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## Facilitated referral to asthma specialist reduces relapses in asthma emergency room visits

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*Facilitated asthma-specialist care delivered by allergists was compared to generalist care on the rate of relapse of asthma emergency room (ER) visits and hospitalizations and on asthma control in a prospective, controlled study of San Diego Kaiser Health Plan members with asthma. Subjects with asthma between the ages of 6 and 59 years presenting for acute ER care for asthma were systematically assigned by alternating, consecutively, the day of their ER visit to receive either (1) facilitated referral to an asthma specialist within the allergy department and concomitant comprehensive ongoing asthma care (intervention group, n = 149) or (2) continued outpatient management from generalist physicians (control group, n = 160). The course of their asthma was evaluated blindly during the subsequent 6 months by review of medical records, initial and follow-up questionnaires, and spirometry. Compared to the control group, the intervention group noted (1) a 75% reduction in the number of, and percent of, subjects with asthma awakenings per night ( $p \leq 0.0001$ ), (2) an almost 50% reduction in asthma ER relapses ( $p = 0.017$ ) resulting from a reduction in the frequency of multiple relapses ( $p = 0.005$ ), and (3) a greater use of inhaled corticosteroids ( $p < 0.00001$ ) and cromolyn ( $p = 0.002$ ). Thus, facilitated referral of subjects with asthma to specialists in asthma therapy after acute ER therapy appears to reduce asthma ER relapses and to improve asthma outcome. (J ALLERGY CLIN IMMUNOL 1991;87:1160-8.)*

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With the increases in asthma prevalence,<sup>1, 2</sup> hospitalization,<sup>1, 3</sup> and deaths<sup>1, 4</sup> noted during the past decade, attempts to reduce asthma morbidity and mortality and to measure asthma therapy outcomes are being studied. Asthma-education programs have frequently demonstrated knowledge acquisition, but less often have demonstrated improvement in asthma care and reduction in ER visits.<sup>5, 6</sup> The outcome of asthma care delivered by asthma specialists compared to generalists has only been examined recently in a few investigations. ER areas staffed by specialists in the delivery of acute asthma treatment expedited care and reduced acute hospitalizations.<sup>7</sup> An intensive outpatient asthma-treatment clinic program staffed by chest physicians reduced asthma rehospitalizations in adults with frequent asthma hospitalizations during an 8-month period compared to routine outpatient care.<sup>8</sup> A similarly designed study directed toward inner-city children with asthma in which asthma education but not concomitant asthma treatment was stressed, in contrast, failed to reduce subsequent ER visits for asthma.<sup>9</sup> In addition, a recent nonrandomized study noted better asthma control, reduced ER visits, decreased hospital days, but at an increased total patient cost for allergist care compared to nonallergist care.<sup>10</sup>

From 1983 to 1989, the rate of asthma hospitalization and frequency of children aged 1 to 16 years with repeat asthma hospitalizations have decreased among the San Diego Kaiser Health Plan membership as noted in Fig. 1. This decrease in asthma admissions contrast to the increasing asthma hospitalization rates noted elsewhere in Southern California<sup>11</sup> and the United States.<sup>1-3</sup> The proactive efforts of the allergy department since 1984 to facilitate and encourage the referral of children hospitalized with asthma to the allergy service for comprehensive and ongoing asthma care may be one of the possible reasons for the favorable asthma outcomes noted in Fig. 1. The present study attempted to determine prospectively and in a controlled manner whether such facilitated care provided by asthma specialists does indeed favorably affect asthma outcome. We report now in a prospective, controlled study that such facilitated access of high-risk subjects with asthma to allergists specializing in asthma treatment reduces asthma ER relapses and improves asthma care.

## MATERIAL AND METHODS

### Subject recruitment and entry criteria

Members of the Kaiser Health Plan HMO in San Diego who obtained ER or hospital asthma treatment by the Southern California Permanente Medical Group from May 4, 1988, to Feb. 26, 1989 (hereafter noted as the *index* ER visit), were eligible. Daily registries of ER visits and hospital admissions identified potential subjects with asthma. Medical records of these subjects were examined by a

### Abbreviations used

ER:	Emergency room
CI:	95% Confidence interval
HMO:	Health Maintenance Organization
PEF:	Peak expiratory flow

trained allergy nurse practitioner (S. H.) to confirm the ER or hospital diagnosis. Subjects were excluded by the nurse practitioner only if documentation noted (1) previous allergy or pulmonary care, (2) pulmonary function laboratory-confirmed chronic obstructive pulmonary disease, and (3) ages younger than 6 years or older than 59 years. Further subject exclusions were based on complex medical histories suggestive of chronic obstructive lung disease rather than asthma and exercised by a staff allergist (J. W. or R. Z.) with no knowledge of group allocation. Eligible subjects met the American Thoracic Society criteria for asthma,<sup>12</sup> each exhibiting during the index ER visit acute wheezing or dyspnea that improved after bronchodilator therapy. The study was approved by the Kaiser Permanente Innovation Review Committee.

### Study design

Systematic sampling according to the day of the index ER visit (alternating consecutively) assigned subjects to an intervention group (facilitated allergist referral) (N = 149) or to a control group (uninterrupted routine generalist care) (N = 160). In both groups, subjects were contacted by telephone by the allergy nurse practitioner (S. H.) shortly after their index ER visit ( $3.9 \pm 3.5$  days and  $4.8 \pm 3.2$  days for the intervention and control groups, respectively). Subjects gave their informed consent to permit monitoring of the course of their asthma for a 6-month period and were requested to complete a demographic and asthma-focused questionnaire on entry and a questionnaire and spirometry at final follow-up.

### Interventions

The study interventions for the two groups were as follows:

1. *Allergist intervention group.* An expedited allergy-clinic evaluation was offered to intervention-group subjects. Efforts were made to obtain this evaluation as soon as possible after the index ER visit. Since health care is prepaid in this HMO, extra costs to patients, if there are any, are minimal for any specialist evaluation, including an allergy workup. Although MediCal recipients have no physician-visit copayment requirements or pharmacy charge, a copayment from \$2 to \$5 is borne by 40% of other subscribers, and a pharmacy benefit is held by >85% of subscribers. The health plan has determined that the visit copayment does not serve to deter patients from seeking or receiving health care. Allergists provided intervention-group subjects with a detailed evaluation that included history, physical examination,

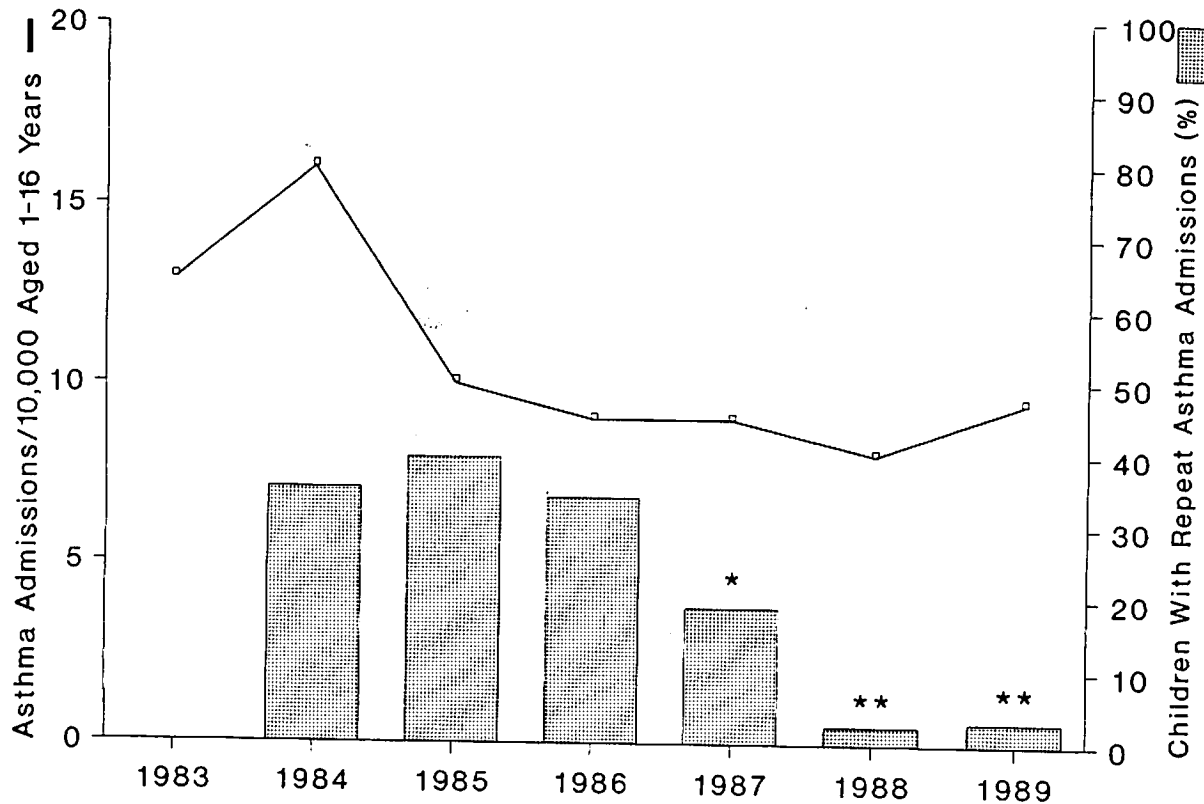


FIG. 1. San Diego Kaiser Health Plan asthma hospitalization trends represented by asthma admissions per 10,000 age-adjusted membership and percent of children with repeat asthma admissions in children 1 to 16 years of age. The frequency of children with repeat asthma admissions in 1987, 1988, and 1989, separately, are compared to the frequency of children with repeat asthma admissions in 1984 through 1986 combined, with Fisher's exact test (\* $p < 0.01$ ; \*\* $p < 10^{-8}$ ).

spirometry, inhalant skin tests, and a comprehensive treatment program, including instruction in relevant environmental control measures, asthma education aided by visual and written material, and individualized medication recommendations. General treatment guidelines included (1) inhaled bronchodilators for daily or as needed use, (2) inhaled anti-inflammatory agents, especially inhaled corticosteroids, and, less frequently, cromolyn, for chronic asthma, (3) written instructions, supplemented with an asthma information and treatment manual detailing appropriate therapeutic responses to worsening asthma, including the home use of oral corticosteroids, (4) instruction on the proper use of metered-dose inhalers and spacer devices, the latter, particularly for pediatric patients and those adults unable to learn the technique adequately, (5) use of peak flow monitors (Assess peak flow monitors, HealthScan Products, Inc., Cedar Grove, N.J.) for home PEF assessment, and (6) environmental control efforts directed at those subjects demonstrating specific inhalant IgE. No subject received immunotherapy during the study.

2. **Control group.** Control-group subjects received their routine outpatient asthma care from generalists within

the medical group. The therapy received by the control-group subjects during the asthma monitoring phase included, principally, long-term and/or as needed oral bronchodilators (theophylline and/or  $\beta$ -agonists) and inhaled bronchodilators (see RESULTS and Table III). Subjects were informed that an evaluation in the allergy clinic, if this were desired, would be provided at completion of the asthma monitoring phase.

### Measurement of variables

The following variables were evaluated: (1) severity of the index asthma ER visit (based on PEF, pulse oximetry, blood gases, and therapy required), (2) occurrence of asthma ER relapses or hospitalizations (by examination of patient medical records, computerized hospital admission lists, and questionnaires), (3) pulmonary function at 6 months after the index asthma ER visit, (4) asthma and demographic characteristics (derived from the index asthma ER visit, and (4) asthma and demographic characteristics (derived from their initial and follow-up questionnaires, health plan enrollment listings, and medical records). Spirometry was performed on a Collins S/560 (Warren E. Collins Inc., Braintree, Mass.) spirometer attached to an IBM personal com-

**TABLE I.** Characteristics of asthma study groups\*

Characteristic†	Intervention (N = 149)	Control (N = 160)
Sex (% F)	58.4	56.3
Age (yr)	24.0 ± 14.4	24.8 ± 14.6
Race (% black)	14.1	21.1
Medi-Cal (%)	3.4	5.0
Current smokers (%)	14.1	13.8
Cigarettes/day	13.8 ± 7.7	12.8 ± 9.5
Pack/years	14.8 ± 13.2	15.3 ± 15.5
Past smokers (%)	8.7	15.6
Other smokers in home (%)	23.5	25.6
Asthma duration (yr)	9.7 ± 9.9	9.9 ± 10.2 (N = 159)
Asthma ER visits		
Present only episode (%)	35.3 (N = 147)	33.1 (N = 157)
Past year	1.7 ± 1.4	1.7 ± 1.1
Lifetime	5.4 ± 6.4 (N = 143)	5.8 ± 6.2 (N = 154)
Asthma hospitalizations		
Past year (%)	14.1	12.5
Lifetime (%)	36.5 (N = 148)	32.5
Asthma absences past year (days)	5.6 ± 8.2 (N = 142)	5.9 ± 8.2 (N = 156)

\**p* > 0.05 for all comparisons.

†Values are means ± SD or percent of subjects.

puter (International Business Machines, Danbury, Conn.) with option No. 1 of 560 software version 4.42 for predicted equations of lung functions based on age, height, sex, and corrected for the black race.

### Data analysis

Statistical analyses were performed with the BMDP statistical software package (BMDP Statistical Software, Inc., Los Angeles, Calif.) and True Epistat (Epistat Services, Richardson, Texas). Mean values ± SD were calculated for continuous data unless it is stated. The following statistical procedures or tests were used: (1) Fisher's exact test or Pearson's chi-square analysis for univariate categorical data, (2) Mann-Whitney U test for nonparametric or Student's *t* test for parametric continuous data, (3) chi-square test for trend to determine the effect of intervention on the number of ER relapses, (4) life table and survival analysis for determination of the time calculated for the first and second ER relapse after the index ER visit with the generalized Wilcoxon (Breslow) test for significance, and (5) stepwise logistic regression for multivariate analysis to estimate the effect of the intervention on asthma ER relapses and also controlling for the following possible confounding

**TABLE II.** Characteristics and management of index asthma ER visit in asthma study groups\*

Characteristics and management of index ER visit†	Intervention group (N = 149)	Control group (N = 160)
Duration of ER visit (hr)	2.8 ± 2.9 (N = 145)	2.9 ± 2.8
PEF initial (% predicted)	46.7 ± 19.9 (N = 114)	52.0 ± 24.9 (N = 120)
Arterial blood gases initial		
pH	7.44 ± 0.05 (N = 26)	7.41 ± 0.08 (N = 17)
Po <sub>2</sub> (mm Hg)	69.0 ± 16.2 (N = 25)	66.7 ± 14.1 (N = 17)
Pco <sub>2</sub> (mm Hg)	35.3 ± 7.2 (N = 26)	38.8 ± 13.6 (N = 17)
Oxygen saturation initial (%)	94.8 ± 3.7 (N = 86)	94.4 ± 4.4 (N = 102)
β-Agonist inhaled (%)	86.5 (N = 148)	91.3
Epinephrine SC (%)	32.7 (N = 147)	26.9
Sus-Phrine SC (%)‡	17.0 (N = 147)	15.0
Aminophylline IV (%)	18.4 (N = 147)	20.0
Methylprednisolone IV (%)	17.7 (N = 147)	18.1
PEF discharge (% predicted)	70.6 ± 21.3 (N = 112)	75.6 ± 23.8 (N = 119)
Hospitalized (%)	11.4	8.1

\**p* > 0.05 for all comparisons between groups.

†Values are means ± SD or percent of subjects. Doses of asthma drugs were similar between groups.

‡Forest Pharmaceuticals, Inc., Maryland Heights, Mo.

variables, each of which, on univariate analyses, appeared to effect ER relapses: race (black versus nonblack), indigency (Medi-Cal recipients versus non-Medi-Cal recipients), age (continuous in years), and number of ER visits in the previous 12 months (continuous). A *p* value (two-tailed) of ≤0.05 was considered statistically significant. Odds ratios or relative risks and 95% CIs were calculated for categoric and multivariate analyses.

## RESULTS

### Recruitment and retention

In the intervention group of 149 subjects, a total of 39 (26%) subjects either declined (N = 29), delayed more than 6 months (N = 6), or delayed between 2 to 6 months (N = 4) their facilitated allergy referral. Seven intervention-group subjects, three of whom obtained an expedited allergy evaluation, left

**TABLE III.** Asthma treatment in study groups immediately after index ER visit and at final follow-up

Treatment	% Of subjects*			
	Post index ER discharge		Final follow-up	
	Intervention (N = 149)	Control (N = 160)	Intervention (N = 137)	Control (N = 151)
$\beta$ -Agonist				
Inhaled	79.2	85.6	73.0	66.9
Oral	22.8	18.1	13.9	11.9
Theophylline	67.1	65.0	34.3	37.1
Cromolyn	0.7	0.0	5.8†	0.0
Corticosteroid				
Inhaled	7.4	2.5	36.5‡	13.9
Oral	24.8	25.0	6.6	4.6
Antibiotic	34.2	33.8	2.2	2.0

\* $p > 0.05$  by Fisher's exact or chi-square tests for comparisons between groups except as it is noted.

† $p = 0.002$ .

‡ $p < 0.00001$ .

the health plan during the study but were all evaluated at follow-up, allowing inclusion of their data.

In the control group of 160 subjects, 21 (13.1%) subjects were referred directly to allergy by their generalist physician either after the index ER event or subsequent to the first ER relapse and were evaluated by an allergist within  $53.4 \pm 36.8$  days of their index ER visit. Three control-group subjects left the health plan during the study but were evaluated at follow-up, permitting inclusion of their data.

Data comparisons between groups were performed on all the subjects in both study groups without omission of any of the above subgroups of subjects (1) to avoid biasing group selection that could result from the confounding effects of differences in characteristics of the above subgroups (see below) and (2) to determine the real effect of a facilitated, compared to a normally generated, allergy referral on asthma outcome in an HMO.

All 309 subjects completed the initial demographic questionnaire. The time from the index ER visit to allergy evaluation of the intervention group was  $27.2 \pm 48.5$  days ( $N = 120$ ). Final follow-up evaluations occurred in 92% (137/149) of the intervention-group and 94% (151/160) of the control-group subjects at similar times ( $167.4 \pm 35.4$  and  $170.1 \pm 32.1$  days, respectively;  $p > 0.1$ ). Final spirometry data were available on 92/149 (62%) of the intervention and 92/160 (58%) of the control group. Final 6-month ER relapse and hospitalization data were available on all 309 subjects.

### Characteristics of the study groups

Demographic characteristics appeared comparable in the entire cohort of subjects comprising both study groups (Table I). Similarly, the severity, treatment, and outcome of both groups' index asthma ER visit was similar (Table II). On discharge from the index ER visit, both groups received asthma medication and antibiotics to a similar extent (Table III).

### Asthma condition and therapy during follow-up

The allergy intervention group exhibited better asthma control than the control group at final follow-up, as demonstrated by (1) improvement in asthma on a scale of 1 (much better) to 5 (much worse) ( $p < 0.00001$ ; chi-square, 27.57) or percent of subjects much better or better (odds ratio, 3.5; CI, 2.1 to 5.8) (Table IV) and (2) a reduced frequency of awakening from asthma (odds ratio, 0.24; CI, 0.11 to 0.52) (Table IV). Absenteeism and spirometry were comparable in both groups at follow-up (Table IV). A greater proportion of the intervention-group compared to the control-group subjects on follow-up used (1) inhaled corticosteroids (odds ratio, 3.6; CI, 1.9 to 6.6 and (2) inhaled cromolyn (relative risk, 2.2; CI, 1.9 to 2.5) (Table III). Oral  $\beta$ -agonists, theophylline, oral corticosteroids, and antibiotics were used by a similar proportion of subjects in both groups at final follow-up (Table III). The schedule of use of all medications was similar in both groups ( $p > 0.1$ ).

**TABLE IV.** Asthma condition of asthma study groups at final follow-up after index asthma ER visit

Asthma condition at final follow-up	Asthma study groups*			
	Intervention (N = 149)†		Control (N = 160)	
Improved post index ER (%)	64.0	(N = 136)‡	34.0	(N = 150)
Awakened by asthma				
% of subjects	7.4	(N = 136)‡	25.0	(N = 148)
Episodes/night	0.1 ± 0.3‡	(N = 136)	0.4 ± 0.8	(N = 148)
Absences (days)	1.4 ± 3.3	(N = 128)	2.3 ± 7.6	(N = 143)
PEF (% predicted)	109.2 ± 36.5	(N = 88)	104.3 ± 32.2	(N = 87)
FEV <sub>1</sub> (% predicted)	92.9 ± 22.6	(N = 92)	88.7 ± 21.9	(N = 92)
FEF <sub>25-75</sub> (% predicted)	74.2 ± 28.8	(N = 92)	72.9 ± 29.4	(N = 92)
Asthma ER relapse by 6 mo				
% of subjects	22.1§		33.1	
No. of episodes	0.3 ± 0.6§		0.6 ± 1.0	
≥2 ER relapses (%)	5.4§		13.1	
Hospitalized (%)	1.3		3.1	

FEF<sub>25-75</sub>, Forced expiratory flow rate between 25% and 75% during the middle half of the FVC.

\*Values are means ± SD or percent of subjects.

† $p > 0.05$  for comparisons between groups' unless it is indicated otherwise with chi-square or Mann-Whitney U tests.

‡ $p \leq 0.0001$ .

§ $p < 0.05$ .

### Asthma ER relapses and rehospitalizations

Asthma ER relapses within the first month after the index ER visit occurred similarly in the intervention (7.4%, 11/149) and control (10.6%, 17/160) groups. However, both the incidence (odds ratio, 0.57; CI, 0.34 to 0.98) and number ( $p = 0.017$ ) of ER relapses during the 6-month follow-up interval were lower within the intervention than in the control group (Table IV). Consistent with the aforementioned, a product-limit survival comparison of the time in weeks for the first (Fig. 2, A) and second (Fig. 2, B) ER relapse demonstrates that significantly more intervention-group subjects *did not* experience at least one ( $p = 0.030$ ) or at least two ( $p = 0.023$ ) ER relapses after the index asthma ER/hospitalization. Linear trend chi-square analysis revealed a reduction in the number of intervention-group subjects experiencing multiple asthma ER relapses during the 6-month follow-up ( $p = 0.005$ ; chi-square, 7.71). With multivariate stepwise logistic regression analyses, the number of asthma ER relapses during the 6-month follow-up remained significantly lower for the intervention compared to the control group for (1) at least one ER relapse (relative risk, 0.56; 95% CI, 0.34 to 0.95;  $p = 0.028$ ) and (2) two or more ER relapses (relative risk, 0.39; 95% CI, 0.16 to 0.96;  $p = 0.032$ )

when the possible confounding covariates for black race, Medi-Cal recipient, subject's age, and frequency of asthma ER visits in the previous year were being controlled.

### Analyses of subgroups

Subgroups of the intervention and control groups, formed according to a subsequent allergy evaluation, exhibited several characteristics different from one another (Table V). Consistent and supportive of the asthma outcomes observed for the entire study cohort, the expedited intervention-group subjects experienced (1) reduced asthma awakenings, (2) higher subject-rated improvement in asthma, (3) more use of inhaled bronchodilators, corticosteroids, and cromolyn, and (4) less asthma ER relapses than the control-group subjects without an allergy evaluation (Table V).

### DISCUSSION

Compared to standard generalist care after an asthma ER visit or hospitalization, the present prospective, systematically sampled, and controlled study demonstrates that facilitated comprehensive follow-up and treatment by asthma-care specialists, in this instance, allergists, compared to routine generalist care in an HMO setting appear to significantly (1)

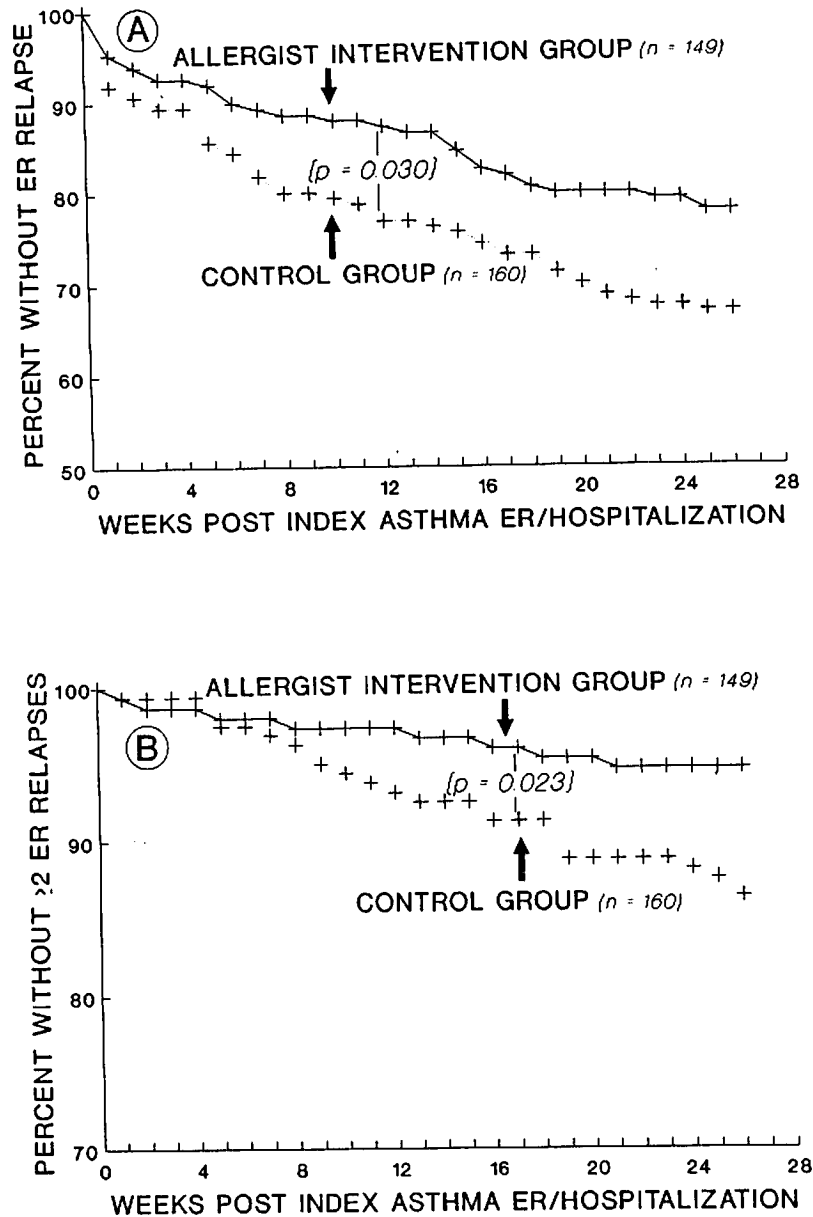


FIG. 2. Kaplan-Meier Survival Curve. A, For time to first and B, second asthma ER relapse after the index ER visit in intervention and control groups. Significances noted ( $p$ ) determined by generalized Wilcoxon method.

reduce the incidence and number of asthma ER relapses (Table IV and Fig. 2), (2) improve asthma status (Table IV), and (3) increase the long-term use of inhaled corticosteroids and cromolyn (Table III). These outcomes persisted whether analyses compared the entire cohort of subjects or only those subjects in both groups remaining after exclusion of intervention-group subjects declining or delaying allergist evaluation and control-group subjects referred by generalists and given an allergy evaluation after their index asthma ER visit or first asthma ER relapse (Table V).

### Measurements of outcome

The comparability of the entire cohort of the treatment groups was confirmed by their similar demographic, asthma severity, index ER treatment, and index ER discharge characteristics (Tables I to III).

The health-care setting of the study permitted obtaining accurate records of ER visits and hospitalizations because the subjects received their medical care at one comprehensive HMO. All asthma hospitalizations at non-Kaiser facilities were also recorded, since they required reimbursement. A potential source of

**TABLE V.** Selective characteristics and outcomes of subjects categorized according to group and allergy evaluation

	Allergy evaluation*				
	Intervention group			Control group	
	Declined (N = 29)	Delayed (N = 10)	Expedited (N = 110)	None (N = 139)	Referred (N = 21)
Sex (% F)	55.2	50.0	60.0	51.8 —†—	85.7
Blacks (%)	24.1	0.0	12.7	23.0	9.5
Current smokers (%)	24.1	30.0	10.0	15.1	4.8
Prior year hospitalizations	0.2 ± 0.4	0.2 ± 0.4	0.2 ± 0.6	0.1 ± 0.5 —†—	0.6 ± 1.0
Lifetime hospitalizations (N = 28)	1.3 ± 2.7	1.5 ± 1.8	0.8 ± 1.7	1.1 ± 3.3	1.6 ± 3.6
Index ER Visit					
Hours	1.9 ± 1.5 —‡—	4.4 ± 3.1	2.9 ± 3.1	2.7 ± 2.8	3.8 ± 3.0
	(N = 27)		(N = 108)		
Aminophylline (%)	7.4 —†—	50.0 —‡—	18.2	18.7	28.6
	(N = 27)				
Methylprednisolone (%)	11.1	50.0 —†—	15.5	16.5	28.6
	(N = 27)				
Discharge index ER					
Inhaled β-Agonists (%)	62.1†,§	100.0	81.8	85.6	85.7
Inhaled corticosteroids (%)	6.9	0.0	8.2	2.2	4.8
Oral corticosteroids (%)	27.6	50.0 —‡—	21.8	21.6 —†—	47.6
Days to allergy evaluation	Not seen	168.6 ± 74.6	14.3 ± 10.1	Not seen	53.4 ± 36.8
Final follow-up	(N = 23-29)	(N = 10)	(N = 103-110)	(N = 128-139)	(N = 20-21)
ER relapses	0.1 ± 0.4	0.8 ± 0.9	0.3 ± 0.6 —‡—	0.1 ± 1.0	0.6 ± 0.8
≥2 ER relapses (%)	0.0 —†—	30.0 —‡—	4.5 —‡—	13.7	9.5
Asthma awakenings	0.0†§	0.1 ± 0.3	0.1 ± 0.4 —†—	0.4 ± 0.8	0.5 ± 1.0
Improved post index ER (%)	31.8†§	60.0	71.2 —  —	32.3	45.0
Inhaled β-agonists (%)	43.5†§	80.0	78.8 —‡—	63.4	90.0
Inhaled corticosteroids (%)	4.3  §	10.0 —†—	46.2 —  —	5.3 —  —	70.0
Inhaled cromolyn (%)	0.0	10.0	6.7 —†—	0.0	0.0
Oral corticosteroids (%)	0.0	10.0	7.7	3.1 —‡—	15.0

\*Values are means ± SD or percent of subjects; *p* > 0.05 for comparisons unless it is otherwise noted.

†*p* < 0.01.

‡*p* ≤ 0.05.

§Comparison of declined versus expedited subgroups.

||*p* < 0.001.

error relates to the absolute determination of ER relapses, since non-Kaiser ER visits could only be determined by subject recall during completion of the asthma questionnaire. Because 6% to 8% of subjects in both groups failed to complete the final questionnaire, the effect on determining asthma ER relapses would be expected to be similar in both groups.

### Intervention on asthma course

The recent increase in asthma prevalence, hospitalizations, and deaths<sup>1</sup> has stimulated investigation into, and development of, efforts to impede this phenomenon. Interventions that have generally demonstrated favorable effects on asthma hospitalizations and ER visits include (1) asthma self-management programs for children<sup>5, 6</sup> and adults,<sup>13</sup> (2) intensive

outpatient asthma-treatment programs managed by chest physicians,<sup>8</sup> (3) special acute asthma-treatment areas situated within ERs staffed by physicians experienced in the acute management of asthma,<sup>7</sup> and (4) asthma management confined to hospital wards specializing in respiratory medicine.<sup>14</sup>

The outpatient asthma-treatment program described by Mayo et al.<sup>8</sup> that successfully reduced asthma re-hospitalizations provided intensive evaluation and follow-up by personal chest physicians, education on self-management techniques, and frequent use of inhaled corticosteroids with backup oral corticosteroids for asthma exacerbations. The present investigation, although it is similar in design, differed from the above study<sup>8</sup> in the following ways: (1) use of allergists instead of chest physicians, (2) studying a

younger population of subjects with asthma of generally lesser severity, (3) implementing the study in a prepaid HMO, generating most of its members from the workplace rather than a university setting in which most subjects were unemployed. Unlike Mayo et al.,<sup>8</sup> the present study, being composed of subjects with less severe asthma, could not detect an effect of the intervention efforts on the rate of rehospitalization because of its infrequency in either study group during the 6-month follow-up interval. However, the present intervention efforts did reduce ER relapses that could eventually lead to reduced hospitalizations over time, since most asthma admissions in the HMO follow ER treatment, although this speculation must await further follow-up. In a nonrandomized study of hospitalized adults with asthma that compared the effects of asthma care delivered by physicians with or without a "special interest in respiratory care," Bucknall et al.<sup>14</sup> noted that specialist care, starting during hospitalization and continuing after discharge, led to significantly (1) increased use of corticosteroids, spirometry, and asthma education during hospitalization and (2) reduced sleep disturbances, morning chest tightness, and wheezing by 2 weeks and asthma readmissions by 1 year after discharge.

In summary, the present study and the other recent studies noted above,<sup>8, 14</sup> taken together, provide strong support for the referral of subjects with asthma at increased risk for ER visits or hospitalizations to intensive outpatient asthma-treatment programs staffed by medical personnel skilled in the delivery of asthma care to improve asthma outcome.

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