USE OF ASTHMA GUIDELINES BY PRIMARY CARE PROVIDERS TO REDUCE HOSPITALIZATIONS AND EMERGENCY DEPARTMENT VISITS IN POOR, MINORITY, URBAN CHILDREN

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Objectives To determine whether an organized, citywide asthma management program delivered by primary care providers (PCPs) increases adherence to the National Asthma Education and Prevention Program (NAEPP) Asthma Guidelines and whether adherence to the guidelines by PCPs decreases medical services utilization in low-income, minority children.

Study design Analysis of the utilization of medical services for a cohort of 3748 children with asthma who presented for care at one of six primary care urban clinics in Hartford, Connecticut, and who were enrolled in a disease management program (Easy Breathing™) between June 1, 1998 and August 31, 2002.

Results Of the 3748 children with physician-confirmed asthma, 48% had persistent disease. Paid claims for inhaled corticosteroids increased 25% (P <.0001) after enrollment in Easy Breathing. Provider adherence to the NAEPP guidelines for anti-inflammatory therapy increased from 38% to 96%. Easy Breathing children with asthma experienced a 35% decrease in overall hospitalization rates (P <.006), a 27% decrease in asthma emergency department (ED) visits (P <.01), and a 19% decrease in outpatient visits (P <.0001).

Conclusions An organized, disease management program increased adherence to the NAEPP guidelines for anti-inflammatory use by PCPs in urban clinics. Adherence to this element of the guidelines by PCPs reduced hospitalizations, ED visits, and outpatient visits for children with asthma. *(J Pediatr 2005;146:591-7)*

In the United States, asthma disproportionately affects poor, minority populations, especially children living in urban areas. Asthma prevalence rates as high as 36.8% have been reported in minority, urban, low-socioeconomic populations, and the rates are rising.[1-5]

Reducing asthma morbidity is a national healthcare objective. Despite the wide dissemination of national guidelines for the management of asthma from the National Asthma Education and Prevention Program (NAEPP), anti-inflammatory drugs, first line therapy for chronic asthma, are under-prescribed.[6-12] In addition, the effectiveness of these guidelines in reducing asthma morbidity and hospitalizations, when used in primary care settings by primary care providers (PCPs), has not been established.[13]

We conducted a study to determine whether a systematic, standardized, asthma disease management program would increase adherence by PCPs to the 1997 NAEPP guidelines for anti-inflammatory therapy and whether greater adherence was associated with a decrease in hospitalizations and emergency department (ED) visits in low-income, minority children who reside in Hartford, Connecticut, a medium-sized city, with a large low-income population.

See editorial, p 581, and related article, p 598.

METHODS

Subjects

All children between 6 months and 18 years of age who presented for medical care regardless of payer or chief complaint at any of the six primary care clinics in Hartford,

ED	Emergency department	PCP	Primary care provider
NAEPP	National Asthma Education and Prevention Program	S-CHIP	State Children's Health Insurance Plan

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Connecticut, between June 1, 1998 and August 31, 2002 constituted the eligible sample. Other than age, there were no exclusion criteria. The study was approved by the Institutional Review Board at Connecticut Children's Medical Center.

The Easy Breathing Program

Easy Breathing™ is an asthma management program for primary care clinicians.[14] The Easy Breathing program focuses on four elements of care: diagnosing asthma, determining asthma severity, prescribing therapy appropriate for the asthma severity, and developing a written Asthma Treatment Plan that is given to the family. The Easy Breathing Survey consists of four previously validated questions that aid clinicians in diagnosing asthma.[15] The Survey is completed by the parent of any child (6 months to 18 years of age) who presents for care, *regardless of chief complaint,* at a participating clinic. The Survey responses and information from the medical record are reviewed by the clinician, who responds to the question: "Does this child have asthma?" Clinicians consider a diagnosis of asthma for children with a history of recurrent (>2) episodes of wheezing, cough, and/or shortness of breath in response to known asthma triggers, when other diseases have been excluded.[6] Clinical criteria have been successfully used to predict asthma even in young children.[16]

If the clinician determines that the child has asthma, the clinician uses a separate instrument (the Provider Assessment) to ask a series of five questions about the frequency of daytime and nocturnal symptoms, exercise impairment, as needed bronchodilator use, corticosteroid prescriptions, and missed school days for asthma. Asthma severity is then determined by the clinician using the symptom frequency associated with the highest disease severity according to the NAEPP guidelines.

Once asthma severity has been determined, the clinician chooses the child's therapy using the Asthma Treatment Selection Guide, a list of drugs and dosages appropriate for asthma of that severity and of the HMOs that cover those drugs. For each child with asthma, a field-tested, written Asthma Treatment Plan is developed and is given to the child's caregiver.[17] A copy of the treatment plan also is placed in the child's medical record and is given to the program. The Asthma Treatment Plan instructs the family in how to manage the child's asthma daily; how, when, and how long to treat an asthma exacerbation; what to do in an emergency; and when to call the doctor. Changes in therapy are noted through the development and submission to the Easy Breathing program of new treatment plans.

If the clinician determines that the child does not have asthma, the clinician answers "no" to the question "Does this child have asthma?" and signs the form. No further evaluation is necessary, and these children have physician-confirmed "no asthma."

A child was considered "enrolled" in Easy Breathing if a Survey, Provider Assessment, and Asthma Treatment Plan (if the child had asthma) were completed. Ninety-three percent of all children who were surveyed were enrolled.

Providers and Clinics

Between June 1, 1998 and August 31, 2002, 33 physicians, 28 mid-level (Advanced Practice Registered Nurse, Pediatric Nurse Practitioner, Physician Assistant) practitioners, and more than 90 pediatric residents and medical students were trained in the Easy Breathing program. Newly hired clinicians were trained each year. The Easy Breathing curriculum has been previously described.[18] Briefly, the curriculum consisted of a presentation of what is known about asthma in Hartford, the definition of asthma, the clinical diagnosis of asthma, especially in young children, a brief overview of the NAEPP guidelines, and the role of inhaled corticosteroids in asthma management, including the risks. Then clinicians were introduced to the various record forms and instructed in how to use them. Finally, a series of cases were presented, and clinicians used the forms to determine the asthma diagnosis and severity and to develop a severity-specific Asthma Treatment Plan. More than 95% of the clinicians attended the training session; for the few who missed the training, the program coordinator discussed how to use the forms with the clinicians. During the first year, a pediatric pulmonologist visited the clinics for 2 hours per week to provide on-site consultation and program-related education as needed.

Of the six primary care clinics, two were hospital-based, two were federally funded health centers, and two were university-affiliated clinics. Four clinics were part of the pediatric or family medicine residency program at the University of Connecticut Health Center. These six clinics provide care for most (85%) of Hartford's children.

Sources of Data

Patient demographic information and exposure histories were obtained from the Easy Breathing Survey. Demographic data for children residing in Hartford were obtained from the 2000 United States Census. Claims data and eligibility files were obtained from Connecticut's Peer Review Organization, Qualidigm, Inc., for all Medicaid and State Children's Health Insurance Plan (S-CHIP) enrollees residing in Hartford. Asthma drugs were identified using National Drug Codes and were grouped into four categories: bronchodilators, inhaled corticosteroids, oral corticosteroids, and nonsteroidal anti-inflammatory drugs (including leukotriene modifiers).

Statistical Analyses

Univariate and multivariate logistic regression and χ^2 analysis were used to compare demographic and exposure information for children with and without asthma who were enrolled in Easy Breathing.

For the primary efficacy analyses, we examined utilization of medical services including hospitalizations, ED visits, outpatient visits, and prescriptions through analysis of paid Medicaid/S-CHIP claims. We examined the relative rates of utilization (in events/child months) of these services by children after enrollment into Easy Breathing vs the rates for the same children before enrollment. Claims data were therefore obtained for an entire year (July 1997-June 1998)

Table I. Demographics of study population

Characteristic	Hartford children: 2000 census (n = 36,568)	Medicaid children enrolled (%) (n = 8324)	Medicaid children with asthma enrolled (%) (n = 3748)
Gender			
Male	18,754 (51%)	4266 (51%)	2110 (56%)
Female	17,814 (49%)	4058 (49%)	1638 (44%)
Ethnicity			
Hispanic	18,850 (51%)	4830 (58%)	2436 (65%)
African American	13,785 (38%)	2228 (27%)	825 (22%)
Caucasian	2,172 (6%)	226 (3%)	50 (1%)
(Mixed, Other, Unknown)	1761 (5%)	1040 (12%)	437 (12%)
Age			
0.5 - 4 y	10,116 (28%)	3105 (37%)	1308 (35%)
5 - 9 y	10,746 (29%)	2442 (29%)	1169 (31%)
10 - 14 y	9,959 (27%)	2,058 (25%)	952 (25%)
15 - 18 y	5,747 (16%)	719 (9%)	319 (9%)

before the beginning of the program in order to have sufficient pre-enrollment follow-up data.

Children were continuously enrolled into the Easy Breathing program during years 2, 3, and 4 of the analysis period. Each child contributed to the analysis for every month of claims data that were available during the 4 years of data analysis. Thus, during years 2, 3, and 4, at any point in time, there were children already enrolled in Easy Breathing and children not yet enrolled. Utilization was determined by pooling the time and events of all children *after* enrollment and comparing them with the utilization rates calculated in the same way *before* enrollment. Therefore, the primary efficacy comparisons are both historical (using each child's entire utilization experience after and before enrollment) and contemporaneous, (using the utilization of all children enrolled at a given time along with all children yet to be enrolled).

To control for demographics, asthma severity at the time of enrollment into Easy Breathing, seasonal[19] and longer-term secular trends, and the effect of the aging of the cohort, the efficacy analyses were performed using multivariate marginal binary and Poisson regression models, with generalized estimating equations used to fit the models.[20] This approach takes into account the fact that children contribute multiple observations to the dataset.

RESULTS

Study Population

Between June 1, 1998 and August 31, 2002, 9339 children who resided in Hartford were enrolled in Easy Breathing. Of these 9339 children, 8324 (89%) were Medicaid or S-CHIP participants and were matched with claims data; these children constitute the study population (Table I).

Compared with all children in Hartford, children enrolled in Easy Breathing were younger (P <.001) and more often Hispanic (P <.001) (Table I). In all other respects the children who were enrolled were representative of Hartford's children.

Asthma in the Study Population

Of the 8324 Medicaid children enrolled in Easy Breathing, 3748 children had a physician-confirmed diagnosis of asthma; 1799 children (48% of the 3748 children with asthma) were diagnosed with persistent disease. In the unadjusted analysis, children *with* asthma were more likely to be Hispanic, ≥5 years of age, and male compared with children *without* asthma. Children with asthma also were more likely to report a family history of asthma, exposure to environmental tobacco smoke, cockroaches, rodents, and dust but not to cat or dog (Table II). In the multivariate analysis that controlled for family history of asthma, gender, ethnicity, age, environmental tobacco smoke exposure, rodents, cockroaches, and dust, all variables were still significantly associated with asthma.

Asthma severity was greatest in Hispanic and older children but did not vary by gender. In both the univariate and the multivariate analyses, greater disease severity was associated with Hispanic ethnicity, age of ≥5 years, a family history of asthma, and exposure to cockroaches and dust (Table II).

Prescription Drug Use

After enrollment in Easy Breathing, there was a 25% overall increase in inhaled corticosteroid use. Children with persistent asthma filled more prescriptions for inhaled corticosteroids and fewer prescriptions for bronchodilators and oral corticosteroids (Table III). Inhaled corticosteroid use also increased in children with intermittent asthma. This increase usually occurred within 6 months of enrollment in the program and was associated with an increase in asthma

Table II. Risk factors for asthma prevalence and increased asthma severity

	Unadjusted odds ratio	95% CI*	Adjusted odds ratio	95% CI
Asthma prevalence				
Hispanic ethnicity	1.79	(1.62, 1.96)	1.50	(1.36, 1.67)
≥5 years of age	1.21	(1.10, 1.32)	1.18	(1.07, 1.31)
Male gender	1.45	(1.33, 1.58)	1.50	(1.36, 1.65)
Family history of asthma	3.95	(3.54, 4.41)	3.35	(2.97, 3.77)
Tobacco smoke	1.56	(1.41, 1.72)	1.47	(1.32, 1.65)
Cockroaches	1.97	(1.76, 2.21)	1.35	(1.18, 1.55)
Rodents	2.08	(1.77, 2.44)	1.34	(1.11, 1.61)
Cat	1.03	(0.89, 1.20)	N/A†	N/A
Dog	1.1	(0.98, 1.24)	N/A	N/A
Dust	1.8	(1.63, 1.99)	1.47	(1.32, 1.65)
Increased asthma severity				
Hispanic ethnicity	1.26	(1.09, 1.44)	1.22	(1.05, 1.40)
≥5 years of age	1.16	(1.02, 1.32)	1.16	(1.02, 1.33)
Male gender	1.05	(0.93, 1.18)	N/A	N/A
Family asthma	1.34	(1.12, 1.61)	1.30	(1.08, 1.57)
Tobacco smoke	1.09	(0.95, 1.25)	N/A	N/A
Cockroaches	1.48	(1.28, 1.71)	1.40	(1.19, 1.65)
Rodents	1.32	(1.09, 1.60)	1.02	(0.82, 1.26)
Cat	1.00	(0.81, 1.23)	N/A	N/A
Dog	1.06	(0.90, 1.24)	N/A	N/A
Dust	1.37	(1.20, 1.57)	1.25	(1.09, 1.45)

*CI: 95% Confidence interval.
†N/A: not included in multivariate analysis.

severity from intermittent to persistent disease as a result of a follow-up visit. The ratio of inhaled corticosteroid to bronchodilator prescriptions almost doubled in Easy Breathing participants (0.20 to 0.35). Before Easy Breathing, 38% of the 1799 children with persistent disease were treated with anti-inflammatory therapy and half of these children were treated with cromolyn. After enrollment in Easy Breathing, 1724 of the 1799 children with persistent disease were prescribed an appropriate anti-inflammatory drug resulting in a 96% adherence to the NAEPP recommendations for the treatment of persistent asthma. Eighty-five percent of these children were treated with inhaled corticosteroids. Paid claims for prescriptions of inhaled corticosteroids in children never enrolled in Easy Breathing but cared for by the same primary care clinicians in the same clinics increased 10% between 1998 and 1999, and the increase was temporally related to program training. This suggests a "spillover" effect of the training on the provider's prescribing behavior, but changes in secular trends also could be occurring and cannot be ruled out.

Hospitalization and Emergency Department Visits

The hospitalization rate for *all* Medicaid children for asthma in Hartford before Easy Breathing (1997), was 9.65 per 100 child-years, and the rate for ED visits was 73.05 per 100 child-years (Connecticut Department of Public Health). Children subsequently enrolled in Easy Breathing accounted for 65% of all of these pre-intervention asthma hospital discharges and 46% of all ED visits where asthma was the primary diagnosis. Rates of hospitalization for asthma before enrollment in Easy Breathing demonstrated marked seasonal variation (Figure). In the multivariate analysis, the overall rate of hospitalization for all children with asthma decreased 35% after enrollment in Easy Breathing (P <.006), and the decrease was sustained for 3 years. After enrollment in Easy Breathing, seasonal variation in hospitalization rates was present, but the magnitude of the variation was substantially lower. The hospitalization rate for children with asthma (identified by ICD-9 codes) but *never* enrolled in Easy Breathing remained elevated over the 4 years of the program (data not shown).

After enrollment in Easy Breathing, Easy Breathing participants experienced a 27% overall decrease in ED visits for asthma (P <.01). Adjusted rates of both total ED visits and total hospitalizations as well as ED visits and hospitalizations specifically for asthma (ICD-9 493.xx) decreased significantly for children with persistent disease of all severities (Table IV). Hospitalization rates were low for children with intermittent disease before and after program enrollment. ED visit rates for asthma for children with intermittent disease approached but did not reach significance. In contrast, decreases in adjusted rates of outpatient visits after enrollment in Easy Breathing were found for children overall (19%; P <.0001), as well as for children with intermittent asthma (22%; P <.0001) and children with persistent asthma (18%; P <.0001). These changes in prescription patterns and medical services utilization were seen in children of all age groups and ethnicity. Rates of ED visits for children identified with asthma (493.xx) but never enrolled in Easy Breathing varied over the 4 years of the program but have increased overall over the past 3 years (from 71.3 per 100 child-years in 1997 to a low of 50.5 per 100 child-years in 1998 to 82.1 per 100 child-years in 2001).

DISCUSSION

This study demonstrates the effectiveness of a disease management program based on use of the NAEPP guidelines in reducing asthma morbidity in a large group of low-income, urban, minority children whose asthma is managed entirely by PCPs. Asthma diagnosis and treatment using the NAEPP's asthma severity categories and recommended therapies including the development of a written Asthma Treatment Plan increased inhaled corticosteroid use and decreased overall hospitalizations and asthma-specific ED visits and outpatient visits.

Inhaled anti-inflammatory therapy has been shown to decrease asthma exacerbations leading to hospitalizations [21,22] but continues to be under-prescribed by primary care

Table III. Rate of prescription drug use for children with asthma before and after enrollment in Easy Breathing

Drug (#/child/year)	Intermittent asthma†				Persistent asthma†			
	Before Easy Breathing*	After Easy Breathing*	Adjusted relative rate (CI)§	P value	Before Easy Breathing*	After Easy Breathing*	Adjusted relative rate (CI)§	P value
Inhaled corticosteroid	0.064	0.238	2.539 (1.784, 3.614)	<.0001	0.797	1.283	1.155 (1.031, 1.295)	.01
Bronchodilator	1.309	1.388	0.806 (0.728, 0.893)	<.0001	2.947	2.868	0.839 (0.769, 0.914)	<.0001
Nonsteroidal anti-inflammatory††	0.093	0.06	N/A	N/A	0.484	0.332	0.741 (0.584, 0.939)	.01
Oral corticosteroid	0.151	0.055	0.821 (0.513, 1.316)	.41	0.353	0.105	0.675 (0.505, 0.901)	.01

CI: 95% Confidence Interval.
N/A, Insufficient number of events.
*Crude rates.
†Asthma severity at time of enrollment.
††Includes cromolyn and leukotriene modifiers.
§Adjusted for gender, severity, age, ethnicity, clinic site, calendar time.

clinicians.[8-12] In this study, adherence to the NAEPP recommendations for treatment of persistent asthma by PCPs increased from 38% before Easy Breathing to 96% and has remained high for the past 3 years. In 1997, before beginning Easy Breathing, 18% of all of the Medicaid children with asthma in Hartford filled a prescription for an anti-inflammatory drug, but only half of these prescriptions were for an inhaled corticosteroid. After enrollment in the program, 46% (1724/3748) of all of the children with asthma in Easy Breathing and 96% of all the children with persistent asthma filled at least one prescription for an anti-inflammatory drug, and 85% of these prescriptions were for an inhaled corticosteroid. Prescribing an inhaled corticosteroid *alone* without the program, however, was insufficient in decreasing medical services utilization, suggesting that other program elements such as the written treatment plan or the standardized approach to therapy within the practice may be important contributors to the success of this disease management program. Use of a written Asthma Treatment Plan has been implicated in reducing asthma hospitalization and ED visits.[23]

Almost all (85%) of the children cared for in these urban clinics were either Hispanic or African American, and all were from low-income families. Racial disparities in asthma care, particularly medical prescription, have been found in children and adults in both managed care and urban clinic settings.[22,24] Easy Breathing decreased medical services utilization and increased inhaled corticosteroid therapy in children with a full range of asthma severities and appeared to be effective in both younger and older children, and in Hispanic and African American children. Importantly, the benefits of the program have been sustained for 3 years.

We believe that Easy Breathing has been successful in changing provider behavior because it focused almost exclusively on asthma diagnosis and therapy, areas that were important to the providers rather than taking a multi-domain,

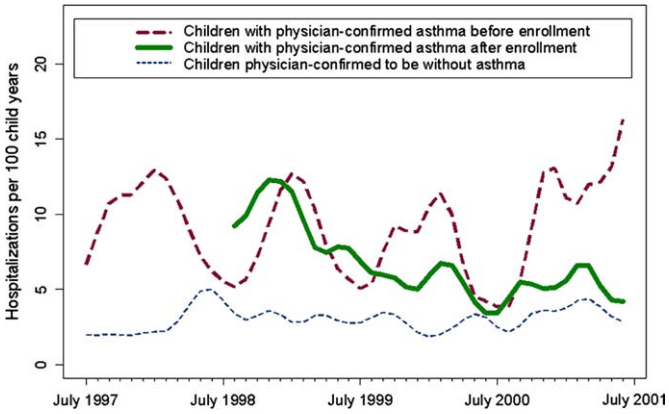

Figure. Rates of hospitalization per 100 children years enrolled in Easy Breathing. The rates of hospitalization per month were determined from Medicaid claims data for children with physician confirmed no asthma, for children with physician-confirmed asthma before their enrollment in Easy Breathing, and for children with asthma after their enrollment in Easy Breathing. The individual monthly rates were connected by lines that reflect the weighted moving averages for each of these three groups.

all-encompassing, comprehensive approach. This prioritization of the components of care might have helped clinicians better allocate their limited time. Furthermore, some clinicians have argued that not all components of asthma care are necessary, and some have even eliminated parts of the asthma guidelines that they consider "inapplicable" and "nonpractical."[25,26] In this project, clinicians conceptually agreed that proper diagnosis and treatment of asthma were important, and the program focused on this outcome.[14]

The study has a number of limitations. First, study participants were not randomized and although all children in Hartford were eligible and more than one third of the children identified with asthma (using ICD-9 codes and Medicaid

Table IV. Rates of medical services utilization for children with asthma before and after enrollment in Easy Breathing

Medical service (#/child/year)	Intermittent asthma†				Persistent asthma†			
	Before Easy Breathing*	After Easy Breathing*	Adjusted Relative Rate (CI)§	*P* value	Before Easy Breathing*	After Easy Breathing*	Adjusted relative rate (CI)§	*P* value
Hospitalization	0.058	0.042	0.782 (0.453, 1.350)	.38	0.138	0.074	0.651 (0.454, 0.932)	.02
ED visit	0.631	0.568	0.915 (0.799, 1.049)	.20	0.82	0.678	0.880 (0.776, 0.999)	.05
Outpatient visit	3.76	3.182	0.782 (0.722, 0.847)	<.0001	4.639	3.775	0.821 (0.770, 0.876)	<.0001
Hospitalization (493.xx)	0.012	0.012	N/A††	N/A	0.086	0.0342	0.611 (0.372, 1.002)	.05
ED visit (493.xx)	0.07	0.067	0.689 (0.466, 1.018)	.06	0.169	0.111	0.717 (0.525, 0.979)	.04
Outpatient visit (493.xx)	0.526	0.445	0.607 (0.517, 0.712)	<.0001	1.262	0.93	0.746 (0.658, 0.846)	<.0001

CI: 95% Confidence Interval.
*Crude rates.
†Asthma severity at time of enrollment.
††*N/A*: insufficient number of events.
§Adjusted for gender, severity, age, ethnicity, clinic site, calendar time.

claims data, Department of Public Health, State of Connecticut) were surveyed, this study sample was not random. Providers appear to have targeted children with asthma. Many other eligible children with asthma were not enrolled in the program. Reasons for not enrolling children in Easy Breathing included time constraints during office visits and the need to deal with other urgent issues at the time of the visit including acute asthma management. Children with asthma continue to be enrolled in the program, and it is hoped that eventually all children will be enrolled. Children with asthma who used more medical services were more likely sampled. These children also experienced high rates of hospitalization and ED visits. Nevertheless, these children represent the burden of asthma on the medical community. Over-sampling of persons who utilize medical services may be appropriate for programs like Easy Breathing that are designed to decrease medical services utilization. Despite this over-sampling, the risk factors for asthma prevalence and increased asthma severity are similar to what have been reported in other urban, minority communities with similar ethnic groups.[27-29]

We also used paid claims data that underestimate the number of prescriptions written by PCPs (eg, dispensed samples). This underestimation should be the same for children in Easy Breathing and for children with asthma not enrolled in the program. We also have no measure of patient adherence to therapy. Although these factors are undoubtedly significant, they do not change the results of improved asthma management in the enrolled children. Finally, all of the study sites were urban clinics, and thus, our results may not be generalized to private practices.

We did not directly measure the cost and savings associated with the Easy Breathing program. Children with asthma enrolled in Easy Breathing experienced an overall decrease in hospital days of 0.209 days/child-year. Using the average cost of a hospital day in Connecticut, this amounts to an average decrease of approximately $355/enrolled child with asthma per year. Implementation of the program required a coordinator, a physician champion, a data manager, and forms at a cost of $34/enrolled child per year. These net savings are sufficient to offset the cost associated with the increased use of prescription medication. We also observed that total hospitalizations decreased more than hospitalizations for asthma. This would seem to indicate that some of the burden of asthma is not reflected in hospital primary discharge diagnoses, and that children are hospitalized with other diagnoses that are probably aggravated by their asthma (eg, pneumonia). A similar association, although not significant, has been previously observed.[30]

In summary, a citywide asthma disease management program for PCPs was successful in increasing adherence to the NAEPP guidelines. In addition, adherence to the guidelines resulted in a reduction in hospitalizations, ED visits, and outpatient visits.

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