

Epidemiology of a Pediatric Emergency Medicine Research Network

The PECARN Core Data Project

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Objective: To examine the epidemiology of pediatric patient visits to emergency departments (ED).

Methods: We conducted a cross-sectional study of pediatric ED visits at the participating Pediatric Emergency Care Applied Research Network (PECARN) hospitals in 2002. We provide descriptive characteristics of pediatric ED visits and a comparison of the study database to the National Hospital Ambulatory Medical Care Survey (NHAMCS). Bivariate analyses were calculated to assess characteristics associated with hospital admission, death in the ED, and length of ED visit. We also performed multivariate regression to model the likelihood of admission to the hospital.

Results: Mean patient age was 6.2 years; 53.5% were boys; 47.5% black; and 43.2% had Medicaid insurance. The most common ED diagnoses were fever, upper respiratory infection, asthma, otitis media, and viral syndromes. The inpatient admission rate was

11.6%. The most common diagnoses requiring hospitalization were asthma, dehydration, fever, bronchiolitis, and pneumonia. In multivariate analysis, patients who were black or Hispanic, had Medicaid insurance or were uninsured, or were older than 1 year were less likely to be hospitalized. Demographics of the PECARN population were similar to NHAMCS, with notable exceptions of a larger proportion of black patients and of admitted patients from the PECARN EDs.

Conclusion: We describe previously unavailable epidemiological information about childhood illnesses and injuries that can inform development of future studies on the effectiveness, outcomes, and quality of emergency medical services for children. Most pediatric ED patients in our study sought care for infectious causes or asthma and were discharged from the ED. Hospital admission rate differed according to age, payer type, race/ethnicity, and diagnosis.

Key Words: health services research, PECARN, NHAMCS

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Emergency departments (EDs) collect substantial amounts of patient data that have the potential to provide information for analysis of important public health questions pertaining to the care of acutely ill and injured children. However, the capacity to collect and analyze these data for surveillance purposes has been lacking.^{1–5} Several advisory groups have called for the collection of key clinical data elements for ED and emergency medical services (EMS) patients, including representatives from the National Center for Injury Prevention and Control, the American Academy of Pediatrics, National Highway Traffic Safety Administration, and the Maternal and Child Health Bureau.^{6–10} Data regarding EMS for children (EMSC) are particularly lacking.^{11,12} Epidemiological surveillance data are necessary to evaluate EMSC services and processes and to plan for future allocation of resources directed to specifically identified needs such as regionalization or specialty designation. Opportunities have been identified for expanded ED surveillance using electronic methods to provide information on the occurrence, outcomes, and costs of ED visits.⁵

The newly developed Pediatric Emergency Care Applied Research Network (PECARN) infrastructure provides a unique opportunity to collect such data.^{13,14} PECARN

is the first federally funded national network for research on pediatric emergencies and EMSC and was established to overcome barriers to such research, including the rare occurrence of pediatric emergency events, the lack of generalizability of research conducted in single, and largely academic centers, and the lack of standardized outcome measures.

The PECARN Core Data Project (PCDP) is designed to collect key data elements from pediatric ED visits. The primary goal of this project is to establish an ED-based data collection and surveillance system at all sites within the network. The project is multistaged and includes several forms of data elements, methods of abstraction, and variations in seasonality. In this study, we report the number and characteristics of pediatric ED visits within PECARN during a complete calendar year. This information was obtained from the initial phase of the PCDP and serves to describe the population served by PECARN. This study provides previously unavailable epidemiological information about childhood illnesses and injuries in this population that we hope will stimulate and inform further studies of the effectiveness, outcomes, and quality of EMSC.

METHODS

Study Design and Setting

We conducted a cross-sectional study of pediatric patients visiting participating PECARN EDs in calendar year 2002. All member EDs of PECARN ($n = 25$) were eligible to participate in the study. Of all 25 member hospitals within PECARN during the study period, 36% are freestanding children's hospitals, and 64% are designated as pediatric level I trauma centers. Within member hospitals, the EDs are 48% separate pediatric EDs, 40% pediatric EDs within a general ED, and 12% general EDs without a separate area where pediatric ED patients are seen and evaluated. See Appendix for a further description of each participating site. The Institutional Review Boards of all 25 sites and of the PECARN Central Data Management and Coordinating Center (CDMCC) approved the study.

Selection of Participants

All ED patients registered at any of the PECARN sites in the calendar year 2002 were studied. This manuscript provides data from all ED visits by pediatric patients (birth until 19th birthday) from the participating EDs.

Data Collection and Processing

We obtained data from existing electronic sources, including billing data and patient tracking systems. Site investigators worked with information technology personnel to determine the most appropriate data sources available. Data elements requested include date of birth, date and times of ED arrival, triage, and discharge, sex, race, ethnicity, ED disposition, *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* diagnoses codes (up to 10 codes for each patient), procedure codes (either *Current Procedural Terminology [CPT]* codes or *ICD-9*

procedure codes; up to 5 codes for each patient), external cause of injury codes (E-codes; up to 3 codes for each patient), arrival mode, and insurance payer type.

Each site submitted encrypted data to the data coordinating center, where the data were reviewed and summarized. We presented site-specific descriptive statistics for each variable to the site investigator to determine face validity. In addition, 2 study investigators (ERA and JMC) reviewed the summary statistics for all data elements from each site to assess face validity. If we identified potential errors or biases, we presented them to the site investigator for resolution. Because many hospitals do not report ethnicity separately from race, we created a combined race/ethnicity variable to provide comparability across sites. Because ED length of stay (LOS) greater than 24 hours were thought to capture hospital admissions or observation unit admissions rather than true ED stays, these were excluded from LOS analyses. Visits with LOS greater than 24 hours accounted for only 3.8% of all visits at sites reporting arrival and discharge times. We summarized the diagnoses as *ICD-9-CM* codes to the fourth digit to capture distinct diagnosis information and also by the 18 *ICD-9* major diagnosis tabular list categories.¹⁵ Each variable was included in the analysis on a site-specific basis. We decided a priori to include a variable from a given site if it was available for at least 80% of visits at the site and we could not identify systematic biases or concerns about face validity. Of the sites described in this manuscript, 7 had no variables excluded for missing data; the remaining sites had between 1 and 5 variables that were either not provided by the site or excluded because of missing data.

Analyses

We describe continuous variables using means and SDs or medians and interquartile range (IQR), as appropriate. We present discrete variables using counts and percentages. We compared descriptive information from the PCDP with national estimates for children of the same age based on the 2002 National Hospital Ambulatory Medical Care Survey (NHAMCS). All NHAMCS statistics were weighted appropriately for the sampling design and reflect national estimates.¹⁶

We performed bivariate analyses to measure the relationships between age and admission, age and death in the ED, and age and length of ED stay. We calculated odds ratios (ORs) and 95% confidence intervals (CIs) for comparisons between categorical variables. The CI for the difference in median length of visit between age groups was calculated using the bias-corrected bootstrap method.¹⁷ We also performed multiple regression analysis to model the likelihood of admission to the hospital (compared with discharge from the ED) using generalized estimating equations to account for both the correlation between patients within hospitals and the correlation between multiple visits by the same patient.^{18,19} The study investigators determined the variables to be included in the model following bivariate analyses; stepwise methods were not used. All diagnoses listed for a visit were included in the

analysis. We considered patients “admitted” if admitted to the hospital, to a short stay observation unit, or transferred from the ED to another institution. We performed all analyses using SAS 9.1 (SAS Institute, Inc, Cary, NC).

RESULTS

Twenty-four of the 25 sites provided data for the calendar year 2002; one site was unable to submit its data. We excluded one additional site because of a systematic loss of data related to data archiving for the first quarter of the year; thus, 23 sites are included in the analyses presented below.

There were 754,004 ED visits by patients <19 years during the study period. The 23 sites ranged in annual visits from 4256 to 82,414 with a median of 25,532 (IQR, 17,578–44,752). The mean patient age was 6.2 ± 5.7 years, with 16.7% of patients younger than 1 year old. The patients were 53.5% boys, and 47.5% were identified as black, non-Hispanic. Most patients had either commercial (48.3%) or Medicaid (43.2%) insurance; 6.9% of patients were uninsured. Most patients arrived by non-EMS transport (91.5%), and only a small proportion were admitted to the hospital or 23-hour observation unit or transferred to another facility

TABLE 1. Patient and Visit Demographics for PECARN Population and NHAMCS National Estimates, 2002

	No. PCDP	Percent of PCDP	Percent of NHAMCS
No. patient visits*	754,004	—	—
Patient age (23 sites, n = 754,004)			
<1 yr	125,926	16.7	14.2
1–4 yrs	252,133	33.4	29.2
5–9 yrs	150,022	19.9	19.0
10–14 yrs	132,711	17.6	19.4
15–18 yrs	93,212	12.4	18.2
Patient sex (22 sites, n = 728,040)			
Male	389,842	53.5	51.6
Female	338,198	46.5	48.4
Race/ethnicity (19 sites, n = 667,595)			
Black, non-Hispanic	317,302	47.5	24.1
White, non-Hispanic	237,809	35.6	57.9
Hispanic	74,116	11.1	14.8
Asian/Pacific Islander, non-Hispanic	9203	1.4	2.3
American Indian/Alaskan native, non-Hispanic	1317	0.2	0.7
Other, non-Hispanic	27,848	4.2	0.2
Primary payer (23 sites, n = 744,072)			
Commercial insurance	359,382	48.3	45.2
Medicaid	321,470	43.2	39.4
Self-pay	51,650	6.9	10.8
Workers compensation	478	0.1	0.2
Medicare	267	0.0	1.5
Other governmental insurance	3484	0.5	NA
Other	7341	1.0	2.9
Mode of arrival (15 sites, n = 541,856)			
Non-EMS/walk-in	495,609	91.5	NA
EMS ground	41,577	7.7	NA
EMS air	1681	0.3	NA
Other	2989	0.6	NA
Disposition (20 sites, n = 653,083)			
Discharged	566,130	86.7	92.0
Admitted/transferred/23-hour observation	75,657	11.6	5.0
Died	246	0.0	0.0
Other [†]	11,050	1.7	3.0

*Number of sites and visits included in analysis for each variable is parenthetically listed after variable.

[†]“Other” disposition status includes left without being seen, left against medical advice, and other.

NA indicates not available.

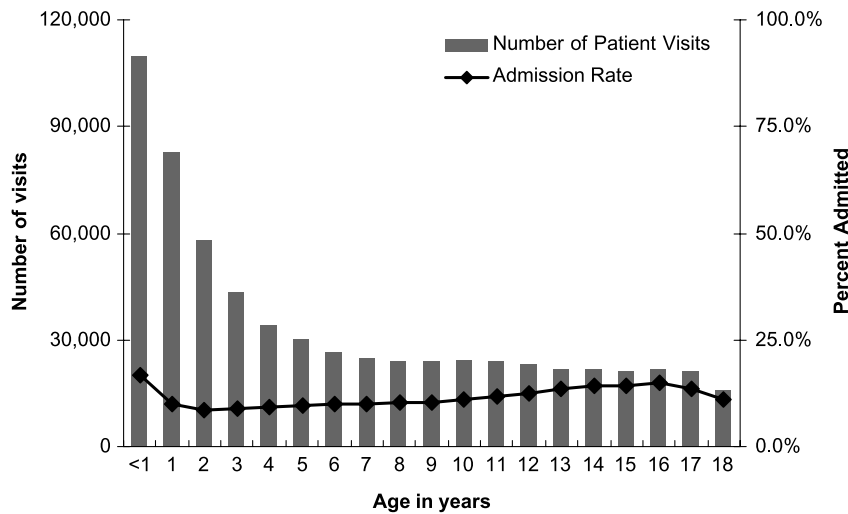


FIGURE 1. Emergency department visits and admission rates by age (n = 653,083 patient visits at 20 sites).

(11.6%). Table 1 depicts descriptive variables for the study population compared with the 2002 NHAMCS data.

The overall monthly rate of admission ranged from 11.1% to 12.4%. Admission rates varied by age with children younger than 1 year having the highest admission rate (16.8% vs. 10.8% for all other age groups; OR, 1.67; 95% CI, 1.64–1.70); (Fig. 1). Infants died or were declared dead in the ED more often than any other age group (0.08% vs. 0.03% for all other age groups; OR, 2.96; 95% CI, 2.28–3.83).

The median time spent in the ED was 133 minutes (IQR, 82–209 minutes). This compared with a median ED LOS presented in the 2002 NHAMCS of 104 minutes (IQR, 62–167 minutes). On average, adolescent patients (15–18 years old) spent the longest period in the ED (median time 152 minutes vs. 130 minutes for all other age groups; median difference, 22; 95% CI, 20–23). Of the 10 most common diagnoses, patients with abdominal pain (ICD-9, 789.0) had the longest ED time (median time 195 minutes, IQR, 123–299 minutes).

Data on ED diagnoses were available from 20 sites. For 639,330 visits, there were 1,111,308 diagnoses repre-

senting 4577 unique ICD-9 diagnosis codes (to the fourth digit). 47.5% of patients had more than 1 code. Seven codes accounted for 25% of all diagnoses. The 10 most common diagnoses overall, with median ED LOS, are presented in Table 2. The 5 most common diagnosis codes by age group are presented in Table 3.

Diagnoses were aggregated based on the 18 ICD-9 major diagnosis tabular list categories and are presented in Table 4 in order of frequency in our study population with comparison to NHAMCS 2002 data. The most common group was “symptoms, sign, and ill-defined conditions.” Within this category, for example, are the ICD-9 diagnoses of “fever,” “vomiting,” and “diarrhea.” “Injury and poisonings” was the second most common grouping. Table 5 presents the most common major diagnosis tabular list categories by age in the PCDP. “Injury and poisonings” was the most common diagnosis group for patients 5 years and older. For 15 to 18 year olds, “mental disorders” was 1 of the 5 most common categories.

The most common ICD-9 diagnoses associated with EMS transport (air or ground) to the ED were convulsions

TABLE 2. Most Frequent Diagnoses of Pediatric ED Patients (n = 639,330 Patient Visits at 20 Sites)

Rank	ICD-9 Code	Description	Count	Percent*	Median Time in ED, 15 Sites (min)
1	780.6	Fever	55,175	8.6	162
2	465.9	Acute upper respiratory infections	49,219	7.7	118
3	493.9	Unspecified asthma	47,333	7.4	158
4	382.9	Unspecified otitis media	43,320	6.8	115
5	079.9	Unspecified viral and chlamydial infections	41,479	6.5	130
6	787.0	Nausea and vomiting	23,585	3.7	174
7	789.0	Abdominal pain	22,243	3.5	195
8	558.9	Gastroenteritis and colitis	21,132	3.3	153
9	462	Acute pharyngitis	20,253	3.2	115
10	873.4	Open wound of face	17,614	2.8	123

*Denominator for percent is total number of patient visits reporting at least one ICD-9 code (n = 639,330). Up to 10 diagnoses are reported per visit.

TABLE 3. Most Common ED Diagnoses by Age (n = 639,330 Patient Visits at 20 Sites)

Age	Top 5 ICD-9 Codes	Description	Count	Percent*
<1 yr (n = 108,446)	465.9	Acute upper respiratory infections	16,714	15.4
	780.6	Fever	14,710	13.6
	382.9	Unspecified otitis media	11,884	11.0
	079.9	Unspecified viral and chlamydial infections	9603	8.9
	466.1	Acute bronchiolitis	9559	8.8
1–4 yrs (n = 215,458)	780.6	Fever	26,852	12.5
	382.9	Unspecified otitis media	24,533	11.4
	465.9	Acute upper respiratory infections	22,189	10.3
	493.9	Unspecified asthma	19,458	9.0
	079.9	Unspecified viral and chlamydial infections	18,337	8.5
5–9 yrs (n = 126,924)	493.9	Unspecified asthma	11,270	8.9
	780.6	Fever	8411	6.6
	079.9	Unspecified viral and chlamydial infections	7603	6.0
	462	Acute pharyngitis	6290	5.0
	465.9	Acute upper respiratory infections	6073	4.8
10–14 yrs (n = 110,618)	493.9	Unspecified asthma	8565	7.7
	789.0	Abdominal pain	5906	5.3
	462	Acute pharyngitis	4264	3.9
	079.9	Unspecified viral and chlamydial infections	4159	3.8
	780.6	Fever	3780	3.4
15–18 yrs (n = 77,884)	789.0	Abdominal pain	5493	7.1
	493.9	Unspecified asthma	4044	5.2
	462	Acute pharyngitis	2472	3.2
	784.0	Headache	2284	2.9
	786.5	Chest pain	2215	2.8

*Denominator for percent is total number of patient visits reporting at least one ICD-9 code (n = 639,330). Up to 10 diagnoses are reported per visit.

(9.3% of all EMS transports), asthma (7.8%), and injury of the head, face, or neck (5.7%). Of patients requiring hospitalization, the most common diagnoses were asthma (14.3% of admitted patients), dehydration (8.9%), fever (6.4%), bronchiolitis (5.8%), and pneumonia (5.6%). For patients transferred from the ED to other facilities, the 2 most frequent diagnosis codes were both psychiatric diagnoses: neurotic disorder (13.8% of transferred patients) and depressive disorder (8.9%).

E-codes were reported for 75.3% of all patient visits with injury diagnoses (ICD-9 codes 800–999). This figure represents all 20 sites with valid diagnosis codes, including 3 sites with more than 20% missing E-codes. E-codes were reported for 94% of patient visits with injury diagnoses if the 3 sites with more than 20% missing E-codes were excluded. Of patients with reported location E-codes, 37.0% were injured in the home, 12.5% at a place for recreation or sport, 4.5% in a street or highway, 19.2% in another specified location (eg, public building, industrial location), and 26.8% in an unspecified location.

CPT procedure codes (excluding evaluation and management codes) were reported at 9 sites for 121,918 patient visits (36.8%). The most commonly reported procedures (in decreasing order of frequency) were chest radio-

graph, urinalysis, complete blood count, pulse oximetry, urine culture, basic metabolic panel, blood culture, and rapid streptococcal immunoassay. From sites that reported CPT codes, 63.2% (n = 209,345) of patient visits did not have any associated procedures reported. ICD-9 procedure codes were reported at 10 sites for 56,406 patient visits (18.2%). The most common procedures reported using these categories were wound closure, splint application, medication injection or infusion, lumbar puncture, nebulized respiratory medication, fracture reduction, and cranial computerized tomography. From sites that reported ICD-9 procedure codes, 81.8% (n = 253,740) of patient visits had no associated procedure billed.

In multivariate analyses, subgroups of the following variables were significantly associated with hospital admission: age group, race/ethnicity, payer type, and major ICD-9 diagnosis category. As presented in Table 6, patients who were older than 1 year, were black or Hispanic, were insured by Medicaid, or were self-pay were less likely to be admitted to the hospital.

DISCUSSION

In this study, we describe the epidemiology of a large and diverse research network of hospitals providing emergency care for children during a 1-year period. Data

TABLE 4. Major ICD-9 Tabular Diagnosis Group in Order of Frequency for PCDP (n = 639,330 Patient Visits at 20 Sites) with Comparison to NHAMCS

Rank in PCDP	Group	ICD-9	Count in PCDP	Percent of PCDP*	Percent of NHAMCS†
1	Symptoms, signs, and ill-defined conditions	780–799	185,615	29.0	17.4
2	Injury and poisoning	800–999	168,299	26.3	31.7
3	Diseases of the respiratory system	460–519	165,035	25.8	25.4
4	Infectious and parasitic diseases	001–139	80,207	12.5	9.4
5	Diseases of the nervous system and sense organs	320–389	80,124	12.5	13.8
6	Diseases of the digestive system	520–579	58,911	9.2	5.8
7	V-codes	V01–V82	38,216	6.0	7.9
8	Diseases of the Skin and Subcutaneous Tissue	680–709	30,350	4.7	4.0
9	Endocrine, nutritional, and metabolic diseases and immunity disorders	240–279	24,461	3.8	1.9
10	Diseases of the musculoskeletal system and connective tissue	710–739	23,278	3.6	2.9
11	Mental disorders	290–319	21,455	3.4	1.6
12	Diseases of the genitourinary system	580–629	20,429	3.2	3.5
13	Diseases of the blood and blood-forming organs	280–289	12,641	2.0	0.7
14	Congenital anomalies	740–759	7598	1.2	0.3
15	Certain conditions originating in the perinatal period	760–779	5963	0.9	0.2
16	Diseases of the circulatory system	390–459	4953	0.8	0.4
17	Neoplasms	140–239	3067	0.5	0.1
18	Complications of pregnancy, childbirth, and the puerperium	630–677	1845	0.3	0.6

*Denominator for percent is total number of patient visits reporting at least one ICD-9 code (n = 639,330). Up to 10 diagnoses are reported per visit.
†Denominator for percent is total number of patient visits reporting at least one ICD-9 code in NHAMCS. Up to 3 diagnoses are reported per visit.

were available from 23 of 25 sites and more than 750,000 pediatric ED patient visits. Although prior studies have presented information concerning pediatric ED visits as part of a larger general ED population, they have either concentrated on a subgroup of all children such as adolescents or have not allowed for in-depth evaluation of visits by age.^{20,21} Other reports have included ED visits as part of studies of general health care utilization of children, but not provided information on infants separated from other aged children nor detailed ED diagnosis and disposition analyses.^{22,23} To our knowledge, this is the first study describing a large sample of pediatric emergency patients that provides details pertaining to the type and nature of the visit, processes of care, and descriptive statistics by age.

We were able to identify certain broad patterns of ED utilization. For example, our data suggest that the EDs of our network are used heavily by very young patients and by members of minority populations. In our study, infants younger than 1 year old accounted for the largest number of ED visits for children of any single year of age. High utilization of the ED has been established in a prior study of a limited population of infants but has not previously been demonstrated in a large diverse population.²⁴ In addition, although the absolute number of deaths in the ED from our study is relatively small, the children affected were disproportionately young infants. Admission to the hospital was also more likely for children younger than 1 year. Future study of the circumstances surrounding these visits may impact both prehospital and ED resources.

In general, we found that large numbers of patients sought care for infectious diseases or asthma. In addition, adolescence is a time of significant behavioral and social stress with resultant health concerns reflecting these issues, and our study corroborates a prior study's finding that adolescents commonly seek care for injury or somatic and psychiatric diagnoses.²⁰ Interestingly, when the patients from sites that provided *CPT* or *ICD-9* procedure codes were analyzed, a significant majority did not have any ED procedures documented. Although, on average, patients spent a significant amount of time in the ED for each visit, most patients in our population were discharged to home at the completion of the visit. Despite these general features of ED utilization, a more thorough understanding of diagnoses treated in the ED is limited by the lack of a clinically sensible diagnosis grouping system designed to apply to pediatric ED visits.

Historical barriers to ED surveillance have included the inability to collect data prospectively for various reasons. Some of these include the chaotic work environment of the ED, incomplete or absent electronic ED data, and the lack of a coordinated system for collecting and analyzing such data. Several EMSC stakeholders have called for prospective collection of standardized data to help overcome these historical limitations.^{6–10} Prospective data collection may be more feasible in the future as electronic medical records become more common. In the meantime, the availability of electronic data is improving as hospitals strive to bill accurately for evaluations and procedures performed in EDs.

TABLE 5. Diagnosis Grouping for the 5 Most Common Diagnoses by Age Group (n = 639,330 Patient Visits at 20 Sites)

Age	Diagnosis Group	ICD-9	Count	Percent*
<1 yr (n = 108,446)	Symptoms, signs, and ill-defined conditions	780–799	39,991	36.9
	Diseases of the respiratory system	460–519	38,307	35.3
	Infectious and parasitic diseases	001–139	19,177	17.7
	Diseases of the nervous system and sense organs	320–389	17,624	16.3
	Diseases of the digestive system	520–579	14,955	13.8
1–4 yrs (n = 215,458)	Symptoms, signs, and ill-defined conditions	780–799	66,418	30.8
	Diseases of the respiratory system	460–519	66,092	30.7
	Injury and poisoning	800–999	49,342	22.9
	Diseases of the nervous system and sense organs	320–389	37,721	17.5
	Infectious and parasitic diseases	001–139	32,049	14.9
5–9 yrs (n = 126,924)	Injury and poisoning	800–999	40,179	31.7
	Symptoms, signs, and ill-defined conditions	780–799	33,596	26.5
	Diseases of the respiratory system	460–519	30,050	23.7
	Infectious and parasitic diseases	001–139	15,714	12.4
	Diseases of the nervous system and sense organs	320–389	12,466	9.8
10–14 yrs (n = 110,618)	Injury and poisoning	800–999	43,100	39.0
	Symptoms, signs, and ill-defined conditions	780–799	26,097	23.6
	Diseases of the respiratory system	460–519	20,019	18.1
	Infectious and parasitic diseases	001–139	8455	7.6
	Diseases of the musculoskeletal system and connective tissue	710–739	7,969	7.2
15–18 yrs (n = 77,884)	Injury and poisoning	800–999	27,661	35.5
	Symptoms, signs, and ill-defined conditions	780–799	19,513	25.1
	Diseases of the respiratory system	460–519	10,567	13.6
	Mental disorders	290–319	8902	11.4
	Diseases of the genitourinary system	580–629	6675	8.6

*Denominator for percent is total number of patient visits reporting at least one ICD-9 code (n = 639,330). Up to 10 diagnoses are reported per visit.

Finally, robust multicenter efforts such as the PECARN can provide the infrastructure needed to handle large quantities of data from disparate sources.

Emergency departments are important components of the health care delivery system for children across the spectrum of age, race, insurance status, and diagnosis—an observation that is illustrated by the results of this study. For this reason, it becomes critical to develop an accurate understanding of the true epidemiological and ecological features of the population of pediatric ED users. Surprisingly, little data have been published regarding the frequencies of diseases and injuries seen among children in EDs. Injury data, for example, are often provided by trauma registries, which overrepresent severe injury, as typically only hospitalized patients are accounted for in these registries. Similarly, many state databases are based on encounters that result in hospitalization. Data from EDs are more representative of the entire spectrum of injury and illness evaluated by health care professionals than are inpatient data. For example, one study demonstrated that there were important differences in etiology when comparing injury data obtained from ED surveillance to data obtained from trauma registries.⁵

There are several potential limitations to this study. First, not all data were available on all patients.²⁵ Therefore, we examined data for face validity and included only

variables at each site for which more than 80% of data were available. Second, data were obtained from extant electronic data sets such as billing and tracking systems. These systems were designed and are used for administrative purposes, and most sites needed to obtain data from several sources to acquire data for all the fields requested. One problem in this regard is that, with the exception of discharge diagnosis, no data are available on clinical severity, which limits the ability to draw conclusions about the association between demographic data and outcomes. In addition, there are known limitations in accuracy with the use of diagnoses in administrative databases.²⁶ However, much of health service research is based on information within preexisting databases and has led to important early exploration of many important health care issues. Third, there may be systematic variations in care and resource utilization across sites. For example, there may be institutional variation on determination of triage or discharge times. However, we attempted to control for this in the multivariate analysis by using generalized estimating equations that account for the correlation between patients within hospitals. In addition, although PECARN is a broad, diverse network, its population may not be representative of all children presenting for care to EDs nationally. Many of the PECARN sites are tertiary referral centers for pediatric emergency care, which may limit the

TABLE 6. Multivariate Analysis of Factors Associated with Hospital Admission (Including Transfer to Another Facility and Admission to 23-hour Observation Unit) (n = 511,679; 14 Sites)*

Variable	Adjusted OR	95% CI
Age group		
<1 yr (reference)	—	—
1–4 yrs	0.56	0.54–0.58
5–9 yrs	0.60	0.58–0.62
10–14 yrs	0.72	0.69–0.74
15–18 yrs	0.68	0.65–0.71
Race		
White, non-Hispanic (reference)	—	—
Black, non-Hispanic	0.63	0.62–0.65
Hispanic	0.58	0.56–0.60
Asian/Pacific Islander, non-Hispanic	0.99	0.90–1.07
American Indian/Alaskan Native, non-Hispanic	0.84	0.68–1.03
Other, non-Hispanic	0.80	0.77–0.84
Payer type		
Commercial (reference)	—	—
Medicaid	0.92	0.90–0.94
Self-pay	0.52	0.49–0.54
Other governmental insurance	1.18	1.03–1.36
Other	1.14	1.02–1.28
ICD-9 diagnosis grouping [†]		
Infectious and parasitic diseases	1.23	1.19–1.26
Neoplasms	8.45	7.56–9.44
Endocrine, nutritional, and metabolic diseases and immunity disorders	6.88	6.64–7.12
Diseases of the blood and blood-forming organs	9.98	9.47–10.52
Mental disorders	7.33	7.03–7.64
Diseases of the nervous system and sense organs	1.10	1.07–1.13
Diseases of the circulatory system	6.37	5.85–6.93
Diseases of the respiratory system	2.08	2.03–2.13
Diseases of the digestive system	1.81	1.75–1.87
Diseases of the genitourinary system	2.48	2.37–2.60
Complications of pregnancy, childbirth, and the puerperium	1.67	1.35–2.06
Diseases of the skin and subcutaneous tissue	1.69	1.62–1.76
Diseases of the musculoskeletal system and connective tissue	1.00	0.94–1.06
Congenital anomalies	6.02	5.64–6.42
Certain conditions originating in the perinatal period	9.46	8.88–10.09
Symptoms, signs, and ill-defined conditions	0.97	0.95–1.00
Injury and poisoning	1.20	1.17–1.24
V-code	1.71	1.64–1.78

*Generalized estimating equations were used to account for the correlation between patients treated at the same hospital and the correlation between multiple visits by the same patient.

[†]Each ICD-9 diagnosis category serves as its own reference category.

generalizability of some of these results. Our basic demographic comparisons to a nationally representative database, the NHAMCS, illustrates both the similarities and differences between ED visits within the PECARN network and nationwide. This information will be necessary to inform results from future studies that will certainly be conducted by this network.

Improving our understanding of pediatric illness and injury etiology and severity will serve several purposes. First, these data will provide a baseline against which change may be measured. Second, these data can inform the decision as to which interventions that may impact pediatric illnesses and injuries are most critically needed, and they may provide the antecedents of new, relevant, and specific measures of

outcomes. Third, such an aggregate of ED data will be of use in devising child advocacy programs and prevention strategies. Finally, reliable and broad-based data such as these can form the foundation for further, more detailed epidemiological and sociologic explorations. These may then help to uncover nonmechanistic causes of child morbidity and mortality, if appropriate measures of social and cultural antecedents of illness and injury can be developed. Careful study of these data, and similar data collected prospectively, will likely help to reveal both the extent, and associations, of disparities in access to health care and health outcomes between well-served and underserved populations.

In summary, data on more than 750,000 pediatric visits from a large multicenter pediatric emergency research network revealed a diverse group of patients. The PCDP describes a large sample of pediatric emergency visits, giving details of the type and nature of the visit, processes of care, and descriptive statistics of patients using the ED. Most of these patients sought care for infectious causes or asthma and were discharged from the ED after evaluation. In school-age children, injuries accounted for the most common category of diagnoses and E-codes to describe these injuries were documented frequently. Common diagnoses for adolescents (abdominal pain, headache, and chest pain) differ from the top diagnoses of other patients seeking care. Hospital admission was associated with age, payer type, race/ethnicity, and diagnosis category. We identified broad patterns of health care utilization including that the EDs within the network are used heavily by very young patients and by members of minority populations. This study provides previously unavailable epidemiological information about childhood illnesses and injuries that can inform development of future studies on the effectiveness, outcomes, and quality of EMSC.

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APPENDIX

Table A1. Description of Participating Hospital Sites

Hospital Site	2002 Pediatric ED Volume	Freestanding Children's Hospital	Emergency Department	Pediatric Level I Trauma Center	General Level I Trauma Center	Academic Hospital	Departmental Affiliation
Atlantic Health System/Morristown Memorial Hospital	15,848	No	Pediatric ED within general	No	No	Yes	Emergency medicine
Bellevue Hospital Center	18,026	No	Separate pediatric ED	Yes	Yes	Yes	Pediatrics
Calvert Memorial Hospital	14,020	No	General ED	No	No	No	Emergency medicine
Children's Hospital of Buffalo*	45,000	Yes	Separate pediatric ED	Yes	NA	Yes	Pediatrics
Children's Hospital of Michigan	68,339	Yes	Separate pediatric ED	Yes	NA	Yes	Pediatrics
Children's Hospital of New York–Presbyterian	43,471	Yes	Separate pediatric ED	Yes	NA	Yes	Pediatrics
Children's Hospital of Philadelphia	65,829	Yes	Separate pediatric ED	Yes	NA	Yes	Pediatrics
Children's National Medical Center	61,826	Yes	Separate pediatric ED	Yes	NA	Yes	Pediatrics
Cincinnati Children's Hospital Medical Center	82,414	Yes	Separate pediatric ED	Yes	NA	Yes	Pediatrics
DeVos Children's Hospital	29,863	No	Separate pediatric ED	No	Yes	Yes	Emergency medicine
Franklin Square Hospital	20,016	No	General ED	No	No	No	Emergency medicine
Harlem Hospital Center*	24,000	No	Pediatric ED within general	Yes	Yes	Yes	Pediatrics
Holy Cross Hospital	16,447	No	Pediatric ED within general	No	No	No	Emergency medicine
Howard County Medical Center	17,578	No	Pediatric ED within general	No	No	No	Pediatrics
Hurley Medical Center	27,742	No	Pediatric ED within general	No	Yes	Yes	Emergency medicine
Johns Hopkins Medical Center	23,551	No	Pediatric ED within general	Yes	No	Yes	Pediatrics
Marquette General Hospital	4256	No	General ED	No	No	No	Emergency medicine
Medical College of Wisconsin/Children's Hospital of Wisconsin	44,752	Yes	Separate pediatric ED	Yes	NA	Yes	Pediatrics
St. Barnabas Health Care System	25,941	No	Separate pediatric ED	No	No	Yes	Emergency medicine
University Hospital/SUNY–Upstate Medical University	18,211	No	Pediatric ED within general	Yes	Yes	Yes	Emergency medicine
University of California Davis Medical Center	12,251	No	Pediatric ED within general	Yes	Yes	Yes	Emergency medicine
University of Michigan	21,700	No	Pediatric ED within general	Yes	Yes	Yes	Emergency medicine
University of Rochester	25,532	No	Pediatric ED within general	Yes	No	Yes	Emergency medicine
University of Utah/Primary Children's Medical Center	37,544	Yes	Separate pediatric ED	Yes	NA	Yes	Pediatrics
Washington University/St. Louis Children's Hospital	58,847	Yes	Separate pediatric ED	Yes	NA	Yes	Pediatrics

*Because 2002 data were unavailable for Children's Hospital of Buffalo and Harlem Hospital Center, annual pediatric ED volume is an estimate reported from the hospital.

NA indicates not applicable.

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