A Comprehensive Educational Program Improves Clinical Outcome Measures in Inner-City Patients With Asthma

Maureen R. George, MSN, RN, CS; Liza C. O’Dowd, MD; Iris Martin, RN; Kathleen O. Lindell, MSN, RN; Fay Whitney, PhD; Martha Jones; Tracey Ramondo; Lynne Walsh, RN; Jacqueline Grissinger, RN; John Hansen-Flaschen, MD; Reynold A. Panettieri, Jr, MD

Background: Despite improved understanding of the pathophysiology of asthma, morbidity and mortality continue to rise, with disproportionate increases occurring among urban, indigent minorities. New approaches in the management of asthma are therefore necessary to reverse these dramatic and costly trends.

Objective: To determine if patients who are admitted to the hospital with acute asthma and receive inpatient education will have improved outpatient follow-up and clinical outcome measures compared with those receiving conventional care.

Methods: Patients enrolled in the study had a primary admission diagnosis of asthma and were between ages 18 and 45 years. Exclusion criteria included comorbid disease, inability to speak English, absence of a telephone in the primary residence, or pregnancy. Seventy-seven patients admitted from the emergency department with asthma were randomized to either the inpatient educational program (IEP) or routine care (control group). Patients in the IEP received asthma education, bedside spirometry, a telephone call 24 hours after discharge, and scheduled follow-up in an outpatient asthma program within 1 week of discharge. Those individuals randomized to the routine management group received conventional inpatient asthma care and routine follow-up.

Results: The patients enrolled in the IEP had a markedly higher follow-up rate compared with outpatient appointments (60% vs 27%; \( P = .01 \)) and significantly fewer emergency department visits (\( P = .04 \)) and hospitalizations (\( P = .04 \)) for asthma in the 6 months following IEP intervention, as compared with control patients. This represented a substantial cost savings to the managed care organization.

Conclusion: Our study suggests that an IEP in the treatment of indigent, inner-city patients hospitalized with asthma reduces the need for subsequent emergent care and improves outpatient follow-up in a cost-effective manner.

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Asthma is a common disease, effective diagnosis and treatment remain a challenge owing to the heterogeneity of disease presentation, exacerbating factors, and severity. Effective pharmacotherapy in asthma requires substantial cooperation and education of the patient to promote adherence to a prescribed regimen. Possibly as a consequence of these factors, asthma morbidity and mortality are increasing.\(^1\) In the United States, morbidity and mortality seem to be increasing disproportionately in indigent, inner-city patients with asthma.\(^8,12\) Although the precise factors that contribute to these increases remain unknown, access to health care, differences in exposure to allergens, smoking, and psychosocial factors may all play a role.\(^15,17\)

Despite substantial evidence that excessive asthma-related morbidity occurs in adults and strongly correlates with poverty and urban residence, few studies have examined new approaches to improve asthma care in this population. A major obstacle to improving asthma management in the inner city has been patient follow-up for long-term care. By improving inpatient education, we postulate that follow-up rates would improve and, thus, subsequent hospital use would also decrease. The value of a specialized asthma outpatient program has been described previously by other investigators who reported that rigorous outpatient management improves hospital readmission rates in indigent, inner-city patients with asthma.\(^10,16\) Others have had similar success from intensive inpatient and outpatient educational and management pro-
SUBJECTS AND METHODS

SUBJECTS

A total of 77 patients admitted from the ED with an acute exacerbation of asthma were studied. Patients enrolled in the study were between ages 18 and 45 years. Patients admitted to an intensive care unit or those with comorbid disease were excluded to limit the study to patients with uncomplicated asthma exacerbations. In addition, patients were excluded if they (1) did not have telephone access, (2) were pregnant, or (3) did not speak English. The geographic area surrounding the hospital is populated predominantly by English-speaking African Americans. Few potential study participants were affected by the third study criterion. All patients who met the study criteria were invited to participate. Forty-four patients (54%) admitted from the ED with asthma were randomized to receive an IEP, and 33 patients (46%) were randomized to a control group who received conventional therapy. The study was approved by the University of Pennsylvania's Institutional Review Board Committee on Studies Involving Human Beings. All subjects provided written informed consent.

STUDY DESIGN

At the time of admission, patients with acute exacerbations of asthma were randomly assigned to 1 of 2 treatment groups: inpatient education or routine care. Participants in both groups received identical medical treatment regimens that included nebulized albuterol and intravenous methylprednisolone sodium. Patients randomized to the educational program group received interventions that included inpatient asthma instruction, bedside spirometry, assistance with discharge planning, a postdischarge telephone call, and scheduled follow-up in the outpatient Asthma Care Program at the University of Pennsylvania Medical Center (UPMC) in Philadelphia. This program was available during workday hours 7 days a week. Individuals who were randomized to the conventional treatment group received education, peak flow measurements, discharge planning, and scheduled follow-up at the discretion of the nursing and house staff. Importantly, the decision to discharge the patient was made by the house staff and the patient's attending physician, who was not a study investigator. The study investigators did not offer criteria for patient discharge nor comment on the appropriateness of the decision to discharge the patient. Choice of discharge medications, provision of a peak flowmeter, and provision of an emergency plan were left to the discretion of the patients' attending physicians. Clinical outcome measures collected for patients in both groups included hospital length of stay (LOS), readmission rates, attendance at subsequent outpatient appointments, frequency of ED visits, and hospitalizations 6 months prior to and following study enrollment.

IEP INTERVENTIONS

Inpatient Asthma Education and Identification of Obstacles to Care

All study patients randomized to the IEP group received repetitive teaching sessions with an asthma clinical nurse specialist during the course of their hospitalization. The goal of these educational sessions was to improve metered-dose inhaler administration technique and to stress the chronic nature of asthma and the need for long-term therapy, with emphasis on the importance of regular outpatient follow-up. Patients were also taught the early warning signs of asthma and received action plans for appropriate responses to these warning signs. The asthma nurse educator screened patients for obstacles to care, which included inability to fill prescriptions, lack of transportation to outpatient appointments, lack of child care, or substance abuse. The nurse educator worked closely with a social worker to remove barriers to care when possible.

RESULTS

SUBJECTS

From December 1991 to December 1994, a total of 657 patients were admitted with a primary diagnosis of asthma to the Hospital of the University of Pennsylvania from the ED. From this cohort, 88 patients were eligible for study enrollment; 11 declined to participate, resulting in 77 patients randomized by random number generator to receive either routine care or the experimental IEP. All subjects enrolled successfully completed the study.

Demographic data for the study patients are summarized in Table 1. There were no significant differences between the control and experimental groups re-
As shown in Figure 1, the mean hospital LOS for patients in the IEP group was 2.1 days (95% confidence interval [CI], 1.82-2.46 days) compared with 2.7 days (95% CI, 2.17-3.2 days) for those in the routine care group. This difference was not statistically significant ($P = .12$). In addition, there was no difference between the IEP and routine care group with regard to successful discharges from the hospital. In the IEP group, all patients were successfully discharged, whereas in the conventional care group, 32 (97%) of 33 patients were successfully discharged, as shown in Figure 2.

**EFFECTS OF THE IEP ON HOSPITAL LOS AND SUCCESSFUL PATIENT DISCHARGE**

We reasoned that patients with asthma who received comprehensive inpatient education and telephone follow-up within 24 hours after discharge were more likely to return for outpatient follow-up than those treated in a routine manner. As shown in Figure 3, 26 (60%) of subjects enrolled in the IEP group returned for their initial follow-up visit compared with 9 (27%) of those enrolled in the routine care group. Of the IEP subjects who returned for their initial visit, 24 (75%) of 32 continued to be observed in the asthma outpatient program 1 year after enrollment (Figure 4). Interestingly, men and women returned for their initial outpatient visit at approximately the same rate, but women were far more likely to continue to follow-up.

**EFFECTS OF THE IEP ON OUTPATIENT FOLLOW-UP**

At the time of discharge, the charts of study patients were examined to determine the written plan for outpatient follow-up as required in the physician's discharge summary. Computer-based outpatient visit records were then examined for all planned ambulatory visits for physicians who practiced at the UPMC to determine if patients had seen that physician within 1 month of the planned visit. Investigators contacted all community-based primary care physicians who were scheduled to see study patients to request access to information regarding whether the patients had kept their scheduled appointments or had been seen within a 1-month period of the original postdischarge visit.

**Poststudy Hospitalization and ED Visits**

Data on the frequency of ED visits and hospitalizations for acute exacerbations of asthma for the Medicaid patients enrolled in this study were obtained from the database of the Medicaid managed care organization (MCO) serving this region. Similar data were not available for non-Medicaid patients or for self-pay patients. Emergency department visits and hospitalizations in any medical center for asthma were identified by the *International Classification of Diseases, Ninth Revision* (ICD-9) code on the claims data submitted to the MCO (ICD-9 codes 493.0-493.20). Data were examined for the 6-month period prior to study enrollment and the 6-month period following enrollment to examine patterns of health care use.

**STATISTICAL ANALYSIS**

Continuous, normally distributed data were analyzed using $t$ tests. Categorical data were analyzed using the Pearson $\chi^2$ test. Nonnormally distributed data were analyzed using the Mann-Whitney test and the Wilcoxon signed rank test.

**CLINICAL OUTCOME MEASURES**

**Hospital LOS and Successful Patient Discharge**

To investigate whether an IEP that provides outpatient follow-up would affect a physician's decision to discharge a patient with asthma from the hospital, we studied the hospital LOSs for subjects enrolled in the IEP group as compared with those receiving routine care. Data on hospital LOS, defined as the number of 24-hour intervals from admission to discharge, were collected for patients randomly assigned to either of the 2 parallel treatment groups. Decisions to discharge patients in both groups were made by attending physicians, who were not study investigators. It was considered a successful patient discharge when the patient hospitalized for an acute exacerbation of asthma did not require emergent evaluation for asthma symptoms in the 1 week following discharge.

**Twenty-Four-Hour Postdischarge Telephone Contact**

Attempts to contact those patients admitted to the hospital for an acute exacerbation of asthma and randomly assigned to the IEP regimen were made 24 hours following discharge. The purpose of this contact was to address questions about discharge instructions, medications, and asthma symptoms.

**Outpatient Follow-up in the Combined Allergy-Pulmonary Asthma Program**

At the time of hospital discharge, patients who were enrolled in the IEP group were asked to return to the outpatient Asthma Care Program at the UPMC within the first 7 days after discharge. During the visit, the patient received repeated spirometric evaluation of their forced vital capacity and forced expiratory volume in 1 second, a physician examination, and patient education by the asthma nurse educator to reinforce the principles introduced during the inpatient hospitalization.

**Rates of Outpatient Follow-up**

Disease severity was not significantly different between the 2 groups as determined by examination of records from the UPMC ED database (data not shown). Medical management was identical in both groups with regard to the use of aerosolized $\beta$-agonists and intravenous methylprednisolone.
more likely to return for their serial follow-up visits than men. These data, however, must be viewed cautiously because men were greatly underrepresented in this study. Only 1 (14%) of the men enrolled in the IEP continued to be observed in the outpatient program after 1 year compared with 23 (62%) of the women, as shown in Figure 4.

To address whether outpatient follow-up to an asthma program affected subsequent hospital use for asthma, the number of hospitalizations and ED visits for patients in the IEP 6 months prior to enrollment were compared with those obtained 6 months after enrollment in the asthma program. Complete data concerning hospital and ED use, which were obtained from a Medicaid MCO database, were available for 30 of 44 IEP subjects and 20 of 33 patients in the routine care group during the 12-month study period. In this cohort of patients, the number of ED visits and hospitalizations for acute asthma decreased markedly after patients attended the outpatient asthma program, as shown in Figure 5. In this patient cohort, the IEP subjects had 27 ED visits prior to enrollment compared with 3 ED visits after enrollment. The number of hospitalizations for acute asthma also decreased from 26 hospitalizations per year to 3 hospitalizations per year in this group. In comparison, there was no difference in the number of ED visits (17 preprogram and 15 post-program) or hospitalizations (14 preprogram and 12 post-program) for patients enrolled in the routine group during the 6-month study interval. Rank sum analysis

### Table 1. Demographic Characteristics of the Patients Enrolled in the 2 Study Groups*

<table>
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<th>Routine Care Group (n = 33)</th>
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<tr>
<td>Private</td>
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*CI indicates confidence interval.
†χ² Analysis performed.
‡Unpaired t test analysis performed.
§NA indicates data are not available.

**Figure 1.** Hospital length of stay was analyzed in patients enrolled in the inpatient educational program (IEP) and compared with length of stay for patients treated in a conventional manner. The center line represents the mean, and the box represents the 95% confidence intervals in the groups examined. Patients with asthma enrolled in the IEP group (n = 44) had no significant differences in their length of stay compared with those in the routine care group (n = 33) (rank sum test).

**Figure 2.** The frequency of successful hospital discharge following admission for an acute exacerbation of asthma in the inpatient educational program (IEP) group was compared with that of the routine care group. Data are represented as the percentage of patients who were successfully discharged. No patient in the IEP group required an emergency department evaluation or rehospitalization for asthma within 7 days of discharge compared with 1 patient requiring readmission in the conventional care group. There were no differences between groups by χ² analysis.

**Figure 3.** Adherence to follow-up outpatient appointments was examined in patients who were hospitalized with acute exacerbations of asthma. Patients whose treatments were guided by the inpatient educational program had markedly higher follow-up rates compared with those receiving conventional therapy (P = .01, χ² test). Asterisk indicates significant difference from conventional treatment.

**Figure 4.** To address whether there were sex differences in adherence to follow-up, we examined initial and serial outpatient follow-up rates by sex. Data are represented as percentage of men and women who kept their appointments. Men and women were equally likely to keep their initial appointment; however, significantly more men failed to return for subsequent outpatient care (χ² test).

**EFFECTS OF OUTPATIENT FOLLOW-UP ON SUBSEQUENT ED VISITS AND HOSPITALIZATIONS FOR ACUTE ASThma**

To address whether outpatient follow-up to an asthma program affected subsequent hospital use for asthma, the number of hospitalizations and ED visits for patients in the IEP 6 months prior to enrollment were compared with those obtained 6 months after enrollment in the asthma program. Complete data concerning hospital and ED use, which were obtained from a Medicaid MCO database, were available for 30 of 44 IEP subjects and 20 of 33 patients in the routine care group during the 12-month study period. In this cohort of patients, the number of ED visits and hospitalizations for acute asthma decreased markedly after patients attended the outpatient asthma program, as shown in Figure 5. In this patient cohort, the IEP subjects had 27 ED visits prior to enrollment compared with 3 ED visits after enrollment. The number of hospitalizations for acute asthma also decreased from 26 hospitalizations per year to 3 hospitalizations per year in this group. In comparison, there was no difference in the number of ED visits (17 preprogram and 15 post-program) or hospitalizations (14 preprogram and 12 post-program) for patients enrolled in the routine group during the 6-month study interval. Rank sum analysis.
between the groups showed significantly fewer ED visits ($P = .04$) and hospitalizations ($P = .04$) in the IEP group compared with the routine group, as given in Table 2.

**COMMENT**

Although the benefits of an intensive outpatient asthma management and educational program have been demonstrated,\textsuperscript{21,24-28} we sought to determine the value of an intensive inpatient asthma educational program. Our program, which focused on inpatient asthma education and discharge planning, was maximally effective in reducing subsequent ED visits and hospitalizations for asthma, perhaps by improving attendance at an outpatient asthma program. In addition, patients with asthma having characteristics similar to our study population but admitted to other hospitals in Philadelphia had an increased hospital LOS compared with those patients hospitalized at the UPMC. Whether the decreased hospital LOS reflected a more coordinated level of care at UPMC, a stronger influence to decrease the LOS by managed care, or less disease severity remains unknown.

Two studies have investigated the benefit of an adult asthma educational program in the acute care setting. Kelso et al\textsuperscript{10} reported that ED visits and hospitalizations were reduced following a single educational session in the ED. The generalizability of this study, however, is limited by its design. Control patients were retrospectively selected, and the 30 patients in the study cohort had histories of high health care use (more than 5 ED visits, 2 hospitalizations, an admission to the intensive care unit over the previous 2 years, or more than 3 ED visits over the last year), which may not be comparable with most patients with asthma seen in the ED. Through the use of an inpatient asthma educational program, combined with the implementation of treatment and house staff education guidelines, Mayo et al\textsuperscript{29} were able to demonstrate a 4.8-day to 4.0-day (17%) reduction in LOS. Historical controls were used in this study, however, and patients were not randomized to an intervention group.

No recommendations for treatment or discharge were made to the house staff or attending physician in our study. Interestingly, a reduction in LOS was not evident in the IEP group despite the house staff knowledge that IEP patients would receive intensive inpatient education, spirometric evaluation and interpretation, follow-up within 7 days of discharge in a combined allergy and pulmonary outpatient asthma program, and a telephone call 24 hours after discharge. This knowledge did not seem to influence the house staff and attending physicians' confidence in the stability of the patients' asthma or adequacy of the discharge plan. This is in contrast to other IEPs that have been able to demonstrate an impact on LOS in newly diagnosed patients with diabetes\textsuperscript{30} and patients undergoing cardiac surgery.\textsuperscript{31}

An important outcome of this study is the improvement in outpatient follow-up rates. As many studies have demonstrated, improving outpatient follow-up leads to improvement in patient outcomes, including reduced acute care use,\textsuperscript{19} increased quality of life,\textsuperscript{32} and reduced total asthma-related health care costs.\textsuperscript{33} Risk factors for underuse of outpatient care with excessive dependence on acute care facilities include lower socioeconomic status, inadequate primary care, race (particularly African Americans), age (adolescents), and sex, with men having the lowest rates of follow-up.\textsuperscript{33-36} An analysis of posthospitalization follow-up in this study also found that men were less likely to attend the outpatient clinic despite having kept their initial appointment.

Patients who attended the outpatient asthma clinic in this study also had a reduction in subsequent ED use and hospitalizations for acute asthma. While a cost analysis was not included as part of this study, we believe that the comprehensive asthma educational program has the
potential to substantially reduce costs to the MCO through a reduction in acute care use. Acute care use has been shown to account for the largest proportion of asthma-related direct costs.\(^{47}\) Our inpatient program is relatively inexpensive. Our nurse educator spends approximately 8 hours per week providing education for the approximately 300 asthma admissions per year. We have previously demonstrated the cost-effectiveness and efficacy of our outpatient program in the reduction of acute care use and costs in the Medicaid patient population.\(^{38-41}\) However, it should be noted that not every asthma educational program has been demonstrated to be cost-effective.\(^{42}\) A limitation of our study is that hospital use data were only available for those patients enrolled in a Medicaid MCO. It is possible that non-Medicaid patients have different patterns of outpatient and acute patient hospital use and may not receive the same benefits from this program.

A potential limitation of our study is its nongeneraliability. We excluded patients who were critically ill and who had clinically significant comorbid disease. Since a major goal of the program is to improve follow-up to the outpatient asthma program, we would expect that these excluded patients would also derive substantial benefit from such an intervention. We now include these patients in our ongoing inpatient asthma program. Our program was evaluated in an inner-city minority population. It is unknown if patient populations with different ethnic and socioeconomic backgrounds would derive similar benefit.

A second limitation of this study is the placebo effect. It is possible that the benefit that the IEP group derived from the intervention was based solely on more frequent contact with a health care provider. Because placebo visits to the inpatient routine care group were not made and because follow-up visits to the patients’ primary care practitioners were not arranged, the benefits of our specific educational program relative to regular health professional contact cannot be determined.

The IEP we have developed is multidimensional, focusing on education, metered-dose inhaler technique, a symptom recognition and response plan, simple regimens to promote adherence, and identification and removal of obstacles to care, such as providing sample medications for those without prescription benefits and transportation to outpatient visits. It is unclear which component of this program provides the most benefit. This study did not attempt to determine the specific intervention that had the most effect. A criticism of much of the literature in this field, in fact, has been the heterogeneous approach to asthma education, making different programs difficult to compare.\(^{43}\) It is likely, however, that the most successful programs will be those that are diversified and comprehensive. Indeed, we are currently investigating the efficacy of adding a standardized asthma clinical pathway to our inpatient care algorithm,\(^{40}\) as well as an asthma disease state management program for high-risk patients.\(^{39}\) Clinical pathways have been shown to be effective in pediatric asthma.\(^{44}\)

In the present study, we determined that an intensive inpatient asthma educational program improves follow-up in an outpatient asthma program. In addition, through continued outpatient education and management, hospitalizations were averted and ED use seems to be reduced. We plan to further investigate the impact of these interventions on acute care use. The cost-effectiveness of this approach and the effect these interventions have on patient-related functional and quality-of-life measures need to be further studied.


