Outcomes of a population-based asthma management program: quality of life, absenteeism, and utilization

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Background: Despite the availability of the National Asthma Education Program (NAEP) guidelines since 1991, asthma remains inadequately managed. To improve quality of life, functional status, and self-management behavior of asthma patients, a large health maintenance organization (HMO) in California implemented an asthma management program in 1996.

Objective: To evaluate the effectiveness of an asthma management program in an HMO setting.

Design and Setting: Prospective study. Survey data from members who participated in the intervention program and data from members who received usual care were analyzed using propensity score technique.

Results: A total of 1,043 asthma patients who responded both baseline and follow-up survey were included in the analysis. From baseline to followup, participants in the in-home intervention program reported significant improvement in functional status (improvements range from 0.2 to 7.2), daily use of steroid inhaler (+4.1%), daily peak flow meter use (+6.4%), self-reported knowledge of what to do for an asthma attack (+12.4%), and feeling that their asthma was under control (+10.8%). Absenteeism (−11.8%) and hospitalization due to asthma (−3.5%) were significantly reduced from baseline to follow-up. Participants did not report significant changes in overuse of beta2-agonists and emergency room visits due to asthma. In comparison with the asthmatic patients who received usual care (non-participants), participants had significantly greater improvement on daily use of steroid inhaler (+4.0% versus −6.0%), daily use of home peak flow meter (+6.4% versus 1.9%) and self-reported knowledge on what to do for an asthma attack (+12.4% versus +5.4%).

Conclusion: These findings suggest that population-based programs can improve functional status, increase self-monitoring and knowledge about asthma, and decrease absenteeism and hospitalization for asthma by directly providing asthmatic patients with educational materials and self-monitoring tools. Such “direct-to-consumer” outreach programs may help bridge the gap between NAEPs 1991 practice guidelines and the reality of current asthma management.


INTRODUCTION

Asthma affects 14 to 15 million people in the United States and is one of the most common chronic illnesses in all age groups. It is a frequent cause of both school and work absence and often limits a person’s ability to participate in routine activities of daily life. Asthma morbidity and mortality have increased in the last two decades despite improvements in understanding the pathophysiology of asthma and the availability of effective pharmacologic agents. Many factors have been identified as possible causes for the increased morbidity and mortality. These include poor patient understanding of the disease process, inappropriate medication use, noncompliance with prescribed medications and poor inhaler technique. In addition, the lack of asthma self-management skills has been identified as a major problem for patients with moderate and severe asthma.

In an effort to improve asthma management, the National Asthma Education Program (NAEP) Expert Panel, sponsored by the National Heart, Lung, and Blood Institute, published Guidelines for the Diagnosis and Management of Asthma in 1991. The guidelines emphasize the appropriate use of preventive and treatment medication and routine measurement of lung function. The guidelines are currently considered the standard of care for asthma patients in the United States.

Despite the availability of the NAEP practice guidelines since 1991, asthma treatment remains inadequate. Studies have shown that patients fail to use peak flow meters, underuse preventive medications and over-use symptom relief agents.

Increasing numbers of Americans receive their medical care from health maintenance organizations (HMOs). Health maintenance organizations have created a unique environment for treating patients with chronic diseases, such as asthma and diabetes, by emphasizing patient education, and health promotion, and by creating a chronic care system for these patients. In addition, HMOs pro-
vide the opportunity to implement a standard follow-up system for treating patients. To improve quality of life, functional status, and self-management behavior of asthma patients, a large HMO in California (Health Net) implemented an asthma disease management program (Peak Performance) in 1996. The intervention began with a baseline assessment survey sent to all HMO members with asthma as identified through pharmacy data. The intervention included direct mailing of educational materials and self-monitoring tools to all survey respondents with moderate or severe asthma who consented to participate. A random sample of members was also invited to participate in asthma self-management classes at their medical groups. The program aims to improve functional status, increase knowledge of self-management techniques, improve compliance with recommended treatment regimens, and reduce work and school absenteeism and acute treatment utilization (eg, emergency room visits and hospitalizations). Results from a follow-up survey 6 months postintervention are presented.

METHODS

Subjects

The present study includes all asthmatic patients between the ages of 5 and 65 who completed the baseline and follow-up assessments, and were classified as moderate or severe asthmatics. Using the selection criteria outlined in the Health Plan Employer Data and Information Set (HEDIS 2.5), a total of 31,911 “asthmatic” patients were identified through Health Net’s pharmacy database in 1996. Health Net is a major network/independent physician’s association-type HMO in California with more than 1.7 million members. Broad criteria were adopted in order to cast a wide net and include all possible asthmatic patients within the HMO population. In doing so, the criteria may have also included members with COPD or other related conditions. For this reason, the first question on the survey assessed whether the member had asthma. Members who were not diagnosed with asthma were asked to check the “no” box and return the survey.

Baseline Assessment

The “Health Survey for Asthma Patients” was administered in April 1996. The validated survey instrument has been used in previous studies. The adult version of the survey was designed and used in the Outcome Management System Consortium Asthma Project (CAP) sponsored by The Managed Health Care Association, and the child version of the survey was designed by Integrated Therapeutics Group (ITG). These two instruments are very similar and contain the following three components:

- **Asthma-specific information**: This section includes a series of questions about asthma symptoms, prescribed medication (no question about over-the-counter treatment was asked), knowledge of disease self-management, medical care utilization (eg, emergency room visits and hospital admissions), medical history, and satisfaction with care.

- **Functional status**: The Health Status Questionnaire (HSQ), measures eight functional attributes of the patient: general health perception, mental health, physical functioning, social functioning, role limited by physical conditions, role limited by emotional conditions, bodily pain, and energy/fatigue (this attribute was not measured for child asthmatics). All eight functional dimensions were converted into a 0 to 100 scale with the higher score representing better health or functional status.

- **Personal information**: Demographics, socioeconomic and health insurance coverage of prescription drugs were also measured in the questionnaire (Table 1).

Intervention Programs

A total of 9,748 patients responded to the baseline survey. Although HEDIS selection criteria were used to identify this cohort as having asthma, 2,269 respondents indicated that they were not asthmatic. Using self-reported survey data and a classification algorithm modified from the NAEP guidelines, 15% of the asthmatics were classified as mild asthmatics, 42% as moderate asthmatics, and 43% as severe asthmatics. The classification algorithm and the results of the baseline assessment were reported previously. All the moderate and severe asthmas (N = 6,337) were targeted for intervention.

The intervention program was designed to improve asthma management through patient education and encouragement of a partnership among the patient, the patient’s family, and the physician. The following two forms of delivery for the education program were developed:

- (1) A small group education class taught by a nurse-educator in a physician group setting. Educational materials were developed to provide nurses and patient educators with a set of tools to facilitate the educational process. This training enabled these professionals to educate asthmatics in proper self-management skills.

- (2) Patients received educational materials (Asthma Control Kit) directly from the HMO. The kit included all components of the physician group-based education program to help the asthmatics and/or their parents to control the disease. The kit included a peak flow meter, an Asthma Review Guide (educational material), a personal diary, a spacer device and an educational video.

The initial study design was a controlled clinical trial, with patients in physician groups randomized to the preceding intervention groups. Due to low participation rate in the physician group-based education program (only 62 out of 1,230 asthmatics participated, 5% participation rate), the main analysis of this paper was to study the effectiveness of the intervention by sending the Asthma Control Kit directly to asthmatic patients.

Among 5,107 moderate and severe asthmatics who were invited to participate and receive the Asthma Control Kit directly from the HMO, 1,679
agreed to participate (33% participation rate).

Followup Assessment
The “Health Survey for Asthma Patients” was sent to all participants and a random sample of nonparticipants, 6 months after the interventions. A total of 1,043 asthmatics responded to the followup survey (614 participants and 385 nonparticipants).

Statistical Analysis
The final analysis presented in this article was composed of all asthmatics who completed the baseline and followup assessments. The analysis sample can be divided into the following two groups:

- **Group 1 (participants).** Asthmatics who received the Asthma Control Kit (educational materials) directly from the HMO and responded to both baseline and followup assessments.
- **Group 2 (nonparticipants).** Asthmatics who did not participate in the intervention program but responded to both baseline and followup assessment.

Since the assignment of comparison groups was not random, the study design can be interpreted as a nonequivalent control group design. It would therefore be inappropriate to draw conclusions from comparisons of unadjusted outcomes because of the probable differences in the distribution of patient characteristics between groups. An approach to reduce or eliminate this potential bias is to base the analysis on estimated “propensity scores.”

A propensity score is the probability that a patient would participate in the intervention given the patient’s characteristics. The propensity score was estimated using logistic regression through a two-step approach. First, all main effects of the variables were selected for inclusion in the first stepwise logistic regression. Then a second stepwise logistic regression added interactions of those variables that were selected by the first stepwise regression.

In this article, we divided the respondents into five subclasses of approximately equal size (quintiles) on the basis of the distribution of the estimated propensity score. Previous results showed that for many situations, five subclasses would remove approximately 90% of the initial bias in the observed confounding covariates. The estimated average before-and-after differences and comparison between participants and non-participants were calculated using a directly standardized technique. All analyses were performed using SAS.

RESULTS

Description of the Analysis Sample
Table 2 summarizes the baseline characteristics of participants and nonparticipants, and displays the comparison between groups. Participants were significantly older than nonparticipants (37 ± 19 versus 31 ± 19), and more likely to be female (65% versus 57%). A higher percentage of whites (74% versus 66%) and more severe asthmatics (51% versus 43%) participated in the intervention. A significantly higher percentage of participants had a steroid inhaler (73% versus 63%) and reported using it daily (38% versus 28%). There were no differences between participants and nonparticipants in the following: smoking status, specialty care, having and using a home peak flow meter daily, overuse of beta2-agonists, knowledge on what to do for an asthma attack, overall satisfaction with care, feeling that their asthma was under control, missed one or more days from work or school, emergency room visits, and hospitalization for asthma.

Table 1. Selected Questions from the Survey Tool*

<table>
<thead>
<tr>
<th>Functional status</th>
<th>The Health Status Questionnaire/SF36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthma-specific questions</td>
<td>Questions on asthma symptoms</td>
</tr>
<tr>
<td></td>
<td>• During the past 4 weeks, how often have you been bothered by the following symptoms? (Never, Once a week or less, 2 to 3 times a week, 4 to 5 times a week, Daily)</td>
</tr>
<tr>
<td></td>
<td>a) Cough</td>
</tr>
<tr>
<td></td>
<td>b) Sputum</td>
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<tr>
<td></td>
<td>c) Chest tightness</td>
</tr>
<tr>
<td></td>
<td>d) Wheezy or whistling sound in the chest</td>
</tr>
<tr>
<td></td>
<td>e) Shortness of breath?</td>
</tr>
<tr>
<td></td>
<td>• During the past 4 weeks, how many times did your asthma awaken you at night? (Never, Once, 2 to 4 times, 5 to 7 times, 8 or more times)</td>
</tr>
<tr>
<td></td>
<td>Questions on medication usage</td>
</tr>
<tr>
<td></td>
<td>• Do you have any bronchodilator inhalers? (No, Yes, Don’t know)</td>
</tr>
<tr>
<td></td>
<td>• Do you have a steroid inhaler for your asthma? (No, Yes, Don’t know)</td>
</tr>
<tr>
<td></td>
<td>• Do you have a peak flow meter at home? (No, Yes)</td>
</tr>
<tr>
<td></td>
<td>Questions on utilization</td>
</tr>
<tr>
<td></td>
<td>• During the past 12 months, how many times have you gone for care to a hospital emergency room for your asthma?</td>
</tr>
<tr>
<td></td>
<td>• When was the last time you were admitted to a hospital for your asthma?</td>
</tr>
<tr>
<td>Demographic information</td>
<td>Age, Gender, Ethnicity, Schooling</td>
</tr>
</tbody>
</table>

* The MHCA OMS Consortium Health Survey for Asthma Patients.
Propensity Score Analysis

Propensity score was estimated using logistic regression through a two-step approach as outlined in the method section. The analysis sample was then divided into quintiles on the basis of the patient’s estimated propensity score. The suitability of the propensity score to adjust for important confounding covariates was evaluated by testing for differences in these covariates within quintiles of propensity. The values of the covariates associated with the likelihood of participation were not significantly different between participants and non-participants within each quintile of propensity. These covariates include age, gender, race, possessing steroid inhaler, calling the doctor to ask what to do when patient’s asthma is worsening, information provided by the doctor on what to do when having a severe asthma flare-up occurs, satisfaction with waiting time for doctor appointment, and physical function.

Before-and-After Analysis

Table 3 summarizes the changes in the outcomes among participants and non-participants. From baseline to followup, participants of the intervention program had significant improvement in daily use of steroid inhaler (+4.1%), daily use of peak flow meter (+6.4%), knowledge on what to do for an asthma attack (+12.4%), and feeling that their asthma was under control (+10.8%), while the percentage of specialty care (−3.9%) significantly declined. Absenteeism due to asthma (−11.8%) and hospitalization due to asthma (−3.5%) were significantly reduced among participants. Participants also reported significant improvement in several dimensions of functional status, including general health perception, physical functioning, social functioning, role limited by physical condition, and bodily pain. There were no changes on overuse of beta2-agonists, overall satisfaction with care, and ER visits due to asthma.

Among the nonparticipants, knowledge on what to do for an asthma attack (+5.4%) and feeling that their asthma was under control (+10.9%)
were significantly improved from baseline, whereas the percentages of specialty care (−6.9%) and daily use of a steroid inhaler (−6.0%) significantly declined. Three dimensions of functional status, including general health perception, social functioning and role limited by physical condition were significantly improved. There were no significant changes on the other parameters.

**Comparison of Outcomes Between Participants and Nonparticipants**

When comparing the outcomes between participants and nonparticipants, participants had significantly greater improvement with daily use of a steroid inhaler, daily use of a peak flow meter and knowledge on what to do for an asthma attack. There were no significant differences between the groups in all other parameters although the improvements were higher among the participants.

**DISCUSSION**

The goals of the asthma education program described above were to improve functional status of asthmatic patients, increase knowledge of self-management techniques, improve compliance with recommended treatment regimens, reduce school and workplace absenteeism, and decrease acute treatment utilization (eg, emergency room visits and hospitalizations). From baseline to followup, participants in the intervention program reported significant improvements in five aspects of functional status (general health perception, physical functioning, social functioning, role limitation due to physical problems, and bodily pain).

Participants also reported a significant increase in daily use of a steroid inhaler, daily use of a peak flow meter, knowledge of what to do for an asthma attack, and feeling that their asthma was under control. Absenteeism due to asthma and hospitalizations for asthma were also significantly reduced among participants. While there were no changes in overuse of beta2-agonists and ER visits due to asthma, the percentage in the use of specialty care was significantly decreased in both participants and nonparticipant groups. Even though there is evidence that, without concurrent intervention and adjusting for severity, patients treated by specialists tend to have better outcomes than those treated by generalists. In this study, however, the decreased specialty care associated with improved overall functional status of asthmatics may be the result of patients becoming more educated about their disease, and being able to better adhere to prescribed treatment plans.

The results of this study suggest that the act of completing the survey, but not participating in the actual intervention, was also associated with improvements in several outcomes including knowledge of what to do for an asthma attack, feeling that their asthma was under control, and three aspects of functional status. This phenomenon may be due to some other interventions such as a visit to the doctor or the Hawthorne effect (positive effect of just being under study).28

Improvements in knowledge of asthma and asthma management pre-

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### Table 3. Changes in Outcomes Among Participants and Non-participants

<table>
<thead>
<tr>
<th>Outcome Measure</th>
<th>Participants*</th>
<th>Non-participants*</th>
<th>Participants vs Non-participants*</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialty care</td>
<td>−3.9% (P = .010)†</td>
<td>−6.9% (P &lt; .001)†</td>
<td></td>
<td>.227</td>
</tr>
<tr>
<td>Having a steroid inhaler and use it daily</td>
<td>4.1% (P = .035)†</td>
<td>−6.0% (P = .033)†</td>
<td></td>
<td>.003†</td>
</tr>
<tr>
<td>Having a home peak flow meter and use it daily</td>
<td>6.4% (P &lt; .001)†</td>
<td>1.9% (P = .233)†</td>
<td></td>
<td>.038†</td>
</tr>
<tr>
<td>Overuse beta2-agonist</td>
<td>−2.4% (P = .091)</td>
<td>−3.8% (P = .093)</td>
<td></td>
<td>.603</td>
</tr>
<tr>
<td>Knowledge on what to do for an asthma attack</td>
<td>12.4% (P &lt; .001)†</td>
<td>5.4% (P = .015)†</td>
<td></td>
<td>.016†</td>
</tr>
<tr>
<td>Overall satisfaction with care</td>
<td>1.9% (P = .217)</td>
<td>2.4% (P = .251)</td>
<td></td>
<td>.844</td>
</tr>
<tr>
<td>Feeling their asthma was under control</td>
<td>10.8% (P &lt; .001)†</td>
<td>10.9% (P &lt; .001)†</td>
<td></td>
<td>.999</td>
</tr>
<tr>
<td>Missed one or more days from work or school in the past month</td>
<td>−11.8% (P &lt; .001)†</td>
<td>−6.5% (P = .069)</td>
<td></td>
<td>.238</td>
</tr>
<tr>
<td>ER visits for asthma in the past year</td>
<td>−1.1% (P = .542)</td>
<td>−2.0% (P = .385)</td>
<td></td>
<td>.759</td>
</tr>
<tr>
<td>Hospitalization for asthma in the past year</td>
<td>−3.5% (P &lt; .001)†</td>
<td>−1.2% (P = .321)</td>
<td></td>
<td>.147</td>
</tr>
<tr>
<td>Functional status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General health perception</td>
<td>1.89 (P = .002)†</td>
<td>3.55 (P &lt; .001)†</td>
<td></td>
<td>.149</td>
</tr>
<tr>
<td>Mental health</td>
<td>1.00 (P = .115)</td>
<td>−0.17 (P = .860)</td>
<td></td>
<td>.312</td>
</tr>
<tr>
<td>Physical functioning</td>
<td>2.49 (P &lt; .001)†</td>
<td>0.43 (P = .657)</td>
<td></td>
<td>.075</td>
</tr>
<tr>
<td>Social functioning</td>
<td>3.84 (P &lt; .001)†</td>
<td>3.40 (P = .020)†</td>
<td></td>
<td>.799</td>
</tr>
<tr>
<td>Role limited by physical condition</td>
<td>7.19 (P &lt; .001)†</td>
<td>4.61 (P = .028)†</td>
<td></td>
<td>.322</td>
</tr>
<tr>
<td>Role limited by emotional condition</td>
<td>0.20 (P = .885)</td>
<td>2.43 (P = .217)</td>
<td></td>
<td>.353</td>
</tr>
<tr>
<td>Body pain</td>
<td>4.58 (P &lt; .001)†</td>
<td>1.80 (P = .229)</td>
<td></td>
<td>.125</td>
</tr>
</tbody>
</table>

* Difference in percentages or means (functional status) between follow-up and baseline. The differences and P values associated with before-and-after analyses as well as comparison between participants and non-participants were based on propensity score analysis with 5 subclasses and direct standardized technique.

† Significance at .05 level.
sented above are consistent with those reported for other asthma education programs. Longer term followup evaluations of other asthma programs have also reported significant reductions in emergency room visits.

Another important finding of this study was that recruiting patients into asthma education classes in a physician group setting is difficult. Although every effort was made to encourage asthma patients to attend the class, only 27% of the patients who originally agreed to participate actually attended. For future implementation, it may be more effective to deliver the intervention program through other formats (for example, sending the educational materials and self-monitoring tools directly to the asthmatic patients’ homes, or replacing the education class with a series of phone calls from a nurse counselor during which the asthma education topics are covered). Although the number of participants of the physician group-based class was very small (N = 40), participants reported significant improvement in knowledge of what to do for an asthma attack, feeling that their asthma was under control, and general health perception (data not shown but available upon request).

Potential limitations of this study include the relatively low response rate of the baseline assessment survey and low participation rates. It may create a selective participant group, which may not represent the total population. Given the nature of this population-based asthma study and the use of inclusive HEDIS 2.5 criteria, a response rate of 31% is fairly reasonable. As stated above, 25% of respondents indicated that they did not have asthma. It is also likely that a substantial proportion of individuals without asthma failed to return the survey at all. Although propensity score technique was used to reduce or eliminate the potential bias due to low response rate and nonequivalent control group, some factors affecting the likelihood of responding to the survey and participating in the intervention may not be measurable, and hence, were not included in the analysis; however, the authors believe that the effect was not significant.

Another potential limitation is the lack of reliable actual cost data necessary to conduct cost-effectiveness analyses associated with this program. Capitation is the prevailing reimbursement in California when this study was conducted. Capitation pays a preset dollar amount per member, per month to the physician group, regardless of whether services are actually rendered. Self-reported absenteeism from work and hospitalizations due to asthma were used as proxies for this information.

The effectiveness of the asthma management programs evaluated here suggests that population-based programs can significantly help their asthmatic members by directly providing asthmatic patients with educational materials and self-monitoring tools. These population-based interventions can be used to improve functional status, increase self-monitoring and asthma knowledge, and decrease both absenteeism and hospitalizations for asthma. A “direct-to-consumer” outreach program such as the one described in this paper can potentially affect the lives of asthmatics, improve school and workplace attendance, and decrease asthma health care costs. Such programs may help bridge the gap between NAEPs 1991 practice guidelines and the reality of current asthma management.

REFERENCES