

The costs of implementing the 1999 Canadian Asthma Consensus Guidelines recommendation of asthma education and spirometry for the family physician

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BACKGROUND: National and international asthma guidelines recommend that patients with asthma be provided with asthma education and spirometry as a component of enhanced asthma care. The cost of implementing these interventions in family physician practices is not known.

OBJECTIVE: The objective of the present study was to determine the cost of providing recommended asthma care to adult patients in the family practice setting.

METHODS: The present study was conducted using three scenarios of care in family practice. Small, medium and large asthmatic patient populations were used. The incremental costs of implementing enhanced asthma care based on the Canadian Asthma Consensus Guidelines, including the provision of spirometry and asthma education in both group and individual sessions, and the resources required for these interventions were calculated for each scenario.

RESULTS: For a physician with 50 asthmatic patients, the cost of providing enhanced asthma care with spirometry and group education sessions was approximately \$78 per patient in the first year of implementation. For individual sessions, the cost increased to \$100 per patient for the first year. If the physician had 100 asthmatic patients, the per patient cost would decrease; however, the overall cost of the program would be \$7,000.

CONCLUSIONS: The costs of providing enhanced asthma care are significant. In most cases, physicians are inadequately reimbursed (or not reimbursed) for these interventions. In light of the evidence of the effectiveness of these interventions, health insurance plans should consider adding these services to fee schedules.

Key Words: Asthma; Consensus guidelines; Economic analysis; Family medicine

Asthma is a serious chronic condition that impacts the lives of over two million Canadians or 8.4% of the population (1). In Alberta, 8.9% of the population over 12 years of age have been diagnosed with asthma and the physician billing for asthma care was \$10.5 million for over 300,000 office visits in 2001 (1, [L Svenson, personal communication]). The 1997 mortality

Principes directeurs du consensus canadien sur l'asthme 1999 : coût de la mise en œuvre des recommandations auprès des médecins de famille en ce qui concerne la spirométrie et l'enseignement aux patients

CONTEXTE : Selon des lignes directrices nationales et internationales, les patients asthmatiques devraient recevoir de l'enseignement sur leur maladie et être soumis à des épreuves de spirométrie comme mesures d'amélioration des soins. Toutefois, on ne connaît pas le coût de la mise en œuvre de ces mesures auprès des médecins de famille.

BUT : La présente étude avait pour but de déterminer le coût d'application de ces recommandations chez les adultes asthmatiques, en médecine générale.

MÉTHODE : L'étude a été menée suivant trois scénarios de soins en pratique générale, dans trois populations de taille différente : petite, moyenne, grande. Pour chaque scénario, nous avons calculé le coût marginal de la mise en œuvre des recommandations contenues dans les Principes directeurs du consensus canadien sur l'asthme, y compris des épreuves de spirométrie et des séances individuelles ou collectives d'information sur l'asthme, ainsi que des ressources nécessaires.

RÉSULTATS : Pour le médecin traitant une population de 50 patients asthmatiques, le coût de prestation des soins améliorés avec épreuves de spirométrie et séances collectives d'information revenait à 78 \$ par patient pour la première année d'application. Pour les séances individuelles, le coût atteignait 100 \$ par patient pour la première année. Pour le médecin traitant une population de 100 patients asthmatiques, le coût par patient diminuait; par contre, le coût global du programme pouvait s'élever à 7000 \$.

CONCLUSIONS : Le coût de prestation des soins améliorés aux asthmatiques est passablement élevé et, dans la plupart des cas, les médecins se voient rémunérés insuffisamment (ou pas du tout) pour ces interventions. La preuve de l'efficacité de ces mesures n'étant plus à faire, les régimes d'assurance-maladie devraient inclure ces services au barème d'honoraires.

rate for asthma in Canada was 1.3 per 100,000 (2). The best estimates suggest that the total annual cost of asthma care in Canada is between \$504 and \$648 million (1990 dollars) (3).

The Canadian Asthma Consensus Guidelines were developed, in large measure, to provide physicians with evidence-based recommendations for the diagnosis and management of

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patients with asthma (4). The guideline committee made several major recommendations to improve the process of care for asthmatic patients. These included more widespread use of anti-inflammatory agents, objective testing of lung function and improved patient education. While there appears to be some progress in the use of anti-inflammatory agents, there is little evidence that the latter two recommendations are being followed. A recent review of primary care practices encompassing 1548 asthmatic patients in Alberta revealed that approximately 30% of adults had pulmonary function tests during the course of their illness and less than 2% received a written action plan for asthma (5). Chapman et al (6) and Jin et al (7) have reported similar findings from other jurisdictions.

Why expert panel recommendations on spirometry and asthma education are not being translated to clinical practice has not been systematically studied and largely remains a mystery. In many settings, primary care physicians do not have easy access to community-based asthma educators or to lung function laboratories. As well, in the 'real world', primary care providers rarely have the time or the expertise to provide sufficient education to patients during clinic visits (7). Moreover, many do not have spirometers in their offices. Although physicians can bill the health ministry for performing spirometry in their offices, this sum may be insufficient to cover the expenses incurred during the procedure. We postulate that one of the major obstacles to the implementation of lung function testing and patient education is that the physicians or patients would have to bear the costs for these services within the current health care structure. Therefore, the purpose of the present paper is to explore the incremental costs to the family physician for providing enhanced (or the recommended) asthma care (defined as standard care plus asthma education and spirometric testing) to their adult asthma patients according to the 1999 Canadian Asthma Consensus Guidelines.

METHODS

Scenarios

To reflect the heterogeneity of family practices across Canada, the incremental costs of providing enhanced care in three different scenarios were considered. The first scenario had physicians with a relatively small asthmatic patient population ($n=25$); the second scenario was built for a moderate sized asthmatic practice ($n=50$); and the final scenario was for physicians with a large asthmatic practice ($n=100$). For each scenario, only the incremental costs related to the provision of asthma education and spirometric testing (above and beyond that of usual care) were calculated.

Calculation of costs related to spirometric testing

A vast majority of family physicians do not have spirometers in their offices (5,6). However, they receive financial reimbursements from provincial health care plans for technical components of spirometric tests, only if the tests are performed in their offices. Therefore, it was assumed that family physicians would not generate any revenue from spirometry testing performed elsewhere. With enhanced care, it was assumed that physicians would purchase a spirometer and perform spirometric testing in their clinics. It was also assumed that in the first year, spirometric testing would be performed two times (spaced six months apart).

In subsequent years, only one test would be done. The amount paid by the provincial health care plan was considered to be a revenue source for the family physician. It was also assumed that a nurse or respiratory therapist would conduct the test (and not the physician himself/herself) and the wage for the technician was incorporated into the costs.

Expenditures would also occur with the institution of spirometric testing within physicians' offices. It was assumed that the initial capital cost of purchasing a spirometer would be amortized over a three-year span and that 75% of its use would be for asthmatic patients in a given practice. To this capital cost, a nominal fee for necessary accessories and parts for the spirometer, such as mouthpieces and filters (\$2 per test), were added. Finally, the personnel cost of operating and maintaining spirometric equipment, based on an average time of 20 min per test, was included. It was assumed that one individual would both perform spirometric testing and provide asthma education to the patients.

Based on the assumptions that equipment costs would be amortized over three years and that the equipment would be used for asthmatic patients 75% of the time, the spirometry equipment costs were \$371/year ($\$1,500 \times 0.75 \times 0.33/\text{year}$). Accessory costs were \$100 to \$400 for the initial year, based on two tests per year, and \$50 to \$200 for subsequent years, with one test per year. The total cost for spirometry equipment was \$621 for the initial year (range of plausible values \$471 to \$771) and \$496 for follow-up years (range of plausible values \$421 to \$571).

Calculation of costs related to education

The costs related to asthma educators were based on published data for registered nurses (with a Bachelor of Science degree) or respiratory therapists, as they are the professions most likely to perform this task. The published salary range for a registered nurse with a Bachelor of Science degree and asthma education certification is \$26.45 to \$34.17 per hour (8), while the current salary range for a respiratory therapist is \$23.76 to \$29.60 per hour (9), plus 18% fringe benefits. The duration and format of asthma self-management education programs reported in previous studies were heterogeneous, with both group and individual sessions being popular. Therefore, both scenarios were explored to estimate the cost of group and individual sessions. In general, group sessions averaged 6 h to 12 h over a four to seven week period (10-14). For analytical purposes, it was assumed that the group program would teach eight to 10 patients per session. In the first year, all patients would be exposed to four 90 min sessions for a total of 6 h. In each follow-up year, patients would attend two 1 h group sessions for a total of 2 h.

As with group programs, a review of the literature revealed large variations in the length of individualized programs; in general, one-on-one education sessions ranged from 30 min to 3 h (10,15-19). Based on these figures, it was assumed that patients enrolled in individualized programs would have 2 h of education in total, comprised of an initial visit that would last 1 h, followed by two 30 min reinforcement sessions that would be spaced four to six weeks apart. This timetable is consistent with recommendations by the Global Initiative for Asthma by the National Institutes of Health Committee and has been used by others (18,20). In every subsequent year, patients would be exposed to one 45 min individual educational session. For both group and individualized programs, a fee of \$5 per patient was added to

TABLE 1
Initial year net per patient and annual program costs: Group education

Program component	Costs (revenues = negative costs) (\$)*		
	Optimal care (25 patients)	Optimal care (50 patients)	Optimal care (100 patients)
Spirometry equipment	471	571	771
PFTs [†] billing rates	-1,002 [‡]	-2,003 [‡]	-4,006 [‡]
CAE cost for conducting PFTs [†] (mean [range of plausible values])	564 (463–665)	1,128 (925–1331)	2,256 (1,850–2,661)
CAE cost for education sessions (mean [range of plausible values])	616 (505–726)	1,231 (1009–1452)	2,461 (2,019–2,903)
Educational materials	125	250	500
Office space cost (mean [range of plausible values])	1,350 (900–1800)	2,700 (1800–3600)	5,400 (3,600–7,200)
Net/patient/year cost (mean [range of plausible values])	85 (58–111)	78 (51–104)	74 (47–100)
Total annual net cost of program (mean [range of plausible values])	2,124 (1462–2785)	3,877 (2552–5201)	7,382 (4,734–10,029)

*Rounded to the nearest Canadian dollar; [†]Pulmonary function tests (PFTs) including baseline and follow-up examinations; [‡]Billing rates for the technical aspects of the tests. CAE Certified asthma educator

TABLE 2
Initial year net per patient and annual program costs: Individual education

Program component	Costs (revenues = negative costs) (\$)*		
	Optimal care (25 patients)	Optimal care (50 patients)	Optimal care (100 patients)
Spirometry equipment	471	571	771
PFTs [†] billing rates	-1,002 [‡]	-2,003 [‡]	-4,006 [‡]
CAE cost for conducting PFTs [†] (mean [range of plausible values])	564 (463–665)	1,128 (925–1,331)	2,256 (1,850–2,661)
CAE cost for education sessions (mean [range of plausible values])	1,709 (1,402–2,016)	3,418 (2,804–4,032)	6,836 (5,607–8,064)
Educational materials	125	250	500
Office space cost (mean [range of plausible values])	811 (122–1,500)	1622 (244–3,000)	3,244 (48–6,000)
Net/patient/year cost (mean [range of plausible values])	107 (63–151)	100 (56–144)	96 (52–140)
Total annual net cost of program (mean [range of plausible values])	2,678 (1,581–3,775)	4,986 (2,791–7,181)	9,601 (5,210–13,990)

*Rounded to the nearest Canadian dollar; [†]Pulmonary function tests (PFTs) including baseline and follow-up examinations; [‡]Billing rates for the technical aspects of the tests. CAE Certified asthma educator

cover the costs of educational materials and the administrative costs of running the programs.

An additional source of expenditure for education and spirometric services would be the costs related to office space rental. Room rental rates of \$30/h for individual education sessions and between \$50/h and \$100/h for group education sessions were estimated.

Statistical analysis

For the base case analysis, point estimates that were derived from a survey of the literature, and consultations with relevant organizations (eg, Alberta Health and Wellness) and experts in the area were used. Using a similar method, a range of plausible values for these point estimates (where necessary) were determined to reflect uncertainty in the calculations. The analysis was conducted in 2003 Canadian dollars. Expenditures are expressed as positive numbers, while revenues to physicians are expressed as negative numbers.

RESULTS

The incremental costs for the provision of enhanced asthma care for 25, 50 and 100 patients using group education and individual education in the initial year of the program are summarized in Tables 1 and 2, respectively. The incremental costs for follow-up years are summarized in Tables 3 and 4.

For a physician with 50 asthmatic patients, in the initial year of the program, the cost would be approximately \$78 per patient to provide enhanced asthma care with office-based spirometry

and group education sessions. If the program provided enhanced asthma care with office-based spirometry and individual education sessions for 50 patients, the cost would be approximately \$100 per patient per year. With group education sessions, physicians would incur a total loss of \$3,877 for the first year, if no revenue sources could be found. The per patient costs declined slightly if physicians had 100 asthmatic patients; however, the overall costs would be over \$7,000. The per patient costs increased if fewer asthmatic patients were in a practice, but the overall costs would diminish.

Individualized programs would be more costly. For an average practice that has 50 asthmatic patients, the physician would incur a loss of \$100 per patient (an overall loss of \$4,986). As with group sessions, by having more asthmatic patients in a practice, the per patient cost would decrease but the overall costs would increase. However, the reverse is true if there were fewer than 50 asthmatic patients in a practice.

In the follow-up years, the per patient and overall costs decreased relative to the first year, but remained substantial. In a practice where there were 50 asthmatic patients, the physician would lose on average \$32 to \$43 per patient, depending on whether a group or individualized educational format was used.

DISCUSSION

Our study indicates that costs may be a major barrier to the implementation of spirometry and asthma education services in

TABLE 3
Follow-up year net per patient and annual program costs: Group education

Program component	Costs (revenues = negative costs) (\$)*		
	Optimal care (25 patients)	Optimal care (50 patients)	Optimal care (100 patients)
Spirometry equipment	421	471	571
PFTs [†] billing rates	-501 [‡]	-1002 [‡]	-2003 [‡]
CAE cost for conducting PFTs [†] (mean [range of plausible values])	282 (231–333)	564 (463–665)	1128 (925–1,331)
CAE cost for education sessions (mean [range of plausible values])	205 (168–242)	410 (336–484)	821 (673–968)
Educational materials	125	250	500
Office space cost (mean [range of plausible values])	450 (300–600)	900 (600–1200)	1800 (1,200–2,400)
Net/patient/year cost (mean [range of plausible values])	39 (30–49)	32 (22–41)	28 (19–38)
Total annual net cost of program (mean [range of plausible values])	982 (744–1,220)	1593 (1,118–2,068)	2817 (1,866–3,767)

*Rounded to the nearest Canadian dollar; [†]Pulmonary function tests (PFTs) including baseline and follow-up examinations; [‡]Billing rates for the technical aspects of the tests. CAE Certified asthma educator

TABLE 4
Follow-up year net per patient and annual program costs: Individual education

Program component	Costs (revenues = negative costs) (\$)*		
	Optimal care (25 patients)	Optimal care (50 patients)	Optimal care (100 patients)
Spirometry equipment	421	471	571
PFTs [†] billing rates	-501 [‡]	-1,002 [‡]	-2,003 [‡]
CAE cost for conducting PFTs [†] (mean [range of plausible values])	282 (231–333)	564 (463–665)	1128 (925–1,331)
CAE cost for education sessions (mean [range of plausible values])	641 (526–756)	1,282 (1,051–1,512)	2564 (2,103–3,024)
Educational materials	125	250	500
Office space cost (mean [range of plausible values])	305 (46–563)	609 (92–1,125)	1217 (183–2,250)
Net/patient/year cost (mean [range of plausible values])	51 (34–68)	43 (27–60)	40 (23–57)
Total annual net cost of program (mean [range of plausible values])	1,273 (848–1,697)	2,174 (1,325–3,021)	3977 (2,279–5,673)

*Rounded to the nearest Canadian dollar; [†]Pulmonary function tests (PFTs) including baseline and follow-up examinations; [‡]Billing rates for the technical aspects of the tests. CAE Certified asthma educator

the community. We found that the marginal expenditure required to provide enhanced asthma care for a practice with 50 patients, as recommended by the 1999 Canadian Asthma Consensus Guidelines (4), ranged from \$78 to \$100 per asthmatic patient for the first year and \$32 to \$43 per patient per year in follow-up years. If no third party payers are found (as is the case in most jurisdictions in Canada), the physicians or patients would have to incur these costs. Therefore, it is not surprising that despite widespread promulgation of asthma consensus guidelines, these services are not being performed with asthmatic patients.

Notwithstanding, there is emerging evidence that asthma education is effective. A systematic review by Gibson et al (21) found that compared with usual care, asthma self-management education programs led to a significant reduction in hospitalizations, emergency admissions, unscheduled doctor visits, absenteeism from work and nocturnal symptoms, and they improved quality of life. Moreover, some, but not all, studies have demonstrated that asthma educational programs are, in general, 'cost-effective' and in some settings, cost saving (15,21–26). For instance, a before-and-after study of an extensive group teaching program in Germany resulted in a net benefit of approximately \$630 in the first year of the program (1991 Canadian [CDN] dollar equivalent to German mark) (27). The net benefits in the second and third year after implementation of the education program were approximately \$4,200 and

\$3,700, respectively (1991 CDN dollar equivalent to German mark) (27). These benefits were realized through the reduction of hospitalizations, severe asthma attacks, work absences and physician visits as a result of the asthma education program. Another study (28) in the United States demonstrated a net savings of approximately \$728 per person (1990 CDN dollar equivalent to the American dollar), largely due to reductions in repeat emergency visits. A different education program in Norway reported a mean net savings in the education group of approximately \$1,050 overall or \$16 per patient (1994 CDN dollar equivalent to Norwegian krone), primarily as a result of increased labor productivity from better asthma control (29). In view of the effectiveness and potential cost savings to the health care system attributable to asthma education, physicians, patients and provincial health care plans may benefit from the implementation of these services.

Many patients with asthma underestimate the severity of their condition and have inadequate asthma control. For instance, Chapman et al (6) found that nine of 10 patients felt their asthma was under control despite contrary evidence. This suggests that patients do not understand how to properly manage their asthma, and that provision of asthma education and objective assessment of asthma severity (by spirometry) are generally necessary. However, the reality is that patients rarely, if ever, receive education or spirometric testing.

There were several limitations in the present study. In our analysis, we made several key assumptions. Because the present study was conducted using cost estimates based on current values rather than actual expenses incurred, there may be some variation in these costs. In addition, in group practices, family physicians may be able to share some of the expenses with their colleagues to reduce their individual costs. These estimates were based on the average uncomplicated asthma patient, but costs may be greater for patients requiring additional intervention. Administrative time was not factored into the costs calculated and there may be some additional expenses related to telephone calls and booking patients. Various studies have used different models of education requiring a variety of time from the educator; therefore, if a model other than the one described was chosen, this would also impact these costs. Alternative models of spirometric testing may also be explored, such as increasing access to well-equipped laboratories that provide this service. However, this would eliminate the revenue generated from the physician billing for the spirometry testing, thereby increasing the overall cost. Finally, the results of our model cannot be generalized to jurisdictions where asthma education is funded by a third-payer or the government. Moreover, future studies are needed to determine whether targeting of education and spirometry to certain

subgroups of patients, such as those with high asthma morbidity, would provide cost savings to the health care system.

CONCLUSIONS

Our analysis suggests that the costs of providing asthma education and spirometric testing are significant. In many jurisdictions where educational services and spirometric services are inadequately reimbursed (and, in some cases, not reimbursed at all), family physicians would incur a loss of \$78 to \$100 per new asthma patient in the first year and \$32 to \$43 per patient per year in follow-up years. This is likely a major disincentive for physicians to provide these services. However, studies suggest that educational interventions for asthma could potentially reduce the overall costs of asthma care by reducing the rates of emergency department visits and hospitalizations, and by increasing work productivity (27-29). In view of the purported benefits of these services to patients and to society, health insurance plans should consider adding these services to provincial fee schedules.

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REFERENCES

1. Statistics Canada. CANSIM II, Tables 104-0001 and 105-0001. 2000/01 (Health Share File).
2. Alberta Health and Wellness. Health trends in Alberta 2000 – working document. <www.health.gov.ab.ca/resources/publications/Health_Trends/Health_Trends_2000.pdf> (Version current at July 15, 2004).
3. Krahn MD, Berka CB, Langlois P, Detsky AS. Direct and indirect costs of asthma in Canada, 1990. *CMAJ* 1996;154:821-31.
4. Boulet LP, Becker A, Berube D, Beveridge R, Ernst P, on behalf of the Canadian Asthma Consensus Group. Canadian asthma consensus report, 1999. *CMAJ* 1999;161(11 Suppl):S1-6.
5. Sin D, Man P, Cowie R, for the Alberta Strategy to Help Manage Asthma (ASTHMA) Executive Committee. Standards of asthma practice for rural and urban primary care physicians. *Am J Respir Crit Care Med* 2002;165:A322. (Abst)
6. Chapman KR, Ernst P, Grenville A, Dewland P, Zimmerman S. Control of asthma in Canada: Failure to achieve guideline targets. *Can Respir J* 2001;8(Suppl A):35A-40A.
7. Jin R, Choi BC, Chan BT, et al. Physician asthma management practices in Canada. *Can Respir J* 2000;7:456-65.
8. United Nurses of Alberta. Collective Agreement Salaries Appendix 2001-2003. <www.unitednurses.org/collective%20Agreements/002889A7-000F7D10> (Version current at June 21, 2004).
9. Health Sciences Association of Alberta. Collective Agreement of the Provincial Health Authorities of Alberta and the Paramedical Professional/Technical Employees. Salaries Appendix 2000-2002. Edmonton: Health Science Association of Alberta, 2000.
10. Wilson SR, Scamagas P, German DF, et al. A controlled trial of two forms of self-management education for adults with asthma. *Am J Med* 1993;94:564-76.
11. Allen RM, Jones MP, Oldenburg B. Randomised trial of an asthma self-management programme for adults. *Thorax* 1995;50:731-8.
12. Kotses H, Bernstein IL, Bernstein DI, et al. A self-management program for adult asthma. Part 1: Development and evaluation. *J Allergy Clin Immunol* 1995;95:529-40.
13. Neri M, Migliori GB, Spanevello A, et al. Economic analysis of two structured treatment and teaching programs on asthma. *Allergy* 1996;51:313-9.
14. Berg J, Dungar-Jacob J, Sereika SM. An evaluation of a self-management program for adults with asthma. *Clin Nurs Res* 1997;6:225-38.
15. Cote J, Cartier A, Robichaud P, et al. Influence on asthma morbidity of asthma education programs based on self-management plans following treatment optimization. *Am J Respir Crit Care Med* 1997;155:1509-14.
16. Mayo PH, Richman J, Harris HW. Results of a program to reduce admissions for adult asthma. *Ann Intern Med* 1990;112:864-71.
17. Knoell DL, Pierson JE, Marsh CB, Allen JN, Pathak DS. Measurement of outcomes in adults receiving pharmaceutical care in a comprehensive asthma outpatient clinic. *Pharmacotherapy* 1998;18:1365-74.
18. Levy ML, Robb M, Allen J, Doherty C, Bland JM, Winter RJ. A randomized controlled evaluation of specialist nurse education following accident and emergency department attendance for acute asthma. *Respir Med* 2000;94:900-8.
19. Gallefoss F, Bakke PS, Rsgaard KP. Quality of life assessment after patient education in a randomized controlled study on asthma and chronic obstructive pulmonary disease. *Am J Respir Crit Care Med* 1999;159:812-7.
20. National Heart, Lung and Blood Institute. Global initiative for asthma. Washington: National Institute of Health (publication number 95-3659), 1995.
21. Gibson PG, Powell H, Coughlan J, et al. Self-management education and regular practitioner review for adults with asthma. *Cochrane Database Syst Rev* 2003;1:CD001117.
22. Sondergaard B, Davidsen F, Kirkeby B, Rasmussen M, Hey H. The economics of an intensive education programme for asthmatic patients. A prospective controlled trial. *Pharmacoeconomics* 1992;1:207-12.
23. Perneger TV, Sudre P, Muntner P, et al. Effect of patient education on self-management skills and health status in patients with asthma: A randomized trial. *Am J Med* 2002;113:7-14.
24. Kauppinen R, Sintonen H, Tukiainen H. One-year economic evaluation of intensive vs conventional patient education and supervision for self-management of new asthmatic patients. *Respir Med* 1998;92:300-7.
25. Kauppinen R, Sintonen H, Vilkkä V, Tukiainen H. Long-term (3-year) economic evaluation of intensive patient education for self-management during the first year in new asthmatics. *Respir Med* 1999;93:283-9.
26. Kauppinen R, Vilkkä V, Sintonen H, Klaukka T, Tukiainen H. Long-term economic evaluation of intensive patient education during the first treatment year in newly diagnosed adult asthma. *Respir Med* 2001;95:56-63.
27. Trautner C, Richter B, Berger M. Cost-effectiveness of a structured treatment and teaching programme on asthma. *Eur Respir J* 1993;6:1485-91.
28. Bolton MB, Tilley BC, Kuder J, Reeves T, Schultx LR. The cost and effectiveness of an education program for adults who have asthma. *J Gen Intern Med* 1991;6:401-7.
29. Gallefoss F, Bakke PS. Cost-effectiveness of self-management in asthmatics: A 1-yr follow-up randomized, controlled trial. *Eur Respir J* 2001;17:206-13.

