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ORIGINAL REPORT

Identification of Potentially Avoidable Hospitalizations in Patients With GI Cancer

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ABSTRACT

Purpose

To identify and characterize potentially avoidable hospitalizations in patients with GI malignancies.

Patients and Methods

We compiled a retrospective series of sequential hospital admissions in patients with GI cancer. Patients were admitted to an inpatient medical oncology or palliative care service between December 2011 and July 2012. Practicing oncology clinicians used a consensus-driven medical record review process to categorize each hospitalization as "potentially avoidable" or "not avoidable." Patient demographic and clinical data were abstracted, and quantitative and qualitative analyses were performed to identify patient characteristics and outcomes associated with potentially avoidable hospitalizations.

Results

We evaluated 201 hospitalizations in 154 unique patients. The median age was 62 years, and colorectal cancer was the most common diagnosis (32%). The majority of hospitalized patients had metastatic cancer (81%). In all, 53% of hospitalizations were attributable to cancer symptoms, and 28% were attributable to complications of cancer treatment. Medical oncologists identified 39 hospitalizations (19%) as potentially avoidable. Hospitalizations were more likely to be categorized as potentially avoidable for patients with the following characteristics: age ≥ 70 years (odds ratio [OR], 2.63; 95% CI, 1.15 to 6.02), receipt of an oncologist's advice to consider hospice (OR, 6.09; 95% CI, 2.54 to 14.58), or receipt of three or more lines of chemotherapy (OR, 2.68; 95% CI, 1.01 to 7.08). Ninety-day mortality was higher after avoidable hospitalizations compared with hospitalizations that were not avoidable (OR, 6.4; 95% CI, 1.8 to 22.3).

Conclusion

Potentially avoidable hospitalizations are common in patients with advanced GI cancer. The majority of potentially avoidable hospitalizations occurred in patients with advanced treatment-refractory cancers near the end of life.

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INTRODUCTION

Hospitalization is a common, costly, and distressing experience for patients with cancer and their families. Hospitalizations in patients with cancer are particularly common near the end of life[1]; however, hospitalization in this setting frequently conflicts with patients' stated preferences regarding end-of-life care.[2,3] Thus, the National Quality Forum has endorsed a measure identifying multiple hospitalizations in the last month of life as a marker of poor-quality cancer care.[4,5]

Addressing the high cost of cancer care is an urgent priority for the US health care system,[6] and hospitalization is the largest single component of spending for cancer care.[7] There is substantial institutional and regional variation in hospital admissions for patients with cancer,[1,8,9] and differences in hospitalization rates are a major driver of regional variation in advanced cancer spending.[8] The finding of substantial variability in hospital admission practices for patients with cancer suggests that many hospitalizations are avoidable, and strategies to reduce potentially avoidable hospitalizations hold the potential to further the objectives of high-quality, cost-conscious, patient-centered care.

The concept of potentially avoidable hospitalization has been broadly examined in the medical literature, including the derivation of "ambulatory care sensitive conditions"[10-12] and the study of avoidable hospital readmissions.[13-16] Nevertheless, prior definitions of potentially avoidable

hospitalizations are poorly generalizable to oncology care. Studies examining potentially avoidable hospitalization in patients with cancer have primarily focused on chemotherapy-related hospitalizations.[17-20] These studies have shown that one quarter to one third of hospitalizations in patients receiving chemotherapy are toxicity-related, but they have not addressed the extent to which chemotherapy-related hospitalizations are avoidable.

We designed our study to examine the incidence and characteristics of potentially avoidable hospitalizations in patients with GI cancers by using direct review of medical records coupled with a consensus-driven peer review process. GI cancers include two of the five leading causes of cancer death in the United States (colorectal and pancreas cancer)[21] and contribute substantially to inpatient hospitalization in patients with cancer.[22,23] Through characterization of potentially avoidable hospitalizations in patients with cancer, we sought to establish a conceptual framework for the study of potentially avoidable oncology hospitalizations and to enhance the knowledge base that informs the design of future interventions.

PATIENTS AND METHODS

Site and Patients

We examined 201 sequential hospital admissions in 154 unique patients with GI cancer. All patients were followed in the outpatient oncology clinic at the Dana-Farber Cancer Institute and were subsequently admitted to Brigham and Women's Hospital, with eventual discharge from a medical oncology or inpatient palliative care service. Patients discharged from surgical and general medical services were excluded, because reasons for hospitalization are likely to differ in patients managed on these services. Patient lists were generated from billing records linked to discharge dates, and inclusion of eligible hospitalizations was based on hospital discharge between January 1, 2012, and July 31, 2012. This project was granted a waiver of review by the Dana-Farber/Harvard Cancer Center institutional review board.

Identification of Avoidable Hospitalization

Practicing oncology care providers assessed the avoidability of hospitalization from direct review of the electronic medical record (EMR) as part of a two-stage consensus-driven review process. Reviewers included seven medical oncologists and one oncology nurse practitioner. Reviewers were instructed to make their conclusions about the avoidability of hospitalization using only medical records dated from the day of hospital admission or before. Reviewers did not evaluate hospitalizations of patients for whom they had provided clinical care. Contents of the EMR included outpatient, emergency department, and hospital admission notes as well as laboratory, procedure, imaging, and infusion records. Design of the review process was informed by recommendations from a meta-analysis of potentially avoidable readmissions.[16]

In the first stage of the review, each hospitalization was independently reviewed by two clinicians using a standardized assessment tool (Data Supplement). In the second stage of the review process, any hospitalization identified as potentially avoidable by at least one reviewer in the first stage was re-examined by a committee of four clinicians (G.A.B., T.A.A., D.S., and C.S.F.) for a final consensus determination of avoidability. In cases in which the committee was unable to reach consensus, hospitalization was deemed to be not avoidable.

Patient Characteristics and Outcomes

Patient characteristics and outcomes of hospitalization were abstracted from the EMR to identify factors associated with potentially avoidable hospitalization. Patient characteristics included age, sex, primary language, cancer site, extent of disease, previous hospitalizations, recent treatment with chemotherapy, surgery or radiation, recent outpatient visits with social work and palliative care, residential setting before hospitalization, and hospital admission route (eg, via clinic or emergency department). Outcomes included length of hospital stay, inpatient palliative care consultation, discharge destination and services, readmission, and death. Additional patient characteristics were abstracted by clinicians during the avoidability assessment, including the primary reason for hospitalization and the clinical status at the time of hospitalization (whether the patient was refractory to conventional chemotherapy, whether the performance status precluded further chemotherapy, whether the patient had received an oncologist's advice to consider hospice, and whether the patient had enrolled in hospice.)

Statistical Analysis

We calculated descriptive statistics regarding patient characteristics, reasons for hospitalization, outcomes of hospitalization, and the proportion of hospitalizations deemed potentially avoidable. We then tested the univariable association of potentially avoidable hospitalization with patient characteristics and hospitalization outcomes by using generalized estimating equations for a binary response. This approach adjusted for clustering by patient to account for patients with multiple hospital admissions.[24] Finally, we constructed a multivariable logistic regression model of characteristics associated with potentially avoidable hospitalization. We limited our model to four variables based on the number observed of events (avoidable hospitalizations).[25] Variable selection was based on a univariable screen with a significance level of $P <$ .10 as well as clinical considerations. Treatment-related hospitalization was forced into the model based on a priori interest. The two-sided P value was set at .05 for all reported measures of statistical significance.

Qualitative Analysis

Two investigators (G.A.B. and D.S.) reviewed all hospitalizations identified as potentially avoidable, using a grounded theory approach to extract clinical themes associated with avoidable hospitalization.[26] Each potentially avoidable hospitalization was inductively coded with one to two themes identifying the reasons for which the hospitalization was considered to be potentially avoidable. Investigators compared thematic assignments and revised the code list until thematic saturation was achieved. Descriptive statistics of findings are reported.

RESULTS

We identified 201 hospitalizations among 154 unique outpatients with GI cancer. The median age was 62 years, and the most common cancer site was colorectal cancer (32%). The majority of hospitalized patients had metastatic cancer (81%) and had been hospitalized at least once in the preceding year (70%). Demographic and clinical characteristics are detailed in Table 1.

Reasons for hospitalization were categorized by using two non-overlapping organizational schemas to identify the categorical reason for hospitalization (eg, attributable to cancer symptom v adverse effect of cancer treatment) and the symptomatic reason for hospitalization (eg, abdominal pain). Findings are shown in Table 2. In the categorical schema, more than half (53%) of the admissions were a result of cancer-related symptoms, with 28% of admissions resulting from complications of cancer treatment. The symptomatic reasons for hospitalization varied considerably; the three most common reasons for admission were fever/infection (27%), undifferentiated abdominal pain (12%), and GI tract obstruction (9%).

After completion of the two-stage consensus review process, clinician-reviewers identified 39 (19%) of 201 hospitalizations as potentially avoidable. Of these hospitalizations, most were identified as preventable (avoidable by different management in the 30 days before hospitalization; 33 [85%] of 39), and a minority were identified as discretionary (avoidable by outpatient management on the day of hospital admission; 13 [33%] of 39). In the initial dual-review stage of the avoidability determination process, 24 hospitalizations were identified as potentially avoidable by both reviewers (with 23 subsequently

Table 1. Patient Demographic and Clinical Characteristics

	Hospitalizations							
			Potentially Avoidable					
	All		Yes		No			
Characteristic	No.	%	No.	%	No.	%	OR*	95% CI
No. of hospitalizations	201	100	39	19	162	81		
Sex								
Male	103	51	17	44	86	53	Reference	
Female	98	49	22	56	76	47	1.2	0.6 to 2.7
Age, years								
Median		62		66		61		
< 50	34	17	4	10	30	19	Reference	
50-59	49	24	8	21	41	25	"	
60-69	60	30	11	28	49	30	"	
70-79	43	21	12	31	31	19	2.2	1.0 to 4.8
≥ 80	15	7	4	10	11	7	"	
Primary language								
English	169	84	33	85	136	84	Reference	
Spanish	11	5	1	3	10	6	1.0	0.4 to 2.6
Other	21	10	5	12	16	10	"	
Cancer site								
Colorectal	65	32	10	26	55	34	Reference	
Pancreas	55	27	16	41	39	24	2.1	0.8 to 5.7
Esophagogastric	28	14	8	21	20	12	2.2	0.7 to 6.8
Hepatobiliary	25	12	0	—	25	15	0.6	0.2 to 2.1
Neuroendocrine	14	7	0	—	14	9	"	
Other†	14	7	5	13	9	6	"	
Disease status								
Metastatic	163	81	36	92	127	78	Reference	
Localized	35	17	3	8	32	20	0.4	0.1 to 1.3
No evidence of disease	3	1	0	—	3	2	"	
No. of hospitalizations in last 12 months								
0	59	30	8	21	51	32	Reference	
1	49	25	10	26	39	24	2.0	0.7 to 6.1
2	36	18	7	18	29	18	1.0	0.2 to 4.9
≥ 3	56	28	14	36	42	26	3.6	1.1 to 11.7
Recent evaluation and treatment‡								
Chemotherapy§	101	50	15	38	86	53	0.3	0.1 to 0.9
Surgery‖	15	7	5	13	10	6	2.3	0.8 to 6.3
Radiation‖	15	7	1	3	14	8	0.3	0.0 to 2.4
Outpatient palliative care‖	33	16	9	23	24	15	1.9	0.6 to 6.8
Outpatient social work‖	70	35	17	44	53	33	0.8	0.4 to 1.8
Median days since last clinic visit*		8		8		7		
Latest line of chemotherapy								
Palliative, first line	58	30	9	23	50	31	Reference	
Palliative, second line	30	15	5	13	25	16	1.1	0.3 to 3.4
Palliative, third line or greater	39	20	14	36	25	16	2.7	1.0 to 7.5
Curative intent/adjuvant	30	15	3	8	27	17	0.6	0.2 to 2.3
No prior chemotherapy	42	21	8	21	34	21	1.4	0.5 to 3.9
Clinical status prior to hospitalization‡								
Refractory to standard therapy	47	23	14	36	33	20	1.9	0.8 to 4.6
Poor performance status	48	24	17	44	31	19	4.1	1.7 to 9.8
Advised to consider hospice	49	24	20	51	29	18	4.9	2.2 to 10.9
Enrolled in hospice	13	6	5	13	8	5	3.0	0.8 to 11.0
Residential setting prior to hospitalization								
Home	182	91	32	82	150	93	Reference	
Home with hospice	13	6	5	13	8	5	3.1	0.8 to 11.9
Rehabilitation or nursing facility	6	3	2	5	4	2	2.9	0.5 to 16.8
Site of initial evaluation on day of hospital admission								
Emergency department	118	60	20	51	98	62	Reference	
Clinic	69	34	16	41	53	33	1.4	0.5 to 3.4
Direct admission	11	5	3	8	8	5	1.2	0.4 to 4.4

Abbreviation: OR, odds ratio.
*ORs adjusted for clustering by patient.
†Other cancer site includes unknown primary cancer, anal cancer, and cancers of the small bowel.
‡For each row under the subheading, the reference level is patients without the listed characteristic.
§Within 30 days of hospital admission.
‖Within 60 days of hospital admission.

Table 2. Reasons for Hospital Admissions

	Hospitalizations							
	All		Potentially Avoidable					
			Yes		No			
Reason	No.	%	No.	%	No.	%	OR*	95% CI
No. of hospitalizations	201	100	39	19	162	81		
Categorical reason for hospitalization								
Treatment complication/adverse effect	57	28	9	23	48	30	Reference	
Cancer symptom	107	53	25	64	82	51	1.8	0.7 to 4.9
Noncancer medical condition	19	9	3	8	16	10	1.1	0.2 to 5.8
Planned hospitalization	18	9	2	5	16	10	0.4	0.0 to 3.8
Symptomatic reason for hospitalization†								
Fever/infection	54	27	12	31	42	26	1.1	0.3 to 3.2
Abdominal pain, undifferentiated	25	12	2	5	23	14	0.3	0.1 to 1.4
GI tract obstruction	19	9	3	8	16	10	0.5	0.0 to 5.1
Asthenia/dehydration	17	8	5	13	12	7	2.0	0.6 to 7.0
Ablation procedure	15	7	2	5	13	8	0.4	0.1 to 3.0
Nausea/vomiting	15	7	3	8	12	7	1.0	0.2 to 6.0
Other‡	56	28	12	31	44	27	1.9	0.8 to 4.8

Abbreviation: OR, odds ratio.
*ORs adjusted for clustering by patient (154 unique patients).
†For each row under the subheading, the reference level is patients without the listed characteristic.
‡Other symptomatic reasons for hospitalization representing less than 5% of admissions included biliary obstruction (eight hospitalizations), neurologic complaints (seven), thrombosis (seven), diarrhea (six), dyspnea (six), cardiovascular complaints (five), bleeding (four), renal failure (three), and miscellaneous complaints (10).

confirmed as potentially avoidable by consensus review), and 62 were identified as avoidable by one of two reviewers (with 16 subsequently confirmed). Illustrative vignettes of two potentially avoidable hospitalizations are presented in Table 3.

The univariable associations of patient characteristics with potentially avoidable hospitalization are detailed in Table 1. Potentially avoidable hospitalizations were associated with age ≥ 70 years, three or more hospitalizations over the preceding year, poor performance status, and receipt of an oncologist's advice to consider hospice. Potentially avoidable hospitalizations were inversely associated with receipt of chemotherapy within 30 days of hospital admission. We also

created a multivariable model of factors associated with potentially avoidable hospitalization. Because of the low absolute number of potentially avoidable hospitalizations, we limited our model to four explanatory variables.[25] Treatment-related hospitalization was included in the baseline model because of a priori clinical interest, since prior studies have made an implicit assumption that chemotherapy-related hospitalizations are more likely to be avoidable.[18,19] Variables significantly associated with potentially avoidable hospitalization in multivariable analysis included age ≥ 70 years, receipt of an oncologist's advice to consider hospice, and receipt of third-line or higher palliative chemotherapy. Treatment-related hospitalization was not

Table 3. Patient Vignettes

Vignette 1 (GI-050)—A 63-year-old woman with metastatic treatment-refractory pancreas cancer, hospitalized for febrile neutropenia on day 6 after her fifth dose of single-agent docetaxel. Her cancer had progressed on five previous treatment regimens prior to starting docetaxel (including two clinical trials). The ECOG performance status on the day of her last chemotherapy treatment was 1.

Case review

  Avoidable over the 30 days prior to hospitalization? Yes, through cessation of guideline nonconcordant chemotherapy and hospice referral.[27,28]

  Avoidable on the day of hospital admission? No, hospitalization clinically necessary at time of presentation.

  Themes of potentially avoidable hospitalization

    Primary—avoidable chemotherapy-related hospitalization

    Secondary—avoidable end-of-life hospitalization

Vignette 2 (GI-011)—A 73-year-old man with metastatic pancreas cancer, rehospitalized with fever and altered mental status 7 days after a prior hospital discharge. Hospice referral had been planned at the time of the previous hospital discharge because of declining performance status and rapidly progressive disease; however, planned hospice care was never initiated.

Case review

  Avoidable over the 30 days prior to hospitalization? Yes, through timely initiation of hospice care.

  Avoidable on the day of hospital admission? No, logistically infeasible to arrange hospice enrollment from the emergency department.

  Themes of potentially avoidable hospitalization:

    Primary—hospitalization related to care-coordination failure

    Secondary—avoidable end-of-life hospitalization

Abbreviation: ECOG, Eastern Cooperative Oncology Group.

Table 4. Multivariable Model of Factors Associated With Potentially Avoidable Hospitalization

Factor	OR	95% CI	P
Oncologist advice to consider hospice	6.09	2.54 to 14.58	< .001
Age ≥ 70 years	2.63	1.15 to 6.02	.021
Third-line or greater palliative chemotherapy	2.68	1.01 to 7.08	.047
Treatment-related hospitalization	1.13	0.44 to 2.92	.796

Abbreviation: OR, odds ratio.

significantly associated with potentially avoidable hospitalization; the final model is provided in Table 4.

Outcomes of hospitalization—abstracted independently of the avoidability review process—are listed in Table 5. The median length of stay for all hospitalizations was 4 days. Hospice enrollment increased from 6% at the time of hospital admission to 23% at hospital discharge. In the 90 days following the index hospitalization, readmission and death occurred in 43% and 39% of all patients, respectively. Inpatient palliative care consultation, discharge to home hospice, and death within 90 days were all significantly more common following potentially avoidable hospitalization.

Qualitative analysis identified five themes associated with potentially avoidable hospitalization (Table 6). The dominant theme was potentially avoidable end-of-life hospitalization, identified in 72% of potentially avoidable hospitalizations. Subjectively, hospitalizations falling under the end-of-life theme were felt to have been avoidable

through timely referral to coordinated, high-quality hospice care. Avoidable chemotherapy-related hospitalization was a component in eight (21%) of 39 potentially avoidable hospitalizations and overlapped with potentially avoidable end-of-life hospitalization for five of eight hospitalizations.

DISCUSSION

To maintain and expand access to high-quality cancer care, health system stakeholders are increasingly focused on reducing the unsustainable growth of cancer treatment costs.[6,27] Hospital care accounts for more than half of all medical spending in patients with advanced cancer,[7] making hospitalization a strategic area for identifying opportunities to improve care delivery. The concept of potentially avoidable hospitalization has been developed by the Agency for Healthcare Research and Quality to aid in the measurement of hospital admissions for ambulatory care sensitive conditions—that is, hospitalizations that could have been avoided with timely access to outpatient care.[12] However, this concept has never been adapted for patients with cancer, who are frequently hospitalized. Identification of potentially avoidable hospitalizations in patients with cancer represents a high-impact opportunity to improve the value and quality of cancer care. We sought to determine the attributes of hospitalizations for patients with GI cancer that were perceived as potentially avoidable by medical oncologists.

We used a consensus-driven medical record review process to study hospitalizations in patients with GI cancer, and our approach

Table 5. Outcomes of Hospitalization

	Hospitalizations							
			Potentially Avoidable					
	All		Yes		No			
Outcome	No.	%	No.	%	No.	%	OR*	95% CI
No. of hospitalizations	201	100	39	19	162	81		
Length of stay, days								
Median		4		3		4		
1	30	15	5	13	25	15	Reference	
2-3	61	30	18	46	43	27	"	
4-7	67	33	9	23	58	36	0.6	0.3 to 1.3
≥ 8	43	21	7	18	36	22	"	
Readmission†								
Within 30 days of discharge	55	27	10	26	45	28	0.7	0.2 to 2.1
Within 90 days of discharge	86	43	15	38	71	44	0.5	0.2 to 1.4
Death†								
Within 30 days of admission	38	19	13	33	25	15	2.8	1.2 to 6.3
Within 90 days of admission	78	39	25	64	53	33	6.4	1.8 to 22.3
Inpatient palliative care†								
Palliative care consultation	42	21	12	31	30	19	2.2	1.0 to 4.6
Admission/transfer to IPCU	25	12	8	21	17	10	2.8	0.9 to 8.2
Discharge destination								
Home	125	63	18	47	107	67	Reference	
Hospice (home or facility)	46	23	15	39	31	20	3.1	1.1 to 8.4
Rehabilitation or nursing facility	21	11	3	8	18	11	1.2	0.2 to 7.0
Death in hospital	5	3	2	5	3	2	3.2	0.8 to 13.1

Abbreviations: IPCU, inpatient palliative care unit; OR, odds ratio.
*ORs adjusted for clustering by patient.
†For each row under the subheading, the reference level is patients without the listed characteristic.

Table 6. Qualitative Themes of Potentially Avoidable Hospitalizations

Theme	Primary Theme		Primary or Secondary Theme	
	No.	%	No.	%
Avoidable end-of-life hospitalization				
Avoidable through timely provision of coordinated, high-quality hospice care	21	54	28	72
Avoidable chemotherapy-related hospitalization				
Avoidable through selective chemotherapy use and aggressive management of adverse effects	7	18	8	21
Hospitalization related to failure to coordinate care				
Avoidable through coordinated multidisciplinary care	5	13	13	33
Discretionary hospitalization				
Avoidable through safe and effective outpatient management	5	13	6	15
Hospitalization related to medical care oversight				
Avoidable through deliberative clinical decision making and effective care oversight	1	3	2	5

identified 19% of hospitalizations as potentially avoidable. Examination of patient characteristics demonstrated a clear and consistent link between potentially avoidable hospitalization and advanced, refractory cancer. Although survival was poor for the entire cohort of hospitalized patients, outcomes were strikingly worse after potentially avoidable hospitalization, with a 90-day mortality of 66% (v 34% after hospitalization that was not avoidable). Qualitative analysis identified avoidable end-of-life hospitalization as a contributing theme in 28 (72%) of 39 potentially avoidable hospitalizations. Taken together, these findings suggest that oncologists perceive that a substantial number of hospitalizations are potentially avoidable, particularly near the end of life. This finding underscores the potentially large impact of intervention strategies for improving symptom control and illness understanding in patients with advanced cancer.

Prior studies have implicated end-of-life hospitalizations in patients with cancer as potentially avoidable. Experimental evidence of potentially avoidable end-of-life hospitalizations in patients with cancer comes from the randomized trial of early palliative care conducted by Temel et al[29] in which a companion analysis showed decreased spending for inpatient hospitalization among patients randomly assigned to early palliative care.[30] In addition, multiple observational studies have illustrated regional or institutional variation in end-of-life hospitalization for patients with cancer.[1,8,9] For example, Morden et al[1] observed greater than two-fold between-institution variation in end-of-life hospital use measures despite adjustment for patient and institutional characteristics, suggesting that institutional practices can exert a strong influence on end-of-life hospital use. Our findings complement prior observations by providing a detailed clinical context for the phenomenon of potentially avoidable oncology hospitalizations.

The identification of a substantial proportion of oncology hospitalizations as potentially avoidable has important implications for clinical practice. Reducing the incidence of avoidable hospitalizations is both patient centered and potentially cost saving, and novel clinical approaches are needed. In initial discussions of our findings, a common response from clinicians has been that hospitalization can be a useful intervention for helping patients transition between aggressive and explicitly palliative goals of care. This transition is facilitated by the team-based approach activated during inpatient hospitalization, as opposed to the bilateral relationship between patient and oncologist wherein the transition to explicitly palliative care may be perceived as a failure. Interventions to reduce potentially avoidable hospitalization will need to find ways to foster and support patient-centered cancer care teams in the outpatient setting without interfering with the therapeutic relationship between patient and oncologist.

To develop and test clinical interventions for reducing hospitalizations in patients with cancer, clinicians need reliable metrics to measure the impact of new approaches. Our consensus-driven approach demonstrated that potentially avoidable hospitalization in patients with cancer is a complex and multidimensional construct. Potentially avoidable hospitalizations were not readily identifiable by the reason for hospitalization or by patient characteristics, and this construct will be difficult to capture by using automated approaches that rely on administrative data. Instead of attempting to directly measure potentially avoidable hospitalizations, an alternative strategy is to measure all hospitalizations in specified populations of patients for whom avoidance of hospitalization is especially desirable. With this approach, practices and health systems can establish their baseline rate of hospital admissions within a defined population and measure the impact of interventions against this baseline.

A limited set of cancer-specific hospital use metrics has already been approved by the National Quality Forum that focuses on visits to the emergency department and admissions to the intensive care unit in the last 30 days of life.[5] Metrics for other populations have also been proposed, including measurement of hospitalizations and emergency department visits among patients receiving chemotherapy.[31,32] Our findings suggest that the patients with cancer at the highest risk of potentially avoidable hospitalization are those with refractory, metastatic cancer, whether or not they are currently receiving chemotherapy treatment, and metrics to measure hospital admissions in this population should be developed and evaluated.

Policy and organizational reforms are also needed. Within the fee-for-service payment system there is no financial incentive for care providers to reduce avoidable hospitalizations, and much of the clinical work involved in this endeavor will be uncompensated. The anticipated arrival of accountable care organizations and episode-based payments could begin the process of realigning incentives for oncology care providers.[33] Oncology patient–centered medical homes, which will be well suited to participate in accountable care organizations, have already started to report anecdotal success with care reorganization to reduce hospital use.[31] New payment models will also permit the development of programs that facilitate earlier and more coordinated integration of palliative care and hospice treatment, such as open-access hospice.[34,35]

There are potential limitations to the validity of our findings. Because of our retrospective design, determination of avoidable hospitalizations may have been influenced by knowledge of hospitalization outcomes. We guarded against this bias by excluding from review any record dated after the day of hospital admission. The consensus-driven review process used in our study was necessarily subjective,

because there is no validated objective measure of potentially avoidable oncology hospitalization. Nevertheless, our detailed review process is also a strength—this time-intensive exercise yielded unexpected observations about patterns of care within our own institution and stimulated discussion about a number of potential interventions to reduce avoidable hospitalizations. Finally, reviewers might have been biased toward perceiving all hospitalizations for patients with advanced disease as potentially avoidable. We did not find evidence of this, because only a minority of hospitalizations were deemed avoidable, even among patients hospitalized in the last 30 days of life (13 [34%] of 38) or among patients actively enrolled in hospice (five [38%] of 13). Our results suggest that clinicians make distinctions between different types of hospitalizations in patients with poor-prognosis cancer, viewing only some as potentially avoidable.

The generalizability of our study is limited by the patient population and setting, which encompassed patients with GI cancers hospitalized at a single large academic medical center. Actively managed patients who were not hospitalized during the study period did not contribute to the analysis. Review of the existing literature, however, suggests that our patient population is representative of inpatients seen at other academic centers, where the majority of hospitalized patients have metastatic disease and poor posthospitalization outcomes.[22] In our sample, only 16% of patients were seen in a palliative care clinic in the 60 days before hospitalization, and the generalizability of our findings may be limited in settings with higher uptake of early palliative care. Nevertheless, late and infrequent palliative care referral is well documented in other institutional series,[22,36] and likely remains the prevailing norm in both academic and private practice settings.

In conclusion, we studied medical hospitalizations in patients with GI cancer who received outpatient cancer care at our center and identified 19% of hospitalizations as potentially avoidable. Potentially avoidable hospitalization was associated with age $\geq$ 70 years as well as with characteristics of advanced, refractory cancer, including prior receipt of three or more lines of palliative chemotherapy and receipt of an oncologist's recommendation to consider hospice care. Survival after potentially avoidable hospitalization was markedly decreased, and patients with potentially avoidable hospitalization were more likely to be discharged home with hospice. Improving the quality of outpatient cancer care holds promise for reducing potentially avoidable hospitalizations and health care costs, particularly for patients with a short life expectancy. Significant clinical and policy innovations will be needed to realize these objectives. Future work should focus on the evaluation of clinical interventions targeted at reducing potentially avoidable hospitalizations, which are likely to take diverse forms.

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GLOSSARY TERMS

clustering: organization of data consisting of many variables (multivariate data) into classes with similar patterns. Hierarchical clustering creates a dendrogram on the basis of pairwise similarities in gene expression within a set of samples. Samples within a cluster are more similar to one another than to samples outside the cluster. The vertical length of branches in the tree represents the extent of similarity between the samples. Thus, the shorter the branch length, the fewer the differences between the samples.