

Why Pediatric Patients with Cancer Visit the Emergency Department: United States, 2006–2010

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Background. Little is known about emergency department (ED) use among pediatric patients with cancer. We explored reasons prompting ED visits and factors associated with hospital admission. **Procedure.** A retrospective cohort analysis of pediatric ED visits from 2006 to 2010 using the Nationwide Emergency Department Sample, the largest all-payer database of United States ED visits. Pediatric patients with cancer (ages ≤19 years) were identified using Clinical Classification Software. Proportion of visits and disposition for the top ten-ranking non-cancer diagnoses were determined. Weighted multivariate logistic regression was performed to analyze factors associated with admission versus discharge. **Results.** There were 294,289 ED visits by pediatric patients with cancer in the U.S. over the study period. Fever and fever with neutropenia (FN) were the two most common diagnoses, accounting for almost 20% of visits. Forty-

four percent of pediatric patients with cancer were admitted to the same hospital, with admission rates up to 82% for FN. Risk factors for admission were: FN (odds ratio (OR) 8.58; 95% confidence interval (CI) 5.97–12.34); neutropenia alone (OR 7.28; 95% CI 5.08–10.43), ages 0–4 years compared with 15–19 years (OR 1.19; 95% CI 1.08–1.31) and highest median household income ZIP code (OR 1.27; 95% CI 1.08–1.49) compared with lowest. “Self-pay” visits had lower odds of admission (OR 0.42; 95% CI 0.35–0.51) compared with public payer. **Conclusion.** FN was the most common reason for ED visits among pediatric patients with cancer and is the condition most strongly associated with admission. Socioeconomic factors appear to influence ED disposition for this population. *Pediatr Blood Cancer* 2015;62:490–495. © 2014 Wiley Periodicals, Inc.

Key words: emergency service; febrile neutropenia; health care surveys; oncology; supportive care; United States

INTRODUCTION

Cancer treatment and supportive care measures have greatly improved the overall survival of pediatric patients with cancer. Cancer related complications, such as life threatening infections and tumor related compression of vital organs, can require prompt medical evaluation [1–3]. Recognition of these complications may be delayed in children related to diminished communication ability and different pathophysiology, that can mask early signs of sepsis [4].

A systematic review of emergency department (ED) utilization among adult cancer patients revealed a variety of cancer-treatment or disease related presentations, including fever and neutropenia (FN), infection, pain, fever and dyspnea. Over half of ED visits for adult cancer patients resulted in admission [5]. Given an interest in reducing these high admission rates, there are recent publications exploring the safety of direct ED discharge for adult cancer patients with FN [6]. To date, existing literature on pediatric patients with cancer has predominantly focused on outcomes among hospitalized patients [7,8] without an acknowledgement of the ED management prior to admission.

The purpose of this investigation was to explore reasons prompting ED visits among pediatric patients with cancer and risk factors for admission to hospital from the ED. We hypothesized that younger age and neutropenia would be independently associated with higher rates of admission from the ED among pediatric patients with cancer.

METHODS

Study Design and Setting

Pediatric patients with cancer were identified from an analysis of pediatric ED encounters from 2006 to 2010, using the Healthcare Cost and Utilization Project's (HCUP) Nationwide Emergency Department Sample (NEDS), compiled by the Agency for Healthcare Research and Quality [9]. The NEDS is a nationally representative database that provides a 20% stratified probability sample of all

United States (U.S.) hospital-based EDs. The NEDS has been used in several prior studies to examine ED utilization of pediatric patients in the U.S. [10–12]. Data elements within the NEDS include international classification of diseases, ninth revision, clinical modification (ICD-9-CM) codes, patient demographic characteristics, hospital characteristics, and inpatient data for ED admissions. Discharge weights based on the sampling scheme were applied to permit inference for a nationally representative population of ED visits with pediatric cancer diagnoses. Each year of data contained approximately 6 million pediatric (ages 0–19 years) ED encounters that represented about 30 million weighted encounters in the U.S. pediatric population per year. The analysis was based on de-identified national data and therefore was considered exempt from institutional review board approval by the University of Michigan Medical School.

Identification of Sample

Pediatric patients, defined as those between ages 0–19 years, were selected for analysis in order to allow U.S. population-

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adjusted estimates of ED utilization [13]. The pediatric cancer patient subpopulation was identified using the HCUP Clinical Classification Software (CCS) codes 11–45, which encompass all types of malignancies. The CCS is a diagnosis and procedure categorization scheme that collapses ICD-9-CM codes into a smaller number of clinically meaningful categories. Demographic and hospital characteristics were evaluated including: patient's age, sex, primary expected payer, median household income of the patient's ZIP code, hospital trauma designation, and hospital teaching status. The disposition categories that were analyzed included: discharged (patient treated and released from the ED), admitted (patient admitted to same institution), transferred (patient transferred to another short-term hospital), or died in the ED.

Variables

The reason prompting an ED visit was defined as the primary ICD-9-CM discharge diagnosis associated with the visit, unless the primary diagnosis was a cancer diagnosis (ICD-9-CM Codes 140–239). In cases where a cancer diagnosis was the primary diagnosis (18.4% of visits), the second listed ICD-9-CM diagnosis was considered to be the reason prompting the ED visit. Cancer diagnoses were excluded from our analysis in order to focus on symptom or complication diagnoses among pediatric patients with cancer who present to the ED.

A rank list of diagnoses was generated and visits were categorized based on the top twenty diagnoses. For common diagnoses to which multiple ICD-9-CM codes could map, general categories were defined including fever (780.6, 780.60, 780.61), neutropenia (288.0, 288.09), pneumonia (480–485), and upper respiratory infection (460–465). Blood stream infections were identified by the following ICD-9-CM codes: bacteremia (790.7), septicemia (38), infection due to a vascular device, implant or graft (996.62), or infection due to central venous line (999.31, 999.32).

The presence of FN has clinical importance, though it does not have a unique ICD-9-CM code. Therefore, visits were assessed for the combination of fever and neutropenia. Among patients with a primary diagnosis of fever, all associated diagnoses were examined for the presence of neutropenia and vice versa. Patients were classified as having FN if their primary diagnosis was fever with neutropenia in any of the diagnostic fields or primary diagnosis of neutropenia with fever in any of the diagnostic fields.

Outcome

The primary outcome of interest was admitted to same institution or discharged to home. Transfers out of the ED (3.7%) were excluded from the regression because of the uncertainty about the final disposition status of transferred patients due to lack of patient level identifiers in the dataset. Patients who died in the ED were also excluded (0.1%).

Data Analysis

In order to achieve nationally representative estimates, analyses were weighted according to the Agency for Healthcare Research and Quality-specified discharge variable (DISCWT). All results are presented as weighted data unless otherwise specified. Descriptive statistics were used to demonstrate the distribution of demographic and hospital characteristics. The number of encounters for pediatric patients with cancer were described as the rate of discharges per

100,000 U.S. children per year, using national census data for each year [13]. The proportion of visits made by pediatric patients with cancer and the disposition status was determined for the top 10 primary non-cancer diagnoses and for the FN variable.

A weighted multivariate logistic regression model was used to estimate factors associated with admission for pediatric patients with cancer and to account for clustering of patients by hospital. Variables were included based on our defined model: patient's age, sex, primary expected payer, median household income for the patient's ZIP code, hospital trauma designation, hospital teaching status, dichotomous variables for the presence or absence of each of the top 10 most common primary diagnoses, and a dichotomous variable for the presence of a hematologic malignancy. Due to the limitations of administrative data which lack information regarding disease stage and type or phase of therapy, a variable for hematologic malignancy was included in our model. Previous studies have documented an increased risk for serious infections among patients with a hematologic malignancy as compared with non-hematologic malignancies [14]. Statistical analyses were performed using STATA version 12.0 (Stata Corp, College Station, TX).

RESULTS

Characteristics of the Study Population

There were 294,289 weighted ED visits for pediatric patients with cancer ages 0–19 years over the 5 year study period, accounting for approximately 0.2% of all pediatric ED visits in the U.S. The rate of pediatric cancer-related ED visits in 2010 was 67 visits per 100,000 U.S. children ages 0–19 years. This was relatively unchanged over the 5-year time span studied; ranging from the lowest at 65 visits per 100,000 U.S. children ages 0–19 years in 2006 to the highest at 78 visits per 100,000 in 2008. Baseline demographic characteristics of pediatric patients with cancer presenting to the ED are described in Table I. Acute lymphoblastic leukemia (ALL) was the most common cancer diagnosis (25.9%) among pediatric patients with cancer who visited the ED. The distribution of the ten most common types of cancer among pediatric ED visits is demonstrated in Table II. Overall, 51.9% of pediatric patients with cancer were evaluated in the ED and discharged to home, 43.6% were admitted to the same institution, and 3.7% were transferred to another short-term hospital. Only 390 (0.1%) of pediatric patients with cancer died in the ED.

The 10 most common reasons prompting an ED visit for pediatric patients with cancer are listed in Table III. Together these 10 diagnoses accounted for more than one-third of all non-cancer primary diagnoses for ED visits by pediatric patients with cancer. The primary diagnoses of fever or FN were the reason for almost one in five ED visits; this finding was consistent across all 5 years.

There was variation in ED disposition across diagnoses. Pediatric patients with cancer were admitted, the majority of the time, when they presented with a primary diagnosis of fever and neutropenia (82.3%), neutropenia only (80.1%), bloodstream infections (74.7%), or pneumonia (67.8%). The lowest ED admission rates were observed for visits with a primary diagnosis of headache (10.6%) or fever alone (17.3%). The average transfer rate for a pediatric cancer patient was 3.7%. The highest rates of transfer were for seizures (9.9%), fever and neutropenia (6.5%), and neutropenia only (6.2%).

TABLE I. Characteristics of Pediatric Cancer Patients Presenting to the Emergency Department, Overall and by Disposition Status—United States, 2006–2010

	Overall (%)	Admitted	Discharged	P-value
		Proportion (95% CI)	Proportion (95% CI)	
Patient characteristics				
Gender				<0.001
Female	47.6	46.6 (45.6–47.5)	48.7 (47.4–50.0)	
Age				<0.001
0–4 years	28.6	32.7 (31.3–34.1)	25.0 (23.5–26.5)	
5–9 years	22.7	22.2 (21.2–23.3)	23.0 (21.6–24.5)	
10–14 years	18.5	18.3 (17.3–19.2)	18.5 (17.6–19.4)	
15–19 years	30.3	26.8 (24.7–28.9)	33.4 (30.6–36.2)	
Primary payer				<0.001
Public	43.0	43.5 (39.2–47.9)	42.4 (37.8–47.0)	
Private	47.2	48.3 (44.4–52.2)	46.2 (42.7–49.7)	
Self-pay	4.2	2.2 (1.8–2.7)	5.7 (4.8–6.7)	
Other	5.7	5.9 (3.8–8.0)	5.6 (3.7–7.5)	
Median household income per zip code				<0.001
1st quartile	24.6	23.3 (20.3–26.2)	25.8 (22.8–28.8)	
2nd quartile	26.6	25.2 (23.1–27.4)	27.8 (26.1–29.4)	
3rd quartile	24.7	25.8 (24.0–27.6)	24.3 (22.5–26.0)	
4th quartile	22.9	25.7 (21.9–29.5)	21.0 (18.6–23.4)	
Hospital characteristics				
Trauma level				<0.001
Level 1	32.1	42.9 (31.4–54.5)	25.1 (17.1–33.1)	
Level 2	8.0	8.0 (3.4–12.7)	8.0 (4.6–11.4)	
Level 3	5.2	2.6 (0.4–4.9)	6.4 (4.5–8.4)	
Non-trauma	32.5	21.0 (13.7–28.2)	39.5 (32.2–46.9)	
Teaching Status				<0.001
Metro, non-teaching	19.7	9.9 (5.2–14.6)	25.5 (20.6–30.3)	
Metro, teaching	71.8	87.9 (83.0–92.8)	62.3 (55.4–69.3)	
Non-metro	8.5	2.3 (1.6–2.9)	12.2 (9.8–14.6)	

Factors Affecting Admission Among Pediatric Patients With Cancer

In a multivariate analysis, factors associated with significantly increased odds of admission included being between the ages of 0–4 years (OR 1.19, 95% CI 1.08–1.31) as compared with those between the ages of 15–19 years, having a median household income in the highest income quartile (OR 1.27, 95% CI 1.08–1.49) compared with the lowest quartile, and presenting to a metropolitan

teaching hospital (OR 3.72, 95% CI 2.58–5.48) compared with metropolitan non-teaching hospital, as listed in Table IV. There were increased odds of admission for those presenting with the following primary diagnoses: fever and neutropenia (OR 8.58, 95% CI 5.97–12.34), neutropenia only (OR 7.28, 95% CI 5.08–10.43), pneumonia (OR 3.89, 95% CI 3.39–4.46), or dehydration (OR 1.84, 95% CI 1.52–2.23). Those whose primary payer was labeled as self-pay were statistically less likely to be admitted (OR 0.42, 95% CI 0.35–0.51) as compared with public payers.

TABLE II. Pediatric Cancer Patient ED Visits—by Cancer Type, 2006–2010

Type of Cancer	N	Proportion (%)
Acute lymphoblastic leukemia	76,226	25.9
Central nervous system tumor	23,842	8.1
Acute myelogenous leukemia	22,105	7.5
Bone tumor	11,551	3.9
Neuroblastoma	7,760	2.6
Hodgkin lymphoma	7,491	2.5
Soft tissue sarcoma	7,075	2.4
Wilms tumor	6,959	2.4
Non-hodgkin lymphoma	4,636	1.6
Hepatic tumor	3,113	1.1

DISCUSSION

In this study, using administrative data, we found that fever and FN are among the most common reasons for presentation to the ED. Consistent with our hypothesis, we found that younger age (0–4 years) and having a diagnosis of FN or neutropenia were factors associated with increased rate of admission from the ED. Our results provide important insight into reasons behind ED visits for pediatric patients with cancer and may help in resource planning. Differences in ED admission rates across the wide range of reasons for ED visits cannot be fully explained with hospital administrative data available to our group, but may reflect processes around cancer care within individual institutions. Studies including patient-level factors, such as disease stage and treatment regimen, will be needed to determine if this variation is warranted. Understanding whether

TABLE III. Top Reasons Prompting ED Visits Among Pediatric Cancer Patients—Rank and Disposition Status, 2006–2010

Rank ^a	Diagnosis	N (%)	Disposition Status (%)		
			Admitted to same hospital	Transferred to another facility	Discharged to home
1	Fever only	33,356 (11.3)	17.3	4.4	77.3
2	Febrile neutropenia	23,120 (7.9)	82.3	6.5	11.0
3	Bloodstream infection	12,768 (4.3)	74.7	2.8	22.4
4	Upper respiratory infection	8,277 (2.8)	21.5	0.5	77.5
5	Pneumonia	7,463 (2.5)	67.8	5.0	26.8
6	Neutropenia only	6,428 (2.2)	80.1	6.2	12.8
7	Headache	6,420 (2.2)	10.6	5.4	83.3
8	Seizure	4,395 (1.5)	40.9	9.9	48.5
9	Urinary tract infection	3,818 (1.3)	35.1	1.8	62.0
10	Dehydration	3,790 (1.3)	56.7	3.3	39.4

^aRank list based off of combined 5 years.

some of these admissions may be preventable will require further research and has important implications for quality of care.

In addition to variations associated with the reason for ED visits, we found that pediatric patients with cancer presenting to a metropolitan teaching hospital ED had higher odds of admission and patients presenting to non-metropolitan hospitals had lower odds of admission than patients presenting to metropolitan non-teaching. Previous literature has demonstrated that there are no significant differences in outcomes, including mortality, between teaching and nonteaching health care systems [15]. The patients presenting at metropolitan teaching hospital EDs could be expected to have higher acuity given that these centers are typically where more intensive therapies, such as bone marrow transplants and early phase clinical trials are performed, and where many pediatric patients with cancer receive their care. Higher rates of ED admission at metropolitan teaching hospitals may be the result of clinical management protocols in the ED or by subspecialty services, particularly with the inclusion of physician trainees. The influence of patient acuity, location of care, and subspecialty services on admission decision deserves future study.

Our results also indicate that socioeconomic factors may have a significant impact on admission with lower odds of admission among those designated as “Self Pay” in the dataset and higher odds of admission among patients from highest quartile median household income per ZIP code. What is not clear is whether patients of higher socioeconomic status are being admitted more often than is clinically necessary or if these children present to the ED with more severe illness and admission is required. Alternatively patients of lower means may be admitted too infrequently or these children present to the ED earlier in the course of illness when outpatient management is possible. These findings lead to questions about the impact of available resources at home and family preference on rates of admission. There is also potential for providers’ decisions to admit to be influenced by families’ socioeconomic status. While we observed differences in rates of admission along socioeconomic lines, we cannot assess clinical outcomes for these patients who were admitted compared with those who were not admitted with NEDS. This is an essential area to investigate in order to ensure equitable care is provided to children with ED visits for cancer or treatment-related complications.

ED admission decisions may also be related to more practical issues such as traveling distance to the hospital system where the child primarily receives their cancer care. Pediatric patients with cancer in this study had inter-hospital transfer rates as high as 9.9%, with an overall rate (3.7%) almost seven times higher than the general pediatric population [16]. This highlights that pediatric patients with cancer may not be initially presenting to the hospital system where the child primary receives their cancer care. Thus, the care of pediatric patients with cancer requires high levels of pediatric medical expertise and involvement of many disciplines and health care facilities to coordinate care. Qualitative research is needed to understand how patients and their families consider finances and travel related to the care of pediatric patients with cancer in ED settings as well as how health care providers can communicate most effectively across disciplines and institutions to delivery coordinated care to pediatric patients with cancer.

Due to the clinical importance of FN as a potentially life-threatening complication of chemotherapy [3,17], the high frequency with which pediatric patients with cancer seek ED care for fever or FN, and published guidelines that make a weak recommendation for pediatric outpatient management of FN if appropriate resources are available to support this model of care [18], this is an important area for future research. Our results show discharge from the ED for FN happens only 11% of the time. The implementation of pediatric practices for outpatient management of FN is not well understood. Previous evidence has demonstrated several key principles for optimal outpatient care. The role of the ED to provide prompt evaluation and treatment has been shown to improve outcomes with decreased need for resuscitation measures and decreased mortality [19]. After the initial ED triage and treatment, there is evidence that a subset of patients at lower risk of infectious complications can be safely and effectively managed in the outpatient setting [20,21]. A survey of parental and health care provider preferences for the treatment of FN among lower risk pediatric patients revealed that the majority preferred outpatient therapy and that the perceived impact of admission on health-related quality of life appears to be complex and multifactorial [22]. In a decision-analytic model performed by Teuffel et al, inpatient therapy for FN could not be justified on the basis of safety and efficacy or patient/parent preferences [23].

TABLE IV. Multivariate Logistic Regression to Evaluate Factors Associated With Admission Versus Discharge from the ED Among Pediatric Cancer Patients

Factors	Adjusted odds ratio (OR)	95% CI	P-value
Gender			
Female	0.95	0.90–1.01	0.08
Age			
15–19 years	Ref		
10–14 years	0.94	0.87–1.02	0.124
5–9 years	0.88	0.79–0.98	0.016
0–4 years	1.19	1.08–1.31	<0.001
Primary payer			
Public	Ref		
Private	0.93	0.83–1.05	0.244
Self-pay	0.42	0.35–0.51	<0.001
Other	0.98	0.59–1.63	0.954
Median household income per zip code			
1st quartile	Ref		
2nd quartile	1.04	0.96–1.13	0.342
3rd quartile	1.14	1.00–1.30	0.056
4th quartile	1.27	1.08–1.48	0.004
Teaching status			
Metro, non-teaching	Ref		
Metro, teaching	3.76	2.58–5.48	<0.001
Non-metro	0.62	0.48–0.81	<0.001
Hospital trauma status			
Non-trauma	Ref		
Level 1	1.41	0.93–2.13	0.102
Level 2	0.95	0.62–1.46	0.824
Level 3	0.71	0.44–1.15	0.17
Patient characteristics			
Hematologic malignancy	0.93	0.84–1.03	0.148
Top 10 ED visit diagnoses			
Fever only	0.25	0.17–0.36	<0.001
Febrile neutropenia	8.61	5.99–12.38	<0.001
Bloodstream infection	3.67	0.93–14.58	0.064
Upper respiratory infection	0.38	0.32–0.45	<0.001
Pneumonia	3.90	3.39–4.47	<0.001
Neutropenia only	7.28	5.08–10.43	<0.001
Headache	0.17	0.14–0.20	<0.001
Seizure	1.13	0.93–1.37	0.235
Urinary tract infection	0.87	0.72–1.06	0.173
Dehydration	1.85	1.52–2.25	<0.001

Therefore, multi-centered collaborations with an appreciation for differences in institutional resources and involving emergency care providers, oncologists, and primary care providers as well as patients/families will ultimately be required to develop a framework to facilitate outpatient management of FN for a subset of patients at low risk of serious infections [18,24].

Our study has several important limitations. We narrowed our evaluation to include only a single diagnostic code per patient because this allowed for a framework to analyze the effect of the reason for ED presentation on the odds of admission. This approach does not take into account the fact that ED visits may be driven by multiple symptoms or complications of cancer or cancer treatment. Due to the nature of administrative databases, the discharge diagnosis was utilized to define the reason for ED visit, but this is not necessarily equivalent to the chief complaint at ED presentation.

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The first diagnosis listed, other than cancer, was assumed to be the symptom or complication that prompted the ED encounter by the patient, but may vary by hospital based on the method to assign the order of the ICD-9-CM codes. The order of ICD-9-CM codes may be determined by the ED clinicians, inpatient providers for admitted patients, or billers, depending on hospital coding practices, and this may result in an overestimation or underestimation of the number of patients presenting with certain symptoms. Conversely, the absence of the diagnostic code does not necessarily guarantee the lack of the symptom. Most importantly, FN holds high clinical significance, but is not a single diagnostic code and was conferred by the presence of both ICD-9-CM codes for fever and neutropenia. It is likely that this was an underestimation of patients with FN since those with “neutropenia only” had very similar disposition patterns and odds of admission. Administrative databases do not hold detailed information regarding the patients’ cancer staging, therapy regimens, vital signs or laboratory values, which are all important factors in the decision making regarding admission for a patient experiencing FN [14,18]. Lastly, counts of visits may be overestimated because patients who were transferred to another institution providing data to HCUP, the single patient ED visit may have produced two encounters within the NEDS.

However, our report has several strengths. This study provides a baseline evaluation of the ED utilization of pediatric patients with cancer across the United States. Our data are highly generalizable given the nature of the data source. Several key areas have been highlighted for future investigation and intervention to improve the care of this unique population. In time, longitudinal analyses of the multi-institutional or national databases may allow for assessment of ED utilization among pediatric patients with cancer in relation to changes in clinical practice guidelines and evidence based practices on an institutional or national level. While the level of detailed information is typically not available in administrative data and thus, our study demonstrates the utility of this type of research and underscores the importance of pursuing innovative approaches to data collection.

CONCLUSION

In conclusion, we found that fever and FN are among the most common reasons for presentation to the ED for pediatric patients with cancer. Factors associated with increased rate of admission from the ED included younger age (0–4 years), median household income in the highest quartile, and having a diagnosis of FN or neutropenia. Important areas for future research include determining whether some of these admissions are preventable and developing mechanisms to reduce admission rates for pediatric patients with cancer.

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