

# Emergency Department Allies: A Web-Based Multihospital Pediatric Asthma Tracking System

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

## ABSTRACT

**OBJECTIVE.** To describe the development of a Web-based multihospital pediatric asthma tracking system and present results from the initial 18-month implementation of patient tracking experience.

**DESIGN.** The Emergency Department (ED) Allies tracking system is a secure, password-protected data repository. Use-case methodology served as the foundation for technical development, testing, and implementation. Seventy-seven data elements addressing sociodemographics, wheezing history, quality of life, triggers, and ED management were included for each subject visit.

**SETTING.** The ED Allies partners comprised 1 academic pediatric ED and 5 community EDs.

**POPULATION.** Subjects with a physician diagnosis of asthma who presented to the ED for acute respiratory complaints composed the asthma group; subjects lacking a physician diagnosis of asthma but presenting with wheezing composed the wheezing group.

**RESULTS.** The tracking-system development and implementation process included identification of data elements, system database and use case development, and delineation of screen features, system users, reporting functions, and help screens. For the asthma group, 2005 subjects with physician-diagnosed asthma were enrolled between July 15, 2002 and January 14, 2004. These subjects accounted for 2978 visits; 10.4% had  $\geq 3$  visits. Persistent asthma was noted in 68% of the subjects. During the same time period, 1297 wheezing subjects with a total of 1628 ED visits (wheezing group) were entered into the tracking system. After enrollment, 57% of the subjects with  $\geq 1$  subsequent ED visits received a physician diagnosis of asthma.

**CONCLUSIONS.** Our sophisticated tracking system facilitated data collection and identified key intervention opportunities for a diverse ED wheezing population. A significant asthma burden was identified with significant rates of hospitalization, acute care visits and persistent asthma in 68% of subjects. The surveillance component provided important insights into health care issues of both asthmatic subjects and wheezing subjects, many of whom subsequently were diagnosed with asthma.

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

doi:10.1542/peds.2005-2000C

### Key Words

asthma, wheezing, tracking system, emergency department

### Abbreviations

ED—emergency department  
NAEPP—National Asthma Education and Prevention Project  
IHC—Infinity HealthCare  
ITG-CASF—Integrated Therapeutics Group Child Asthma Short Form  
QoL—quality of life  
PCP—primary care provider  
HMO—health maintenance organization

Accepted for publication Dec 6, 2005

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

**A**STHMA IS THE most common chronic childhood disorder, affecting >6 million children, including 1.3 million children under the age of 5 years.<sup>1</sup> The 1992–1995 National Hospital Ambulatory Medical Care Survey reported an annual rate of 570 000 emergency department (ED) visits for wheezing in children ≤14 years of age.<sup>2</sup> In 2000 the annual volume of ED visits in the United States for asthma in children aged 0 to 17 years exceeded 728 000.<sup>1</sup> Understanding the factors that contribute to ED use for childhood asthma care may best be identified through the use of a longitudinal system of tracking. Reduction of episodic and expensive ED asthma care may be accomplished in part by early identification of, and greater knowledge about, wheezing children who lack a confirmed diagnosis of asthma. There are limited longitudinal studies of wheezing or the development of asthma in children who present to EDs for treatment of wheezing. Major asthma-related goals of the US Department of Health and Human Services' *Healthy People 2010* program include reducing ED visits and hospitalizations for children with asthma, increasing the percentage of asthmatics receiving care according to the National Asthma Education and Prevention Program (NAEPP) guidelines, and establishing state surveillance systems for tracking asthma management and other issues in a minimum of 25 states.<sup>3</sup> In October 2001 we began the development of a Web-based ED asthma tracking system for children at selected hospitals in southeastern Wisconsin. This article focuses on the development and implementation of the tracking system, defines our study population, and presents results from the first 18 months of patient tracking.

## METHODS

### Project Objective

The primary project objective was to develop, implement, use, and evaluate a unique ED tracking system with the goal of improving asthma care for children. We hypothesized that use of the tracking system would improve our understanding of factors associated with acute asthma exacerbations and effective acute and chronic management and provide a tool for monitoring and improving adherence to ED asthma-management guidelines. A secondary objective was to use the tracking system to characterize wheezing patients without an asthma diagnosis by collecting longitudinal patient-specific information. The underlying premise of the project was to demonstrate the value and feasibility of a Web-based, multihospital, secure patient-data system for the management of asthma in both the individual patient and the community.

### Tracking-System Development

The ED Allies tracking system was designed, developed, and implemented in collaboration with Infinity Health-

Care (IHC), an emergency medicine management company with extensive medical informatics and system-design experience. IHC had prior experience with the development, implementation, and maintenance of a secure, multihospital Internet-based emergency resource-management system called EMsystem. This system coordinates hospital ED receiving status and mass casualty response and is currently operative in 30 major US metropolitan regions, 9 states, and Melbourne, Australia. Redundant application servers and databases are housed in secure sites in the Madison and Milwaukee areas of Wisconsin.

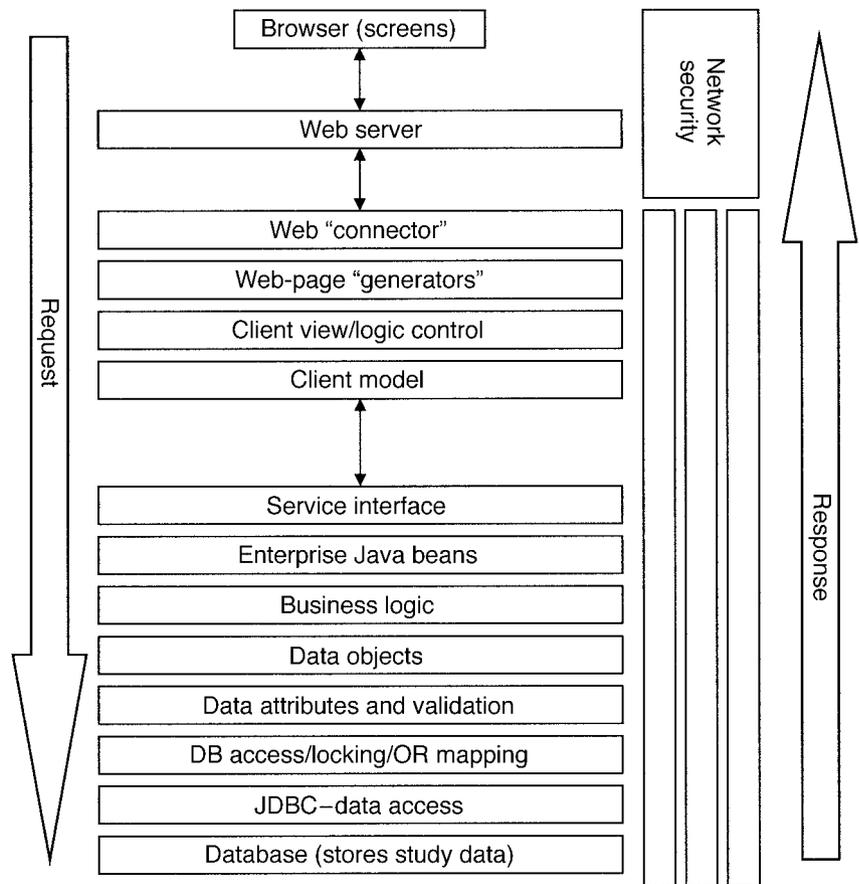
Essential attributes of our tracking system included a World Wide Web-based system with password-protected access from a standard Web browser, Health Insurance Portability and Accountability Act (HIPAA)-compliant security, a secure data repository, and scalable architecture (ie, expandable to multiple users). The tracking system was created by using industry-standard Java- and J2EE-compliant code and an Oracle database for the data repository. All data transactions related to the application, including user log-in, are transferred by using a secured-sockets communication protocol, Secured Sockets Layer (SSL), applying 128-bit encryption. SSL is an Internet standard for securing Web pages. All key components, including the system database and Web and application servers, have redundant power sources and are protected by comprehensive security architecture that incorporates multiple proxy firewalls. Access to the system requires only a standard Web browser, an Internet connection, and an Internet protocol (IP) address.

The ED Allies partners met over a 6-month period to delineate study requirements, data to be collected, screen features, users and their level of privileges, and additional system requirements such as reporting functions and help screens. Use-case methodology (Appendix 1) served as the foundation for the technical development, testing, and implementation of the ED Allies tracking system.

The development of use cases is a highly detailed object-modeling process that incorporates a description of the complete flow through a system until a resulting value is achieved. A set of use cases was developed for the tracking system that outlined all possible ways of using the system, including system access, data parameters, and data verification. This set was used as a communication tool to gain final user approval and manage change. The application screens and reports were designed and the architecture and application software engineered as outlined in Fig 1.

Seventy-seven data elements were identified for collection and entry into the tracking system, including sociodemographic items; information from a 38-item parent questionnaire, which included the Integrated Therapeutics Group Child Asthma Short Form (ITG-

FIGURE 1  
ED Allies tracking-system architecture.



CASF), an asthma-specific quality-of-life (QoL) questionnaire; and data from the subjects' ED course and disposition (Appendix 2). Permission to use the ITG-CASF<sup>4</sup> was obtained through the National Program Office of the Robert Wood Johnson Foundation. The questionnaire was self-administered, with assistance provided if requested by the parent.

Before implementation of the system, testing was performed to assure and validate that all system and data requirements had been addressed. To accomplish this objective, an integrated system test plan was developed to explore all system pathways outlined in the use cases. Test scripts or scenarios were written to describe each system pathway that required validation, and test patients were assigned to each scenario. Twenty-five patients who were part of a pilot process formed the core of the test population using deidentified data. Ten fictitious patients were added to provide sufficient data to complete the 306 test conditions listed in the test plan. Each of the 35 test-patient encounters was entered into the application to stress all test-condition criteria to identify any problems with the system. After this procedure, 2 study personnel performed acceptance testing of the application to ensure that the system met all stated requirements. All system issues discovered during the functional and acceptance testing phases were docu-

mented and resolved by using the IHC organizational software development change-control process.

Study coordinators at each of the 6 EDs received on-site training in system access and operation from an IHC representative. These coordinators subsequently provided training for ED research personnel at each site.

### Population

Asthma affects >100 000 children in Wisconsin. The majority of these asthmatic children live in the southeastern region of the state. Of the 2248 inpatient admissions statewide for asthma in children 0 to 17 years of age in 1995, 51% occurred in a 5-county region. Five community hospital EDs in this southeastern Wisconsin region were selected to participate as partners with Children's Hospital of Wisconsin, the lead hospital, forming ED Allies (Fig 2). Collectively, these 6 EDs serve diverse patient populations located in rural, suburban, and urban settings.

Entry criteria for enrollment into the tracking system from any of the 6 EDs included patients who (1) were aged 0 to 18 years who were residents of Wisconsin, (2) had a parent or guardian able to read English, (3) had a history of physician-diagnosed asthma, reactive airway disease, or bronchospasm, and (4) had a presenting complaint of wheezing, difficulty breathing, asthma prob-

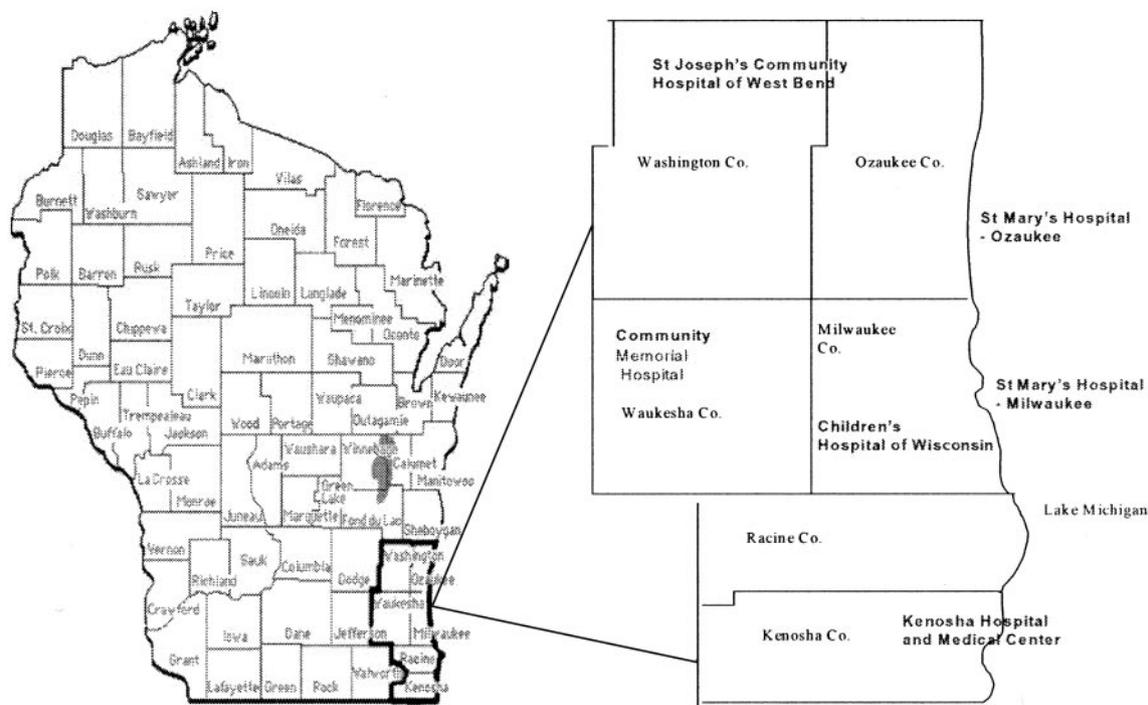


FIGURE 2  
ED Allies participating hospitals.

lems, cough, or respiratory distress. Children presenting to the ED with wheezing and no history of physician-diagnosed asthma were eligible if they met the age, language, and residency criteria. This study was reviewed and approved by the institutional review boards of all 6 hospitals.

Subjects were screened on presentation to the ED 24 hours per day, 7 days per week. Research assistants and ED physicians used the ED patient census board and nurse triage to identify patients with respiratory complaints for potential inclusion. Eligible subjects were approached for enrollment in the tracking system after evaluation by the attending ED physician and initial management of the acute complaint. Asthmatic subjects (asthma group) received management of their acute respiratory problem according to ED asthma-management guidelines.<sup>5</sup> Before implementation of the tracking-system project, these guidelines had been revised to include documentation of chronic asthma severity, asthma video education, instruction in or review of medication spacer technique, instruction in or review of peak expiratory flow meter technique when appropriate, provision of

asthma care plans at discharge, and distribution of a follow-up letter to the primary care provider (PCP). Chronic asthma severity was assigned by using the standard symptom-based National Heart, Lung, and Blood Institute system<sup>6</sup> modified by the addition of controller medication information (Table 1). The PCP follow-up letter included the assigned chronic severity score and recommendations for controller medications. Wheezing subjects with no history of physician-diagnosed asthma (wheezing group) received management of their acute respiratory problem and appropriate education at the discretion of the treating attending ED physician.

Researchers entered demographic data directly into the tracking system at the time of subject consent. Subjects previously entered into the system were identified and additional ED visits were entered under a single identification number to facilitate tracking. Data from the questionnaire and the ED course were transferred from paper surveys and records into the tracking system during or after the ED visit. After complete entry of all data elements, the subject's visit information was veri-

TABLE 1 Asthma: Chronic Severity

	Mild Intermittent	Mild Persistent	Moderate Persistent	Severe Persistent
Activity limitation	Rarely	Occasionally	≥2 per week	Always
Daytime symptoms	≤2 per week	>2 per week	Daily	Always
Nighttime symptoms	≤2 per month	>2 per month	>1 per week	Frequent
Controller medications	0	1	2	3 or 2, with 1 high-dose steroid

fied and “locked down” by the research coordinator or one of the investigators (C.M.W.-K.).

## RESULTS

The ED Allies tracking system was tested in a pilot study conducted between April 1 and 9, 2002. A total of 19 patients were approached for enrollment in the pilot project, and consent was obtained from 18. All 18 enrolled subjects completed questionnaires. Assistance with questionnaire completion was required by 2 (11%) enrollees. Time to complete the questionnaire was collected for 16 of the 18 subjects. The mean time was 12 minutes, with a range of 7 to 20 minutes. No process or consent issues were identified.

The ED Allies tracking system was implemented on July 15, 2002. Results presented in this report include ED visits from July 15, 2002, to January 14, 2004. A total of 4606 visits for 3302 subjects with either a physician diagnosis of asthma or wheezing were entered into the system. These visits represent 74% of eligible patients; 6% of eligible patients approached for consent refused. The remaining 20% were not approached for enrollment because of time constraints in our high-volume EDs. Patients who were not approached had similar characteristics to our asthma group, with 61% males (vs 64%) and a mean age of 4.8 years (vs 5.5 years).

Most visits, 4422 (96%), occurred at the Children’s Hospital. The 5 community EDs provide care to a limited number of children, including asthmatic children. Eight subjects had ED visits at 2 hospitals. No subject had ED visits at  $\geq 3$  hospitals.

### Asthma Group

A total of 2978 visits for 2005 physician-diagnosed asthma subjects were entered. Mean subject age was 5.5 years (range: 0–18 years). Demographic data are presented in Table 2. Private insurance was defined as indemnity and private health maintenance organization (HMO) insurance. Public insurance included Medicaid HMO, Badger Care, and Title 19 insurance. Within this group, 582 (29%) had  $\geq 2$  ED visits and 208 (10.4%) subjects had  $\geq 3$  ED visits entered into the tracking system; 22% of the visits resulted in hospital admission. Persistent asthma, as defined by the asthma chronic severity score calculated in the ED, was noted in 68%. Chronic asthma severity, controller medication use as documented by the attending ED physician at the time of the ED visit, use of home medication-delivery devices, history of eczema or previous endotracheal intubation, exposure to household tobacco smoke, and a history of asthma in a parent or sibling are noted in Table 3. Leukotriene-modifier medication use was reported for 17% of ED asthma visits; any controller medication use was reported for 54%. Recommended primary care follow-up visit intervals were 0 to 3 days in 52% of subjects and 4 to 7 days in 28%. The most common ED diagnoses

**TABLE 2 ED Tracking-System Demographics**

Tracking System	Asthma Group	Wheezing Group
Subjects, <i>n</i>	2005	1297
Total visits, <i>n</i>	2978	1628
Mean age (range), <i>y</i>	5.5 (0–18)	1.9 (0–18)
Gender, %		
Male	64	60
Race/ethnicity, %		
Black	57	43
White	31	41
Hispanic	8	9
Other	4	7
Insurance, %		
Public <sup>a</sup>	55	49
Private <sup>b</sup>	41	47
None	4	4
Unknown	<1	<1

<sup>a</sup> Public: Medicaid, HMO, Title 19, BadgerCare.

<sup>b</sup> Private: indemnity, private HMO.

were asthma with acute exacerbation (64%), upper respiratory infection (17%), and status asthmaticus (8%). Pneumonia was diagnosed in 0.4% of the subjects.

Prior health care utilization, reported in the parent questionnaire, is presented in Table 4. Possible questionnaire responses regarding hospitalizations and visits to the ED and PCP in the previous 12 months for asthma or wheezing were 0, 1, 2, 3, 4, 5, or more. Previous hospitalization for asthma at any time was reported at 52% of the visits.

Asthma-specific QoL scores, obtained by using the ITG-CASF, are presented in Table 5. The range of possible scores is 0 to 100, with 100 being the best possible QoL. The mean score for this asthma cohort was 59.1 (SD: 23.6). A decrease in QoL score with increasing asthma chronic severity was noted.

**TABLE 3 Asthma Group: Subject Characteristics**

Characteristic	Subjects, %
Chronic severity index <sup>a</sup>	
Mild intermittent	32
Mild persistent	29
Moderate persistent	24
Severe persistent	15
Controller medication, % <sup>a</sup>	
None	46
1	32
2	15
3	7
Metered-dose inhaler use	79
Spacer use	65
Nebulizer use	76
Previous intubation	15
Tobacco exposure	37
History of eczema	33
Family history of asthma	72

<sup>a</sup> Information sources: ED record and parent questionnaire.

**TABLE 4 Asthma Group: Health Care Utilization in Prior 12 Months**

ED visits		
Mean $\pm$ SD		2.49 $\pm$ 1.71
$\geq 2$ visits, %		68
PCP visits		
Mean $\pm$ SD		2.94 $\pm$ 1.68
$\geq 2$ visits, %		77
Hospitalizations		
Mean $\pm$ SD		0.6 $\pm$ 1.19
$\geq 2$ admissions, %		15

Information source: parent questionnaire.

### Wheezing Group

A total of 1628 visits for 1297 wheezing subjects without a physician diagnosis of asthma were entered into the tracking system. The mean age of subjects in this population was 1.9 years (range: 0–18 years). Gender and race/ethnic origin were similar to those in the asthma group (Table 2). In the 12 months before enrollment, 34% of the wheezing subjects had  $\geq 2$  ED visits, 37% had  $\geq 2$  PCP visits, and 4% had  $\geq 2$  hospital admissions. Two hundred twenty-five subjects (17%) had  $\geq 1$  subsequent ED visits recorded in the tracking system. Of those subjects in this group who had  $\geq 2$  ED visits, 57% were noted to receive a physician diagnosis of asthma before the subsequent visit. The most common ED diagnoses were bronchospasm (19%), bronchiolitis (16%), wheezing (13%), acute upper respiratory tract infection (13%), and asthma (9%).

### DISCUSSION

Asthma is a key public health problem in the United States. One key function of our tracking system is to provide surveillance of the physician-diagnosed childhood asthma population that presents to EDs for acute care. The usual public health methods of retrospective tracking of asthma visits through claims data, hospital reporting, or random sampling may provide a gross estimate of the community burden of disease but gives no opportunity for individual patient intervention, anticipatory care, or future preventive strategies. Our results also clearly illustrate the significant burden that childhood asthma imposes on the health care system in our community, with an annual mean of 2.9 visits per subject to PCPs, 2.5 visits to the ED, and a 22% hospitalization rate. Moreover, because 15% of our subjects reported  $\geq 2$  hospitalizations and 10% had  $\geq 3$  ED visits in

**TABLE 5 Asthma Group: ITG-CASF Quality of Life (QoL) Score Versus Chronic Severity**

Chronic Severity	Subjects, <i>n</i>	QoL Mean Score $\pm$ SD
Mild intermittent	638	72.2 $\pm$ 19.2
Mild persistent	586	62.1 $\pm$ 20.9
Moderate persistent	487	51.2 $\pm$ 21.5
Severe persistent	299	38.1 $\pm$ 22.2

the preceding 12 months, there is a significant impact on the health care costs borne by our community.

In addition to estimating asthma-related resource use, our system allows us to better characterize the burden of asthma for individual subjects. QoL is impacted significantly in many of our subjects. Persistent asthma was identified in 68% of subjects presenting to the ED for acute asthma. It is surprising that 32% of the subjects were classified as mild intermittent asthma based on parental recall of their symptoms in the previous 4 to 8 weeks. Although this percentage seems to be higher than expected, no comparative data are available from other studies.

Another key function of our tracking system is the ability to characterize key historical and management attributes of our ED population. One unexpected finding was the 15% rate of intubation for asthma reported on the questionnaire. The questionnaire asked, "Has your child ever been intubated (had a tube placed into the throat to help breathing) for asthma or wheezing?" Intubation for an acute asthma exacerbation is a rare event in our community, with a rate far below the 15% reported by our subjects. History of previous intubation for asthma has been identified as a risk factor for asthma mortality. It is clear from our data that parent reporting of previous intubation grossly overestimates this intervention, and routine use of this question requires additional verification before assuming that the child is in a high-risk category.

Use of the tracking system has allowed us to characterize the baseline community and individual burden of asthma in our ED population. Ongoing use of the tracking system allows us to identify trends in asthma prevalence and severity, health care utilization, and asthma management. Additional collection and analysis of data will allow us to evaluate the reasons for our asthma burden and identify strategies to reduce this problem.

A key objective of developing our tracking system was to improve the provision of quality care for our pediatric asthmatic population. Suboptimal care, defined by NAEPP objectives, was believed to contribute significantly to the excessive acute health care utilization of our target population. We endeavored to enhance our ED asthma care by implementing chronic asthma care initiatives into our acute ED asthma management.

Parameters included in our database were chosen to allow us to focus on quality asthma care and assess interventions to improve that quality. Subsequent to the development of our tracking system, in a March 2003 *Morbidity and Mortality Weekly Report* article, the NAEPP published key clinical activities for quality asthma care.<sup>7</sup> Ten key clinical activities were described, and action steps were identified. Before this report, we had identified and implemented many of these activities as important components of our ED standard of care. Information about these key activities had also been included as

essential data elements collected in our tracking system, including chronic asthma severity classification, follow-up PCP visit recommendations, prescription of medication according to chronic severity, development of a written asthma-management plan, and the provision of routine education on patient self-management. Analysis of performance on these parameters is a key feature of our system, and we are currently analyzing individual and collective provider performance and the effect of simple interventions to improve this performance. In addition, the ability of physicians to access information about individual patient trends in QoL, chronic severity, and medication use has the potential to improve the patient's outcome.

Our interest in the wheezing child who does not carry a diagnosis of asthma prompted us to include this group in our tracking system. Analysis of information collected about this group demonstrates that the wheezing/non-asthma group is significantly younger than the asthma group, a finding that was not surprising. However, tracking of these patients provided useful insight into their subsequent clinical course. In the 18 months of tracking, 17% of the wheezing subjects presented to the ED with at least 1 additional episode of wheezing. Given the fact that many of these subjects had been in the tracking system for <6 months, this 17% likely represents an underestimation of the actual ED revisit rate. At the subsequent ED visit for this subgroup, more than half had received a physician-confirmed diagnosis of asthma. The ability to track this patient group over time will allow us to study this group of patients in an attempt to identify early predictors of asthma and opportunities for more specific therapeutic and educational interventions.

The ED Allies tracking system is simple to access and use. Data retrieval for individual subjects requires a simple log-in procedure and a patient identifier. Production of defined reports for aggregate data requires access privileges, log-in, report selection, and date parameters. An additional reporting option, the longitudinal individual patient report, has been developed to address the ED physicians' requests for an individual patient summary of key clinical parameters for each ED visit. It is anticipated that this report will provide useful real-time clinical information for the ED and subsequent management of wheezing patients.

Our project has several limitations. We chose not to include patients whose parent or legal guardian could not read English. This decision was made because the asthma video used as a key component of our ED education was available only in English. During the project dates (July 15, 2002, to January 14, 2004), 373 Hispanic patients presented to our ED with an asthma diagnosis. We enrolled 160 of these patients. Given our overall 74% enrollment rate of eligible subjects, and assuming there was no effect of race on willingness to participate, we estimate that 276 of the eligible Hispanic patients

would have consented to participate. Based on the enrollment of 160 Hispanic patients, we estimate that our language restriction eliminated 43% of Hispanic patients likely to consent to participate. This population did receive many of the components of our ED asthma-education program but are not included in our tracking system because of ineligibility. We are currently evaluating a proposal to eliminate the English-reading ability as a project criterion and to use a Spanish-speaking research assistant and Spanish-language consent forms.

A second limitation of this project was the 20% rate of eligible visits from patients who were not approached for enrollment. Factors associated with failure to enroll patients were generally the result of a high ED volume or lack of a research assistant in the ED. Overall, failure to approach patients for enrollment occurred more frequently during the night shift. Among the patients who were not approached, 41% were treated in the ED between 3 and 11 PM (vs 40% of enrolled subjects), 31% between 11 PM and 7 AM (vs 16%), and 28% between 7 AM and 3 PM (vs 44%). In many cases, patients who were not enrolled were enrolled on subsequent ED visits.

Finally, it is important to emphasize that our data reflect the experience of a wheezing population presenting to the ED and may not be generalizable to the entire population of wheezing children in the community.

## CONCLUSIONS

The development and implementation of a Web-based pediatric asthma/wheezing tracking system requires a team of clinical and technical experts, user training, and validation of entered data. Tracking systems facilitate the collection and analysis of data for a diverse asthma population presenting to the ED, and analysis of population characteristics, acute and chronic asthma management, and education has identified key issues for future interventions and subsequent analysis. Our Web-based system is multifunctional, scalable, and portable for use in any location. We continue to track enrolled subjects and enter new subjects into our system.

## ACKNOWLEDGMENTS

Project support was provided by the Robert Wood Johnson Foundation, an Emergency Department Demonstration Project grant, and the American Academy of Asthma, Allergy and Immunology (principal investigator: Kevin J Kelly, MD).

Technical assistance was provided by the National Program Office (director, Gary Rachelefsky, MD, Allergy Research Foundation Inc; deputy director, Amy Stone, American Academy of Allergy, Asthma and Immunology; and research associate, Suzanne Kennedy, PhD, American Academy of Allergy, Asthma and Immunology).

## REFERENCES

1. National Center for Health Statistics. National Health Interview Survey: asthma prevalence, health care use and mortality, 2002. Available at [www.cdc.gov/nchs/products/pubs/pubd/hestats/asthma/asthma.htm](http://www.cdc.gov/nchs/products/pubs/pubd/hestats/asthma/asthma.htm). Accessed February 28, 2006
2. National Center for Health Statistics. *National Ambulatory Medical Care Survey, 1992–1995* [computer file]. Hyattsville, MD: National Center for Health Statistics; 1998
3. US Department of Health and Human Services. *Healthy People 2010. Understanding and Improving Health*. 2nd ed. 2 vols. Washington, DC: Office of Disease Prevention and Health Promotion, US Department of Health and Human Services; 2000. Available at: [www.healthypeople.gov](http://www.healthypeople.gov). Accessed February 28, 2006
4. Bukstein DA, McGrath MM, Buchner DA, Landgraf J, Goss TF. Evaluation of a short form for measuring health-related quality of life among pediatric asthma patients. *J Allergy Clin Immunol*. 2000;105:245–251
5. American Academy of Allergy, Asthma, and Immunology Taskforce. *Pediatric Asthma: Promoting Best Practice Guide for Management of Asthma in Children*. Milwaukee, WI: American Academy of Allergy, Asthma and Immunology; 1999
6. National Asthma Education and Prevention Program. *Expert Panel Report 2: Guidelines for the Diagnosis and Management of Asthma*. Bethesda, MD: National Heart Lung and Blood Institute; 1997. NIH Publication 97-4051
7. Williams SG, Schmidt DK, Redd SC, Storms W; National Asthma Education and Prevention Program. Key clinical activities for quality asthma care: recommendations of the National Asthma Education and Prevention Program. *MMWR Recomm Rep*. 2003; 52(RR-6):1–8. Available at: [www.cdc.gov/mmwr/PDF/RR/RR5206.pdf](http://www.cdc.gov/mmwr/PDF/RR/RR5206.pdf). Accessed February 28, 2006

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*Pediatrics* 2006;117;S63

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