Effectiveness of an Asthma Management Program for Pediatric Members of a Large Health Maintenance Organization

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**Objective:** To assess the impact of an asthma management program on the dispensing of inhaled corticosteroids, hospitalizations, and emergency department (ED) visits on children, adolescents, and young adults.

**Design:** We used medical record and pharmacy data for the 18 months after initiation of a pilot asthma management program. Two intervention offices were matched with 2 control offices on pediatric volume, number of pediatricians or family practitioners, and specialist availability.

**Setting:** Primary care offices at Kaiser Permanente Colorado, in Denver and Boulder.

**Patients:** We identified 298 patients, 18 years or younger, who were listed in an asthma registry between February 1 and July 31, 1997, as having moderate or severe asthma.

**Intervention:** The Kaiser Permanente Colorado Asthma Care Management Program is an outpatient-based program that provides comprehensive evaluation, education, and follow-up to patients identified from an asthma registry or referred by providers.

**Main Outcome Measures:** The proportion of patients who received more than 1 dispensing of inhaled corticosteroid during the observation period. Additional outcomes measured the proportion of patients with 1 or more hospitalizations or ED visits.

**Results:** A significantly greater proportion of patients from the intervention group received more than 1 dispensing of inhaled corticosteroid compared with controls (relative risk [RR], 1.41; 95% confidence interval [CI], 1.08-1.72). We found no significant difference in the proportion of patients who were hospitalized (RR, 1.37; 95% CI, 0.48-3.71) or visited the ED (RR, 0.86; 95% CI, 0.49-1.40).

**Conclusions:** The presence of an asthma management program may improve dispensing of inhaled corticosteroids to young patients with moderate or severe asthma, as recommended by national guidelines. This type of program may not have an effect on hospitalizations or ED visits.

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**Asthma:** The most common chronic illness of childhood, affects an estimated 4.8 million children, adolescents, and young adults in the United States. This number represents a marked increase in prevalence during the past 2 decades. Medical treatment of asthma has also recently changed. Changes in therapy are due to awareness of airway inflammation as a major mechanism in the pathophysiology of chronic asthma. National guidelines developed by the National Asthma Education Program of the National Institutes of Health recommend inhaled anti-inflammatory medications as a major component of treatment. Published literature suggests that provider compliance with National Asthma Education Program guidelines is low. When guidelines are followed, evidence suggests improved outcomes for patients receiving inhaled anti-inflammatory medications. Some studies indicate a 40% to 50% reduction in hospital admissions for children and adults with asthma.

Recently, asthma management programs have evolved as a response to increasing trends in prevalence, morbidity, and mortality of asthma. Outcome evaluations of asthma management programs have identified increasing knowledge about asthma and symptom-free days, but the effects on emergency department (ED) visits and hospitalizations are less clear. Few studies have examined the effect of asthma programs on processes of health care, particularly studies targeting children.

In February 1997, a pilot asthma management program began at 2 of the 15...
offices of Kaiser Permanente Colorado (KPC). We compared the effects of the program on intervention group patients receiving health care where the asthma management program was available and control group patients receiving health care at an office where the program was not available. The KPC pilot asthma program targeted high-risk patients with moderate or severe disease. The primary aim of our study was to determine whether this program resulted in improved medical management for children, adolescents, and young adults with moderate or severe asthma as measured by an increase in the dispensing of inhaled corticosteroids. The secondary objective of the study was to assess the effect of asthma management on the use of health care services (hospitalizations and ED, acute outpatient, and allergy-related visits).

### PATIENTS AND METHODS

#### STUDY SETTING

The study was conducted at KPC, a nonprofit, group-model health maintenance organization that serves 350,000 members and approximately 86,000 pediatric members in the Denver/Boulder metropolitan area. Members of KPC receive comprehensive health care, including prescription medications and equipment. Approximately 97% of members have a pharmacy benefit. In 1997, 3% of KPC patients aged 5 to 18 years (approximately 2000 patients) were identified as having persistent asthma.

Subjects for the study were identified from the Asthma Disease Management System at KPC. This is a registry of all members identified with asthma from the KPC administrative databases (outpatient, ED, inpatient, and pharmacy tables). Asthma care managers can manually add missed members or delete members from the registry when their medical charts indicate an incorrect assessment. Criteria for entry include members who, in the previous 12 months, meet at least 1 of the following: 1 inpatient hospitalization for asthma, 2 or more outpatient asthma-related visits, 2 or more β-agonist dispensings, 1 or more corticosteroid and 1 or more β-agonist dispensings, or 4 or more of the total of all β-agonist, cromolyn sodium, corticosteroid, and theophylline dispensings.

The intervention group for the study included 2 offices that piloted the KPC Asthma Care Management Program. The control group was ascertainment during study design by selecting 2 KPC offices matched to the 2 intervention offices by geographic location, pediatric department size, number of pediatricians, office hours, accessibility to an allergist, and patients’ Medicaid status. Intervention and control offices consisted of 1 larger office and 1 smaller office. The larger office in both groups included 8 to 9 pediatricians and an on-site allergist. These offices had daytime hours, 7 days a week. The smaller office in both groups included 1 pediatrician and 3 family practitioners. No allergist was staffed at either small office. Office hours were daytime, Monday through Friday. Routine asthma care for all patients at KPC included medical therapy by a primary care physician or a midlevel provider with the availability of allergy consultation, standardized written home health care plans, and regionwide asthma education programs. Intervention group patients and their providers also had an on-site asthma care nurse. Intervention group patients with moderate or severe asthma were eligible for outreach by the asthma care nurse and could receive care if identified and if the parents agreed to participate.

### THE ASTHMA CARE MANAGEMENT PROGRAM

The KPC Asthma Care Management Program began development in 1995 to provide disease management to members with asthma. In addition to focusing on individual patient care, asthma care nurses identified high-risk patients for outreach, provided physicians with consultation and guidelines for referral, created patient-status reports, and provided education and in-service training for staff. Two registered nurses performed all program activities after receiving education on asthma management from an asthma nurse specialist and a KPC pulmonologist.

Initial evaluation of program implementation during the pilot period indicated that the asthma care nurses spent approximately 40% of their time with patients (eg, giving patient care and making telephone calls) and 60% of their time with administration, training and education, and meetings. Asthma classes were also provided during the pilot period to members with less severe disease who were referred by their health care provider.

#### STUDY POPULATION

The study population consisted of patients 18 years or younger who were identified from the asthma registry between February 1 and July 31, 1997. A total of 6274 patients were identified. The population was limited to those whose primary office site was 1 of the 2 pilot offices or 1 of the 2 control offices (n=2613). The population was further limited to continuous KPC members from 1 year before registry identification to the end of the 18-month study after registry identification (February 1, 1996, through August 1, 1998) (n=1921).

From this population, patients with moderate or severe asthma were identified. Criteria for defining these patients were based on similar criteria used by asthma care nurses to identify high-risk patients. The criteria reflect National Asthma Education Program classification of asthma severity and included patients with 1 or more of the following: at least 1 hospitalization or ED visit for asthma in greater than 6 canister equivalents of β-agonist in the past 6 months, or dispensing of 2 or more oral prednisone bursts in the past 6 months.

Study population patients receiving care at a pilot office were eligible to receive the asthma management program. Nurses identified patients with moderate or severe asthma from the monthly asthma registry and provided outreach to patients they identified as being at high risk. Parents of identified patients were contacted via telephone and participation was voluntary. If a parent agreed to participate, the patient received an initial comprehensive evaluation by the asthma care nurse, including a thorough medical and environmental history. Patients and parents also received education regarding asthma physiology, symptom and trigger recognition, and methods to avoid triggers. Patients and their families were educated on proper use of medications and equipment, such as peak flow meters and inhalers. Finally, each patient was given a written home health care plan for long-term treatment and for response to exacerbations. All patients received a follow-up telephone call within 2 to 3 weeks after the initial visit. Continued telephone contacts or office visits depended on the patient’s needs. Patients were discharged from the program when they demonstrated the ability to manage their asthma at home, the patient or the parent declined further management, or the patient left KPC.

#### OUTCOMES MEASURED

The observation period was defined as the 18 months after initiation of the pilot program (February 1, 1997, through August 1, 1998). The primary outcome of interest was the
The proportion of patients with more than 1 dispensing of an inhaled corticosteroid during the observation period and was measured by means of electronic pharmacy data. We hypothesized that a greater proportion of intervention group children would receive more than 1 dispensing of inhaled corticosteroid than controls. Since dispensing of 1 canister of inhaled corticosteroid may represent short-term or rescue use of the medication during an acute exacerbation, our primary outcome attempted to characterize the dispensing of an inhaled corticosteroid as a controller or long-term medication. Although the number of inhaled corticosteroid canisters dispensed may be the ideal outcome, this measurement was not possible because of the large number of subjects not dispensed any inhaled corticosteroids during the observation period. This necessitated the use of a dichotomous outcome variable.

Hospitalizations, ED visits, acute asthma-related outpatient visits, and referrals to an allergist were assessed as secondary health care outcomes and measured by means of electronic claims data. We hypothesized that proportionately fewer intervention group patients than controls would have 1 or more hospitalizations, ED visits, acute asthma-related outpatient visits (defined as an outpatient asthma-related visit with a nebulized β-agonist treatment given at the visit), or allergy referrals. Finally, in an effort to assess medical treatment after an acute asthma exacerbation, we hypothesized that a greater proportion of intervention group patients would be dispensed an inhaled corticosteroid within 1 month of an acute visit for asthma (outpatient or ED visit or hospital admission) and would have had no dispensing of an inhaled corticosteroid in the previous 2 months.

**STATISTICAL ANALYSIS**

Analysis was performed using SAS Version 8.0 software. Baseline characteristics were measured for the 12 months preceding the study period (February 1, 1996, through January 31, 1997). Baseline covariates included age, sex, dispensing of asthma medications, asthma-related visits, asthma-related hospitalizations, ED visits, and referrals to an allergist. Information regarding income and race/ethnicity was not available. We performed univariate analyses using χ² tests. Logistic regression was used to estimate the odds ratios of the various outcomes for the intervention group vs the controls after controlling for the primary outcome at baseline and for important confounders. Relative risks (RRs) were then calculated from the odds ratios according to the methods of Zhang and Yu. We tested interactions between the group assignment and the primary outcome at baseline and between the group assignment and the covariates retained in the final model. In all models, the independent variables age, sex, dispensing of baseline β-agonist and inhaled corticosteroid, baseline allergy referral, baseline asthma-related hospitalizations, and ED and acute outpatient visits were retained. Post hoc power analyses were performed for observed intervention differences, because sample size was limited to data available. Consistent with the intention-to-treat model, all subjects were included in the analyses according to their site assignment and regardless of actual enrollment in the asthma management program.

**RESULTS**

Of the 1921 patients identified from the asthma registry and eligible for this study population, 298 met the defined criteria for moderate or severe asthma (Figure). Patients enrolled in Medicaid constituted less than 3% of the population.

The Table compares the characteristics of the intervention and control groups during the 12-month baseline period. Significant differences at baseline included a higher percentage of intervention group patients dispensed a β-agonist (P = .02) and a higher percentage of controls referred to an allergist (P = .04).

Forty-five (28%) of the 163 patients in the intervention group visited the asthma care nurse. Baseline characteristics of these 45 patients compared with those in the intervention group who did not receive the program revealed no significant differences in age, sex, use of health care services, or dispensing of asthma medications. Data were not available to determine the extent to which patients not participating in the program were contacted regarding participation.

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**Table**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Intervention, No. (%)</th>
<th>Control, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-4</td>
<td>(n = 163)</td>
<td>(n = 135)</td>
</tr>
<tr>
<td>0-4</td>
<td>22 (13)</td>
<td>28 (21)</td>
</tr>
<tr>
<td>5-9</td>
<td>35 (21)</td>
<td>33 (24)</td>
</tr>
<tr>
<td>10-14</td>
<td>70 (43)</td>
<td>47 (35)</td>
</tr>
<tr>
<td>15-18</td>
<td>36 (22)</td>
<td>27 (20)</td>
</tr>
<tr>
<td>Male†</td>
<td>98 (60)</td>
<td>91 (67)</td>
</tr>
<tr>
<td>Use of health care services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospitalized in past year</td>
<td>25 (15)</td>
<td>15 (11)</td>
</tr>
<tr>
<td>ED visit(s) in past year</td>
<td>75 (46)</td>
<td>63 (47)</td>
</tr>
<tr>
<td>Dispensings of asthma medications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In past year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>β-agonist‡</td>
<td>160 (98)</td>
<td>125 (93)</td>
</tr>
<tr>
<td>Inhaled corticosteroid</td>
<td>102 (63)</td>
<td>74 (55)</td>
</tr>
<tr>
<td>Oral corticosteroid</td>
<td>123 (75)</td>
<td>98 (73)</td>
</tr>
<tr>
<td>Referral to an allergist‡</td>
<td>34 (21)</td>
<td>42 (31)</td>
</tr>
</tbody>
</table>

*ED indicates emergency department.
†Sex was unknown in 1 patient.
‡Differences were significant (P < .05).
During the 18-month observation, 86 (53%) of 163 patients in the intervention group and 55 (41%) of 135 controls received more than 1 dispensing of inhaled corticosteroid (crude RR, 1.30; 95% confidence interval [CI], 1.01-1.66). Results of multivariate analysis indicated that the RR for more than 1 dispensing of inhaled corticosteroid was significantly greater for patients receiving health care at an office where an asthma management program was available (RR, 1.41; 95% CI, 1.08-1.72). This result was independent of the patient’s age, sex, and baseline asthma characteristics (ie, dispensing of a β-agonist medication or >1 inhaled corticosteroid, referral to an allergist, and asthma-related hospital admissions, ED visits, and acute outpatient visits during the baseline period).

During the observation period, we found a trend toward intervention group patients having a greater proportion of hospital admissions (n=17 [10%]) compared with controls (n=6 [4%]). After controlling for baseline differences between groups, the adjusted RR for hospitalizations was 1.37, and was not statistically significant (95% CI, 0.48-3.71). Assessment of ED visits indicated that the proportions of intervention group patients and controls visiting the ED were similar during the observation period (26% and 22%, respectively). Results of multivariate analysis also showed no significant difference between the groups (RR, 0.86; 95% CI, 0.49-1.40).

Multivariate analysis predicting 1 or more acute outpatient asthma-related visits showed no significant difference between the intervention and control groups (RR, 1.16; 95% CI, 0.70-1.84). Also, no significant difference was found between the intervention and control groups for the proportion of patients referred to an allergist during the observation period (RR, 0.92; 95% CI, 0.52-1.48). Finally, we examined all patients who had any type of acute visit (outpatient or ED visit or hospitalization) and did not receive a dispensing of an inhaled corticosteroid in the preceding 2 months and compared the proportion of intervention and control patients who received a dispensing of an inhaled corticosteroid within 1 month of their visit. We found no significant difference for this outcome (RR, 1.11; 95% CI, 0.65-1.59).

Our data, however, limit us from inferring improvement in adherence to recommended treatment guidelines. Continued emphasis on program delivery may lead to better guideline adherence over time and possibly to better clinical outcomes measured by hospitalizations and ED visits.

The absence of a reduction in asthma-related hospitalizations and ED or acute outpatient visits in this study may be due to a lack of statistical power to detect a difference of the magnitude observed. Other studies have shown mixed results for these outcomes. Greineder et al22 evaluated an asthma management program provided in a large health maintenance organization outpatient setting. Intervention group patients receiving the program plus telephone follow-up for 1 year demonstrated an additional 57% decline in ED visits and an additional 75% decline in hospitalizations compared with controls receiving the initial program only. Two studies evaluating hospital-based programs in the United Kingdom showed a significant decline in hospital readmissions.20,21 Several other studies evaluating the effects of programs on hospital and ED visits, however, showed no significant difference.10,16,18,22,23

Interpreting results from this study may be limited by the lack of program implementation to most of the intervention group. Although a statistically significant RR was found for patients receiving care where an asthma management program was available, the effect of the intervention itself is indeterminate. Lack of significant effect on the use of health care services may also be due to a lack of program implementation. As noted, only 27% of the patients identified with moderate or severe asthma actually received the program. Lack of an effect on use of health care services may be due to what McKinley26 has termed type III error, ie, the conclusion that an intervention is not effective when in actuality the intervention is not implemented. Examining program effectiveness, however, may be useful and clinically important because it better reflects the effects of an active, working program in a primary care setting.

The lack of full implementation in this study also highlights the inability of many programs to reach all of their target population and suggests the need to improve recruitment to or participation by the most needy groups. In our study, asthma care nurses saw approximately 300 adults and children and contacted an additional 250 persons by telephone during the observation period. Asthma care nurses spent less than half of their time providing patient care and the remainder identifying high-risk patients, consulting, and performing administrative duties. Thus, the workload of asthma care nurses may limit the feasibility of the program to reach children with more severe asthma. One strategy might be to refer children with less severe asthma to more general asthma classes and to restrict use of the asthma management program to those with more severe disease.

This study was also limited by unknown differences among providers and staff working in the intervention and control offices that could affect the management of asthma. Finally, this study measured only the dispensing of asthma medications, which does not take into account compliance or proper medication use.

**COMMENT**

This study evaluated the effectiveness of an outpatient-based asthma management program for pediatric members of a large health maintenance organization by assessing the dispensing of inhaled corticosteroids and the use of various health care services (asthma-related hospital admissions, ED and acute outpatient visits, and allergy referrals). The program, delivered by registered nurses to patients of all ages in a primary care office, was designed to provide thorough evaluation, education, treatment, and follow-up to patients and consultative support to staff and health care providers.

We found that a significantly greater proportion of intervention group patients received more than 1 dispensing of inhaled corticosteroid compared with controls. Our result suggests that the presence of this type of program may improve clinical management of moderate or severe asthma in our study age group.
This study suggests that presence of an asthma care management program may increase the proportion of children and adolescents with moderate or severe asthma who are dispensed an inhaled corticosteroid. It did not find a reduction in clinical outcomes of asthma-related hospital admissions, ED or acute outpatient visits, or allergy referrals. The lack of significant clinical effect may be due to the small percentage of patients with moderate or severe asthma actually receiving the program, which emphasizes the need for improved recruitment and implementation of the program to these patients. Further evaluation assessing the effect of increased dispensing of inhaled corticosteroids on the quality of the lives of children, adolescents, and young adults (eg, symptom-free days, hospitalizations, and ED visits) would be useful.

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