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Compliance With National Asthma Management Guidelines and Specialty Care

A Health Maintenance Organization Experience

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Background: To improve asthma disease management, the National Asthma Education Program (NAEP) Expert Panel published *Guidelines for the Diagnosis and Management of Asthma* in 1991.

Objectives: To compare the current status of asthma disease management among patients in a large health maintenance organization with the NAEP guidelines and to identify the factors that may be associated with medical care (eg, emergency department visits and hospital admissions) and adherence to the guidelines.

Methods: Analyses of 1996 survey data from 5580 members with asthma (age range, 14 to 65 years) covered by a major health maintenance organization in California (Health Net).

Results: In general, adherence to NAEP guidelines was poor. Seventy-two percent of respondents with severe asthma reported having a steroid inhaler, and of those, only 54% used it daily. Only 26% of respondents reported having a peak flowmeter, and of those, only 16% used it daily. Age (older), duration of asthma (longer), increasing current severity of disease, and treatment by an asthma specialist correlated with daily use of inhaled steroids. Ethnicity (African American and Hispanic) correlated negatively with inhaled steroid use but positively with emergency department visits and hospital admissions for asthma. Increasing age and treatment by an asthma specialist were also identified as common factors significantly related to the daily use of a peak flowmeter and, interestingly, to overuse of β_2-agonist metered-dose inhalers.

Conclusions: Although the NAEP guidelines were published 7 years ago, compliance with the guidelines was low. It was especially poor for use of preventive medication and routine peak-flow measurement. Furthermore, the results showed that asthma specialists provided more thorough care than did primary care physicians in treating patients with asthma. Combining the results of the regression analyses revealed that some of the variation in rates of emergency department visits and hospitalizations among some subpopulations can be explained by the underuse of preventive medication. This study serves the goal of documenting the quality of care and services currently provided to patients with asthma through a large health maintenance organization and provides baseline information that can be used to design and assess effective population-based asthma disease management intervention programs.

Arch Intern Med. 1998;158:457-464

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An estimated 14 to 15 million people in the United States suffer from symptoms of asthma that may limit their ability to participate in the activities of daily life.[1] Despite improvements in understanding the pathophysiology of asthma and the availability of effective pharmacologic agents, the incidence and mortality rates due to asthma have increased in the United States in the last several years.[2,3]

Many factors have been identified as possible causes of the increased morbidity and mortality, including poor patient understanding of the disease process and of appropriate medication use,[4,5] noncompliance with prescribed medical regimens,[6-8] and an inability to use medications properly, especially inhalers.[9,10] In addition, the lack of disease self-management knowledge has been identified as the major problem for patients with moderate and severe asthma. To improve asthma disease 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.[11] (Also see the guidelines from the International Consensus Report.[12]) 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 patients with asthma in the United States. Although the guidelines have been available for 7 years, few studies have been conducted to determine adherence.

PATIENTS AND METHODS

STUDY SAMPLE

The present study includes all patients aged 14 years or older with asthma who were enrolled in Health Net, a major network-based and independent physicians' association–type HMO in California with over 1.3 million members. Using the selection criteria outlined in the Health Plan Employer Data and Information Set (HEDIS 2.5),[15] a total of 24 018 patients with asthma were identified through the HMO pharmacy database in 1996. The algorithm identified a cohort of members who were continuously enrolled for 1 year before the selection point and had been dispensed any of the following: (1) 1 or more prescriptions for cromolyn sodium or inhaled corticosteroid; (2) 2 prescriptions for a bronchodilator (β_2-agonist); or (3) 2 prescriptions for theophylline. These broad criteria were adopted to cast a wide net and to include all possible patients with asthma within the HMO population. In doing so, the criteria may have also included members with chronic obstructive pulmonary disease or other related conditions. For this reason, the first question on the survey asked whether the member had asthma. Members who were not diagnosed with asthma were asked to check the "no" box and return the survey.

PROCEDURE

The Health Survey for Asthma Patients was administrated in April 1996. The mailing included endorsement letters from 10 of the HMO's largest medical groups. To help further increase the response rate, a follow-up reminder postcard was sent out and an 800 number survey hotline was installed. The survey hotline allowed members to discuss questions or concerns regarding the survey.

MEASURES

The survey instrument, the Health Survey for Asthma Patients, has been validated and was used in a previous study: The Outcome Management System Consortium Asthma Project, sponsored by the Managed Health Care Association.[16] The instrument contains the following 3 components:

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

2. Functional status. The questionnaire, Health Status Questionnaire, measures 8 functional attributes of the patient: general health perception, physical functioning, social functioning, role limited by physical conditions, role limited by emotional conditions, bodily pain, mental health, and energy or fatigue. All 8 functional dimensions are converted into a scale numbered from 0 to 100, with the higher scores representing better health or functional status. In addition, the questionnaire measures the risk of depression.

3. Personal information. Demographic, socioeconomic, and health insurance coverage of prescription drugs was also measured in the questionnaire.

Using self-reported data from the survey, the respondents' level of disease severity was categorized as mild, moderate, or severe. The classification algorithm (**Table 1**) is a modified version of the severity classification in the NAEP guidelines based on self-reported data. It is important to note that the current severity is a function of pretreatment severity and degree of asthma control.

ANALYSIS

Descriptive statistics were used to summarize patient characteristics. Means and SDs were calculated for continuous variables such as age and standardized scores of functional status. Frequency tables were generated for the categorical variables of compliance with use of prescribed medication and hospital admission.

Subgroup analyses were also performed on several variables. The classification variables were current asthma severity and type of treatment provider (generalist or asthma specialist). Analysis of variance procedures and χ^2 statistics were used for continuous and categorical variables, respectively.

Logistic regression analyses were performed to determine factors that might explain differences in outcome variables, such as compliance with NAEP guidelines, emergency department visits, and hospital admissions. Covariates analyzed were age, sex, education, working status, current asthma severity, type of treatment provider, smoking status, and preexisting health conditions. Variables, such as use of steroid inhaler, use of a peak flowmeter, and type of treatment provider, were not included in the regression analysis for emergency department visits and hospital admissions, because it is not feasible to interpret the direction of causality (eg, whether the use of a steroid inhaler causes emergency department visits or emergency department visits cause the use of a steroid inhaler) with the available data. In the analyses, the data set was randomly split into 2 sets by a ratio of 75%:25%. The first sample, called *training sample*, was used to develop the model. The second sample, called *validation sample*, was used to validate the model using the Hosmer-Lemeshow method.[17] We fitted the data with all the covariates and examined all the pairwise interaction terms 1 at a time. The 55 interaction terms were not included at the same time to avoid numerical instability. The variables were retained only if they were significant with the 2-sided test at a 5% significance level. The final model presented here was based on the whole sample. All analyses were performed using SAS software.[18]

Increasing numbers of Americans receive their medical care from health maintenance organizations (HMOs).[13] 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 provide the opportunity to implement a standard follow-up system for treating patients.[14] To assess the quality of life, functional status, and self-management behaviors of patients with asthma, a large HMO in California administered a survey to its members with asthma. The survey also provided an opportunity to document the current status of care for patients with asthma, to compare cur-

Table 1. Current Asthma Severity Classification Criteria

Current Severity	Symptom Frequency	Nocturnal Symptoms	Symptom Chronicity
Mild	Mild symptoms, not more than once a week	Not more than once a month	Asymptomatic between exacerbations
Moderate	Exacerbations 2-5 times a week	2-7 times a month	Some symptoms on most days, requiring inhaler for relief
Severe	Frequent exacerbations, more than 5 times a week	Frequent nocturnal symptoms, more than 7 times a month	Symptoms most of the time

rent practices with the NAEP guidelines, and to identify factors related to adherence. This study presents the analysis of the survey data.

RESULTS

A total of 7423 members responded to the survey (31% response rate). Although every effort was made to correctly identify this cohort as currently having asthma, 1843 respondents indicated that they were not asthmatic. The remaining 5580 respondents were included in the analyses.

DESCRIPTIVE AND SUBGROUP ANALYSES

Characteristics of the Respondents

Table 2 summarizes the demographic and socioeconomic characteristics of the respondents: approximately 71% were white, 66% were female, 75% had completed at least some college education, 66% were employed (either full-time or part-time), and 76% were treated by generalists (internists or family practitioners). The average age of the respondents was approximately 42±14 years (mean [±SD]). Eighteen percent of the respondents were classified as having mild asthma, 38% as having moderate asthma, and 43% as having severe asthma. The percentages of patients receiving primary care from an asthma specialist were not significantly different among current severity levels. Only 27% of patients with severe asthma received care from an asthma specialist.

Table 2. Patient Characteristics

Characteristic	Value*
Sex	
F	3677 (65.9)
M	1903 (34.1)
Age, mean (±SD), y	41.7±13.7
Duration of asthma, mean (±SD), y	19.0±15.2
Race/ethnicity	
African American	284 (5.1)
White	3911 (70.8)
Asian	337 (6.1)
Hispanic	837 (15.1)
Other	157 (2.8)
Education (some college or above)	
Yes	4120 (75.1)
No	1363 (24.9)
Employed (full- or part-time)	
Yes	3625 (65.5)
No	1909 (34.5)
Smoking Status	
Current smoker	454 (8.4)
Past smoker	1545 (28.6)
Never smoked	3409 (63.0)
Current asthma severity	
Mild	1014 (18.3)
Moderate	2126 (38.3)
Severe	2410 (43.4)
Type of Provider	
Generalist	4114 (75.5)
Asthma specialist	1336 (24.5)

**Values are expressed as number (percentage) unless otherwise indicated.*

Steroid Inhaler

Inhaled corticosteroids are now the mainstay of treatment for asthma.[19,20] The NAEP guidelines recommend inhaled corticosteroids as first-line therapy for moderate and severe asthma. **Table 3** indicates that even among respondents with severe asthma, fewer than 72% reported having a steroid inhaler, and less than 54% of those with a steroid inhaler reported using the inhaler daily, as recommended by the guidelines. Patients treated by asthma specialists were more likely to receive a prescription for a steroid inhaler (81%) than were those treated by generalists (63%).

β_2-Agonist Inhaler

Recently, there has been controversy about the link between frequent use of β_2-agonists and morbidity as well as mortality.[21-24] The NAEP guidelines recommend that patients with asthma should use their β_2-agonist inhaler for no more than 8 inhalations daily. However, 11% of all patients and 20% with severe asthma reported using their β_2-agonist inhaler more than 8 times daily. The percentage of overuse increased substantially as the level of severity increased.

Peak Flowmeter

One major component of asthma therapy recommended by the NAEP guidelines is objective measurement of lung function by using a peak flowmeter.[25] The NAEP guidelines suggest that patients with asthma, especially those taking medication daily, should use their peak flowmeter twice a day to monitor lung function. However, only 26% reported having a peak flowmeter at home. Patients who received care

Table 3. Compliance of the NAEP Guidelines and Satisfaction With Care*

Criteria	Percentage of Patients					
	Current Severity of Asthma			Type of Provider†		Entire Sample
	Mild	Moderate	Severe	Generalist	Specialist	
Steroid inhaler						
How many respondents have a steroid inhaler?	60.5	65.7	71.7	62.7	81.3	67.3
Among those having one, how many have used steroid inhaler daily in the past month?	43.4	42.5	53.6	42.2	60.9	47.7
β_2-Agonist inhaler						
How many respondents have a β_2-agonist inhaler?	90.7	94.4	95.9	94.2	95.5	94.4
Among those having one, how many have used it more than 8 inhalations per day in the past month?	2.5	4.5	20.0	10.1	13.8	11.0
Home peak flowmeter						
How many respondents have a home peak flowmeter?	20.6	25.0	28.1	18.8	46.4	25.5
Among those having one, how many use it daily?	10.8	14.2	18.5	10.5	22.2	15.7
How many respondents rate their knowledge as "good to excellent" on what to do for a severe asthma attack?	74.7	70.1	67.4	66.0	81.4	69.8
How many respondents have been given all information from physician or nurse about						
What to do when he or she has a severe flare-up of asthma?	51.8	42.6	39.2	37.5	59.0	42.8
How to adjust medications when asthma gets worse?	49.6	41.4	37.2	35.9	56.6	41.1
What things can make asthma worse and how to avoid them?	50.4	43.2	38.6	37.1	59.2	42.5
Overall satisfaction with quality of care received for asthma	91.4	86.1	81.9	83.0	91.0	85.1

**NAEP indicates National Asthma Education Program. The* P *values associated with all subgroup analyses were less than .001.*
†Generalist indicates a visit to a physician specializing in internal medicine and/or family practice only; specialist, a visit to an asthma specialist (pulmonologist, allergist, or otolaryngologist).

from asthma specialists (46%) were more likely to have a peak flowmeter than were those treated by generalists (19%). For those respondents with a peak flowmeter, only 16% reported using it daily. The percentages increased significantly if the respondents were treated by asthma specialists.

Disease Self-management Knowledge

Disease self-management plays an important role in asthma therapy. Approximately 70% of the respondents rated themselves as "good to excellent" in knowing what to do for a severe asthma attack. The percentage increased significantly if the respondents were treated by asthma specialists. The NAEP guidelines specify that physicians or nurses should provide asthmatic patients with information about (1) what to do for a severe episode of asthma, (2) how to adjust medications when asthma worsens, and (3) how to avoid triggers of asthma. Approximately 42% of the respondents reported that they were provided with these self-management tools. The percentage increased significantly if the respondents were treated by asthma specialists. However, current severity level was inversely correlated with the availability of disease self-management material.

Patient Satisfaction With Treatment

Table 3 also presents the level of patients' overall satisfaction with their treatment. Patients with asthma reported high levels of satisfaction with their health care, although levels of satisfaction decreased slightly as the current level of severity increased. Patients receiving treatment from specialists were significantly more satisfied than were patients seeing a generalist.

Coexisting Health Conditions

Table 4 displays the percentage of asthmatic patients with other health conditions. The major coexisting conditions were allergies or hay fever (83%) and rhinosinusitis (46%).

Functional Status

Table 4 also presents a summary of the 8 domains of functional status as well as the risk of the development of depression. The mean scores of all 8 dimensions decreased and the risk of depression increased substantially as the current level of severity increased. Furthermore, the mean scores of functional status for patients with asthma, especially those whose disease was moderate or severe, were significantly lower than the mean scores for the general population, after age and sex were adjusted for.[26]

Effect of Asthma on Work and Activities

Table 5 summarizes the effect of asthma on work and activities. Approximately 33% of the respondents reported that they had canceled or rearranged normal activities in the past month because of asthma-related problems. The percentage increased significantly with current severity level. Also, 47% of respondents reported missing 1 or more days of work or school in the past month owing to asthma, and the percentage increased significantly as the current level of severity increased.

Table 4. Health Conditions and Functional Status*

Variables	Current Severity of Asthma			Entire Sample	General Population†
	Mild	Moderate	Severe		
Percentage of the respondents with the following comorbidities					
Allergies or hay fever	78.4	82.9	85.6	83.2	NA
Rhinosinusitis	38.1	45.3	51.6	46.6	NA
Heartburn (gastroesophageal reflux)	22.0	29.2	37.4	31.4	NA
Arthritis	18.9	20.1	28.4	23.5	NA
Chronic bronchitis	9.7	17.4	29.1	20.9	NA
Diabetes	4.1	3.5	5.6	4.5	NA
Ulcer or gastrointestinal bleeding	2.8	3.7	5.3	4.2	NA
Emphysema	0.6	2.2	7.1	4.0	NA
Other lung disease	1.6	1.4	5.1	3.0	NA
Congestive heart failure	0.7	1.1	2.4	1.6	NA
Depression	6.6	10.1	16.1	12.0	NA
Functional status (0-100 scale), mean (±SD)					
General health perception	72.3±19.0	63.2±20.1	52.8±23.1	60.4±22.5	73.8
Physical functioning	87.8±15.9	81.2±19.1	69.1±24.6	77.1±22.5	87.5
Social functioning	87.5±19.1	79.1±22.6	70.3±26.5	76.8±24.6	84.3
Role limited by physical conditions	86.8±28.0	74.1±35.9	55.7±41.6	68.4±39.1	84.9
Role limited by emotional conditions	86.1±28.7	79.3±33.4	73.1±38.3	77.8±35.1	82.4
Bodily pain	77.9±22.0	70.5±23.8	62.6±25.5	68.4±24.9	76.4
Mental health	77.1±15.3	72.0±17.4	69.4±19.0	71.8±18.0	74.6
Energy/fatigue	62.3±19.3	54.3±19.8	45.9±21.8	52.1±21.5	61.7

**The P values associated with all the subgroup analyses on functional status as well as the risk of developing depression were less than .001.*
†The mean scores for the general population were calculated using the data of the 1990 national survey of functional status and were adjusted for age and sex (from Thalji et al[26]). NA indicates not applicable.

Table 5. Asthma-Specific Outcome Measures*

Outcome Measures	Current Severity of Asthma			Entire Sample
	Mild	Moderate	Severe	
Impact of asthma on work and activities				
Canceled activities in the past month	6.8	28.4	47.9	32.9
Missed ≥1 d from work or school in the past month	33.0	46.9	53.0	46.9
Asthma-specific use of medical care				
Number of visits to a physician for asthma in the past 6 mo, mean (±SD)	0.85±2.3	1.54±2.8	2.27±4.0	1.72±3.4
Emergency department visits for asthma in the past year	6.3	13.7	17.2	13.8
Hospitalization for asthma in the past year	2.2	4.9	7.0	5.3

**Values are expressed as percentages unless otherwise indicated. The P values associated with all the subgroup analyses were less than .001.*

Asthma-Specific Medical Care Utilization

Fourteen percent of the respondents reported asthma-related emergency department visits in the past year, and 5% were hospitalized owing to asthma in the past year. The likelihood of asthma-specific use of medical care increased as the asthma severity level increased.

Logistic Regression Analyses

For each of the dependent variables in the logistic regression analyses, we first fitted the model using the training sample. The model was then applied to the validation sample to calculate the Hosmer-Lemeshow statistic.[17] The values of the Hosmer-Lemeshow goodness-of-fit statistic are all lower than the corresponding χ^2 critical value, indicating that the model seems to fit the data quite well. **Table 6** depicts the results, based on the whole sample, of the logistic regression analyses of the factors related to the compliance with the NAEP guidelines. None of the interaction terms examined was significant. The following characteristics were associated with an increased likelihood of having a steroid inhaler: being older, female, and non–African American; having completed at least some college; having moderate or severe asthma; receiving treatment from an asthma specialist, never having smoked, and having allergies or hay fever. Among those who had a steroid inhaler, the important predictors of using it daily were as follows: being older, having a longer duration of asthma, being non–African American or Hispanic, having severe asthma, and being treated by an asthma specialist.

The following characteristics were associated with having a peak flowmeter: being non–middle-aged and female, having a longer duration of asthma, having moderate or severe asthma, being treated by an asthma specialist, and never having smoked. Among the patients who

Table 6. Results of Logistic Regresssion Analyses of the Predictors of Medication Use

Criteria	Estimated Odds Ratio (95% Confidence Interval)*				
	Have a Steroid Inhaler	Use Steroid Inhaler Daily	Have Home Peak Flowmeter	Use Home Peak Flowmeter Daily	Use β_2-Agonist More Than 8 Inhalations per Day
Age group, y (reference group, 14-25 y)					
26-35	1.57 (1.23-2.01)†	1.82 (1.32-2.52)†	0.88 (0.67-1.15)	1.89 (0.91-3.93)	1.47 (0.94-2.28)
36-45	1.81 (1.44-2.29)†	1.77 (1.30-2.41)†	0.76 (0.59-0.98)‡	2.23 (1.12-4.42)‡	1.87 (1.25-2.81)†
46-55	2.03 (1.61-2.57)†	2.31 (1.70-3.15)†	0.79 (0.61-1.02)	2.58 (1.30-5.11)†	1.85 (1.23-2.77)†
56-65	2.45 (1.91-3.15)†	3.29 (2.40-4.52)†	0.96 (0.74-1.25)	2.93 (1.48-5.80)†	1.84 (1.23-2.77)†
Sex, M	0.79 (0.69-0.90)†	1.04 (0.89-1.22)	0.77 (0.66-0.89)†	0.65 (0.44-0.94)‡	1.04 (0.85-1.29)
Duration of asthma, y (reference group, 0-5 y)					
6-15	1.18 (0.99-1.40)	1.18 (0.96-1.45)	1.54 (1.28-1.86)†	0.87 (0.56-1.36)	1.74 (1.30-2.33)†
16-25	1.09 (0.90-1.34)	1.47 (1.17-1.85)†	1.36 (1.09-1.69)‡	0.80 (0.47-1.36)	1.93 (1.40-2.67)†
≥26	1.02 (0.86-1.21)	1.60 (1.31-1.95)†	1.49 (1.24-1.80)†	0.97 (0.64-1.48)	1.81 (1.36-2.40)†
Race/ethnicity (reference group, white)					
African American	0.65 (0.49-0.86)†	0.41 (0.28-0.60)†	0.83 (0.60-1.13)	1.20 (0.58-2.48)	1.18 (0.75-1.83)
Hispanic	0.98 (0.82-1.18)	0.70 (0.56-0.87)†	0.91 (0.75-1.10)	1.49 (0.96-2.31)	1.34 (1.02-1.76)‡
Asian	0.81 (0.62-1.05)	0.89 (0.65-1.22)	0.93 (0.70-1.25)	1.15 (0.57-2.29)	0.93 (0.57-1.52)
Others	0.80 (0.55-1.16)	0.66 (0.41-1.07)	0.59 (0.37-0.94)‡	1.47 (0.46-4.66)	1.27 (0.72-2.25)
Completed at least some college	1.48 (1.26-1.73)†	1.12 (0.92-1.37)	1.04 (0.88-1.25)	0.99 (0.65-1.51)	0.90 (0.71-1.14)
Employed (full- or part-time)	0.98 (0.84-1.14)	0.89 (0.75-1.07)	0.88 (0.75-1.04)	0.86 (0.61-1.22)	0.67 (0.54-0.84)†
Current asthma severity (reference group, mild)					
Moderate	1.29 (1.09-1.53)†	0.96 (0.78-1.19)	1.18 (0.97-1.44)	1.27 (0.75-2.14)	1.85 (1.12-3.05)‡
Severe	1.58 (1.33-1.87)†	1.39 (1.13-1.72)†	1.30 (1.08-1.58)†	1.64 (0.99-2.71)‡	9.44 (5.96-14.96)†
Type of provider (reference group, generalist)					
Asthma specialist	2.40 (2.04-2.82)†	2.25 (1.91-2.64)†	3.76 (3.26-4.33)†	2.34 (1.70-3.23)†	1.30 (1.05-1.61)‡
Ever smoked	0.88 (0.77-1.01)‡	0.99 (0.84-1.16)	0.84 (0.72-0.97)†	1.03 (0.73-1.45)	1.38 (1.12-1.70)†
Have allergies or hay fever	1.19 (1.01-1.41)‡	0.98 (0.80-1.20)	1.01 (0.84-1.22)	0.94 (0.61-1.45)	0.74 (0.57-0.95)‡

**The estimates represent the relative odds of compliance compared with the reference group. An odds ratio with value less than (or greater than) 1 suggests that the outcome variable and the covariate are negatively (or positively) correlated.*

†P<.01.

‡P<.05.

had a peak flowmeter, being older and female, having severe asthma, and receiving treatment from a specialist predicted daily use of the peak flowmeter. Finally, the following factors were associated with a higher rate of overuse of a β_2-agonist (more than 8 inhalations per day): being older, having a longer duration of asthma, having moderate or severe asthma, not working, and receiving treatment from an asthma specialist. The current asthma severity level was an especially significant predictor: respondents with severe asthma had rates of β_2-agonist overuse that were approximately 10 times higher than those of respondents with mild asthma and 5 times higher than those of respondents with moderate asthma.

Table 7 presents factors related to emergency department visits and hospital admissions. It suggests that respondents of a younger age (14-25 years) who had a longer duration of asthma, were female and African American or Hispanic, had moderate to severe asthma, had ever smoked, and had an absence of allergies or hay fever were more likely to visit an emergency department. Similar factors were found to be significantly correlated with hospital admission: age (younger or older), longer duration of asthma, sex (female), race (African American), current severity of asthma (moderate to severe), absence of allergies, work status (not working), and history of smoking. Despite higher rates of emergency department visits and hospital admissions in women and ethnic minorities, the overall severity of asthma in these groups was not significantly higher.

COMMENT

The goals of the current study were 2-fold. The initial goal was to document the quality of care and services currently provided to members with asthma enrolled in a large HMO. Quality of care was assessed by determining compliance with NAEP guidelines, differences in care provided by specialists and generalists, and patient satisfaction with care. Second, we were interested in assessing the health and functional status of these patients to identify a baseline with which to determine the effectiveness of future population-based disease management programs.

Quality of care provided to patients with asthma was assessed both objectively (ie, "Did observed practices meet the standards of care set forth by the NAEP?") and subjectively (ie, "Were members satisfied with the care they received?"). In most areas, the care currently received by these patients did not meet the guidelines established by the NAEP. In regard to use of medication, the NAEP guidelines indicate that a steroid inhaler should be used as the first line of treatment for moderate to severe asthma. However, only two thirds of these patients had a steroid inhaler and fewer than half of the patients with moderate to severe asthma who had an inhaler used it daily. These guidelines also recommend that patients use a β_2-agonist inhaler for no more than 8 inhalations daily. Twenty percent of the patients with severe asthma exceeded this

recommendation. Finally, the NAEP guidelines suggest that all patients, especially those with moderate or severe asthma, measure their peak expiratory flow rate daily. However, only about 25% of the patients had a peak flowmeter and of those, fewer than 20% used it daily.

Overall, patients with asthma reported high levels of satisfaction with their health care, although the levels of satisfaction decreased slightly as the level of severity increased (eg, 92% for those with mild asthma and 82% for those with severe asthma). This high level of satisfaction is interesting in light of the low rates of compliance with the NAEP treatment guidelines, suggesting that patients may be unaware of them. Patients receiving treatment from specialists were more satisfied than patients seeing generalists. Patient satisfaction is an important aspect of quality of care, just as a positive relationship with the health care provider is an important first step in motivating patients to adhere to treatment plans for their asthma.

Specialists provided more thorough care than the primary care physicians did in treating patients with asthma. Patients treated by specialists were more likely to have a steroid inhaler and to use it daily. The same was true for possession and use of a peak flowmeter. Specialists also provided more information to their patients about what to do to prevent or control an asthma attack. Interestingly, patients with severe asthma were not more likely to be seeing an asthma specialist. These findings suggest the need to establish criteria for providing access to an asthma specialist based on disease severity.

We were also interested in assessing the effect of asthma on the functioning of the patients in the current study. Asthma, especially at the moderate and severe levels, affected patients' health and functional status in a variety of ways. As expected, health and functional status were more impaired as disease severity increased. It is noteworthy that approximately 50% of the patients with severe asthma missed 1 or more days of work or school in the month before they responded to the survey instrument. Effective population-based interventions should improve productivity at the worksite by reducing asthma-related absenteeism. Finally, a high level of risk for depression and high rates of emotional problems attributable to asthma were seen in this cohort, suggesting that any intervention should incorporate these areas as well.

African American and Hispanic patients with asthma had higher rates of emergency department visits and hospital admissions. In a separate logistic regression analysis, these groups were also found to be less likely to have a steroid inhaler and were less likely to use the steroid inhaler as recommended. These findings suggest that the higher rate of emergency department and hospital use by these subgroups of the population may be related to an inadequate use of maintenance medication. However, it should be noted that we did not include medication use in the logistic regression analyses of the outcome variables, emergency department visits, and hospital admissions, since the interpretation of the direction of causality is beyond the data currently available. The use of longitudinal data from follow-up assessments will allow us to clarify the direction of this relationship in the future. Interestingly, although female respondents were more likely to have a steroid inhaler and to have and use a peak flowmeter daily, they also had higher rates of emergency department visits and hospital admissions.

Table 7. Results of Logistic Regression Analyses of the Predictors of Asthma-Specific Outcome Measures

Covariate	Estimated Odds Ratio (95% Confidence Interval)*	
	Emergency Department Visit for Asthma in the Past Year	Hospital Admission for Asthma in the Past Year
Age group, y (reference group, 14-25 y)		
26-35	0.71 (0.53-0.97)†	0.50 (0.28-0.88)†
36-45	0.57 (0.43-0.77)‡	0.62 (0.38-1.01)
46-55	0.65 (0.49-0.87)‡	0.84 (0.52-1.33)
56-65	0.43 (0.31-0.60)‡	0.52 (0.31-0.88)†
Sex, M	0.56 (0.46-0.67)‡	0.56 (0.40-0.77)‡
Duration of asthma, y (reference group, 0-5 y)		
6-15	1.14 (0.91-1.43)	1.13 (0.77-1.66)
16-25	1.31 (1.01-1.69)†	1.55 (1.02-2.37)†
≥26	1.31 (1.04-1.64)†	1.30 (0.87-1.93)
Race/ethnicity (reference group, white)		
African American	2.76 (2.04-3.73)‡	2.12 (1.27-3.52)‡
Hispanic	1.53 (1.23-1.90)‡	1.49 (1.03-2.15)†
Asian	1.04 (0.72-1.52)	1.33 (0.72-2.46)
Others	1.01 (0.60-1.69)	0.81 (0.32-2.05)
Completed at least some college	0.86 (0.70-1.06)	0.85 (0.61-1.18)
Employed (full- or part-time)	1.00 (0.82-1.21)	0.68 (0.50-0.93)†
Current asthma severity (reference group, mild)		
Moderate	2.17 (1.62-2.90)‡	2.00 (1.20-3.34)‡
Severe	2.89 (2.17-3.84)‡	2.92 (1.78-4.80)‡
Ever smoked	1.22 (1.02-1.45)†	1.50 (1.11-2.02)‡
Have allergies or hay fever	0.75 (0.61-0.93)‡	0.62 (0.44-0.87)‡

**An odds ratio with value less than (or greater than) 1 suggests that the outcome variable and the covariate are negatively (or positively) correlated.*
†P<.05.
‡P<.01.

Potential limitations of this study include the low response rate. It is recognized that the response rate is an important component of any survey study. Given the nature of this population-based asthma study and the length and sensitive nature of this instrument, a 31% response rate is fairly reasonable. We chose to use pharmacy data over claims data for the purpose of identification, because reimbursement for medical services under a capitated environment decreases the completeness and timeliness of claims data. Also, it provides an opportunity to cast a wide net and include all possible patients with asthma within the HMO population. We recognized that these criteria were likely to include a substantial number of false positives (eg, patients with chronic obstructive pulmonary disease as well as patients who were prescribed these medications for other conditions). For this reason, we directly asked about the presence of an asthma diagnosis to rule out these individuals and to create a pure sample of patients with asthma. As stated above, 25% of respondents returned the survey indicating that they did not have asthma. It is also

likely that a substantial proportion of individuals who do not have asthma failed to return the survey at all. Importantly, in recognizing that the sample may be biased to some extent toward more compliant patients, we believe that the compliance may be significantly underestimated in this study.

Another potential limitation is that asthma severity was determined according to the NAEP pretreatment criteria, although the patients in our study were identified from pharmacy records and therefore had already been prescribed asthma-related medication. Because the sample in the present study represents a group of individuals who are receiving treatment for asthma, these criteria may more accurately reflect the combination of pretreatment severity and degree of asthma control. Thus, patients categorized as having mild asthma may actually represent those who initially had severe asthma that was being successfully managed or controlled, and patients with severe asthma may be those who were less compliant or responsive to prescribed treatment or who were prescribed suboptimal treatment regimens to control their asthma.

Failure to meet treatment standards for asthma management may negatively affect the health and functional status of patients with asthma and is likely to result in increased use of the emergency department and the hospital. The HMOs are in an excellent position to monitor the treatment of their members with chronic conditions such as asthma and to implement population-based disease management programs. Optimal interventions must involve comanagement of the condition by the physician and patient, as responsibility for adhering to treatment guidelines should be shared by both health care provider and patient. While 93% of respondents with a peak flowmeter reported that they had received education about its proper use, only 16% used it daily as recommended. These findings suggest the importance not only of educating patients about the disease, but also of developing a long-term proactive partnership between physician and patient for management of asthma. Important aspects of such a collaborative approach, as indicated by the NAEP, include assessment of monitoring and treatment, establishment of medical plans for the appropriate long-term treatment of patients with chronic conditions and for managing acute exacerbations, encouragement of adherence to monitoring and treatment plans, education about ways to avoid and control asthma triggers, and the importance of regular follow-up care.

Because asthma is a complex disease that affects patients physically, socially, and emotionally, interventions should be comprehensive. For example, smoking cessation is a critical component of treatment for the large number of patients with asthma who continue to smoke. Additionally, targeting depression and other emotional problems is important for improving well-being and quality of life and for increasing motivation for adherence to other aspects of asthma therapy. By improving the quality of asthma care by both the physician and the patient, we should enhance appropriate use of medication, significantly improve the health and functioning of patients with asthma, and, as a byproduct of these elements, achieve a more effective consumption of health care resources.

Accepted for publication June 3, 1997.

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