

## Influence of an Interventional Program on Resource Use and Cost in Pediatric Asthma

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### **Abstract**

**Objective:** Asthma is the most common chronic condition of childhood, for which morbidity, mortality, and cost are increasing. This study was performed to determine whether patient education and assignment to a primary care provider improve outcomes and cost in the management of pediatric asthma.

**Study Design:** A prospective pilot study of 61 patients was conducted with a retrospective review. Data were obtained from health and pharmacy records.

**Patients and Methods:** Sixty-one unassigned pediatric asthma patients who were noted to be frequent users of emergency department services and who had no primary care provider were identified. This cohort received asthma education and was assigned a provider trained in the national asthma guidelines. Hospital admissions, Emergency Department and clinic visits, use of  $\beta_2$  agonists and anti-inflammatory drugs, number of chest radiographs, and continuity of care were recorded for a mean of 58.1 months before and 11.2 months after the intervention. A cost analysis was done.

**Results:** All measured parameters showed favorable changes after intervention, with the decrease in the number of prescriptions of monthly inhaled anti-inflammatory drugs and chest radiographs ordered being statistically significant ( $P = 0.007$  and  $P = 0.040$ , respectively). Monthly admissions, Emergency Department visits, and clinic visits declined after intervention when evaluated after 22.8 months of follow up. Annual resource savings after intervention was estimated to be \$4845.29 per patient for this military hospital.

**Conclusions:** A combined intervention consisting of provider and patient education and assignment to a primary care provider was associated with improved care and economic outcomes in this group.

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Asthma is the most common chronic disease of childhood, and over the decades, its prevalence, morbidity, and cost have increased, with no decline in mortality.<sup>1,5</sup> The outcome remains poor despite the reversible nature of the disease, heightened asthma awareness, and an expanding formulary of therapeutic agents.<sup>6</sup> To reverse these trends, not only have national guidelines for the management of pediatric asthma been issued in Australia, England, and the United States,<sup>7,9</sup> but global guidelines and strategies for prevention and management have also been developed.<sup>10,11</sup>

The overall economic impact of asthma in the United States has been estimated at \$6 billion a year, the major portion attributable to hospitalization.<sup>12,13</sup> Deaths and hospitalizations from asthma are largely preventable, but failure to recognize the disease and suboptimal treatment contribute significantly to the morbidity and mortality.<sup>10</sup> Because appropriate outpatient management can reduce the need for hospitalization and conserve resources expended for acute exacerbations,<sup>14</sup> significant financial resources are being devoted to asthma self-management and partnership programs.<sup>15</sup>

The Department of Defense Civilian External Peer Review Program recently assessed compliance with the "Guidelines for the Diagnosis and Management of Asthma" issued by the National Heart, Lung, and Blood Institute (NHLBI) and the impact of these guidelines on the care of pediatric asthma patients.<sup>16</sup> Eleven Military Treatment Facilities across the United States with high numbers

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of pediatric asthma patients were studied. An Asthma Focus Management Group was formed at one of the participating military hospitals to improve local asthma outcomes using the NHLBI guidelines.

The management of asthma is still being optimized. Education and outreach programs can improve outcomes and decrease costs,<sup>17,18</sup> and facilitated referral of care to specialists appears to produce more favorable outcomes.<sup>19,21</sup> The effects of the NHLBI guidelines on the provision of asthma care by generalists has not been well documented as yet.

The purpose of this study was to evaluate whether local intervention could improve care and decrease costs for children requiring frequent care for attacks of acute asthma. The intervention was twofold: (1) education of patients and providers in the National Asthma Education Program guidelines and (2) assignment of patients to a primary care provider

... METHODS ...

**Patients**

A prospective pilot study of pediatric asthma patients was conducted at a southeastern US military hospital. "Unassigned" pediatric asthma patients (patients without a primary care provider) were identified during an acute asthma exacerbation by the Emergency Department staff. The entry dates for these patients were 7/1/95 through 10/30/95. If siblings were subsequently identified to have asthma, they were excluded from the study in order to minimize possible environmental factors (eg, selection bias).

**Interventions**

The patients' parents were offered an asthma education class between July 1995 and October 1996. The classes were taught by pediatric nurse practitioners. Classes were held in small groups of 2 to 10 parents and consisted of two sessions. Parents were instructed in the NHLBI asthma guidelines including recognition, triggers, environmental factors, management plan, medication use, spacer, and peak flow use.

Patients were also assigned a primary care provider at the time of the class for regular healthcare maintenance and follow-up. This designated provider was either a nurse practitioner, pediatrician, or family physician trained in the NHLBI guidelines. A total of five 1-hour continuing medical education "asthma update" lectures were given at noon conferences during the time of the study. Lecturers included guest pulmonologists, allergists, and pediatric pulmonologists. The lectures were well attended by providers, an outcome of wide publicity, encouragement to attend, and provision of lunch.

**Data Collection**

Data was collected for all class attendees with available health records (n = 61) for the periods before and after the intervention (the date of the first of the two classes was taken as the date of the intervention). Outpatient records provided the date of the first visit for asthma symptoms that resulted in a diagnosis and treatment for asthma and the date of the asthma class attended. Time intervals were measured in months before and after the asthma class. The observation period ended on February 1, 1997, the date that the chart review was initiated.

Outpatient health records and pharmacy data were reviewed by physicians or nurse practitioners who were unfamiliar with the patients, uninvolved with teaching the class, and unaware of whether the patient had attended the class. Reviewers were trained by the investigator. Class attendance was documented in a separate log book and in most cases was not listed in the outpatient chart.

**Costs of Resource Use**

The resource use for six parameters was projected over a 12-month period before and after the intervention. Pharmaceutical costs

**Table 1.** Resource Utilization Per Patient Before and After Intervention

	Annual Cost Before Intervention (\$)	Annual Cost After Intervention (\$)	Difference (\$)
Hospitalization	4563.20	214.40	4348.80
ER visits	330.90	82.00	248.930
Clinic visits	605.60	408.10	197.50
Chest radiographs	60.85	5.23	55.62
Inhaled anti-inflammatory drugs	7.86	16.47	-8.61
β <sub>2</sub> agonists	8.94	5.86	3.08
Total cost per patient year before class			\$5,577.35
Total cost per patient year after class			\$732.06
Difference in resources used per year per patient			\$ 4845.29

were obtained from the military pharmacy price listing for the most commonly prescribed inhaled  $\beta_2$  agonist (albuterol 17gm, \$2.91) and inhaled anti-inflammatory agent (triamcinolone 20gm, \$6.97) as of May 1997. Average costs for treating pediatric asthma were obtained from the Managed Care Department at the military hospital as of May 1997. Costs used were as follows: hospitalization, \$2552.16 for 2.1 days, the average length of stay; ED, \$244.05 including professional fee; clinic visits, \$109; and posterior/anterior and lateral chest radiographs, \$31.11.

### Outcomes

Outcomes measured both before and after the interventions were (1) hospital admissions, (2) ED visits, (3) outpatient clinic visits (Pediatric, Family Practice, or Primary Care), (4) visits with the same provider (continuity measure), (5) number of chest radiographs ordered, (6) number of prescriptions for inhaled anti-inflammatory agents and  $\beta_2$  agonists.

### Analysis

Outcomes data were converted to monthly means for comparison. The means, before and after intervention, were compared with a paired *t* test. Data were entered into Epi Info Version 6 (Centers for Disease Control, Atlanta, GA) and analyzed with SPSS software (Chicago, IL).

Table 1 shows the projected annual costs of treating pediatric asthma before and after the intervention. The power was 0.98 with one standard difference and was calculated with the Altman method.<sup>22</sup>

## ... RESULTS ...

A total of 61 outpatient charts and pharmacy records were reviewed. These 61 patients had documented attendance at the asthma class and were assigned a primary care provider. The demographic characteristics of this population were as follows: mean age, 8.4 years (range, 2.1 to 17.1 years); gender—67.2% male, 32.8% female; race—50.9% Caucasian, 38.6% African American, 4.0% Asian, and 2.0% Hispanic (four patients did not list their race).

### Outcomes

The absolute numbers of clinical events are listed in Table 2. The period of review was a mean of 58.1 months before the class and 11.2 months after the class. Monthly means were also calculated before and after the intervention for the various outcomes. After the intervention, statistically significant reductions were observed in the number of chest radiographs ordered (*P* = 0.040) and prescriptions for inhaled anti-inflammatory medication (*P* = 0.007). There was a strong trend toward statistical significance for inpatient admissions, ED, and clinic visits after 11.2 months of follow up.

Additional follow up for admissions and ED visits was obtained from computer records for 44 patients

**Table 2.** Clinical Activities Before and After Intervention (Absolute Numbers)

	Before Intervention (Mean, 58.1 Months)	After Intervention (Mean, 11.2 Months)
Hospital admissions	44	4
ED visits	147	18
Clinic visits	764	212
Chest radiographs	119	9
Visits with primary provider	260	141
Inhaled anti-inflammatory drugs	168	134
Prescriptions of $\beta_2$ agonists	324	115

ED = emergency department

**Table 3.** Clinical Activities (Monthly Means) Before and After Intervention

	Monthly Mean Before Intervention	Monthly Mean After Intervention	<i>P</i> Value
Hospital admissions	0.149	0.007	0.164
ED visits	0.113	0.028	0.147
Clinic visits	0.463	0.312	0.083
Visits with same provider	0.181	0.201	0.610
Chest radiographs	0.163	0.014	0.040
Prescriptions of inhaled anti-inflammatory drugs	0.094	0.197	0.007
Prescriptions of $\beta_2$ agonists	0.256	0.168	0.345

ED = emergency department

who were still receiving healthcare at the facility. The mean time postintervention was 22.8 months for this group. The number of postintervention admissions and ED visits for asthma in this group totaled 5 and 24, respectively ( $P = 0.155$  for admissions and  $P = 0.093$  for ED visits, when compared with preintervention data).

### Resource Use

The intervention led to savings in all categories, except the inhaled anti-inflammatory drugs. The highest annual savings was on inpatient admissions—\$4348.80 per patient—followed by savings on ED and clinic visits.

### ... DISCUSSION ...

In our cohort, the combined intervention of patient and provider education and assignment to a primary care provider was associated with improvement in all measured parameters, with the decrease in numbers of chest radiographs and prescriptions for anti-inflammatory drugs being significant. Although the decrease in mean number of admissions after intervention was not statistically significant, the clinical and financial implications of an annual admission rate (calculated from the monthly average in Table 3) of 1.78 before intervention versus 0.084 after intervention is noteworthy. The same is true for annual ED visits (1.36 before intervention versus 0.34 after intervention) and clinic visits (5.56 before intervention and 3.74 after intervention). The continuity of care measure and inhaled  $\beta_2$  agonist use did not demonstrate clinical or statistical significance.

An additional 1003 patient months of follow up, to 22 months, for patients still in our healthcare system was obtained from review of computerized medical records. We used the same methods to analyze numbers of admissions and ED visits for asthma. This data showed a continued trend toward statistical significance as the  $P$  values decreased to 0.155 and 0.93 for admissions and ED visits.

On the basis of quoted costs the intervention was associated with savings on resource use per patient year of \$4845.29 for this hospital. The largest savings was on inpatient admission (constituting 93.4% of the total savings). A 2.1 day stay, the average length of stay at this facility (ICD-9 493.00) for a ward admission, was used in our calculations. After 11 months of follow up for these 61 patients, a cumulative reduction in resources used equated to \$270,932.44 for this hospital.

This pilot study has several limitations. (1) Since attendees of these classes chose to do so, they may represent a more motivated group. (2) The records were available and reviewed for only 61 of the 216 class

attendees. (3) In this military population for whom the average tour of duty at a specific location may be 2 to 4 years our sample may be representative of that population; however, sampling bias and local environmental factors must be considered. (4) Changes in current practice patterns may account for some of the decreases in measured parameters, for example, providers may be ordering fewer chest radiographs in general. (5) The reviewers were not completely blinded in the chart review process because some charts contained progress notes documenting attendance or nonattendance at asthma class. (6) Follow up was short, less than 1 year after intervention. Longer follow up would presumably document statistically significant changes in several key parameters (eg, admissions, ED visits, and clinic visits). The effect of aging and the natural course of asthma on this young cohort of frequent users of services is probably of only minimal significance.

Although the results from this sample are not expected to be generalizable to other than the general military population, this study does support intervention by local asthma focus groups and primary care providers trained in the National Asthma Education Program guidelines. The high prevalence, preventative and reversible nature of this disease, and opportunity to further optimize treatment, provide tremendous potential for improving the management of pediatric asthma.<sup>15</sup>

Although issues such as the degree of patient self-management, and nature of the therapeutic alliance forged with the healthcare delivery system is ongoing, primary care providers are central to the national management plan for pediatric asthma.

In summary, a combined intervention of education and assignment to a primary care provider was associated with improved outcomes and resource savings among our pediatric patients who were users of asthma emergency services. Further randomized, controlled studies with wider sampling and longer follow up are needed.

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