HHS Public Access

Author manuscript

Am J Emerg Med. Author manuscript; available in PMC 2021 April 15.

Published in final edited form as:

Am J Emerg Med. 2016 October ; 34(10): 1934–1938. doi:10.1016/j.ajem.2016.06.076.

An ED pilot intervention to facilitate outpatient acute care for cancer patients

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Abstract

Introduction: Unplanned hospitalizations are common in patients with cancer, and most hospitalizations originate in the emergency department (ED).

Methods: We implemented an ED-based pilot intervention designed to reduce hospitalizations among patients with solid tumors. The intervention, piloted at a single academic medical center, involved a medical oncologist embedded in the ED during evening hours. We used a quasiexperimental preimplementation/postimplementation study design to evaluate the proportion of ED visits that resulted in inpatient hospital admission, before and after pilot implementation. General estimating equations were used to evaluate the association between the intervention and hospital admission.

Results: There were 390 ED visits by eligible cancer patients in the preintervention period and 418 visits in the intervention period. During the intervention period, 158 (38%) of 418 ED visits were identified by the embedded oncologist during the evening intervention shift. The proportion of ED visits leading to hospitalization was 70% vs 69% in the preintervention and intervention periods (odds ratio, 0.93 [95% confidence interval, 0.69–1.24]; P= .62). There were no differences between periods in ED length of stay or subsequent use of acute care. Among patients with initial ED presentation during the operating hours of the intervention, the proportion of ED visits leading to hospitalization was 77% vs 67% in the preintervention and intervention periods (odds ratio, 0.62 [0.36–1.08]; P= .08).

Conclusion: Embedding an oncologist in the ED of an academic medical center did not significantly reduce hospital admissions. Novel approaches are needed to strengthen outpatient acute care for patients with cancer.

1. Introduction

Unplanned hospitalizations in patients with cancer are common [1] and costly [2]. Approximately 1 in 5 of these hospitalizations may be avoidable, as evaluated by various

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criteria [3–5]. Most unplanned hospitalizations in cancer patients transit through the emergency department (ED), a clinical environment where high patient acuity, inconsistent access to outpatient resources, and the absence of longitudinal patient relationships all create barriers to outpatient discharge plans. In this context, population-based studies report that 63% to 72% of ED visits in cancer patients result in hospital admission [6,7]. Enhancing the capacity of emergency physicians to reduce the proportion of ED visits resulting in hospital admission is a promising strategy to enhance the value of ED care generally and is of considerable relevance to cancer care [8].

To improve the effectiveness and efficiency of acute care for patients with cancer, we designed and pilot tested an intervention to reduce the hospital admission rate among cancer patients presenting to the ED affiliated with our institution. We reasoned that placing a medical oncologist in the ED to consult directly with ED care providers and patients would improve communication and care coordination, thus facilitating outpatient discharges for cancer patients. Because we lacked resources to post an oncologist in the ED at all hours, we chose to staff our intervention between 5 PM and 11 PM—hours with high volumes of oncology patients in the ED and with restricted capacity for acute care in the outpatient clinics. Here, we describe the findings of the 5-week pilot implementation, compared with the preceding 5-week control period.

2. Methods

2.1. Setting and patients

The intervention setting is an urban, academic tertiary care hospital that serves as the ED and inpatient affiliate of an NCI-designated comprehensive cancer center. The ED is a 39-bed facility with more than 60 000 patient visits annually. The target population for our intervention included patients under active outpatient management for solid tumor malignancy at the affiliated cancer center, as this population is at increased risk for seeking acute care and has established access to follow-up with an outpatient care team. *Active management* was defined as 2 or more outpatient oncology clinic visits in the 6-month period preceding an ED visit.

2.2. Intervention

The 5-week pilot intervention involved embedding a medical oncologist in the ED between 5 PM and 11 PM, 6 nights per week (Sunday through Friday). The intervention oncologist was stationed inside the ED and identified patients in the target population through active review of the electronic ED patient list and regular communication with on-duty emergency physicians. When the intervention oncologist identified an appropriate patient, he or she discussed the patient with the attending emergency physician. When an outpatient discharge was considered potentially feasible, the oncologist assisted with clinical evaluation and discharge planning, including coordination of outpatient follow-up and communication with the patient’s primary medical oncology team. All final management and disposition decisions were made by the responsible emergency physician. The oncologist was not involved in the care of patients when the emergency physician declined his or her involvement or once a decision for inpatient admission was made. Oncologists who

participated in the intervention also completed a log of all solid tumor malignancy patients identified in the ED during intervention shifts, including subjective assessments of the feasibility of alternative management approaches. Six board-certified or board-eligible medical oncologists participated in the intervention.

2.3. Evaluation

The intervention was evaluated using a quasiexperimental preintervention/postintervention design. The preintervention period was the 5-week interval immediately preceding the intervention period. The primary study outcome was the proportion of eligible oncology patients admitted to the hospital within 2 calendar days of ED presentation. Patients who were managed on the ED observation service but never admitted to inpatient status were not considered to be admitted to the hospital. The key secondary outcome and safety outcome was the proportion of nonadmitted patients who received additional acute care (inpatient hospital admission or a second ED visit) within 5 calendar days of the index ED presentation. All objective study data were collected from clinical and administrative records and were assessed from the same data sources in both study periods. In addition to the study outcomes defined above, additional descriptive characteristics and outcomes reported include age, primary cancer diagnosis, timing of ED and oncology clinic visits, ED principal visit diagnosis (categorized using the Healthcare Cost and Utilization Project's single-level clinical classification system [9], with the authors' modifications for relevance to oncology care), ED disposition, ED and hospital length of stay, 30-day mortality after the index ED visit, and survey response data from the participating medical oncologists' intervention log (regarding the avoidability of ED or hospital care).

For both the primary and secondary outcomes, we used generalized estimating equations to evaluate the association between study period and outcome. This approach accounts for clustering of outcomes by patient, as some patients had multiple ED visits during the study. For other categorical outcomes, the association between study period and outcome was evaluated using χ^2 tests. Right-skewed outcomes (eg, length of stay) were compared using Wilcoxon tests. The study was designed to have 80% power to detect a 10% reduction in the primary outcome (hospitalization within 2 days of ED presentation), with a 2-tailed type I error rate of 5%. This study was reviewed and approved by the applicable institutional review board.

3. Results

3.1. Descriptive findings

Among all visits to the ED between March 15 and May 24, 2015, we identified 11,515 live discharges (inclusive of home discharges, hospital admissions, and admissions to the ED observation service). There were 808 eligible ED discharges in patients with solid tumor malignancy (7.0% of all ED discharges), for a mean of 11.5 ED visits per day among actively managed solid tumor oncology patients. Characteristics of visits and patients are shown in Table 1. A plurality of the ED visits occurred during weekday daytime hours, 8 AM to 4 PM (37%). There were 390 qualifying ED visits in the first 5 weeks of the study (preintervention period) and 418 visits during the following 5 weeks (intervention period).

Of the 418 ED visits occurring during the intervention period, 158 (38%) were identified by study staff (including 99 of 128 patients [77%] who presented to the ED between 4 PM and 11 PM, Sunday through Friday). The intervention oncologist screened the medical records of all 158 identified patients, discussed 114 patients (71%) with the attending emergency physician, directly evaluated 29 patients (18%), and contacted the primary medical oncologist (by telephone or e-mail) for 30 patients (18%).

3.2. Association of the intervention with key outcomes

Among all patients, we found no association between the study intervention and the primary outcome of hospital admission within 2 days of ED evaluation, with 70% of ED visits leading to hospital admission in the preintervention period vs 69% in the intervention period (P= .62). Similarly, we found no change in the proportion of nonadmitted patients who received acute care in the ED or hospital within 5 days of disposition from the ED (21% vs 23%; P= .65). Emergency department disposition patterns, ED and inpatient length of stay, and 30-day mortality were all unchanged across study periods (see Table 2). Hospital admission rates for the most frequently encountered ED diagnosis categories are shown in Table 3. Admission rates ranged from 96% for pneumonia (24 of 25 ED visits) to 41% for nonspecific chest pain (9 of 22 ED visits).

We performed a secondary, exploratory analysis of ED disposition outcomes in the subset of 252 ED visits with presentation to the ED between 4 PM and 11 PM on Sunday through Friday—the visit subset corresponding to those patients most likely to be present in the ED during the operating hours of the intervention (31% of all ED visits; see Table 2). The proportion of all patients hospitalized within 2 days of ED presentation in the exploratory analysis population was 77% in preintervention period vs 67% in the intervention period (P= .08). The proportion of nonadmitted patients receiving additional acute care within 5 days of ED disposition was 33% in the preintervention period vs 15% in the intervention period (P= .07).

3.3. Subjective assessments of intervention participants

Oncologists participating in the study intervention judged that the complaints leading to 42 (27%) of 158 identified patient visits could “probably or definitely” have been effectively managed in the oncology clinic, without ED evaluation and/or management. Among 98 patients who were evaluated by the intervention oncologist in the ED and were subsequently admitted to the hospital, the oncologist identified 19 admissions (19%) as potentially avoidable. The intervention oncologist also identified 29 admissions (30%) that could have been safely coordinated as direct admissions from the outpatient oncology clinic, rather than transiting through the ED. Among these admissions, 8 of 29 admitted patients had been referred to the ED after initial evaluation in clinic, and an additional 9 patients registered in the ED before 4 PM on a weekday, without initial oncology clinic evaluation.

4. Discussion

Based on prior research indicating that approximately 1 in 5 hospital admissions among patients with cancer may be avoidable, [3–5] we created and pilot tested a pragmatic

intervention to reduce hospital admissions among patients with solid tumor malignancies. We hypothesized that embedding a medical oncologist in the ED would increase outpatient discharges in cancer patients by (1) enhancing coordination of care between the ED and the outpatient oncology clinics and (2) sharing clinical expertise between oncology and ED care teams.

In the primary analysis, our intervention was not associated with any significant change in hospital admissions (primary outcome) or short-term acute care utilization (secondary outcome) among patients under active management for solid tumor malignancies. Concurrently, the intervention was not associated with any differences in ED or inpatient length of stay. In an exploratory analysis focusing only on patients presenting to the ED during or immediately preceding the operating hours of the intervention, we found that the study intervention was associated with a nonsignificant 10% reduction in the proportion of ED visits leading to hospital admission (77% in the preintervention period vs 67% in the intervention period; $P = .08$) as well as a nonsignificant reduction in the proportion of outpatient ED discharges leading to further acute care within 5 days (33% vs 15%; $P = .07$).

Although the intervention failed to show a significant association with key study outcomes, the results observed in the exploratory analysis population (the population of patients most directly exposed to the intervention) leave open the possibility that the intervention may have been modestly effective. The finding from the exploratory analysis of a greater than 50% reduction in the receipt of additional acute care over the 5 days after ED presentation is of particular interest. Although not statistically significant, this finding suggests that early oncologist involvement may have led to improved care coordination after ED discharge, at times obviating the need for subsequent unplanned acute care. This finding emphasizes the relevance of care coordination for cancer patients after an initial ED presentation.

What lessons can we learn from this pilot implementation study? First, oncologists participating in the intervention perceived that the goal of safely reducing acute care intensity for patients with cancer was feasible. Oncologist participants viewed 19% of ED visits leading to hospital admission as potentially avoidable—a figure that is well-aligned with previously reported estimates of the prevalence of potentially avoidable hospitalizations in cancer patients [3,4]. Additional evidence to support the feasibility of preventing hospital admissions comes from a considerably larger quasiexperimental study, where investigators at Memorial-Sloan Kettering showed that an observation care model was associated with a modest but statistically significant reduction in the hospital admission rate among cancer patients presenting to an urgent care center [10].

Second, our pilot intervention provided substantial experience in understanding the obstacles to and opportunities for improving outpatient acute care for cancer patients. Our intervention design in this implementation followed a consultative model and relied on the development of effective collaboration between emergency physicians and ED-embedded medical oncologists. Because of the rapid pace of ED evaluation and management, we observed that this consultative approach often resulted in the oncologist becoming involved in patient care only after the initial evaluation and laboratory testing had been completed by the ED care team. A more explicit plan for integration of the oncologist in the ED care team workflow

(eg, through joint initial evaluation by both the emergency physician and oncologist) may have strengthened the evaluation by facilitating earlier, deeper involvement of the oncologist in management deliberations and decision making.

In addition, our approach did not involve standard use of acute care protocols or pathways, largely because of a lack of tested approaches that are applicable to cancer patients. An example of an oncology acute care situation where protocolized management may be appropriate is febrile neutropenia, where high-quality evidence demonstrates that risk algorithms accurately identify patients who can be safely managed as outpatients [11,12]. A recent National Institutes of Health workshop on emergency care in cancer patients identified ED management of febrile neutropenia as a priority area for further study [13]. Further research is also needed to identify other oncology acute care populations where outpatient management is safe and effective or where early specialized management can otherwise contribute to improved outcomes of care. Candidate areas for study may include pneumonia [14], thromboembolism, or nausea and vomiting—all common acute diagnoses where severity of illness varies widely.

Third, the optimal setting for an intervention to reduce hospitalizations in cancer patients is uncertain. We chose to implement our pilot intervention in the ED because it is the most proximal care setting before hospital admission for a majority of patients. Alternatively, reaching patients before they present to the ED may be a preferable approach to reducing hospital admissions and enhancing outpatient management. Exponents of the oncology patient-centered medical home have described their experience in reducing acute care utilization [15,16] which is largely based on availability of high-functioning telephone triage services and timely outpatient clinical evaluation for acute complaints [17]. Although promising, the generalizability of these types of interventions remains unproven. Enhancing the capability of outpatient oncology clinics to manage acute complaints (including expanded clinic access in the later afternoon and early evening and greater capacity for same-day outpatient palliative procedures, such as paracentesis or thoracentesis) is another promising approach for reducing hospital admissions. Alternative payment models may provide the needed stimulus for this kind of care redesign [18–20], as current fee-for-service payment systems provide little incentive for institutions to make systematic investments in outpatient acute care [21].

The principal strength of this study is its interventional, quasiexperimental design. Although prior observational studies have suggested that a substantial proportion of hospitalizations in cancer patients may be avoidable, experimental and quasiexperimental approaches provide the strongest lens for identifying and examining avoidable hospitalizations. As a pilot evaluation, our study was limited by its short duration (5-week intervention period) and by certain features of the evaluation design. Our intervention was staffed during evening hours, Sunday through Friday; however, the prospectively defined analysis population included all patients presenting to the ED at any time during the preintervention and intervention periods. We planned the analysis in this way because it allowed for a clean definition of the preintervention and intervention populations and because we hypothesized that the effectiveness our intervention might spill over into nonintervention hours. However, this

decision meant that many patients in the analysis population were not effectively exposed to the study intervention.

In addition, we decided prospectively to limit our intervention to patients with solid tumor malignancies. This decision was made due to initial concerns that emergency presentations in patients with hematologic malignancy might differ substantially from those in patients with solid tumors. During the course of conducting this study, however, the intervention oncologist frequently participated in “curbside” discussions regarding patients with hematologic malignancy, and emergency presentations in this population often shared many similarities with presentations in solid tumor malignancy patients. Inclusion of hematologic malignancy patients in our study population would have increased both the reach of our study and the power of the analysis, and future acute care interventions targeting cancer patients need not necessarily segregate hematologic and solid tumor malignancy patients. Finally, our intervention was labor intensive and would likely be challenging for many hospitals and EDs to implement.

In summary, our intervention—consisting of a medical oncologist embedded in the ED to participate in team-based acute care of cancer patients—did not demonstrate effectiveness in reducing inpatient hospital admissions. An analysis of patients who were most directly exposed to the intervention does not exclude the possibility of a modest reduction in hospitalizations and subsequent acute care; however, this analysis was underpowered and was not part of the original research plan. We conclude that future ED-based interventions to reduce hospital admissions in cancer patients should include deeper, more systematic collaborations among emergency physicians and oncologists, perhaps leveraging health informatics–based approaches to identify patients who can be safely managed without acute hospital admission. Alternatively, we recommend designing acute care interventions that can be offered in extended access clinic settings, outside of the ED environment, as another promising area for innovation in oncology acute care delivery. The recently established Comprehensive Oncologic Emergencies Research Network (supported by the National Cancer Institute) provides a new forum to facilitate multisite studies of acute care interventions in cancer and presents a promising setting to further explore approaches for preventing potentially avoidable hospitalizations in patients with cancer [22].

Acknowledgments

This research was supported by an intramural grant to GAB from the Dana-Farber Cancer Institute Department of Medical Oncology. MAM acknowledges support from an institutional research training grant from the National Cancer Institute of the National Institutes of Health awarded to the Dana-Farber Cancer Institute Department of Medical Oncology (T32-CA009172).

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Table 1

Visit and patient characteristics of solid tumor oncology patients with ED visits

Characteristic	Period, n (%)		
	All	Preintervention	Intervention
Visit characteristics			
ED visits, n	808	390	418
ED arrival time			
Weekday daytime (8 AM-4 PM, Mon-Fri)	295 (37)	139 (36)	156 (37)
Intervention hours (4 PM-11 PM, Sun-Fri)[a]	252 (31)	124 (32)	128 (31)
Weekday overnight (11 PM-8 AM, Sun-Thu)	78 (10)	36 (9)	42 (10)
Weekend (Fri 11 PM-Sun 4 PM)	183 (23)	91 (23)	92 (22)
Oncology clinic visit within prior 30 d	685 (85)	344 (88)	341 (82)
Chemotherapy receipt within prior 30 d[b]	236 (29)	114 (29)	122 (29)
ED principal visit diagnosis			
Abdominal pain	55 (7)	27 (7)	28 (7)
Fever of unknown origin	34 (4)	16 (4)	18 (4)
Respiratory complaint (eg, dyspnea)	33 (4)	18 (5)	15 (4)
Hypovolemia and hypotension	28 (3)	14 (4)	14 (3)
Cancer (primary site code)	27 (3)	12 (3)	15 (4)
Pneumonia and empyema	25 (3)	14 (4)	11 (3)
Nausea and vomiting	25 (3)	11 (3)	14 (3)
Thromboembolism (including PE)	25 (3)	7 (2)	18 (4)
Nonspecific chest pain	22 (3)	8 (2)	14 (3)
Intestinal obstruction	21 (3)	10 (3)	11 (3)
Other	513 (63)	253 (65)	260 (62)
Patient characteristics			
Unique patients, n	663	343	379
Sex			
Female	389 (59)	200 (58)	143 (42)
Male	274 (41)	189 (59)	131 (41)
Age (y), median (IQR)			
Median (IQR) (y)	62 (53, 70)	62 (53, 71)	62 (53, 70)
18–49	118 (18)	67 (20)	62 (16)
50–59	170 (26)	79 (23)	106 (28)
60–69	195 (29)	103 (30)	112 (30)
70–95	180 (27)	94 (27)	99 (26)
Cancer diagnosis			
Lung	105 (13)	51 (13)	54 (13)
Breast	103 (13)	48 (12)	55 (13)
Ovary	92 (11)	47 (12)	45 (11)
Colorectal	40 (5)	22 (6)	18 (4)

Characteristic	Period, n (%)		
	All	Preintervention	Intervention
Prostate	39 (5)	19 (5)	20 (4)
Pancreas	34 (4)	14 (4)	20 (5)
Other solid tumors	395 (49)	189 (48)	196 (48)
ED visits per patient			
1 visit	544 (82)	300 (87)	345 (91)
2 visits	94 (14)	39 (11)	29 (8)
3 visits[c]	25 (4)	4 (1)	5 (1)

Abbreviation: IQR, interquartile range.

[a]Patients registering in the ED between 4 *PM* and 11 *PM* (Sunday through Friday) were considered to be exposed to the intervention. Intervention hours were 5 *PM* to 11 *PM*.

[b]Intravenous chemotherapy, oral chemotherapies not captured.

[c]One patient had 4 visits across both study periods.

Table 2

Outcomes of ED management of cancer patients, before and after intervention implementation

Outcome measure	Preintervention period	Intervention period	OR (95% CI)	P
All ED visits (primary analysis), n	390	418		
Hospital admission within 2 d of ED evaluation[a]	274 (70%)	287 (69%)	0.93 (0.69–1.24)	.62
Acute care within 5 d after ED evaluation[b]	29/138 (21%)	35/154 (23%)	1.15 (0.64–2.06)	.65
Death within 30 d of ED visit[c]	47 (12%)	45 (11%)	0.88 (0.57–1.36)	.57
ED disposition			-	.82
Inpatient admission	252 (65%)	264 (63%)	-	-
ED observation care	41 (11%)	42 (10%)	-	-
Discharged	97 (25%)	112 (27%)	-	-
ED length of stay (h:min), median (IQR)	5:37 (4:09, 7:31)	5:15 (4:01,7:03)	-	.07
Inpatient length of stay (d), median (IQR)	4 (2, 7)	4 (2, 7)	-	.21
ED visits with presentation 4 PM-11 PM, Sun-Fri (exploratory analysis), n	124	128		
Hospital admission within 2 d of ED evaluation	95 (77%)	86 (67%)	0.62 (0.36–1.08)	.08
Acute care within 5 d after ED evaluation[b]	13/40 (33%)	7/46 (15%)	0.37 (0.13–1.06)	.07
Death within 30 d of ED visit	13 (10%)	14 (11%)	1.05 (0.47–2.33)	.43
ED disposition			-	.49
Inpatient admission	84 (68%)	82 (65%)	-	-
ED observation care	12 (10%)	10 (8%)	-	-
Discharged	28 (23%)	36 (28%)	-	-
ED length of stay (h:min), median (IQR)	5:11 (3:55, 6:45)	4:55 (3:53, 6:27)	-	.20
Inpatient length of stay (d), median (IQR)	4 (2, 8)	4 (3, 8]	–	.31

[a]Primary outcome.

[b]Hospitalization or repeat ED evaluation, assessed among patients with an ED disposition other than hospital admission.

[c]Thirty-day follow-up complete for 98% of ED visits.

Table 3

Hospital admission rates, stratified by ED principal diagnosis category

ED principal diagnosis category	Admissions[a], ED visits	Admission rate (%)
Pneumonia (including empyema)	24 of 25	96
Cancer (primary site code)	24 of 27	89
Thromboembolism (including PE)	20 of 25	80
Hypovolemia and hypotension	22 of 28	79
Respiratory complaint (eg, dyspnea)	23 of 33	70
Fever of unknown origin	23 of 34	68
Nausea and vomiting	14 of 25	56
Other gastrointestinal disorders	11 of 20	55
Abdominal pain	28 of 55	51
Complications of surgical/medical care	10 of 20	50
Nonspecific chest pain	9 of 22	41
Other[b]	353 of 494	71
All	561 of 808	69

[a]Hospital admission within 2 days of ED evaluation.

[b]Includes all principal diagnosis categories with less than 20 ED visits.