Complexity and Severity of Pediatric Patients Treated at United States Emergency Departments

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Objective To compare the complexity and severity of presentation of children in general vs pediatric emergency departments (EDs).

Study design We performed a cross-sectional study of pediatric ED visits using the National Emergency Department Sample from 2008 to 2012. We classified EDs as "pediatric" if >75% of patients were <18 years old; all other EDs were classified as "general." The presence of an *International Classification of Diseases, Ninth Revision* code for a complex chronic condition was used as an indicator of patient complexity. Patient severity was evaluated with the severity classification system. In addition, rates of critical procedures and hospitalization were assessed.

Results We identified 9.6 million encounters to pediatric EDs and 169 million to general EDs. Younger children account for a greater proportion of visits at pediatric EDs than general EDs; children <1 year of age account for 18% of visits to a pediatric ED compared with 9% of visits to a general ED ($P < .01$). Encounters at pediatric EDs had greater complexity (5% vs 2%; $P < .01$). Although severity classification system scores did not significantly differ by ED type, pediatric EDs had greater rates of hospitalization (10% vs 4%).

Conclusions Pediatric EDs provided care to a greater proportion of medically complex children than general EDs and had greater rates of hospitalization. This information may inform educational efforts in residency or postgraduate training to ensure high-quality care for children with complex health care needs. *(J Pediatr 2017;186:145-9).*

Most children seeking emergency care in the US are treated in general emergency departments (EDs) as opposed to pediatric EDs.[1] A number of studies have indicated that patterns of testing and treatment differ for children in these 2 settings.[2-6] It is unclear, however, whether this is the result of differences in clinical practice between general and pediatric EDs or whether the types of patients seen in these settings differ. No study to date has directly compared the case-mix of pediatric and general EDs with respect to patient complexity and disease severity. This type of information is critical in the development of guidelines for pediatric preparedness in these different care environments.[7,8]

It also is possible that differences in case-mix between pediatric and general EDs contribute to differences in resource use observed in other studies. A better understanding of differences in patient population may inform future studies seeking to improve care, cost, and outcomes in varying types of ED settings and allow for targeted training and educational interventions. The aim of this study is to characterize and compare patient characteristics of children seeking care in pediatric and general EDs across the US in terms of disease characteristics and diagnoses, complexity, and disease severity.

Methods

We performed a cross-sectional analysis of all ED visits for patients <21 years of age who were seem between January 1, 2008, and December 31, 2012, using the Nationwide Emergency Department Sample (NEDS). The institutional review board of the study institution deemed the protocol exempt.

NEDS is a publicly available database and is part of the Healthcare Cost and Utilization Project supported by the Agency for Healthcare Research and Quality. As the largest ED database in the US, NEDS includes more than 28 million ED visits annually from 20% of US hospitals (approximately 980 hospitals per year) regardless of payer status. The deliberate sampling strategy stratified by geographic region, teaching status, trauma center, urban or rural location, and hospital ownership allows for

CCC	Complex chronic condition
CPT	Current Procedural Terminology
ED	Emergency department
ICD-9	*International Classification of Diseases, Ninth Revision*
NEDS	National Emergency Department Sample
SCS	Severity classification system

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accurate national population-based estimates. NEDS is an "event-level" database, so each visit is treated individually and does not account for the same patient visiting an ED more than one time.

Demographic characteristics of each visit included age (categorized according to Healthcare Cost and Utilization Project as <1 year, 1-4 years, 5-9 years, 10-14 years, 15-17 years),[9] sex, insurance payer (Medicare, Medicaid, private insurance, self-pay, or other), median income quartile of the patient's home zip code, and the urban-rural classification of the patient's residence (large central metropolitan area, large fringe metropolitan area, medium and small metropolitan areas, metropolitan area, and micropolitan and rural areas). Hospitals were further categorized by their region (Northeast, Midwest, South, and West) by the use of US census tracts.[10] We classified an ED as pediatric when >75% of visits to an ED were for patients <19 years of age. All other EDs were classified as general EDs.[1,11]

To determine the most common conditions within each hospital type, we used the subgroup classification of the Diagnostic Grouping System,[12] a diagnostic classification system designed for and validated for the categorization of ED visits for children. Each patient was classified into a diagnostic subgroup based on their principal diagnosis. We determined the 10 most common diagnostic subgroup categories for each hospital type.

We measured patient complexity using the complex chronic conditions (CCCs) grouping system.[13] CCCs represent defined diagnosis groupings expected to last >12 months that involve either a single organ system severely enough to require specialty pediatric care and hospitalization or involve multiple organ systems.[13,14] We classified an individual encounter as that of a patient with a complex condition if any *International Classification of Diseases, Ninth Revision* (ICD-9) discharge diagnostic code associated with the ED visit contained a CCC. If the visit was categorized as complex, then we ascertained the number of CCCs (1, 2, or ≥3). We also included the presence of any of the following technology-assisted interventions in our complexity assessment: presence of a tracheostomy (ICD-9 procedure codes of 31.1 or 31.2; or Current Procedural Terminology [CPT] codes of 31502 or 31600), gastrostomy tube (ICD-9 procedure codes of V44.1, V44.2, V44.3, or V44.4 or CPT codes of 43760, 73430, 44500, 43324, 43830, 44125, or 43280), or a ventricular shunt (ICD-9 procedure codes of 02.34, 02.31, 02.32, 02.33, 02.35, 02.39 or CPT code of 62258).[15] In addition, each patient visit was assessed on the presence or absence of an ICD-9 code of malignancy (140.0-239.9, inclusive).

We assessed disease severity in 2 ways. First, we used the severity classification system (SCS), a consensus-derived, diagnosis-based system that uses the most severe ICD-9 codes attached to each record to assign each ED encounter a disease severity score ranging from 1 (minimal resources used) to 5 (maximum resources used).[16] The SCS score has been validated previously as a measure of patient severity in the ED setting and is correlated with resource use.[17,18] Second, we abstracted other measures of disease severity including patient disposition (hospitalized, transferred to another institution, or deceased) and the type and number of critical procedures performed. Based on other studies in this area, we included the following critical procedures as markers of disease severity during the ED encounter: endotracheal intubation (ICD-9 code of 96.04, 96.05), central venous line placement (38.93), and chest tube placement (34.02, 34.04).[19,20] We then stratified hospitalization rates and performance of both procedures and critical procedures by SCS and compared these rates by hospital type.

Statistical Analyses

All analyses were conducted within the context of the survey design characteristics of NEDS, with the ED encounter used as the unit of analysis. We specified the primary sampling units, patient visit sampling weights, and the stratum identifiers as implemented in STATA's *svyset* command (Version 13.1; StataCorp, College Station, Texas), allowing for the calculation of nationally representative estimates of ED visit frequencies and proportions across hospital types. To compare patients treated in pediatric vs general EDs on demographic, clinical, complexity, and severity characteristics, survey-weighted χ^2 tests were used. A Bonferroni adjustment was applied to the *P* values calculated within each domain of outcomes (ie, complexity, severity) to maintain a per-family Type I error rate (where "family" is defined as a set of outcomes within a domain) of .05.

Results

In the weighted sample, the NEDS database included 178 million pediatric visits over the study period. Of these, 9 million (5% of all pediatric visits) were to a pediatric ED, and 169 million (95%) were to a general ED (**Table I**). The age distribution differed across hospital type, as 56% of children treated in pediatric EDs were <5 years of age, compared with 33% of patients in general EDs ($P < .01$). In addition, patients <1 year of age accounted for a greater proportion of ED visits in pediatric EDs compared with general EDs. Pediatric EDs treated a greater proportion of patients with Medicaid insurance and a greater proportion residing in metropolitan areas.

The most common discharge diagnosis subgroups for children differed between pediatric and general EDs. Medical conditions such as gastroenteritis and asthma were treated more commonly in pediatric EDs, whereas minor trauma such as contusions and sprains were more cared for frequently within general EDs (**Table II**; available at www.jpeds.com).

Five percent of visits to pediatric EDs were by children with one or more CCCs, compared with 2% of visits to general EDs ($P < .01$) (**Table III**). Among patients with a chronic condition, children with 2 or more CCCs were more likely to be treated in a pediatric ED than a general ED. The proportion of patients with technology dependence and malignancy was greater in pediatric EDs compared with general EDs. Although the prevalence of specific CCC categories differed based on ED type, there was considerable overlap between the 2 settings (**Table IV**; available at www.jpeds.com). Eight CCC