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Unplanned Hospitalization Among Individuals With Cancer in the Year After Diagnosis

Robin L. Whitney, PhD, RN^{1,2}; Janice F. Bell, PhD²; Daniel J. Tancredi²; Patrick S. Romano, MD²; Richard J. Bold, MD²; Ted Wun, MD²; and Jill G. Joseph, PhD, MD²

QUESTION ASKED: What is the population burden of unplanned hospitalization in the year after cancer diagnosis?

SUMMARY ANSWER: The burden of unplanned hospitalization in the year after diagnosis is substantial; approximately two thirds of hospitalizations in this timeframe are unplanned, and a majority of unplanned hospitalizations originate in the emergency department.

WHAT WE DID: Using California Cancer Registry data linked with administrative inpatient data, we used multistate models to estimate age-adjusted unplanned hospitalization rates accounting for time at risk and examined diagnosis codes commonly associated with unplanned hospitalization in a cohort of adults diagnosed with cancer in California between 2009 and 2012.

WHAT WE FOUND: Rates of unplanned hospitalization are highest among individuals with hepatobiliary or pancreatic, lung, and brain or CNS cancers. Many

unplanned hospitalizations are associated with potentially preventable admission diagnoses, including infections and complications of a device or medical care.

BIAS, CONFOUNDING FACTOR(S), REAL-LIFE IMPLICATIONS:

Limitations of the study included the use of administrative data, which contain limited details about the clinical factors contributing to unplanned hospitalization. In addition, individuals who could not be linked because of missing data were excluded, which may have affected estimates of hospitalization rates. Efforts to reduce unplanned acute care use among individuals at highest risk might focus on the sites we identified as having higher unplanned hospitalization rates. A majority of unplanned hospitalizations in the year after diagnosis originated in the emergency department, consistent with a growing body of literature that suggests that enhancing access to care for urgent support needs may be a promising approach.

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Unplanned Hospitalization Among Individuals With Cancer in the Year After Diagnosis

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abstract

PURPOSE Reducing acute care use is an important strategy for improving value in cancer care. However, little information is available to describe and compare population-level hospital use across cancer types. Our aim was to estimate unplanned hospitalization rates and to describe the reasons for hospitalization in a population-based cohort recently diagnosed with cancer.

MATERIALS AND METHODS California Cancer Registry data linked with administrative inpatient data were used to examine unplanned hospitalization among individuals diagnosed with cancer between 2009 and 2012 (n = 412,850). Hospitalizations for maintenance chemotherapy, radiotherapy, or planned surgery were excluded. Multistate models were used to estimate age-adjusted unplanned hospitalization rates, accounting for survival.

RESULTS Approximately 67% of hospitalizations in the year after diagnosis were unplanned, 35% of newly diagnosed individuals experienced an unplanned hospitalization, and 67% of unplanned hospitalizations originated in the emergency department (ED). Nonmalignancy principal diagnoses most frequently associated with unplanned hospitalization included infection (15.8%) and complications of a medical device or care (6.5%). Unplanned hospitalization rates were highest for individuals with hepatobiliary or pancreatic cancer (2.08 unplanned hospitalizations per person-year at risk), lung cancer (1.58 unplanned hospitalizations), and brain or CNS cancer (1.47 unplanned hospitalizations), and were lowest among individuals with prostate cancer (0.18 unplanned hospitalizations) and melanoma (0.25 unplanned hospitalizations).

CONCLUSION The population burden of unplanned hospitalization among individuals newly diagnosed with cancer is substantial. Many unplanned hospitalizations originate in the ED and are associated with potentially preventable admission diagnoses. Efforts to reduce unplanned hospitalization might target subgroups at higher risk and focus on the ED as a source of admission.

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INTRODUCTION

Hospitalization is a primary driver of cancer-related health care spending.¹⁻⁴ Outpatient treatment modalities are increasingly common, and the cost of cancer drugs and imaging continues to rise; nonetheless, hospitalizations for cancer, which recent data suggest last longer and cost more than those for other conditions,⁵ make up more than one half of total cancer-related treatment costs in the year after diagnosis as well as in the last year of life.⁴ A growing body of evidence suggests that cancer-related acute care use can be reduced with timely outpatient management enhanced access and early palliative care.⁶⁻⁸ Consequently, reducing potentially avoidable hospitalizations has been increasingly viewed as a

promising target for improving the quality and reducing the costs of cancer care.

Despite growing attention to acute care use among individuals with cancer, population estimates of hospitalization rates are lacking. Many studies of cancer hospitalizations have been restricted to small subgroups of patients with cancer in clinical trials^{9,10} or Medicare beneficiaries 65 years of age and older,^{4,11,12} limiting generalizability. Other studies examining acute care use have focused heavily on costs⁴ rather than on patterns of admission^{5,12} and have not accounted for differences in time at risk (eg, because of competing risk of mortality and time hospitalized)^{5,11} or have examined use only within a narrow window of time during cancer treatment, such as among decedents

ASSOCIATED CONTENT

Data Supplement

Author affiliations and support information (if applicable) appear at the end of this article.

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near the end of life^{13,14} or within 30 days after cancer surgery.¹⁵⁻¹⁷ Recent recommendations suggest that a key strategy for reducing unplanned acute care use is to identify subgroups of and individual patients with cancer at high risk.¹⁸ Studies that examine hospitalization patterns broadly (across cancer types and throughout the trajectory of care) would help inform these efforts.

In this study, we sought to address this gap by producing population-based estimates of unplanned hospitalization across all cancer types during the 1-year period after initial diagnosis, using a multistate modeling approach to account for the competing risk of mortality. Our results shed light on the population burden of unplanned hospitalization among individuals with cancer, and may provide benchmarks against which to examine future trends, as well as to guide targeted interventions to reduce unplanned hospitalization rates.

MATERIALS AND METHODS

Study Design and Data Sources

We examined hospitalization among patients with cancer, using a retrospective cohort design and two linked data sources: (1) the California Department of Public Health's California Cancer Registry (CCR), a population-based cancer surveillance system that collects clinical and sociodemographic information about all individuals diagnosed with cancer in California¹⁹; and (2) the California Office of Statewide Health Planning and Development (OSHPD) death registry–linked Patient Discharge Data files, which include coded patient discharge information for all acute care hospitals licensed in the state of California (excluding Veterans Administration and military hospitals).²⁰ OSHPD and CCR records are linked by CCR using probabilistic matching that is based on patient demographic variables such as social security number (SSN) and date of birth.²¹⁻²³

Cohort

Our cohort included all adults identified in the CCR as having been diagnosed with cancer (other than non-melanoma skin cancer) between 2009 and 2012 ($n = 520,838$). We excluded individuals who were younger than 18 years of age at diagnosis (1.1%), who were diagnosed with in situ disease (9.7%), who did not have an OSHPD ID number for linkage (either because they had never had an OSHPD encounter or because they lacked a valid SSN; 9.5%), or who had multiple values of the variables needed for uniquely identifying individuals and hospital encounters ($< 1\%$). The final eligible sample included $n = 412,850$ adults with cancer.

Variable Definitions

We obtained sociodemographic variables from CCR data. These included: age (in years); sex (female or male); race/ethnicity (white, non-Hispanic; black, non-Hispanic; Hispanic or Latino of any race; Asian or Pacific Islander, non-Hispanic; or other); marital status (married or not married

[single, widowed, separated, divorced]); and socioeconomic status (SES) quintiles that were based on composite scores developed for use by the CCR.²⁴ Composites were derived using census tract–level SES indicators (eg, education, income). Individuals were classified into quintiles from lowest to highest (highest, upper middle, middle, lower middle, or lowest) and insurance type (private, public [Medicare and Medicaid], uninsured, or other).

Using SEER site recode variables,²⁵ we created 15 broad categories of cancer site, accounting for all malignancies (breast, prostate, lung, colorectal, hepatobiliary and pancreatic, melanoma, thyroid, brain and CNS, other digestive, urinary, head and neck, bone and soft tissue, other female reproductive, hematologic, or other). Cancer stage (I, II, III, or IV) was classified using the SEER-modified American Joint Commission on Cancer staging manual. A full description of cancer site and stage categories is available in the Data Supplement.

All-cause hospitalization was defined as any inpatient admission to an acute care hospital that began on or after the day of cancer diagnosis (recorded in CCR) to 365 days after diagnosis. We considered multiple admission records for an individual patient within an overlapping timeframe (ie, admission records with a zero-day difference between the discharge date and subsequent admission date) as a single episode and obtained information about that episode from the last record. In our analysis of hospitalization rates and reasons for hospitalization, we focused on a subset of hospitalizations that excluded admissions for maintenance chemotherapy or radiotherapy, as well as admissions for planned surgery (defined as a scheduled admission with a primary surgical procedure and a primary diagnosis of cancer). Hereafter, we refer to this subset as unplanned hospitalizations.

Principal diagnoses associated with each unplanned hospitalization were classified using International Classification of Diseases (9th revision, clinical modification) codes derived from the hospitalization record in OSHPD. Principal diagnosis codes were grouped using the single-level Clinical Classification Software program downloaded from the Healthcare Cost and Utilization Project Web site.²⁶ We further collapsed procedures and principal diagnoses into relevant categories selected on the basis of common procedures and reasons for admission among patients with cancer in previous studies,^{5,11} including (1) cancer related, (2) infection and/or fever, (3) cardiovascular (including heart attack, stroke, embolism, and dysrhythmias), (4) complications of a medical device or medical care, (5) GI, and (6) respiratory. A full list of Clinical Classification Software groups included in each category can be found in the Data Supplement.

Statistical Analysis

All analyses were conducted using Stata 14 MP (StataCorp, College Station, TX), with descriptive statistics calculated for all variables. Statistical significance was set at $P < .05$.

We calculated the percentage of patients with cancer with any all-cause hospitalization or unplanned hospitalization stratified by cancer type, stage, and sociodemographic characteristics. All hospitalizations beginning on or after the day of diagnosis were included in this analysis.

Multistate modeling is a flexible approach capable of modeling multiple changes in a patient's condition over a period of time, including both absorbing events (eg, death) and events that are not absorbing but may occur multiple times per subject (eg, hospitalization).²⁷ Because many individuals with cancer die or spend prolonged periods of time in the hospital, we sought to estimate rates of unplanned hospitalization using multistate models that accounted for the duration each individual was at risk of being hospitalized within the observation period. To this end, we created a person-period data set by partitioning each person's follow-up data into nonoverlapping periods, with each person-period classified into one of three states in a multistate model. The three possible states included: (1) at risk (alive, not hospitalized, and therefore at risk of hospitalization), (2) hospitalized (alive, but temporarily not at risk of hospitalization), or (3) dead (and therefore not at risk of hospitalization for the remainder of the observation period). Persons could transition in and out of the hospitalized or at risk states until either transitioning to the dead state, an absorbing event, or until the end of the 365-day period after cancer diagnosis (Data Supplement).

We modeled the unplanned hospitalization incidence rate (ie, transition from the at-risk to the hospitalized state) as a function of cancer type using a log-linear Poisson regression model for clustered data. Lung cancer was selected as the reference category because it was the most prevalent cancer type that affected both men and women. We adjusted rates for patient age but did not include other individual sociodemographic or clinical characteristics in our models because our goal was to estimate unplanned hospitalization rates that accounted for time spent at risk, rather than to identify individual predictors of unplanned hospitalization. Clustering at the individual level (ie, multiple person-periods at risk of hospitalization per individual) was accounted for using a robust sandwich estimator of standard errors. To assess whether age-adjusted between-site differences were modified by patient age, we fit models with and without site \times age interaction terms. Postestimation predictive margins were calculated to estimate the predicted age-adjusted unplanned hospitalization rate in the year after diagnosis adjusted for time spent at risk, for each cancer type (see Data Supplement for additional details about our modeling approach). Because unplanned hospitalization rates were calculated on the basis of transitions from the at-risk to the hospitalized state, they do not include the first hospitalization for individuals who were diagnosed with cancer while in the hospital.

RESULTS

Cohort Characteristics

In this cohort of 412,850 adults diagnosed with cancer between 2009 and 2012, just over one half were female (51.7%), and a majority were white, non-Hispanic (61.4%). The most common cancer site was breast (17.1%), followed by prostate (14.4%), lung (10.3%), and colorectal (9.2%) cancers. More than one third were diagnosed with advanced cancer, defined as either stage III (16.4%) or stage IV (21.3%) disease, and 21.1% died within a year after diagnosis (Table 1).

Unplanned Hospitalization

Among individuals diagnosed with cancer between 2009 and 2012, a majority (62%) had at least one all-cause hospitalization in the year after diagnosis, and more than one third (35%) had an unplanned hospitalization (Table 1). By sociodemographic characteristics, the proportion with an unplanned hospitalization was highest in the age group older than 76 years (42.5%), among individuals of non-Hispanic black race/ethnicity (41.3%), who were not married (40.5%), and who were uninsured (47.8%). The proportion with an unplanned hospitalization increased as SES decreased, ranging from 28.6% of individuals in the highest SES quintile to 42.7% of individuals in the lowest quintile. The proportion with an unplanned hospitalization also differed substantially by cancer site and stage, ranging from 14.7% for prostate cancer to 58.5% for brain or CNS cancers. Unplanned hospitalization increased together with stage at diagnosis, ranging from 21.9% for stage I disease to 58.3% for stage IV disease (Table 1).

Unplanned Hospitalization Rates

In our multistate modeling of unplanned hospitalization rates, all cancer types had significantly lower rates of unplanned hospitalization than lung cancer (the reference category), with the exception of hepatobiliary and pancreatic cancer (incidence rate ratio [IRR], 1.31; 95% CI, 1.28 to 1.34; Table 2). We found that age modified the between-site differences. Therefore, we included an interaction term of cancer site by age in our model and used postestimation predictive margins to estimate rates for each site separately at ages 30, 45, 60, 75, and 90 years. For a 60-year-old patient, estimated unplanned hospitalization rates were highest for hepatobiliary or pancreatic cancer (2.08 unplanned hospitalizations per person-year at risk), and lung cancer (1.58 unplanned hospitalizations), and lowest for prostate cancer (0.18 unplanned hospitalizations) and melanoma (0.25 unplanned hospitalizations; Table 2).

Characteristics of Unplanned Hospitalizations

Of the 458,573 all-cause hospitalizations in the cohort, approximately 67% ($n = 309,008$) met our definition of an unplanned hospitalization (not listed in tables).

TABLE 1. Hospitalization and Mortality in the Year After Cancer Diagnosis by Sociodemographic and Clinical Characteristics, 2009 to 2012

Characteristic	Total Sample		All-Cause Hospitalization (%)	Unplanned Hospitalization (%)*	Mortality (%)†
	No.	%			
Total sample	412,850		62	35	21.1
Age at diagnosis, years					
18-35	15,850	3.8	61.8	34.1	6.3
36-45	27,670	6.7	63.1	32.0	7.6
46-55	69,615	16.9	63.4	32.3	12.3
56-65	108,379	26.3	63.1	32.2	16.6
66-75	101,044	24.5	61.5	34.1	21.8
≥ 76	90,292	21.9	59.7	42.5	39.1
Sex					
Female	213,343	51.7	61.6	34.9	19.1
Male	199,507	48.3	62.3	35.1	23.1
Race/ethnicity					
Asian or Pacific Islander	47,119	11.4	65	36.2	20.6
Black, non-Hispanic	27,683	6.7	66.7	41.3	24.6
Latino or Hispanic	76,485	18.5	66.8	38.7	20.8
Other	8,227	2.0	35.9	22.4	9.4
White, non-Hispanic	253,336	61.4	60.3	33.4	21.2
Marital status					
Married	228,766	58.8	62.4	32.2	17.7
Not married	160,336	41.2	64.4	40.5	27.0
SES quintile					
Highest	97,524	23.6	58.1	28.6	15.4
Upper middle	93,249	22.6	60.6	32.9	19.0
Middle	85,758	20.8	62.3	35.9	22.2
Lower middle	76,258	18.5	64.3	38.7	24.4
Lowest	60,061	14.5	66.9	42.7	27.6
Insurance type					
Other	8,075	2.0	59.9	37.1	19.6
Private	209,566	52.4	60.9	29.6	14.7
Public	174,781	43.7	64.8	41.3	28.3
Uninsured	7,221	1.8	65.9	47.8	29.5
Cancer site					
Bone and soft tissue	3,665	0.9	71.2	43.5	19.1
Brain or CNS	5,897	1.4	81.2	58.5	41.8
Breast	70,513	17.1	44.5	26.5	3.4
Colorectal	37,952	9.2	80.7	32.4	18.2
Head and neck	14,155	3.4	57.7	38.3	15.6
Hematologic	35,388	8.6	56.9	47.8	23.6
Hepatobiliary or pancreatic	24,013	5.8	74.5	57.9	60.9
Lung	42,505	10.3	72.0	55.0	55.2
Melanoma	16,824	4.1	20.4	16.7	5.3

(continued on following page)

TABLE 1. Hospitalization and Mortality in the Year After Cancer Diagnosis by Sociodemographic and Clinical Characteristics, 2009 to 2012 (continued)

Characteristic	Total Sample		All-Cause Hospitalization (%)	Unplanned Hospitalization (%)*	Mortality (%)†
	No.	%			
Other	19,930	4.8	52.9	47.4	38.4
Other digestive	17,938	4.3	75.4	48.5	39
Other female reproductive	28,463	6.9	82.1	29.3	13.2
Prostate	59,276	14.4	51.7	14.7	2.9
Thyroid	13,763	3.3	73.4	25.2	2.2
Urinary	22,568	5.5	79.7	32.4	19.7
Cancer stage					
I	124,518	35.6	52.0	21.9	4.8
II	93,182	26.7	60.4	24.8	7.0
III	57,390	16.4	77.2	36.3	18.8
IV	74,366	21.3	72.8	58.3	54.8

NOTE. Cancer diagnosis excludes nonmelanoma skin cancers.

Abbreviation: SES, socioeconomic status.

*Excludes hospitalizations for maintenance chemotherapy, radiotherapy, or scheduled surgery.

†All-cause, not cancer specific.

Emergency department admissions. Approximately two thirds of unplanned hospitalizations in the year after diagnosis originated in the emergency department (ED; 67.0%; Table 3). The percentage of ED admissions varied widely by cancer type. Rates were lowest among unplanned hospitalizations for thyroid (22.3%), breast (48.1%), and bone and soft tissue (49.1%) cancer, and highest among unplanned hospitalizations for lung (78.6%), hepatobiliary or pancreatic (75.3%), and other digestive cancers (73.8%). The percentage of unplanned hospitalizations originating in the ED also increased together with cancer stage, from 53.9% for stage I cancer to 75.7% for stage IV cancer (Table 3).

Principal diagnoses. Among unplanned hospitalizations in the year after diagnosis, one third listed cancer as the principal diagnosis or reason for admission (32.9%). The most common noncancer principal diagnosis was infection or fever, associated with 15.8% of hospitalizations, followed by complication of medical device or care (6.5%), GI (5.8%), cardiovascular (5.8%), and respiratory (4.3%) diagnoses (Table 3). Cancer types with the highest incidence of unplanned hospitalization for each primary diagnosis were hematologic cancer for infection or fever hospitalizations (21.0%); prostate cancer for cardiovascular hospitalizations (11.1%); colorectal cancer for complications of a medical device or care (9.9%) and GI-related hospitalizations (16.4%); and lung cancer for respiratory hospitalizations (10.5%).

DISCUSSION

In this population-based cohort of individuals newly diagnosed with cancer, we found that more than one third

experienced an unplanned hospitalization during the year after diagnosis, with substantial variation by cancer site and stage. There was a higher incidence of unplanned hospitalization among groups known to have higher rates of acute care service use, including individuals of black, non-Hispanic race/ethnicity and lower SES.^{28,29} These findings are consistent with results of other studies using multivariable models to identify predictors of acute care use in patients with cancer^{16,30-33} and point to the need for a greater understanding of the predictors of unplanned hospitalization by cancer type, particularly among sociodemographic subgroups with higher rates of use.

The higher incidence of unplanned hospitalization among those with advanced-stage cancer suggests that inpatient use may, to some extent, be driven by disease severity. At the same time, other work suggests that there is an overuse of inpatient care among patients with cancer with incurable late-stage disease, with the result that many individuals with cancer spend their last weeks of life receiving aggressive hospital care that may not be consistent with their preferences.³⁴⁻³⁷ Additional investigation of variation in hospitalization among patients with cancer with incurable, advanced-stage disease is warranted to identify opportunities to reduce unnecessary inpatient use and promote end-of-life care that is consistent with patients' expressed wishes.

Our estimates of noncancer principal diagnoses associated with unplanned hospitalization were similar to results from previous work using administrative data.⁵ Common reasons for unplanned hospitalization in our study have been suggested to be potentially preventable or amenable to outpatient management, including certain infections such

TABLE 2. Age-Adjusted Unplanned Hospitalization Rates in the Year After Diagnosis by Cancer Site, 2009 to 2012 (n = 412,850)

Cancer Site	No.	IRR (95% CI)	Estimated Unplanned Hospitalization Rate by Age in Years*				
			30	45	60	75	90
Bone and soft tissue	3,665	0.70 (0.66 to 0.74)	0.93	1.00	1.11	1.27	1.53
Brain or CNS	5,897	0.93 (0.89 to 0.97)	1.24	1.33	1.47	1.68	2.03
Breast	70,513	0.27 (0.27 to 0.28)	0.36	0.39	0.43	0.49	0.59
Colorectal	37,952	0.53 (0.52 to 0.54)	0.71	0.76	0.84	0.96	1.16
Head and neck	14,155	0.54 (0.53 to 0.55)	0.72	0.78	0.86	0.98	1.19
Hematologic	35,388	0.79 (0.77 to 0.81)	1.05	1.13	1.25	1.43	1.73
Hepatobiliary and pancreatic	24,013	1.31 (1.28 to 1.34)	1.75	1.88	2.08	2.38	2.87
Lung	42,505	Ref	1.33	1.43	1.58	1.81	2.18
Melanoma	16,824	0.15 (0.15 to 0.16)	0.21	0.23	0.25	0.29	0.34
Other	19,930	0.68 (0.66 to 0.70)	0.91	0.98	1.08	1.23	1.49
Other digestive	17,938	0.91 (0.89 to 0.94)	1.22	1.31	1.44	1.65	1.99
Other female reproductive	28,463	0.46 (0.45 to 0.47)	0.61	0.66	0.73	0.83	1.01
Prostate	59,276	0.11 (0.11 to 0.12)	0.15	0.16	0.18	0.20	0.24
Thyroid	13,763	0.27 (0.26 to 0.28)	0.36	0.38	0.42	0.48	0.58
Urinary	22,568	0.50 (0.48 to 0.51)	0.66	0.71	0.79	0.90	1.08

NOTE. A total of 791,794 at-risk person-periods for 412,850 individuals.

Abbreviation: IRR, incidence rate ratio.

*Rate is based on postestimation predictive margins and is measured in No. of events per person-year in the at-risk state (ie, adjusted for survival time and length of time spent in the hospital). Models were age adjusted and included a site × age interaction term.

as pneumonia and urinary tract infections.^{11,38-40} One of the most common noncancer principal diagnoses in our cohort was complication of a medical device or care. Recent work examining adverse events experienced by patients with cancer in the year after treatment initiation found that nearly one third of adverse events could have been prevented or mitigated in severity.⁴¹

More than two thirds of the unplanned hospitalizations in our study originated in the ED. A recent study of visits by patients with cancer to the ED found that nearly one half were associated with potentially preventable diagnoses.⁴² In addition, medical home models, patient navigation, and related interventions to improve outpatient support (eg, community-based palliative care, after-hours telephone support, evidence-based treatment guidelines, out-of-hospital emergency teams) have been shown to address patients' urgent needs while reducing acute care use and improving quality of care.⁴³⁻⁴⁵ One oncology practice found that implementing an oncology nurse practitioner-led supportive care clinic to address urgent care needs reduced symptom-related care admissions by 31%.⁴⁶ Another found that establishing a specialized cancer ED reduced all-cause hospitalizations by 51%.⁴⁷ Taken together, the large percentage of ED admissions among unplanned hospitalizations in our study and recent evidence that enhanced support for urgent care needs can effectively reduce acute care use suggest that targeting

cancer-related ED visits may be a promising approach to reduce unplanned hospitalization. These findings support additional examination of potentially unmet needs among patients with cancer who experience unplanned admission through the ED.

Our study has several important limitations. As with any inpatient use study using an observational design and inpatient administrative data, we did not have available many clinical details (eg, outpatient treatment information, comorbidities performance status, laboratory data) that influence hospitalization and that could shed additional light on the potential preventability of the hospitalizations. For instance, as has been noted in other work, the primary diagnosis in cancer hospitalizations is often malignancy related, which can be a barrier to understanding other factors underlying hospitalization and their potential preventability.¹¹ In addition, our reliance on SSNs for the linkage procedures used to combine CCR, OSHPD, and vital statistics data may have resulted in underrepresentation of some minority racial/ethnic groups as well as individuals of lower SES.⁴⁸ The exclusion of individuals in CCR who were unable to be linked with the OSHPD inpatient data may have led to overestimation of rates if a large proportion of excluded individuals never experienced a hospitalization. Because our data were limited to individuals who were diagnosed and received treatment in California, we may have underestimated

TABLE 3. Characteristics of Unplanned Hospitalizations in the Year After Cancer Diagnosis by Site and Stage, 2009 to 2012

Characteristic	No.	Length of Stay, days, median (IQR)	Admitted Through ED (%)	Principal Diagnoses* (%)					
				Cancer Related†	Infection or Fever	Cardiovascular	Complication of Medical Device or Care	GI	Respiratory
Total visits	309,008	4 (5)	67.0	32.9	15.8	5.8	6.5	5.8	4.3
Cancer site									
Bone and soft tissue	3,843	4 (5)	49.1	44.5	11.1	3.2	9.1	3.1	2.9
Brain or CNS	7,486	4 (5)	69.6	50.5	10.4	4.6	4.8	1.8	2.3
Breast	30,317	2 (3)	48.1	38.6	11.5	4.9	8.8	3.5	2.9
Colorectal	31,066	4 (6)	70.3	29.3	13.5	5.5	9.9	16.4	2.3
Head and neck	11,591	4 (5)	62.3	32.5	15.2	4.3	7.7	4.9	7.4
Hematologic	39,831	5 (8)	67.4	31.2	21.0	5.4	4.1	3.9	3.2
Hepatobiliary and pancreatic	31,743	4 (5)	75.3	32.9	18.8	4.0	6.5	4.6	2.1
Lung	47,592	4 (5)	78.6	34.9	18.7	7.1	3.6	3.0	10.5
Melanoma	4,409	3 (3)	57.0	30.6	12.6	10.1	7.0	4.2	3.5
Other	18,062	4 (5)	72.3	32.2	18.6	7.0	3.8	3.9	4.9
Other digestive	20,922	4 (6)	73.8	35.3	12.6	4.5	7.5	10.4	3.8
Other female reproductive	21,272	4 (4)	62.3	36.6	12.2	4.4	8.8	7.5	2.0
Prostate	15,241	3 (3)	62.7	15.4	14.7	11.1	8.8	5.6	3.6
Thyroid	6,855	2 (2)	22.3	46.9	3.7	2.2	2.2	1.7	3.7
Urinary	18,778	4 (5)	68.2	23.2	17.1	7.5	7.7	5.3	3.4
Cancer stage									
I	53,843	3 (3)	53.9	25.9	13.0	6.7	8.9	6.5	4.2
II	48,098	3 (4)	60.1	28.1	15.1	6.3	9.1	7.4	3.5
III	50,986	4 (5)	66.9	31.4	15.9	5.2	8.0	8.1	4.7
IV	93,568	4 (6)	75.7	40.5	16.2	4.7	4.5	4.7	4.7

Abbreviations: ED, emergency department; IQR, interquartile range.

*See Data Supplement for complete list of included International Classification of Diseases (9th revision, clinical modification) codes.

†Includes any general or site-specific malignancy diagnosis.

hospitalization rates for individuals who were diagnosed in California but who received inpatient care in other states.

Reducing potentially avoidable cancer hospitalizations remains an important target for improving the quality and reducing the costs of cancer care. Our study has provided valuable baseline population estimates of unplanned hospitalization among individuals with cancer in the year after diagnosis, a period that coincides with active treatment

of many patients. Although we examined hospitalization broadly by cancer type, such information is critical given the urgent need to reduce the costs of cancer care. Efforts to target subgroups of newly diagnosed individuals at a high risk of unplanned hospitalization might focus on hepatobiliary or pancreatic, lung, and advanced cancers, and on the ED as a point of entry for a majority of unplanned hospitalizations.

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST AND DATA AVAILABILITY STATEMENT

Disclosures provided by the authors and data availability statement (if applicable) are available with this article at DOI <https://doi.org/10.1200/JOP.18.00254>.

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

Unplanned Hospitalization Among Individuals With Cancer in the Year After Diagnosis

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