

The Effect of Acute and Chronic Asthma Severity on Pediatric Emergency Department Utilization

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ABSTRACT

OBJECTIVE. Our goal was to teach emergency department (ED) physicians how to use standardized criteria for diagnosing and classifying asthma severity and to describe the patterns of pediatric ED utilization of these criteria for classification of both acute and chronic severity.

METHOD. A health care provider education module was developed and implemented in 4 participating EDs in southeast Texas to educate ED physicians and health care providers on the diagnosis and acute and chronic severity classification of pediatric asthma patients. We undertook both retrospective (medical chart extraction) and prospective surveillance over a 2-year period of all children presenting to 1 of 4 EDs with acute asthma. Demographic characteristics, classification of severity, health care resource utilization, and primary physician contact information were collected.

RESULTS. The health care provider educational intervention was provided for 84 different physicians. A subset of 16 physicians was randomly tested preintervention and postintervention. Mean mock-scenario scores at 2 weeks showed an improvement of 55.6%, which was sustained at retesting at 6 months. Over the 2-year period, 6222 individual pediatric ED encounters were entered into the surveillance database. The median age of presentation was 5 years. More than 32% of the patients in the study were uninsured. The majority of the patients in each category had asthma of mild severity: mild intermittent chronic (58.7%) and mild acute (53.9%).

CONCLUSIONS. Physicians who completed a health care provider education module learned to effectively diagnose asthma and recognize standardized acute and chronic severity classifications. The majority of children with asthma who presented to the Texas Emergency Department Asthma Surveillance project's participating EDs were classified as having mild acute severity and mild intermittent chronic disease. Almost one third of these patients did not have health insurance.

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Key Words

pediatric asthma classifications, diagnostic criteria, emergency department, physician training, chronic disease management

Abbreviations

ED—emergency department
PCP—primary care provider
TEDAS—Texas Emergency Department Asthma Surveillance
CI—confidence interval
OR—odds ratio
NAEPP—National Asthma Education and Prevention Program

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ASTHMA IS CURRENTLY the most common chronic disease among children, affecting almost 5 million children in the United States and accounting for almost 200 000 hospitalizations for children in Texas each year.^{1,2} Asthma mortality has been increasing nationally and in Texas, with a disproportionate rise among minority and urban populations. Between 1980 and 1998, the asthma mortality rate nearly doubled in all age groups in Texas, with a 1998 asthma mortality rate higher among black children (3.1 of 100 000) than white (1.9 of 100 000) or Hispanic (0.8 of 100 000) children.³

The impact of asthma on families and health care providers is substantial. The National Cooperative Inner-City Asthma Study phase I found high rates of morbidity and functional limitation among inner-city asthmatic children. Although only 17% had ≥ 1 hospitalizations for asthma in the previous year, 66% had unscheduled urgent care visits.⁴ There were an estimated 4 million asthma exacerbations in 2000, resulting in 728 000 emergency department (ED) visits, 214 000 hospitalizations, and 223 deaths among children aged 0 to 17 years.⁵

Characteristics of children who primarily seek care in the ED are not well-studied. It is known that adults are more likely to seek care in the ED if they have less knowledge about asthma, moderate or severe asthma, lower income, and no predetermined crisis plan.^{6,7} One recent study found that many parents of children with asthma could identify a primary care provider (PCP) but preferred to use the ED for asthma care because they perceived asthma as a disorder that should be treated as an emergency.⁸

There is evidence that children with asthma present to the ED repeatedly⁹; several published surveys suggest that at least 25% of such patients may be chronic users of the ED for primary asthma care, multiple acute episodes, or repeated visits during 1 exacerbation.^{7,8} Overall, 30% of children treated for asthma in EDs require admission to the hospital.¹⁰ A recent multicenter study suggested that children presenting to EDs report "severe" symptoms acutely ($\sim 65\%$ of the cohort).¹¹ Moreover, this same group overall had a great number of features more consistent with severe chronic asthma than with mild asthma and were particularly pronounced in black and Hispanic children. However, the distribution of intermittent versus persistent chronic disease classifications among these children is not described. The need to better delineate the characteristics of children with asthma presenting for ED care is essential to understanding how best to develop strategies for managing chronic asthma and prevent the need for emergency care.

Asthma severity may be considered in the context of both acute and chronic severity. Chronic asthma severity is defined by National Heart, Lung, and Blood Institute guidelines and modified for children by the American

Academy of Allergy, Asthma and Immunology's *Pediatric Asthma: Promoting Best Practice Guide for Management of Asthma in Children*.¹² It includes 4 categories of chronic disease severity, the first being mild intermittent disease, requiring treatment only on an as-needed basis. The remaining 3 categories are mild persistent, moderate persistent, and severe persistent, in ascending order of chronic severity. Each category is linked to a stepwise guide to medical therapy and monitoring. Although stepwise severity classification and treatment guidelines have been in place for >10 years, physician compliance with these guidelines seems to be poor.¹³ When tested regarding characteristics of chronic severity of asthma, $<16\%$ of PCPs could correctly identify the class of chronic severity of asthma.¹⁴ Most physicians were aware of the published guidelines¹⁵ but were unfamiliar with their specific recommendations and how to implement them.¹⁶

The National Heart, Lung, and Blood Institute guidelines also describe asthma in terms of acute severity: mild, moderate, severe, and respiratory arrest imminent. Although it is presumed that a child with any category of chronic severity may present to the ED with any category of acute severity, it is unclear how either the classification of acute or chronic severity relates to the characteristics of children who utilize EDs for their asthma care. Large-scale interventions that are designed to aid in the chronic management of asthma have not as yet integrated this information into strategies for ED-based interventions.

To address some of these issues, the Texas Emergency Department Asthma Surveillance (TEDAS) project was implemented to provide pediatric asthma surveillance of 4 pediatric EDs in southeast Texas. The primary goals of the study were to teach ED physicians how to use standardized criteria for diagnosing and classifying asthma severity and to describe the patterns of pediatric ED utilization by classification of both acute and chronic severity while controlling for demographic and access-to-care factors.

METHODS

Setting

The Texas Department of State Health Services, region 6, comprises 13 counties in southeast Texas, the largest being Harris County with the largest city, Houston (estimated population: 5 213 931). Texas Children's Hospital, Ben Taub General Hospital, Lyndon B. Johnson General Hospital, and University of Texas Medical Branch at Galveston serve the vast majority of pediatric patients in this region and were partners in the TEDAS project. As tertiary pediatric care centers, each of these children's hospitals or children's EDs provides care for patients who are transferred from outlying rural or community hospitals and require more expert pediatric care.

Institutional review board approval for human subject research was obtained from all the institutions that supervise research activities in the 4 participating EDs.

ED Health Care Provider Educational Module

To assure consistency in classification and accuracy of the surveillance data collected, a health care provider asthma-education program was developed on a PowerPoint platform (Microsoft Office 2000, Microsoft Corp, Redmond, WA) and delivered to ED physicians at all 4 participating pediatric EDs. The presentation was repeated every 6 months to reinforce messages and include any new clinicians providing asthma care to children in the participating EDs. The health care provider intervention addressed 4 critical elements: (1) how to make a diagnosis of pediatric asthma based on a standardized definition; (2) how to characterize acute severity; (3) how to classify chronic asthma severity; and (4) how to tailor controller-medication treatment regimens to a given level of chronic severity for patients with persistent asthma.

To test the efficacy of this intervention, a subset of physicians was tested preintervention and postintervention with 8 mock patient scenarios derived from real cases, and the correct severity classifications were agreed on a priori by a panel of 3 expert clinicians (1 pediatric emergency medicine physician, 1 pediatric pulmonologist, and 1 pediatric allergy and immunology physician). Participating ED physicians were tested just before the educational program, 2 weeks postintervention, and again at 6 months postintervention. One point was given for each correct answer, for a maximum score of 8.

Severity Cohort

After undergoing training, physicians were asked to assess each ED patient encountered based on 3 items: (1) a diagnosis of asthma by standardized definition (one prior acute wheezing episode with evidence of reversibility); (2) an assessment of acute severity (mild, moderate, severe, or respiratory arrest); and (3) an assessment of chronic severity (mild intermittent; or mild, moderate, or severe persistent). Patient ED charts at all participating EDs were stamped with the 3 items and multiple-choice responses that enabled rapid physician completion.

All children between 1 and 18 years of age presenting to a participating ED for asthma care were entered into the TEDAS database by ED staff or a TEDAS research assistant. Prospective enrollment involved a detailed survey conducted in the ED by TEDAS interviewers and ED physicians and required informed consent from parents and, when applicable, patient assent. Information collected for the surveillance database included, but was not limited to, basic demographic data, insurance information, and primary health care provider information.

In addition to this prospective enrollment, a retro-

spective enrollment was conducted to capture information on patients missed in the prospective component. The chart-review procedure was defined by the investigators for each participating ED and used a combination of billing codes, medications ordered, and chief complaint as identifiers for patients with asthma to identify charts to be reviewed. Subsequent inclusion in the database required independent review of each chart to determine inclusion by standard criteria for diagnosis of asthma or exclusion. Any patients for whom standard inclusion or exclusion criteria were not met underwent panel review by coinvestigators and interventionists.

Data Analysis

ED Health Care Provider Educational Module

Comparisons of the number of correct responses to the mock case testing for the health care intervention module were made by using paired *t* tests. A *P* value of $<.05$ was considered significant.

Severity Cohort

Demographic characteristics of the enrolled ED subjects were described by using measures of central tendency and dispersion for continuous variables and proportions and a 95% confidence interval (CI) for categorical variables.

Data on chronic and acute asthma severity were separated for additional analysis. Chronic severity was separated into mild intermittent versus persistent. Acute severity was separated into mild, moderate, or severe. Demographic characteristics were compared between mild intermittent versus persistent chronic classifications, as well as mild versus moderate or severe acute severity classifications.

Odds ratios (ORs) and 95% CIs were used to describe the univariate relationship between contact with a PCP and acute and chronic asthma severity. Logistic regression was then used to evaluate the associations between contact with a PCP and acute asthma severity adjusting for the following variables: age, ethnicity, and primary language spoken. Age was categorized in 3 groups: 1 to 4, 5 to 14, and 15 to 18 years. Variables were retained in the model if they changed the OR for the associations by $>10\%$. Because medical insurance could modify the relationship between these variables, the analysis was stratified further by insurance status, which was dichotomized into insured versus uninsured. Because the univariate analysis did not demonstrate a significant association between PCP contact and chronic severity, multivariate analyses for this association are not presented.

The database was maintained in Microsoft Access 2000 format. Analyses were performed by using SPSS for Windows (SPSS Inc, Chicago, IL), Minitab 11.12

(Minitab Inc, State College, PA), and SAS 8.2 for Windows (SAS Institute, Inc, Cary, NC).

RESULTS

ED Health Care Provider Educational Module

The health care provider educational intervention was provided to 84 different physicians in the participating institutions. A subset of 16 physicians was randomly selected for testing with the set of mock case scenarios. Mean score preintervention was 3.4 (SD: 1.02), with a 2-week improvement of 56% to a mean score of 5.3 (SD: 1.24). At 6 months the mean score was 5.0 (SD: 0.73), with an improvement of 47% over the preintervention score. The improvements seen at 2 weeks and 6 months were significantly different from baseline ($P < .01$), and there was no significant decrease in scores from 2 weeks to 6 months postintervention.

Severity Cohort

During the period of January 1, 2002, to December 31, 2003, the TEDAS project identified 6222 pediatric asthma encounters across the 4 participating EDs. Of these, 1553 were identified prospectively and 4669 retrospectively. Patients represented all 13 counties served in the region.

The median age at presentation was 5 years. The distribution of visits by age demonstrates a decreasing frequency of visits with increasing age (Fig 1). The cohort was ethnically/racially diverse; however, the greatest proportion of patients were black (48.7%). Hispanic children accounted for 32.6%, and white children ac-

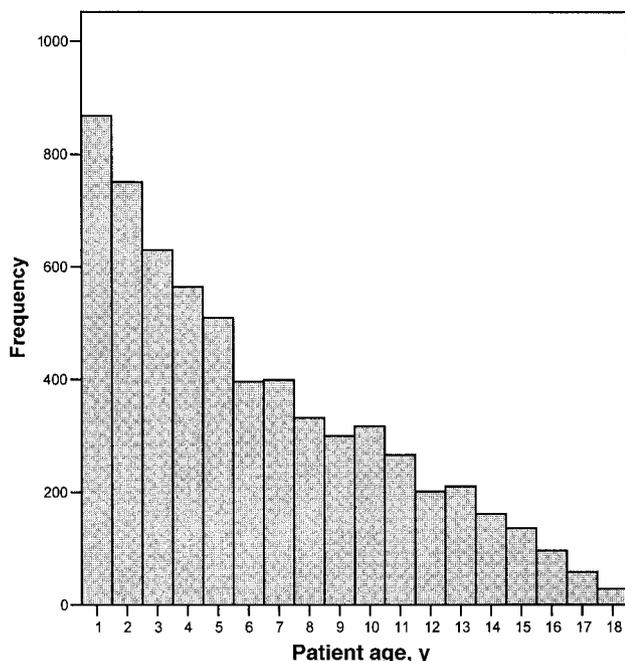


FIGURE 1

Age distribution for all children presenting to the participating EDs.

counted for 14.0%. The majority of children were insured under a variety of different plans. However, almost one third (32.4% [2013]) were reported to have no medical insurance coverage. Of those with medical insurance, 6.8% ($n = 423$) were enrolled in the State Children's Health Insurance Program, 1.7% ($n = 103$) had indemnity insurance, 30.2% ($n = 1882$) were in a managed care plan, and 28.9% ($n = 1796$) were covered by Medicaid.

Data regarding contact with a PCP before arrival at the ED was limited to a subgroup of patient encounters (3394). Of those, 27% ($n = 918$) of the families reported contacting their PCP, whereas 73% ($n = 2476$) did not attempt contact before the ED visit.

Of the 6222 total patients enrolled both retrospectively and prospectively, a subset of 33% ($n = 2084$) had acute and chronic severity classification labeled by the treating physician, as shown in Table 1. There was a greater proportion of encounters with children who were classified as having mild intermittent disease (58.7%) as compared with the combined categories of persistent chronic disease. A small proportion of children were characterized as having severe persistent chronic disease. Although a larger proportion of children <4 years old had mild intermittent disease, the overall distribution of children within each classification of chronic asthma severity did not differ greatly between the 1- to 4-year-old and 5- to 18-year-old cohorts (Fig 2). There was also a greater proportion of encounters in children with mild acute severity (53.9%) versus those with moderate or severe acute severity (Table 1). The overall distribution of children within each classification of acute asthma severity was similar in children ≤ 4 years and those 5 to 18 years old (Fig 3).

Table 2 presents demographic characteristics according to chronic severity classification. Those with mild intermittent chronic asthma were more likely to be Hispanic and younger than those with any chronic persistent asthma classification; those with any chronic persistent asthma classification were more likely to be black. Age, gender, and language were similar across all chronic asthma classifications. An increasing frequency of having insurance and contacting the PCP before going

TABLE 1 Physician-Graded Chronic and Acute Severity at Time of ED Presentation

Asthma Classification	% (95% CI)
Chronic severity	
Mild intermittent	58.7 (56.6–60.8)
Mild persistent	23.3 (21.5–25.1)
Moderate persistent	15.1 (13.6–16.6)
Severe persistent	2.9 (2.2–3.6)
Acute severity	
Mild	53.9 (51.8–56.0)
Moderate	36.1 (34.0–38.2)
Severe	10.0 (8.7–11.3)

FIGURE 2
Distribution of children of varying chronic severity in each age group.

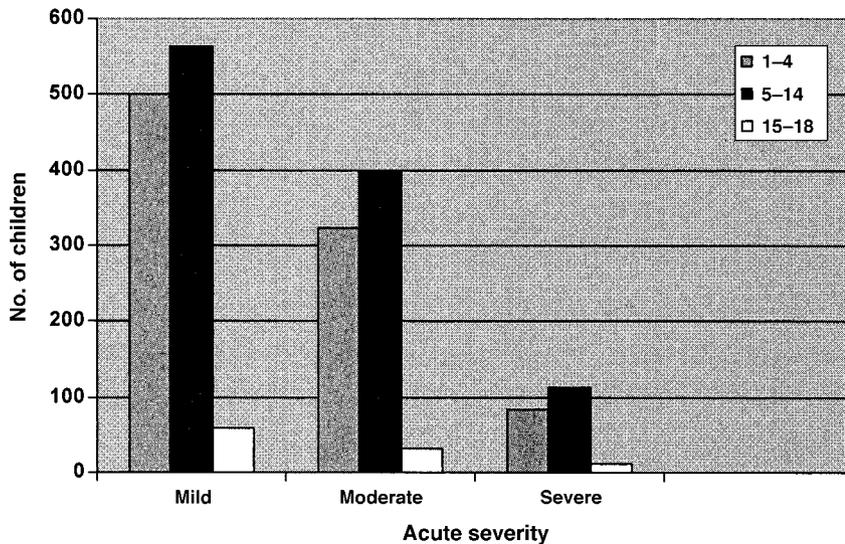
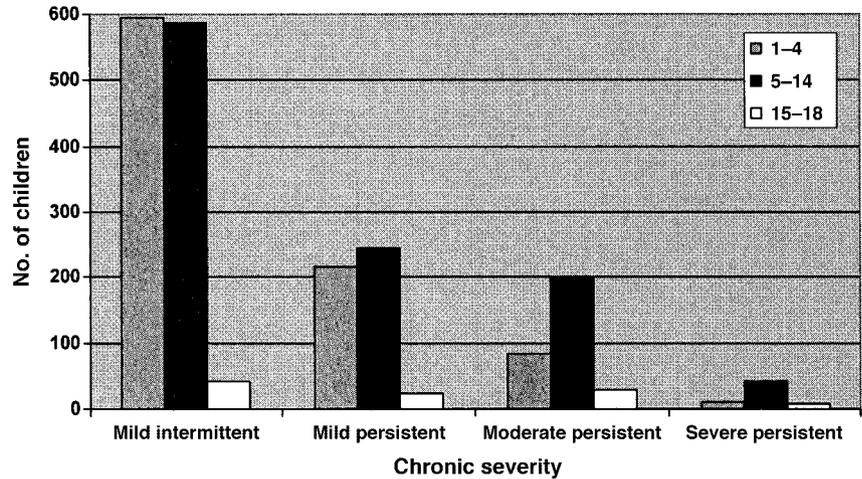


FIGURE 3
Distribution of children of varying acute severity in each age group.

to the ED seems to correlate with an increasing severity of chronic asthma, although the CIs overlap for all frequencies.

Table 3 shows the demographic characteristics according to acute severity classification. Age, ethnicity, gender, and language were similar across all acute asthma classifications. There seemed to be a trend toward an increasing frequency of having insurance with an increasing severity of acute asthma, although the CIs overlap for all frequencies. Those children with moderate or severe acute asthma were more likely to have contacted their PCP than those with mild acute asthma. Without adjusting for other variables, those children with moderate or severe acute asthma were 1.46 times (95% CI: 1.18–1.80) as likely to have contacted their PCP before going to the ED as those with mild acute asthma. Inclusion of age, gender, ethnicity, and language did not change the magnitude of these associations. For those children with medical insurance, those with moderate or severe acute asthma were 1.41 times

(95% CI: 1.11–1.77) as likely to have contacted their PCP before going to the ED as those with mild acute asthma. For those children without medical insurance, those with moderate or severe acute asthma were 1.53 times (95% CI: 0.87–2.69) as likely to have contacted their PCP before going to the ED as those with mild acute asthma. Thus, the association between acute asthma severity and contacting the PCP before going to the ED was significant only for those children with medical insurance.

Information on whether the subjects were diagnosed for the first time in the ED was available only for those children enrolled prospectively. Of 1255 subjects enrolled prospectively, 7.7% ($n = 97$) were diagnosed for the first time on presentation to the ED; 88.4% ($n = 1109$) were diagnosed previously, 2.0% ($n = 25$) did not know when they were diagnosed, and 1.9% ($n = 24$) were missing information on the time of diagnosis. Table 4 shows the distributions of acute severity, chronic se-

TABLE 2 Demographic Characteristics According to Chronic Severity Classification

Characteristic	Mild Intermittent (N = 1223)		Mild Persistent (N = 485)		Moderate Persistent (N = 315)		Severe Persistent (N = 61)		Combined Persistent (N = 861) ^a	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Age, y										
1–4	596	48.7 (45.9–51.5)	216	44.5 (40.1–41.9)	84	26.7 (21.8–31.6)	11	18.0 (8.4–27.6)	311	36.1 (32.9–39.3)
5–14	586	47.9 (45.1–50.7)	246	50.7 (46.3–55.1)	202	64.1 (58.8–69.4)	42	68.9 (57.3–80.5)	490	56.9 (53.6–60.2)
15–18	41	3.4 (2.4–4.4)	23	4.7 (2.8–6.6)	29	9.2 (6.0–12.4)	8	13.1 (4.6–21.6)	60	7.0 (5.3–8.7)
Ethnicity										
Black	592	48.4 (45.6–51.2)	243	50.1 (45.7–54.5)	194	61.6 (56.2–67.0)	35	57.4 (45.0–69.8)	472	54.8 (51.5–58.1)
Hispanic	389	31.8 (29.2–34.4)	135	27.8 (23.8–31.8)	73	23.2 (18.5–27.9)	9	14.8 (5.9–23.7)	217	25.2 (22.2–28.1)
White	178	14.6 (12.6–16.6)	84	17.3 (13.9–20.7)	38	12.1 (8.5–15.7)	16	26.2 (15.2–37.2)	138	16.0 (13.6–18.4)
Other	64	5.2 (3.9–6.4)	23	4.7 (2.8–6.6)	10	3.2 (1.3–5.1)	1	1.6 (0.0–4.7)	34	3.9 (2.6–5.2)
Gender										
Male	771	63.0 (60.3–65.7)	307	63.3 (59.0–67.6)	205	65.1 (59.8–70.4)	36	59.0 (46.6–71.3)	548	63.6 (60.4–66.8)
Female	452	37.0 (34.3–39.7)	178	36.7 (32.4–41.0)	110	34.9 (29.6–40.2)	25	41.0 (28.7–53.3)	313	36.4 (33.2–39.6)
Language										
English	1020	87.3 (85.4–89.2)	412	89.6 (86.8–92.4)	271	88.9 (85.4–92.4)	57	95.0 (89.5–100.0)	740	89.7 (87.6–91.8)
Spanish	138	11.8 (10.0–13.6)	46	10.0 (7.3–12.7)	30	9.8 (6.5–13.1)	3	5.0 (0.0–10.5)	79	9.6 (7.6–11.6)
Other	11	0.9 (0.4–1.4)	2	0.4 (0.0–0.9)	4	1.3 (0.0–2.6)	0	0.0	6	0.7 (0.1–1.3)
Insurance status										
Insured	906	74.3 (71.8–76.8)	368	76.0 (72.2–79.8)	242	76.8 (72.1–81.5)	54	88.5 (80.5–96.5)	664	77.2 (74.4–80.0)
Uninsured	314	25.7 (23.2–28.2)	116	24.0 (20.2–27.8)	73	23.2 (18.5–27.9)	7	11.5 (3.5–19.5)	196	22.8 (20.0–25.6)
PCP contact ^b										
No	605	67.6 (64.5–70.7)	238	63.6 (58.7–68.5)	153	62.4 (56.3–68.5)	29	60.4 (46.6–74.2)	420	63.0 (59.3–66.7)
Yes	290	32.4 (29.3–35.5)	136	36.4 (31.5–41.3)	136	37.6 (31.5–43.7)	19	39.6 (25.8–53.4)	247	37.0 (33.3–40.7)

^a Combined persistent indicates mild, moderate, and severe persistent.

^b Contacted PCP before going to the ED.

TABLE 3 Demographic Characteristics According to Acute Severity Classification

Characteristic	Mild (N = 1123)		Moderate (N = 752)		Severe/Arrest (N = 209) ^a		Combined Moderate/Severe/Arrest (N = 961)	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Age, y								
1–4	500	44.5 (41.6–47.4)	323	43.0 (39.5–46.5)	84	40.2 (33.6–46.8)	407	42.4 (39.3–45.5)
5–14	564	50.2 (47.3–53.1)	398	52.9 (49.3–56.5)	114	54.5 (47.7–61.3)	512	53.3 (50.1–56.5)
15–18	59	5.3 (4.0–6.6)	31	4.1 (2.7–5.5)	11	5.3 (2.3–8.3)	42	4.4 (3.1–5.7)
Ethnicity								
Black	565	50.3 (47.4–53.2)	380	50.5 (46.9–54.1)	119	56.9 (50.2–63.6)	499	51.9 (48.7–55.1)
Hispanic	344	30.6 (27.9–33.3)	215	28.6 (25.4–31.8)	47	22.5 (16.8–28.2)	262	27.3 (24.5–30.1)
White	160	14.2 (12.2–16.2)	122	16.2 (13.6–18.8)	34	16.3 (11.3–21.3)	156	16.2 (13.9–18.5)
Other	54	4.8 (3.5–6.1)	35	4.7 (3.2–6.2)	9	4.3 (1.5–7.1)	44	4.6 (3.3–5.9)
Gender								
Male	705	62.8 (60.0–65.6)	475	63.2 (59.8–66.6)	139	66.5 (60.1–72.9)	614	63.9 (60.9–66.9)
Female	418	37.2 (34.4–40.0)	277	36.8 (33.4–40.2)	70	33.5 (27.1–39.9)	347	36.1 (33.1–39.1)
Language								
English	945	88.6 (86.7–90.5)	636	87.5 (85.1–89.9)	179	89.5 (85.3–93.7)	815	87.9 (85.8–90.0)
Spanish	112	10.5 (8.7–12.3)	85	11.7 (9.4–14.0)	20	10.0 (5.8–14.2)	105	11.3 (9.3–13.3)
Other	10	0.9 (0.3–1.5)	6	0.8 (0.2–1.4)	1	0.5 (0.0–1.5)	7	0.8 (0.2–1.4)
Insurance status								
Insured	828	73.9 (71.3–76.5)	578	77.0 (74.0–80.0)	164	78.5 (72.9–84.1)	742	77.3 (74.7–79.9)
Uninsured	292	26.1 (23.5–28.7)	173	23.0 (20.0–26.0)	45	21.5 (15.9–27.1)	218	22.7 (20.1–25.3)
PCP contact ^b								
No	564	69.7 (66.5–72.9)	357	61.4 (57.4–65.4)	104	60.5 (53.2–67.8)	461	61.2 (57.7–64.7)
Yes	245	30.3 (27.1–33.5)	224	38.6 (24.6–42.6)	68	39.5 (32.2–46.8)	292	38.8 (35.3–42.3)

^a Combined severe (*n* = 206) and arrest (*n* = 3) because of low arrest number.

^b Contacted PCP before going to the ED.

verity, and age according to the timing of asthma diagnosis.

Those children diagnosed in the ED were just as likely

to have had moderate to severe acute asthma as those who were not diagnosed in the ED (OR: 1.02; 95% CI: 0.68–1.55). Those children diagnosed in the ED were

61% less likely to have persistent chronic asthma than those who were not diagnosed in the ED (OR: 0.39; 95% CI: 0.25–0.63). The associations between location of diagnosis and acute or chronic asthma severity were not influenced by age.

DISCUSSION

Although much is known about the pathophysiology and emergent treatment modalities of asthma, few studies describe the populations of children who utilize pediatric EDs for their asthma care. This study describes characteristics of a population of children who presented to pediatric EDs in southeast Texas for acute asthma care. Because health care systems must determine allocation of resources in ED settings, it is essential to understand the characteristics of disease severity to begin to intervene in chronic disease–management strategies. We found a high proportion of children with asthma who used pediatric EDs to be of mild intermittent chronic severity and mild acute severity. We also found a high proportion of uninsured families as well as a low rate of PCP contact before the child’s presentation to the ED.

This study describes a cohort of 6222 pediatric asthma encounters. The literature suggests that 25% of pediatric ED visits may be from chronic users of the ED.⁹ However, for the purpose of this study, the number of patients that had repeat visits was less important than independent encounters. The paradigm for treatment by ED physicians currently presumes no continuity of care within that setting; thus, each encounter is approached and treated independently. Therefore, the effect of return visits was outside the scope of this study.

Using National Asthma Education and Prevention Program (NAEPP)–defined criteria for classifying chronic asthma severity, >58% of children presenting to EDs in this cohort were classified as having mild intermittent asthma. It was anticipated that children with persistent asthma would be more likely than those with intermittent asthma to have an exacerbation serious enough to prompt them to seek ED care. However, it is

possible that those with intermittent disease had less experience dealing with acute symptoms and thus sought ED care regardless of the severity of their disease. ED care for patients whose acute episodes are mild or moderate may run counter to the public’s perception that ED care is delivered almost exclusively to patients whose asthma exacerbations are quite severe. Our findings are also contrary to previous findings that described a larger percentage of ED patients with more severe chronic asthma.¹¹ The differences in these findings may be related to the more comprehensive sampling provided by this project. There could have been some classification bias, with a tendency to underestimate severity for children with whom the ED clinicians had no previous experience and relied on parent/guardian history. However, results of the impact assessment of the educational intervention module suggested that the clinicians could make an objective assessment. Because the majority of patients had intermittent symptoms yet perceived a need for ED management, either the term “mild” may not be appropriate and/or more proactive effort may be needed to help families to identify acute exacerbations early and initiate home management. Many of these patients may have been able to be managed by a PCP if access to care was possible and if such care increased asthma self-management knowledge and access to physician consultation.

Similarly, acute disease severity had a higher likelihood of being mild in this cohort. Patients with any level of chronic severity can have a severe acute exacerbation. Given that there are national guidelines for home management that should address most mild exacerbations, one would predict that most ED visits would be for moderate to severe exacerbations. However, almost 54% of this ED asthma cohort was characterized as presenting with a mild acute exacerbation. This finding underscores the fact that the acuity of disease did not explain utilization of the ED for their asthma management. It is possible that children with mild exacerbations did not have a rescue bronchodilator available at home;

TABLE 4 Location and Severity Characterization of First Asthma Diagnosis

	Non-ED (n = 1109), n (%)	ED (n = 97), n (%)	Unknown (n = 25), n (%)	Missing (n = 24), n (%)
Acute severity				
Mild	532 (89.0)	46 (7.7)	9 (1.5)	11 (1.8)
Moderate	438 (87.8)	36 (7.2)	15 (3.0)	10 (2.0)
Severe/arrest	139 (88.0)	15 (9.5)	1 (0.6)	3 (1.9)
Chronic severity				
Mild intermittent	589 (84.1)	72 (10.3)	23 (3.3)	16 (2.3)
Mild persistent	286 (94.1)	12 (3.9)	2 (0.7)	4 (1.3)
Moderate persistent	193 (92.8)	11 (5.3)	0 (0.0)	4 (1.9)
Severe persistent	41 (95.3)	2 (4.7)	0 (0.0)	0 (0.0)
Age, y				
1–4	471 (85.6)	54 (9.8)	11 (2.0)	14 (2.5)
5–14	586 (90.0)	41 (6.3)	14 (2.2)	10 (1.5)
15–18	52 (96.3)	2 (3.7)	0 (0.0)	0 (0.0)

however, this factor was not examined in our study. Access to a PCP for acute care may have been a factor as well, because the subjects frequently reported not contacting their PCP before going to the ED; however, this study did not explore the reason for the lack of contact or whether all subjects had a provider whom they could contact.

The age distribution for this asthma cohort showed a decreasing frequency of visits with increasing age, which is consistent with other studies that profiled pediatric utilization of an ED for asthma that have described younger children being taken to the ED substantially more often than older children.⁹ Although recurrent visits may have accounted for some portion of repeat presentations in younger children in the current study, an assessment of repeat visits was outside the scope of this study. Possible reasons for the predominance of young children may have included a higher prevalence of asthma overall in this age group or a greater prevalence of virus-associated exacerbations with symptoms (such as fever or ear pain) that might have led parents to seek medical attention. Also, infants and toddlers have smaller airways and thus require proportionately less narrowing of their airways to become symptomatic. One might also postulate that younger children may have presented with more severe disease. However, our study found younger children to be more likely to have had mild acute asthma. Parents of very young children may have had less experience and felt less comfortable instituting rescue therapy. Young children also may have been less cooperative with home therapy.

A larger proportion of young children with asthma may have also represented a lack of prior diagnosis of asthma, and thus the parents may not have been familiar or comfortable with the illness. In this study, only 7.7% of the children were diagnosed with asthma for the first time in the ED; thus, this explanation would only account for a small number of the young children seen. This finding may reflect inadequate parental knowledge for managing asthma resulting from a lack of prior education provided by the physician, who may have been reluctant to label a patient with asthma, or an underrepresentation of symptoms reported to the PCP.¹⁷

ED clinicians were given instruction on how to make a diagnosis of asthma using standardized criteria, and this diagnosis was the one used to define inclusion in the asthma cohort. This standardization was critical to uniformly describe the population of children with asthma through a multihospital surveillance system. Regardless of the reasons for a greater proportion of young children in our cohort, the distribution of patients into each category of chronic severity or acute severity was nearly equal between the 2 younger age strata (1–4 and 5–14 years). In contrast, there was a greater proportion of children with more severe asthma in the 15- to 18-year-old age group; however, this group represented a small

proportion of the total cohort, which suggests that interventions designed to be age-appropriate may recognize only small differences in severity distributions among children 1 to 14 years of age.

The ethnic/racial constitution of the current study cohort was very different from the general ethnic/racial constitution of all children presenting to each of the participating EDs but was consistent with other asthma studies. Whereas black patients constituted 26% to 33% of the populations served by the 4 EDs when considering an aggregate of all diseases, in this study they constituted 49% of the cohort. The disparities in prevalence of asthma among minority children in comparison to white children have varied widely in the literature.^{18–20} Other studies have found that when controlling for race, income, and/or residence in an urban setting, those disparities may diminish.^{21–23} Nonetheless, the literature would suggest that morbidity is indeed higher among minority children.²¹ In our study, children who were Hispanic and families that were Spanish-speaking were more likely to have had mild intermittent chronic disease, but those associations were not seen with the acute severity of asthma. This lack of relationship between race/ethnicity and acute severity is consistent with previous data.¹¹

More than 32% of the children presenting with asthma in this cohort were uninsured. Of those with insurance coverage, most were enrolled in a public insurance program (either the State Children's Health Insurance Program or Medicaid). Although our data suggested a trend for increasing insurance coverage with increasing levels of acute and chronic asthma severity, the differences failed to reach statistical significance, possibly because of the small number of subjects in the more severe categories. It is interesting to note that previous studies have also suggested that lower severity of asthma seen in the ED was associated with more frequent recurrent visits.⁹ Given the current state of crisis in the United States with ED overcrowding,^{24,25} the need for appropriate health care resource utilization is clear. The prevalence of mild acute exacerbations in our current study far exceeded that of moderate or severe exacerbations, and one would have expected that many of these mild exacerbations could have been cared for by the PCP or with home management.

While investigating access-to-care barriers, we discovered that >63% of patients failed to contact their PCP before arrival in the ED. The specific reasons for that failure were difficult to ascertain and not explored fully in this study. One might postulate that there were multiple factors influencing a parent's decision to take the child to the ED. Lieu et al²⁶ found that not having a written asthma action plan was a predictor of hospitalization. In addition, the advice from the PCP may not have been fully consistent with NAEPP guidelines. Moreover, <16% of PCPs could correctly categorize

chronic asthma severity when tested.¹⁴ Most physicians were aware of the NAEPP guidelines¹⁵ but were unfamiliar with their specific recommendations or how to implement them.¹⁶ This lack of familiarity with the guidelines impacts ED populations, as demonstrated in a study that described a cohort of children with asthma presenting for ED care in which approximately two thirds met the criteria for persistent disease, yet only 38% took daily antiinflammatory medication.²⁷ Although it is not certain whether the primary source of these failures is the PCP or the family, it does suggest a failure to achieve the appropriate disease management.

In our study, families of children with moderate or severe acute asthma were more likely to have contacted their PCP before the ED visit than those with mild acute asthma. Not surprisingly, the relationship between acute severity and PCP contact seems to have been modified by insurance status. That is, only those children with insurance were more likely to have called their PCP, possibly because they were more likely to have had a PCP whom they could contact. Our data also suggested that those with persistent chronic asthma were more likely to contact their PCP before going to the ED than those with mild intermittent asthma; however, this association did not reach statistical significance. Nonetheless, a rate of contact of ~27% suggests that the safety net for patients with mild asthma symptoms seemed to default to the ED rather than to the PCP. Any solution to improving public knowledge and education about asthma should consider this association. Although the investigation of why families would choose not to contact their PCP first was outside the scope of this study, ease of access (beyond insurance) may have been an additional determinant for why patients chose ED care over PCP care when either choice may have produced similar outcomes. This finding implies a significant need for interventions that help families better manage their children's asthma, with the input of the PCP, to prevent more expensive ED care utilization.

CONCLUSIONS

Physicians who completed a health care provider education module learned to effectively diagnose asthma and recognize standardized acute and chronic severity classifications. The majority of children presenting to the participating EDs had asthma of mild acute severity and mild intermittent chronic severity as classified by NAEPP guidelines. Almost one third of the children presenting to the ED for asthma care did not have insurance. There was a low rate of contact (27%) with the PCP before visiting the ED. Those children who did contact their PCP were more likely to have had moderate or severe acute asthma than those who did not, underscoring the need for PCP care in assuring more effective ED utilization.

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