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Characteristics of Recurrent Utilization in Pediatric Emergency Departments

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KEY WORDS

frequency, emergency department, utilization

ABBREVIATIONS

APR-DRG—All Patient Refined-Diagnosis Related Group
CCC—complex chronic condition
CI—confidence interval
ED—emergency department
IQR—interquartile range
OR—odds ratio
PCP—primary care physician

Drs Neuman, Alpern, Kharbanda, Shah, Freedman, Aronson, Florin, Mistry, and Berry conceptualized and designed the study, analyzed and interpreted the data, drafted the initial manuscript, and revised the manuscript critically for important intellectual content; Dr Hall conceptualized and designed the study, conducted data analyses, analyzed and interpreted the data, drafted the initial manuscript, and revised the manuscript critically for important intellectual content; and all authors approved the final manuscript as submitted.

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WHAT'S KNOWN ON THIS SUBJECT: Although frequent utilizers of emergency departments (EDs) are targeted for quality improvement initiatives across the United States, little is known about the health services these patients receive in the ED.

WHAT THIS STUDY ADDS: Eight percent of children account for 24% of ED visits and 31% of all costs. Frequent utilizers of pediatric EDs, especially infants without a chronic condition, are least likely to need medications, testing, and hospital admission during their ED visits.

abstract

BACKGROUND AND OBJECTIVE: Nationally, frequent utilizers of emergency departments (EDs) are targeted for quality improvement initiatives. The objective was to compare the characteristics and ED health services of children by their ED visit frequency.

METHODS: A retrospective study in 1 896 547 children aged 0 to 18 years with 3 263 330 visits to 37 EDs in 2011. The number of ED visits per child within 365 days of their first visit was counted. Patient characteristics (age, chronic condition) and ED care (medications, testing [laboratory and radiographic], and hospital admission) were assessed. We evaluated the relationship between patient characteristics and ED health services received with multivariable regression.

RESULTS: Children with ≥4 ED visits (8%) accounted for 24% of all visits and 31% ($1.4 billion) of all costs. As visit frequency increased from 1 to ≥4, the percentage of children aged <1 year increased (12.1% to 33.2%) and the percentage of children without a chronic condition decreased (81.9% to 45.6%) ($P < .001$ for both). Children with ≥4 ED visits had a higher percentage of visits without medication administration (aside from acetaminophen or ibuprofen), testing, or hospital admission when compared with children with 1 visit (35.4% vs 29.0%; $P < .001$). Children with ≥4 ED visits who were aged <1 year (odds ratio: 3.8; 95% confidence interval: 3.7–3.9) and who were without a chronic condition (odds ratio: 3.1; 95% confidence interval: 3.0–3.1) had the highest likelihood of experiencing this type of visit.

CONCLUSIONS: With a disproportionate share of pediatric ED cost and utilization, frequent utilizers, especially infants without a chronic condition, are the least likely to need medications, testing, and hospital admission. *Pediatrics* 2014;134:e1025–e1031

Minimizing frequent emergency department (ED) visits is a priority for federal, state, and local health systems that seek to provide high-value health care and to reduce excessive health care cost.[1] Adult patients identified as ED "super-utilizers" have very frequent ED visits (eg, >50 times each year) and account for a substantial percentage of ED utilization and cost.[2,3] Adults residing in urban settings and those with public insurance[2,4,5] are more likely to frequently use the ED for the treatment of low-severity health problems.[1] Clinical initiatives that improve access to an outpatient provider for the treatment of these health problems have been shown to decrease excessive ED use in adults.[2,6–8]

Much less is known about frequent users of pediatric EDs, but the knowledge base is growing. One ED reported that 39% of its pediatric patients experience ≥3 annual visits.[9] Younger age, minority status, and publicly insured patients are more likely to recurrently use the ED, especially for common illnesses such as asthma and upper respiratory infections.[9–12] Little is known about the health care services (eg, medications, testing, and subsequent admission) that frequent users of pediatric EDs experience while in the ED. Understanding the health service needs of frequent users may help inform initiatives to decrease the recurrent use of pediatric EDs.

With the use of a multicentered cohort of children's hospital EDs, the objectives of this study were to compare the patient characteristics and ED health services experienced by children with infrequent and frequent ED use, and to determine which children were most likely to experience ED visits associated with low ED health care service use.

METHODS

Study Design, Setting, and Participants

We performed a retrospective longitudinal study in children aged 0 to 18 years with at least 1 ED visit between January 1, 2011, and December 31, 2011, to 37 EDs in freestanding children's hospitals in 25 states that submitted data to the Pediatric Health Information System.[13] The Children's Hospital Association (Overland Park, KS) and Pediatric Health Information System–participating hospitals jointly ensure the quality and integrity of the data.[14] Data are deidentified before inclusion in the database; encrypted unique patient identifiers permit tracking of patients across multiple ED visits and hospitalizations. Children were followed for 365 days after the date of their index ED visit to examine subsequent ED utilization. Children who died during any ED visit or hospitalization during the study period were excluded because they did not have the opportunity for a full follow-up period of 365 days. This study was approved by the Institutional Review Board at Boston Children's Hospital with a waiver of informed consent.

ED Utilization

We used the number of ED visits experienced by each child during the 365-day period after their index ED encounter in 2011 to classify them into 1 of 4 categories: 1, 2, 3, or ≥4 visits. Children were not categorized beyond 4 visits because those with ≥5 visits accounted for only 4.1% of the study population. We measured the number of days between ED visits for those patients with multiple visits and calculated the proportions of patients with subsequent ED visits within 3, 7, 14, and 30 days. We also assessed the day of the week (weekend versus weekday) and the time of each ED visit (ie, 12:00 AM to 7:59 AM, 8:00 AM to 3:59 PM, and 4:00 PM to 11:59 PM.) We used the All Patient Refined-Diagnosis Related Group (APR-DRG) classification system to identify the diagnosis category for each ED visit. We totaled the cost accrued across visits for each patient; costs were estimated by applying hospital-specific cost-to-charge ratios to total hospital charges that were adjusted with the Centers for Medicare and Medicaid price/wage index.[15]

Health Services Delivered During ED Visits

For each ED visit, we assessed whether (1) hospital admission occurred, (2) medications other than acetaminophen or ibuprofen were administered in the ED, and (3) laboratory testing or radiologic testing was performed during the ED visit.[16] We classified ED visits that did not result in hospitalization, medication administration, and diagnostic testing as a low health service resource visit ("low-resource ED visit").[16] Hospital admissions coded as "observation" were counted as an admission.[17,18] We identified medication delivery by using the National Drug Code Directory,[19] and laboratory and radiology testing was identified by using charges for such testing.

Patient Demographic and Clinical Characteristics

Demographic characteristics were ascribed at the time of the initial ED visit and included age (<1 year, 1–4 years, 5–9 years, 10–14 years, and ≥15 years), gender, race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Asian, or other), insurance status (public versus nonpublic), location of home residence (ie, urban versus rural) defined with the Rural-Urban Commuting Area Code[20] of the patient's home zip code, distance from the hospital calculated as the number of miles between the centroids of the patient's and hospital's zip codes, and primary care physician (PCP) density in the county of the patient's home residence. PCP density, obtained from the *Dartmouth Atlas of Healthcare*, was measured as the number of PCPs per 100 000 residents within a county.[21]

We assessed the presence of a chronic condition and a complex chronic condition for each patient. To identify the presence of a chronic condition, we

used the Agency for Healthcare Research and Quality Chronic Condition Indicator classification system, which categorizes >14 000 International Classification of Diseases, Ninth Revision, diagnosis codes into chronic versus nonchronic conditions.[22] Patients with a chronic condition were further classified as having a complex chronic condition (CCC) versus a non-CCC by using a previously validated classification scheme.[23] CCCs represent defined diagnosis groupings expected to last longer than 12 months and involve either a single organ system severely enough to require specialty pediatric care and hospitalization or multiple organ systems.[23,24] Diagnosis codes assigned during any of a patient's ED visits or resultant hospitalization were used for these classifications.

Statistical Analyses

In bivariate analysis, we used a Mantel-Haenszel χ^2 test to assess trends in demographic and clinical characteristics of patients across categories of ED visit frequency. We derived generalized linear mixed-effects models treating hospital as a random effect to assess the likelihood of a patient experiencing an ED visit that was not associated with admission, medication administration (aside from acetaminophen or ibuprofen), or laboratory/radiologic testing on these demographic and clinical characteristics, and included demographic and clinical characteristics of patients as covariates. Separate models were derived for each category of ED visit frequency (ie, model 1 was derived for patients with 1 ED visit, model 2 for patients with 2 ED visits, and so on). An overall model with all patients in the cohort was also built, and this model additionally included a covariate for the patient's ED visit frequency. Results are presented as adjusted odds ratios (ORs) with 95% confidence intervals (CIs). Model performance was assessed with the C-statistic. All analyses were performed by using SAS version 9.3 (SAS Institute, Cary, NC). A 2-sided $P < .006$ was considered statistically significant to account for multiple comparisons (Bonferroni-adjusted level of significance = .00625).

RESULTS

ED Utilization and Visit Frequency

There were 1 896 547 patients with 3 263 330 ED visits during the study period; 712 976 (37.6%) experienced ≥1 subsequent ED visits within 365 days of their index visit. Twenty-one percent (n = 396 690) of patients had 2 ED visits, 8.6% (n = 163 080) had 3 visits, and 8.1% (n = 153 206) had ≥4 visits (Fig 1). Children with ≥4 ED visits accounted for 24% of all ED visits and 31% ($1.4 billion) of all costs.

As ED visit frequency increased, the median number of days between ED visits decreased. Children with 2 ED visits experienced these visits a median of 134 days (interquartile range [IQR]: 43–244 days) apart, whereas children with ≥4 ED visits experienced the visits a median of 36 days (IQR: 12–79 days) apart. As visit frequency increased from 1 to ≥4, the proportion of patients experiencing revisits within 30 days increased from 9.8% to 32.5% ($P < .001$) (Supplemental Fig 2).

Across visit frequencies, the most common APR-DRG diagnoses were as follows: infections of the upper respiratory tract (15.5%), asthma (8.6%), and nonbacterial gastroenteritis (5.9%). As visit frequency increased from 2 to ≥4, the percentage of children with the same APR-DRG for all of their ED visits decreased from 18.5% to 2.6%.

Demographic and Clinical Characteristics

As ED visit frequency increased from 1 to ≥4, there was an increase in the percentage of children who were <1 year of age (12.1%–33.2%; $P < .001$), non-Hispanic black (24.7% to 37.0%; $P < .001$), and publicly insured (52.6%–75.2%; $P < .001$) (Table 1). As visit frequency increased, there was an increase in the percentage of children with a chronic condition of any kind (from 18.1% to 54.4%; $P < .001$), a non-CCC (14.4%–37.2%; $P < .001$), and a CCC (3.7%–17.2%; $P < .001$). Compared with children with 1 ED visit, those with ≥4 visits were more likely to reside in urban settings (97.7% vs 94.5%; $P < .001$) and live closer to the hospital (median of 6.8 [IQR: 3.7–12.3] versus 9.6 [IQR: 5.1–18] miles; $P < .01$). As visit frequency increased from 1 to ≥4, the proportion of patients living in an area with a high PCP density increased from 27.5% to 29.3% ($P < .001$).

Health Services Delivered During ED Visits

Of the 3 263 330 visits, 32.3% (n = 1 053 250) did not require medication administration aside from acetaminophen or ibuprofen or laboratory or radiologic investigations or result in hospital admission. The most common APR-DRG diagnoses of these low-resource ED visits were as follows: (1) infections of the upper respiratory tract (25.0%; n = 263 388 [eg, acute upper respiratory infection]); (2) skin, subcutaneous, and breast disorders (8.9%; n = 94 053 [eg, rash and other nonspecific skin eruption]); (3) ear, nose, mouth, throat, and cranial/facial diagnoses (7.8%; n = 82 515 [eg, head injury, unspecified]); (4) fever (5.0%; n = 52 586 [eg, fever, unspecified]); and (5) contusion, open wound, and other trauma to skin and subcutaneous tissue (4.9%; n = 51 357 [eg, contusion of face, scalp, and neck except for eye or eyes]). The percentage of low-resource ED visits increased from 29.0% among children with 1 visit to 35.4% among children with ≥4 visits ($P < .001$) (Table 2).

In multivariable analysis, ED visits without medications, testing, or hospital admission were more likely to occur in children without a chronic condition compared with those with a CCC (OR: 2.9; 95% CI: 2.8–2.9; $P < .001$) (Table 3);

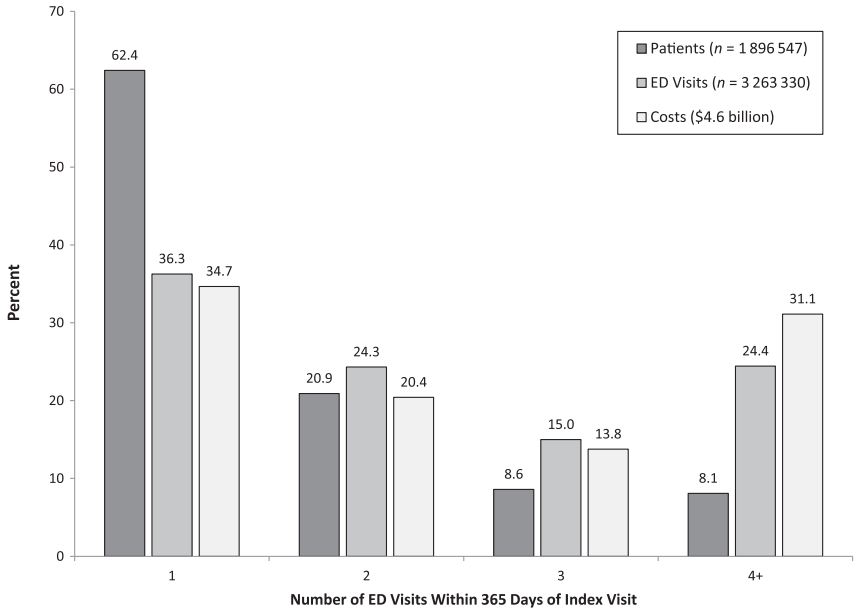

FIGURE 1

ED utilization by visit frequency. The dark gray–shaded bars represent the percentage of all patients for each of the 4 visit categories (1, 2, 3, or ≥4 visits). The medium gray–shaded bars represent the percentage of ED visits made by children on the basis of visit frequency; and the light gray–shaded bars depict the proportion of costs attributable to children on the basis of ED visit frequency.

and as ED visit frequency increased from 1 to ≥4, these odds increased from 2.8 (95% CI: 2.7–2.9) to 3.1 (95% CI: 3.0–3.1). Children <1 year of age were more likely to experience a low-resource ED visit compared with those aged >15 years (OR: 3.0; 95% CI: 3.0–3.0), and these odds increased from 2.4 (95% CI: 2.4–2.4) to 3.8 (95% CI: 3.7–3.9) as ED visit frequency increased from 1 to ≥4 ($P < .001$). In addition, such ED visits were more likely to occur in children with the following characteristics: non-Hispanic black or Hispanic race/ethnicity, use of public insurance, urban residence, residence in close proximity to the ED, and ED visit between 8:00 AM and 3:59 PM ($P < .001$ for all) (Table 3).

DISCUSSION

Consistent with previous studies in adults,[1,2,4,25,26] we found that many children recurrently use the ED and these children consume a disproportionate share of visits and cost. ED visits not associated with medication use, laboratory/radiographic testing, or hospital admission account for nearly one-third of all ED visits in children. The rate of these low-resource utilization visits increased as the frequency of recurrent ED visits increased. Recurrent users <1 year of age without a chronic condition were most likely to experience this type of low-utilization ED visit. These findings may be useful when developing interventions to reduce frequent ED utilization in children.

Detailed clinical, familial, and social data are needed to determine the true reasons for frequent ED utilization in children, particularly for young infants without a chronic condition. Previous studies reported that nearly half of parents of infants who use the ED for nonemergent health problems are first-time mothers, who may not be as confident in assessing symptoms than mothers with more experience.[27] Other investigators have observed that factors motivating parents to seek ED care for their infants include the perceived severity of their infant's illness and the difficulty accessing timely primary care.[28] If it is found that many ED visits for these infants are truly for "assessment" or "parental education" only (without receipt of medications or testing of any kind) then it may be imperative for the medical community to develop strategies to provide improved parental education and convenient access to alternative care venues.

Consistent with previous studies in adult patients, our findings suggest that most children with frequent ED use have insurance and reside in an area with a high density of primary care physicians.[29] This finding suggests that many children who are frequent utilizers of the ED should have potential for access to primary care. Beyond access, ED diversion success is likely dependent on the availability of timely, high-quality urgent care in the outpatient setting, including telephone consultation during and after office hours, same-day sick visits, and extended weekday or weekend office hours. Of these resources, extended office hours have been the most effective way to reduce ED use in children.[30] Further study is needed to assess the cost-effectiveness of ED diversion tactics to primary and community care for children.

The findings from the current study suggest that the opportunities to plan for and potentially break the cycle of recurrent ED use in children may exist. Use of the patient's characteristics associated with the likelihood of a recurrent visit (ie, young age, absence of a chronic condition, public insurance) could be used to target children for initiatives to redirect subsequent care to the primary care setting. Perhaps children with these characteristics could be "flagged" in an electronic health record, prompting ED clinicians to consider taking action to mitigate a return visit (eg, by empowering families through anticipatory guidance to receive care at the office of the child's primary care physician). The effectiveness of ED initiatives to redirect care for recurrent users is dependent on the compliance and feasibility

TABLE 1 Demographic and Clinical Characteristics of the Children Experiencing at Least 1 ED Visit Between January 1, 2011, and December 31, 2011

	Overall (n = 1 896 547)	No. of ED Visits Within a 365-Day Period			
		1 (n = 1 183 571)	2 (n = 396 690)	3 (n = 163 080)	≥4 (n = 153 206)
Chronic condition[a], n (%)					
None	1 415 385 (74.6)	969 654 (81.9)	277 951 (70.1)	97 923 (60.0)	69 857 (45.6)
Non-CCC[b]	368 866 (19.4)	170 620 (14.4)	92 364 (23.3)	48 950 (30.0)	56 932 (37.2)
CCC[c]	112 296 (5.9)	43 297 (3.7)	26 375 (6.6)	16 207 (9.9)	26 417 (17.2)
Age, n (%)					
<1 year	300 665 (15.9)	143 194 (12.1)	68 816 (17.3)	37 762 (23.2)	50 893 (33.2)
1–4 years	642 217 (33.9)	384 979 (32.5)	144 180 (36.3)	60 300 (37.0)	52 758 (34.4)
5–9 years	428 577 (22.6)	290 740 (24.6)	85 546 (21.6)	30 328 (18.6)	21 963 (14.3)
10–14 years	318 471 (16.8)	219 775 (18.6)	60 957 (15.4)	21 443 (13.1)	16 296 (10.6)
≥15 years	206 617 (10.9)	144 883 (12.2)	37 191 (9.4)	13 247 (8.1)	11 296 (7.4)
Female gender, n (%)	893 024 (47.1)	558 489 (47.2)	186 382 (47.0)	76 384 (46.8)	71 769 (46.9)
Race/ethnicity, n (%)					
Non-Hispanic white	774 095 (40.8)	526 980 (44.5)	146 035 (36.8)	53 873 (33.0)	47 207 (30.8)
Non-Hispanic black	527 776 (27.8)	291 953 (24.7)	123 159 (31.0)	56 052 (34.4)	56 612 (37.0)
Hispanic	411 090 (21.7)	244 069 (20.6)	91 706 (23.1)	38 905 (23.9)	36 410 (23.8)
Asian	34 171 (1.8)	24 085 (2.0)	6218 (1.6)	2230 (1.4)	1638 (1.1)
Other	149 415 (7.9)	96 484 (8.2)	29 572 (7.5)	12 020 (7.4)	11 339 (7.4)
Public insurance, n (%)	1 101 297 (58.1)	622 245 (52.6)	250 532 (63.2)	113 262 (69.5)	115 258 (75.2)
Rural (versus nonrural) , n (%)	85 656 (4.5)	65 220 (5.5)	12 626 (3.2)	4210 (2.6)	3600 (2.3)
Distance from hospital[d], median (IQR), miles	8.6 (4.6–16.1)	9.6 (5.1–18)	7.6 (4.2–14)	7.1 (3.9–12.9)	6.8 (3.7–12.3)
Primary care physician density[e], n (%)					
Lowest quartile (<57.2)	373 126 (19.7)	244 625 (20.7)	74 396 (18.8)	28 770 (17.6)	25 335 (16.5)
Second quartile (57.2–67.9)	526 469 (27.8)	332 948 (28.1)	109 207 (27.5)	44 122 (27.1)	40 192 (26.2)
Third quartile (68.0–78.7)	453 965 (23.9)	272 174 (23.0)	97 392 (24.6)	42 038 (25.8)	42 361 (27.6)
Highest quartile (≥78.8)	532 896 (28.1)	325 931 (27.5)	114 390 (28.8)	47 727 (29.3)	44 848 (29.3)

[a] Diagnoses reported during all ED encounters were used to categorize patients by chronic condition.
[b] These children had a chronic condition, identified with the Agency for Healthcare Research and Quality's Chronic Condition Indicator system but did not have a CCC, identified with Feudtner's diagnosis list.
[c] These children had a CCC identified with Feudtner's diagnosis list.[23]
[d] Calculated with the 5-digit zip code of residence in relation to hospital address.
[e] Primary care physician density is the number of primary care physicians per 100 000 residents based on zip code of residence.

of the instructions that the family and outpatient health care providers are expected to follow. Adherence to ED aftercare instructions is lower in children with public insurance and in children who present to the ED with low-acuity health problems[31]; these 2 attributes were common among recurrent ED users both in our study and in previous ones.[9,10] Adherence may be better optimized by bolstering outpatient health services with a community health worker, telemedicine, access to an urgent care center, or retail-based clinics affiliated with a medical home.

This study has several limitations. The "right amount" of recurrent ED use in children is unknown. Although we speculate that some recurrent users are visiting the ED too much, this speculation should be assessed further with more detailed clinical information beyond the administrative data used in the current study. Although we identify a population of children for whom no medications, testing, or subsequent admission occurred while in the ED, the administrative data used in the study are limited in their ability to truly ascertain ED visits that could have been safely redirected to an outpatient setting. It is likely that some children who did not experience the use of medications, testing, or hospital admission during an ED visit appropriately used the ED for an emergent health problem

TABLE 2 Health Services Delivered During ED Visits in Children by Visit Frequency

	Overall (n = 326 3330)	No. of ED Visits Within a 365-Day Period			
		1 (n = 1 183 571)	2 (n = 793 380)	3 (n = 489 240)	≥4 (n = 797 139)
Visits not associated with inpatient admission	2 899 305 (88.8)	1 038 852 (87.8)	718 621 (90.6)	442 532 (90.5)	699 300 (87.7)
Among patients with no inpatient admission					
No medications administered[a]	1 862 281 (64.2)	662 186 (63.7)	464 885 (64.7)	286 494 (64.7)	448 716 (64.2)
No laboratory tests performed	2 059 993 (71.1)	729 868 (70.3)	511 849 (71.2)	315 939 (71.4)	502 337 (71.8)
No radiologic studies performed	2 128 035 (73.4)	718 902 (69.2)	528 946 (73.6)	335 889 (75.9)	544 298 (77.8)
Low-use ED visit (all of the above)	1 053 250 (32.3)	342 872 (29.0)	259 597 (32.7)	168 316 (34.4)	282 465 (35.4)

Data are presented as n (%).
[a] No medications given aside from acetaminophen or ibuprofen.

TABLE 3 Multivariate Analysis of Children Experiencing a Low-Resource ED Visit

	Overall[a]	No. of ED Visits Within a 365-Day Period			
		1	2	3	≥4
Chronic condition					
None	2.9 (2.8–2.9)	2.8 (2.7–2.9)	2.5 (2.5–2.6)	2.6 (2.6–2.7)	3.1 (3.0–3.1)
Non-CCC[b]	1.9 (1.9–1.9)	1.8 (1.7–1.9)	1.7 (1.6–1.7)	1.7 (1.7–1.8)	2.0 (2.0–2.0)
CCC[c]	Ref	Ref	Ref	Ref	Ref
Age					
<1 year	3.0 (3.0–3.0)	2.4 (2.4–2.4)	3.0 (3.0–3.1)	3.4 (3.3–3.5)	3.8 (3.7–3.9)
1–4 years	2.4 (2.4–2.5)	2.1 (2.1–2.2)	2.5 (2.5–2.6)	2.7 (2.7–2.8)	2.9 (2.9–3.0)
5–9 years	1.7 (1.6–1.7)	1.5 (1.5–1.5)	1.7 (1.7–1.8)	1.8 (1.8–1.9)	1.8 (1.8–1.9)
10–14 years	1.2 (1.2–1.2)	1.1 (1.1–1.1)	1.3 (1.2–1.3)	1.3 (1.3–1.3)	1.3 (1.3–1.3)
≥15 years	Ref	Ref	Ref	Ref	Ref
Race/ethnicity					
Non-Hispanic black	1.3 (1.3–1.3)	1.4 (1.4–1.4)	1.4 (1.3–1.4)	1.3 (1.3–1.3)	1.2 (1.2–1.2)
Hispanic	1.2 (1.2–1.2)	1.3 (1.3–1.3)	1.2 (1.2–1.3)	1.2 (1.2–1.2)	1.2 (1.1–1.2)
Asian	1.0 (1.0–1.0)	1.0 (1.0–1.1)	1.1 (1.0–1.1)	1.0 (1.0–1.1)	1.0 (0.9–1.0)
Other	1.2 (1.2–1.2)	1.2 (1.2–1.3)	1.2 (1.1–1.2)	1.2 (1.1–1.2)	1.1 (1.1–1.1)
Non-Hispanic white	Ref	Ref	Ref	Ref	Ref
Public insurance	1.1 (1.1–1.1)	1.1 (1.1–1.1)	1.1 (1.1–1.1)	1.1 (1.1–1.1)	1.1 (1.1–1.1)
Urban (versus rural)	1.2 (1.2–1.2)	1.2 (1.2–1.2)	1.2 (1.1–1.2)	1.2 (1.1–1.2)	1.3 (1.2–1.3)
Distance from hospital[d]					
<5 miles	1.4 (1.4–1.4)	1.4 (1.4–1.5)	1.3 (1.3–1.4)	1.4 (1.3–1.4)	1.4 (1.3–1.4)
5–10 miles	1.3 (1.3–1.4)	1.4 (1.3–1.4)	1.3 (1.3–1.3)	1.3 (1.3–1.4)	1.3 (1.3–1.4)
11–20 miles	1.2 (1.2–1.2)	1.2 (1.1–1.2)	1.2 (1.1–1.2)	1.2 (1.2–1.2)	1.2 (1.2–1.2)
>20 miles	Ref	Ref	Ref	Ref	Ref
Primary care physician density[e]					
Highest quartile (≥78.8)	1.1 (1.0–1.1)	1.1 (1.1–1.1)	1.1 (1.1–1.1)	1.1 (1.1–1.1)	1.1 (1.1–1.1)
Third quartile (68.0–78.7)	1.1 (1.1–1.1)	1.1 (1.1–1.1)	1.1 (1.1–1.1)	1.1 (1.1–1.2)	1.2 (1.2–1.2)
Second quartile (57.2–67.9)	1.1 (1.1–1.1)	1.1 (1.1–1.1)	1.1 (1.1–1.1)	1.1 (1.1–1.2)	1.1 (1.1–1.2)
Lowest quartile (<57.2)	Ref	Ref	Ref	Ref	Ref
Time of day					
8:00 AM–3:59 PM	1.5 (1.5–1.5)	1.4 (1.4–1.5)	1.5 (1.4–1.5)	1.5 (1.5–1.5)	1.6 (1.5–1.6)
4:00 PM–11:59 PM	1.4 (1.4–1.4)	1.4 (1.3–1.4)	1.4 (1.4–1.4)	1.5 (1.4–1.5)	1.5 (1.5–1.5)
Midnight–7:59 AM	Ref	Ref	Ref	Ref	Ref
Day of the week					
Weekday	Ref	Ref	Ref	Ref	Ref
Weekend	1.0 (1.0–1.0)	1.1 (1.0–1.1)	1.0 (1.0–1.0)	1.0 (1.0–1.0)	1.0 (1.0–1.0)
Model C-statistic	0.66	0.64	0.64	0.65	0.68

Data are presented as ORs (95% CIs). A low-resource ED visit is one not associated with admission, laboratory testing, radiographic testing, or medication administration (aside from acetaminophen or ibuprofen). Ref, reference.

[a] Model additionally adjusted for number of ED visits.

[b] These children had a chronic condition, identified with the Agency for Healthcare Research and Quality's Chronic Condition Indicator system, but did not have a CCC, identified with Feudtner's diagnosis list.[23]

[c] These children had a CCC identified with Feudtner's diagnosis list.

[d] Calculated with the 5-digit zip code of residence in relation to hospital address.

[e] Primary care physician density is the number of primary care physicians per 100 000 residents based on zip code of residence.

(eg, a fracture in a patient who did not receive an opioid analgesic or a radiograph in the ED). Without information on clinical events that occurred before each ED visit, we were unable to assess whether any testing or medication administration occurred shortly before the child arrived to the ED. Visits to a different ED were not contained in the data set, which likely led to a small degree of undercounting children with recurrent visits.

The generalizability of our findings may be limited to children who visit EDs that are affiliated with children's hospitals. Children cared for in such institutions have a higher prevalence of chronic conditions relative to other types of hospitals.[24,32] We included all visits as distinct patient encounters regardless of the time between visits. It is possible that ED visits within a short time frame may cluster around a single illness and not represent visits for distinct illnesses. Therefore, we repeated our analyses considering all visits occurring within 3 days as a single visit cluster and our findings did not materially differ. Last, the assessment of ED-only cost is limited for children who experienced a hospital admission, because the admission and the ED costs are summed together.

Despite these limitations and with increasing attention toward health system interventions for high-utilizing patients,[10,15,33,34] pediatric EDs may find it valuable to measure the frequency of their patients' visits and to assess the reasons why some children use the ED at a high frequency.

The findings from the current study may help stimulate the integration of pediatric EDs with their local outpatient and community health systems to improve health care value while reducing costs for children who recurrently use the ED. Further investigation is needed to determine the most appropriate site of care and the safest, most effective approach to caring for children who recurrently use the ED, particularly for children who use few resources during their ED visit.

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Characteristics of Recurrent Utilization in Pediatric Emergency Departments

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