1,942	988	1,078	928	377	992	1,503	103
6	404	1,485	866	975	1,020	331	897	1,240	198
7	381	1,262	747	940	906	297	873	1,071	129
8	372	1,160	655	893	673	277	864	996	161
9	365	1,096	636	881	646	263	904	926	154
10	351	1,037	625	836	681	247	921	892	124
11	345	997	657	837	706	241	936	904	127
12	290	1,017	731	819	901	236	973	871	277
13	238	1,017	665	799	841	217	960	842	209
14	224	1,010	652	768	720	211	979	823	151
15	208	1,001	611	738	683	201	949	811	184
16	200	1,005	586	711	673	196	917	778	199
17	199	975	580	684	697	188	921	754	189

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.20. Data for "Figure 4.5. Percentage of Beneficiaries with Positive Part D Chemotherapy Payments per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	9	3	5	4	4	9	3	2	3
-5	9	3	5	4	4	9	3	3	3
-4	9	3	5	5	4	9	3	3	3
-3	11	4	6	6	4	10	4	4	4
-2	10	4	7	7	5	10	5	5	4
-1	11	8	9	12	10	12	11	11	4
0	76	31	40	39	32	63	34	34	20
1	40	14	22	21	21	20	17	20	10
2	42	12	21	19	19	19	15	17	9
3	46	11	20	17	17	18	15	17	10
4	40	10	19	16	13	17	13	16	9
5	39	10	18	15	10	16	10	15	9
6	42	9	18	15	8	16	10	14	9
7	39	8	17	15	8	16	10	14	9
8	38	8	18	15	7	16	10	13	9
9	41	8	18	15	7	16	10	12	9
10	38	8	17	15	7	15	10	13	9
11	38	8	17	15	7	16	10	12	8
12	41	8	18	15	7	16	10	13	9
13	35	7	16	14	6	14	10	12	8
14	33	6	15	13	6	13	10	10	7
15	31	6	15	12	5	12	8	9	7
16	27	5	13	10	5	11	8	9	6
17	24	5	11	9	4	9	7	7	5

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.21. Data for "Figure 4.6. Average Payments for Part D Chemotherapy per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	3	2	11	2	1	8	1	1	4
-5	3	1	12	1	1	7	1	1	4
-4	3	2	20	1	1	7	1	1	4
-3	4	2	16	2	2	10	1	2	4
-2	3	3	20	2	2	14	2	2	3
-1	4	5	22	7	7	24	7	7	3
0	256	54	703	232	100	342	44	202	49
1	105	37	411	161	67	197	32	173	14
2	118	36	452	150	58	186	32	156	13
3	132	35	483	151	52	175	28	172	18
4	98	32	451	154	45	166	21	150	16
5	93	32	466	163	40	161	20	152	13
6	91	30	489	174	33	154	16	140	16
7	78	27	483	171	34	151	15	132	14
8	77	22	482	183	32	153	13	138	15
9	80	21	520	188	32	155	18	120	17
10	73	19	525	192	29	154	16	109	17
11	73	19	542	196	28	155	14	125	20
12	76	19	543	208	28	158	20	124	24
13	64	22	514	191	21	142	21	112	23
14	58	14	520	178	25	131	21	97	24
15	52	15	473	166	25	116	15	101	26
16	44	12	436	150	17	105	16	80	26
17	37	13	372	129	17	87	13	77	23

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.22. Data for "Figure 4.7. Percentage of Beneficiaries with Positive E&M Payments per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	51	46	61	51	55	55	52	50	52
-5	51	46	61	52	55	54	52	52	48
-4	55	51	63	55	58	56	56	56	51
-3	60	58	65	62	62	59	61	62	54
-2	65	68	68	72	70	63	70	72	54
-1	70	84	78	87	83	71	80	87	61
0	82	95	93	96	94	88	91	97	87
1	70	90	87	91	88	74	89	90	57
2	69	88	83	88	85	70	89	86	54
3	70	85	81	85	83	68	87	84	60
4	67	83	79	82	80	66	85	83	61
5	65	81	76	79	75	65	80	82	54
6	66	79	75	77	73	65	77	81	60
7	63	75	73	76	71	64	75	79	54
8	62	72	72	75	69	63	75	78	56
9	62	72	71	74	68	62	73	77	57
10	61	70	71	73	68	61	73	75	55
11	60	69	71	73	68	61	73	76	55
12	61	69	71	73	68	62	74	74	62
13	60	68	72	73	67	62	75	75	58
14	60	67	71	73	67	61	75	74	55
15	60	67	70	72	66	60	73	75	57
16	59	66	70	71	66	60	73	75	57
17	59	66	70	71	66	60	74	75	55

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.23. Data for "Figure 4.8. Average E&M Payments per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	62	54	83	62	70	69	62	61	58
-5	65	57	84	65	71	69	63	66	53
-4	76	67	91	75	78	75	71	80	58
-3	92	86	98	95	91	83	88	103	64
-2	111	119	110	134	119	98	124	136	68
-1	131	188	152	232	185	137	163	238	87
0	156	243	225	285	236	181	204	319	133
1	108	184	184	198	174	131	168	217	74
2	107	170	165	183	164	120	170	199	68
3	106	161	155	170	154	113	163	191	76
4	99	152	144	155	139	106	150	183	75
5	94	146	138	146	127	103	139	178	68
6	93	135	132	140	120	100	128	174	75
7	87	124	124	135	113	97	122	165	68
8	85	119	124	133	108	94	123	161	70
9	84	116	120	132	104	93	119	158	73
10	83	112	120	128	105	92	120	152	70
11	82	109	119	130	104	91	121	154	70
12	83	108	118	128	104	92	122	151	79
13	81	106	120	126	103	90	124	148	75
14	81	105	119	126	103	89	127	145	71
15	80	104	116	125	100	88	124	148	73
16	80	103	117	122	101	88	123	142	73
17	79	103	116	121	99	87	126	145	71

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.24. Data for "Figure 4.9. Percentage of Beneficiaries with Positive Laboratory Payments per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	37	36	54	37	44	42	41	37	44
-5	38	37	55	38	44	43	42	40	39
-4	41	41	57	42	47	45	44	44	44
-3	47	49	59	48	51	47	50	51	46
-2	53	61	63	60	61	52	61	63	46
-1	57	74	76	79	78	60	73	80	55
0	66	90	91	92	91	73	90	94	74
1	56	85	84	87	84	62	87	87	45
2	55	81	81	83	80	59	85	82	44
3	55	78	78	79	77	58	83	80	53
4	52	76	76	74	73	55	80	78	52
5	49	74	74	70	67	54	74	77	45
6	50	71	72	68	66	53	70	75	53
7	47	66	69	67	63	52	68	73	46
8	47	64	69	65	61	51	67	72	48
9	46	63	68	65	60	51	66	70	48
10	46	62	67	64	60	50	67	68	46
11	45	61	66	63	60	50	66	70	45
12	46	60	67	63	59	50	66	67	54
13	44	59	66	62	59	49	67	68	48
14	44	58	66	62	58	49	66	67	45
15	44	58	65	61	58	48	66	67	48
16	44	57	66	61	58	48	66	68	48
17	43	57	65	60	57	48	67	66	46

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.25. Data for "Figure 4.10. Average Laboratory Payments per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	39	32	87	35	54	47	33	34	34
-5	46	35	95	39	54	49	34	38	32
-4	64	42	106	48	63	53	38	50	36
-3	87	58	118	68	84	61	49	66	40
-2	124	89	157	113	144	79	84	98	51
-1	134	115	286	217	338	119	123	172	82
0	82	122	418	173	283	141	140	185	72
1	55	99	327	125	136	102	128	129	38
2	55	92	291	128	131	95	134	121	36
3	53	89	275	119	126	91	133	116	41
4	50	83	256	99	114	85	116	106	40
5	47	80	238	85	102	80	99	107	37
6	45	73	216	80	93	78	86	105	41
7	43	69	204	74	86	75	81	96	38
8	41	67	199	73	83	73	76	98	38
9	41	66	196	71	80	72	77	92	40
10	41	65	183	72	80	71	76	89	38
11	40	64	177	71	81	70	76	95	39
12	41	64	174	70	80	70	78	89	43
13	40	60	167	71	74	69	78	90	41
14	39	61	165	68	76	68	83	88	38
15	40	60	163	69	75	66	81	88	40
16	39	58	163	67	74	66	82	91	41
17	39	58	149	67	72	66	84	83	40

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.26. Data for "Figure 4.11. Percentage of Beneficiaries with Positive Imaging Payments per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	25	19	20	25	23	21	24	21	16
-5	27	20	21	26	24	22	25	23	16
-4	32	23	22	31	26	23	27	26	17
-3	39	29	23	39	30	26	34	34	18
-2	45	41	26	54	41	30	46	47	21
-1	46	58	34	76	60	38	59	66	30
0	43	60	36	70	56	40	53	68	33
1	27	30	25	52	34	29	31	43	23
2	27	35	27	56	44	30	36	50	24
3	29	34	26	53	39	28	33	47	25
4	29	31	25	50	39	28	39	42	23
5	29	31	24	49	36	27	39	42	20
6	29	33	24	48	34	26	35	43	19
7	28	31	23	47	31	25	33	41	18
8	28	30	24	46	31	25	35	42	17
9	29	31	23	46	31	25	34	40	17
10	29	30	23	44	31	24	33	39	17
11	28	30	23	45	30	24	33	40	17
12	28	30	23	44	30	24	33	38	17
13	26	29	22	42	29	24	33	37	17
14	25	28	23	43	29	24	33	38	17
15	25	29	23	42	29	23	33	38	17
16	26	28	23	41	29	23	33	38	17
17	26	28	22	42	28	23	34	38	16

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.27. Data for "Figure 4.12. Average Imaging Payments per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	65	73	52	86	86	60	86	64	43
-5	74	83	52	93	84	61	87	73	44
-4	99	102	55	121	96	69	106	96	47
-3	131	138	62	175	121	83	147	144	52
-2	174	220	78	287	199	119	216	222	65
-1	216	381	123	570	432	195	318	412	112
0	182	325	111	471	360	182	229	363	129
1	75	149	55	264	156	115	97	180	92
2	81	181	74	295	265	117	163	270	118
3	90	188	73	282	228	106	147	238	132
4	91	149	67	269	232	101	187	208	115
5	88	150	68	255	198	98	183	207	86
6	87	174	66	243	175	90	154	216	64
7	81	161	60	233	149	84	134	208	52
8	80	150	60	221	145	80	144	199	45
9	80	153	55	222	140	78	133	185	45
10	80	149	56	217	139	75	129	184	42
11	78	149	54	219	136	73	134	200	40
12	76	151	53	212	135	71	128	172	41
13	71	140	57	202	123	70	128	179	41
14	70	133	57	204	124	68	133	168	40
15	70	143	54	202	124	67	135	178	39
16	70	141	58	194	125	66	134	193	41
17	70	137	56	202	123	65	141	181	39

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.28. Data for "Figure 4.13. Percentage of Beneficiaries with Positive Radiation Therapy Payments per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	1	1	0	2	1	1	0	1	1
-5	2	1	0	2	1	1	0	1	1
-4	2	1	0	2	1	1	0	1	1
-3	4	1	0	2	1	1	1	1	2
-2	7	1	0	4	1	2	1	1	2
-1	9	7	0	15	2	6	1	6	2
0	8	18	1	29	2	11	1	15	5
1	6	18	0	26	2	10	1	17	8
2	6	9	1	19	3	7	1	13	11
3	6	3	1	10	4	3	1	9	12
4	7	2	1	10	4	2	1	8	10
5	8	2	1	10	4	2	1	6	6
6	7	2	1	9	3	2	1	5	4
7	5	2	1	8	3	2	1	4	3
8	4	1	0	6	2	1	1	4	2
9	2	1	0	6	2	1	1	3	2
10	2	1	0	5	1	1	1	3	1
11	1	1	0	5	1	1	1	2	1
12	1	1	0	5	1	1	1	2	1
13	1	1	1	5	1	1	1	2	1
14	1	1	1	5	1	1	1	2	1
15	1	1	1	4	1	1	1	2	1
16	1	1	0	4	1	1	1	2	1
17	1	1	0	4	1	1	1	2	1

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.29. Data for "Figure 4.14. Average Radiation Therapy Payments per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	47	27	6	49	23	26	14	19	61
-5	57	27	7	48	23	27	12	21	66
-4	78	28	5	51	22	28	15	23	69
-3	136	28	8	62	26	34	18	33	73
-2	260	37	10	105	36	46	25	51	82
-1	306	134	9	325	45	114	17	111	94
0	238	839	12	1,127	45	494	21	654	180
1	227	824	9	1,111	48	502	23	762	379
2	169	218	13	504	88	210	17	464	632
3	188	81	16	299	139	106	21	361	701
4	265	60	11	305	133	84	26	306	534
5	288	53	10	297	122	68	30	257	317
6	255	48	15	257	104	56	31	228	183
7	185	49	13	209	75	46	34	194	115
8	121	44	15	165	54	38	34	145	84
9	74	39	9	148	44	33	32	109	66
10	50	41	10	137	39	32	20	92	51
11	38	40	10	136	40	31	19	70	43
12	30	39	13	135	34	28	28	57	39
13	26	37	17	127	31	26	30	69	36
14	22	33	18	131	31	26	30	66	36
15	21	34	16	119	28	25	38	66	32
16	21	32	14	109	30	25	31	60	33
17	22	30	11	106	31	24	28	81	31

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.30. Data for "Figure 4.15. Cumulative Proportion of Radiation Therapy Payments per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	0.01	0.01	0.03	0.01	0.02	0.01	0.02	0.01	0.02
-5	0.03	0.02	0.05	0.02	0.04	0.02	0.04	0.01	0.03
-4	0.05	0.03	0.07	0.03	0.05	0.04	0.07	0.02	0.05
-3	0.09	0.04	0.11	0.04	0.08	0.05	0.1	0.03	0.07
-2	0.17	0.05	0.15	0.06	0.11	0.08	0.15	0.04	0.09
-1	0.27	0.1	0.19	0.12	0.14	0.13	0.18	0.07	0.11
0	0.35	0.41	0.24	0.35	0.18	0.38	0.22	0.27	0.16
1	0.43	0.72	0.28	0.56	0.22	0.62	0.27	0.49	0.26
2	0.49	0.8	0.33	0.66	0.3	0.72	0.3	0.62	0.42
3	0.55	0.83	0.4	0.71	0.41	0.77	0.34	0.71	0.6
4	0.63	0.85	0.44	0.76	0.52	0.81	0.39	0.78	0.74
5	0.73	0.86	0.48	0.81	0.61	0.84	0.44	0.83	0.82
6	0.81	0.88	0.54	0.84	0.69	0.87	0.5	0.87	0.87
7	0.87	0.9	0.58	0.87	0.75	0.89	0.56	0.91	0.89
8	0.91	0.91	0.64	0.89	0.79	0.9	0.62	0.93	0.92
9	0.93	0.92	0.66	0.91	0.82	0.92	0.67	0.94	0.93
10	0.95	0.93	0.7	0.92	0.85	0.93	0.7	0.96	0.94
11	0.96	0.95	0.73	0.94	0.88	0.94	0.73	0.96	0.95
12	0.97	0.96	0.77	0.95	0.9	0.95	0.78	0.97	0.96
13	0.97	0.97	0.82	0.96	0.92	0.96	0.82	0.98	0.97
14	0.98	0.98	0.88	0.97	0.94	0.97	0.86	0.98	0.98
15	0.99	0.98	0.93	0.98	0.96	0.98	0.92	0.99	0.99
16	0.99	0.99	0.97	0.99	0.98	0.99	0.96	0.99	0.99
17	1	1	1	1	1	1	1	1	1

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.31. Data for "Figure 4.16. Percentage of Beneficiaries with Positive Inpatient Payments per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	4	5	6	5	5	5	4	5	4
-5	4	6	7	5	5	5	4	7	4
-4	5	8	8	7	6	6	5	9	4
-3	6	13	10	10	8	7	8	15	4
-2	11	28	13	19	13	10	21	28	5
-1	14	34	20	34	25	14	39	39	6
0	8	17	22	27	23	14	23	31	6
1	7	16	20	22	17	12	15	25	6
2	6	15	17	20	15	11	14	21	5
3	6	16	15	18	14	10	14	20	5
4	6	14	14	17	12	9	12	19	6
5	6	12	13	16	11	9	11	18	6
6	5	11	12	15	10	8	10	18	6
7	5	11	12	15	9	8	10	18	6
8	5	10	11	15	8	8	9	17	5
9	5	10	12	14	8	7	8	16	5
10	4	10	11	13	8	7	9	16	6
11	4	9	11	13	8	7	9	16	6
12	4	9	10	13	8	7	9	16	5
13	4	9	10	13	7	7	9	15	5
14	4	9	11	12	7	6	9	15	5
15	4	8	10	12	7	6	10	15	5
16	4	8	10	12	7	6	10	16	5
17	4	8	9	11	7	6	9	13	5

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.32. Data for "Figure 4.17. Average Inpatient Payments per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	280	641	786	491	428	466	377	554	328
-5	294	819	823	516	516	514	425	862	341
-4	344	1,173	1,183	676	648	593	580	1,121	366
-3	423	1,939	1,544	1,037	856	760	1,157	2,521	371
-2	688	4,469	2,448	2,328	1,658	1,246	3,491	5,013	413
-1	875	4,404	2,808	3,675	3,284	1,656	5,622	4,952	464
0	564	1,276	2,629	2,304	2,151	1,208	1,942	2,798	442
1	578	1,572	2,788	2,148	1,999	1,267	1,508	2,442	542
2	522	1,552	2,331	1,933	1,738	1,190	1,477	2,122	510
3	498	2,017	2,051	1,838	1,613	1,150	1,477	2,056	515
4	490	1,746	1,884	1,674	1,440	1,084	1,262	2,078	523
5	466	1,412	1,786	1,520	1,262	983	1,122	2,081	522
6	434	1,240	1,662	1,490	1,117	917	996	2,028	540
7	415	1,189	1,651	1,469	1,026	896	1,012	1,959	541
8	408	1,108	1,541	1,451	951	828	842	1,782	503
9	389	1,094	1,469	1,393	997	790	843	1,648	511
10	388	1,020	1,477	1,298	954	749	889	1,580	525
11	380	1,015	1,350	1,247	887	747	965	1,525	528
12	393	1,019	1,339	1,296	853	724	813	1,703	525
13	387	935	1,269	1,230	826	696	879	1,591	531
14	386	906	1,417	1,228	853	687	1,022	1,676	538
15	389	851	1,193	1,225	825	647	879	1,500	507
16	389	850	1,224	1,109	838	652	924	1,620	513
17	385	774	1,221	1,100	772	641	962	1,267	528

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.33. Data for "Figure 4.18. Percentage of Beneficiaries with Positive Skilled Nursing Facility or Home Health Payments per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	3	3	3	2	2	3	2	2	3
-5	3	3	3	2	2	3	2	2	3
-4	3	3	3	3	3	3	2	3	3
-3	4	5	3	3	3	4	3	4	4
-2	5	9	4	5	4	4	6	8	4
-1	7	12	6	9	7	6	14	12	4
0	5	11	7	10	8	7	11	11	4
1	5	8	7	9	8	6	9	10	4
2	5	10	7	10	7	7	8	10	4
3	4	9	6	9	7	6	7	9	4
4	4	11	6	8	6	6	7	8	4
5	4	8	6	8	6	5	6	9	4
6	4	8	5	8	5	5	6	8	5
7	4	7	5	7	5	5	5	8	5
8	4	6	5	7	4	5	5	8	5
9	4	6	5	7	4	5	4	8	5
10	4	6	5	7	4	5	5	7	5
11	4	6	5	7	4	5	4	8	5
12	4	6	5	7	4	5	5	7	5
13	4	5	5	7	4	4	4	7	5
14	4	5	5	7	4	4	4	7	5
15	4	5	5	7	4	4	5	6	5
16	4	5	5	6	4	4	5	7	5
17	4	5	5	6	4	4	5	6	5

Table A.34. Data for "Figure 4.19. Average Skilled Nursing Facility and Home Health Payments per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	105	113	124	83	91	112	73	74	119
-5	111	123	97	92	103	114	82	81	136
-4	131	154	136	103	115	123	79	118	156
-3	175	250	119	123	136	136	135	158	150
-2	179	387	155	198	175	167	265	343	138
-1	196	454	209	340	370	216	613	439	131
0	150	283	244	330	394	233	443	317	120
1	153	311	260	358	334	244	307	367	162
2	157	359	275	376	320	262	300	353	179
3	156	356	255	307	310	234	283	283	179
4	152	395	221	317	287	232	273	306	193
5	158	323	248	289	249	214	224	302	190
6	147	279	196	282	216	207	205	295	203
7	143	267	199	276	193	196	176	316	192
8	145	241	217	283	174	193	176	268	196
9	143	232	194	265	205	186	169	267	194
10	141	228	204	278	179	183	166	279	207
11	137	200	207	250	189	182	136	290	202
12	143	201	182	258	166	174	170	259	201
13	139	194	193	257	160	169	135	284	197
14	130	207	206	244	177	166	144	255	200
15	144	175	196	242	171	164	199	178	197
16	134	194	205	234	159	167	184	309	194
17	131	183	167	240	163	159	179	199	187

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.35. Data for "Figure 4.20. Percentage of Beneficiaries with Positive Hospice Payments per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	0	0	0	0	0	0	0	0	0
-5	0	0	0	0	0	0	0	0	0
-4	0	0	0	0	0	0	0	0	0
-3	0	0	0	0	0	0	0	0	0
-2	0	0	0	0	0	0	0	0	0
-1	0	0	0	0	0	0	0	0	0
0	0	1	1	2	1	1	1	3	0
1	1	2	2	5	1	2	2	9	1
2	1	3	2	7	2	3	3	12	1
3	1	3	2	8	2	3	3	14	1
4	1	4	3	8	2	3	4	13	1
5	1	4	3	9	2	3	4	13	1
6	1	4	3	9	2	3	4	13	1
7	1	4	2	10	2	3	4	14	1
8	1	4	2	10	2	3	4	14	1
9	1	4	2	10	2	3	4	14	1
10	1	5	2	10	2	3	5	14	2
11	1	5	2	10	2	3	5	13	2
12	1	5	2	10	2	3	5	14	2
13	1	5	2	10	2	2	4	13	2
14	1	5	2	10	2	2	5	12	2
15	1	5	2	10	2	2	5	13	2
16	1	5	2	9	2	2	5	13	2
17	1	4	2	9	2	2	5	11	2

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.36. Data for "Figure 4.21. Average Hospice Payments per Month Relative to Chemotherapy Initiation"

Months relative to chemotherapy initiation	Breast	Colorectal	Leukemia	Lung	Lymphoma	Other	Ovarian	Pancreas	Prostate
-6	6	3	4	3	2	5	2	3	5
-5	6	4	4	4	3	5	4	4	6
-4	6	4	4	5	4	5	5	4	6
-3	6	4	5	6	4	5	4	3	7
-2	7	4	5	7	4	6	5	5	7
-1	7	4	5	9	5	7	5	8	8
0	13	12	13	31	9	17	16	56	13
1	25	51	42	118	33	54	62	246	25
2	33	81	56	177	50	73	97	339	31
3	37	99	66	222	58	85	113	392	37
4	40	110	78	242	57	87	130	400	37
5	43	117	74	263	63	91	129	395	40
6	44	128	78	283	63	91	138	426	43
7	45	132	71	296	68	90	131	434	46
8	46	140	60	317	69	90	142	426	46
9	48	143	64	321	65	88	160	443	50
10	47	151	65	322	62	84	177	444	51
11	45	155	66	329	62	86	164	431	53
12	47	151	66	330	59	83	154	427	51
13	46	152	68	328	55	77	152	412	52
14	48	158	61	323	57	77	166	397	54
15	47	161	59	319	56	76	167	413	55
16	47	158	56	307	49	72	181	394	55
17	45	152	61	312	54	69	178	414	57

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.37a. Data for "Figure 4.22a. Average Total Medicare Spending per Month Relative to Chemotherapy Initiation, by Cancer Type and Quartile of Average Monthly Medicare Spending: Breast Cancer"

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	11	138	395	2,939
-5	12	145	420	3,109
-4	18	174	501	3,608
-3	32	229	661	4,467
-2	49	323	974	6,072
-1	70	410	1,264	7,094
0	376	995	2,431	8,634
1	122	563	1,810	8,607
2	123	558	1,655	8,218
3	123	520	1,388	7,639
4	94	440	1,221	7,206
5	84	399	1,087	6,815
6	85	377	1,005	6,350
7	67	325	884	5,930
8	63	310	832	5,674
9	63	304	796	5,424
10	57	289	763	5,279
11	55	281	751	5,171
12	58	287	738	5,029
13	41	243	649	4,763
14	33	225	619	4,651
15	30	211	588	4,605
16	24	192	545	4,503
17	19	174	510	4,441

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.37b. Data for "Figure 4.22b. Average Total Medicare Spending per Month Relative to Chemotherapy Initiation, by Cancer Type and Quartile of Average Monthly Medicare Spending: Colorectal Cancer"

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	0	70	297	4,282
-5	0	74	320	5,088
-4	1	97	396	6,714
-3	7	155	604	10,232
-2	45	404	1,757	20,192
-1	202	985	3,236	19,532
0	1,455	3,973	6,555	14,210
1	1,025	3,928	6,933	15,555
2	513	2,691	5,943	14,919
3	383	2,307	5,632	15,903
4	275	1,891	5,105	14,917
5	207	1,442	4,374	13,679
6	137	891	3,322	12,239
7	90	588	2,599	11,785
8	72	477	2,268	11,206
9	67	437	1,996	11,086
10	62	399	1,803	10,734
11	58	374	1,679	10,541
12	54	363	1,656	10,675
13	46	326	1,514	10,347
14	39	304	1,450	10,260
15	36	288	1,365	9,977
16	32	266	1,352	10,031
17	27	257	1,252	9,546

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.37c. Data for "Figure 4.22c. Average Total Medicare Spending per Month Relative to Chemotherapy Initiation, by Cancer Type and Quartile of Average Monthly Medicare Spending: Leukemia"

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	13	151	450	5,409
-5	14	151	458	5,485
-4	17	165	502	7,157
-3	23	188	569	8,641
-2	35	237	743	12,585
-1	89	467	1,455	14,552
0	1,353	5,119	9,026	21,481
1	397	3,384	7,554	20,819
2	216	1,784	5,870	17,998
3	164	1,176	5,098	16,731
4	128	753	4,042	15,473
5	98	565	3,211	14,862
6	89	495	2,567	14,052
7	75	425	2,184	13,718
8	67	387	2,005	13,070
9	66	392	1,956	12,786
10	61	369	1,828	12,902
11	64	375	1,908	12,505
12	68	382	1,884	12,677
13	59	357	1,739	12,142
14	50	330	1,737	12,762
15	41	296	1,447	11,664
16	40	284	1,326	11,601
17	35	254	1,163	11,218

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.37d. Data for "Figure 4.22d. Average Total Medicare Spending per Month Relative to Chemotherapy Initiation, by Cancer Type and Quartile of Average Monthly Medicare Spending: Lung Cancer"

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	1	103	380	3,772
-5	2	114	408	3,935
-4	5	141	490	4,758
-3	14	203	662	6,516
-2	57	426	1,303	12,193
-1	372	1,476	3,726	17,551
0	1,759	4,706	7,877	17,834
1	1,179	4,105	7,345	17,179
2	804	3,083	6,094	16,020
3	493	2,179	5,152	14,927
4	324	1,652	4,558	14,002
5	231	1,243	4,083	13,190
6	197	1,049	3,713	12,913
7	172	938	3,486	12,714
8	160	889	3,394	12,515
9	159	851	3,256	12,298
10	146	799	3,139	11,907
11	141	784	3,094	11,713
12	140	780	3,046	11,919
13	121	713	2,906	11,586
14	113	677	2,792	11,423
15	104	628	2,596	11,308
16	90	556	2,330	10,761
17	83	538	2,225	10,645

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.37e. Data for "Figure 4.22e. Average Total Medicare Spending per Month Relative to Chemotherapy Initiation, by Cancer Type and Quartile of Average Monthly Medicare Spending: Lymphoma"

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	3	110	385	3,702
-5	4	111	380	4,023
-4	6	129	431	4,676
-3	13	167	537	5,725
-2	37	292	918	9,413
-1	182	967	2,452	16,857
0	2,652	6,490	10,413	20,335
1	814	4,692	8,439	18,712
2	262	2,712	6,935	16,924
3	201	1,928	5,817	15,890
4	121	894	3,987	13,908
5	75	499	2,240	12,109
6	65	416	1,812	11,421
7	52	338	1,433	10,551
8	46	293	1,093	9,414
9	41	282	1,037	9,532
10	40	275	1,004	9,422
11	38	273	1,006	9,257
12	38	283	1,090	9,706
13	33	256	985	9,257
14	30	235	872	9,091
15	26	222	853	8,749
16	23	214	826	8,630
17	21	203	800	8,474

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.37f. Data for "Figure 4.22f. Average Total Medicare Spending per Month Relative to Chemotherapy Initiation, by Cancer Type and Quartile of Average Monthly Medicare Spending: Ovarian Cancer"

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	2	95	318	2,989
-5	3	97	324	3,214
-4	4	112	374	3,922
-3	12	155	517	6,578
-2	43	324	1,066	16,423
-1	180	936	4,978	22,627
0	825	2,168	4,340	13,897
1	603	1,854	4,000	12,309
2	591	1,865	3,989	12,447
3	486	1,680	3,865	12,263
4	331	1,277	3,256	11,177
5	163	843	2,614	10,389
6	104	587	2,111	9,753
7	82	466	1,872	9,676
8	81	455	1,786	9,039
9	76	441	1,717	9,272
10	79	439	1,857	9,389
11	77	455	1,827	9,584
12	83	479	1,893	9,241
13	76	463	1,837	9,370
14	73	471	1,932	10,018
15	67	472	1,967	9,581
16	63	451	1,860	9,641
17	68	450	1,871	9,783

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.37g. Data for "Figure 4.22g. Average Total Medicare Spending per Month Relative to Chemotherapy Initiation, by Cancer Type and Quartile of Average Monthly Medicare Spending: Pancreatic Cancer"

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	0	78	302	3,694
-5	1	89	341	5,048
-4	3	118	430	6,320
-3	14	190	695	12,260
-2	50	427	1,648	22,520
-1	348	1,330	4,240	20,925
0	2,274	4,307	7,008	17,572
1	1,985	4,399	6,821	16,944
2	1,275	3,781	5,893	15,392
3	965	3,464	5,616	15,009
4	785	3,153	5,264	14,957
5	587	2,821	5,022	14,972
6	452	2,318	4,713	14,528
7	307	1,802	4,341	14,366
8	268	1,583	4,087	13,452
9	229	1,333	3,832	12,941
10	187	1,242	3,665	12,668
11	187	1,173	3,629	12,727
12	166	1,108	3,495	13,114
13	152	961	3,315	12,866
14	136	936	3,226	12,782
15	131	900	3,123	11,905
16	115	861	3,009	12,754
17	100	745	2,774	11,154

Source: Authors' analysis of 2009–2012 CCW Medicare claims for patients with cancer and chemotherapy initiation in 2010.

Table A.37h. Data for "Figure 4.22h. Average Total Medicare Spending per Month Relative to Chemotherapy Initiation, by Cancer Type and Quartile of Average Monthly Medicare Spending: Prostate Cancer"

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	2	101	367	3,154
-5	0	78	296	3,201
-4	2	102	369	3,485
-3	5	120	397	3,536
-2	6	119	385	3,715
-1	18	178	562	4,168
0	513	905	1,377	5,404
1	14	169	570	6,039
2	12	163	583	6,992
3	30	267	803	7,442
4	28	266	824	6,874
5	11	153	538	5,840
6	23	223	717	5,580
7	10	151	526	5,174
8	12	166	582	4,971
9	13	171	574	4,955
10	9	142	482	4,996
11	9	140	483	4,968
12	25	228	738	5,302
13	12	164	573	5,191
14	6	128	457	5,092
15	7	137	496	4,991
16	6	134	502	5,026
17	3	115	444	5,013

Table A.38a. Data for "Figure 4.23. Average Total Medicare Payments per Month Relative to Chemotherapy Initiation, Beneficiaries with Colorectal Cancer, by Stage at Diagnosis (a. Stage 0)"

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	9	139	505	5,129
-5	7	166	619	4,945
-4	20	171	662	7,627
-3	44	226	741	8,735
-2	79	330	1,124	12,451
-1	103	460	1,413	15,932
0	618	1,846	5,660	15,567
1	194	1,203	5,443	15,544
2	118	625	2,990	10,801
3	165	961	2,942	11,250
4	87	505	2,108	12,974
5	95	480	1,846	9,814
6	78	521	1,838	10,936
7	67	503	1,440	7,322
8	63	380	1,117	7,912
9	73	483	1,848	9,583
10	62	410	1,695	7,308
11	57	354	1,203	8,156
12	60	430	1,578	11,857
13	29	211	924	8,632
14	35	227	952	6,380
15	61	435	1,541	9,465
16	40	264	998	10,250
17	46	258	980	8,081

Table A.38b. Data for "Figure 4.23. Average Total Medicare Payments per Month Relative to Chemotherapy Initiation, Beneficiaries with Colorectal Cancer, by Stage at Diagnosis (b. Stage I) "

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	6	133	419	4,454
-5	8	146	449	3,844
-4	8	146	471	5,333
-3	22	213	607	6,027
-2	42	303	888	9,187
-1	134	637	1,789	12,287
0	615	2,882	6,607	14,381
1	312	2,253	6,161	15,510
2	181	713	3,077	13,342
3	153	782	3,449	16,303
4	120	583	2,705	14,243
5	75	455	1,655	9,784
6	89	520	1,601	9,565
7	74	406	1,175	9,362
8	71	313	952	7,883
9	63	360	935	7,253
10	60	320	768	5,785
11	52	286	832	7,214
12	42	262	729	8,490
13	44	262	621	7,721
14	46	245	667	7,150
15	29	214	603	5,556
16	19	241	597	6,279
17	30	232	689	6,366

Source: Authors' analysis of 2003–2009 SEER-Medicare Medicare claims for patients with seven cancer types and chemotherapy initiation in 2003–2009.

Table A.38c. Data for "Figure 4.23. Average Total Medicare Payments per Month Relative to Chemotherapy Initiation, Beneficiaries with Colorectal Cancer, by Stage at Diagnosis (c. Stage II)"

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	0	75	298	5,033
-5	0	86	322	4,338
-4	1	99	388	6,565
-3	16	190	630	12,039
-2	44	399	1,685	19,837
-1	154	765	2,739	19,197
0	812	2,930	6,078	12,255
1	523	2,588	6,282	14,651
2	255	1,226	3,872	14,103
3	185	980	4,103	16,967
4	121	758	2,818	13,488
5	120	648	2,482	12,772
6	91	523	1,793	12,016
7	48	339	1,111	9,296
8	39	263	899	7,365
9	36	266	884	8,988
10	29	232	730	6,523
11	32	227	736	7,377
12	37	254	725	6,544
13	24	226	696	6,901
14	17	173	610	6,263
15	17	188	627	6,566
16	22	180	596	6,290
17	13	176	585	6,677

Source: Authors' analysis of 2003–2009 SEER-Medicare Medicare claims for patients with seven cancer types and chemotherapy initiation in 2003–2009.

Table A.38d. Data for "Figure 4.23. Average Total Medicare Payments per Month Relative to Chemotherapy Initiation, Beneficiaries with Colorectal Cancer, by Stage at Diagnosis (d. Stage 3) "

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	0	62	234	3,999
-5	0	68	294	4,958
-4	0	82	346	7,825
-3	-211	195	702	12,161
-2	115	720	7,179	26,971
-1	294	1,347	8,353	23,709
0	1,337	3,974	6,619	13,542
1	979	4,193	7,121	14,979
2	540	2,629	6,547	14,930
3	453	2,638	6,608	16,830
4	336	1,857	5,226	14,492
5	244	1,337	4,320	13,147
6	121	673	2,326	10,587
7	56	342	1,207	9,437
8	47	267	936	8,894
9	41	252	818	7,693
10	38	223	701	7,611
11	36	218	681	7,086
12	30	213	673	6,943
13	27	206	683	6,736
14	25	192	632	6,700
15	22	176	594	6,583
16	24	196	633	6,917
17	27	214	647	6,341

Source: Authors' analysis of 2003–2009 SEER-Medicare Medicare claims for patients with seven cancer types and chemotherapy initiation in 2003–2009.

Table A.38e. Data for "Figure 4.23e. Average Total Medicare Payments per Month Relative to Chemotherapy Initiation, Beneficiaries with Colorectal Cancer, by Stage at Diagnosis (e. Stage 4)"

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	0	51	201	4,183
-5	0	55	247	4,934
-4	0	66	319	7,931
-3	0	125	593	12,360
-2	35	434	2,800	24,669
-1	288	1,431	7,390	25,196
0	1,918	5,372	8,847	18,281
1	1,189	5,383	9,743	18,606
2	1,107	5,206	9,753	18,928
3	791	4,387	8,834	20,243
4	624	4,175	8,876	20,933
5	560	3,582	7,750	17,516
6	419	2,616	6,416	16,210
7	289	1,912	5,647	15,828
8	182	1,423	4,807	13,843
9	159	1,320	4,864	13,216
10	162	1,320	4,976	14,528
11	184	1,410	5,037	14,196
12	160	1,360	5,200	14,426
13	148	1,263	4,893	13,033
14	145	1,058	4,196	12,647
15	160	992	4,210	12,170
16	121	815	3,583	11,025
17	149	1,158	4,303	14,780

Table A.39a. Data for "Figure 4.24. Average Total Medicare Payments per Month Relative to Chemotherapy Initiation, Beneficiaries with Lung Cancer, by Stage at Diagnosis (a. Stage I)"

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	18	227	632	4,544
-5	34	252	681	5,702
-4	38	294	864	6,351
-3	75	431	1,157	9,636
-2	150	633	1,651	13,907
-1	320	1,236	2,992	16,455
0	1,211	3,604	6,430	14,855
1	741	3,342	6,109	14,999
2	526	2,089	4,754	14,760
3	281	1,269	3,602	12,053
4	216	999	3,170	12,895
5	144	720	2,709	14,120
6	121	630	2,165	9,468
7	121	572	1,881	10,642
8	103	522	2,033	11,260
9	89	500	1,881	10,069
10	99	504	1,740	10,358
11	90	487	1,600	9,252
12	89	480	1,483	10,848
13	87	456	1,438	9,030
14	101	490	1,728	9,209
15	86	428	1,342	7,902
16	79	487	1,446	8,786
17	86	458	1,444	8,896

Source: Authors' analysis of 2003–2009 SEER-Medicare Medicare claims for patients with seven cancer types and chemotherapy initiation in 2003–2009.

Table A.39b. Data for "Figure 4.24. Average Total Medicare Payments per Month Relative to Chemotherapy Initiation, Beneficiaries with Lung Cancer, by Stage at Diagnosis (b. Stage II)"

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	3	141	412	7,723
-5	12	172	507	4,433
-4	14	200	634	5,535
-3	60	419	1,245	10,176
-2	190	896	2,398	18,967
-1	330	1,304	4,751	21,588
0	1,302	3,567	6,410	14,935
1	1,158	3,500	5,867	16,086
2	724	2,649	4,697	13,916
3	309	1,457	3,434	11,528
4	166	846	2,442	10,898
5	93	547	1,888	9,581
6	111	519	1,677	8,379
7	79	458	1,468	9,661
8	57	376	1,348	8,231
9	78	476	1,297	9,419
10	76	383	1,177	10,023
11	82	395	1,150	9,153
12	72	388	1,311	9,225
13	99	422	1,436	11,947
14	73	417	1,242	7,160
15	78	384	1,134	7,250
16	68	396	1,292	9,298
17	74	432	1,274	8,879

Source: Authors' analysis of 2003–2009 SEER-Medicare Medicare claims for patients with seven cancer types and chemotherapy initiation in 2003–2009.

Table A.39c. Data for "Figure 4.24c. Average Total Medicare Payments per Month Relative to Chemotherapy Initiation, Beneficiaries with Lung Cancer, by Stage at Diagnosis (c. Stage III)"

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	0	99	349	3,269
-5	1	107	370	3,741
-4	5	140	466	5,030
-3	15	222	737	7,370
-2	80	479	1,369	12,348
-1	501	1,704	4,125	17,360
0	1,965	4,863	7,644	18,358
1	1,478	4,597	7,606	17,062
2	873	3,095	5,884	15,917
3	496	2,215	4,939	15,776
4	328	1,574	4,079	14,093
5	223	1,127	3,480	12,198
6	173	908	3,099	12,412
7	157	844	2,886	12,965
8	140	721	2,769	12,166
9	132	683	2,494	12,155
10	111	617	2,335	11,178
11	115	635	2,399	10,798
12	99	541	2,082	10,426
13	97	554	2,188	10,845
14	101	557	2,176	10,977
15	96	533	2,218	14,348
16	88	516	2,190	10,498
17	77	519	2,030	10,979

Source: Authors' analysis of 2003–2009 SEER-Medicare Medicare claims for patients with seven cancer types and chemotherapy initiation in 2003–2009.

Table A.39d. Data for "Figure 4.24. Average Total Medicare Payments per Month Relative to Chemotherapy Initiation, Beneficiaries with Lung Cancer, by Stage at Diagnosis (d. Stage IV)"

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	0	80	306	2,565
-5	0	91	350	3,230
-4	2	114	400	4,097
-3	6	160	522	5,859
-2	47	393	1,216	11,486
-1	494	1,907	5,595	19,648
0	2,100	4,993	8,576	20,029
1	1,364	4,117	7,372	18,402
2	1,035	3,417	6,322	15,780
3	797	3,165	5,949	15,501
4	593	2,616	5,445	15,154
5	389	1,885	5,009	15,723
6	313	1,814	4,984	14,731
7	304	1,722	4,751	15,027
8	293	1,781	4,886	14,577
9	243	1,628	4,666	13,679
10	278	1,591	4,777	13,682
11	248	1,604	4,827	13,435
12	282	1,729	4,832	14,292
13	279	1,665	4,738	13,480
14	235	1,839	4,961	15,726
15	229	1,497	4,492	14,022
16	227	1,414	4,347	12,072
17	179	1,202	4,361	13,821

Table A.40a. Data for "Figure 4.25. Average Total Medicare Payments per Month Relative to Chemotherapy Initiation, Beneficiaries with Lymphoma, by Stage at Diagnosis (a. Stage I)"

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	3	109	366	3,880
-5	6	118	368	3,849
-4	9	133	414	4,186
-3	16	164	543	7,254
-2	65	355	994	10,147
-1	294	1,183	2,538	13,930
0	2,187	6,088	9,193	18,694
1	1,241	5,044	8,023	17,006
2	567	3,882	7,074	16,715
3	358	2,518	5,946	15,600
4	149	1,077	4,036	13,731
5	84	469	1,899	9,575
6	65	382	1,406	8,774
7	44	292	965	8,805
8	46	234	804	6,775
9	29	246	832	7,398
10	24	198	769	7,434
11	32	252	755	6,458
12	30	224	864	8,653
13	20	211	761	7,902
14	24	219	909	10,281
15	29	202	864	8,944
16	20	200	764	7,615
17	20	179	695	7,070

Source: Authors' analysis of 2003–2009 SEER-Medicare Medicare claims for patients with seven cancer types and chemotherapy initiation in 2003–2009.

Table A.40b. Data for "Figure 4.25b. Average Total Medicare Payments per Month Relative to Chemotherapy Initiation, Beneficiaries with Lymphoma, by Stage at Diagnosis (b. Stage II)"

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	3	113	343	3,534
-5	1	87	351	3,075
-4	4	125	407	3,452
-3	13	194	532	4,903
-2	60	429	1,169	8,908
-1	429	1,519	3,235	18,431
0	2,774	6,503	10,103	19,564
1	1,586	5,169	8,287	16,775
2	712	4,850	7,677	15,230
3	468	3,508	6,873	15,214
4	203	1,500	4,591	13,197
5	116	670	2,532	9,593
6	97	494	1,518	12,608
7	70	433	1,523	10,938
8	63	326	1,084	9,068
9	54	324	1,117	10,122
10	33	274	977	8,187
11	50	295	989	9,789
12	55	300	1,036	9,853
13	28	234	762	6,776
14	39	229	812	9,578
15	50	287	1,023	8,145
16	32	252	898	7,373
17	32	253	975	7,664

Source: Authors' analysis of 2003–2009 SEER-Medicare Medicare claims for patients with seven cancer types and chemotherapy initiation in 2003–2009.

Table A.40c. Data for "Figure 4.25c. Average Total Medicare Payments per Month Relative to Chemotherapy Initiation, Beneficiaries with Lymphoma, by Stage at Diagnosis" (c. Stage III)"

Months relative to chemotherapy initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	1	83	307	2,791
-5	2	112	330	3,627
-4	3	107	368	2,885
-3	10	136	449	4,201
-2	49	329	985	8,521
-1	383	1,384	3,601	21,360
0	2,554	5,973	9,176	20,191
1	1,337	5,321	8,882	17,944
2	632	4,353	7,826	17,749
3	366	3,261	6,554	14,845
4	196	1,297	4,686	14,930
5	85	669	3,010	12,924
6	68	541	1,836	10,654
7	63	359	1,380	10,741
8	36	303	1,076	11,154
9	52	327	1,228	9,771
10	30	276	1,125	10,943
11	44	288	956	7,104
12	44	273	938	8,549
13	27	292	989	9,636
14	31	243	820	7,094
15	30	266	984	8,510
16	31	254	1,004	8,226
17	22	230	844	7,386

Source: Authors' analysis of 2003–2009 SEER-Medicare Medicare claims for patients with seven cancer types and chemotherapy initiation in 2003–2009.

Table A.40d. Data for "Figure 4.25. Average Total Medicare Payments per Month Relative to Chemotherapy Initiation, Beneficiaries with Lymphoma, by Stage at Diagnosis (d. Stage IV)"

Months relative to chemotherapy Initiation	Lowest quartile	Second quartile	Third quartile	Highest quartile
-6	0	74	305	3,552
-5	0	76	345	3,812
-4	0	100	383	4,248
-3	11	166	493	6,679
-2	54	360	1,111	12,147
-1	387	1,469	4,468	21,366
0	2,898	7,013	10,883	20,751
1	1,804	5,485	8,783	18,871
2	560	4,017	7,682	17,537
3	400	3,092	6,752	15,831
4	205	1,440	4,575	12,337
5	128	771	2,812	12,937
6	81	495	2,338	12,290
7	54	428	1,793	12,723
8	55	367	1,353	13,297
9	50	380	1,277	11,966
10	53	350	1,350	10,084
11	42	309	1,090	8,648
12	48	322	1,137	10,055
13	36	269	954	7,714
14	37	257	1,023	9,573
15	32	245	898	9,019
16	30	265	1,024	8,020
17	38	276	1,009	8,376

Source: Authors' analysis of 2003–2009 SEER-Medicare Medicare claims for patients with seven cancer types and chemotherapy initiation in 2003–2009.