

Improving Asthma Treatment in a Managed Care Population

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Objective: To identify and educate members of ConnectiCare, Inc & Affiliates, a regional managed care organization, who were not using asthma medications as recommended by the National Heart, Lung, and Blood Institute, by means of a nurse-administered 6-month telephonic case management intervention called the Asthma Treatment Awareness Project.

Study Design: A randomized controlled design was used to evaluate intervention and control groups. Self-selected members who opted in, opted out, or did not respond to an invitation to participate were included in the analysis.

Methods: Changes in asthma medication use, physician office visits, emergency department visits, hospitalizations, and quality of life were measured. A change in asthma medication use was measured using an asthma medication index ranging from 0 to 1.00, with a higher score indicating a better prescribing pattern.

Results: There was significant improvement in asthma medication use for all groups, but the asthma medication index increase of 0.176 for the intervention group was nearly 2 times the 0.091 increase for the control group. This difference remained significant ($P = .04$) after using analysis of variance to control for age and the preintervention asthma medication index. There was also a significant increase in overall quality of life for the intervention group ($P = .04$) but not for the control group.

Conclusion: Individualized telephonic case management from a specially trained registered nurse may be effective in improving asthma medication use and quality of life in subjects that do not use asthma medications according to National Heart, Lung, and Blood Institute guidelines.

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Asthma prevalence in the United States has been steadily increasing. From 1980 to 1996, asthma prevalence increased by 74%.¹ Asthma ranks among the most common chronic conditions in the United States, affecting an estimated 16 million adults, or 7.5% of the US population, and causing more than 470 000 hospitalizations and nearly 5000 deaths a year.^{1,2} The National Heart, Lung, and Blood Institute (NHLBI) estimates that the economic burden of asthma is \$14.0 billion in direct (\$9.4 billion) and indirect (\$4.6 billion) costs.³

Although asthma is a chronic condition, it remains treatable and amenable to self-management education. Asthma can be managed through "trigger" avoidance and medication therapy in accord with recognized

treatment guidelines.⁴ The NHLBI created asthma guidelines to improve quality of care and patient outcomes. The guidelines call for a stepwise approach to asthma management, recommending inhaled corticosteroids as the most effective method for controlling persistent asthma.

Nationally, physicians are increasingly more likely to treat their patients with asthma according to NHLBI best practices. Stafford and colleagues⁵ found that the proportion of annual total asthma visits for which an inhaled corticosteroid was prescribed increased from 8% from 1978 to 1988 to 48% in 2002. Although the prescribing of inhaled corticosteroids has increased substantially, at least 1 study⁶ reports that as many as 64% of users of inhaled corticosteroids underuse the drug.

Asthma management programs have been developed to assist with the identification and removal of asthma triggers, increase anti-inflammatory medication use, decrease short-term rescue medication use, improve quality of life, and decrease medical service utilization.⁷⁻⁹ Asthma education delivered in the physician's office,¹⁰ through interactive multimedia programs¹¹ and asthma education classes,¹² is associated with appropriate anti-inflammatory medication use.

The primary limitation of asthma education delivered through a physician's office is that only about half of adults with asthma routinely visit their physician.¹³ This is especially true for those who have not been prescribed an anti-inflammatory medication or are not using it as intended. Persons using short-acting rescue medications may be refilling their prescriptions without having had a recent evaluation by their physician.

As more persons with asthma enroll in managed care organizations, an opportunity exists to identify persons with the condition and offer self-management education telephonically and through printed educational materi-

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als. Educational self-management intervention has been found to significantly improve adherence with inhaled corticosteroid therapy and perceived control of asthma.⁹ Population-based disease management programs have resulted in reduced medical service utilization,^{8,14,15} improved quality of life,^{8,15} decreased costs,¹⁶ and increased anti-inflammatory medication use.¹⁴ Although telephonic interventions have been described in association with asthma and other chronic conditions,^{17,18} none of the identified studies used a nurse-administered telephonic intervention tested in a randomized controlled trial.

This article describes the effectiveness of an asthma management program in improving asthma medication use in accord with nationally recognized guidelines, in reducing medical service utilization, and in improving disease-specific quality of life. A randomized controlled design was used to identify study participants. The Asthma Treatment Awareness Project is an asthma management program that was developed and implemented by ConnectiCare, Inc & Affiliates, a regional managed care organization, as an adjunct to an existing asthma management program called Better Respiration Equals Asthma Treatment and Health Education.

METHODS

ConnectiCare, Inc & Affiliates Asthma Management Program

ConnectiCare, Inc & Affiliates is an independent practice association–model regional managed care organization with approximately 270 000 members and a network of 14 000 practitioners and 61 hospitals. Members identified as having asthma using the *International Classification of Diseases, Ninth Revision, Clinical Modification* code 493.XX are automatically enrolled in the ConnectiCare, Inc & Affiliates Better Respiration Equals Asthma Treatment and Health Education asthma management program. Since the program began in 1996, targeted members have periodically received printed educational materials, an invitation to attend a free asthma education class, and a quarterly copy of the ConnectiCare, Inc & Affiliates member publication. Physicians are notified quarterly of members' asthma-related emergency department visits, hospitalizations, or inappropriate medication use according to NHLBI guidelines.

Asthma Medications

The Asthma Treatment Awareness Project was added in 2001 to identify members who were not using asthma medications as recommended by the NHLBI.¹⁹

Pharmacy claims data were used to identify members who had been dispensed 3 or more short-acting or long-acting β_2 -agonist prescriptions for any 3 consecutive months in a 12-month period without a corresponding prescription for an anti-inflammatory medication during the same 3 consecutive months. Long-acting β_2 -agonist prescriptions were included even though the NHLBI identifies long-acting β_2 -agonists as 1 of several long-term control medications. The guidelines stipulate that they should not be used in place of anti-inflammatory therapy but rather used concomitantly with anti-inflammatory medication for long-term control of symptoms.¹⁹

β_2 -agonist prescriptions included 1 or more short-acting β_2 -agonists (albuterol, albuterol sulfate, pirbuterol acetate, metaproterenol sulfate, or terbutaline sulfate) or a long-acting β_2 -agonist (albuterol sulfate extended-release tablets or salmeterol xinafoate). Anti-inflammatory medications included inhaled corticosteroids (beclomethasone dipropionate, budesonide, flunisolide, fluticasone propionate, or triamcinolone acetonide), leukotriene modifier (montelukast sodium, zafirlukast, or zileuton), cromolyn sodium, or nedocromil sodium.

Asthma Medication Index

The asthma medication index is a value that ranges from 0 to 1.00, with a higher score indicating a better prescribing pattern. It is derived by dividing the total number of dispensed anti-inflammatory drug prescriptions by the sum of dispensed β_2 -agonist prescriptions and dispensed anti-inflammatory drug prescriptions. Dispensed prescriptions were identified in rolling 3-month intervals throughout a 12-month period. An asthma medication index of 0 during any of the 3-month intervals qualified a member for the study. A member could have an asthma medication index greater than 0 during the 12-month period, however, if the member was dispensed an anti-inflammatory medication outside of the rolling 3-month interval that qualified him or her for the study. The asthma medication index has been used in previous studies,²⁰⁻²³ demonstrating a correlation with hospital admissions²¹ and emergency department visits.²³

An asthma medication index of 0.50 or greater indicates that for every β_2 -agonist prescribed there would be at least 1 anti-inflammatory medication prescribed. The index would move in the desired direction with decreases in β_2 -agonist use or increases in anti-inflammatory medication use. Members with an index of 0.50 or greater were excluded from the study, because they had attained a minimum desired index before the intervention. Although opportunities for improvement in asthma management among members with an index

of 0.50 or greater may exist, the intervention was intended for members who had a less favorable prescribing pattern.

Subjects

Members had been enrolled in ConnectiCare, Inc & Affiliates for at least 3 months before the time of identification. Members were identified quarterly during 1 year and then followed up for 12 months after entry into the study to address seasonal differences in asthma symptoms. Members 65 years and older were excluded because of the prevalence of chronic obstructive pulmonary disease as a comorbid condition in this age group. Those younger than 13 years were excluded from the analysis because the asthma quality-of-life instrument used (discussed in the next subsection) was only validated for persons 13 years and older.

Study Design

After identification, members were sent a letter describing the benefits of using long-term asthma control medication if they were using quick-relief asthma medication 3 or more times per week or waking up at night with asthma symptoms such as wheezing, coughing, or chest tightness. Members were introduced to the Better Respiration Equals Asthma Treatment and Health Education program and were asked to complete a quality-of-life questionnaire and to indicate their willingness to receive a telephone call from a nurse case manager.

The 15-item Mini Asthma Quality of Life Questionnaire by Juniper et al²⁴ was used to measure quality of life at baseline and at the 12-month follow-up, which was 6 months after the final telephone contact for those who completed the intervention. The Mini Asthma Quality of Life Questionnaire, developed from the 32-item Asthma Quality of Life Questionnaire, has been validated and has shown good reliability.²⁴

Subjects who responded “probably yes” or “probably no” to the invitation to be contacted by a nurse case manager were deemed appropriate for randomization and were equally likely to be placed in the intervention or control groups. Unrestricted randomization was used to determine assignment of the first subject, followed by alternating group assignment according to the order in which responses were received. Because this study was conducted with active members of a health plan, definitive requests were honored. Therefore, those who responded “definitely yes” were considered part of an opt-in group and received the intervention, while those who responded “definitely no” were considered part of an opt-out group and did not receive the intervention. These categories remained distinct in the analysis in an effort to address selection bias. A final category of mem-

bers included those who did not respond to the initial questionnaire. Asthma medication use was measured for nonresponders as a way to assess the potential for temporal bias in asthma medication trends during the study period.

The asthma nurse case managers were required to have a registered nurse license from the state of Connecticut, a minimum of 4 years’ clinical experience, and asthma education training from a board-certified allergist or pulmonologist and to maintain compliance with the ConnectiCare, Inc & Affiliates requirements for continuing education.

Follow-up reminder telephone calls and questionnaires were provided to all nonrespondents. Members who were randomized to the intervention group or who requested a telephone call from a nurse case manager were telephoned for initial assessment within 1 month after their questionnaire was received. The nurse then provided monthly telephonic self-management educational sessions for 6 months. The nurse case manager assessed members’ knowledge of their disease process, existence of an asthma action plan, awareness of nationally recognized treatment guidelines, and overall level of confidence with managing their asthma. Compliance with medication use, adherence to the physician-directed asthma management plan, peak flow monitoring behaviors, and trigger minimization and avoidance were evaluated monthly by obtaining self-reported information from the members during case management telephone contact. The nurse case manager provided feedback to the members regarding these behaviors. In addition, members receiving case management received a packet of educational materials tailored specifically to their needs. This packet included age-specific bilingual printed and video educational materials, as needed, as well as specific asthma management devices. A language telephone line for non-English speakers and a telephone device for the deaf for members with a hearing impairment were also available, as needed.

Data Analysis

The outcome variables included the before and after asthma medication indexes, physician office visits, emergency department visits, hospitalizations, and quality of life. Statistical Package for the Social Sciences, version 12.0 (SPSS Inc, Chicago, Ill) was used to conduct χ^2 tests and Wilcoxon signed rank tests for univariate analyses, and analysis of variance was used for multivariate analyses. Statistical significance was considered at $P < .05$.

A square root transformation was used for skewed distributions of the preintervention and postintervention

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tion asthma medication indexes before multivariate analysis. Square root transformations were also used for skewed before and after quality-of-life scores. Initial univariate models included the preintervention variables and showed significant improvement between preintervention and postintervention variables. The preintervention variables were included in the multivariate model to account for between-group differences in the preintervention asthma medication index, as well as the quality-of-life scores. By testing and rejecting the hypothesis that the preintervention asthma medication indexes were equal to 1, it was demonstrated that preintervention indexes were not consistent with postintervention indexes and that a preintervention index should be used to adjust for the effect of different starting points on the preintervention index. A dummy variable was created for all groups, with the control group serving as the referent group.

ously enrolled in ConnectiCare, Inc & Affiliates for 24 months were excluded. In addition, 39 members who self-reported that they did not have asthma and 31 who had an asthma medication index of 0.50 or greater were excluded. Members with an asthma medication index of 0.50 or greater were considered less likely to be using their asthma medications inappropriately and thus were not targeted to receive an intervention. Therefore, 399 members (48%) were included in the final analysis, including 67 in the intervention group, 67 in the control group, 28 in the opt-in group, 52 in the opt-out group, and 185 who did not return a baseline questionnaire. There were 134 members randomized to the intervention or control groups, for a participation rate of 34%.

Telephone contacts were attempted for all members in the intervention group and the opt-in group. An initial contact was made with 81% of the intervention group and 89% of the opt-in group. During the initial contact, members received general information about asthma management and were asked to identify a treatment plan. Some members indicated that they had obtained all of the information they needed from this initial contact and did not want further contacts. A second contact was made with 40% of the intervention

RESULTS

Subject Identification and Demographics

There were 836 members who met the identification criteria. Of these, 367 members who were not continu-

Table 1. Demographic and Treatment Variables*

Variable	Intervention Group (n = 67)	Control Group (n = 67)	Opt-in Group (n = 28)	Opt-out Group (n = 52)	Nonrespondents (n = 185)	Total (N = 399)	P
Sex							
Male	29 (43.3)	35 (52.2)	16 (57.1)	21 (40.4)	94 (50.8)	195 (48.9)	.45 [†]
Female	38 (56.7)	32 (47.8)	12 (42.9)	31 (59.6)	91 (49.2)	204 (51.1)	
Age, y							
Mean	35.0	36.0	43.9	37.3	34.8	36.0	.03 [‡]
13-20	16 (23.9)	11 (16.4)	2 (7.1)	9 (17.3)	42 (22.7)	80 (20.1)	
21-44	30 (44.8)	38 (56.7)	10 (35.7)	25 (48.1)	92 (49.7)	195 (48.9)	
45-64	21 (31.3)	18 (26.9)	16 (57.1)	18 (34.6)	51 (27.6)	124 (31.1)	
Preintervention short-acting β₂-agonist prescriptions, No.							
Mean	8.4	7.9	9.3	7.3	8.1	8.1	.31 [‡]
0-6	21 (31.3)	29 (43.3)	7 (25.0)	26 (50.0)	79 (42.7)	162 (40.6)	
7-12	37 (55.2)	33 (49.3)	15 (53.6)	20 (38.5)	80 (43.2)	185 (46.4)	
≥ 13	9 (13.4)	5 (7.5)	6 (21.4)	6 (11.5)	26 (14.1)	52 (13.0)	
≥ 1 Postintervention anti-inflammatory prescriptions	30 (44.8)	27 (40.3)	15 (53.6)	19 (36.5)	74 (40.0)	165 (41.4)	.61 [†]

*Data are given as number (percentage) unless otherwise indicated.
[†]χ² Contingency test was used to test differences between groups.
[‡]Independent t test was used to test differences in means between groups.

Table 2. Medication and Utilization Outcome Differences*

Variable	Intervention Group (n = 67)	Control Group (n = 67)	Opt-in Group (n = 28)	Opt-out Group (n = 52)	Nonrespondents (n = 185)
Asthma medication index	0.108	0.093	0.097	0.092	0.084
Preintervention	0.284	0.184	0.382	0.258	0.198
Postintervention	0.176	0.091	0.285	0.166	0.114
Difference <i>P</i> value	< .001	.002	< .001	< .001	.001
≥ 1 Physician office visits	43.3	46.3	53.6	40.4	49.2
Preintervention	55.2	43.3	60.7	53.8	44.9
Postintervention	11.9	-3.0	7.1	13.4	-4.3
Difference	.13	.66	.56	.11	.31
≥ 1 Emergency department visits	4.5	3.0	17.9	0	4.9
Preintervention	7.5	6.0	7.1	1.9	7.6
Postintervention	3.0	3.0	-10.8	1.9	2.7
Difference <i>P</i> value	.41	.41	.08	.32	.20
≥ 1 Hospitalizations					
Preintervention	0	0	0	0	0
Postintervention	1.5	0	0	0	0
Difference	1.5	0	0	0	
<i>P</i> value	.32	1.00	> .99	> .99	> .99

*Data are given as percentages unless otherwise indicated. Wilcoxon signed rank test was used to test differences in preintervention and postintervention values.

group and 79% of the opt-in group. Four or more contacts were used as an indicator of program completion. Twenty-seven percent of the intervention group and 68% of the opt-in group completed the program.

As presented in **Table 1**, the 399 members included in the final analysis were equally divided between male (49%) and female (51%) subjects. The mean age was 36.0 years, with two thirds of the members being younger than 45 years. Although there was an overall difference ($P = .03$) among the groups with respect to age, this was only significant for the opt-in group (43.9 years) compared with the nonrespondents (34.8 years) ($P = .02$). There was no statistically significant difference in the mean age of the subjects in the intervention (35.0 years), control (36.0 years), or opt-out (37.3 years) groups. Forty-one percent of subjects had an anti-inflammatory medication dispensed in the previous 12 months, while the entire cohort had a mean of 8.1 short-acting β_2 -agonist prescriptions dispensed.

Asthma Medication Outcomes

There were significant increases in the asthma medication index for all groups (**Table 2**). The increase of 0.285 for the opt-in group was the largest, while the 0.091 increase for the control group was the smallest. The 0.176 increase for the intervention group was

nearly 2 times the 0.091 increase for the control group. After using analysis of variance to control for age and the preintervention asthma medication index, the difference between all groups was significant ($P = .04$). Age was entered in the multivariate analysis as a categorical variable (13-20, 21-44, 45-64 years). Sex was removed as a covariate because it was not a significant predictor in the model. Compared with the control group, improvements were significant for the intervention group ($P = .04$) and the opt-in group ($P = .01$) (**Table 3**). Age was also a statistically significant predictor of asthma medication index differences, revealing improvements in the groups aged 21 to 44 years ($P = .001$) and 45 to 64 years ($P = .008$) compared with the group aged 13 to 20 years. However, there were no statistically significant differences in the numbers of physician office visits, emergency department visits, or hospitalizations.

Quality-of-Life Outcomes

Quality-of-life differences were measured for all responding groups (**Table 4**). There was a statistically significant increase in overall quality of life for the intervention group ($P = .04$). The intervention group also demonstrated increases in 2 of the 4 subscales, including emotional function ($P = .045$) and environmental

Table 3. Postintervention Asthma Medication Index Multivariate Analysis

Variable	β Level	P
Preintervention asthma medication index	.601	< .001
Age, years		
13-20	Referent	Referent
21-44	-.143	.001
45-64	-.087	.008
Group		
Control	Referent	Referent
Intervention	-.095	.04
Opt-in	-.158	.01
Opt-out	-.075	.15
Nonrespondents	-.023	.56

stimuli ($P = .04$). There were no statistically significant differences for the control group, opt-in group, or opt-out group, nor were there significant between-group differences in the multivariate analysis.

DISCUSSION

This study provides evidence of improvement in asthma medication use among 5 different groups of study participants. Regardless of randomization or intervention status, the mean asthma medication index increased during a 12-month period. The improvement in all groups is consistent with recent studies^{5,25,26} that demonstrate trends in increased use of controller medications with concomitant decreased use of short-acting reliever medications. Nevertheless, the largest increases were seen in those members who received the intervention, whether randomized or self-selected.

The study revealed that member motivation is an important factor in determining improvement in asthma management. The opt-in group had the highest proportion of members to complete the program and the largest asthma medication index increase. The findings indicate that members who chose to receive the intervention achieved better outcomes. This study highlights the importance of self-motivation as an indicator of readiness to initiate and maintain asthma self-management.

As previously stated, 27% of the intervention group and 68% of the opt-in group completed the program. Because significant improvement in the asthma medication index was achieved for these 2 groups, they appear to have benefited from receiving a portion of the Asthma Treatment

Awareness Program. A redesigned shorter program may have similar success. It is also likely that increased completion rates may lead to improved outcomes.

Improvements in the asthma medication index were greater in the older compared with the younger age groups. This finding is consistent with other studies^{6,26} that demonstrate the association of the underuse of inhaled corticosteroids with younger age. This may signal the need for age-appropriate interventions that target younger age groups.

A multicontact telephone intervention delivered by a nurse case manager was effective in increasing

appropriate asthma medication use. Because of the seasonality of the disease, and to improve adherence with proper medication therapy, ConnectiCare, Inc & Affiliates developed and implemented the 6-month Asthma Treatment Awareness Project intervention to accomplish this goal. Others have reported interventions ranging from a single session to multiple sessions during a 12-month period, with varying levels of success.⁸

The program demonstrated improvement in asthma medication use for members in the intervention group compared with those in the control group. This was accomplished in spite of the low program completion rates. Because subjects mostly had mild-to-moderate intermittent asthma, no hospitalizations in the past year, minimal emergency department visits, and high quality-of-life scores at baseline, it is likely that they were not significantly impaired by their condition. This could have contributed to the low program completion rate. A larger sample would be needed to determine the optimal level of intervention that would be required to produce desired changes in medication use, quality of life, and medical service utilization. A longer observation period may have also resulted in greater medical service utilization among the control group.

The asthma medication index threshold chosen for inclusion in the study was less than 0.50, because these subjects would have the least favorable prescribing patterns. In accord with recommendations in the NHLBI guidelines, members using a short-acting β_2 -agonist more than 2 times per week for intermittent asthma may need to receive long-term control therapy.¹⁹ Once anti-inflammatory medication is initiated and maintained, the asthma medication index is expected to increase, representing a decrease in β_2 -agonist use and

an increase in anti-inflammatory medication use. Although an index of 0.50 does not necessarily infer optimal control, increases in the asthma medication index across an asthma population indicate improved changes in prescribing patterns consistent with NHLBI guidelines. Asthma medication index increases are also likely to result from member behavior changes, including medication compliance. The group that attained the highest postintervention asthma medication index was the opt-in group, at 0.382 for a 12-month period. Further research would be needed to determine the mean asthma medication index for a population with asthma.

A limitation of this study was the use of pharmacy claims data as an indicator of actual medication use. The exclusive use of pharmacy claims data may underestimate actual medication use by not considering the use of samples received from physicians or prescriptions that are covered by a different pharmacy benefit. As many as 13% of study participants reported receiving at least 1 free sample of an anti-inflammatory medication from their physician.

Based on an earlier study²⁷ of children with asthma, a poor correlation between self-reported compliance and objectively measured compliance would seem to indicate that pharmacy claims data may underestimate actual medication use. However, a recent study²⁸ demonstrated a significant correlation between daily anti-inflammatory drug intake as estimated by pharmacy records and daily anti-inflammatory drug intake as determined by inhaler emptying rates, thereby calling the previous assumption into question.

The lack of sociodemographic, ethnic, and racial information limits the generalizability of our results to specific subgroups. The sample was drawn from a managed care organization that does not offer services to Medicare or Medicaid beneficiaries, and most subjects are employed or are dependents of employed health insurance subscribers. Previous research has shown

that insured persons are more likely to promptly fill their prescriptions and take recommended dosages.²⁹ Our sample was representative of the employed, mostly white, populations of Connecticut and western Massachusetts. Therefore, the study may overestimate the use of inhaled corticosteroids for the general population, because underuse of inhaled corticosteroids has been shown to be associated with nonwhite race.^{6,10}

Individualized telephonic case management from a specially trained registered nurse is an effective way to provide self-management education to a high-risk group with asthma. By identifying persons who are not using asthma medications as recommended by the NHLBI, a telephonic intervention such as the one in this study can address basic self-management issues to yield desired medication adjustments. Extending this research will assist healthcare organizations in selecting effective programs to treat individuals with asthma.

Table 4. Quality-of-Life Comparisons*

Quality-of-Life Subscale	Intervention Group (n = 39) [†]	Control Group (n = 31) [†]	Opt-in Group (n = 15) [†]	Opt-out Group (n = 18) [†]
Overall				
Preintervention	5.18	5.11	4.33	5.88
Postintervention	5.44	5.23	4.65	5.80
Difference	0.26	0.12	0.32	-0.08
P value	.04	.31	.32	.76
Symptoms				
Preintervention	5.17	5.08	4.21	5.57
Postintervention	5.34	5.17	4.79	5.61
Difference	0.17	0.09	0.58	0.04
P value	.24	.66	.21	> .99
Activity limitations				
Preintervention	6.03	5.94	5.52	6.61
Postintervention	6.15	6.09	5.38	6.20
Difference	0.12	0.15	-0.14	-0.41
P value	.20	.20	.78	.18
Emotional function				
Preintervention	4.52	4.48	3.29	6.02
Postintervention	4.98	4.56	4.02	5.80
Difference	0.46	0.08	0.73	-0.22
P value	.045	.82	.29	.24
Environmental stimuli				
Preintervention	4.75	4.71	4.00	5.29
Postintervention	5.14	4.87	4.09	5.61
Difference	0.39	0.16	0.09	0.32
P value	.04	.49	.86	.57

*Wilcoxon signed rank test was used to test differences in preintervention and postintervention values.

[†]Number of subjects who completed a baseline and 12-month follow-up Quality of Life Questionnaire.

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REFERENCES

- Mannino DM, Homa DM, Akinbami LJ, Moorman JE, Gwynn C, Redd SC. Surveillance for asthma—United States, 1980-1999. *MMWR Surveill Summ.* 2002;51(SS-1):1-13.
- Centers for Disease Control and Prevention. Asthma prevalence and control characteristics by race/ethnicity—United States, 2002. *MMWR Morb Mortal Wkly Rep.* 2004;53:145-148.
- National Heart, Lung, and Blood Institute. *Morbidity and Mortality: 2002 Chart Book on Cardiovascular, Lung, and Blood Diseases.* Bethesda, Md: US Dept of Health and Human Services; 2003:17.
- National Heart, Lung, and Blood Institute. *Quick Reference for the NAEP Expert Panel Report 2: Guidelines for the Diagnosis and Management of Asthma: Update on Selected Topics, 2002.* Bethesda, Md: US Dept of Health and Human Services; 2002.
- Stafford RS, Ma J, Finkelstein SN, Haver K, Cockburn I. National trends in asthma visits and asthma pharmacotherapy, 1978-2002. *J Allergy Clin Immunol.* 2003;111:729-735.
- Diette GB, Wu AW, Skinner EA, et al. Treatment patterns among adult patients with asthma: factors associated with overuse of inhaled β -agonists and underuse of inhaled corticosteroids. *Arch Intern Med.* 1999;159:2697-2704.
- Guevara JP, Wolf FM, Grum CM, Clark NM. Effects of educational interventions for self management of asthma in children and adolescents: systematic review and meta-analysis. *BMJ.* 2003;326:1308-1309.
- Powell H, Gibson PG. Options for self-management education for adults with asthma. *Cochrane Database Syst Rev.* 2003;1(CD004107):1-32.
- Janson SL, Fahy JV, Covington JK, Paul SM, Gold WM, Boushey HA. Effects of individual self-management education on clinical, biological, and adherence outcomes in asthma. *Am J Med.* 2003;115:620-626.
- Adams RJ, Weiss ST, Fuhlbrigge A. How and by whom care is delivered influences anti-inflammatory use in asthma: results of a national population survey. *J Allergy Clin Immunol.* 2003;112:445-450.
- Krishna S, Francisco BD, Balas EA, Konig P, Graff GR, Madsen RW. Internet-enabled interactive multimedia asthma education program: a randomized trial. *Pediatrics.* 2003;111:503-510.
- Cote J, Cartier A, Robichaud P, et al. Influence of asthma education on asthma severity, quality of life and environmental control. *Can Respir J.* 2000;7:395-400.
- Centers for Disease Control and Prevention. Self-reported asthma prevalence and control among adults—United States, 2001. *MMWR Morb Mortal Wkly Rep.* 2003;52:381-384.
- Buchner DA, Butt LT, De Stefano A, Edgren B, Suarez A, Evans RM. Effects of an asthma management program on the asthmatic member: patient-centered results of a 2-year study in a managed care organization. *Am J Manag Care.* 1998;4:1288-1297.
- Jowers JR, Schwartz AL, Tinkelman DG, et al. Disease management program improves asthma outcomes. *Am J Manag Care.* 2000;6:585-592.
- Suh DC, Shin SK, Okpara I, Voytovich RM, Zimmerman A. Impact of a targeted asthma intervention program on treatment costs in patients with asthma. *Am J Manag Care.* 2001;7:897-906.
- Georgiou A, Buchner DA, Ershoff DH, Blasko KM, Goodman LV, Feigin J. The impact of a large-scale population-based asthma management program on pediatric asthma patients and their caregivers. *Ann Allergy Asthma Immunol.* 2003;90:308-315.
- Riegel B, Carlson B, Kopp Z, LePetri B, Glaser D, Unger A. Effect of a standardized nurse case-management telephone intervention on resource use in patients with chronic heart failure. *Arch Intern Med.* 2002;162:705-712.
- National Heart, Lung, and Blood Institute. *Expert Panel Report 2: Guidelines for the Diagnosis and Management of Asthma.* Bethesda, Md: US Dept of Health and Human Services; 1997.
- Shelley M, Croft P, Chapman S, Pantin C. Is the ratio of inhaled corticosteroid to bronchodilator a good indicator of the quality of asthma prescribing? cross sectional study linking prescribing data to data on admissions. *BMJ.* 1996;313:1124-1126.
- Griffiths C, Sturdy P, Naish J, Omar R, Dolan S, Feder G. Hospital admissions for asthma in east London: associations with characteristics of local general practices, prescribing, and population. *BMJ.* 1997;314:482-486.
- Goodman DC, Lozano P, Stukel TA, Chang C, Hecht J. Has asthma medication use in children become more frequent, more appropriate, or both? *Pediatrics.* 1999;104:187-194.
- Fuhlbrigge A, Carey VJ, Adams RJ, et al. Evaluation of asthma prescription measures and health system performance based on emergency department utilization. *Med Care.* 2004;42:465-471.
- Juniper EF, Guyatt GH, Cox FM, Ferrie PJ, King DR. Development and validation of the Mini Asthma Quality of Life Questionnaire. *Eur Respir J.* 1999;14:32-38.
- Sullivan SD. Asthma in the United States: recent trends and current status. *J Manag Care Pharm.* 2003;9(suppl):3-7.
- van Staa TP, Cooper C, Leufkens HG, Lammers JW, Suissa S. The use of inhaled corticosteroids in the United Kingdom and the Netherlands. *Respir Med.* 2003;97:578-585.
- Bender B, Wamboldt FS, O'Connor SL, et al. Measurement of children's asthma medication adherence by self report, mother report, canister weight, and Doser CT. *Ann Allergy Asthma Immunol.* 2000;85:416-421.
- Walewski KM, Cicutto L, D'Urzo AD, Heslegrave RJ, Chapman KR. Evaluation of a questionnaire to assess compliance with anti-asthma medications. *J Asthma.* 2004;41:77-83.
- Stevens D, Sharma K, Kesten S. Insurance status and patient behavior with asthma medications. *J Asthma.* 2003;40:789-793.