Academic Emergency Medicine
Official Journal of the Society for Academic Emergency Medicine

ORIGINAL CONTRIBUTION

Recurrent and High-frequency Use of the Emergency Department by Pediatric Patients

Elizabeth R. Alpern, MD, MSCE, Amy E. Clark, MS, Evaline A. Alessandrini, MD, MSCE, Marc H. Gorelick, MD, MSCE, Marlena Kittick, MPH, Rachel M. Stanley, MD, J. Michael Dean, MD, MBA, Stephen J. Teach, MD, MPH, and James M. Chamberlain, MD, for the Pediatric Emergency Care Applied Research Network (PECARN)

Abstract

Objectives: The authors sought to describe the epidemiology of and risk factors for recurrent and high-frequency use of the emergency department (ED) by children.

Methods: This was a retrospective cohort study using a database of children aged 0 to 17 years, inclusive, presenting to 22 EDs of the Pediatric Emergency Care Applied Research Network (PECARN) during 2007, with 12-month follow-up after each index visit. ED diagnoses for each visit were categorized as trauma, acute medical, or chronic medical conditions. Recurrent visits were defined as any repeat visit; high-frequency use was defined as four or more recurrent visits. Generalized estimating equations (GEEs) were used to measure the strength of associations between patient and visit characteristics and recurrent ED use.

Results: A total of 695,188 unique children had at least one ED visit each in 2007, with 455,588 recurrent ED visits in the 12 months following the index visits. Sixty-four percent of patients had no recurrent visits, 20% had one, 8% had two, 4% had three, and 4% had four or more recurrent visits. Acute medical diagnoses accounted for most visits regardless of the number of recurrent visits. As the number of recurrent visits per patient rose, chronic diseases were increasingly represented, with asthma being the most common ED diagnosis. Trauma-related diagnoses were more common among patients without recurrent visits than among those with high-frequency recurrent visits (28% vs. 9%; $p < 0.001$). High-frequency recurrent visits were more often within the highest severity score classifications. In multivariable analysis, recurrent visits were associated with younger age, black or Hispanic race or ethnicity, and public health insurance.

Conclusions: Risk factors for recurrent ED use by children include age, race and ethnicity, and insurance status. Although asthma plays an important role in recurrent ED use, acute illnesses account for the majority of recurrent ED visits.

ACADEMIC EMERGENCY MEDICINE 2014;21:365–373 © 2014 by the Society for Academic Emergency Medicine

From the Department of Pediatrics, Northwestern University Feinberg School of Medicine, Division of Emergency Medicine, Ann & Robert H. Lurie Children's Hospital of Chicago (ERA), Chicago, IL; the Department of Pediatrics, University of Utah (AEC, JMD), Salt Lake City, UT; the Department of Pediatrics, University of Cincinnati College of Medicine, James M. Anderson Center for Health Systems Excellence and Division of Emergency Medicine, Cincinnati Children's Hospital and Medical Center (EAA), Cincinnati, OH; the Department of Pediatrics, Medical College of Wisconsin, Children's Research Institute (MHG), Milwaukee, WI; the Division of Emergency Medicine, The Children's Hospital of Philadelphia (MK), Philadelphia, PA; the Department of Emergency Medicine, The University of Michigan Medical Center (RMS), Ann Arbor, MI; and the Division of Emergency Medicine, Children's National Medical Center (SJT, JMC), Washington, DC.

Received July 9, 2013; revisions received October 4 and November 13 2013, accepted November 14, 2013.

PECARN is supported by the Health Resources and Services Administration (HRSA), Maternal and Child Health Bureau (MCHB), Emergency Medical Services for Children (EMSC) Program through the following cooperative agreements: U03MC00001, U03MC00003, U03MC00006, U03MC00007, U03MC00008, U03MC22684 and U03MC22685. Neither Dr. Alpern nor Dr. Gorelick, both of whom are associate editors for this journal, had a role in the peer review or publication decision process for this paper.

The authors have no relevant financial information or potential conflicts of interest to disclose.

Supervising Editor: Michelle D. Stevenson, MD, MS.

Address for correspondence and reprints: Elizabeth R. Alpern, MD, MSCE; e-mail: ealpern@luriechildrens.org.

A related commentary appears on page 465.

doi: 10.1111/acem.12347
ISSN 1069-6563
PII ISSN 1069-6563583

Emergency department (ED) use has been steadily increasing over the past decade,[1] with children accounting for over one-quarter of the 114 million annual ED visits in the United States.[2,3] Every day, approximately 80,000 children seek emergency care in U.S. EDs, and 20% of all children in the United States will have at least one ED visit each year.[2,3] EDs are now the most common site for acute care visits nationally.[4] As ED visits and costs increase, recent debate on U.S. health care has focused attention on the effect of potentially inefficient and expensive use of EDs.[5–8] Recent policy initiatives, including the Affordable Care Act[9] and the establishment of accountable care organizations, have stressed improving the coordinated treatment of patients across different settings of care to improve patient outcomes and decrease the strain on our health care system.[10–13]

Repetitive or frequent use of ED services is defined as recurrent ED use over a period of time by specific individuals.[14,15] The rate of repeat visits to a pediatric ED has been used as a quality improvement metric of ED care and has been postulated to serve as a marker of suboptimal quality or access to health care or an indication of limited self-management skills or health literacy.[16] Researchers have noted the need for further study to better understand frequent ED utilization, to help identify at-risk populations, and to develop interventions to decrease repetitive ED use.[17]

Frequent users of the ED account for up to 40% of all ED visits.[15,18–21] A recently published systematic review of the literature on frequent ED users indicated that a small proportion (4.5% to 8%) of all ED users accounted for approximately one-quarter of all ED visits.[22] This review of 25 studies included only two studies of solely pediatric ED patients.[23,24] With this in mind, this systematic review noted that "subgroups have not yet been sufficiently defined to allow clearly directed policy design" and identified several limitations of the published literature, noting that site-specific analyses produced a large degree of heterogeneity and limited generalizability.[22]

We performed this study to avoid some of the limitations of previous studies; specifically, we have access to large pediatric patient populations from a diverse national consortium of pediatric EDs, the Pediatric Emergency Care Applied Research Network (PECARN).[25] We hypothesized that important patient-level factors, including diagnoses and illness severity, are associated with pediatric recurrent and high-frequency ED use. This information will be important for resource allocation and policy decisions, especially in light of recent national initiatives concerning coordination of care of pediatric patients across care settings. Thus, the objectives of this study were to assess the rates of, diagnoses associated with, and risk factors for recurrent ED use by pediatric patients.

METHODS

Study Design

We conducted a retrospective cohort study of pediatric patients. The institutional review boards of all sites and of the PECARN data center approved the study.

Study Setting and Population

Patients presenting to participating PECARN[25] EDs during the calendar year 2007 were the cohort. Follow-up data were available for all participants making index visits in 2007 through December 31, 2008. Data were provided by 22 EDs. Of these, 77% are separate pediatric EDs and 23% are pediatric EDs within general EDs. Patients were eligible if they were of age birth to 18th birthday and presented to any of the participating PECARN EDs in the calendar year 2007. We excluded patients who died in the ED because they would be censored from follow-up.

Study Protocol

Recurrent visits were defined as any repeat visit within 12 months following an index visit in calendar year 2007. PECARN sites (listed in the acknowledgments) are independent hospital entities and some may have overlapping catchment areas. To improve capture of return visits, patients were linked longitudinally using a unique patient identifier within each site's data and via probabilistic linkage methods between sites.[20,26] This methodology allowed 1) identification of patients who returned to the same institution, using the same site patient identifier at each visit, and 2) capture of recurrent visits to other EDs in PECARN. Return visits within 72 hours may represent progression of disease processes.[27,28] As the aim of this study was to evaluate recurrent use of the ED, rather than return visits within a single course of illness; visits within a 3-day period by the same patient were counted as a single visit. High-frequency use was defined a priori as four or more recurrent visits within the 12 months following the index visit.[14,15] We obtained data from existing electronic sources using previously described methods.[29] Each site submitted encrypted data to the data center where the data were reviewed and summarized. Each site reviewed summary statistics for data elements from that site and a study investigator (ERA) reviewed summary statistics for data elements from all sites to assess for outliers and potential errors. Full data validity procedures have been previously described.[29]

Variables were included based on availability in the database and past association with recurrent ED visits.[22] Data elements included both patient-level and visit-level characteristics. Patient-level characteristics are those defined once for the patient across all visits. Patient characteristics included age, sex, race, ethnicity, and payer type. Because these variables were collected longitudinally for each visit, patient-level information was based on the first, nonmissing value available with the exception of payer type, which was assigned the most frequent type observed for that patient. Age groupings were based on Centers for Disease Control and Prevention categories.[30] Visit-level characteristics relate only to a specific visit and may describe acute or situational influences. Visit-level information included dates and times of ED arrival and discharge; arrival mode; ED type; ED diagnoses using International Classification of Diseases, Clinical Modification (ICD-9-CM), diagnosis codes (up to 15 per visit); and ED disposition. Time of ED arrival was categorized as weekday business hours if arrival occurred on a Monday through

Friday from 8:00 a.m. until 4:59 p.m. Diagnosis information excluded one site, which provided hospital (rather than ED) discharge diagnoses for admitted patients. ICD-9-CM codes were grouped using the Diagnosis Grouping System[31] to allow for clinically sensible groupings of pediatric ED diagnoses and were broadly categorized as trauma (e.g., fractures and dislocations [extremities], brain and skull trauma), acute medical (e.g., fever, infectious respiratory diseases), or chronic medical (e.g., congenital circulatory and cardiovascular diseases, diabetes mellitus). Although each ICD-9-CM diagnosis code was placed into only one category, each visit could be classified into multiple diagnosis groupings based on all diagnosis codes available for that visit. Severity of the ED visit was determined using the Severity Classification System, which assigns a severity level from 1 (least severe) to 5 (most severe) for each diagnosis, based on anticipated resource needs for that diagnosis. Because patients may have had more than one diagnosis, the most severe rating was used for each visit.[32] We designated patients as admitted if they were admitted to the hospital or to a short-stay observation unit or if transferred from the ED to another institution.

Data Analysis

We summarize variable distributions for continuous variables using minimum and maximum values and the median and interquartile range. We present categorical variables using counts and percentages. Unavailable (missing) values were excluded from calculations of percentages and summary statistics. Each patient was categorized as having 0 (index visit only), one, two, three, or four or more recurrent visits. We calculated mean days between recurrent visits, rates of arrival by emergency medical services (EMS), and rates of hospital admission and compared across levels of ED utilization. Visit-level diagnoses and associated severity were also described and compared by level of ED utilization. Patient-level analyses used generalized estimating equations (GEEs) with an exchangeable correlation structure to evaluate the association of recurrent ED use with ED type, patient age, sex, race/ethnicity, and payer type. GEE modeling allows adjustment for clustering or correlation of outcomes within EDs. The primary outcome of interest was recurrent visit rate, modeled using a negative binomial framework due to overdispersion. Observed unadjusted recurrent visit rates, adjusted rate ratios, and associated 95% confidence intervals (CIs) are reported. We additionally modeled high-frequency use (four or more recurrent visits) as a binary outcome, again using GEE, but with a logistic regression framework. Adjusted odds ratios (ORs) and associated 95% CIs are reported. Comparisons of EMS arrival and admission rates also used a GEE model to assess statistical significance of observed differences across levels of ED utilization. A significance level of 0.05 was used for all analyses without adjustment for multiple comparisons. We performed all analyses using SAS 9.2 (SAS Institute, Inc., Cary, NC).

RESULTS

Twenty-two PECARN sites provided data on 695,188 children with at least one ED visit in 2007, after excluding those who died in the ED (n = 347). Table 1 shows the demographics of this cohort. As noted above, return visits within 3 calendar days were collapsed into a single visit; 7% of patients had multiple ED visits within a 3-day period either of the initial visit or of a visit during the 12-month follow-up period. There were 455,588 recurrent ED visits during the 1-year follow-up period, representing an overall recurrent visit rate of 0.66 visits per patient per year. A total of 2,199 (0.3%) patients had at least one recurrent visit at a PECARN ED that differed from the original visit site. The recurrent visit rate by age is depicted in Figure 1. The overall percentage of patients with one or more recurrent visits was 36% and ranged from 26% to 44%.

Twenty percent of patients had one recurrent visit, 8% had two visits, 4% had three visits, and 4% had four or more recurrent visits (Table 2). The maximum number of recurrent visits was 26. The mean days between visits ranged from 57 for those with high frequency use, to 162 days for those with only one recurrent visit (Table 2). Recurrent visits were associated with hospital admission: those with high-frequency use (four or more recurrent visits) had the highest admission rates, followed by patients with only one visit (Table 2). Of the 18 sites reporting arrival mode consistently, use of EMS services for arrival to the ED also differed by number of recurrent visits ($p < 0.001$); patients with only a single ED visit had the highest rate (10 per 100 visits). The percentage of visits occurring during weekday business hours was 32% overall and was similar for each category of recurrent visits (range = 31.7% to 32.3%).

Recurrent ED visits were also associated with diagnosis group: Table 2 summarizes the distribution of broad categories of trauma, acute medical, and chronic medical diagnoses by number of recurrent visits. Acute

Table 1
Description of Overall Cohort (Total N = 695,188)

Characteristic	n (%)*
Patient age, yr	
Infant	118,182 (17)
1 to 4	224,269 (32)
5 to 9	150,203 (22)
10 to 14	123,552 (18)
15 to 17	78,982 (11)
Patient sex	
Male	372,812 (54)
Female	322,351 (46)
Race/ethnicity	
Black, non-Hispanic	267,451 (40)
White, non-Hispanic	248,571 (37)
Hispanic	115,231 (17)
Asian/Pacific Islander	10,867 (2)
American Indian/Alaska Native	1,308 (0.2)
Other	29,717 (4)
Primary payer	
Public	347,885 (51)
Commercial	291,966 (42)
Self-pay	39,219 (6)
Other	8,761 (1)

*Unavailable (missing) values were excluded for the following variables: sex (n = 25), race/ethnicity (n = 22,043), and payer (n = 7,357).

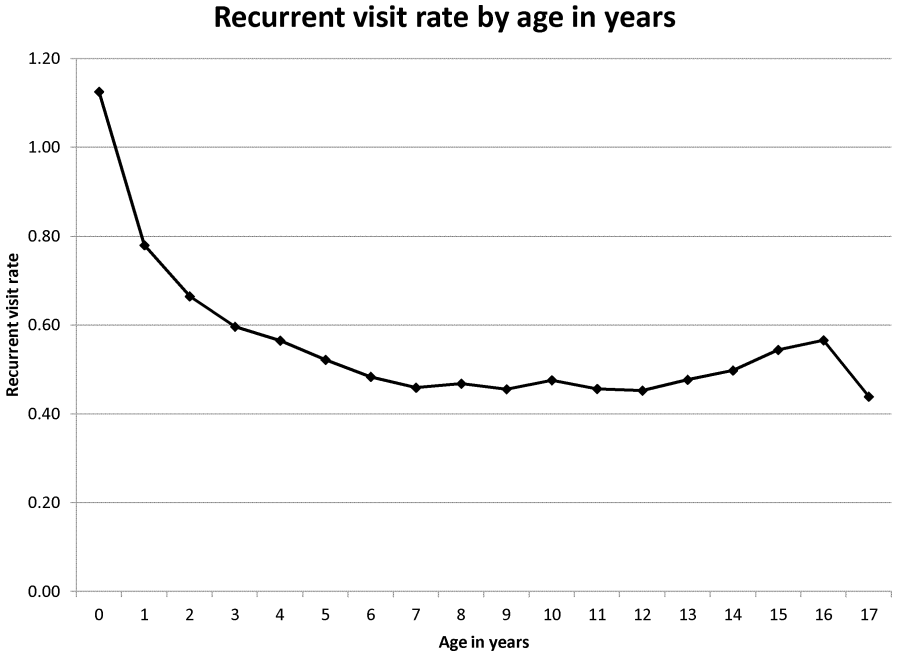

Figure 1. Recurrent visit rate by age in years.

medical illnesses accounted for most of the ED visits for all patients regardless of number of recurrent visits. Chronic conditions were most common in high-frequency users. Over one-quarter of ED visits for patients without any recurrent visits were related to trauma, but this was only 9% for high-frequency users. Table 3 depicts the association between recurrent visits and specific diagnosis groups. Asthma was in the top three most common diagnosis groups for all patients and was the most common diagnosis group for high-frequency users. Severity was associated with return visits: 17% of high-frequency recurrent visits were high severity (4 or 5), compared to 11% to 13% in all other recurrent visit categories ($p < 0.001$).

The multivariable model for recurrent visit rate is shown in Table 4. Recurrent ED visits within 1 year of an index visit were associated with younger age; black, Hispanic, Native American, or other race/ethnicity; and public health insurance. Recurrent visit rates were not associated with patient sex or ED type. We also examined the same patient characteristics in relationship to high utilization (four or more recurrent visits). Findings were similar; in addition, females were slightly less likely than males to be high users (OR = 0.93, 95% CI = 0.90 to 0.96, not considered to be clinically significant) and those with payer type of self-pay were also less likely (than commercial) to be high utilizers (OR = 0.68, 95% CI = 0.48 to 0.96).

DISCUSSION

This is the first large, multicenter study of recurrent ED visits in a solely pediatric population. Previous studies of the recurrent use of the ED by pediatric patients have been limited to single-center studies,[23,24] to short-term follow-up (recurrent use within 3 months),[24] or to subsets of children.[33] We found recurrent use common, with 36% of patients having at least one recurrent visit in the 12 months following an index visit and 4% having high-frequency ED use. Our findings are similar to those of previous adult studies indicating that 8% have some recurrent use,[34] and 4.5% to 8% of adult patients have four or more recurrent visits.[22] However, our findings may underrepresent pediatric recurrent ED utilization as our results differed from prior adult studies by eliminating return visits within 3 calendar days, which is generally considered to represent progression of a single illness.[27,28]

Our study design allowed us to examine the diagnoses associated with recurrent ED visits. Asthma is within the top three most common diagnostic groups within all categories of ED use, and it is the most common chronic illness within each category. This finding is similar to those of previous studies, which indicate that chronic health issues in adults,[35] and asthma, particularly in children, is associated with frequent use of the ED.[36] Notably, other than asthma, the illnesses most common for patients with recurrent visits were predominantly self-limited acute medical conditions. These include infectious nose and sinus disorders (including upper respiratory infections), fever, viral illnesses, infectious ear disorders, and gastroenteritis. Trauma accounted for 20% of all ED visits but was an infrequent reason for recurrent visits to the ED. Visits within the highest category of ED recurrent utilization had the greatest admission rate (17 per 100 visits) and greatest percentage within the maximal severity categories.

Previous studies have identified at-risk populations with increased ED utilization.[37,38] Our study identifies risk factors for high-frequency ED utilization within a geographically diverse, solely pediatric population. We found that age younger than 5 years, black or Native American race, Hispanic ethnicity, and public insurance are each independent risk factors for any recurrent visit

Table 2
Description of Cohort Stratified by Number of Recurrent Visits

Number of Recurrent Visits	Number of Patients (%)	Number of Visits (%)	Mean Days Between Visits	Admission Rate per 100 Visits*	Arrival by EMS, Rate per 100 Visits*	Acute Medical,†%	Chronic Medical,†%	Trauma,†%	Max Severity 4–5,%
None	447,611 (64)	447,611 (39)	N/A	14	10	67	23	28	13
One	141,742 (20)	283,484 (25)	162	11	6	74	26	21	11
Two	56,395 (8)	169,185 (15)	114	11	5	78	28	16	11
Three	24,889 (4)	99,556 (9)	87	12	5	80	32	13	12
Four or more	24,551 (4)	150,940 (13)	57	17	6	81	40	9	17
Overall	695,188	1,150,776	109	13	7	71	27	20	13

GEE = generalized estimating equations.
*Unadjusted $p < 0.001$ for differences across recurrent visit category based on GEE modeling of admission/EMS arrival rates.
†Percentage represents percentage of total visits within each recurrent visit category and may add to more than 100% as each visit could have up to 15 diagnoses. Visits reporting diagnosis codes classified by DGS within the no revisit group = 403,719; one revisit group = 257,411; two revisit group = 154,252; three revisit group = 91,346; four or more revisit group = 139,281.

as well as for high-frequency utilization. Similar to prior adult studies, our study indicates that publicly insured children are frequent users of the ED.[39] However, similar to previous studies in adults,[22,39] our results indicate that uninsured children do not have an increased rate of recurrent use. This finding may be indicative of a monetary disincentive for using the ED for self-pay patients. Alternatively, these findings may reflect higher relative enrollment of pediatric patients in insurance programs in general, and patients with chronic illnesses specifically, into public insurance programs. Prior studies have indicated that patients with frequent ED use also have frequent primary care utilization,[15,40] and in pediatric care, the most at-risk patients socioeconomically are eligible for public insurance (including the S-CHIP programs) and potentially have increased opportunity for enrollment in these insurance programs.

These findings echo those of a recent adult study[34] and accompanying editorial,[41] which highlight the importance of the ED to provide access and needed care to those "socioeconomically, medically, and psychiatrically vulnerable [who] tend to use the ED heavily ...." We also found that younger, minority, publically insured children were more likely to have frequent ED utilization for common pediatric diagnoses (both acute and chronic), with those visiting the most frequently having the highest severity and admission rates. An understanding of the needs of these patients and how they are served (or not served) both by the current, and by potential future, coordinated medical system is important in shaping public policy.[42]

LIMITATIONS

As with any study using administrative data, there is the potential for misclassification or missing data. Other risk factors (health literacy, access to primary care, etc.) for recurrent use of the ED may exist that we were unable to examine due to limited information within the administrative database. In addition, as we are relying solely on ED-generated diagnoses, the ED discharge diagnosis information available within our study may be more likely to capture chronic illnesses that have acute exacerbations (asthma, seizures) and may underidentify chronic conditions that represent important comorbidities in the face of acute illnesses (e.g., cystic fibrosis, developmental delay). For example, documentation and diagnosis generation in the ED may more likely capture those issues that are currently being treated during that visit (e.g., seizure disorder in patient with active status epilepticus) than those comorbidities that affect but may be more remote to the presenting acute illness (e.g., developmental delay in the setting of aspiration pneumonia). Our study methodology does not allow us to make any conclusions about the appropriateness of ED use and whether, for example, patients were referred to the ED by their primary care providers. While we linked patients longitudinally within and between participating institutions, we could not identify recurrent visits made to EDs not participating in this study. Thus, our estimates of recurrent visit rates are likely an underestimate,[20] and the rate of repeat utilization may be higher than our results indicate. As described previously, PECARN is not a nationally representative sampling of patients, including care skewed toward pediatric tertiary care hospitals; however, this study does provide previously unavailable pediatric data from a large geographically diverse network.[29] As the majority of PECARN sites are pediatric EDs, our estimate of recurrent visits may overrepresent children with chronic care conditions who have the potential for increased risk of acute medical issues and thus lead to an overestimate of recurrent visits.

CONCLUSIONS

This large multicenter study of high-frequency pediatric ED users identifies risk factors for recurrent ED use, including young age; black, Native American, or Hispanic race or ethnicity; and public insurance status. Uninsured patients did not have an increased rate of recurrent visits. Asthma and short-term acute illnesses are among the most prevalent diagnoses for recurrent pediatric ED visits. Our findings highlight that high-frequency recurrent

Table 3
Ten Most Frequent Diagnosis Grouping System Subgroups by Number of Recurrent Visits*

Rank	No Recurrent Visits (n = 403,719)	One Recurrent Visit (n = 257,411)	Two Recurrent Visits (n = 154,252)	Three Recurrent Visits (n = 91,346)	Four or More Recurrent Visits (n = 139,281)
1	Fever (8%)	Infectious nose and sinus disorders, including URI (11%)	Infectious nose and sinus disorders, including URI (13%)	Infectious nose and sinus disorders, including URI (15%)	Asthma (16%)
2	Infectious nose and sinus disorders, including URI (7%)	Asthma (11%)	Asthma (13%)	Asthma (14%)	Infectious nose and sinus disorders, including URI (16%)
3	Asthma (7%)	Fever (10%)	Fever (11%)	Fever (12%)	Fever (13%)
4	Lacerations, amputations, foreign bodies (7%)	Viral illnesses (9%)	Viral illnesses (9%)	Infectious ear disorders (10%)	Infectious ear disorders (11%)
5	Viral illnesses (7%)	Infectious ear disorders (8%)	Infectious ear disorders (9%)	Viral illnesses (10%)	Viral illnesses (10%)
6	Gastroenteritis (7%)	Gastroenteritis (7%)	Gastroenteritis (8%)	Gastroenteritis (8%)	Other respiratory diseases (9%)
7	Extremity fractures and dislocations (6%)	Noninfectious skin, dermatologic, and soft tissue diseases (6%)	Noninfectious skin, dermatologic, and soft tissue diseases (7%)	Noninfectious skin, dermatologic, and soft tissue diseases (8%)	Other gastrointestinal diseases (9%)
8	Other gastrointestinal diseases (6%)	Infectious respiratory diseases (6%)	Infectious respiratory diseases (7%)	Other respiratory diseases (7%)	Infectious respiratory diseases (8%)
9	Infectious respiratory diseases (6%)	Other respiratory diseases (6%)	Other respiratory diseases (7%)	Infectious respiratory diseases (7%)	Noninfectious skin, dermatologic, and soft tissue diseases (8%)
10	Infectious ear disorders (5%)	Infectious mouth and throat disorders (6%)	Infectious mouth and throat disorders (6%)	Other gastrointestinal diseases (6%)	Gastroenteritis (8%)

URI = upper respiratory infection.
*Based on all diagnoses reported. Percentage represents percentage of total visits within each recurrent visit category.

Table 4
Unadjusted Rates, Adjusted Rate Ratios, and 95% CIs for Relative Risk of an Additional ED Visit Within One Year of Index Visit*

Variable	Recurrent Visit Rate per Patient per Year	Adjusted Rate Ratio	95% CI
ED type			
Separate pediatric ED	0.69	1.10	0.83–1.45
Pediatric ED within general ED	0.57	Reference	
Patient age, yr			
Infant	1.16	1.97	1.83–2.13
1 to 4	0.69	1.26	1.16–1.36
5 to 9	0.50	0.91	0.83–0.98
10 to 14	0.49	0.92	0.86–0.97
15 to 17	0.53	Reference	
Patient sex			
Male	0.68	Reference	
Female	0.67	0.99	0.97–1.00
Patient race/ethnicity			
White, non-Hispanic	0.43	Reference	
Black, non-Hispanic	0.86	1.62	1.49–1.76
Asian/ Pacific Islander	0.51	1.06	0.95–1.18
American Indian/ Alaska Native	0.69	1.40	1.25–1.56
Hispanic	0.82	1.47	1.33–1.62
Other race	0.62	1.16	1.06–1.28
Primary payer			
Commercial	0.43	Reference	
Public	0.92	1.69	1.56–1.82
Self-pay	0.44	0.91	0.78–1.06
Other	0.41	0.96	0.84–1.09

GEEs = generalized estimating equations.
*Based on GEEs model using a negative binomial regression framework. Rate calculations were restricted to those with full data for the multivariable model, $N = 666{,}763$. Overall recurrent visit rate for this population was 0.68.

visits include both common pediatric diagnoses, potentially evaluated in a range of outpatient settings, and more severe conditions that result in a higher likelihood of admissions. Knowledge of patient- and visit-level factors may be used to target at-risk patients or design health care system modifications for potential intervention programs to enhance access to and improve coordination of care for all children.

Participating centers and site investigators are listed in alphabetical order: Atlantic Health System/Morristown Memorial Hospital (Michael Gerardi); Bellevue Hospital Center (Michael Tunik); Calvert Memorial Hospital (Kraig Melville); Children's Hospital of Buffalo (Kathleen Lillis); Children's Hospital of Michigan (Prashant-Mahajan); Children's Hospital of New York–Presbyterian (Peter Dayan); Children's Hospital of Philadelphia (Elizabeth Alpern); Children's National Medical Center (James Chamberlain); Cincinnati Children's Hospital Medical Center (Richard Ruddy); DeVos Children's Hospital (John Hoyle Jr); Franklin Square Hospital (Diana Alexander); Harlem Hospital Center (Nadine Levick); Holy Cross Hospital (Christina Johns); Howard County Medical Center (David Monroe); Hurley Medical Center (Dominic Borgialli); Johns Hopkins Medical Center (Jen Anders); Marquette General Hospital (Donald Snowden); Medical College of Wisconsin/Children's Hospital of Wisconsin (Marc Gorelick); St. Barnabas Health Care System (John Brennan); University of California Davis Medical Center (Leah Tzimenatos); University of Michigan (Alex Rogers); University of Rochester (Madelyn Garcia); University of Utah/Primary Children's Medical Center (Doug Nelson); Upstate Medical Center (James Callahan); and Washington University/St. Louis Children's Hospital (David Jaffe).

PECARN Steering Committee: N. Kuppermann, Chair; E. Alpern, J. Chamberlain, J. M. Dean, M. Gerardi, J. Goepp, M. Gorelick, J. Hoyle, D. Jaffe, C. Johns, N. Levick, P. Mahajan, R. Maio, K. Melville, S. Miller*, D. Monroe, R. Ruddy, R. Stanley, D. Treloar, M. Tunik, and A. Walker.

MCHB/EMSC liaisons: D. Kavanaugh and H. Park.

Central Data Management and Coordinating Center (CDMCC): M. Dean, R. Holubkov, S. Knight, and A. Donaldson.

Data Analysis and Management Subcommittee (DAMS): J. Chamberlain, Chair; M. Brown, H. Corneli, J. Goepp, R. Holubkov, P. Mahajan, K. Melville, E. Stremski, and M. Tunik.

Grants and Publications Subcommittee (GAPS): M. Gorelick, Chair; E. Alpern, J. M. Dean, G. Foltin, J. Joseph, S. Miller*, F. Moler, R. Stanley, and S. Teach.

Protocol Concept Review and Development Subcommittee (PCRADS): D. Jaffe, Chair; K. Brown, A. Cooper, J. M. Dean, C. Johns, R. Maio, N. C. Mann, D. Monroe, K. Shaw, D. Teitelbaum, and D. Treloar.

Quality Assurance Subcommittee (QAS): R. Stanley, Chair; D. Alexander, J. Brown, M. Gerardi, M. Gregor, R. Holubkov, K. Lillis, B. Nordberg, R. Ruddy, M. Shults, and A. Walker.

Safety and Regulatory Affairs Subcommittee (SRAS): N. Levick, Chair; J. Brennan, J. Brown, J. M. Dean, J. Hoyle, R. Maio, R. Ruddy, W. Schalick, T. Singh, and J. Wright.

*deceased.

References

1. Pitts SR, Niska R, Xu J, Burt CW. National Hospital Ambulatory Medical Care Survey 2006 Emergency Department Summary. Hyattsville, MD: National Center for Health Statistics, 2008.
2. National Center for Health Statistics. Health, United States, 2005, Chartbook on Trends in the Health of Americans. Hyattsville, MD: National Center for Health Statistics, 2005, p 311.
3. National Center for Health Statistics. Health, United States, 2009: With Special Feature on Medical Technology. Hyattsville, MD: National Center for Health Statistics, 2010, p 333.
4. Pitts SR, Carrier ER, Rich EC, Kellermann AL. Where Americans get acute care: increasingly, it's not at their doctor's office. Health Aff 2010;29:1620–9.
5. Cunningham P. Nonurgent Use of Hospital Emergency Departments. Testimony before the U.S. Senate Health, Education, Labor and Pensions Committee Subcommittee on Primary Health and Aging. Hearing on "Diverting Non-urgent Emergency Room Use: Can It Provide Better Care and

Lower Costs?" Center for Studying Health System Change, 2011. Available at: http://www.hschange.com/CONTENT/1204/?words=au07. Accessed Dec 29, 2013.
6. Mathison DJ, Chamberlain JM, Cowan NM, et al. Primary care spatial density and nonurgent emergency department utilization: a new methodology for evaluating access to care. Acad Pediatr 2013;13:278–85.
7. Agency for Healthcare Research and Quality. National Healthcare Disparities Report, 2011. Available at: http://www.ahrq.gov/research/findings/nhqrdr/nhqr11/nhqr11.pdf. Accessed Dec 29, 2013.
8. Carroll AE, Frackt AB. New evidence supports, challenges, and informs the ambitions of health reform. JAMA 2013;309:2600–1.
9. United States Congress. Affordable Care Act. Available at: http://www.gpo.gov/fdsys/pkg/BILLS-111hr3590enr/pdf/BILLS-111hr3590enr.pdf. Accessed Dec 28, 2013.
10. Centers for Medicare & Medicaid Services. Accountable Care Organizations: Improving Care Coordination for People With Medicare. Available at: http://www.medicare.gov/manage-your-health/coordinating-your-care/accountable-care-organizations.html. Accessed Dec 28, 2013.
11. Berwick DM. Making good on ACO's promise–the final rule for the Medicare shared savings program. N Engl J Med 2011;365:1753–6.
12. Fisher ES, McClellan MB, Safran DG. Building the path to accountable care. N Engl J Med 2011;365:2445–7.
13. Rieselbach RE, Kellermann AL. A model health care delivery system for Medicaid. N Engl J Med 2011;364:2476–8.
14. Locker TE, Baston S, Mason SM, Nicholl J. Defining frequent use of an urban emergency department. Emerg Med J 2007;24:398–401.
15. Hunt KA, Weber EJ, Showstack JA, Colby DC, Callaham ML. Characteristics of frequent users of emergency departments. Ann Emerg Med 2006;48:1–8.
16. DePiero AD, Ochsenschlager DW, Chamberlain JM. Analysis of pediatric hospitalizations after emergency department release as a quality improvement tool. Ann Emerg Med 2002;39:159–63.
17. Pines JM, Asplin BR, Kaji AH, et al. Frequent users of emergency department services: gaps in knowledge and a proposed research agenda. Acad Emerg Med 2011;18:e64–9.
18. Blank FS, Li H, Henneman PL, et al. A descriptive study of heavy emergency department users at an academic emergency department reveals heavy ED users have better access to care than average users. J Emerg Nurs 2005;31:139–44.
19. Riggs JE, Davis SM, Hobbs GR, Paulson DJ, Chinnis AS, Heilman PL. Association between early returns and frequent ED visits at a rural academic medical center. Am J Emerg Med 2003;21:30–1.
20. Cook LJ, Knight S, Junkins EP, Mann NC, Dean JM, Olson LM. Repeat patients to the emergency department in a statewide database. Acad Emerg Med 2004;11:256–63.
21. Fuda KK, Immekus R. Frequent users of Massachusetts emergency departments: a statewide analysis. Ann Emerg Med 2006;48:9–16.
22. LaCalle E, Rabin E. Frequent users of emergency departments: the myths, the data, and the policy implications. Ann Emerg Med 2010;56:42–8.
23. Yamamoto LG, Zimmerman KR, Butts RJ, et al. Characteristics of frequent pediatric emergency department users. Pediatr Emerg Care 1995;11:340–6.
24. LeDuc K, Rosebrook H, Rannie M, Gao D. Pediatric emergency department recidivism: demographic characteristics and diagnostic predictors. J Emerg Nurs 2006;32:131–8.
25. PECARN. The Pediatric Emergency Care Applied Research Network (PECARN): rationale, development, and first steps. Acad Emerg Med 2003;10:661–8.
26. Cook LJ, Olson LM, Dean JM. Probabilistic record linkage: relationships between file sizes, identifiers and match weights. Methods Inf Med 2001;40:196–203.
27. Logue EP, Ali S, Spiers J, Newton AS, Lander JA. Characteristics of patients and families who make early return visits to the pediatric emergency department. Open Access EM 2013;5:9–15.
28. Ali AB, Place R, Howel J, Malubay SM. Early pediatric emergency department return visits: a prospective patient-centric assessment. Clin Pediatr 2012;51:651–8.
29. Alpern ER, Stanley RM, Gorelick MH, et al. Epidemiology of a pediatric emergency medicine research network: The Pediatric Emergency Care Applied Research Network core data project. Pediatr Emerg Care 2006;22:689–99.
30. Centers for Disease Control and Prevention. NCHS Data Brief. Available at: http://www.cdc.gov/nchs/data/databriefs/db99.htm. Accessed Dec 29, 2013.
31. Alessandrini EA, Alpern ER, Chamberlain JM, Shea JA, Gorelick MH. A new diagnosis grouping system for child emergency department visits. Acad Emerg Med 2010;17:204–13.
32. Alessandrini EA, Alpern ER, Chamberlain JM, Shea J, Holubkov R, Gorelick MH. Developing a diagnosis-based severity classification system for use in emergency medical systems for children. Acad Emerg Med 2012;19:70–8.
33. Walsh-Kelly CM, Kelly K, Drendel AL, Grabowski L, Kuhn EM. Emergency department revisits for pediatric acute asthma exacerbations. Pediatr Emerg Care 2008;24:505–10.
34. Doren KM, Raven MC, Rosenheck RA. What drives frequent emergency department use in an integrated health system? National data from the Veterans Health Administration. Ann Emerg Med 2013;62:151–9.
35. Lasser KE, Kronman AC, Cabral H, Samet JH. Emergency department use by primary care patients at a safety-net hospital. Arch Intern Med 2012;172:278–80.
36. Akinbami LJ, Moorman JE, Garbe PL, Sondik EJ. Status of childhood asthma in the United States, 1980-2007. Pediatrics 2009;123(Suppl 3):S131–45.

37. Guenther E, Knight S, Olson LM, Dean JM, Keenan HT. Prediction of child abuse risk from emergency department use. J Pediatr 2009;154:272–7.
38. Jacobstein CR, Alessandrini EA, Lavelle JM, Shaw KN. Unscheduled revisits to a pediatric emergency department: risk factors for children with fever or infection-related complaints. Pediatr Emerg Care 2005;21:816–21.
39. Newton MF, Keirns CC, Cunningham R, Hayward RA, Stanley R. Uninsured adults presenting to US emergency departments: assumptions vs data. JAMA 2008;300:1914–24.
40. Sandoval E, Smith S, Walter J, et al. A comparison of frequent and infrequent visitors to an urban emergency department. J Emerg Med 2010;38:115–21.
41. Pines JM. How Frequent emergency department use by U.S. veterans can inform good public policy. Ann Emerg Med 2013;62:160–1.
42. Fieldston ES, Alpern ER, Nadel FM, Shea JA, Alessandrini EA. A qualitative assessment of reasons for nonurgent visits to the emergency department: parent and health professional opinions. Pediatr Emerg Care 2012;28:220–5.