Factors that Affect Nonurgent Emergency Department Visits in a Publicly Insured Pediatric Population: An Observational Study

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Background: Publicly insured children have high rates of nonurgent emergency department visits (LAVs). The factors that drive consumption of these services are unknown.
Methods: Demographics, emergency department visits, hospitalizations, missed preventative care appointments, zip code, and asthma status as factors for LAVs were determined by univariate, multivariate, and classification/regression tree analysis. Subjects were publicly insured and received care between March 1 and December 31, 2011.
Results: A total of 4,387 children were identified; 856 (19.5%) had at least 1 nonurgent and 1,173 (26.7%) had at least 1 urgent emergency department visit; 526 (12%) missed ≥2 primary care appointments and 779 children had asthma. By univariate analysis, at least one high acuity emergency department visit, hospitalization during the study period, and asthma were directly associated with LAVs; age was inversely related. Multivariate and classification tree analyses identified children younger than 31.5 months with at least 1 high acuity emergency department visit as the highest risk group (0.807 visits per patient; 95% confidence interval: 0.699–0.916, $p < .00001$). Missed appointments, asthma status, hospitalizations, zip code of residence, and gender were not significant factors.
Conclusions: Young age and at least one high acuity emergency department visit are associated with high rates of nonurgent emergency department use among publicly insured children.

Background

Patients with public insurance have high rates of emergency department utilization for nonacute medical problems. Using data from the 1988 National Health Interview Survey on Child Health, Halfon and colleagues (1996) noted that children who reported that the emergency department was their usual source of sick care were more likely to be Black, from a single parent home, to be poor, and to live in an urban area. Phelps and colleagues. (2000) sampled children who received nonurgent care in two urban pediatric emergency departments and found that caretakers who were taken to the emergency department as children for sick care and those who received Medicaid were more likely to use the emergency department for sick care. Finally, a retrospective national database study found that children with public insurance were more likely to use the emergency department for nonurgent care than privately insured or noninsured patients (Brousseau et al., 2007). Despite these studies, it is not known what factors drive rates of nonurgent visits to the emergency department in a population of publicly insured children. A database that combined visit and asthma data from a large, urban primary care practice and demographic and hospital utilization data from a major managed care plan for the same patients was developed to address this question.

Methods

This study was reviewed and approved by the Office for Human Subjects Protection, Institutional Review Board of Temple University.

Study Setting and Population

The subjects of this study were patients who received care at a single site, academic, urban, pediatric primary care practice. The practice is staffed by pediatricians and pediatric nurse practitioners. At the time of the study, care was provided at the site during normal weekday business hours and 24 hours 7 days a week telephone consultation by physicians or trained nurses was available. All visits were scheduled.

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Eighty-five percent of the patients who received care at this site were publicly insured and 60% of these children were insured by a single health plan. The Managed Care Plan in this study is part of a health organization, serving nearly 170,000 Medicaid members in Philadelphia and the surrounding counties and is accredited by the National Committee for Quality Assurance.

The patients included in this study were enrolled continuously in the managed care plan between March 1, 2011, and December 31, 2011, and were scheduled for at least one appointment at the practice during this time frame. Subjects were identified from the practice scheduling system used by the practice.

Data Collection

The following variables were used and recorded for each patient:

- Age: The age of the child, in months, at the time of the first preventative care appointment that was scheduled during the study period.
- Sex.
- Zip code: The residential zip code that was recorded by the practice at the time of the first scheduled preventative visit.
- Low Acuity: The number of visits during the study period to a hospital emergency department recorded by the Managed Care Plan as CPT 99281 or 99282.
- High Acuity: The number of visits during the study period to a hospital emergency department recorded by the Managed Care Plan as CPT 99283, 99284, or 99285.
- Hospitalizations: The number of separate episodes that a subject was admitted to the hospital for observation (<24 hr) or for a higher level of care during the study period.
- Asthma Status: Children were identified as non-asthmatics, intermittent asthmatics (requiring episodic inhaled bronchodilator therapy), or persistent asthmatics (requiring daily use of a controller inhaler).
- Missed Appointments: Subjects were divided into 2 groups: (1) children who attended the first scheduled preventative care office visit and subsequent visits scheduled during the study period and did not miss any scheduled appointments and (2) children who missed the first scheduled preventative care office visits, one or more of the subsequent rescheduled preventative care visits, and were not seen for a preventative visit in the primary care office during the study period.

Outcome

For all analyses, the number of low acuity emergency department visits per subject was used as the response variable.

Statistical Analysis

Differences in mean values of continuous variables were compared with Student's *t*-test. Differences in categorical variables and rates were determined by chi-square test using Yates correction factor. The p values $<.05$ were considered to be statistically significant.

Univariate and multivariate analyses were performed by simple linear regression using the least squares method. Working from an all-inclusive model, confounding variables with p values $>.05$ were eliminated to produce the most parsimonious model. Models were then compared by analysis of variance and adjusted R^2.

Classification and regression tree analysis was performed using the method of Breiman and colleagues (1998) using reiterative sampling with replacement. All variables were included in the formation of the initial tree and splitting was performed by analysis of variance. The minimum split size (node size) was set to 20, whereas the complexity parameter was set to 0.01. To determine the stability of the model, the analysis was rerun 100 times and the frequency of node number in each resulting model was recorded. To verify the validity of the model, the number of low acuity emergency department visits and subjects per group were compared for independence by chi-square

test; post hoc testing for differences in the mean numbers of low acuity emergency department visits within each resulting group were determined by pairwise t test using Bonferroni's correction for α.

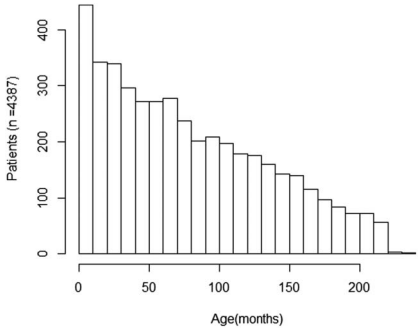
All calculations were performed in R (version 3.1.0; the R Foundation for Statistical Computing, www.r-project.org).

Results

Descriptive Analysis

Between March 1, 2011, and December 31, 2011, 4,387 children were scheduled for appointments. The age distribution of the patient sample is shown in Figure 1. The median age was 68.0 months (interquartile range: 29.0–122.0 months) and the male-to-female ratio was 1.02; 856 children (19.5%) had at least 1 low acuity visit to a local emergency department; 625 (14.2%) had 1 low acuity visit, 167 (3.80%) had 2, 45 (1.0%) had 3, 13 (0.3%) had 4, 3 had 5, 2 had 7, and 1 had 8 low acuity emergency department visits during the study period. During the study period, 1,173 (26.7%) children had at least 1 high acuity visit to the emergency department. A total of 826 children (18.8%) had 1 high acuity visit, 238 (5.4%) had 2, 69 (1.6%) had 3, 27 (0.6%) had 4, 7 had 5, 3 had 6, 2 had 7, and 1 had 8 high acuity emergency department visits during this period.

Figure 1. Age distribution of 4,387 publicly insured children who make up the sample population for this study.



There were 351 hospitalizations during the study period. A total of 355 children were hospitalized (8%); 35 (0.8%) were hospitalized twice, 2 were hospitalized 3 times, 1 child was hospitalized 4 times, and another was hospitalized 5 times. There were 777 (18%) children with asthma in the sample population: 549 (13%) had intermittent asthma and 228 (5%) had persistent asthma. Over the study period, 526 (12%) children missed one scheduled preventative care visit, at least one rescheduled visit, and were not seen in the practice for a scheduled preventative care visit.

Factors Associated With Low Acuity Emergency Department Visits

The factors associated with low acuity pediatric visits to the emergency department are shown in Table 1. Of the seven factors included in the analysis, four were significantly associated with the number of low acuity emergency department visits when considered individually. For every 1 month increase in age, the number of low acuity emergency department visits decreased by 0.002 visits (95% confidence interval [CI]: −0.0023 to −0.0017, $p <$ .0001). Compared with children without asthma, children with asthma had a lower rate of low acuity emergency department visits (−0.046 visits; 95% CI: −0.08 to −0.009, p = .013). Children who had at least 1 high acuity visit to the emergency department had an increased rate of low acuity emergency department visits compared with those without (0.2 visits; 95% CI: 0.17–0.22, $p <$ .0001), whereas children who were hospitalized during the study period had a higher rate of low acuity emergency department visits compared with those without hospitalization (0.157 visits; 95% CI: 0.098–0.21, $p <$ .001).

When all the variables were included in a linear regression model, only age and history of a high acuity emergency department visit were statistically significantly associated with low acuity emergency

Table 1. Univariate and Multivariate Analysis of Factors Associated With Changes in Frequency of Low Acuity Emergency Department Visits in a Publicly Insured Pediatric Population (n = 4,387)

	Univariate Analysis				Multivariate Analysis			
		95% Confidence Interval				95% Confidence Interval		
Factor	Low Acuity ER Visits*	Lower	Upper	*p*	Low Acuity ER Visits*	Lower	Upper	*p*
Age (months)	−0.002	−0.0023	−0.0017	<.0001	−0.0018	−0.0021	−0.0014	<.0001
Missed appointments	−0.002	−0.06	0.057	.95	−0.057	−0.011	0.0002	.051
Asthma (category)	−0.046	−0.08	−0.009	.013	−0.02	−0.056	0.016	.285
High acuity ER visits (n)	0.2	0.17	0.22	<.0001	0.187	0.163	0.211	<.0001
Hospitalizations (n)	0.157	0.098	0.21	<.001	0.017	−0.041	0.075	.567
Male (category)	−0.027	−0.06	0.011	.173	−0.025	−0.0617	0.012	.181
Zip code (category)	0.000028	−0.000085	0.000014	.625	0.000024	−8.5E-05	0.00013	.668

*For age, change in number of visits per month of age decrease; for all other variables, change in visits compared with reference (or absence) of the variable.

department visits. A parsimonious model, where age and high acuity emergency department visits were the sole confounding variables continued to show significant associations with low acuity emergency department visits. In the latter model, every month increase in age was associated with a decrease in low acuity emergency department visits (−0.002 visits; 95% CI: −0.0023 to −0.0017, $p < .0001$), whereas high acuity emergency department visits were associated with an increase in low acuity emergency department visits (0.185 visits; 95% CI: 0.162 to 0.209, $p < .0001$). The parsimonious model was comparable with the complete model by analysis of variance (ANOVA) ($F = 1.49$, $p = .19$) and by comparison of adjusted R^2 (0.0806 vs. 0.0811, respectively).

Classification and regression tree analysis produced three nodes that yielded 4 groups (Fig. 2); divisions were based on the occurrence of at least 1 high acuity emergency department visit during the study period and age. One hundred repeated simulations yielded the three-node model 100% of the time. Although this analysis produced the same predictive variables as the linear regression model, the ANOVA above suggests that the mean rates of low acuity emergency department visits are different among these 4 groups identified

Figure 2. Classification tree defining children at high risk for low acuity emergency department visits.

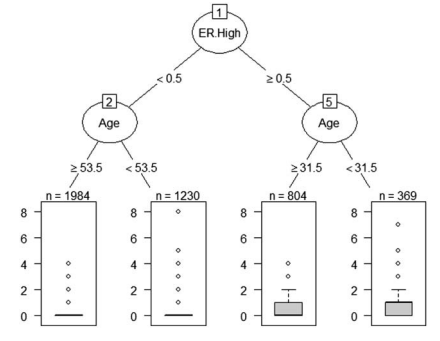


Table 2. Characteristics and Low Acuity Emergency Department Visits for 4 Risk Groups

Group	High Acuity ER Visit	Age Cutoffs (months)		Low Acuity Emergency Department Visits				
		Minimum	Maximum	No. of Subjects	No. of Visits	Mean Visits Per Subject	95% Confidence Intervals Lower	Upper
1	Yes	None	<31.5	369	298	0.808	0.699	0.916
2	Yes	31.5	None	804	284	0.353	0.308	0.398
3	No	None	<53.5	1,230	365	0.297	0.257	0.336
4	No	53.5	None	1,984	236	0.119	0.101	0.136

by classification analysis; this difference was confirmed by contingency table analysis ($\chi^2 = 386.3$, $p < .00001$).

The characteristics, number of subjects, and the mean rates of low acuity emergency department visits/subject for each group are shown in Table 2, and the pairwise comparisons of these rates are shown in Table 3. The rate of low acuity emergency department visits per subject in the highest risk group (0.808 low acuity emergency department visits per subject; 95% CI: 0.699–0.916) was statistically significantly higher than the rate in each of the other three groups ($p < .00001$ for each comparison). The rate in the lowest risk group (0.119 low acuity emergency department visits per subject; 95% CI: 0.101–0.136) was statistically significantly lower than each of the other three groups ($p < .00001$ for each comparison).

Discussion

In a population of 4,387 publicly insured children who were scheduled for at least one preventative care visit at a single primary care site, those individuals less than 31.5 months of age with at least 1 high acuity emergency department visit during the 10-month study interval were significantly more likely to have at least one low acuity emergency department visit than older children or those without a high acuity visit. Missed preventative care visits, gender, zip code of residence, asthma status, or hospitalization during the study period were not associated with changes in the rate of low acuity emergency department visits.

Publicly insured children have high rates of missed appointments with primary care providers. Lamberth and colleagues (2002) tracked the rate of missed appointments

Table 3. Pairwise Comparison of Risk Groups for Low Acuity Emergency Department Visits

Group vs. Group*	Difference in Mean Low Acuity ER Visits	95% Confidence Interval Lower	Upper	p†
1 vs. 3	0.507	0.396	0.626	<.00001
1 vs. 4	0.688	0.579	0.799	<.00001
2 vs. 3	0.056	−0.003	0.116	.063
2 vs. 4	0.234	0.186	0.282	<.00001
3 vs. 4	0.178	0.135	0.221	<.00001

*Group 1, high acuity emergency department visits ≥1, age <31.5 months. Group 2, high acuity emergency department visits ≥1, age ≥31.5 months. Group 3, high acuity emergency department visits = 0, age <53.5 months. Group 4, high acuity emergency department visits = 0, age ≥53.5 months.

†Bonferonni corrected α = .0083.

over an 11-week period in a mixed suburban/rural primary care pediatric practice. Compared with privately insured children, publicly insured patients missed almost twice as many appointments. Sprecht and colleagues (2004) reported that over the course of a year, publicly insured children missed 33% of scheduled appointments at a hospital-based resident continuity clinic. When the same patient population was seen in a private setting, the missed appointment rate was 18%. O'Connor and colleagues (2006) reported a missed appointment rate of 21% in a predominantly Medicaid pediatric practice in Denver. Eighty-five percent of the children who receive care at Temple Pediatric Care are publicly insured. Between July 1, 2010, and June 30, 2011, Temple Pediatric Care had a missed appointment rate of 26%.

It is generally accepted that children who use emergency departments for nonurgent care lack access to other primary care resources. Halfon and colleagues (1996) used data from the 1988 NHIS Child Health Survey. Children who used the emergency department for nonurgent sick care were more likely to be poor and live in an urban setting. Children who received health maintenance services at neighborhood health centers were more likely to use the emergency department for sick care than those who received care in private practice settings. Phelps and colleagues (2000) identified the factors in 200 caretaker–child pairs associated with nonurgent pediatric usage of emergency departments at two urban hospitals. Caretakers who received care in the emergency department as children and those with Medicaid were more likely than others to seek nonurgent care in the emergency department. Brousseau and colleagues (2007) analyzed a cohort of 8,823 children enrolled in the Medical Expenditure Panel Survey in 2000 to 2002 for emergency department utilization. In this study, children insured by Medicaid comprised 25% of the sample but accounted for 36% of the nonurgent emergency department visits suggesting that these children overused the emergency department compared with privately insured and noninsured patients. In a large prospective study, Medicaid-insured children used the emergency department 1.7 times more frequently than privately insured children and were 90% less likely to have 3 or more visits to the primary care physician (Ortega et al., 2001). Finally, in a large database study comparing healthcare utilization among publicly and privately insured children, Medicaid-insured asthmatics were five times more likely to be admitted to the hospital or to use the emergency department than those with private insurance (Shatin et al., 1998).

The observations noted above suggest that a relationship may exist between missed preventative care appointments or underlying chronic disease, such as asthma, and nonurgent use of the emergency department. The observations from this study do not support this conclusion. Although, missed preventative appointments suggest that the parents of some publicly insured patients are not fully engaged in this aspect of their child's healthcare, it does not appear that the emergency department has supplanted the role of primary healthcare provider. The strong association of high acuity emergency department visits with low acuity visits suggests that some parents are either (1) unable to effectively distinguish between urgent and nonurgent conditions that afflict their children particularly among children younger than 3 years or (2) perceive their child as vulnerable based on an illness that resulted in a high acuity visit. Interventions that address the first possibility include improved education by the primary care team regarding criteria for using emergency services and increased access to the practice, particularly after hours. Before this study was completed, the practice has added daily open access for those patients who want walk-in care and has developed a partnership with a local urgent care facility to improve after-hour care. Interventions that address the second possibility include the use of tools to identify those children who may be perceived as vulnerable and improved counseling of these parents.

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A. Orlansky collated data, drafted the initial manuscript, participated in study conceptualization, and approved the final manuscript as submitted. C. Smolij collected data and participated in the revision of the manuscript and approved the final manuscript as submitted. B. Moughan reviewed and abstracted the hospitalization and birth data, participated in the revision of the manuscript, and approved the final manuscript as submitted. S. C. Aronoff participated in the conceptualization of the project, performed all statistical analyses, critically reviewed and revised the manuscript, and approved the manuscript as submitted.

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The authors declare no conflict of interest.