End-of-Life Services Among Patients With Cancer: Evidence From Cancer Registry Records Linked With Commercial Health Insurance Claims

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QUESTION ASKED: Using a database of commercial insurance claims linked to the Western Washington State SEER registry, we investigated patterns of care to identify areas for improvement and to inform future interventions to enhance end-of-life care for patients with cancer.

SUMMARY ANSWER: Our results suggest that problems with overuse of aggressive care and underuse of palliative and hospice services affect populations of younger patients with commercial insurance as well as Medicare enrollees and that this persisted through 2015.

WHAT WE DID: We included persons ≥ 18 years of age who had been diagnosed with an invasive solid tumor between January 1, 2007, and December 31, 2015, and who had a recorded death date, were enrolled in a commercial plan for the last month of life, and made at least one insurance claim in the last 90 days of life.

WHAT WE FOUND: In the last month of life, among 6,568 commercially insured patients, 56.3% were hospitalized, 48.6% had had at least one imaging scan, 18.5% had received chemotherapy, and 9.8% were given radiation. During the last 14 days of life, 7.8% of patients underwent chemotherapy. Among patients younger than 65 years, 31.4% were enrolled in hospice; of those not enrolled in hospice, 40.5% had received an opioid prescription. Over time, opioid use in the last 30 days of life among those not enrolled in hospice dropped from 44.7% in the period 2007 to 2009 to 42.5% in the period 2010 to 2012 and to 36.7% in the period 2013 to 2015 ($P < .01$).

BIAS, CONFOUNDING FACTOR(S), REAL-LIFE IMPLICATIONS: This is a retrospective claims analysis; as such, we cannot evaluate patient, physician, or family or caregiver care preferences. The time horizon for this study is before the enactment of newer current procedural terminology billing codes for palliative care consultations; thus, we cannot evaluate whether consultations affected outcomes. Because we were unable to access hospice claims, outpatient medication use, or claims on the day of death for patients older than 65 years of age, we report hospice use, opioid use, and place of death for patients under 65 years of age. Our findings identify areas for additional investigation to improve end-of-life care for patients with cancer, especially those younger than 65 years of age. Policies that facilitate appropriate imaging, opioid, and hospice use and encourage supportive care may offer improvement in end-of-life service provision and quality of life. JOP

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ASSOCIATED CONTENT

Appendix available online

Abstract

Purpose

Despite guidelines emphasizing symptom management over aggressive treatment, end-of-life care for persons with cancer in the United States is highly variable. In consultation with a regional collaboration of patients, providers, and payers, we investigated indicators of high-quality end-of-life care to describe patterns of care, identify areas for improvement, and inform future interventions to enhance end-of-life care for patients with cancer.

Methods

We linked insurance claims to clinical information from the western Washington SEER database. We included persons ≥ 18 years of age who had been diagnosed with an invasive solid tumor between January 1, 2007, and December 31, 2015, and who had a recorded death date, were enrolled in a commercial plan for the last month of life, and made at least one insurance claim in the last 90 days of life.

Results

In the last month of life, among 6,568 commercially insured patients, 56.3% were hospitalized and 48.6% underwent at least one imaging scan. Among patients younger than 65 years of age, 31.4% were enrolled in hospice; of those younger than 65 years of age who were not enrolled in hospice, 40.5% had received an opioid prescription. Over time, opioid use in the last 30 days of life among young adults not enrolled in hospice dropped from 44.7% in the period 2007 to 2009 to 42.5% in the period 2010 to 2012 and to 36.7% in the period 2013 to 2015.

Conclusion

Hospitalization and high-cost imaging scans are burdensome to patients and caregivers at the end of life. Our findings suggest that policies that facilitate appropriate imaging, opioid, and hospice use and that encourage supportive care may improve end-of-life care and quality of life.

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INTRODUCTION

During the last few weeks or months of life of a patient with cancer, clinical guidelines recommend changes in patient management, with less focus on aggressive cancer treatment and more focus on relieving symptoms and clarifying goals of care.[1] Studies suggest that a lower intensity of care at the end of life is associated with a higher quality of life for patients and higher satisfaction with care among family members.[2] Despite such guidelines, end-of-life care for persons with cancer in the United States is highly variable in intensity.[3]

Improving cancer care delivery at end of life may decrease the burden for patients and families as they avoid costly interventions that do not increase the length or quality of life. One study found that patients who avoid hospitalization have the highest quality of life at the end of life,[4] whereas chemotherapy near death is associated with decreased quality of life and a reduction in performance status among healthier patients.[5]

To better understand ways to improve cancer care delivery and value in cancer care, we established a regional consortium of patients, clinicians, researchers, and health plan representatives. With our consortium partners, we created a database linking commercial insurance claims to cancer registry and death records. In conjunction with consortium stakeholder input, published literature,[6,7] and society guidelines,[8,9] we identified high-priority quality indicators for palliative and end-of-life care. Data on care patterns for commercially insured adults are needed, because previous studies on end-of-life care in the United States have focused largely on the Medicare population. Studies describing care patterns for patients with cancer who are younger than 65 years of age have focused on Medicaid recipients,[10] enrollees in a single integrated delivery system,[11,12] or commercially insured patients at a single tertiary center.[13] Using this unique database, we describe patterns of care in this population of commercially insured adults in western Washington State and identify areas for care delivery enhancement and future interventions to improve end-of-life care for patients with cancer.

METHODS

Setting and Study Population

Fred Hutchinson Cancer Research Center investigators conducted this study with leaders at Regence Blue Shield and Premera Blue Cross, two not-for-profit commercial insurers. We linked health plan enrollment files to cancer registry records from the Western Washington Cancer Surveillance System (CSS). As part of the National Cancer Institute's SEER registry, the CSS collects comprehensive information on staging, initial treatment, and survival for persons diagnosed with malignancies in western Washington.[14] The linked database includes 80,377 persons ≥ 18 years of age who were diagnosed with cancer between January 1, 2007, and December 31, 2015, representing 37% of people with cancer as recorded by the CSS registry during the same time period.

For this study, we included individuals who had a known date of cancer diagnosis, a solid tumor, and a non–in situ diagnosis, and who were not diagnosed on the day of their death. After linkage of CSS and insurance enrollment records, we extracted claims for inpatient stays, outpatient visits, and pharmacy claims. We restricted our study population to patients with cancer with a recorded death date who made at least one claim in their last 90 days of life and who were enrolled continuously in their insurance plan during their last month of life.

Defining and Identifying Recommended and Undesirable End-of-Life Services

We convened a multistakeholder panel consisting of community and academic clinicians, health insurance executives, and patient advocates to establish the most salient measures of interest. The group reviewed services that are recommended at end of life (eg, use of pain medications, hospice admission) as well as those that are not recommended (eg, advanced imaging scans) or are considered not desirable (eg, emergency department [ED] visits, hospitalizations).[15] Appendix Table A1 (online only) contains the final list of metrics and the corresponding evaluation and management codes used to identify specific services and events.

Hospice services include both inpatient and outpatient care and were identified using procedure, revenue center, and place of service codes. To restrict the measure to patients who enrolled in hospice, rather than those who only had a hospice consult, patients were required to have two hospice claims on different days. Once a patient was flagged with two hospice claims, he or she was considered to be in hospice continuously until death. Because hospice claims were unavailable for all patients older than 65 years of age, we excluded these patients from our hospice analysis. We report opioid use in the last month of life for those younger than 65 years of age who were not enrolled in hospice, because pharmacy claims were unavailable after hospice enrollment and for some patients older than 65 years of age.

Place of death was determined by the location of service for claims on the day of and the day before the day of death, as recorded in the cancer registry. Codes on the claims for inpatient service, ED, nursing home, and hospice were identified for each patient. If multiple locations of service were captured, then the patient was assigned to the location with the highest intensity of care, in the following order, from most to least intense: (1) inpatient, (2) ED, (3) nursing home, and (4) hospice. Patients with no claims or only outpatient claims where classified as Other/Home. Because claims on the day of death were not available for all patients older than 65 years of age, we report the place of death for enrollees who were 18 to 64 years of age.

We created separate groups for patients with the most commonly occurring cancers in our sample, including breast, lung, colorectal, and pancreatic cancers. We grouped cervical, uterine, ovarian, and vaginal cancers in one group as gynecologic malignancy. Given the small number of patients in each group and the small number of decedents in the case of prostate cancer, we categorized the remaining solid tumor cancer diagnoses of bladder, head and neck, kidney, liver, melanoma, prostate, and thyroid under the category of other.

Statistical Analysis

We performed a descriptive analysis of the demographics of the population and determined the percentage of patients receiving recommended or less desirable end-of-life health care services. We constructed multivariate logistic regression models to evaluate the association between health care use at the end of life and demographic factors such as age, sex, ethnicity, and marital status. We fit a logistic regression model for chemotherapy use in the last 14 days of life and each of the following outcomes in the last 30 days of life: hospitalization, ED visit, any imaging receipt, radiation, chemotherapy, hospice enrollment, and use of opioid medication. Imaging receipt included computed tomography (CT) scan, magnetic resonance imaging (MRI) scan, positron emission tomography (PET) scan, and bone scan. Because we included patients in our sample who had lived for < 30 days after diagnosis, in each regression we controlled for the number of days observed between cancer diagnosis and death. We measured trends in health care use over three time periods (2007 to 2009, 2010 to 2012, and 2013 to 2015) and performed a Cochrane-Armitage test for trend. We used Stata version 14.1 (STATA, College Station, TX) for all statistical analyses.

The Fred Hutchinson Cancer Research Center Institutional Review Board approved this study.

RESULTS

The linkage of Western Washington SEER cancer registry and insurance enrollment files identified 80,377 unique individuals with cancer who were ≥ 18 years of age at the time of diagnosis, 395 of whom were later excluded because of a lack of diagnosis date, diagnosis at autopsy, diagnosis via death certificate, or death on the day of diagnosis. We excluded 65,272 patients who did not die during the study period, 1,783 persons without an invasive solid tumor, and 6,359 persons who were not enrolled in either insurance plan for their last month of life or did not make a claim in the last 90 days of life. We included 6,568 persons in our final analysis.

Table 1 lists the demographic characteristics of this commercially insured population, both overall and by cancer type. Of 6,568 people, 61% were ≥ 65 years of age, 50% were female, 93% were white, and 58% were married at the time of diagnosis. Approximately one half of patients (46%) were diagnosed with metastatic disease; this varied from 22% of patients with breast cancer to 68% of patients with lung cancer. Across all cancers, median survival was 342 days after diagnosis. We observed the lowest median survival after diagnosis among patients with pancreatic cancer (182 days) and the highest among patients with breast cancer (990 days).

Patterns of Care

In Table 2, we present health care use during the last month of life, overall and by specific cancer type. During their last 30 days, more than one half of patients (56.3%) were hospitalized, whereas 48.6% received at least one advanced imaging scan. Most scans were CT scans (44.6% of participants); 12.8% of participants underwent an MRI scan, and 4.9% underwent PET or a bone scan. Across all imaging types, the majority of scans occurred in inpatient settings. Almost one fifth of patients received chemotherapy and/or radiation in their last 30 days; 18.5% of patients received chemotherapy, whereas 9.8% received radiation. During the last 14 days of life, 512 patients (7.8%) received chemotherapy. Less than one third of patients (31.4%) younger than 65 years of age were enrolled in hospice for the last 30 days of life. Of those younger than 65 years of age who were not enrolled in hospice, 40.5% received an opioid prescription in their last month of life.

Table 1. Demographic Characteristics of the Study Sample

	Cancer Site						
Characteristic	Breast (n = 482)	Lung (n = 1,625)	Colorectal (n = 609)	Gynecologic Malignancy (n = 428)	Pancreatic (n = 506)	Other (n = 2,918)	Total (N = 6,568)
Age at diagnosis, years, No. (%)							
< 50	75 (16)	62 (4)	74 (12)	46 (10)	18 (4)	211 (7)	486 (7)
50-64	150 (31)	534 (33)	156 (26)	153 (36)	176 (35)	923 (32)	2,092 (32)
≥ 65	257 (53)	1,029 (63)	379 (62)	229 (54)	312 (62)	1,784 (61)	3,990 (61)
Female, No. (%)	471 (98)	848 (52)	309 (51)	428 (100)	241 (48)	976 (33)	3,273 (50)
White, No. (%)	456 (95)	1,530 (94)	566 (93)	400 (93)	469 (93)	2,711 (93)	6,132 (93)
Married, No. (%)	239 (50)	947 (58)	303 (50)	204 (48)	315 (62)	1,774 (61)	3,782 (58)
State at diagnosis, No. (%)							
Localized	172 (36)	159 (10)	107 (18)	66 (15)	28 (6)	970 (33)	1,502 (23)
Regional	180 (37)	288 (18)	158 (26)	86 (20)	135 (27)	631 (22)	1,478 (23)
Distant	106 (22)	1,100 (68)	295 (48)	255 (60)	306 (60)	956 (33)	3,018 (46)
Unknown	24 (5)	78 (5)	49 (8)	21 (5)	37 (7)	361 (12)	570 (9)
Year of death, No. (%)							
2007-2009	30 (6)	309 (19)	82 (13)	55 (13)	89 (18)	398 (14)	963 (15)
2010-2012	181 (38)	635 (39)	253 (42)	179 (42)	217 (43)	1168 (40)	2628 (40)
2013-2015	271 (56)	681 (42)	274 (45)	194 (45)	200 (40)	1357 (47)	2977 (45)
Age at death, years, mean (SD)	70.4 (16.3)	70.8 (12.1)	71.8 (16.7)	69.3 (14.3)	70.5 (12.0)	71.1 (14.1)	70.9 (13.9)
No. days from diagnosis to death, mean (SD)	1,055 (690)	363 (423)	654 (618)	712 (627)	297 (368)	570 (594)	551 (585)
No. days from diagnosis to death, median	990	205	498	547	182	370	342

Abbreviation: SD, standard deviation.

Use Trends Over Time

Figure 1 notes trends in health care use over the last 30 days of life for the different years of this study. We report the significance of Cochrane-Armitage tests for trend together with each finding. Hospice use among patients younger than 65 years of age increased from 27.5% in the period 2007 to 2009 to 34.1% in the period 2010 to 2012, before dropping to 30.4% in the period 2013 to 2015 ($P = .75$). Over time, opioid use dropped from 44.7% in the period 2007 to 2009 to 42.5% in the period 2010 to 2012 and to 36.7% in the period 2013 to 2015 ($P < .01$).

Among all patients, ED visits in the last 30 days of life peaked at 14.1% in the 2010 to 2012 period after starting at 12.9% in the 2007 to 2009 period, then dropped to 12.3% in the 2013 to 2015 period ($P = .25$). Hospitalization in the last month of life decreased over time, from 60.3% to 57.5% and then to 54% ($P < .01$). Chemotherapy use also declined, from 22.2% to 20.2% and then to 15.8% in the last 30 days of life ($P < .01$) and from 10.5% to 8.3% and then to 6.5% in the last 2 weeks of life ($P < .01$). We found a significant decrease in radiation receipt in the last month of life, from 13% to 11% and then to 8% across the three time periods ($P < .01$). We found no significance in trends in CT ($P = .24$) or MRI ($P = .31$) use over time; however, the trend in PET and bone scans was significant ($P < .01$).

Location of Death

Among 2,578 decedents younger than 65 years of age, the locations at death were as follows: hospice (40.1%), hospital inpatient (33.3%), home or other (22.0%), nursing home (2.5%), and ED (2.1%). The highest percentage of patients dying in hospice care (48.2%) was among women with a gynecologic malignancy; this group also had the lowest percentage of patients dying in the hospital (24.6%). Patients with breast cancer were the most likely to die in the hospital (41.3%) and the least likely to die in hospice care (32.4%). Among

Table 2. Health Care Use Within 30 Days of Death, by Cancer Site and Overall

	Cancer Site						
EOL Service or Event	Breast (n = 482)	Lung (n = 1,625)	Colorectal (n = 609)	Gynecologic Malignancy (n = 428)	Pancreatic (n = 506)	Other (n = 2,918)	Total (N = 6,568)
Radiation or chemotherapy use*	129 (26.8)	534 (32.9)	116 (19.0)	138 (32.2)	115 (22.7)	628 (21.5)	1,660 (25.3)
Radiation therapy	39 (8.1)	288 (17.8)	24 (3.9)	28 (6.5)	12 (2.4)	252 (8.6)	643 (9.8)
Chemotherapy	105 (21.8)	339 (20.9)	102 (16.7)	123 (28.7)	106 (20.9)	440 (15.1)	1,215 (18.5)
Any imaging use*	215 (44.6)	850 (52.3)	282 (46.3)	188 (43.9)	251 (49.6)	1,403 (48.1)	3,189 (48.6)
CT scan	196 (40.7)	763 (47.0)	267 (43.8)	179 (41.8)	244 (48.2)	1,282 (43.9)	2,931 (44.6)
Inpatient CT scan	188 (39.0)	701 (43.1)	251 (41.2)	167 (39.0)	214 (42.3)	1,196 (41.0)	2717 (41.4)
MRI	67 (13.9)	278 (17.1)	37 (6.1)	34 (7.9)	44 (8.7)	383 (13.1)	843 (12.8)
Inpatient MRI scan	64 (13.3)	247 (15.2)	33 (5.4)	32 (7.5)	43 (8.5)	338 (11.6)	757 (11.5)
PET or bone scan	31 (6.4)	122 (7.5)	16 (2.6)	14 (3.3)	10 (2.0)	130 (4.5)	323 (4.9)
Inpatient PET or bone scan	26 (5.4)	100 (6.1)	13 (2.1)	12 (2.8)	9 (1.8)	113 (3.9)	273 (4.2)
High-intensity events							
Hospitalization with or without ICU stay	260 (53.9)	930 (57.2)	348 (57.1)	238 (55.6)	280 (55.3)	1,645 (56.4)	3,701 (56.3)
One hospitalization, no ICU stay	75 (15.6)	253 (15.6)	109 (17.9)	85 (19.9)	108 (21.3)	468 (16.0)	1098 (16.7)
Two or more hospitalizations, no ICU stay	21 (4.4)	90 (5.5)	20 (3.3)	33 (7.7)	25 (4.9)	111 (3.8)	300 (4.6)
Hospitalization with ICU stay	164 (34.0)	587 (36.1)	219 (36.0)	120 (28.0)	147 (29.1)	1,066 (36.5)	2303 (35.1)
ED visits	46 (9.5)	230 (14.2)	57 (9.4)	61 (14.3)	63 (12.5)	402 (13.8)	859 (13.1)
One	39 (8.1)	200 (12.3)	52 (8.5)	54 (12.6)	53 (10.5)	349 (12.0)	747 (11.4)
Two or more	7 (1.5)	30 (1.8)	5 (0.8)	7 (1.6)	10 (2.0)	53 (1.8)	112 (1.7)
Recommended services							
Hospice admission† (inpatient or outpatient)	64 (28.4)	177 (29.7)	79 (34.3)	75 (37.7)	69 (35.6)	347 (30.6)	811 (31.4)
One or more opioid prescription filled‡	63 (39.1)	195 (46.5)	56 (37.1)	49 (39.5)	55 (44.0)	297 (37.7)	715 (40.5)

NOTE. Data are presented as No. (%).

Abbreviations: CT, computed tomography; ED, emergency department: EOL, end of life; ICU, intensive care unit; MRI, magnetic resonance imaging; PET, positron emission tomography.

*Patients may have received more than one type of imaging scan or may have received both radiation and chemotherapy.

†For people younger than 65 years of age (total n = 2,578).

‡Among people younger than 65 years of age not enrolled in hospice (total n = 1,767).

patients with pancreatic, colorectal, and lung cancers, the percentages dying in hospice were smaller, at 45.9%, 42.2%, and 38.4%, respectively, and the percentages dying in inpatient settings were 30.4%, 31.7%, and 35.1%, respectively.

Logistic Regression

Adjusting for type of cancer, we found that female sex (odds ratio [OR], 0.79; 95% CI, 0.70 to 0.89) was significantly associated with lower odds of inpatient hospitalization. We found no association between ED use at the end of life and any demographic variables including sex, ethnicity, age, and marital status.

Among enrollees younger than 65 years of age, women (OR, 0.73; 95% CI, 0.61 to 0.87) were 27% less likely to receive opioids in the last 30 days of life compared with men. Patients of nonwhite ethnicity were statistically less likely to enroll in hospice (OR, 0.60; 95% CI, 0.44 to 0.82) or to receive opioids (OR, 0.54; 95% CI, 0.40 to 0.72) compared with white patients.

Female patients (OR, 0.85; 95% CI, 0.76 to 0.96) and nonmarried individuals (OR, 0.87; 95% CI, 0.78 to 0.97) were less likely to receive any imaging scans in their last 30 days of life. Unmarried patients were less likely to receive chemotherapy (OR, 0.71; 95% CI, 0.62 to 0.82) in the last 30 days or last 14 days of life (OR, 0.68; 95% CI, 0.56 to 0.83). Each 1 year increase in age was associated with a reduced likelihood of receiving radiation (OR, 0.82; 95% CI, 0.68 to 0.99).

DISCUSSION

In our cohort of commercially insured adults, we found that a majority of patients received imaging scans, radiation, or

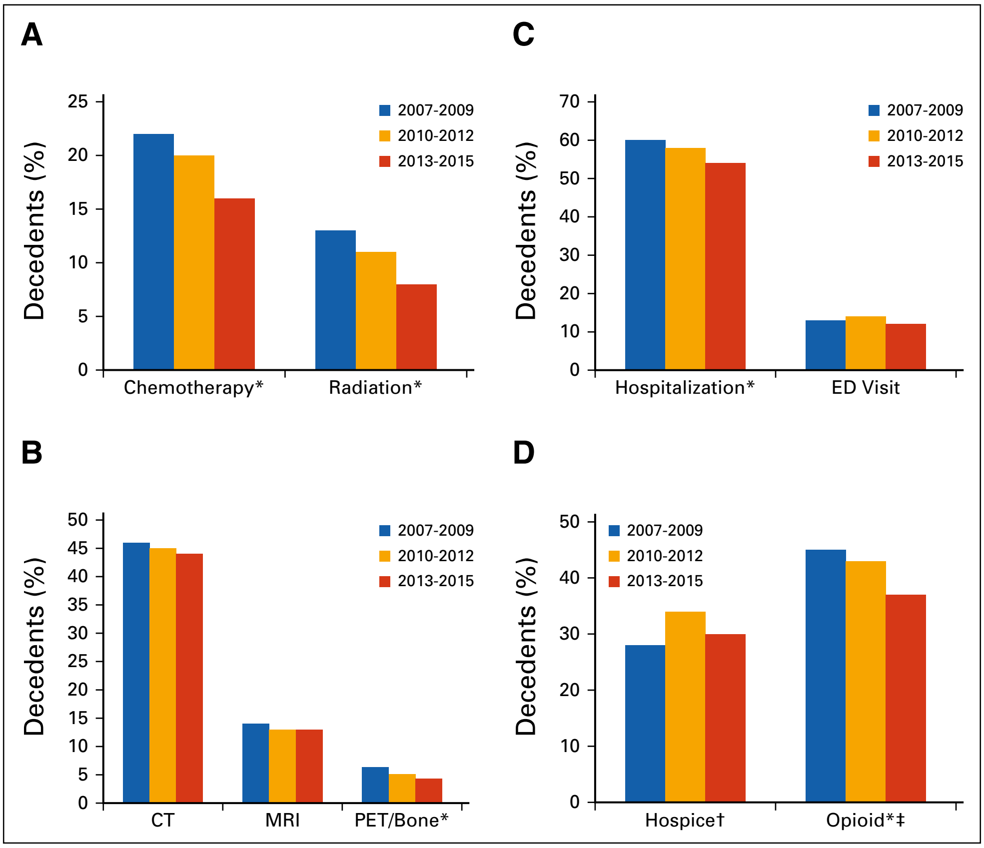

Fig 1. Trends in health care use in the last 30 days of life by year of death and percentage of decedents: (A) chemotherapy or radiation use, (B) imaging use, (C) hospitalization and ED visits, (D) hospice and opioid use. Overall, 963 patients died between 2007 and 2009, 2,628 between 2010 and 2012, and 2,977 between 2013 and 2015. (*) Statistically significant trend over time. (†) For people under 65 years of age: 426 died between 2007 and 2009, 1,088 died between 2010 and 2012, and 1,064 died between 2013 and 2015. (‡) Under 65 years, not enrolled in hospice. CT, computed tomography; ED, emergency department; MRI, magnetic resonance imaging; PET, positron emission tomography.

chemotherapy in the last 30 days of life, and almost one half experienced a hospitalization or emergency room visit. This high observed use may be, in part, a result of insurance structure and incentives, because our study population is composed of people with fee-for-service commercial insurance. As previous studies have noted, when compared with patients in a health maintenance organization or capitation model, those with fee-for-service insurance have higher-intensity health care use at the end of life.[16,17]

Many of our findings align with those of previous studies, because we also note that men with cancer are more likely to experience hospitalization in the last month of life compared with women.[18] Of patients younger than 65 years of age who were not enrolled in hospice, 40.5% received a prescription for an opioid medication, similar to the findings of earlier studies.[19] We found that 33% of younger patients died in the hospital, comparable to the 28% observed in a study of commercially insured patients with cancer who died between July 2010 and December 2013.[13] Although chemotherapy use in the last days of life among Medicare enrollees has stayed steady over time at approximately 4.5%,[20] we observed a downward trend over time. This may have been caused by increased acceptance of palliative care interventions or a reduced offering of chemotherapy by practitioners.

One third of patients younger than 65 years of age enrolled in hospice for the last month of life; other researchers noted 24% to 32% enrollment in hospice among Medicaid-enrolled adults 21 to 64 years of age who had been diagnosed with stage IV lung cancer between 2002 and 2006.[10] This finding may be the result of patient and provider preferences for more aggressive interventions rather than palliative care for younger patients. In one study, despite a documented preference for comfort care, 75% of young adults with advanced cancer received aggressive end-of-life care.[12] Among younger adults, palliative care is more likely to be initiated close to death,[21] and if hospice is elected, stays are shorter[22] compared with adults older than 65 years of age.

Almost one half of patients in this study (48.6%) received an advanced imaging scan. This percentage is higher than the 34.3% observed by Hu et al[23] among Medicare beneficiaries with stage IV cancer diagnosed between 2002 and 2006. Unfortunately, because we did not have access to electronic medical records, we do not know the reasons these imaging scans were ordered, be it in response to new symptoms, to inform de-escalation of care, or to gauge therapy response.

We observed that 40.5% of enrollees younger than 65 years of age received opioids in their last 30 days. Because we did not have access to the medical records, we do not know if some patients did not experience pain or did not feel that their pain symptoms required opioid therapy. The observed low use of opioids may have been a result of patient reluctance caused by fear of addiction or the perceived stigma around opioid use,[24] or a result of caregiver misunderstanding around the use of opioids at the end of life.[25] Of note, the percentage of patients receiving opioids decreased each year from 2007 to 2015, with the largest percentage drop occurring after 2012. It is possible that the 2012 legalization of marijuana in Washington State reduced the stigma associated with use. The legalization of medical marijuana has been associated with a reduction in opioid-related hospitalizations,[26] and the concurrent use of marijuana and opioids can result in a reduction in opioid use.[27] Unfortunately, at this time, no study has documented patterns of marijuana use among patients with cancer in Washington State.

This study has limitations. First, without access to clinical notes, electronic medical records, or patient-reported outcomes, we could not evaluate patient, physician, or family or caregiver care preferences. Second, the time horizon for this study was before the enactment of newer current procedural terminology billing codes for palliative care consultations. The early provision of palliative care has been found to improve patient outcomes,[28] and consultations are associated with reduced intensive care unit admissions during hospitalization.[29] It is possible that palliative care consultations may have influenced some of the care patterns we observed, but we were unable to measure the impact. Finally, because we were unable to access hospice claims, outpatient medication use, or claims on the day of death for patients older than 65 years of age, we reported hospice use, opioid use, and place of death for patients younger than 65 years of age. Despite these limitations, our results suggest that problems with overuse of aggressive care and underuse of palliative and hospice services affected populations of younger patients with commercial insurance as well as Medicare enrollees and persisted through 2015.

Our findings identify areas for additional investigation to improve end-of-life care for patients with cancer. First, more than one half of patients experienced hospitalization or an ED visit in the last month of life, which may represent potentially avoidable health care encounters. Care models that emphasize care coordination and symptom management may help reduce the incidence of such visits. The observed high use of imaging may be for disease progression monitoring or to inform decisions around cancer-directed therapy. Studies that elucidate the reasons for such imaging and the impact of imaging scans on patient and caregiver quality of life are needed to inform reimbursement policies and guidelines that promote value-based, patient-centered care. Finally, fewer than one half of patients younger than 65 years of age who were not enrolled in hospice received opioids for pain relief, and only one third used hospice for the last month of life, indicating areas for potential improvement in end-of-life service provision to younger adults. Research to identify barriers to hospice use and supportive care in this population can inform interventions to ensure that patients do not have untreated pain and are provided services to maximize their quality of life. JOP

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Authors' Disclosures of Potential Conflicts of Interest

Disclosures provided by the authors are available with this article at jop.ascopubs.org.

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

End-of-Life Services Among Patients With Cancer: Evidence From Cancer Registry Records Linked With Commercial Health Insurance Claims

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Appendix

Table A1. List of Codes Used to Define Healthcare Use in the Last 30 Days of Life

Description	Procedure	Type of Code	Code List
Nonrecommended services	Chemotherapy	CPT/HCPCS	96400, 96401, 96405, 96408, 96409, 96410, 96411, 96412, 96413, 96414, 96415, 96416, 96417, 96420, 96422, 96423, 96425, 96440, 96445, 96446, 96450, 96500, 96524, 96535, 96540, 96542, 96545, 96549, 51720, 96406, C8953, C8954, C8955, G0355, G0357, G0358, G0359, G0360, G0361, G0362, G0363, G9021, G9022, G9023, G9024, G9025, G9026, G9027, G9028, G9029, G9030, G9031, G9032, Q0083, Q0084, Q0085, S9329, S9330, S9331, J9015, J9010, J9017, J9019, J9020, J9025, J9031, C9442, J9032, J9033, J9035, S0116, C9417, J9040, J9039, J9041, S0115, J9042, J8510, J9043, J8520, J8521, J9045, C9437, J9050, J9055, S0172, C9418, J9060, J9062, C9419, J9065, J9027, C9420, C9421, J8530, J9070, J9080, J9090, J9091, J9092, J9093, J9094, J9095, J9096, J9097, C9422, J9098, J9100, J9110, C9423, J9130, J9140, J9120, C9424, J9150, J9151, J0894, J9160, J9170, J9171, C9415, J9000, J9001, J9002, Q2048, Q2049, J9178, J9179, C9414, C9425, J8560, J9181, J9182, J7527, J8561, C9426, J9200, J9185, J9190, J8565, J9201, J9300, S0176, C9429, J9211, 15055605, 15055741, C9427, J9208, S0088, J9228, J9206, J9207, J0640, S0178, J9230, J8600, J9245, S0108, J8610, J9250, J9260, C9432, J9280, J9290, J9291, J9293, J9261, C9021, J9302, J8999, J9999, J9263, C9431, J9264, J9265, J9267, J9303, J9266, J9305, J9268, C9292, J9306, J9270, J9307, S0182, C9025, J9310, J9315, J9320, J8700, J9328, J9330, C9433, J9340, J8705, J9350, J9351, A9545, G3001, J9355, J9357, J9360, J9370, J9375, J9380, J9390, J9400
		ICD-9 Procedure	99.25, 99.28
		ICD-9 Diagnosis	V58.1, V58.11, V58.12, V672
		Revenue Center	331, 332, 335
		NDCs*	
	Radiation	CPT/HCPCS	77400, 77401, 77402, 77403, 77404, 77405, 77406, 77407, 77408, 77409, 77410, 77411, 77412, 77413, 77414, 77415, 77416, 77417, 77418, 77419, 77421, 77422, 77423, 77427, 77431, 77432, 77435, 77465, 77470, 77499, 77520, 77522, 77523, 77525, 77750, 77761, 77762, 77763, 77776, 77777, 77778, 77781, 77782, 77783, 77784, 77785, 77786, 77787, 77789, 77790, 77799, C1715, C1716, C1717, C1718, C1719, C1720, C2616, C2632, C2633, C2634, C2635, C2636, C2637, C2638, C2639, C2640, C2641, C2642, C2643, C2698, C2699, G0256, G0261
		ICD-9 Procedure	92.20, 92.21, 92.22, 92.23, 92.24, 92.25, 92.26, 92.27, 92.28, 92.29
		ICD-9 Diagnosis	V58.0
		Revenue Center	330, 333
	Bone scans	CPT/HCPCS	78300, 78305, 78306, 78315, 7832078350, 78351, 78399
		ICD-9 Procedure	92.14
	CT	CPT/HCPCS	70450, 70460, 70470, 70486, 70487, 70490, 70491, 70496, 70498, 71250, 71260, 71270, 71275, 72125, 72126, 72128, 72131, 72132, 72133, 72191, 72192, 72193, 72194, 73200, 73700, 73701, 74150, 74160, 74170, 74174, 74175, 74176, 74177, 74178, 75635, 76380, 0066T, 0067T, G0288, S8092
		ICD-9 Procedure	87.41, 88.01

(continued on following page)

Table A1. List of Codes Used to Define Healthcare Use in the Last 30 Days of Life (continued)

Description	Procedure	Type of Code	Code List
	MRI	CPT/HCPCPS	70540,70543, 70544, 70548, 70551, 70552, 70553, 70554, 70555, 71552, 72141, 72142, 72146, 72147, 72148, 72149, 72156, 72157, 72158, 72195, 72196, 72197, 73218, 73220, 73223, 73720, 73721, 74181, 74182, 74183, 75557, 76093, 76094, 77058, 77059, 77084, 3111F, 3112F, C8900, C8901, C8902, C8903, C8904, C8905, C8906, C8907, C8908, C8909, C8910, C8911, C8912, C8913, C8914, C8918, C8919, C8920, S8042
		ICD-9 Procedure	88.91, 88.92, 88.93, 88.94, 88.95, 88.96, 88.97
	PET/PET-CT	CPT/HCPCS	78205, 78206, 78320, 78459, 78464, 78465, 78469, 78491, 78492, 78494, 78607, 78608, 78609, 78647, 78710, 78803, 78807, 78811, 78812, 78813, 78814, 78815, 78816, G0252, G0253, G0254
High-intensity services	Hospitalization		
	Emergency Department	CPT/HCPCPS	99281, 99282, 99283, 99284, 99285
		Revenue Center	450, 451, 452, 456, 459, 981
Recommended services	Hospice	CPT/HCPCPS	99377, 99378, G0182, Q5001, Q5002, Q5003, Q5004, Q5005, Q5006, Q5007, Q5008, Q5009, Q5010, S0271, S9126, T2042, T2043, T2044, T2045, T2046
		Revenue Center	115, 125, 135, 145, 155, 235, 650, 651, 652, 655, 656, 657, 658, 659
	Opioid prescriptions	NDCs*	

Abbreviations: CPT, current procedural terminology; CT, computed tomography; HCPCS, Healthcare Common Procedure Coding System; ICD-9, International Classification of Diseases, version 9; NDC, National Drug Code; MRI, magnetic resonance imaging; PET, positron emission tomography.

*We used 1,555 NDCs to define chemotherapy and 8,627 NDCs to define opioid prescriptions. The full list is available from the authors upon request.