Long-term economic evaluation of intensive patient education during the first treatment year in newly diagnosed adult asthma

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The cost-effectiveness of intensive patient education of guided asthma self-management given during the first treatment year was evaluated after 5 years of follow-up. Consecutive, newly-diagnosed asthmatics (n = 162, age 18–76 years) were randomized for intensive (80 patients) vs. conventional patient education. Effectiveness was evaluated in terms of lung functions, airway hyperresponsiveness (PD15), and quality of life as measured by the generic 15D and disease-specific St. George’s Respiratory Questionnaire (SGRQ). Total treatment costs were also estimated. All patients had anti-inflammatory treatment from the beginning. Sixty-four intervention group (IG) patients and 70 control group (CG) patients were evaluated after 5 years. Forced expiratory volume in 1 sec (FEV1) improved only in the IG, and only during the first treatment year. However, PD15 improved throughout the follow-up. The unscheduled healthcare costs were significantly higher in the CG than in the IG (P = 0.04) and the relative risk for sickness days due to asthma was lower in the IG than in the CG, odds ratio 0.33 (95% CI 0.28; 0.40). However, because there was no significant difference between the groups in any outcome variable or in total costs at 5 years, the incremental cost-effectiveness ratio could not be calculated. The first year intervention had only a short-term beneficial treatment effect, which the CG could catch up during the two last follow-up years, except in FEV1. The peak expiratory flow (PEF)-based self-management had no advantage over the symptom-based self-management. However, the intervention had a consistent tendency of being less costly in the long-run. It is possible to conclude tentatively that regular effective medical treatment and control visits during the first treatment year is at least as important for the long-term treatment result as intensive patient education.

Key words: patient education and economics; asthma quality of life; self-management and asthma and economics; asthma therapy and economics.

Introduction

Patient education and self-management have had an economic impact among mild, moderate or severe asthmatics in terms of reducing the use of healthcare services, but less of an impact on improving lung function (1–3). However, the findings regarding the effectiveness of different methods for implementing patient education and self-management plans are controversial (4–8). Chapman argued that cost-effectiveness should form an integral part of education studies (9).

Self-management was concluded to reduce unscheduled hospital or physician visits and days off from work or school in the Cochrane review, which included no long-term studies concerning self-management education for newly-diagnosed asthmatics (10). When the costs of intervention for patient education during the first treatment year are considered, there appear to be no economic benefits during the first 3 years from such an intervention (11,12).

The aim of the present study was to evaluate the effectiveness of intensive patient education for self-management given during the first treatment year in terms of asthma progression and quality of life, and evaluate the treatment costs over a follow-up period of 5 years among newly-diagnosed asthmatics.
Methods

The 162 consecutive, newly-diagnosed adult (over 16 years) asthmatic patients were recruited from the outpatient clinic of South Karelia Central Hospital. They were diagnosed according to the criteria of the American Thoracic Society (13). All agreed 1 month later to be randomized into intensive patient education and follow-up during the first treatment year (intervention group IG), or into a control group (CG). At baseline the IG consisted of 80 patients, of whom 64 (25 men) were evaluated at 5 years. The CG consisted of 82 patients at baseline, and 70 (27 men) were evaluated at 5 years. The patient characteristics at baseline are given in Table 1.

The Hospital Ethical Committee approved the study plan (Fig. 1) and informed consent was obtained from all patients. The details of the programme, treatments and outcome measures during follow-up and the calculation of direct and indirect costs have been published previously (11,12).

THE BASIC EDUCATION PROGRAMME FOR ALL PATIENTS

The conventional patient education programme covered the use of inhaled drugs, PEF monitoring and principles of treatment. Two respiratory nurses, earlier trained in the hospital to give patient education in the outpatient clinic, were also trained to conduct this programme. At the randomization visit, the patients were shown a video on asthma and instructed in self-management by the chest physician, who explained the principles and importance of self-management and wrote their personal instructions in a diary according to the plan described below. This basic education package was administered to both patient groups during the visits for diagnosis and randomization.

TREATMENT OF ALL PATIENTS

Treatment followed the normal protocol in the clinic, all patients being routinely prescribed inhaled anti-inflammatory treatment. The mean prescribed daily maintenance doses were 1.01 mg beclomethasone, 0.97 mg budesonide and 11 mg nedocromil in the intervention group, and 1.03 mg beclomethasone, 0.97 mg budesonide and 10 mg nedocromil in the control group. The patients themselves were responsible for buying their drugs. For the first 2 months the doses of anti-inflammatory drugs were doubled compared with the prescribed maintenance doses as explained earlier (11,12).

SELF-MANAGEMENT PLAN

A peak-flow meter and a diary were given to all participants for the first year and after that they were asked to buy their own PEF meter. Patients were asked to monitor their PEF values during the first year for at least 2 weeks every third month, and to record the values in the diary and later to check their PEF at least once a month in the morning. They were also asked to monitor PEF for 2 weeks before the control visits and whenever symptoms appeared. This plan was similar to that later adopted in the Finnish asthma programme (14).

Both groups recorded in the diary the use of extra healthcare services, extra medication and sickness days due to asthma.

The patient was defined as a complier if he or she had used the PEF meter at least once a month, during the symptoms, and for at least 6 days before the follow-up visit. Advice was given when to change the medication, to contact their general practitioner or to go the emergency department (12).

THE INTERVENTION

The extra education beyond that received by the CG was given in the clinic every third month during the first year. It included the repetition of self-management instructions, principles of asthma treatment and use of drugs. The nurse used in total an average of 1-5 h per patient for this education and arranging appointments. The intervention included also a 2-h education programme for all IG patients between the visits at 6 and 9 months. Two or three asthmatic patients attended at a time. A physiotherapist and two nurses gave the education; one specialized in social affairs and the other in rehabilitation (Fig. 1).

OUTCOME MEASURES

Clinical measurements at baseline and at 12, 36 and 60 months were performed at least 12 h after the latest use of bronchodilating drugs, as explained earlier (12). Peak expiratory flow was measured with Wright’s PEF meter (Clement Clarke International Ltd., England) during the visits. Normal Finnish spirometric and Nunn’s PEF values were used (15,16). The results are given as percentages of normal values. The severity of asthma was defined on the basis of FEV1 level. Airway responsiveness was measured as the provocative dose of histamine required causing a 15% fall in FEV1 (PD15) (12,17). At baseline the airway responsiveness and spirometric values were measured before any use of inhaled anti-inflammatory drugs.

Health-related quality of life (HRQOL) was measured by the generic 15D (18), and the disease-specific St. George’s Respiratory Questionnaire (SGRQ) (19,20). Both health-related quality of life (HRQOL) was measured by the generic 15D (18), and the disease-specific St. George’s Respiratory Questionnaire (SGRQ) (19,20). Both
instruments have been used earlier among Finnish asthmatic patients (11,21).

At the 5-year evaluation, the new short version of the SGRQ with 20 items was also used (AQ20). The response to each item is in the form of yes, no or not applicable. The score equals the number of the positive responses (0 = best, 20 = worse) (22). The English version of the short questionnaire was first translated into Finnish, and then translated back to English and from that version once again to Finnish by a translator fluent in Finnish and English.

COSTS

The use of asthma medication (inhaled corticosteroid, Cromons, bronchodilators and theophyllin) was evaluated by collecting the data on bought and reimbursed drugs from the Finnish Social Insurance Institution. This information was available only after the first treatment year. Any extra drugs used for asthma treatment (oral corticosteroids and antibiotics) were valued at average retail prices.

The costing of patient education including the visits to the outpatient clinic, inpatient days and emergency visits was based on the all-inclusive (labour, capital, maintenance etc.) unit costs prevailing in South Karelia Central Hospital in 1993 as explained earlier (11,12).

The main results are presented undiscounted. As a form of sensitivity analysis the difference between the groups in total costs is also reported, discounted at 3% and 6%.

The average annual costs were calculated by including the costs of all patients so long as they remained in the study. The costs of dropouts was compared with those of patients who remained in the study for 5 years.

STATISTICAL ANALYSIS

The study was powered to detect a 5% change in FEV₁ (power 80%, significance level 5%). The minimum sample size thus estimated was 64 pairs.

Apart from airway responsiveness, all other outcome variables are reported as mean values with a 95% confidence interval. Differences between the groups were tested in all variables at baseline and at 5 years with Student’s t-test. Due to the skewed distributions of cost variables, their medians were calculated and the non-parametric Mann-Whitney U-test was also used for analysing differences between the groups in costs.

Differences in outcome variables between baseline and the 5-year follow-up within the groups were tested with the paired t-test.

The unscheduled healthcare costs were grouped into quartiles and the difference between the groups tested by χ²-test. A P-value of <0.05 was considered significant.

Results

BASELINE CHARACTERISTICS

The groups did not differ at baseline in any parameter so the randomization was successful. The baseline character-

istics of the 64 patients in the IG and 70 patients in the CG who were present at the 5-year follow-up did not differ significantly. Details of patients present both at baseline and 5-year follow-up are described in Table 1. The current IG smokers had 6-9 (95% CI 4.25; 9-48) mean pack years at baseline and the CG smokers 8-4 (95% CI 5.75; 11-13), and at 5 years 10-1 (95% CI 4.8; 15-4) and 12-6 (95% CI 8.4; 16-9), respectively. The differences were not significant.

The data on the bought drugs were obtained from the Finnish Social Insurance Institution for 137 patients, of whom 118 were present at the 5-year analysis. Ten patients did not answer the permission request letter and there was no information on the remaining nine patients in the Finnish Social Insurance Institution’s purchase of asthma drugs files, either because their drugs were paid for by their private or occupational insurance or the pharmacies involved were not computerized.

DROPOUTS

Five patients in the IG missed all the control visits after the baseline. Of the other 11 patients who missed at least one of the control visits, four patients had moved away and seven were unwilling to attend, mostly due to being without symptoms. The only significant difference in baseline parameters between the 16 dropouts and the 64 patients remaining in the study for 5 years was gender: 14 of the dropouts were women, P = 0.045.

The dropouts in the CG included one patient who died in a traffic accident after the baseline visit. Eleven patients missed one of the later control visits: one died of coronary heart disease, four moved away and six failed to make contact. The dropouts in the IG and the CG did not differ in any baseline parameter.

Bronchial hyperresponsiveness could not be tested in four IG patients: three were pregnant and one had a low FEV₁ value; nor could it be tested in four CG patients: one was pregnant and three had a low FEV₁ value.

The dropouts from both groups had a better baseline HRQOL score as measured by both the 15D and SGRQ than the patients remaining until 5 years, although the differences were not significant in either group (P = 0.1). The costs of the dropouts were not included when calculating the mean total 5-year costs. The mean annual costs of dropouts did not differ significantly from those of remaining patients.

OUTCOME MEASURES

Results within the groups

Apart from FVC, all lung function parameters improved significantly in the IG between baseline and 5-year follow-up. The improvement in mean FEV₁ was 3-3% units, P = 0.04 (Table 2 and Fig. 2). Only PEF and FEV% improved significantly in the CG (Table 2). The improvements in lung function of the smokers did not differ significantly from those of non-smokers in either group.
Due to a skewed distribution the geometric mean was first calculated for airway responsiveness in mg ml⁻¹ histamine. This logarithmic transformation did not correct the skewness. Therefore the changes in airway responsiveness using the step doses were calculated, which were almost normally distributed. They better describe the change in hyperreactivity.

Bronchial hyperresponsiveness improved in both groups significantly over the 5-year period (P = 0.000) (Table 3 and Fig. 3). One IG patient at baseline and 23 patients (38-3%) from tested patients) at 5 years had a normal level of PD_{15} of ≤ 1.6 mg compared to two and 18 patients (27-3%), respectively, in the CG.

The disease-specific and generic HRQOL scores improved significantly in both groups. The mean SGRQ score improved by 12-0 units in the IG and 14-1 units in the CG. The mean 15D score improved by 0-04 units in both the IG and the CG (Tables 2 and 3). The mean AQ20 scores were 4-4 points in the IG and 5-5 in the CG. The linear correlation of the short SGRQ (AQ20) scores with the ordinary SGRQ total scores and 15D scores was good: r = 0-86 and r = 0-78, respectively.

**Differences between the groups**

There were no significant differences between the groups in lung functions, bronchial hyperresponsiveness or in HRQOL scores at 5 years.

The IG patients experienced 152 (range 0–17) sickness days due to asthma during the 5 years and the CG patients 398 (range 0–90), (P = 0.07). The relative risk for sickness days was significantly lower in the IG than in the CG, odds ratio 0-33 (95% CI 0-28; 0-40).

When compliance was assessed on the basis of the use of PEF-based self-management, 35 patients in the IG and 23 in the CG used PEF and made recordings according to the advice given, this difference being significant P = 0.005. None of the outcome measures differed significantly between the patients who used PEF-based or symptom-based self-management. There was no difference between the two groups.

**COSTS**

The mean total 5-year costs without drug costs were £840 in the IG (direct £421 + indirect £198 + intervention costs £220) and £957 in the CG (direct £467 + indirect £490). The differences between the groups were not statistically significant (Table 4). The unscheduled healthcare costs were £164 in the IG and £261 in the CG, the difference is significant (χ² = 9-5, df = 3, P = 0.02).

The mean cost of bought anti-asthma drugs over 4 years was £803 per patient in the IG, and £1064 per patient in the CG. The difference between the groups was not significant (Table 4).

The average total cost over the 5 years was £1906 in the IG and £2287 in the CG (the average net monetary benefit was £381). The difference was not statistically significant at the conventional levels (Table 4). The conclusion remained

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**TABLE 1. Baseline characteristics of all patients and of those included in the 5-year control (SD in parentheses). There were no significant differences between the groups**

<table>
<thead>
<tr>
<th></th>
<th>Intervention</th>
<th>Control</th>
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<tbody>
<tr>
<td></td>
<td>All patients</td>
<td>Included</td>
</tr>
<tr>
<td></td>
<td>n = 80</td>
<td>at 5 years n = 64</td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td>25/55</td>
<td>25/39</td>
</tr>
<tr>
<td>Mean age years (range)</td>
<td>43.1 (18–76)</td>
<td>43.9 (18–76)</td>
</tr>
<tr>
<td>Atopy*</td>
<td>52</td>
<td>38</td>
</tr>
<tr>
<td>Current smokers</td>
<td>19</td>
<td>9</td>
</tr>
<tr>
<td>FVC (% of predicted)</td>
<td>95.1 (12.5)</td>
<td>94.5 (12.6)</td>
</tr>
<tr>
<td>FEV₁ (% of predicted)</td>
<td>86.1 (14.0)</td>
<td>85.0 (13.5)</td>
</tr>
<tr>
<td>FEV₁/FVC</td>
<td>90.0 (10.0)</td>
<td>89.4 (9.7)</td>
</tr>
<tr>
<td>PEF</td>
<td>84.3 (11.4)</td>
<td>83.7 (11.4)</td>
</tr>
<tr>
<td>PD₁₅ dose step</td>
<td>0.54 (0.09)</td>
<td>0.56 (0.09)</td>
</tr>
<tr>
<td>15D score</td>
<td>0.89 (0.10)</td>
<td>0.89 (0.09)</td>
</tr>
<tr>
<td>SGRQ total score</td>
<td>27.0 (14.6)</td>
<td>26.8 (14.0)</td>
</tr>
<tr>
<td>Treatment:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhaled corticosteroid</td>
<td>75</td>
<td>64</td>
</tr>
<tr>
<td>Nedocromil</td>
<td>5</td>
<td>0</td>
</tr>
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*at least one positive skin-prick test reaction to 10 common allergens.

TABLE 2. The mean values of lung functions (percentage of predicted), bronchial hyperresponsiveness in dose steps (PD₁₅) and health-related quality-of-life scores from baseline to 5-year follow-up (95% CI in parentheses). There were no significant differences between the groups.

<table>
<thead>
<tr>
<th></th>
<th>Intervention</th>
<th>Control</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>n = 64</td>
<td>n = 70</td>
</tr>
<tr>
<td>FVC</td>
<td>1.0</td>
<td>-0.3</td>
</tr>
<tr>
<td></td>
<td>(-4.1; 1.9)</td>
<td>(-3.3; 2.7)</td>
</tr>
<tr>
<td>FEV₁</td>
<td>3.3*</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td>(0.2; 6.4)</td>
<td>(-1.3; 5.0)</td>
</tr>
<tr>
<td>FEV%</td>
<td>3.1***</td>
<td>3.0***</td>
</tr>
<tr>
<td></td>
<td>(1.1; 5.1)</td>
<td>(1.2; 4.7)</td>
</tr>
<tr>
<td>PEF</td>
<td>7.2***</td>
<td>4.6**</td>
</tr>
<tr>
<td></td>
<td>(4.6; 9.6)</td>
<td>(1.9; 7.4)</td>
</tr>
<tr>
<td>PD₁₅ dose step</td>
<td>1.4***</td>
<td>1.0***</td>
</tr>
<tr>
<td></td>
<td>(1.0; 1.5)</td>
<td>(0.8; 1.4)</td>
</tr>
<tr>
<td>1SD</td>
<td>0.04***</td>
<td>0.04***</td>
</tr>
<tr>
<td></td>
<td>(0.02; 0.05)</td>
<td>(0.02; 0.05)</td>
</tr>
<tr>
<td>SGRQtot</td>
<td>12.0***</td>
<td>14.1***</td>
</tr>
<tr>
<td></td>
<td>(8.3; 14.8)</td>
<td>(10.8; 17.0)</td>
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</table>

Significance of difference between baseline and 5-year follow-up within the groups, paired sample t-test: *P<0.05, **P<0.01, ***P<0.001, means that the value deteriorated from the baseline level. FEV%: FEV₁/FVC, PD₁₅: bronchial hyperresponsiveness in dose steps; PEF: peak expiratory flow; 1SD: generic quality of life instrument; SGRQ: St. George's Respiratory Questionnaire, disease-specific quality-of-life instrument, total score.

The mean annual costs were £381 per patient in the IG and £457 per patient in the CG, of which 56% was used for drugs in the IG and 58% in the CG (Fig. 4).

**Discussion**

The intensive patient education for self-management among newly-diagnosed asthmatics did not increase the total treatment costs. The intervention had a consistent tendency of being less costly than the conventional programme, but this conclusion is shadowed by uncertainty beyond conventional levels of statistical significance.

When only unscheduled healthcare costs were considered, there was a significant difference between the groups in favour of the IG. This difference is explained mainly by fewer unscheduled visits to healthcare centres. The asthmatics in both groups needed surprisingly little hospital and emergency department services, only four patients, one twice, visited the emergency department. In Finland, mild asthmatic patients usually first visit a general practitioner if they have problems with their asthma.

The patients in the IG had a significantly lower risk for sickness days during the whole follow-up period. Trautner et al. (23) also found a decrease in the loss of productivity in their 3-year follow-up study among 132 moderate or severe asthmatics. Also the study of Ladhensuo et al. (1) among 122 mild to severe asthmatics showed a similar result, although their follow-up time was only 12 months.

The FEV₁ improved only in the IG, 3-3% units from baseline to 5 years. One reason for this minor improvement might be that the FEV₁ was already normal at baseline, 85-0% from predicted value among the evaluated IG patients. Undoubtedly the patients’ mild asthma according to FEV₁ is reflected in the results. Maybe a bigger sample size would have been needed to find a difference between the groups. The FEV₁ decreased from the first year’s level (Fig. 2). It is noteworthy that the obstruction improved only during the first year, but the hyperreactivity continued to improve slowly during the follow-up. In the CG, the airway obstruction did not improve significantly. However, the lower treatment effectiveness in terms of airway hyperresponsiveness improved during the two last years of the follow-up (Fig. 3).

The intensive education for self-management seemed to be more crucial for the improvement of airway obstruction than for the hyper-responsiveness.

The authors knowledge no published study has reported a 5-year follow-up of bronchial hyperreactivity for newly-diagnosed asthmatics. The improvement of hyperresponsiveness in the present study was roughly the same as that achieved by van Essen-Zandvliert et al. (24) in their 22–36 month follow-up study. About 13% of children with asthma (n = 58) treated with inhaled corticosteroid improved to a normal value. Boulet et al. (25) found in their 5-year follow-up study among 40 mild or moderate asthmatics that the change in hyperreactivity was minimally influenced by the duration of asthma and age at the time of diagnosis. Improvement was greater among atopics and after regular use of inhaled corticosteroids.
Table 3. The mean scores for values of lung functions (percentage of predicted), bronchial hyperresponsiveness in dose steps (PD15) and health-related quality of life of patients included both at baseline and 5-year follow-up (95% CI in parentheses). There were no significant differences between the groups.

<table>
<thead>
<tr>
<th></th>
<th>Intervention</th>
<th>Control</th>
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<tbody>
<tr>
<td></td>
<td>At baseline</td>
<td>At 5 years</td>
</tr>
<tr>
<td></td>
<td>n = 64</td>
<td>n = 64</td>
</tr>
<tr>
<td>FVC</td>
<td>94.5 (91.4; 97.7)</td>
<td>95.6 (92.1; 99.0)</td>
</tr>
<tr>
<td>FEV1</td>
<td>85.0 (81.7; 88.4)</td>
<td>88.3 (84.6; 92.1)</td>
</tr>
<tr>
<td>FEV%</td>
<td>89.4 (87.0; 91.8)</td>
<td>92.5 (90.1; 94.3)</td>
</tr>
<tr>
<td>PEF</td>
<td>83.7 (80.8; 86.5)</td>
<td>90.8 (87.5; 91.4)</td>
</tr>
<tr>
<td>PD15 dose step</td>
<td>0.56 (0.38; 0.74)</td>
<td>1.92 (1.66; 2.18)</td>
</tr>
<tr>
<td>15D</td>
<td>0.89 (0.87; 0.91)</td>
<td>0.93 (0.91; 0.94)</td>
</tr>
<tr>
<td>SGRQtot</td>
<td>27.0 (23.2; 30.3)</td>
<td>15.0 (12.0; 18.0)</td>
</tr>
</tbody>
</table>

FEV%: FEV1/FVC; PD15: bronchial hyperresponsiveness in dose step; 15D: generic quality-of-life instrument; SGRQ: St. George’s Respiratory Questionnaire, disease-specific quality-of-life instrument, total score.

It might be that regular visits to the outpatient clinic were at least as important as patient education in terms of better treatment results, as Chapman pointed out in his review article (9). According to the literature it is unclear whether earlier improvement in bronchial hyperresponsiveness shows later benefit clinically or economically (26). A shortage of studies with long-term economic evaluation among newly-diagnosed asthmatics made the comparison of these results difficult.

The PEF-based self-management had no advantage over the symptom-based approach in the present study although significantly more patients in the IG than in the CG had adopted the use of a PEF-meter in the long-term. The long-term follow-up result agreed with that of Ayres et al. (27), Charlton et al. (4) and Coté et al. (28) with 1-year follow-up and that of Turner et al. (8) with 6 months of follow-up. They found that PEF-based self-management was no more effective than a symptom-based approach and PEF-based self-management alone had a minor effect on the treatment result in mild asthma. However, the significantly lower risk for sickness days without a difference in the costs of the anti-asthma drugs used might mean that the IG patients had assimilated the self-management better and were able to adjust their use of anti-inflammatory drugs according to actual need.

It is also tempting to speculate that one reason for the present findings might be more stable drug consumption in the IG, while the CG patients might have more fluctuation or even interruption in their asthma anti-inflammatory treatment. The results agreed with the 12-month study of Neri et al. (3). They showed that a key feature of an asthma programme was proper treatment and regular supervision. The importance of medication was also discovered in the self-management studies with 12 months of follow-up among moderate and severe asthmatics by Wilson et al. (29) (n = 323), Allen et al. (30) (n = 116) and Coté et al. (28) (n = 188). They achieved similar clinical outcomes through the provision of optimal asthma-medication management compared to intensive short-term patient education. They did not conduct an economic evaluation.
Thus the regular use of anti-asthmatic medication might be more important for improving outcome than the adoption of a self-management plan also for the newly-diagnosed asthmatics, at least during the first 5 years.

The quality of life of newly-diagnosed asthmatics improved significantly in both groups according to both the generic and disease-specific HRQOL instrument. It is worth noting that in terms of HRQOL, change in the most important treatment period was the first year (11,12). The AQ20 scores correlated well with the original SGRQ scores and 15D scores. The AQ20 score was easy to calculate from the number of 'yes' answers. It was also easy to use the AQ20 in normal clinical practice and it was also possible to use it to evaluate patients' own opinion of treatment effects and problems.

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The intensive patient education for self-management during the first treatment year may lead to lower long-term costs, since regardless of which cost item was looked at there was a consistent tendency for the cost to be lower in the IG. However, it was not possible to define a formal incremental cost-effectiveness ratio, since there was no statistically significant difference between the groups in any of the outcome variables at 5 years. The reduced need for unscheduled health services and sickness days without worse outcome indicated better self-management skills. The intervention had a positive effect on airway hyperresponsiveness and FEV₁ over the first 3 years, but after the control visit at 3 years the differences between the groups disappeared. It is possible to tentatively conclude that regular effective medical treatment and control visits during the first years were at least as important for the long-term treatment result as intensive patient education. This result stresses a need to study the importance of the follow-up visits to improve the treatment effectiveness. There is also need for further research among newly-diagnosed asthmatics concerning the cost-effectiveness of treatment follow-ups arranged in specialist outpatient clinics or in primary healthcare centres.

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