

# A self-management program for adult asthma. Part II: Cost-benefit analysis

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**Background:** We performed a cost-benefit analysis of a previously described self-management program for adult asthma.

**Methods:** Direct and indirect cost data from 47 subjects who participated in the self-management program were analyzed. In particular, costs incurred by the subjects 1 year before participation were compared with costs incurred 1 year after participation.

**Results:** The cost-benefit analysis indicated that the program was beneficial, reducing the cost of asthma to each patient by \$475.29. The benefit came primarily from reductions in hospital admissions (reduced from \$18,488 to \$1538) and income lost as a result of asthma (reduced from \$11,593 to \$4589). The asthma self-management program cost \$208.33 per patient. Comparison of the program cost with the program benefit produced a 1:2.28 cost-benefit ratio, demonstrating that the program more than paid for itself.

**Conclusion:** A self-management program for adult asthma effectively reduced the cost associated with asthma. The findings are especially salient because the subjects' asthma was generally under good medical control when they participated in the program. The savings were therefore not the result of improved medical treatment; medical treatment was a controlled parameter, not a variable, in the self-management study. The self-management program for adult asthma was cost-beneficial. (*J ALLERGY CLIN IMMUNOL* 1995;95:672-6.)

**Key words:** Adult asthma, cost-benefit analysis, cost-effectiveness, direct costs, indirect costs, self-management

Asthma is an expensive disorder that affects approximately 10 million Americans. Like expenses for health care in general, the costs associated with asthma have increased rapidly; the estimated expense for the disorder rose from \$1 billion in 1980 to \$4 billion in 1988 to \$6.2 billion in 1990.<sup>1,2</sup> Asthma self-management has been shown to be clinically effective; it may also reduce the cost of asthma.<sup>3</sup>

Cost-benefit and cost-effectiveness analyses of an asthma self-management program can provide the information necessary to evaluate the program's financial impact by identifying, analyzing, and comparing significant program costs and consequences.<sup>4</sup> Cost-benefit analysis differs from

cost-effectiveness analysis in the units chosen to measure program consequences. A cost-benefit analysis balances the monetary cost of conducting a program against the monetary benefit of the program; the result is often reported as a ratio. For example, a cost-benefit analysis might report that a program costing \$100 per person yielded \$110 in savings (a 1:1.1 cost-benefit ratio). A cost-effectiveness analysis balances the cost of a program against some desired nonmonetary consequence, such as a change in behavior or health status. For example, a cost-effectiveness analysis might report that a program costing \$100 per person yielded 20% fewer emergency department visits.

Cost-benefit and cost-effectiveness analyses of health care are relatively new, and only a few researchers have used these methods to analyze asthma treatment programs. In one German study, psychosomatic group therapy for adults with asthma reduced hospitalization and work days lost as a result of asthma.<sup>5</sup> The 1-year therapy consisted of asthma education, instruction in breathing and relaxation techniques, group support, and psychoanalytic interpretation of group dynamics. The cost of the therapy was approximately \$867.11 per

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**TABLE I.** Baseline costs and percentage of household income ( $N = 47$ )

|                             | Mean      | SD        | Minimum | Maximum | Sum     |
|-----------------------------|-----------|-----------|---------|---------|---------|
| Direct costs                |           |           |         |         |         |
| Physician visits            | 489.26    | 473.15    | 0       | 1,813   | 22,995  |
| Hospital admissions         | 576.11    | 1,489.27  | 0       | 6,679   | 27,077  |
| Emergency department visits | 144.83    | 363.74    | 0       | 1,642   | 6,807   |
| Medication                  | 624.51    | 711.86    | 5       | 3,397   | 29,352  |
| Antigen injections          | 45.91     | 218.54    | 0       | 1,479   | 2,158   |
| Laboratory fees             | 41.32     | 106.66    | 0       | 580     | 1,942   |
| Subtotal                    | 1,921.94  | 2,168.49  | 25      | 8,595   | 90,331  |
| Indirect costs              |           |           |         |         |         |
| Travel                      | 70.53     | 149.49    | 0       | 700     | 3,315   |
| Income lost                 | 332.32    | 836.98    | 0       | 3,725   | 15,619  |
| Miscellaneous               | 256.47    | 700.92    | 0       | 3,715   | 12,054  |
| Subtotal                    | 659.32    | 1,086.24  | 0       | 3,943   | 30,988  |
| Total cost                  | 2,581.26  | 2,778.78  | 27      | 10,565  | 121,319 |
| Household income            | 40,495.68 | 23,490.24 | 6000    | 150,000 |         |
| Direct costs (%)            | 9         | 16        | 0       | 73      |         |
| Indirect costs (%)          | 2         | 4         | 0       | 20      |         |
| Total cost (%)              | 11        | 19        | 0       | 79      |         |

All values in U.S. dollars.

**TABLE II.** Mean costs associated with asthma and percentage of household income by income level

|                                | Low ( $n = 15$ ) | Middle ( $n = 15$ ) | High ( $n = 15$ ) |
|--------------------------------|------------------|---------------------|-------------------|
| Household income               | 19,353.13        | 37,400.00           | 61,882.35         |
| Direct costs                   | 2,392.33         | 1,574.27            | 1,813.60          |
| Indirect costs                 | 700.07           | 421.73              | 833.00            |
| Total cost                     | 3,092.40         | 1,996.00            | 2,646.65          |
| Percentage of household income |                  |                     |                   |
| Direct costs (%)               | 19               | 4                   | 3                 |
| Indirect costs (%)             | 4                | 1                   | 2                 |
| Total cost (%)                 | 23               | 5                   | 5                 |

All values in U.S. dollars.

**TABLE III.** Pretreatment and posttreatment asthma-associated costs and average benefit per cost category

|                                                         | <i>N</i> | Pretreatment | Posttreatment | Benefit | Average benefit | <i>p</i> |
|---------------------------------------------------------|----------|--------------|---------------|---------|-----------------|----------|
| Physician visits                                        | 48       | 19,984       | 24,000        | -4,016  | -83.67          | 0.238    |
| Hospital admissions                                     | 51       | 18,488       | 1,538         | 16,950  | 332.35          | 0.017*   |
| Emergency department visits                             | 55       | 5,199        | 3,496         | 1,703   | 30.96           | 0.646    |
| Medication                                              | 47       | 25,555       | 30,485        | -4,930  | -104.89         | 0.114    |
| Antigen injections                                      | 54       | 4,051        | 1,550         | 2,501   | 46.31           | 0.264    |
| Laboratory fees                                         | 52       | 1,820        | 2,315         | -495    | -9.52           | 0.814    |
| Travel                                                  | 52       | 4,354        | 3,101         | 1,253   | 24.10           | 0.166    |
| Income lost                                             | 49       | 11,593       | 4,589         | 7,004   | 142.94          | 0.072*   |
| Miscellaneous                                           | 57       | 16,211       | 9,165         | 7,046   | 123.61          | 0.286    |
| Total                                                   |          |              |               | 27,016  | 502.19          |          |
| Average benefit (including only significant categories) |          |              |               |         | 475.29          |          |

All values in U.S. dollars.

\*Significant at the  $p < 0.10$  level.

TABLE IV. Frequency of cost by category and time

| Value<br>(\$) | Physician<br>visits |       | Hospital<br>admissions |       | ED visits |       | Medication |       | Antigen<br>injections |       | Laboratory<br>fees |       |
|---------------|---------------------|-------|------------------------|-------|-----------|-------|------------|-------|-----------------------|-------|--------------------|-------|
|               | Before              | After | Before                 | After | Before    | After | Before     | After | Before                | After | Before             | After |
| 0             | 1                   | 1     | 42                     | 49    | 45        | 50    | 0          | 3     | 44                    | 44    | 42                 | 45    |
| 1-200         | 15                  | 20    | 0                      | 0     | 1         | 3     | 15         | 11    | 8                     | 8     | 7                  | 6     |
| 201-400       | 14                  | 9     | 1                      | 0     | 3         | 1     | 8          | 10    | 0                     | 2     | 2                  | 0     |
| 401-600       | 6                   | 6     | 1                      | 1     | 4         | 0     | 9          | 3     | 0                     | 0     | 0                  | 0     |
| 601-800       | 6                   | 3     | 0                      | 0     | 1         | 0     | 5          | 4     | 0                     | 0     | 0                  | 0     |
| 801-1000      | 2                   | 2     | 1                      | 1     | 0         | 0     | 2          | 4     | 0                     | 0     | 1                  | 0     |
| 1001-1500     | 2                   | 4     | 0                      | 0     | 0         | 0     | 4          | 6     | 1                     | 0     | 0                  | 0     |
| 1501-2000     | 1                   | 1     | 0                      | 0     | 1         | 0     | 2          | 5     | 1                     | 0     | 0                  | 1     |
| 2001-2500     | 0                   | 1     | 3                      | 0     | 0         | 0     | 2          | 0     | 0                     | 0     | 0                  | 0     |
| 2501-3000     | 0                   | 1     | 1                      | 0     | 0         | 0     | 0          | 1     | 0                     | 0     | 0                  | 0     |
| 3001-3500     | 0                   | 0     | 1                      | 0     | 0         | 1     | 0          | 0     | 0                     | 0     | 0                  | 0     |
| 3501-4000     | 0                   | 0     | 0                      | 0     | 0         | 0     | 0          | 0     | 0                     | 0     | 0                  | 0     |
| 4001-4500     | 0                   | 0     | 1                      | 0     | 0         | 0     | 0          | 0     | 0                     | 0     | 0                  | 0     |

patient, converting the average value of U.S. dollars from deutsche marks in 1981,<sup>6</sup> and the subsequent savings were approximately \$4900.44 per patient, a 1:5.6 cost-benefit ratio.

In the United States, a health education program for low-income families with asthmatic children increased self-management behavior and decreased health care use and cost.<sup>7</sup> The program, consisting of six 1-hour sessions that focused on asthma self-management techniques, decreased health care costs by \$11.22 for every dollar spent on the education program. The savings were noted among children who had previously been hospitalized for asthma. When all subjects—both children who had and those who had not been hospitalized for asthma—were considered, a 62-cent saving was achieved for each dollar spent on the program. This indicated that for a minimal cost the program benefited all families affected by childhood asthma.

An adult asthma health education intervention also proved cost-effective.<sup>8</sup> This intervention involved a 30-minute individual training session on how to use a peak flow meter and an inhaler, an asthma self-help guide, a 60-minute support-group session, and two brief telephone calls. Members of the treatment group exhibited a 44% increase in total medication adherence, whereas members of the control group exhibited a 2% increase in total adherence. The significant increase in the treatment group's total adherence cost \$32.03 per patient. In terms of cost-effectiveness, for every dollar spent on the treatment, there was a 1.37% increase in total adherence.

A recent cost-benefit and cost-effectiveness analysis of asthma treatment focused on an education

program for adults with asthma.<sup>9</sup> The program consisted of three 1-hour educational group sessions that focused on medication compliance, attack control and prevention, relaxation, and smoking cessation. The investigators analyzed the subjects' emergency department visits, physician visits, hospitalizations, and days of limited activity. After treatment, the number of emergency department visits decreased; the other variables did not change. This decrease produced a benefit of \$628 per patient that yielded approximately a 1:7.0 cost-benefit ratio with respect to the \$85 per patient program cost.

This report presents a cost-benefit analysis of a previously described adult asthma self-management program.<sup>10</sup> The program was a 7-week asthma self-management class that included education about asthma, asthma medications, prevention of attacks, and attack management. Unlike most asthma education programs, the program included a behavior control component. Participants were required to keep a daily diary of asthma episodes and to monitor and record their peak expiratory flow rates.

## METHODS

Data from 76 adult patients with asthma who participated in an evaluation of the program<sup>10</sup> were analyzed. Cost data that documented the direct and indirect costs associated with each patient's asthma, gathered at baseline and at a 1-year follow-up, were analyzed. Direct costs included expenses associated with physician visits, hospital admissions, emergency department visits, asthma medication, self-administered antigen injections, and laboratory fees. Indirect costs included travel to health care facilities, income lost because of asthma, and miscellaneous expenses, such as air-conditioning and cleaning devices.

For the cost-benefit analysis, the cost of asthma among

| Travel |       | Income lost |       | Miscellaneous |       |
|--------|-------|-------------|-------|---------------|-------|
| Before | After | Before      | After | Before        | After |
| 6      | 9     | 38          | 42    | 35            | 45    |
| 39     | 37    | 1           | 3     | 9             | 6     |
| 3      | 6     | 5           | 0     | 5             | 2     |
| 1      | 0     | 2           | 1     | 1             | 0     |
| 3      | 0     | 0           | 1     | 3             | 1     |
| 0      | 0     | 0           | 1     | 0             | 1     |
| 0      | 0     | 0           | 0     | 0             | 0     |
| 0      | 0     | 0           | 1     | 0             | 0     |
| 0      | 0     | 1           | 0     | 2             | 1     |
| 0      | 0     | 0           | 0     | 0             | 0     |
| 0      | 0     | 1           | 0     | 1             | 0     |
| 0      | 0     | 1           | 0     | 1             | 0     |
| 0      | 0     | 0           | 0     | 0             | 1     |

the subjects was calculated and the benefit value of the program was determined. Finally, the monetary benefit of the program was balanced against the cost of conducting it.

## RESULTS

### Cost of adult asthma

Of 76 subjects, 47 provided complete baseline data for all cost variables; data from 29 participants were eliminated from analysis because they were incomplete. These baseline data are presented in Table I. For the 12 months preceding entry into the program, each subject spent an average of \$1921.94 on direct costs for asthma and \$659.32 on indirect costs. Most costs (78.3%) were distributed among four variables: medications (\$624.51), hospital admissions (\$576.11), physician visits (\$489.26), and lost income (\$332.32). Moreover, the average total cost of expenses associated with asthma—\$2581.26—consumed on average 11% of the participants' annual household income.

Each cost variable had a large standard deviation, which was often greater than its mean; with the exception of physician visits and medication, each had a modal cost of zero. The total cost of asthma ranged from \$27 to \$10,565; the median was \$1485. These results reflect both the episodic nature of asthma and the high costs associated with the disorder.

Depending on the participants' annual household income, the cost of asthma represented varied levels of financial hardship. Participants were divided into three income levels: less than \$30,000, \$30,000 to \$46,000, and more than \$46,000 per annum. Participants in the low-income group spent the most on asthma; the disorder consumed an average of \$3092, or 23% of their annual income. Those in the high-income group spent an average

of \$2646, or 5% of their annual income on asthma. Finally, the cost of asthma for participants in the middle-income group was an average of \$1996, or 5% of their income. Data obtained from the three groups are depicted in Table II.

### Benefits of the adult asthma self-management program

The benefits of the adult asthma self-management program were calculated for each direct and indirect cost category. In these calculations, we eliminated scores that deviated from the mean by more than five standard deviations, reducing by three the number of individuals in both the "hospital admissions" and the "income lost" categories. Because of this restriction, we calculated benefits for each category separately and divided by the number of participants who provided data. The resulting value represented the average per person benefit for that cost category. A repeated measures analysis of variances was performed to identify any significant differences between pretreatment and posttreatment costs associated with asthma. Only categories with cost differences considered significant ( $p < 0.10$ ) were included in the benefit calculation. The total benefit of the self-management program was estimated as the sum of the average benefits.

The cost associated with asthma decreased after participation in the program. As shown in Table III, however, the only significant changes were for hospital admissions and income lost because of asthma. The overall cost for hospital admissions decreased from \$18,488 to \$1538 for the 51 participants who provided data. The overall income lost because of asthma decreased from \$11,593 to \$4589 for the 49 participants providing data. There were no significant changes in the costs associated with physician visits, emergency department visits, medications, self-administered antigen injections, laboratory fees, travel, or miscellaneous expenses. The average benefit was \$475.29 per patient.

To show the source of benefits, Table IV contains a frequency distribution of costs associated with asthma, broken down by cost category and time. From the pretreatment to the posttreatment interval, the distribution of asthma costs in most categories shifted toward zero.

### Cost-benefit analysis

The cost-benefit analysis entailed comparing the program's cost with its monetary benefits. Because the cost of conducting research on an asthma self-management program is greater than the cost of the program alone, only the cost of implementing the

**TABLE V.** Cost-benefit evaluation, per patient

|                    |          |
|--------------------|----------|
| Program cost       | \$208.33 |
| Program benefit    | \$475.29 |
| Cost-benefit ratio | 1:2.28   |

program without the research component was used in the cost-benefit analysis. Within a 1-year period, Kotses et al.<sup>10</sup> conducted four 7-week sessions. The \$10,000 budget covered all costs for personnel, space rental, advertising, supplies, and materials. With this budget, the researchers were capable of serving 60 patients, although only 48 patients entered the program. Dividing the program's budget by its capacity (60 patients) produced a \$166.67 cost per patient. In a more realistic approach toward the cost analysis, however, the program's budget was divided by the actual number of patients served. The derived cost was thus \$208.33 per patient.

Balancing the program's cost per patient (\$208.33) against the benefit per patient (\$475.29) yielded a cost-benefit ratio of 1:2.28. As noted in Table V, for every dollar spent on the program, a savings of \$2.28 was returned.

## DISCUSSION

Two points about the study warrant discussion. First, as noted by Kotses et al.,<sup>10</sup> the asthma of most patients was controlled adequately by medical treatment when they began their participation in the program. This created a different type of baseline than normally obtained in self-management studies. Consequently, changes that were obtained reflect the role the subjects came to play in helping their physicians with asthma control, not the improved medical care that often is a component of self-management programs. The patients' performance not only enhanced their control over their asthma but reduced the financial burden associated with the disorder. Second, as in previous studies where attempts were made to gather financial costs from patients,<sup>11</sup> the data-gathering task proved difficult. This problem rests less with patients than with the medical and insurance organizations that provide health care to them. It is difficult, if not impossible, to gather accurate cost data on asthma from many health

maintenance organizations, the federal government, or other agencies that supply medical care. In our case, knowledge of these factors was taken into consideration. The result was a conservative estimate of savings that accrued to patients as a consequence of their participation in an adult asthma self-management program.

The adult asthma self-management previously described by Kotses et al.<sup>10</sup> was beneficial in reducing the costs associated with asthma. The 1:2.28 cost-benefit ratio demonstrated that the program more than paid for itself. Consequently, this program not only was effective with subjects but is still being conducted on a regular basis in clinics throughout the Cincinnati area.

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