ORIGINAL REPORT

Patterns and Predictors of Unplanned Hospitalization in a Population-Based Cohort of Elderly Patients With GI Cancer

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ABSTRACT

Purpose

Hospitalizations among patients with cancer are common and costly and, if unplanned, may interrupt oncologic treatment. The rate of unplanned hospitalizations in the population of elderly patients with cancer is unknown. We sought to describe and quantify patterns and risk factors for early unplanned hospitalization among elderly patients with GI cancer.

Patients and Methods

We conducted a retrospective cohort study using linked Texas Cancer Registry and Medicare claims data from 2001 to 2009. Texas residents age 66 years or older initially diagnosed with GI cancer between 2001 and 2007 were included in the study. The unplanned hospitalization rate was estimated, and reasons for unplanned hospitalization were evaluated. Risk factors were identified using adjusted Cox proportional hazards modeling.

Results

Thirty thousand one hundred ninety-nine patients were included in our study, 59% of whom had one or more unplanned hospitalizations. Of 60,837 inpatient claims, 58% were unplanned. The rate of unplanned hospitalization was 93 events per 100 person-years. The most common reasons for unplanned hospitalization were fluid and electrolyte disorders, intestinal obstruction, and pneumonia. Multivariable analysis showed that black race; residing in census tracts with poverty levels greater than 13.3%; esophageal, gastric, and pancreatic cancer; advanced disease stage; high Charlson comorbidity index score; and dual eligibility for Medicare and Medicaid increased the risk for unplanned hospitalization (all *P* values < .05).

Conclusion

Unplanned hospitalizations among elderly patients with GI cancer are common. Some of the top reasons for unplanned hospitalization are potentially preventable, suggesting that comorbidity management and close coordination among involved health care providers should be promoted.

J Clin Oncol 32:3527-3533. © 2014 by American Society of Clinical Oncology

INTRODUCTION

National expenditures for cancer care amounted to $124 billion in 2010 and are projected to increase to $173 billion in 2020.[1] Concern that increasing health care expenditures are unsustainable has resulted in a push to understand the drivers of cancer care costs. The high cost of cancer therapeutic agents and the intensity of care have been identified as reasons for these rising costs.[2] Changes in oncologic practice to address these issues have been proposed and have been incorporated in certain quality initiatives.[2,3]

Hospitalizations have also been identified as a substantial cost in cancer care. Using claims data from almost 720,000 patients with cancer, Yabroff et al[4] found that hospitalizations were responsible for more than 50% of net costs during the initial 12 months after diagnosis for most cancers they studied as well as for more than 60% of costs during the final year of life. In 2009, the Agency for Healthcare Research and Quality (AHRQ) estimated that 4.7 million hospitalizations among adults were related to cancer.[5] In addition, hospitalizations primarily related to cancer lasted longer than hospitalizations for other conditions and cost $5,700 more per stay. Medicare was the identified payer for almost 50% of these hospitalizations.

It is unclear whether these reported cancer-related hospitalizations are planned; unplanned hospitalizations are not considered to be part of the patient's program of care. We believe that this distinction is important, because unlike planned hospitalizations, unplanned hospitalizations are potentially preventable. In fact, unplanned hospitali-

zations have been proposed as a quality metric in other countries, with the assumption that they are adverse outcomes of care, especially in ambulatory-sensitive conditions.[6] In addition, unplanned hospitalizations may delay scheduled treatment and adversely impact disease outcomes and quality of life.

A better understanding of unplanned hospitalizations in the cancer population, particularly among those older than age 65 years who likely have other comorbid illnesses, is needed.[7] Comorbidities may play a role in the use of health resources in this population and may help identify areas of focus for improvement or intervention.

In this study, we sought to describe and quantify patterns of early unplanned hospitalization among elderly Medicare recipients with GI cancer in the state of Texas as well as identify risk factors that contribute to unplanned hospitalization in this population. We focused on GI cancer, because these cancers have some of the highest proportions of cancer care cost attributable to hospitalizations, which suggests that unplanned hospitalizations may be common in this population.[4]

PATIENTS AND METHODS

The institutional review boards at The University of Texas Medical Branch at Galveston, The University of Texas MD Anderson Cancer Center, and the Texas Department of State Health Services approved this study, as did the Privacy Review Board of the Centers for Medicare and Medicaid Services.

Data Sources

We conducted a retrospective cohort study using linked data from the Texas Cancer Registry (TCR) and the Medicare claims database. The TCR is a population-based registry that collects, maintains, and disseminates cancer data within the state of Texas. It is the fourth largest cancer registry in the United States, containing complete statewide data for cancers diagnosed between 1995 and 2008.[8] The Medicare claims database contains all claims filed by qualifying individuals age 65 years or older who have enrolled in the Medicare health insurance plan.[9] Medicare data linked with the TCR contain information on health care paid for by the Medicare program for elderly patients with cancer, including hospital stays, physician services, and hospital outpatient visits. The TCR-Medicare linkage is performed under the guidance of the National Cancer Institute, the TCR, and the Centers for Medicare and Medicaid Services, which collect the Medicare claims data. Medicare enrollment and claims files are available for approximately 98% of all patients age 65 years or older whose records are entered into TCR.

Study Population

We identified Texas residents age 66 years or older who were diagnosed with a GI malignancy (esophageal, gastric, liver or intrahepatic ductal, pancreatic, colon, or anorectal cancer) between 2001 and 2007 from the Medicare-linked TCR data. Because the database contained Medicare claims data through 2009, we excluded patients who were diagnosed after 2007, thus giving each patient a 2-year observation period for claims analysis. Figure 1 illustrates the algorithm for cohort selection.

Study Variables

We reviewed Medicare claims data within the Medicare Provider Analysis and Review hospital stay file for each patient to determine whether the patient had an early unplanned hospitalization within the first 2 years after cancer diagnosis. Skilled nursing facility claim records, which are also located in the Medicare Provider Analysis and Review file, were excluded from the analysis. We defined "unplanned hospitalization" as a hospitalization with an admission type of urgent or emergent, excluding those that were primarily for chemotherapy or radiotherapy (International Classification of Disease, 9th revision [ICD-9] codes V58.0, V58.1, V58.11, and V58.12) or for rehabilitation services (ICD-9 code V57.xx).[6,10-12] If the admission type for a hospitalization
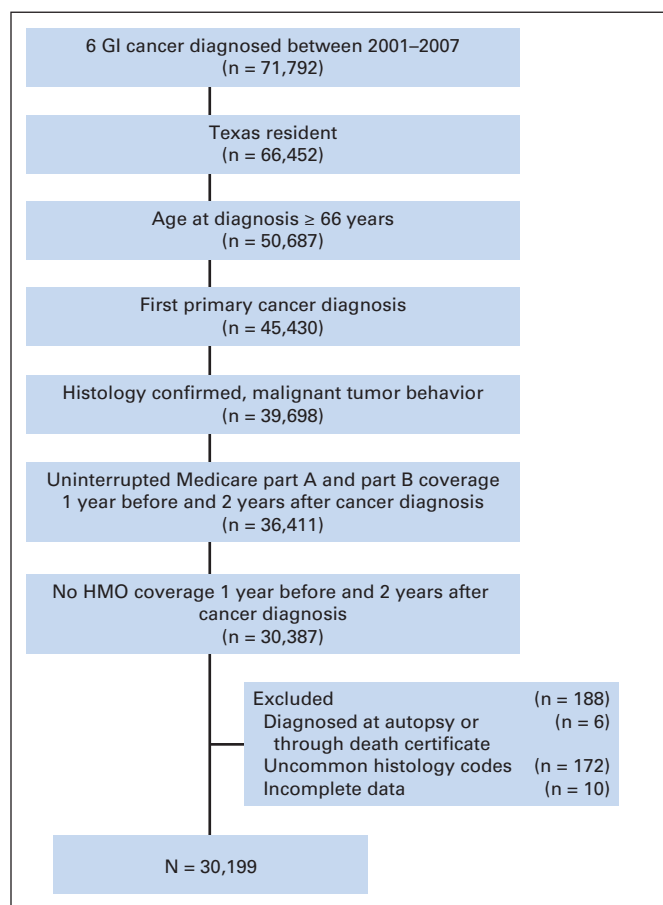

Fig 1. Algorithm for selection of the study cohort. HMO, health maintenance organization.

was unknown, we used an emergency room charge greater than $0 to identify patients who came in through the emergency room.[13] Hospitalizations that did not meet our criteria for unplanned hospitalization were classified as "other" hospitalizations.

Information on length of stay and timing of claim ($\leq$ 1 year after diagnosis or $>$ 1 year after diagnosis) were also collected. We considered the first noncancer diagnosis in the claims data to be the reason for admission, recognizing that a cancer diagnosis may be coded before other medical issues, especially if the other medical issues are related to the cancer. We then used the AHRQ Clinical Classifications Software to assign ICD-9 diagnoses into more meaningful clinical categories.

We also collected demographic and clinical information about each patient at the time of diagnosis. Study variables were selected on the basis of risk factors for unplanned admissions in the general population, as identified from related literature.[12,14,15] The Charlson comorbidity index (CCI) was calculated for each patient by searching all Medicare claims files for ICD-9 codes pertaining to Charlson comorbidities in the 12 months before cancer diagnosis.[16-19] Patients without inpatient or outpatient claims during this 12-month period were initially assigned a separate Charlson category but were later combined with those who had a CCI score of 0 (ie, no comorbidities) after statistical analyses showed no significant difference between these two groups.

Statistical Analysis

The unplanned hospitalization rate was calculated as the number of all unplanned hospitalization events per person-time (years) for the total cohort. We used the Mann-Whitney U test to compare the length of stay between unplanned and other hospitalizations. We also calculated the proportion of unplanned hospitalizations that were preceded within 30 days by a treatment procedure (chemotherapy, radiotherapy, or surgery).

To identify factors significantly associated with an early unplanned hospitalization, we used Cox proportional hazards modeling with the first unplanned hospitalization event as the dependent variable. This allowed comparison of patients with different survival times. Patients were censored at date of death or at the end of the 2-year observation period if they had not experienced an unplanned hospitalization at that point. Independent variables included: age, sex, race, area of residence, census tract poverty level, cancer type, disease stage, comorbidity index, and dual eligibility for Medicare and Medicaid, which was ascertained using a covariate indicating whether the patient was a participant in the state's buy-in program. Using the full Cox model, we estimated hazard ratios for first unplanned hospitalization in two hypothetical patients with different levels of risk compared with a reference patient, by exponentiating the sum of the regression coefficients of each of the covariates in the model.[16,20] The adjusted Cox proportional hazards model was also used to estimate time to first unplanned hospitalization for some of the independent variables. A P value less than .05 was considered statistically significant. Statistical analyses were performed using Statistical Analysis Software version 9.3 (SAS Institute, Cary, NC).

RESULTS

A total of 30,199 patients were included in the cohort. Patient characteristics at the time of diagnosis and association of these characteristics with unplanned hospitalization are listed in Table 1. The most common comorbidities in our study population were diabetes without complications (18.0%), chronic pulmonary disease (10.7%), and congestive heart failure (9.5%).

We included 60,837 claims in our analysis; of these, 35,336 (58.1%) were for unplanned hospitalizations. The unplanned hospitalization rate was 93 unplanned hospitalization events per 100 person-years, with mean observation time of 15 months or 1.3 years per patient. In examining the event rates by year of diagnosis, we found that the rates ranged from 89 to 97 unplanned events per 100 person-years; however, no significant trend was detected (P = .362). The mean time to first unplanned hospitalization among patients who had experienced an unplanned hospitalization (n = 17,842; 59.1% of the cohort) was 2.2 months. These patients had a mean of two unplanned hospitalizations throughout the observation period, and this was similar across the different cancer types. The mean length of stay for unplanned hospitalizations was shorter compared with other hospitalizations (7.4 v 8.9 days; P < .001). Most hospitalizations were unplanned, whether they occurred ≤ 1 year after cancer diagnosis (55.9%) or more than 1 year after diagnosis (66.9%).

Among patients who had experienced an unplanned hospitalization, 19.4% had chemotherapy, radiotherapy, or a surgical procedure in the 30 days before their first unplanned hospitalization. Specifically, 6.9% had chemotherapy, 12.0% had a surgical procedure, and 2.5% had radiotherapy. In addition, 9.4% had visited the emergency department within 30 days before their first unplanned hospitalization.

The most common noncancer reason for unplanned hospitalization was fluid and electrolyte disorders (n = 2,944; 8.3%; Table 2). This was consistent across most cancer types. Intestinal obstruction was the second most common reason (n = 1,871; 5.3%) followed by pneumonia (n = 1,572; 4.4%). Congestive heart failure and chronic obstructive pulmonary disease and bronchiectasis, which were among the top three most common comorbidities in our cohort, were also common reasons for unplanned hospitalization (fourth and ninth most common, respectively).

Table 1. Demographic and Clinical Characteristics of the Entire Study Population (n = 30,199) at Diagnosis, as Well as Those of Patients Who Experienced Unplanned Hospitalizations (n = 17,842)

Characteristic	All Patients		Patients Who Experienced Unplanned Hospitalization	
	No.	%	No.	%
Age group, years				
66–69	5,547	18.4	3,191	57.5
70–74	7,311	24.2	4,313	59.0
75–79	7,184	23.8	4,257	59.3
≥ 80	10,157	33.6	6,081	59.9
Sex				
F	15,149	50.2	9,020	59.5
M	15,050	49.8	8,822	58.6
Race				
White	24,750	82.0	14,393	58.2
Hispanic	1,848	6.1	1,176	63.6
Black	2,921	9.7	1,879	64.3
American Indian	47	0.2	22	46.8
Other	633	2.0	372	58.8
Cancer type				
Colon	14,548	48.2	8,272	56.9
Esophageal	1,695	5.6	1,123	66.3
Liver or intrahepatic ductal	2,059	6.8	1,240	60.2
Pancreatic	4,085	13.5	2,555	62.5
Anorectal	4,979	16.5	2,853	57.3
Gastric	2,833	9.4	1,799	63.5
Disease stage				
Localized	10,003	33.1	5,406	54.0
Regional	10,080	33.4	6,204	61.5
Distant	6,652	22.0	4,211	63.3
Unknown	3,464	11.5	2,021	58.3
Area of residence*				
Big metropolis	14,266	47.2	8,415	59.0
Metropolis	8,817	29.2	5,169	58.6
Urban	2,148	7.1	1,313	61.1
Urban less	4,340	14.4	2,575	59.3
Rural	628	2.1	370	58.9
Census tract poverty level†				
Q1	7,562	25.0	4,316	57.1
Q2	7,547	25.0	4,321	57.3
Q3	7,551	25.0	4,503	59.6
Q4	7,539	25.0	4,702	62.4
Charlson comorbidity index				
0	19,424	64.3	10,850	55.9
1	5,828	19.3	3,614	62.0
2	2,571	8.5	1,685	65.5
≥ 3	2,376	7.9	1,693	71.2
State buy-in‡	6,080	20.1	3,957	65.1

Abbreviation: Q, quartile.
*Big metropolis, population ≥ 1,000,000; metropolis, population of < 250,000 to 1,000,000; urban, population of ≥ 20,000; urban less, population of 2,500 to 19,999; rural, population < 2,500.
†Percentage of people living below the poverty line in the patient's census tract: Q1, 0.00%-7.48%; Q2, 7.49%-13.30%; Q3, 13.31%-21.04%; Q4, ≥ 21.05%.
‡State buy-in variable is used to determine dual eligibility of patients for both Medicare and Medicaid.

All variables studied were risk factors for unplanned hospitalization except for population size of the area of residence and sex (Table 3). Patients age 75 to 79 years and older than 80 years (compared with 66-69 years), black race (compared with white), those residing in

Table 2. Most Common Noncancer Reasons for Unplanned Hospitalization by Cancer Type by Clinical Classifications Software

Reason for Unplanned Hospitalization	All GI Cancer		Esophageal Cancer		Gastric Cancer		Pancreatic Cancer		Liver or Intrahepatic Ductal Cancer		Anorectal Cancer		Colon Cancer	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
All reasons	35,336		2,360		3,561		4,940		2,338		5,773		16,364	
Fluid and electrolyte disorders	2,944	8.3	303	12.8	340	9.6	563	11.4	198	8.5	426	7.4	1,114	6.8
Intestinal obstruction without hernia	1,871	5.3	43	1.8	97	2.7	169	3.4	24	1.0	323	5.6	1,215	7.4
Pneumonia	1,572	4.4	164	7.0	183	5.1	167	3.4	94	4.0	215	3.7	749	4.6
Congestive heart failure, nonhypertensive	1,547	4.4	83	3.5	122	3.4	1.2	2.1	85	3.6	278	4.8	877	5.4
Complications of surgical procedures or medical care	1,504	4.3	98	4.2	140	3.9	116	2.4	37	1.6	316	5.5	797	4.9
Septicemia	1,450	4.1	82	3.5	181	5.1	283	5.7	131	5.6	232	4.0	541	3.3
Gastrointestinal hemorrhage	1,330	3.8	87	3.7	262	7.4	138	2.8	76	3.3	236	4.1	531	3.2
Deficiency and other anemia	1,074	3.0	63	2.7	161	4.5	91	1.8	46	2.0	161	2.8	552	3.4
Chronic obstructive pulmonary disease and bronchiectasis	1,032	2.9	104	4.4	113	3.2	119	2.4	50	2.1	136	2.4	510	3.1
Urinary tract infection	1,030	2.9	44	1.86	103	2.9	119	2.4	72	3.1	194	3.4	498	3.0
Other common reasons*														
Aspiration pneumonitis, food/vomitus			97	4.1										
Biliary tract disease							321	6.6						
Other liver diseases									336	14.4				

*≥ 4% of hospitalizations for specific cancer type.

quartile 3 or quartile 4 census tracts (compared with quartile 1), and those who had dual eligibility for Medicare and Medicaid were at increased risk for unplanned hospitalization (Table 3).

Among patients with different types of GI cancer, those with esophageal cancer had the highest risk for first unplanned hospitalization compared with those with colon cancer. By 1 year after diagnosis, more than half of patients with esophageal cancer had already experienced an unplanned hospitalization (Fig 2A). Advanced-stage disease was associated with an increased risk compared with localized disease. At 6 months after diagnosis, more than 50% of patients with distant or metastatic disease had experienced an unplanned hospitalization (Fig 2B). The risk for unplanned hospitalization also increased with increasing CCI (Fig 2C).

Using the estimated regression coefficients, the fitted model would assign an 80-year-old black woman with metastatic esophageal cancer and a CCI ≥ 3 who resides in an urban area with a poverty level greater than 21.05% and who has dual eligibility (all high-risk variables), a hazard ratio of 3.63. In other words, this hypothetical patient would be 3.63 times more likely to experience an unplanned hospitalization than our reference patient who is male, age 66 to 69 years, and white who has localized colon cancer, a CCI of 0, resides in the most affluent census tract in a big metropolitan area and is not also eligible for Medicaid. Similarly, the model would show that a 75- to 79-year-old Hispanic woman with gastric cancer who has regional disease, has a CCI of 2, lives in a metropolitan area with a poverty level between 13.31% and 21.04% and also has dual eligibility would be 2.32 times more likely to experience an unplanned hospitalization than our reference patient.

DISCUSSION

In our population-based assessment, we observed an unplanned hospitalization rate of 93 events per 100 person-years. To understand the

significance of this, we estimated the unplanned hospitalization rate across 2 years among a cohort of elderly individuals derived from a random 5% sample of Medicare beneficiaries without cancer who were enrolled in the Medicare program during the same inclusive years as our patients. In this cohort of 45,459 beneficiaries, we found a significantly lower unplanned hospitalization rate of 11.4 events per 100 person-years, suggesting that unplanned hospitalizations are disproportionately more common in our study cohort compared with the elderly noncancer population ($P < .001$).

To the best of our knowledge, ours is the first population-based study to report an unplanned hospitalization rate for GI cancer. A recent study by Brooks et al[21] done in a single academic medical center found that 19% of 201 hospitalizations among patients with GI cancer were potentially avoidable. Although our defined outcomes were different, potentially avoidable hospitalizations are a subset of unplanned hospitalizations, and the lower proportion observed in Brooks' study implies that not all unplanned hospitalizations are avoidable. In contrast, a 2009 AHRQ statistical brief reported that approximately 55% of patients who were hospitalized with a secondary diagnosis of colorectal cancer were urgently admitted. Although the report did not make a distinction between planned and unplanned hospitalization, our estimates for unplanned hospitalization (58.1% including both urgent and emergent admissions) was similar to the AHRQ report, probably because a large proportion of our cohort had colon and rectal cancer.[22] Other studies on patients with cancer have focused on chemotherapy-related hospitalizations, and the observed proportions (8% to 35%) were lower than what we observed in our study.[23,24] This is more consistent with our finding that only 6.9% of patients who experienced an unplanned hospitalization had chemotherapy before their first unplanned hospitalization.

Some of the most common reasons for unplanned hospitalization in our study (ie, fluid and electrolyte disorders, pneumonia, congestive heart failure, chronic obstructive pulmonary disease and

Table 3. Adjusted Multivariable Analysis Showing Risk Factors for Unplanned Hospitalization

Variable	Coefficient	Hazard Ratio	95% CI	P
Age, years (v 66-69)				
70-74	0.04	1.04	1.00 to 1.09	.058
75-79	0.06	1.07	1.02 to 1.12	.006
≥ 80	0.11	1.12	1.07 to 1.17	< .001
Sex: F (v M)	0.03	1.03	1.00 to 1.06	.073
Race (v white)				
Hispanic	0.01	1.01	0.95 to 1.08	.689
Black	0.07	1.07	1.02 to 1.13	.007
American Indian	−0.22	0.80	0.53 to 1.22	.295
Other	−0.05	0.95	0.85 to 1.05	.323
Cancer type (v colon)				
Esophageal	0.13	1.14	1.07 to 1.22	< .001
Liver or intrahepatic ductal	0.02	1.02	0.96 to 1.08	.517
Pancreatic	0.07	1.08	1.03 to 1.13	.001
Anorectal	−0.03	0.97	0.93 to 1.01	.171
Gastric	0.13	1.14	1.08 to 1.20	< .001
Disease stage (v localized)				
Regional	0.23	1.26	1.22 to 1.31	< .001
Distant	0.29	1.34	1.28 to 1.40	< .001
Unknown	0.02	1.02	0.97 to 1.08	.384
Area of residence* (v big metropolis)				
Metropolis	−0.04	0.97	0.93 to 1.00	.059
Urban	0.04	1.04	0.98 to 1.10	.201
Urban less	−0.01	0.99	0.95 to 1.04	.762
Rural	−0.01	0.99	0.89 to 1.10	.817
Census tract poverty level† (v Q1)				
Q2	0.001	1.00	0.96 to 1.05	.972
Q3	0.05	1.05	1.00 to 1.10	.043
Q4	0.08	1.08	1.03 to 1.14	< .001
Charlson comorbidity index (v 0)				
1	0.16	1.17	1.13 to 1.22	< .001
2	0.25	1.30	1.22 to 1.35	< .001
≥ 3	0.42	1.52	1.44 to 1.60	< .001
State buy in‡ (v none)	0.12	1.13	1.09 to 1.18	< .001

Abbreviation: Q, quartile.
*Big metropolis, population ≥ 1,000,000; metropolis, population of < 250,000 to 1,000,000; urban, population of ≥ 20,000; urban less, population of 2,500 to 19,999; rural, population < 2,500.
†Percentage of people living below the poverty line in the patient's census tract: Q1, 0.00%-7.48%; Q2, 7.49%-13.30%; Q3, 13.31%-21.04%; Q4, ≥ 21.05%.
‡State buy-in variable is used to determine dual eligibility of patients for both Medicare and Medicaid.
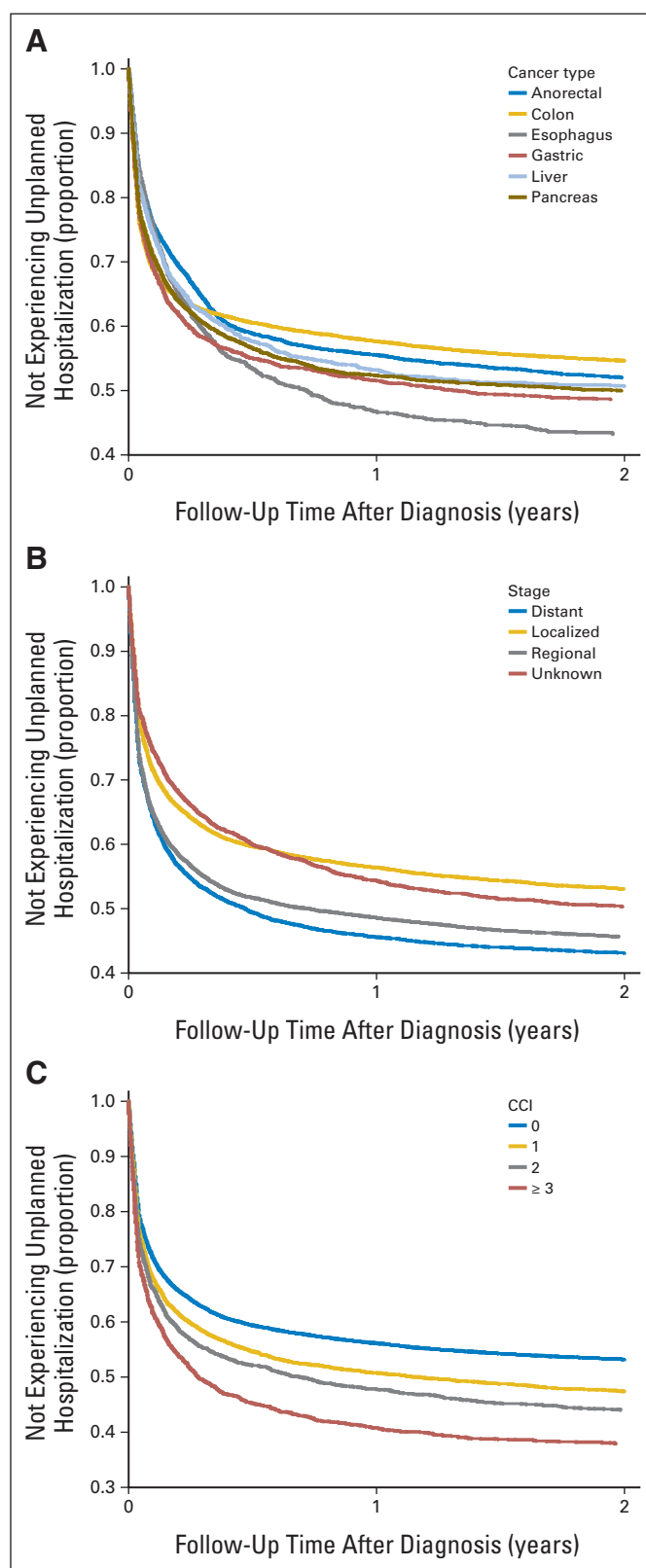
Fig 2. Adjusted survival curves based on Cox proportional hazards regression model for time to first unplanned hospitalization stratified by (A) cancer type, (B) disease stage, and (C) Charlson comorbidity index.

bronchiectasis, and urinary tract infections) are considered potentially preventable by the AHRQ.[25] These conditions are considered ambulatory care–sensitive because hospitalization can be prevented by appropriate outpatient care.[11] Although it is difficult to define and confirm preventable hospitalizations among patients with cancer using claims data alone, the diagnoses that most commonly led to unplanned hospitalizations in our study are amenable to outpatient management if addressed early.

We detected socioeconomic disparities in the risk for unplanned hospitalization in our cohort, similar to other health care utilization studies. One United Kingdom study found that Asian ethnicity and residing in areas of deprivation were predictive of an unplanned first-time hospitalization related to cancer.[6] In a US study examining hospitalization rates for survivors of childhood cancer, low

income was associated with increased hospitalization rates.[26] Whether or not these findings are related to access to outpatient care needs further investigation.

Advanced disease stages and increased comorbidity scores were also identified as risks for unplanned hospitalization in our study. A few other studies have identified the same risk factors for unplanned hospitalization in patients with cancer, although these studies were not focused on elderly patients with GI cancer.[23,27] Our findings are not surprising because advanced-stage disease and comorbidity may be related to the illness or frailty of a patient. These findings support a renewed emphasis on comorbidity management and follow-up care in patients with cancer. Close coordination among primary care providers, oncologists, and inpatient teams is needed throughout a patient's entire cancer trajectory to limit treatment interruptions caused by unplanned hospitalizations. In addition, careful appraisal of risk factors could help identify patients requiring closer follow-up by their primary care physicians and oncologists.

One of our study's strengths is the use of time-to-event analysis, which allowed us to examine unplanned hospitalization among patients with various follow-up times. Our sample size was also substantial, and although it can be argued that this could have driven the statistical significance in our risk factor analysis, our study findings are in fact consistent with other health care utilization studies.[6,23,27] We also provided a hazard estimate for a hypothetical patient given a risk profile using our fitted model. We believe this helps place our results in a clinical context, which will be useful for health care providers who need to stratify their patients by risk.

Our study has some limitations. We included patients age 66 years or older with GI cancer who reside in Texas, and our findings may not be generalizable to all elderly patients with cancer. Additional studies and rate comparisons should be undertaken to determine whether these observations are unique to the state of Texas or to elderly patients with GI cancer. In addition, we presented aggregated data for six GI cancers, recognizing that there may be differences among patients with each of these cancers. To account for this limitation, we presented data adjusted according to cancer type as much as possible, and we stratified results where we felt it was necessary. Although using a large administrative database allowed us to study large

populations, our findings are limited by the absence of specific clinical data and hence must rely on our assumptions and definitions of unplanned hospitalization and reasons for hospitalization. Our definition for an unplanned hospitalization, although not validated, has been used in several studies.[6,11,12,28] Another limitation of our study is the inability to capture services obtained through the Veterans Affairs Health Care System. Although we do not know what proportion of our cohort are veterans, it should be noted that in a study conducted on Medicare-eligible veterans, the majority of those who had an inpatient stay relied solely on Medicare for their inpatient care.[29] Variation in physicians' decisions to admit patients can also introduce unmeasured bias. For example, availability of beds in the admitting hospital may affect a patient's likelihood of being admitted. Lastly, our results are primarily descriptive, and many patterns that we observed cannot be explained by our findings alone.

Nevertheless, we believe that our findings provide useful data for policymakers and health care providers that can be used to inform decisions about resource allocation and coordination efforts among all providers caring for a patient with cancer. Knowing who is at risk for an unplanned hospitalization also opens up opportunities for anticipatory guidance and patient education during the active phase of treatment.

AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

The author(s) indicated no potential conflicts of interest.

AUTHOR CONTRIBUTIONS

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GLOSSARY TERMS

comorbidity: having two or more diseases at the same time.

Acknowledgment