

CONCLUSION. An ED-based childhood asthma tracking system can serve as a basis for designing and implementing an ED-based educational intervention. ED staff, primary care providers, and others can work together to promote asthma care.

ALTHOUGH THERE IS no cure for asthma, self-management can prevent acute asthma exacerbations and irreversible damage to airway function, and improve patients' quality of life (QoL).^{1,2} Accordingly, children and their families need to be a key focus for self-management education.³ National Asthma Education and Prevention Program (NAEPP) guidelines provide a blueprint for such education.¹

To evaluate the status of childhood asthma and its care, assess health care provider adherence to guidelines, and create an integrated system of asthma care, the Hawaii Child Asthma Research to Elevate Standards (CARES) program was developed. The program was directed from the University Tertiary Care Pediatric Teaching Center at the John A. Burns School of Medicine, Kapi'olani Medical Center for Women and Children. Because the medically underserved areas of northeast and west Oahu coincide with the highest incidence of asthma within Honolulu County, 4 medical institutions serving these communities were invited to develop the program jointly. A multiethnic, culturally sensitive approach to data collection was developed to obtain accurate information from this diverse population to develop and implement an emergency department (ED)-based asthma education program for patients, families, and providers.

METHODS

Participating ED Centers

The 4 Hawaii CARES program sites included (1) Kapiolani Medical Center for Women and Children (KMCWC), a university-based, tertiary care children's and women's medical center in urban Honolulu, (2) Kaiser Permanente Medical Center, a general hospital in a residential community of Honolulu serving Kaiser plan patients, (3) Castle Medical Center, a general hospital in a rural/residential community of northern Oahu, and (4) Waianae Coast Comprehensive Health Center, a large clinic in a rural community in western Oahu with a 24-hour emergency care center. Pali Momi Medical Center, a general hospital in a residential Oahu community, participated briefly, contributing 5 patients before declining additional participation. KMCWC served as lead hospital and coordinated the program. The study was approved by the institutional review boards at each of the participating medical institutions.

Patient Enrollment

During convenience basis throughout phase I and II, project staff enrolled children >12 months and <18 years of age presenting to 4 separate EDs on Oahu, Hawaii, with signs and symptoms of asthma, wheezing, or bronchospasm who responded to bronchodilators (including patients with respiratory infections). Convenience periods included the peak weekend (Friday through Sunday), around-the-clock hours; Monday through Thursday from 8:30 AM to 4:00 PM; and Monday through Thursday evenings. Informed consent for study participation was obtained at the time of ED presentation.

Data Collection

During phase I (October 8, 2002, to October 1, 2003) and phase II (October 1, 2003, to July 8, 2004), project staff collected prospective data during the ED visit using standardized pen-and-paper forms (see Appendix 7). Phase I and II ED-encounter data elements included demographics; asthma signs (manifested during the ED visit); asthma symptoms; peak-flow use (for patients 7–17 years of age); types and frequency of medication use; use of a written asthma action plan; previous ED visits and hospitalizations for asthma; acute asthma-severity assessment; medications given in the ED and at discharge; and chronic asthma-severity assessment.

Asthma-severity classification was based on a guidelines-based algorithm that used the daytime and nighttime frequency of asthma symptoms (Fig 1). Written asthma action plans were defined as "written plans made by you and your [child's] doctor to help care for your [child's] asthma." The appropriate use of long-term controller medication was documented as daily (always, even when well), on an as-needed basis (only when sick), or not at all (none).

Follow-up data were collected during phase I by telephone interviews 3 weeks after the ED encounter; during phase II follow-up data were collected at both the 3-week and 3-month follow-up points. Data were collected by project and ED staff, including research assistants, project coordinators, respiratory therapists, nurses, and physicians. Data elements included demographics, QoL indicators, pattern of medical care (including prescription pick-up, primary care provider [PCP] follow-up, current medication use), and home environment (including household smoking and exposure to allergens and triggers). For purposes of follow-up, project staff asked patients for best and alternate telephone numbers as well as an alternate contact person.

Physician Training and Education

During phase I, an education planning and implementation team comprising Hawaii CARES site and case coordinators, representatives from each ED center (including registered nurses, health educators, respiratory

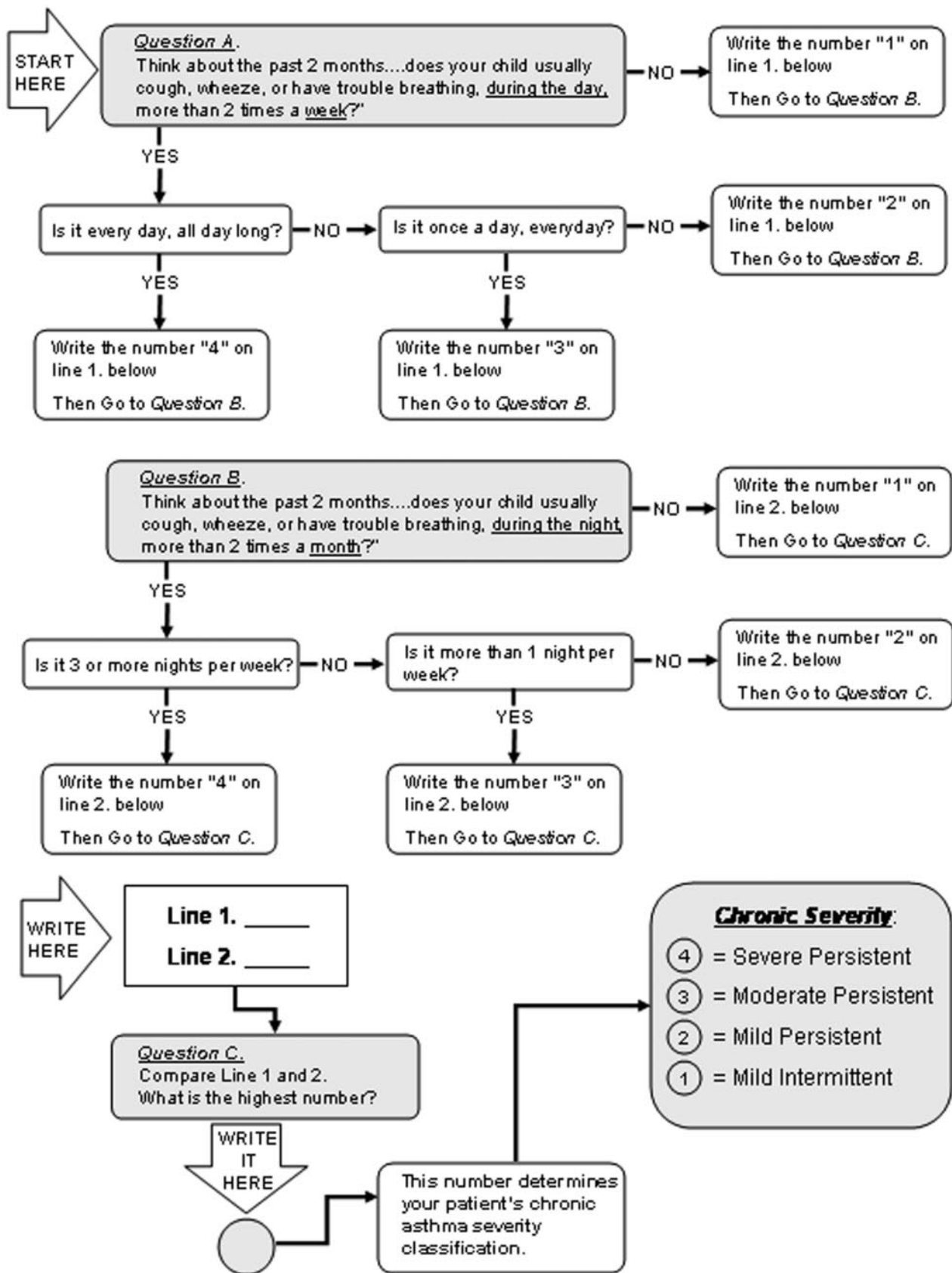


FIGURE 1
Chronic asthma—severity classification.

therapists, and ED physicians), parents of children with asthma, public health personnel, and asthma specialists from throughout the state of Hawaii developed all the elements of the educational program for ED staff, ED asthma patients and their families, and community-based health care providers. The team first established guideline-based asthma education and treatment protocols for ED staff. During the last month of phase I, 182 staff members at each participating ED were introduced to the protocols through 12 continuing medical education (CME) courses that stressed 3 learning objectives:

1. the importance of compliance with asthma care guidelines in treating wheezing pediatric ED patients;
2. the asthma chronic severity classification system and its use in treating patients; and
3. the importance of long-term controller medications and written asthma action plans for managing children with persistent asthma.

During the ED staff education sessions, NAEPP guidelines specific to pediatric asthma were reviewed, data findings from phase I were reported, staff were informed of the goals and expectations for phase II (intervention), and competency training was delivered.

Hawaii CARES also hosted 11 educational dinner discussions for 374 physicians, targeting those physicians whose patients had visited the ED multiple times during phase I. The purpose of the discussions was threefold: to describe the multisite Hawaii CARES educational program; solicit feedback from the physicians regarding their perspectives on “bridge” care (ie, the kind of chronic care ED staff can provide); and promote NAEPP asthma guideline awareness and compliance.

ED-Based Patient and Family Asthma Education Intervention

Throughout phase II, the asthma educational intervention was delivered to patients and their families during their ED visit. A range of educational strategies taught and reinforced basic self-management concepts. Intervention strategies included face-to-face interaction with trained ED staff members using hands-on visual tools such as lung models; an optional 6-minute standardized DVD asthma presentation; and a review of written discharge instructions that included a written asthma action plan tailored to each patient.

During the face-to-face interactions, ED staff emphasized the importance of using an asthma action plan and long-term controller medications (when severity warranted). Parents and patients looked at and touched lung models, seeing and feeling the difference between the normal and inflamed bronchoconstricted lung. This model provided both visual and tactile input, allowing for a clear understanding of the need for controller medication to suppress the swollen and constricted bronchi.

The 6-minute portable DVD presentation encom-

passed signs and symptoms of asthma, pathophysiology, treatment (including controller medications), how to use the asthma action plan, demonstration of equipment use, and other important components of asthma management. It also featured sounds of coughing and wheezing.

After the patient and family viewed the DVD, the ED physician, with study staff assistance, completed a 3-color, temporary written asthma action plan based on chronic severity classification obtained by history. The educator reviewed the plan with the patient and family before ED discharge, emphasizing the severity level and need for long-term controller medicine when warranted. Patient and parent questions were answered, and parents were encouraged to place the plan on the refrigerator, where all home-based caregivers could see it. The educator taught and demonstrated equipment use, including that of nebulizers, metered-dose inhalers with spacers, peak-flow meters, and dry-powder inhalers, using actual equipment that was prescribed on discharge. A discharge instruction sheet summarizing the guidelines and a diagrammatic representation of the lung model were also given to the patient at discharge, along with the temporary written asthma action plan. Follow-up care with the patient’s PCP for the day after the ED encounter was recommended verbally and in writing (on the discharge form and in the temporary written asthma action plan).

Additional educational components included fax communication to the PCP the day after the ED encounter and 2 telephone interviews with the patient/family conducted 3 weeks and 3 months after the ED encounter. The PCP information included data on treatment and medications provided in the ED, education that the patient received while in the ED, patient’s chronic severity classification, and a copy of the patient’s temporary written asthma action plan. (The temporary written action plan was intended for use by the patient and family until the PCP could develop a more permanent plan.)

During the phase II 3-week and 3-month follow-up telephone calls, parents’ questions were answered and additional teaching was performed, including a reemphasis on the importance of long-term controller use (when applicable). Chronic severity was reassessed, and the PCP was notified by fax if the patient’s symptoms had increased or worsened after the ED encounter.

RESULTS

Phase I collected data on 706 patient encounters: 45.8% of 1541 total patient encounters across all 4 EDs. The 706 encounters involved 590 unique patients. Follow-up data were obtained from 473 (80.2%) of the 590 unique patients; 117 patients (19.8%) were lost to follow-up. During phase II, investigators collected prospective data on 353 childhood asthma ED encounters:

27.6% of the 1278 patient encounters across all 4 EDs. The 353 encounters involved 320 unique patients (Table 1). At 3 weeks, data were collected on 313 (97.8%) of the 320 unique patients; 7 (2.0%) patients were lost to follow-up. At 3 months, data were collected on the same 313 patients.

Characterization of Childhood Asthma

Chronic asthma–severity levels were assessed at the phase II ED encounter. Of the 313 unique patients reached at the 3-month follow-up, 147 (47%) had been classified at the ED encounter as having intermittent asthma, and 166 (53%) had been classified as having persistent asthma. Among those with persistent asthma, 73 (23.3%) were classified as having severe asthma, 47 (15%) moderate asthma, and 46 (14.7%) mild asthma. At the 3-month (postintervention) follow-up, 192 (61.3%) patients were classified as having intermittent asthma, and 121 (38.7%) were classified as having persistent asthma. Among the latter, 32 (10.2%) were classified as having severe asthma, 31 (9.9%) moderate asthma, and 58 (18.6%) mild asthma (Fig 2).

Phase I prospective data indicated that of the 388

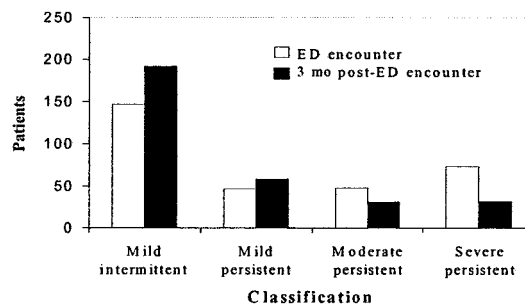


FIGURE 2

Phase II asthma-severity classification of 313 children at time of ED encounter and 3 months after ED intervention.

patients assessed at the ED encounter as having chronic persistent asthma, the majority (278 [71.6%]) were not using controller medications at all (Table 2). During phase II, controller medication use in this group was assessed during the ED encounter and then again at the 3-week and 3-month follow-ups. At ED encounter, only 34 (18.2%) of the 186 patients with persistent asthma used controller medications daily. Three weeks postintervention, daily use of controller medication had increased to 43%; 3 months postintervention, 36.6% of these patients used controller medication daily (Table 3).

Phase II tracking data showed that 48 (13.6%) of the 353 pediatric asthma encounters resulted in a written asthma action plan; 305 (86.4%) patients reported that they did not possess a written plan.

The mean (\pm SD) Integrated Therapeutics Group Child Asthma Short Form scores² for patients with persistent asthma at the 3-week and 3-month assessments are reported in Table 4. All 5 domains showed improvement from 3 weeks to 3 months postintervention.

During the 3-week follow-up calls, patients were asked if they had kept their PCP appointments. Phase I data indicated that 324 (68.5%) had kept their appointments; 149 (31.5%) had not kept them. Phase II data

TABLE 1 Study Cohort Demographics

	Phase I, n	Phase II, n	Total, N
Total encounters	706	353	1059
Total unique patients	590	320	910
Gender			
Male	427	223	650
Female	279	130	409
Age distribution, y			
1–3	391	188	579
4–9	215	112	327
10–14	84	41	125
15–18	16	12	28
Study center			
KMCWC	549	300	849
KPMC	49	33	82
CMC	43	16	59
WCCHC	60	4	64
PMMC	5	0	5
Medical insurance			
Private	301	154	455
Medicaid	381	189	570
No insurance	17	10	27
Not known	7	0	7
Ethnicity			
Black	5	3	8
White	36	13	49
Chinese	11	2	13
Filipino	79	67	146
Japanese	23	14	37
Mixed ancestry	168	102	270
Other Pacific Island	38	27	65
Part Hawaiian	157	93	250
Samoan	56	32	88
Not known/given	40	0	40

KPMC indicates Kaiser Permanente Medical Center; CMC, Castle Medical Center; WCCHC, Waiānae Coast Comprehensive Health Center; PMMC, Pali Momi Medical Center.

TABLE 2 Phase I and II Cohort Descriptions at the Time of ED Encounter

Measure	Phase I, n (%)	Phase II, n (%)
Total encounters	706	353
Chronic severity classification		
Mild intermittent	318 (45)	167 (47.3)
Mild persistent	100 (14.2)	48 (13.6)
Moderate persistent	127 (18)	59 (16.7)
Severe persistent	161 (22.8)	79 (22.4)
Written asthma action plan		
Yes	68 (9.6)	48 (13.6)
No	638 (90.4)	305 (86.4)
Controller medication use (for persistent asthma)		
None	278 (71.6)	118 (63.4)
As needed (only when sick)	46 (11.8)	34 (18.2)
Daily (always, even when well)	64 (16.4)	34 (18.2)

TABLE 3 Phase II Controller-Medication Use in Children With Persistent Asthma at the ED Encounter and at the 3-Week and 3-Month Follow-ups

Medication Use	ED Encounter, <i>n</i> (%)	3-wk Follow-up, <i>n</i> (%)	3- mo Follow-up, <i>n</i> (%)
None	118 (63.6)	84 (45.2)	107 (57.5)
As needed (only when sick)	34 (18.2)	22 (11.8)	11 (5.9)
Daily (always, even when well)	34 (18.2)	80 (43)	68 (36.6)
Follow-up call completed		186 (100)	186 (100)

indicated that 238 (76%) kept their follow-up appointments and 75 (24%) did not.

ED-Based Asthma Education Program for Children and Families

Throughout Phase II, the project delivered a comprehensive patient and family asthma education program to 353 (28%) of the patients.

The DVD asthma education program was offered to all phase II enrollees; 143 (42%) of 353 patients chose to view the video. Reasons for not viewing the video included: already viewed it (27 [19%]); bad timing (41 [29%]); too tired (18 [12.5%]); already knowledgeable about asthma (10 [7%]); not interested (19 [13.2%]); language barrier (6 [4.2%]); and other (23 [16%]). Parental factors that result in viewing or not viewing the video are complex and include a number of other variables (refs 4 and 5; Colonel C. Callahan [US Army Medical Corps, Pediatric Pulmonology, Tripler Army Medical Center], personal communication, 2004; and multiple-center focus-group discussions with Dr Boychuk, Mr DeMesa, Ms Kiyabu, Mr Yamamoto, Dr Sanderson, Ms Gartner, Dr Yamamoto, Ms Beckham, Ms Chong, and Ms Fannucchi, RRT, 2003), as indicated in Table 5.

At discharge, the number of patients who possessed a (temporary) written asthma action plan had increased from 48 (13.6%) at admission to 322 (91.2%) at discharge.

Integrated Asthma Education Program for ED Staff and the Health Care Provider Community

During the last part of phase I, 12 NAEPP guideline-based training sessions were held for 182 ED staff members across the 4 sites. Eleven CME courses and dinner

TABLE 4 Phase II Integrated Therapeutics Group Child Asthma Short Form QoL Domain Scores 3 Weeks and 3 Months After the ED Encounter

	3 wk, Mean ± SD	3 mo, Mean ± SD
Daytime score	65.2 ± 23.6	82.7 ± 23.2
Nighttime score	60.9 ± 26.1	78.5 ± 24.8
Functional limitation	66.6 ± 25.5	86.0 ± 21.9
Family adjustment	59.4 ± 31.4	83.6 ± 27.8
Treatment interference	72.6 ± 30.6	85.7 ± 26.7

discussions were held during phase II throughout Oahu and attended by 374 PCPs.

DISCUSSION

The data provide insights into the pediatric asthma population visiting the 4 participating EDs on Oahu. Initially, the proposed study was to include a randomized control design comparing the effectiveness of an ED-based educational intervention. However, phase I revealed that pediatric asthma patterns and medication use in Hawaii were so poor that the team decided it would have been unethical to have a control group that did not receive any additional education or treatment. For that reason, all phase II patients received the educational intervention. Therefore, comparisons made are general and were not analyzed by statistical significance because of study-design limitations. We do not attempt to identify any causal relationships between education and improvements in QoL of children with asthma who visit the EDs, but we report descriptive findings to (1) help characterize asthma patterns, (2) recommend ways to improve the standard of care, and (3) report changes in patient outcomes.

Results of the study suggest that the ED can serve as an effective venue for asthma patient education. Characteristically, EDs manage and provide acute care and do not focus on education, continuity of care, or PCP follow-up for chronic conditions. There is a perception among emergency physicians and PCPs that such practices intrude on the practice of primary care. To help forge appropriate role agreement among these 2 groups, the planning and implementation team developed the curriculum that was used for educating both ED staff and the community. Interestingly, the team was able to reach important points of agreement that shifted perceptions; they agreed, for example, that it is appropriate and necessary for ED physicians to write long-term controller-medication prescriptions (when warranted) at discharge and to provide temporary written action plans.

The team approach in this study represented a unique and novel effort that was successful in uniting ED personnel, community physicians, and patients. Success was attributed to developing stronger relationships between PCPs and ED physicians. This was accomplished through continued discussion, positive reinforcement of

TABLE 5 Barriers to the Adherence to Pediatric Asthma Management and Practice

ED and primary care physicians
Educational
Failure to make the diagnosis of asthma
Limited knowledge and understanding of guidelines because of lack of familiarity, lack of agreement, and insufficient time to review guidelines
Lack of or incorrect asthma-severity classification leading to inappropriate treatment regimen (eg, not initiating or continuing preventive controller-medication use)
Failure to provide a written asthma action plan
Failure to initiate controller-medication therapy for patients with persistent asthma
Patient, parents, and family
Behavioral
Failure to seek primary care or identify with primary care physician
Non-adherence to appropriate controller-medication use and asthma action plan
Reliance on ED for comprehensive asthma care
Reasons include minimal or no cost, faster service, and continuous availability (24 h/d)
Distractions caused by competing priorities for parents including, but not limited to, employment, social engagements, marital stress/divorce/hostility, psychopathology, and substance abuse
Embarrassment by the child with asthma
Educational
Limited knowledge and understanding of asthma and therapeutic skills (use of metered-dose inhaler, dry-powder inhaler, nebulizer) and misinformation
Misunderstanding of instructions for appropriate controller-medication use
Fear of adverse effects from steroid
Environment dynamic
Cultural barriers between patient, families, and health care providers impeding optimal management
Cultural, religious, or faith-based preconceptions/misconceptions of the disease
Language barriers between patients/families and health care providers impeding optimal management
Multiple caregivers with poor understanding of preventative or acute asthma treatment
Single parent with difficulty managing child with persistent asthma on a daily basis
Nonavailability of 24-h primary care services, poor access to care, lack of medical home and community health care professionals
School prohibitions of asthma medications because of lack of education

guideline-based educational goals, and continuous feedback.

The NAEPP guidelines recommend routine patient self-management education. The written asthma action plan instructed patients to return to their PCPs for regular updates to their treatment. It also provided caregivers with detailed instructions to help them care for their child with asthma and improve the child's symptoms. The DVD presentation simply and explicitly provided the essentials of asthma and its management. This standardized presentation did not require a nurse or physician, and issuing copies of the video to patients and families should be considered for reinforcement and reference.

The NAEPP guidelines also indicate that PCP fol-

low-up (after ED discharge) should be stressed. In an effort to enhance communication between the patient and his or her PCP, ED visit information was faxed to the PCP. Such communication is important in linking care between health care providers, because asthma is a chronic disease that requires continuous care, monitoring, and reinforcement of education.

An ED-based asthma tracking system revealed that a high percentage of patients with persistent asthma neither possessed nor used long-term controller medications. Among all patients with asthma, very few possessed written asthma action plans. To address the problem, participating EDs delivered an educational intervention to patients and families. The success of the intervention was the result of its development by a partnership of ED and community physicians using the NAEPP guidelines as a basis. In addition, the program sponsored CME opportunities to improve provider skill and standardize knowledge of current guidelines.

This program demonstrates that ED-based interventions are possible and effective. The importance of this study lies in the change in approach and delivery of medical care in the ED setting. The shift from providing acute care to participating in chronic care in partnership with community physicians may serve as a prototype for incorporation into ED care of other chronic illnesses.

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**Change in Approach and Delivery of Medical Care in Children With Asthma:
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