

# Asthma Care and Management Before an Emergency Department Visit in Children in Western Michigan: How Well Does Care Adhere to Guidelines?

Mathew J. Reeves, PhD<sup>a</sup>, Susan R. Bohm, MS<sup>a</sup>, Steven J. Korzeniewski, MS<sup>a</sup>, Michael D. Brown, MD, MS<sup>a,b</sup>

<sup>a</sup>Department of Epidemiology, College of Human Medicine, Michigan State University, East Lansing, Michigan; <sup>b</sup>Grand Rapids Medical Education and Research Center/ Michigan State University Program in Emergency Medicine, Grand Rapids, Michigan

The authors have indicated they have no financial relationships relevant to this article to disclose.

## ABSTRACT

**OBJECTIVES.** Asthma is one of the more common reasons for children's visits to the emergency departments (EDs). Many studies show that the level of asthma care and self-management in children before an ED visit for asthma is often inadequate; however, most of these studies have been conducted in the inner cities of large urban areas. Our objectives were to describe asthma care and management in children treated for asthma in 3 EDs located in an urban, suburban, or rural setting.

**METHODS.** We studied a prospective patient cohort consisting of children aged 2 to 17 years who presented with an acute asthma exacerbation at 3 EDs in western Michigan. An in-person questionnaire was administered to the parent or guardian during the ED visit. Information was collected on demographics; asthma history; usual asthma care; frequency of symptoms during the last 4 weeks; current asthma treatment, management, and control; and past emergency asthma care. A telephone interview conducted 2 weeks after the ED visit obtained follow-up information. The 8 quality indicators of asthma care and management were defined based on recommendations from national guidelines.

**RESULTS.** Of 197 children, 70% were enrolled at the urban site, 18% at the suburban site, and 12% at the rural site. The average age was 7.9 years; 60% were male, and 33% were black. At presentation, nearly half (46%) of the children had mild intermittent asthma, 20% had mild persistent asthma, 15% had moderate persistent asthma, and 19% had severe persistent asthma. One quarter of the children had been hospitalized for asthma, and two thirds had at least 1 previous ED visit in the past year. At least 94% had health insurance coverage and 95% reported having a primary care provider.

Less than half of the children had attended at least 2 scheduled asthma appointments with their regular asthma care provider in the past year. Although only 5% of the subjects reported that the ED was their only source of asthma care, at least 30% reported that they always went directly to the ED when they needed urgent asthma care. Only 3 in 5 children possessed either a spacer or a peak-flow meter, whereas ~2 in 5 reported having a written asthma action plan. Among those with persistent asthma, there was considerable evidence of undertreatment, with 36% not on either an inhaled corticosteroid or a suitable long-term control medication. Only 20% completed a visit with their regular asthma care provider within 1 week of their ED visit.

[www.pediatrics.org/cgi/doi/10.1542/peds.2005-2000I](http://www.pediatrics.org/cgi/doi/10.1542/peds.2005-2000I)

doi:10.1542/peds.2005-2000I

### Key Words

pediatric asthma, quality of care, national guidelines

### Abbreviations

ED—emergency department  
 NAEPP—National Asthma Education and Prevention Program  
 ICS—inhaled corticosteroid  
 PCP—primary care provider  
 PFM—peak-flow meter

Accepted for publication Dec 6, 2005

Address correspondence to Mathew J. Reeves, PhD, Department of Epidemiology, B 601 West Fee Hall, Michigan State University, East Lansing, MI 48824. E-mail: reevesm@msu.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275). Copyright © 2006 by the American Academy of Pediatrics

**CONCLUSIONS.** Despite very high levels of health care coverage and access to primary care, the overall quality of asthma care and management fell well short of that recommended by national guidelines.

**A**STHMA IS ONE of the more common reasons for children's visits to emergency departments (EDs).<sup>1-3</sup> National health surveys and utilization rates of hospital services for asthma treatment indicate that the burden of asthma in US children has increased dramatically in the past 2 decades.<sup>4,5</sup> The number of ED visits for asthma in children  $\leq 14$  years of age increased  $\sim 14\%$  in the United States from 1992–1999, and there now are  $>600\,000$  ED visits annually for asthma in this age group.<sup>2</sup> ED use for asthma care in children has been associated with many factors including younger age, gender, minority status, poverty, living in an urban area, having Medicaid or lack of insurance, access to care, quality of care, allergen-prone environments, and poorer health.<sup>6-12</sup> However, the vast majority of these studies have been conducted in the inner-city environments of very large urban centers. There is less known about whether the characteristics of children who visit EDs in more suburban and rural settings differ from those of their urban counterparts.

Studies have shown that the care and management of asthma in children in the outpatient setting frequently fall short of what is recommended in the National Asthma Education and Prevention Program (NAEPP) guidelines.<sup>13,14</sup> Most recent studies of children with asthma who use the ED have shown that although the majority do have access to primary care,<sup>8,9,15-17</sup> this access does not ensure that they receive the recommended asthma care and self-management training in the outpatient setting.<sup>9,10,15,16,18</sup> For example, many children who use the ED seem to be undermedicated in terms of using an inhaled corticosteroid (ICS) or other long-term control medication,<sup>8,10,11,16,17</sup> and follow-up visits with a primary care provider (PCP) usually occur much later than the time frame recommended in the NAEPP guidelines.<sup>19-22</sup>

Here we describe the characteristics of children treated for an acute asthma exacerbation in 3 EDs in western Michigan (selected to represent urban, suburban, and rural settings) and report on several quality indicators of care and management based on NAEPP guidelines.

## **METHODS**

### **Study Design, Patient Eligibility, and Enrollment**

The study was designed as a prospective patient cohort of children who visited the ED for treatment of an acute asthma exacerbation. Three EDs in western Michigan were selected to be representative of an urban, subur-

ban, or rural hospital setting. Eligible subjects (aged 2 to 17 years) had to present with signs and symptoms consistent with an acute asthma exacerbation (ie, wheezing, shortness of breath, chest tightness, or cough) and have a final ED diagnosis of asthma or 1 of the following: a previous physician diagnosis of asthma (ever), a previous physician diagnosis of reactive airway disease (ever), or a history of prescribed bronchodilator medication use in the last year. Patients were excluded if they had life-threatening respiratory distress; had other significant illnesses such as any major chronic disease, disability, or cognitive impairment; were not available for telephone follow-up; were unable to communicate in English or Spanish; or required hospitalization for additional treatment.

Subjects were enrolled when research or hospital staff were available and thus represent a convenience sample of all ED asthma visits. At the urban site, enrollment and data collection were conducted by 3 research nurses who were based in the ED and made regular rounds to identify potential asthma patients. Because of the lower anticipated case load at the suburban and rural hospitals, respiratory therapists agreed to undertake these activities at these sites. To obtain as representative a sample as possible at the urban site, research staff worked a wide range of shifts during the week and weekend and obtained a consecutive sample of subjects within any 1 shift. At the suburban and rural sites, the respiratory therapists provided 24-hour ED coverage and were instructed to enroll all eligible subjects. The ED staff were instructed to page the on-call respiratory therapist whenever a potential asthma case presented. Subject enrollment began in September 2001 and was planned to last 1 year or until the desired sample size of 120 subjects per site was obtained.

Research staff recruited subjects in the ED by approaching the parent or guardian while the child was undergoing treatment. Informed written consent was obtained from the parent or guardian, and assent was obtained from all children aged  $\geq 7$  years. The study was approved by the institutional review boards at Michigan State University, the 3 hospitals, the Michigan Department of Community Health, and the Centers for Disease Control and Prevention. All subjects were treated according to the usual medical care provided by the ED, including routine clinical and diagnostic evaluation, treatment, and discharge instructions. All parents/guardians were instructed to make a follow-up appointment with their regular asthma care provider within 1 week, and a copy of the dictated medical chart was faxed to that physician's office. In the small minority of subjects who did not have a PCP, efforts were undertaken by research staff to identify a medical provider and make an immediate referral.

## Data Collection

A 31-item face-to-face questionnaire was administered in the ED by the research staff or respiratory therapists (Appendix 5). Data were collected on patient demographics; asthma history (eg, age at diagnosis); usual asthma care; frequency of symptoms in the last 4 weeks; current asthma treatment, management, and control; and past emergency asthma care.

Follow-up telephone interviews, conducted by the research nurses at the urban hospital site, were conducted 2 weeks and 6 months after the ED visit. For this current analysis, only information on follow-up appointments made with the child's regular asthma care provider determined from the 2-week follow-up call is included. A copy of the 2-week questionnaire is included in Appendix 6.

## Defining Chronic Asthma Severity

Using criteria derived from the NAEPP guidelines,<sup>14</sup> we classified each patient's underlying chronic asthma severity as mild intermittent, mild persistent, moderate persistent, or severe persistent based on the highest frequency of daytime symptoms, nighttime symptoms, restricted activities, or exacerbations (severe enough to affect speech) during the 4-week period preceding the ED visit.

## Quality Indicators Based on NAEPP Recommendations

To assess the quality of asthma care and management before the ED visit, we defined the following 8 quality indicators based on specific NAEPP recommendations.

1. Regular primary care visits—the proportion of children who had at least 2 regularly scheduled visits in the past year with their regular asthma care provider.
2. Asthma specialist—the proportion of children with moderate or severe persistent asthma who had at least 1 consultation with an asthma care specialist in the previous year.
3. Access to and use of a spacer—the proportion of children who had access to a spacer and the frequency with which it was used.
4. Access to and use of a peak-flow meter (PFM)—the proportion of children ( $\geq 7$  years of age) who had access to a PFM and the frequency with which it was used for self-monitoring.
5. Written asthma-management plan—the proportion of children who had a written plan.
6. Undertreatment—any patient with moderate persistent or severe persistent asthma who was not on at least an ICS at the time of presentation or any patient with mild persistent asthma who was not on any long-term control medication (defined as either an ICS and/or an alternative treatment such as a leukotriene modifier, theophylline, cromolyn, or nedocromil) at the time of presentation.<sup>13</sup>
7. Past asthma education—the proportion of children who reported ever receiving education on the self-management of asthma.
8. Follow-up visits with regular asthma care provider—the proportion of children who had attended a follow-up visit with their regular asthma care provider within 1 week of the ED visit at which they were enrolled in this study.

## Data Management and Statistical Analyses

Data were entered into a database by the research staff at the urban hospital site. Data were checked for completeness and accuracy, and the research staff followed up on missing or illogical responses. Descriptive statistics included proportions for categorical variables and means and SDs for continuous variables. Statistical comparisons among the 3 hospital sites and all variables of interest (ie, demographic factors and indicators for asthma care, control, and management) were generated by using the Pearson 2 test or Fisher's exact test when small cell sizes were encountered. The quality indicators for the total cohort were cross-tabulated with chronic severity, and tests for linear trend were performed by using the Mantel-Haenszel test. All analyses were undertaken in SAS 8.2 (SAS Institute, Inc, Cary, NC), and statistical significance was set at  $P < .05$ .

## RESULTS

Table 1 shows the characteristics of the patients enrolled at each of the 3 sites. Of the 197 total subjects, 139 (70.6%) were enrolled at the urban site, 35 (17.8%) were enrolled at the suburban site, and 23 (11.6%) were enrolled at the rural site. The average age was 7.9 years; 30% ( $n = 60$ ) of the cohort were  $< 5$  years of age. The majority of subjects were male (60% [ $n = 117$ ]); black children accounted for 33% ( $n = 64$ ), and Hispanic children accounted for 15% ( $n = 29$ ). Just over one half (53%) of the parents or guardians accompanying the children had obtained at least some college education. The vast majority of study subjects (94%) had health insurance, with 42% having Medicaid or another public source of insurance. The majority of subjects (87%) had been diagnosed previously with asthma by a physician, with nearly half (47%) having been diagnosed before the age of 2. Race was the only variable that showed a statistically significant difference across the 3 study sites: black children made up a higher proportion of the subjects at the urban and suburban EDs, compared with the rural ED. A marginally significant difference in insurance status across the 3 sites was identified also; the rural site had a lower proportion of subjects with Medicaid insurance and a higher proportion of self-pay (Table 1). The frequency distribution of chronic asthma severity

**TABLE 1** Characteristics of Children Treated for Asthma at 3 Michigan EDs (Urban, Suburban, and Rural)

Characteristic	Total (n = 197), % (n)	Urban (n = 139), % (n)	Suburban (n = 35), % (n)	Rural (n = 23), % (n)	P
Age, y					.23
2–4	30.5 (60)	33.1 (47)	25.7 (9)	17.4 (4)	
5–9	34.5 (68)	32.4 (45)	28.5 (10)	56.5 (13)	
10–14	25.9 (51)	25.9 (36)	31.4 (11)	17.4 (4)	
15–17	9.1 (18)	7.9 (11)	14.2 (5)	8.7 (2)	
Male	59.4 (117)	61.1 (85)	57.1 (20)	52.2 (12)	.69
Hispanic	14.7 (29)	15.1 (21)	8.6 (3)	21.7 (5)	.37
Race					<.001 <sup>a</sup>
Black	32.5 (64)	31.7 (44)	54.3 (19)	4.4 (1)	
White	60.9 (120)	60.4 (84)	42.9 (15)	91.2 (21)	
Other	6.6 (13)	9.3 (11)	2.9 (1)	4.4 (1)	
Parent/guardian education level <sup>b</sup>					.38
<High school	15.8 (31)	13.7 (19)	20.0 (7)	21.7 (5)	
High school grad	31.1 (61)	30.9 (43)	31.4 (11)	34.9 (8)	
1–3 y of college	32.7 (64)	33.8 (47)	22.3 (8)	39.1 (9)	
≥College grad	20.4 (40)	21.6 (30)	25.7 (9)	4.4 (1)	
Insurance status					.08 <sup>a</sup>
HMO/PPO	51.8 (102)	50.4 (70)	48.6 (17)	65.2 (15)	
Medicaid/Public	42.1 (83)	45.3 (63)	42.9 (15)	21.7 (5)	
Self-Pay	2.0 (4)	0.7 (1)	2.9 (1)	8.7 (2)	
Unknown	4.1 (8)	3.6 (5)	5.7 (2)	4.4 (1)	

<sup>a</sup> The P value is based on Fisher's exact test.

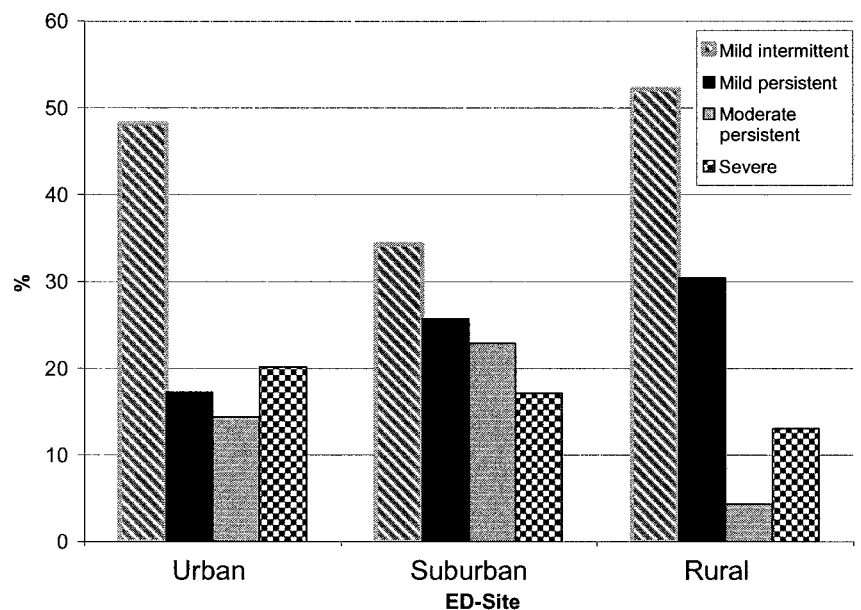
<sup>b</sup> Missing information on education for 1 subject.

for the 3 sites, based on the frequency of symptoms reported in the 4 weeks before presentation to the ED, is shown in Fig 1. There was no statistically significant difference in the distribution of asthma severity across the 3 sites ( $P = .27$ ). Overall, nearly half (46%) of the children had mild intermittent asthma, 20% had mild persistent asthma, 15% had moderate persistent asthma, and the remaining 19% had severe persistent asthma.

#### Usual and Past Urgent Asthma Care

The majority of children (95%) visiting the ED for asthma care had access to a PCP; of these subjects, 85%

stated that their PCP was their regular asthma care provider, defined as the physician who took primary responsibility for their asthma and wrote their prescriptions (Table 2). Of the 5% ( $n = 10$ ) of subjects without a PCP, all reported that the ED was their only source of asthma care. Only approximately half of the cohort had attended at least 2 regularly scheduled appointments with their regular asthma care provider within the past year (Table 2). For those children who received regular asthma care from their PCP ( $n = 158$ ), 55% had had a regularly scheduled appointment within 6 months of the ED visit; however, for 18.3%, the last appointment was



**FIGURE 1** Distribution of chronic asthma severity on the basis of symptoms during the 4-week period before the ED visit to 1 of 3 Michigan EDs.

>1 year ago. Of the 29 children for whom their PCP was not their regular asthma care provider, 86% ( $n = 25$ ) received regular asthma care from an asthma specialist, whereas the remaining 4 reported that they attended another type of clinic. Among those children who received regular asthma care from their PCP, 18% had also visited an asthma specialist in the past year. When specialist use was evaluated only among those children with moderate or severe persistent asthma, ~40% had seen a specialist in the last year.

With respect to urgent asthma care in the year before the ED visit at which they were enrolled in the study, a quarter of the children had been hospitalized for asthma in the past year (Table 2), whereas 53% reported at least 1 inpatient admission for asthma during their lifetime. Approximately two thirds (61%) of the subjects had made at least 1 ED visit in the preceding year, whereas 84% reported at least 1 previous ED visit for asthma during their lifetime. A little more than half (55%) of the children had made an urgent visit to a doctor's office or clinic in the preceding year (Table 2). When parents/guardians were questioned about where they usually took their child for urgent asthma care, 41% said they went to their regular asthma care provider, 25% reported that they went to the ED only if it was after hours, and 30% reported that they went straight to the ED regardless of the time of day.

The only statistically significant difference found in usual and urgent asthma care across the 3 sites was in hospitalization in the past year (Table 2). A much higher proportion of subjects at the urban site had been hospitalized in the past year compared with the other 2 sites ( $P = .02$ ). The proportion of children at the urban site who had an ED visit in the past year or at least 2 regular appointments with their regular asthma care provider was also higher than at the other 2 sites; however, the differences were only marginally statistically significant ( $P < .10$ ).

### Asthma Care and Management

Table 3 shows various aspects of asthma care and management including access and use of asthma equipment,

asthma-management plans, undertreatment, and prior asthma education. Sixty percent of subjects possessed a spacer, among whom >80% reported that they used it always or usually. Approximately 60% of the subjects also reported that they had a PFM, but only 14% used the PFM daily to monitor symptoms, whereas ~40% reported that they used it only during exacerbations. There was a statistically significant association between access to a PFM and study site: a higher proportion of subjects at the urban site had a PFM compared with their counterparts at the other sites. Only 43% ( $n = 85$ ) of the subjects reported having a written asthma-management plan.

Overall, 36% ( $n = 38$ ) of the subjects with persistent asthma had evidence of undertreatment. More than half of the group considered to be undertreated had mild persistent asthma (and thus met the criteria for undertreatment by not currently taking any long-term control medication). Across the 3 study sites, the variation in the prevalence of undertreatment was statistically significant, with suburban and rural sites having a much higher prevalence compared with the urban site; although it should be noted that these estimates are based on relatively small numbers of eligible subjects (23 and 11 at the suburban and rural sites, respectively). Also, the majority of the undertreated subjects (ie, 7 of 11) at the rural site had mild persistent asthma.

Most subjects (71%) had received some type of asthma education; of those, almost all (99%) had been instructed on how to use a nebulizer, and most had received education about medications and treatments (95%), asthma triggers (89%), and asthma attack strategies (83%). However, only a little over half of the children reported ever receiving education about how to use either a PFM or an asthma-management plan (Table 3).

Finally, of the 93% ( $n = 184$ ) of subjects who completed the 2-week follow-up call, only 20% ( $n = 37$ ) had completed a visit with their regular asthma care provider within 7 days; however, by the time the 2-week call was completed, 46% ( $n = 84$ ) had either made or completed

**TABLE 2 Usual and Urgent Asthma Care in the Previous Year Among Children Treated for Asthma at 3 Michigan EDs (Urban, Suburban, and Rural)**

Characteristic	Total ( $n = 197$ ), % ( $n$ )	Urban ( $n = 139$ ), % ( $n$ )	Suburban ( $n = 35$ ), % ( $n$ )	Rural ( $n = 23$ ), % ( $n$ )	<i>P</i>
Usual asthma care					
PCP	94.9 (187)	95.0 (132)	94.3 (33)	95.7 (22)	.78
PCP is regular asthma care provider	84.5 (158)	84.9 (112)	81.8 (27)	86.4 (19)	.89
≥2 regularly scheduled appointments	47.7 (94)	52.5 (73)	40.0 (14)	30.4 (7)	.09
Saw asthma specialist in past year <sup>a</sup>	39.4 (26)	39.6 (19)	35.7 (5)	50.0 (2)	.87
Urgent asthma care					
≥1 hospitalizations in past year	25.4 (50)	30.9 (43)	11.4 (4)	13.0 (3)	.02
≥1 ED visits in past year	61.4 (121)	66.2 (92)	54.3 (19)	43.5 (10)	.08
≥1 Urgent visits in past year to doctor/clinic	55.3 (109)	59.7 (83)	51.7 (15)	47.8 (11)	.56

<sup>a</sup> Among subjects with moderate or severe persistent asthma only ( $n = 66$ ).

**TABLE 3 Asthma Care and Management Among Children Treated for Asthma at 3 Michigan EDs (Urban, Suburban, and Rural)**

Characteristic	Total (n = 197), % (n)	Urban (n = 139), % (n)	Suburban (n = 35), % (n)	Rural (n = 23), % (n)	P
Asthma equipment					
Have spacer	59.9 (121)	61.9 (86)	51.4 (20)	60.9 (15)	.53
Use spacer					.36 <sup>a</sup>
Always	61.2 (74)	66.3 (57)	50.0 (10)	46.7 (7)	
Usually	19.0 (23)	17.4 (15)	20.0 (4)	26.7 (4)	
Rarely	19.8 (24)	16.3 (14)	30.0 (6)	26.7 (4)	
Have PFM <sup>b</sup>	61.1 (69)	68.9 (51)	50.0 (12)	40.0 (6)	.05
Use PFM					.20 <sup>a</sup>
Daily	14.5 (10)	15.7 (8)	8.3 (1)	16.7 (1)	
1–6/wk	18.8 (13)	17.7 (9)	33.3 (4)	0 (0)	
Only during exacerbations	39.1 (27)	45.1 (23)	25.0 (3)	16.7 (1)	
Rarely (<1/wk)	27.5 (19)	21.6 (11)	33.3 (4)	66.7 (4)	
Have asthma-management plan	43.1 (85)	42.5 (59)	48.5 (16)	43.5 (10)	.82
Undertreatment <sup>c</sup>	36.5 (38)	25.7 (18)	47.8 (11)	81.8 (9)	<.001
Asthma education (ever)					
Any type	71.1 (140)	74.3 (104)	62.9 (22)	60.9 (14)	.23
Specific types of education					
How to use inhaler or nebulizer	99.2 (139)	100.0 (104)	100.0 (22)	92.8 (13)	.86
Medications and treatments	95.0 (133)	96.2 (100)	86.4 (19)	100.0 (14)	.12 <sup>a</sup>
Asthma triggers	88.6 (124)	86.5 (90)	90.0 (20)	100.0 (14)	.92 <sup>a</sup>
Asthma attack strategy	82.9 (116)	84.6 (88)	81.8 (18)	71.4 (10)	.41 <sup>a</sup>
How to use a PFM	58.6 (82)	52.7 (60)	72.3 (17)	35.7 (5)	.04
How to use an asthma-management plan	53.6 (75)	52.9 (55)	59.1 (13)	50.0 (7)	.83
Any type	71.1 (140)	74.3 (104)	62.9 (22)	60.9 (14)	.23

<sup>a</sup> The *P* value is based on Fisher's exact test.

<sup>b</sup> Among subjects  $\geq 7$  years of age (*n* = 113).

<sup>c</sup> Undertreatment was defined as no current ICS use among children with moderate persistent (*n* = 29) or severe persistent asthma (*n* = 37) or no current long-term controller-medication use among children with mild persistent asthma (*n* = 40). Two subjects (1 mild persistent, 1 moderate persistent) had missing information on medications; hence *n* = 104 (urban, 70; suburban, 23; rural, 11).

an appointment to see their regular asthma care provider in response to the ED visit.

### Summary of Results for NAEPP Quality Indicators

Table 4 shows the proportion of subjects meeting each of the 8 quality indicators for the overall cohort, as well as by level of asthma severity during the 4-week period before the ED visit. Overall, the proportion of subjects

who met the criteria for the 8 quality indicators was low. There were only 3 quality indicators (access to spacer, access to a PFM, and asthma education) for which more than half of the cohort met the respective criteria. Undertreatment was the only indicator that showed a statistically significant relationship with asthma severity. More than half of the subjects with mild persistent asthma were not taking at least a long-term control

**TABLE 4 Summary of 8 Quality Indicators and Their Association With Asthma Severity**

Quality Indicator	Total (N = 197), % (n)	Asthma Severity				P
		MI (n = 91), % (n)	MildP (n = 40), % (n)	ModP (n = 29), % (n)	SevP (n = 37), % (n)	
1. $\geq 2$ regular checkups last year	47.7 (94)	39.6 (36)	50.0 (20)	62.1 (18)	54.1 (20)	.14
2. Asthma specialist <sup>a</sup>	39.4 (26)	NA	NA	31.0 (9)	46.0 (17)	.22
3. Access to spacer	59.9 (118)	56.0 (51)	70.0 (28)	55.2 (16)	62.2 (23)	.46
4. Access to PFM <sup>b</sup>	61.1 (69)	55.3 (26)	58.3 (14)	65.0 (13)	72.7 (16)	.55
5. Written AMP	43.1 (85)	41.7 (38)	42.5 (17)	41.4 (12)	48.6 (18)	.86
6. Undertreatment <sup>c</sup>	36.5 (38)	NA	51.3 (20)	35.7 (10)	21.6 (8)	.03
7. Asthma education	71.1 (140)	72.5 (66)	75.0 (30)	65.5 (19)	64.9 (24)	.69
8. RACP visit post ED <sup>d</sup>	20.1 (37)	23.0 (20)	19.4 (7)	7.8 (2)	22.9 (8)	.38

MI indicates mild intermittent; MildP, mild persistent; ModP, moderate persistent; SevP, severe persistent; NA, not applicable; AMP, asthma-management plan; RACP, regular asthma care provider.

<sup>a</sup> Proportion of subjects with at least moderate persistent asthma who had at least 1 visit to an asthma specialist in the last year (*n* = 66).

<sup>b</sup> Among subjects  $\geq 7$  years of age (*n* = 113).

<sup>c</sup> Undertreatment was defined as no current ICS use among children with moderate persistent or severe persistent asthma or no current long-term controller-medication use among children with mild persistent asthma. Information is missing on medications for 2 subjects (1 mild persistent, 1 moderate persistent) (*n* = 104).

<sup>d</sup> Proportion of subjects who completed the 2-week follow-up call (*n* = 184) who had a visit with their regular asthma care provider within 7 days of the ED visit.

medication during the 4-week period before their ED visit, and the prevalence of undertreatment among the subjects with either moderate or severe persistent asthma was high also (36% and 22%, respectively).

## DISCUSSION

In this prospective cohort of children who visited 3 EDs in western Michigan for treatment of asthma, we found that the overall quality of asthma care and management fell well short of that recommended by national guidelines despite the fact that almost all the subjects had access to a regular asthma care provider and were insured. Important deficiencies in asthma care and management in this study population included incomplete access to basic equipment (ie, spacers and PFMs), low utilization of written asthma-management plans, and evidence of undertreatment with respect to ICS and other long-term control medications. There were also indications of inadequate communication with the regular asthma care provider, as evidenced by the minority of children who had attended regular checkups in the last year or who had completed a visit with their regular asthma care provider after their ED visit. These findings are in general accordance with other ED-based studies,<sup>9,10,15-18</sup> although we expected that the asthma care of the patients presenting at these EDs would receive substantially better care than those of the previous reports, which were from much larger urban centers.

Just over half of the children in this study had persistent asthma, and there was considerable evidence of undertreatment within that group. More than half of the patients with mild persistent asthma were not on at least a long-term control medication at presentation to the ED, whereas 36% and 22% of those with moderate or severe persistent asthma, respectively, were not on an ICS. Again, these findings are consistent with those of other ED-based studies, although most have reported even lower use of ICS or other long-term control medications.<sup>8,10,11,15-18</sup>

Our study found that the prevalence of undertreatment was much lower at the urban site compared with the suburban and rural sites. We can only speculate as to why this finding was observed; however, given that there were few differences in the underlying characteristics of the asthma populations across the 3 sites, the lower prevalence of undertreatment likely reflects better quality of care among subjects who attended the urban site. The presence of a local asthma coalition in Grand Rapids that has widely promoted the importance of ICS may also play a role in these findings. It should be noted that our definition of undertreatment depends on the accuracy of the classification of chronic asthma severity, an assessment that occurs in the face of ongoing treatment and which therefore has the potential to represent the adequacy of asthma control rather than the underlying asthma severity. We attempted to measure the

underlying severity of asthma by asking 4 specific questions about the frequency of symptoms during the 4-week period before the ED visit, and we were careful to distinguish these symptoms from those that occurred during the period shortly before the ED visit. However, ultimately, our assessment cannot be regarded as a true measure of the underlying asthma severity, and it is likely that the prevalence of persistent asthma is underestimated as a result of the influence of ongoing treatment.

The characteristics of this patient cohort were similar to those of other ED-based asthma studies of children in that more than half of the subjects were boys, the majority were <10 years of age, and there was an overrepresentation of minority populations.<sup>8,9,11,15-18</sup> Approximately one third of the study population was black, which is much higher than the underlying population of the Grand Rapids area, in which ~10% of the population is black.

Similar to some other ED-based studies,<sup>16,23</sup> we found that a relatively high proportion of children (46%) had only mild intermittent asthma, indicating that this patient population was not at particularly high risk. However, like most other studies, we found that a high proportion of these children exhibited health care–utilization patterns that suggest more severe or uncontrolled asthma; 25% had been hospitalized in the last year, and 60% had at least 1 prior ED visit for asthma in the last year. This apparent disconnect between the underlying asthma severity and the high rates of past ED visits and hospitalizations may be a reflection of the inability to accurately measure underlying asthma severity or the fact that health care–utilization patterns are driven in large part by behavioral and psychosocial factors<sup>7,12</sup> rather than disease-specific measures such as asthma severity and control. Another interesting and paradoxical finding with respect to the high frequency of past ED use in this population was that only 5% reported that the ED was their usual source of asthma care. Although this report might lead one to conclude falsely that these children would rarely visit the ED for asthma care, 30% of the study subjects reported that they always went directly to the ED when they needed urgent asthma care, and an additional 25% said they went directly to the ED outside of regular office hours. Thus, more than half of the cohort described a propensity to go directly to the ED for urgent asthma care.

Although almost all of the subjects had access to a regular asthma care provider (either a PCP or asthma specialist), less than half had attended at least 2 regularly scheduled asthma appointments in the last year. These findings suggest that despite access to regular medical care, the continuity of care that is vital for the successful management of asthma<sup>7</sup> remains a problem in this population. Unfortunately, because we did not seek additional information as to why the children had not gone

to their regular asthma care provider more often, we are unable to point to the exact origin of this problem. Another indication of problems with the continuity of care was the fact that only 20% of the cohort had completed a visit with their regular asthma care provider within a week of the ED visit. Even after 2 weeks, less than half of the study subjects had either completed or made an appointment with their regular asthma care provider. These disappointing follow-up results again are similar to those reported previously<sup>18–22</sup> and occurred despite considerable efforts on behalf of the ED staff to facilitate such follow-up visits; these efforts included informing the accompanying adult to make a follow-up appointment, faxing a copy of the dictated medical chart to the regular asthma care provider, and identifying a medical provider and making an immediate referral for the minority of patients who did not have a PCP.

The rationale for looking at differences across urban, suburban, and rural ED sites stems from the observation that key characteristics of asthma, including prevalence, morbidity, and mortality, show clear geographical differences.<sup>24</sup> Asthma in inner-city and rural populations is often regarded differently based on the fact that the underlying etiologies and environmental exposures may vary to some degree.<sup>25,26</sup> However, both populations face similar challenges in terms of multiple barriers to adequate health care including poverty, underinsurance, and less access to health care providers. In this study, we found relatively few significant differences across the 3 sites; children treated at the urban site showed evidence of greater health care utilization, including higher rates of hospitalizations and ED visits in the last year, as well as more frequent regular asthma appointments with their regular asthma care provider. They also had greater access to PFMs and were less likely to be undertreated. Interpretation of these findings is difficult, although they probably represent the result of a complex set of interactions related to access to medical facilities and perhaps better quality of care.

Although this study was designed to explicitly compare and contrast care and management across the 3 different ED populations, we obviously had limited power to do so because of the low number of subjects enrolled at the suburban and rural sites. There were several reasons for this. First, early on in the data-collection period, the referral patterns for pediatric ED visits in the city of Grand Rapids changed dramatically when the urban-site hospital opened a separate pediatric ED. Consequently, the number of pediatric asthma visits to the suburban site fell dramatically. Second, the approach of using the on-duty respiratory therapist to collect study data at the suburban and rural sites was not successful despite the continued effort of the researchers and study staff. The project was promoted frequently at meetings with the respiratory therapists and other ED staff. Indirect incentives, such as book tokens and financial sup-

port for continuing education seminars were provided also. Although the original protocol planned to directly compensate the respiratory therapists for each subject who was enrolled, hospital policies prevented us from implementing such an incentive program. The collection of prospective patient data from ED sites that do not have a high asthma caseload (such as rural sites) therefore remains a challenge, because it is not cost-effective to use designated research staff in such situations.

The other potential limitation of this study relates to its representativeness. Despite the fact that enrollment at all 3 sites occurred across a wide range of days of the week and times of day, the data collected still represent a convenience sample of all ED visits. We therefore compared the age and gender distributions of the 3 study populations to that obtained from ED billing data collected during the same time period. We found no statistically significant differences between any of the study populations and total asthma visits as represented by the billing data (data not shown). Thus, we are confident that the data are a representative sample of all pediatric asthma visits at the 3 sites.

## CONCLUSIONS

Our findings point to the continued need to improve the medical care and management of children with asthma to reduce their dependence on the ED. A major area of focus should involve the PCP and particularly the communication between the PCP and the asthma patient.<sup>7,14</sup> The impact of the NAEP guidelines in the primary care community has been less than optimal; 2 surveys that examined the adherence of PCPs to components of the NAEP guidelines found that a high proportion (>88%) of physicians had heard of the guidelines and that many (~70%) had read them.<sup>27,28</sup> However, obvious gaps existed in the physicians' promotion of patient self-management practices; for example, less than half were providing written asthma-management plans, a finding that is concordant with results of our study. Reasons cited for this noncompliance include barriers in adopting the practices (lack of time/resources), disagreement with the guidelines, and belief that the recommendations are too rigid.<sup>29–31</sup> The problem of excessive and unnecessary ED visits for asthma is obviously multifactorial and highly complex, suggesting that several complementary interventions and/or system changes need to be made. Based on the findings of this study, improving the interaction between ED patients and their regular asthma care provider is probably a sound first step in addressing this problem.

## ACKNOWLEDGMENTS

Support for this article was provided by Centers for Disease Control and Prevention grant U59/CCU519422-01.

Technical assistance was provided by the project offi-



cer, Seymour Williams, MD, and branch chief Stephen Redd, MD, both of the Air Pollution and Respiratory Health Branch, Division of Environmental Hazards and Health Effects, National Center for Environmental Health, Centers for Disease Control and Prevention. We acknowledge all of the staff from the 3 EDs for their assistance in facilitating this project; we are particularly indebted to our 2 primary research nurses, Jan Anderson and Jacque Perrin, who collected the majority of the data at the urban site. We also acknowledge the respiratory therapists who collected data for this project. The following people provided important input during the development phase of the study: Carmen Alexander, Carlos Carmago, Gary Kirk, Sarah Lyon-Callo, Karen Meyerson, Pam Meyer, Ken Rosenman, and Brian Rowe. Finally, we acknowledge the assistance of Karen Meyerson, Seymour Williams, Elizabeth Wasilevich, and Sarah Lyon-Callo, who provided useful comments on earlier drafts.

## REFERENCES

- Zimmerman DR, Allegra JR, Cody RP. The epidemiology of pediatric visits to New Jersey general emergency departments. *Pediatr Emerg Care*. 1998;14:112–115
- Mannino DM, Homa DM, Akinbami LJ, Moorman JE, Gwynn C, Redd SC. Surveillance for asthma: United States, 1980–1999. *MMWR Surveill Summ*. 2002;51(1):1–13
- McCaig LF, Burt CW. National Hospital Ambulatory Medical Care Survey: 2002 emergency department summary. *Adv Data*. 2004;(340):1–34
- Akinbami LJ, Schoendorf KC. Trends in childhood asthma: prevalence, health care utilization, and mortality. *Pediatrics*. 2002;110:315–322
- Beasley R. The burden of asthma with specific reference to the United States. *J Allergy Clin Immunol*. 2002;109:S482–S489
- Halfon N, Newacheck PW. Childhood asthma and poverty: differential impacts and utilization of health services. *Pediatrics*. 1993;91:56–61
- Kennedy S, Stone A, Rachelefsky G. Factors associated with emergency department use in asthma: acute care interventions improving chronic disease outcomes. *Ann Allergy Asthma Immunol*. 2003;90:45–50
- Davidson AE, Klein DE, Settupane GA, Alario AJ. Access to care among children visiting the emergency room with acute exacerbations of asthma. *Ann Allergy*. 1994;72:469–473
- Dinkevich EI, Cunningham SJ, Crain EF. Parental perceptions of access to care and quality of care for inner-city children with asthma. *J Asthma*. 1998;35:63–71
- Farber HJ, Johnson C, Beckerman RC. Young inner-city children visiting the emergency room (ER) for asthma: risk factors and chronic care behaviors. *J Asthma*. 1998;35:547–552
- Friday GA, Khine H, Lin MS, Caliguiri LA. Profile of children requiring emergency treatment for asthma. *Ann Allergy Asthma Immunol*. 1997;78:221–224
- Wasilewski Y, Clark NM, Evans D, Levison MJ, Levin B, Mellins RB. Factors associated with emergency department visits by children with asthma: implications for health education. *Am J Public Health*. 1996;86:1410–1415
- National Asthma Education and Prevention Program. Expert panel report: guidelines for the diagnosis and management of asthma update on selected topics—2002 [published correction appears in *J Allergy Clin Immunol*. 2003;111:466]. *J Allergy Clin Immunol*. 2002;110(5 suppl):S141–S219
- National Heart, Blood, and Lung Institute; National Asthma Education and Prevention Program. *Expert Panel Report 2: Guidelines for the Diagnosis and Management of Asthma*. Bethesda, MD: National Institutes of Health; 1997. NIH publication No. 97-4051
- Crain EF, Kerckmar C, Weiss KB, Mitchell H, Lynn H. Reported difficulties in access to quality care for children with asthma in the inner city. *Arch Pediatr Adolesc Med*. 1998;152:333–339
- Scarfone RJ, Zorc JJ, Capraro GA. Patient self-management of acute asthma: adherence to national guidelines a decade later. *Pediatrics*. 2001;108:1332–1338
- Boudreaux ED, Emond SD, Clark S, Camargo CA. Race/ethnicity and asthma among children presenting to the emergency department: differences in disease severity and management. *Pediatrics*. 2003;111(5). Available at: [www.pediatrics.org/cgi/content/full/111/5/e615](http://www.pediatrics.org/cgi/content/full/111/5/e615)
- Ferris TG, Crain EF, Oken E, et al. Insurance and quality of care for children with acute asthma. *Ambul Pediatr*. 2001;1:267–274
- Stevens MW, Gorelick MH. Short-term outcomes after acute treatment of pediatric asthma. *Pediatrics*. 2001;107:1357–1362
- Leickly FE, Wade SL, Crain E, Kruszon-Moran D, Wright EC, Evans R. Self-reported adherence, management behavior, and barriers to care after an emergency department visit by inner city children with asthma. *Pediatrics*. 1998;101(5). Available at: [www.pediatrics.org/cgi/content/full/101/5/e8](http://www.pediatrics.org/cgi/content/full/101/5/e8)
- Diette GB, Skinner EA, Markson LE, et al. Consistency of care with national guidelines for children with asthma in managed care. *J Pediatr*. 2001;138:59–64
- Warman KL, Silver J, McCourt MP, Stein REK. How does home management of asthma exacerbations by parents of inner-city children differ from NHLBI guideline recommendations? National Heart, Lung, and Blood Institute. *Pediatrics*. 1999;103:422–427
- Boychuk RB, Yamamoto LG, DeMesa CJ, Kiyabu KM. Compliance with asthma care guidelines in wheezing pediatric emergency department patients. *Ann Emerg Med*. 2003;42:S2
- Grant EN, Wagner R, Weiss KB. Observations on emerging patterns of asthma in our society. *J Allergy Clin Immunol*. 1999;104(2 pt 2):S1–S9
- Schwartz DA. Etiology and pathogenesis of airway disease in children and adults from rural communities. *Environ Health Perspect*. 1999;107:393–401
- Grant EN, Alp H, Weiss KB. The challenge of inner-city asthma. *Curr Opin Pulm Med*. 1999;5:27–34
- Finkelstein JA, Lozano P, Shulruff R, et al. Self-reported physician practices for children with asthma: are national guidelines followed? *Pediatrics*. 2000;106:886–896
- Grant EN, Moy JN, Turner-Roan K, Daugherty SR, Weiss KB. Asthma care practices, perceptions, and beliefs of Chicago-area primary-care physicians. *Chest*. 1999;116:145S–154S
- Cabana MD, Rand CS, Powe NR, Wu AW, Wilson MH, Abboud PA. Why don't physicians follow clinical practice guidelines? A framework for improvement. *JAMA*. 1999;282:1458–1465
- Hayward RSA, Guyatt GH, Moore KA, McKibbon A, Carter AO. Canadian physicians' attitudes about and preferences regarding clinical practice guidelines. *CMAJ*. 1997;156:1715–1723
- Picken HA, Greenfield S, Teres D, Hirway PS, Landis JN. Effect of local standards on the implementation of national guidelines for asthma: primary care agreement with national asthma guidelines. *J Gen Intern Med*. 1998;13:659–663

**Asthma Care and Management Before an Emergency Department Visit in Children in Western Michigan: How Well Does Care Adhere to Guidelines?**  
Mathew J. Reeves, Susan R. Bohm, Steven J. Korzeniewski and Michael D. Brown  
*Pediatrics* 2006;117;S118  
DOI: 10.1542/peds.2005-2000I

<b>Updated Information &amp; Services</b>	including high resolution figures, can be found at: <a href="http://pediatrics.aappublications.org/content/117/Supplement_2/S118">http://pediatrics.aappublications.org/content/117/Supplement_2/S118</a>
<b>References</b>	This article cites 28 articles, 6 of which you can access for free at: <a href="http://pediatrics.aappublications.org/content/117/Supplement_2/S118#BIBL">http://pediatrics.aappublications.org/content/117/Supplement_2/S118#BIBL</a>
<b>Subspecialty Collections</b>	This article, along with others on similar topics, appears in the following collection(s): <b>Emergency Medicine</b> <a href="http://www.aappublications.org/cgi/collection/emergency_medicine_sub">http://www.aappublications.org/cgi/collection/emergency_medicine_sub</a> <b>Allergy/Immunology</b> <a href="http://www.aappublications.org/cgi/collection/allergy:immunology_sub">http://www.aappublications.org/cgi/collection/allergy:immunology_sub</a> <b>Asthma</b> <a href="http://www.aappublications.org/cgi/collection/asthma_sub">http://www.aappublications.org/cgi/collection/asthma_sub</a>
<b>Permissions &amp; Licensing</b>	Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at: <a href="http://www.aappublications.org/site/misc/Permissions.xhtml">http://www.aappublications.org/site/misc/Permissions.xhtml</a>
<b>Reprints</b>	Information about ordering reprints can be found online: <a href="http://www.aappublications.org/site/misc/reprints.xhtml">http://www.aappublications.org/site/misc/reprints.xhtml</a>

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™



# PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

**Asthma Care and Management Before an Emergency Department Visit in Children in Western Michigan: How Well Does Care Adhere to Guidelines?**  
Mathew J. Reeves, Susan R. Bohm, Steven J. Korzeniewski and Michael D. Brown  
*Pediatrics* 2006;117;S118  
DOI: 10.1542/peds.2005-2000I

The online version of this article, along with updated information and services, is located on the World Wide Web at:  
[http://pediatrics.aappublications.org/content/117/Supplement\\_2/S118](http://pediatrics.aappublications.org/content/117/Supplement_2/S118)

Pediatrics is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. Pediatrics is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2006 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 1073-0397.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

