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Characterizing Pediatric High Frequency Users of California Emergency Departments

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Abstract

Objective: Emergency department (ED) utilization has increased for the last several decades. Despite a focus on adult frequent ED users, little research has examined pediatric frequent ED users. The purpose of this study was to assess pediatric ED utilization in California and to describe those identified as frequent ED users.

Methods: This was a retrospective multi-facility study of ED visits by children 1–17 years of age using statewide data from the California Office of Statewide Health Planning and Development. Patients were classified into utilization groups by the number of ED visits in a one-year period prior to their last visit in 2016: occasional (1–5 visits) vs. frequent (>5 visits). Differences in patient characteristics were compared between occasional and frequent users.

Results: There were 690,130 patients between 1 and 17 years of age with 1,238,262 visits during the study period. Children with ≥ 6 visits (2.3%) accounted for 9.3% of all visits. 67% of frequent users had no visits to a pediatric ED. Over forty percent (41.4%) of frequent users visited 2 or more hospitals, compared to 7.7% of occasional users. In multivariate analysis, the characteristics with the largest associations with frequent ED use were age, payer, and being admitted/transferred.

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Declarations of interest: none

Conclusions: The majority of pediatric frequent users do not seek care in pediatric EDs. Age, prior admission, and Medicare/Medicaid appear to have the largest associations with pediatric patient frequent ED utilization.

Keywords

Frequent Users; Return Visits; Pediatrics; Statewide Database; Emergency Department; Health Services Research

1. INTRODUCTION:

Over the past several decades, the rate of emergency department (ED) utilization in the U.S. has increased across nearly all age groups.[1] During 2010, hospital-affiliated EDs experienced approximately 128.9 million visits nationally, one fifth of which (25.5 million) involved children less than 18 years of age.[7] While much research has examined characteristics and ED utilization patterns of the adult U.S. population, relatively little research has specifically examined pediatric high frequency users of emergency department services.[1–5] What research is available indicates that, among pediatric patients, increased likelihood of repeat visits to the ED is positively associated with being less than 1 year of age, non-White race/ethnicity (i.e. non-Hispanic Black, Hispanic, and Native American), public health insurance, urban residence, hospital proximity, and presence of a chronic condition.[1–5] One study found higher frequency pediatric ED use to be associated with greater density of primary care physicians in the patient's county of residence.[2]

However, significant gaps in the research of pediatric frequent users remain to be filled. While it is known that adult frequent users often visit multiple hospitals, this pattern has not yet been explored among pediatric patients.[6] Previous research has also described that real differences exist in the care of pediatric patients seen in pediatric vs general EDs. However, it remains unclear to what extent the pediatric frequent user population accesses general vs pediatric EDs.[7]

The purpose of this study was to assess pediatric ED utilization in California and to describe those identified as frequent ED users.

2. METHODS

2.1 Study Design

This was a multicenter retrospective cohort study using visit-level data from all non-military acute care hospitals across the entire state of California using non-public data from the California Office of Statewide Health Planning and Development (OSHPD). All licensed hospitals in the state of California are subject to mandatory reporting of utilization data in a standardized format to OSHPD. The data presented in this study is available in two non-public OSHPD datasets: The Patient Discharge Dataset and the Emergency Department Dataset. Patients included in the Patient Discharge Dataset who were admitted through the ED were merged with the Emergency Department Dataset to construct a complete ED utilization database. More detailed descriptions of these data sources can be found elsewhere.[8,9] County-level measures were based on those used by the University of

Washington and the Health Resources and Services Administration (HRSA). Patient index visits were defined as the last recorded visit in the calendar year 2016, with individual 365-day look back periods extending into 2015. This study was approved by the University of California, San Diego Human Research Protections Program.

2.2 Study Population

The study population included children who visited any of the 323 California non-military emergency departments during the calendar year 2016 and were age 1 to 17 at the last ED visit in the year (index visit). Patients less than 1 year of age at index visit were excluded as they would have been born during the 365-day lookback period. Patients 18 years or older were excluded as they fell outside the target pediatric age range. Patient visits were linked within and across hospitals using unique patient record linkage numbers (RLN). Patient visits without valid RLNs were excluded from the study. Valid RLNs were absent for 60.7% of pediatric visits identified during the study period, most likely due to delays in obtaining SSNs.

2.3 Measures

Frequent use was defined as having 6 or more ED visits within 365 days. Occasional use was defined as having 1–5 ED visits within 365 days. The authors of this study acknowledge that a level of 4+ ED visits is a frequently used definition for frequent use. However, the definitions for frequent and occasional use reported here are supported in previous literature.[6,10–12] Furthermore, given that OSHPD data allows for patient tracking across multiple sites, as opposed to a single hospital or single system, a more robust definition for frequent use was deemed to be more appropriate for this study. Recurrent visits were defined as any recorded patient visit within the 365-day lookback period in addition to the patient's index visit. Patient-level demographic variables were assigned to each patient based on reported values at the index visit. Variables available included race/ethnicity, age in years, zip code of residence, sex, and expected source of payment. Age groups were created to be consistent with previous research and Centers for Disease Control and Prevention age groupings.[1,2,13] Rural or urban designation of patient zip codes was determined using the 2006 Rural-Urban Commuting Area (RUCA) zip code approximations.[14] Patient access to primary care was approximated using primary care physician (PCP) density based on patients' zip codes of residence. PCP density for 2012 was obtained through the Area Health Resource Files (AHRF) provided by HRSA. The AHRF data includes general family medicine, general practice, general internal medicine, and general pediatrics in its definition of primary care. Subspecialties within the previously mentioned specialties are excluded.[15]

Visit-level measures included up to 25 diagnoses from the Tenth Revision of the International Classification of Diseases (ICD-10), ED visit disposition, and facility ID. Primary diagnoses were aggregated using the Clinical Classifications Software (CCS) developed by the Agency for Healthcare Research and Quality (AHRQ).[16] EDs were stratified into pediatric and general EDs based on recorded principal service types in the 2016 State Utilization Data File of Hospitals. EDs listed as "level I – pediatric," "level II – pediatric," or contained within facilities with a recorded primary service type of "pediatric" were coded as pediatric EDs in the dataset. All other EDs were coded as general EDs.

3. Data Analysis

Descriptive statistics are presented as total figures and stratified by occasional and frequent user status. Continuous variables are presented as a mean, minimum, and maximum value. Categorical variables are presented as counts and percentages. The PCP densities of patients' counties of residence are reported as quartiles, with the first quartile representing counties with the lowest PCP density. For each frequent user, the number of visits made to general and pediatric EDs were determined, and the results are reported as the percentage of visits made to each type of ED. The most common primary clinical classifications are reported and stratified by user status.

Multivariate logistic regression was used to evaluate factors associated with frequent user status. Frequent or occasional user status was used as the dependent (or outcome) variable. All predictors included in the model were used as categorical variables with the first category serving as the reference. Predictors included age (1y-4y, 5y-9y, 10y-14y, 15y-17y), race/ethnicity (non-Hispanic White, non-Hispanic Black, non-Hispanic Asian/Pacific Islander, Hispanic, Other), expected payer (private, public, self-pay/indigent), history of hospital admission/transfer during the study period (yes or no), rural or urban zip code of patient residence, and quartile of PCP density in county of patient residence. Multicollinearity diagnostics were assessed for the model and collinearity was not found to be a significant issue; tolerance and variance inflation factor (VIF) values for all variables were found to be acceptable, ranging from 0.4 to 1.0, and 1.0 to 2.6, respectively. Odds ratios (OR) and 95% confidence intervals (CI) are reported. Missing data for all variables was minimal (<0.1%). All statistical analyses were conducted using the IBM SPSS Statistics 24.0 software package.

4. RESULTS

4.1 Study Sample

The current study includes 690,130 patients between 1 and 17 years of age, accounting for 1,238,262 visits across all 323 non-military EDs in the state of California. Frequent users accounted for 2.3% of the study population and 9.3% of visits.

4.2 Demographic Characteristics

Demographic characteristics are summarized in Table 1. Both user groups were skewed toward younger age ranges with a greater trend exhibited among frequent users. Among frequent users, 38.2% (5,941) were between the ages of 1–4 as opposed to 25.2% (170,062) of occasional users. The proportion of females among frequent users (52.4%) was slightly higher than that of occasional users (47.6%). Both frequent and occasional users featured roughly equal proportions of White, Non-Hispanic (24.7% vs 24.1%) and Hispanic (55.0% vs 53.3%) patients. A higher proportion of frequent users accessed public insurance (82.3% vs 65.4%). Frequent users were more likely to have at least one ED visit leading to admission and/or transfer (26.6% vs 5.9%) during the study period than occasional users.

4.3 Patterns of Emergency Department Use

Figure 1 summarizes the recurrent visit rate by age at index visit. Figure 2 displays a similar trend using age groups. In the study population as a whole, higher levels of ED use were found among younger age ranges, particularly those age 1y-4y. Figure 3 summarizes the number of distinct EDs visited by each user category. Over forty percent (41.4%) of frequent users visited 2 or more EDs, compared to 7.7% of occasional users. Only 50 frequent users exhibited “super user” levels of ED utilization (>20 visits), accounting for 0.007% of the total study population. Overall, the study captured 220,394 visits made to pediatric EDs and 1,017,868 visits made to general EDs. Figure 4 summarizes frequent user utilization of pediatric vs general EDs. Among frequent users, 66.9% (10,412) exclusively visited general EDs and had no recorded visits to a pediatric ED during the study period. Only 17.4% (2,713) of frequent users made at least one visit to a pediatric ED and 15.7% (2,437) of frequent users used pediatric EDs for all recorded ED visits.

4.4 Major Diagnoses

Table 2 summarizes the 10 most common primary visit clinical classifications for frequent and occasional users. Upper respiratory infections, abdominal pain, and otitis media and related conditions were among the top 5 most common clinical classifications for both frequent and occasional users. Conditions such as asthma (4.7%) and fever (3.4%) were more common clinical classifications among frequent users. Acute physical injuries including superficial injury or contusion (5.6%), sprains and strains (4.6%), and other injuries and conditions due to external causes (4.0%) were more common among occasional users.

4.5 Logistic Regression

The logistic regression model comparing independent predictors of frequent ED use is summarized in Table 3. The characteristics that had the largest associations with frequent ED use were age, payer, and being admitted/transferred. Those aged 5y-9y and 10y-14y were less likely to be frequent users than those age 1y-4y (OR 0.49, 95% CI 0.46–0.51 and OR 0.45, 95% CI 0.43–0.47, respectively). Asian patients were less likely to be frequent users than their White counterparts (OR 0.53, 95% CI 0.48–0.58). Public health insurance (OR 2.40, 95% CI 2.29–2.51) was associated with greater odds of frequent use than private insurance. A history of at least one admission and/or transfer during the study period was also associated with frequent use (OR 5.93, 95% CI 5.71–6.16). There was not a strong relationship between PCP density in patients’ counties of residence and frequent ED use.

5. DISCUSSION

This is the first statewide study to specifically examine pediatric frequent users of the emergency department. One previous statewide study identified a pediatric frequent user cohort amidst the general population but did not pursue further specific analysis of pediatric frequent users.[18] Another recent study examined ED utilization across multiple EDs among privately insured patients; however, this study did not address frequent users or specifically examine pediatric users.[19] The current study is therefore the first to examine pediatric frequent users accessing multiple EDs, and to quantify pediatric frequent use of non-military

pediatric and general emergency departments. Two previous large, multicenter studies have specifically focused upon pediatric utilization of EDs. However, these studies only utilized data from pediatric EDs.[1,2] Given the relative geographic isolation of pediatric EDs (generally 1 per major metropolitan area), these previous studies could not capture frequent users who accessed multiple EDs within close proximity of one another.

Overall, frequent users, defined as patients with 6 or more visits in a 365-day period, in this study accounted for 2.3% of pediatric patients and 9.3% of visits to non-military EDs in California. This percentage is smaller than previous pediatric and adult studies of frequent users, and may be due to our use 6 or more visits, rather than 4 or more, to define frequent use.[2,18–22] Previous studies of adult frequent users have identified a “super user” cohort, defined as those with more than 20 visits per year and who tend to have lower acuity visits.[6,23] However, only 50 children in this study exhibited such levels of ED utilization, constituting just 0.007% of the total study population. This leads us to conclude that the “super user” phenomenon is exceedingly rare in the pediatric population.

Just as prior research has highlighted the tendency of adult frequent users to utilize multiple EDs, we found that 41.4% of pediatric patients visited more than one ED during the study period.[6] Even more striking, we found that the majority of pediatric frequent users, 66.9%, did not access services from pediatric EDs. These findings have important implications for future research, interventions, and practicing clinicians. Optimal identification of pediatric frequent users may require access to data across general and pediatric hospitals, as a sole focus on pediatric EDs will potentially miss 7 out of 10 pediatric frequent users. Moreover, emergency physicians practicing in non-pediatric EDs must remain prepared to treat complex pediatric patients.

As in earlier studies, our multivariate analysis revealed a strong association between those age 1y-4y and frequent ED use. Prior research suggests that first-time mothers, lacking in experience and less able to interpret their children’s symptoms, may play a role in non-urgent ED utilization among very young children and may benefit from simple educational interventions.[24,25] On the other hand, data from the AHRQ indicates that this age group accounts for the largest proportion of pediatric ED usage, including the largest proportions of ED visits resulting in discharge and ED visits resulting in hospital admission.[26] Therefore, frequent use in this age range appears to be driven by both non-urgent usage and serious medical needs.

Consistent with previous research, our data ties public health insurance to a greater likelihood of frequent ED use.[1,2,4,5] In the absence of data indicating parental level of education and household income, the use of public insurance is our only surrogate for estimating socioeconomic status. Lower socioeconomic status is a well-documented risk factor for decreased access to healthcare and unequal health outcomes. Over 65% of the children identified in this study accessed public health insurance. Altogether, this points to the prominent role that public health insurance plays in promoting healthcare access.

Interestingly, a number of the findings from our multivariate analysis deviate from previous literature. First, this study does not re-demonstrate a clinically meaningful increase in

likelihood of frequent use among African American or Hispanic patients when compared to White patients, as described in previous pediatric and adult research.[1–3,18,27,28] In fact, the most notable difference in terms of race is that children with Asian racial/ethnic backgrounds are roughly half as likely to be frequent users as their White counterparts. Second, previous pediatric literature has found frequent ED use to be associated with urban residence.[1] Our findings indicate the opposite association, with patients reporting a rural residence being slightly more likely to exhibit frequent ED use. This data parallels previous findings of greater ED use among patients in rural settings using data from all age groups.[29,30] Third, our study indicates a negative association between PCP density in a patient's county of residence and the likelihood of frequent use, running counter to the findings of Neuman et al.[1] These last two discrepancies may be due to differences in perspective afforded by our data and the use of both pediatric and general EDs. This study used data from all non-federal pediatric and adult ED's, but preceding literature has utilized data from pediatric EDs, which are largely located in urban areas. Data from pediatric EDs may demonstrate a skewed or inadequate sampling of rural patients and patients residing in areas of lower PCP density on account of distance. This study adds to the ongoing discussion of the association between primary care and frequent ED use. While the National Center of Health Statistics (NCHS) indicates that 28.7% of children who visit an ED do so because it is the closest healthcare provider, various pediatric and adult studies have shown that most frequent users have a usual source of care and also use primary care more often than non-frequent users.[5,20,30–32]

5.1. Limitations

The most significant limitation of the study is that 60.7% of the pediatric visits within the study time frame lacked a valid RLN and were excluded from analysis. Visits lacking valid RLNs are likely explained by delays in obtaining SSNs among children. As a result, our findings likely underestimate the true prevalence of frequent pediatric use of emergency departments. Furthermore, patient-level data used for analysis in this study were limited to those available through OSHPD. As such, our study does not include pediatric patients treated in military facilities. We attempted to approximate rurality and access to primary care through zip code RUCA approximation and data from the AHRF, but the absence of exact patient addresses and survey questions regarding access to care may limit the accuracy of these estimates. As previously noted, patient index visits were identified as the last visit in 2016, with 365-day lookback periods extending into 2015 when necessary. However, in an effort to provide the most recent data at the time of analysis, we did not incorporate a similar look-forward period into 2017. Therefore, if a frequent user visited an ED twice in 2016, but four more times in 2017, they would not be identified in our analysis. Lastly, this study is limited to all non-military EDs across the state of California. As such, the study's findings may not be generalizable to other states with different demographics, healthcare systems, and levels of access to public health insurance.

6. CONCLUSION

The majority of pediatric frequent users do not seek care in pediatric emergency departments. Emergency physicians practicing in non-pediatric EDs must remain prepared

for complex pediatric patients. Age, prior admission, and Medicare/Medicaid appear to have the largest associations with pediatric patient frequent ED utilization.

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Abbreviations:

AHRF	Area Health Resource Files
AHRQ	Agency for Healthcare Research and Quality
CCS	Clinical Classifications Software
CI	Confidence Intervals
ED	Emergency Department
HRSA	Health Resources and Services Administration
IBM	International Business Machines Corporation
ID	Identification
ICD-9	Ninth Revision of the International Classification of Diseases
NCHS	National Center of Health Statistics
OR	Odds Ratio
OSHPD	Office of Statewide Health Planning and Development
PCP	Primary Care Physician
RLN	Record Linkage Number
RUCA	Rural-Urban Commuting Area
SPSS	Statistical Package for the Social Sciences
ZIP Code	Zone Improvement Plan

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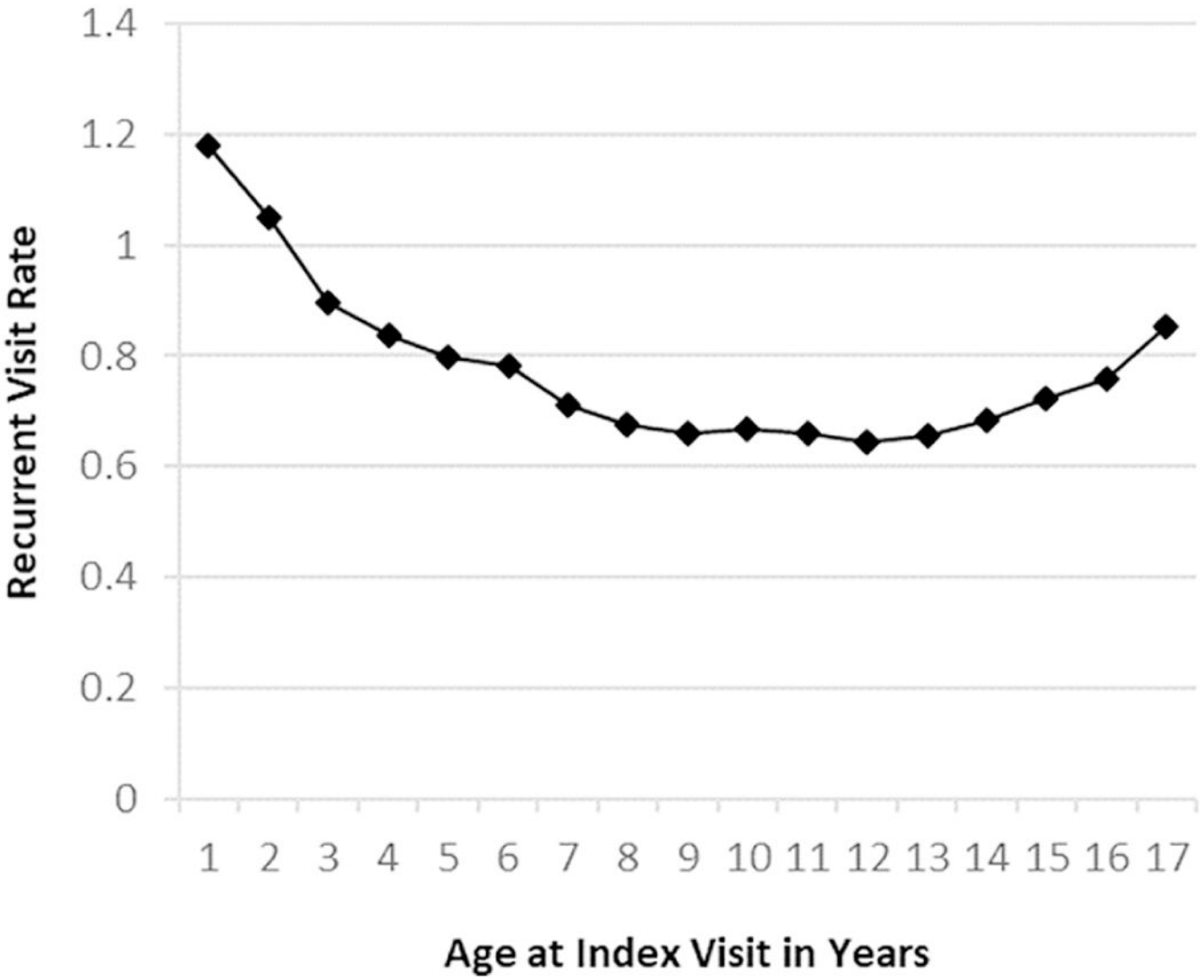

Figure 1.
Recurrent Visit Rate by Age at Index Visit

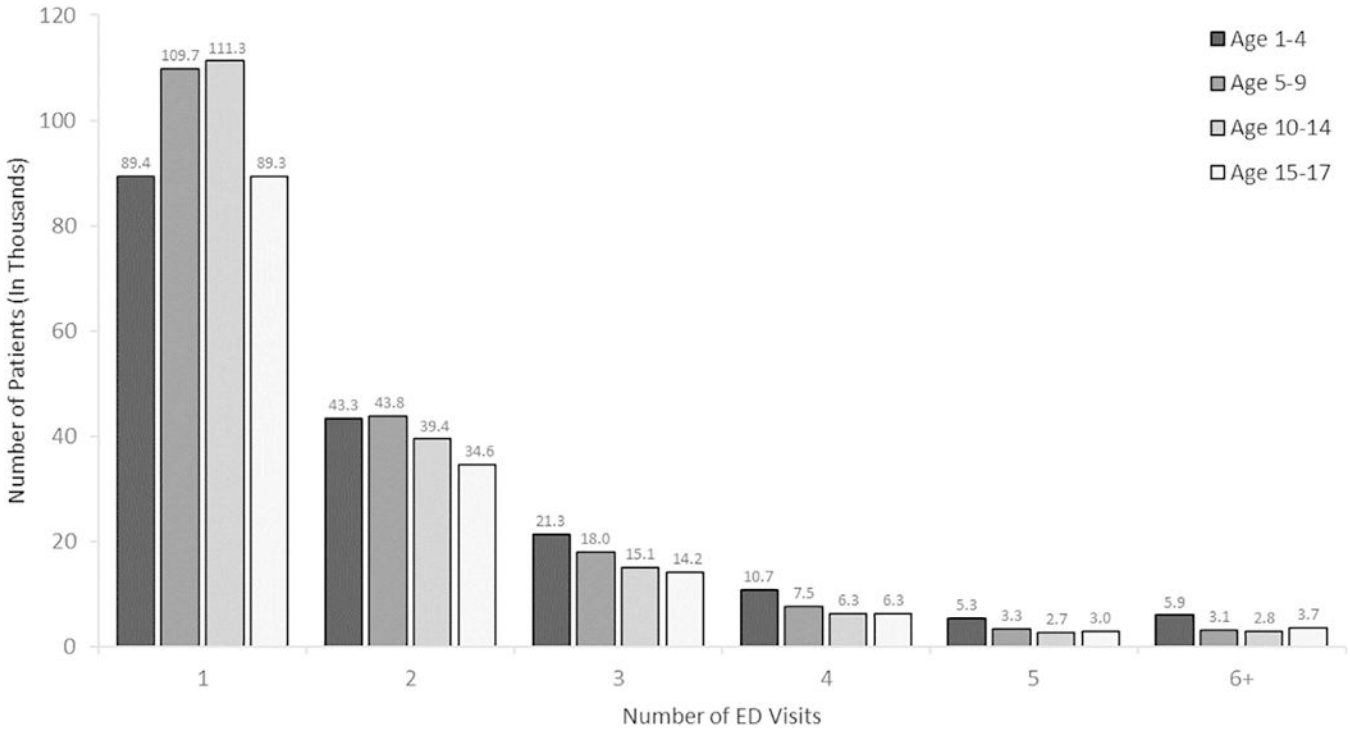

Figure 2:
Number of Recorded ED Visits by Age Group

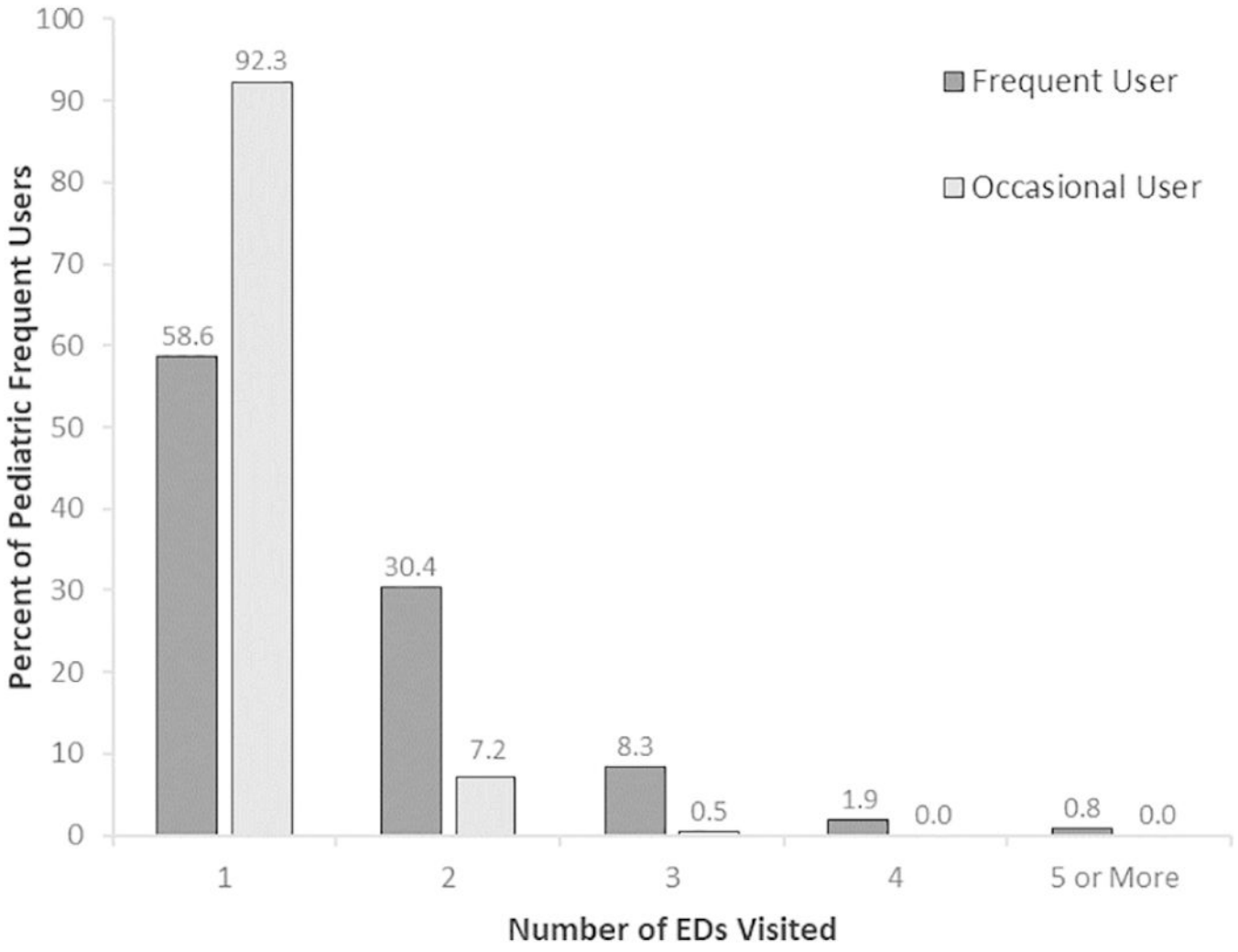

Figure 3.
Number of EDs Visited per User Category

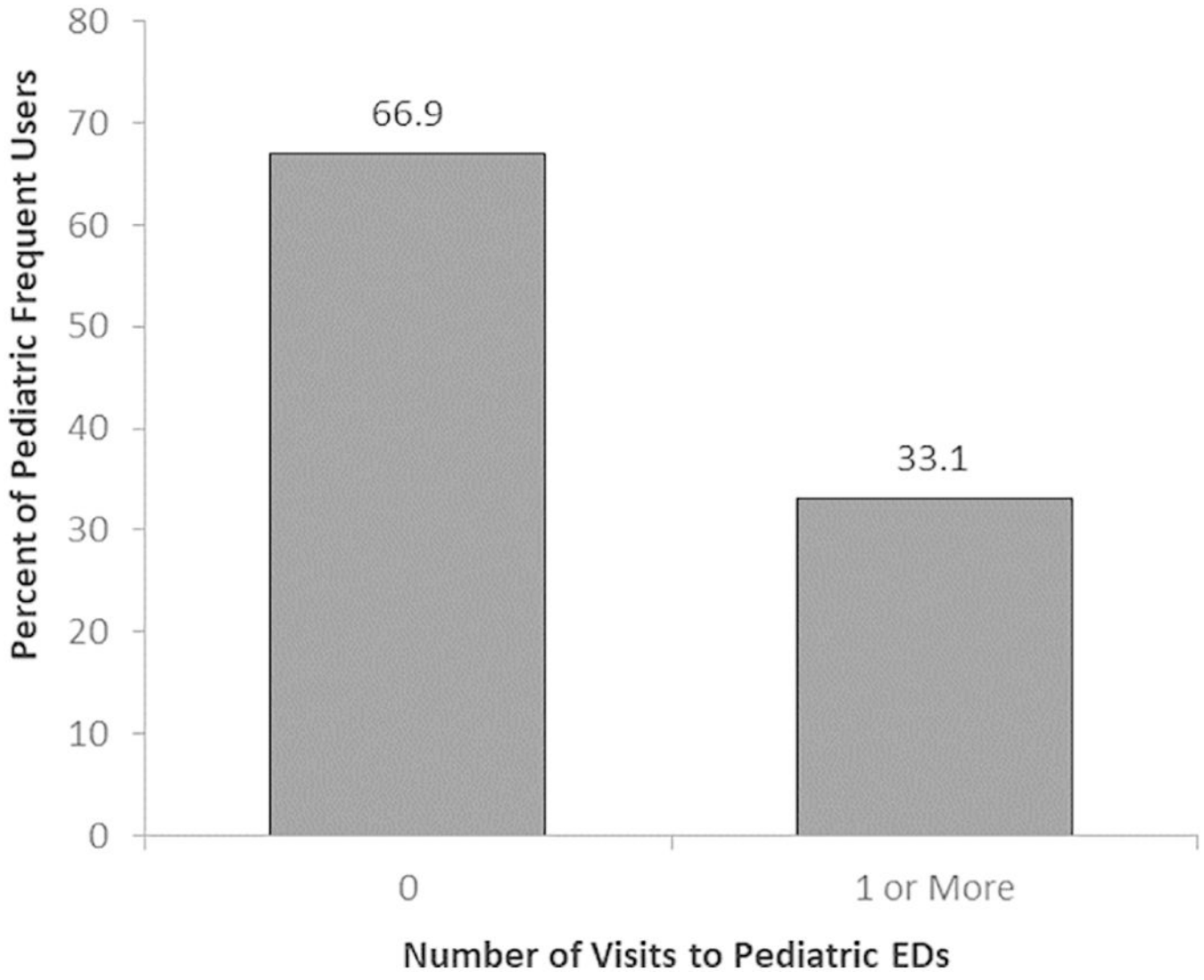

Figure 4.
Number of Visits to Pediatric EDs per Frequent User

Table 1.

Description of Cohort by User Status

Patient Characteristics	Overall (n = 690,130)		Occasional (n = 674,568)		Frequent (n = 15,562)	
Age, yr						
1 to 4	176,003	(25.5)	170,062	(25.2)	5,941	(38.2)
5 to 9	185,441	(26.9)	182,317	(27.0)	3,124	(20.1)
10 to 14	177,641	(25.7)	174,810	(25.9)	2,831	(18.2)
15 to 17	151,045	(21.9)	147,379	(21.8)	3,666	(23.6)
Sex						
Male	360,934	(52.3)	353,533	(52.4)	7,401	(47.6)
Female	329,184	(47.7)	321,023	(47.6)	8,161	(52.4)
Unknown	12	(0.0)	12	(0.0)	0	(0.0)
Race/Ethnicity						
Hispanic	368,300	(53.4)	359,745	(53.3)	8,555	(55.0)
White, non-Hispanic	166,518	(24.1)	162,675	(24.1)	3,843	(24.7)
Black, non-Hispanic	75,412	(10.9)	73,375	(10.9)	2,037	(13.1)
Asian/Pacific Islander	40,277	(5.8)	39,843	(5.9)	434	(2.8)
Other	39,623	(5.7)	38,930	(5.8)	693	(4.5)
Primary Payer						
Private	204,085	(29.6)	201,773	(29.9)	2,312	(14.9)
Medicare	4,443	(0.6)	4,336	(0.6)	107	(0.7)
Medicaid	449,628	(65.2)	436,920	(64.8)	12,708	(81.7)
Self-Pay/Indigent	31,974	(4.6)	31,539	(4.7)	435	(2.8)
Patient Admitted						
No	645,899	(93.6)	634,474	(94.1)	11,425	(73.4)
Yes	44,231	(6.4)	40,094	(5.9)	4,137	(26.6)
Urbanicity of Patient Zip Code						
Urban	615,090	(89.1)	601,816	(89.2)	13,274	(85.3)
Rural	70,368	(10.2)	68,104	(10.1)	2,264	(14.5)
Out of State / Unknown	4,672	(0.7)	4,648	(0.7)	24	(0.2)
Primary Care Density						
Quartile 1	73,924	(10.7)	72,078	(10.7)	1,846	(11.9)
Quartile 2	180,074	(26.1)	174,610	(25.9)	5,464	(35.1)
Quartile 3	280,077	(40.6)	274,312	(40.7)	5,765	(37.0)
Quartile 4	152,480	(22.1)	149,996	(22.2)	2,484	(16.0)
Out of State / Unknown	3,575	(0.5)	3,572	(0.5)	3	(0.0)

Data are reported as *n* (%)

Table 2.

Ten Most Common Primary Clinical Classifications by Frequent User Status

Primary Clinical Classification	n	(%)
Occasional Users (n = 1,122,795 visits)		
Other upper respiratory infections	125,365	(11.2)
Superficial injury; contusion	62,392	(5.6)
Abdominal pain	54,685	(4.9)
Sprains and strains	51,999	(4.6)
Otitis media and related conditions	45,891	(4.1)
Other injuries and conditions due to external causes	45,076	(4.0)
Viral infection	39,720	(3.5)
Open wounds of head; neck; and trunk	36,090	(3.2)
Fracture of upper limb	34,078	(3.0)
Nausea and vomiting	34,037	(3.0)
Frequent Users (n = 115,467 visits)		
Other upper respiratory infections	15,286	(13.2)
Asthma	5,470	(4.7)
Abdominal pain	5,230	(4.5)
Otitis media and related conditions	4,774	(4.1)
Superficial injury; contusion	4,305	(3.7)
Viral infection	4,071	(3.5)
Fever of unknown origin	3,979	(3.4)
Nausea and vomiting	3,814	(3.3)
Sprains and strains	3,031	(2.6)
Other gastrointestinal disorders	2,959	(2.6)

Table 3.

Regression Analysis

Variable	Frequent vs Occasional User Adjusted OR (95% CI)
Age (yr) (Ref = 1–4)	
5–9	0.49 (0.46–0.51)
10–14	0.45 (0.43–0.47)
15–17	0.65 (0.63–0.68)
Female	1.22 (1.78–1.26)
Ethnicity (Ref = NH White)	
Hispanic/Latino	0.90 (0.86–0.94)
NH Black	1.11 (1.05–1.18)
NH Asian	0.53 (0.48–0.58)
NH Other	0.78 (0.72–0.85)
Payer (Ref = Private)	
Public	2.40 (2.29–2.51)
Self-pay/Indigent	1.28 (1.15–1.42)
Admitted/Transferred	5.93 (5.71–6.16)
Rural residence	1.34 (1.28–1.41)
PCP Density (Ref = Quartile 1)	
Quartile 2	1.17 (1.11–1.24)
Quartile 3	0.89 (0.85–0.94)
Quartile 4	0.82 (0.77–0.87)