ORIGINAL ARTICLE

Costs and Management of Asthma Attacks Treated in Primary Care (COAX Study)

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Objectives. To estimate the cost and characterize the management of asthma attacks in primary care.
Design. Prospective, observational study of 1 year's duration.
Setting. 10 physician's offices at 9 primary care centers located in 5 provinces (Asturias, Barcelona, Cadiz, Madrid, and Valencia) of Spain.
Participants. 10 family physicians who saw 133 consecutive patients with an asthma attack.
Method. Prospective, observational study; no intervention was used. Direct and indirect costs arising from asthma attacks were calculated. Episodes were treated according to the physicians' habitually used procedures; the study protocol did not specify any predetermined intervention.
Results. The attacks were classified as mild in 43.6% of the cases, moderately severe in 43.6%, and severe in 12.8%. Of all severe attacks, 17.2% occurred in patients with intermittent asthma. The more severe the attack, the less preventive treatment patients had received previously. The mean cost of asthma attacks was €166.7 (95% CI, 146.5-192.3); 80% (€132.4) (95% CI, 122.7-143.8) were direct costs and 20% (€34.3) (95% CI, 17-56.2) were indirect costs. The most economical management option was to change treatment, perform diagnostic tests and have the patient attend 2 follow-up appointments with the physician.
Conclusions. Mean cost of each asthma attack treated in primary care was €166.7 (95% CI, 146.5-192.3), of which 80% were direct costs and 20% indirect costs.

Key words: Asthma. Resource utilizations. Primary care. Asthma attack.

COSTE Y MANEJO DE LAS CRISIS ASMÁTICAS ATENDIDAS EN ATENCIÓN PRIMARIA (ESTUDIO COAX)

Objetivos. Estimar el coste y conocer el manejo de una crisis asmática en atención primaria.
Diseño. Estudio observacional, prospectivo.
Emplazamiento. Diez consultas de 9 centros de atención primaria de 5 provincias (Asturias, Barcelona, Cádiz, Madrid y Valencia).
Participantes. Diez médicos de familia que incluyeron, secuencialmente, a 133 pacientes con una crisis de asma.
Mediciones principales. Se calcularon los costes directos e indirectos que supone una crisis de asma. El episodio se trató como habitualmente venía haciéndolo cada médico, sin que la intervención estuviera previamente definida en el protocolo del estudio.
Resultados. Se observaron un 43,6% de crisis leves, un 43,6% de crisis moderadas y un 12,8% de crisis graves. El 17,2% de estas últimas ocurrieron en pacientes con asma intermitente. Cuanto más grave era la crisis, menor era el tratamiento preventivo anterior a ella. El coste medio de una crisis asmática fue de 166,7 € (intervalo de confianza [IC] del 95%, 146,5-192,3), el 80% (132,4 €; IC del 95%, 122,7-143,8) debido a costes directos y el 20% (34,3 €, (IC del 95%, 17-56,2) a costes indirectos. La opción más económica de manejo de una crisis fue «cambiar el tratamiento, realizar una prueba diagnóstica y 2 visitas médicas».
Conclusiones. El coste medio de una crisis asmática tratada en atención primaria fue de 166,7 € (IC del 95%, 146,5-192,3), el 80% debido a costes directos y el 20% a costes indirectos.

Palabras clave: Asma. Utilización de recursos. Atención primaria. Crisis asmática.

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Introduction

The prevalence of asthma, a chronic inflammatory respiratory disease, is on the rise in developed countries,[1] where it represents a considerable health and economic problem. Exacerbations and attacks contribute to the increase in resource utilization and limit patients' activities of daily living.[2-4]

Health costs can be divided into 3 categories: direct, indirect, and intangible.[5] Direct costs (DC) are related with the resources consumed (medications, hospital admissions, diagnostic tests, health care personnel costs), whereas indirect costs (IC) are related with reduced productivity owing to illness (sick leave and incapacity for work, early retirement, and premature death) and intangible costs refer to potential earnings lost because of illness.

Studies in a number of countries have found DC and IC to be similar.[6] Moreover, costs arising from asthma attacks represent 33% of all DC and 100% of all IC, or 70% of the total cost of the disease. This situation suggests that the disease is inadequately controlled, and that this in turn leads to an increase in the number and severity of attacks, the number of visits to the doctor, visits to emergency services, diagnostic tests, hospitalizations, and time off from work because of sick leave.[5,6]

To date, studies of the costs arising from asthma have been carried out in hospital settings, and there are no studies of the cost of asthma attacks in Spain. The aims of the present study were therefore to estimate the cost of asthma attacks treated in primary care and characterize the management of exacerbations in primary care.

Patients and Methods

This prospective, observational study was carried out in 10 physician's offices at 9 health centers located in 5 provinces in Spain. Participants were chosen from among family physicians interested in respiratory problems, and the study included consecutive patients seen for asthma attacks during a 12-month period.
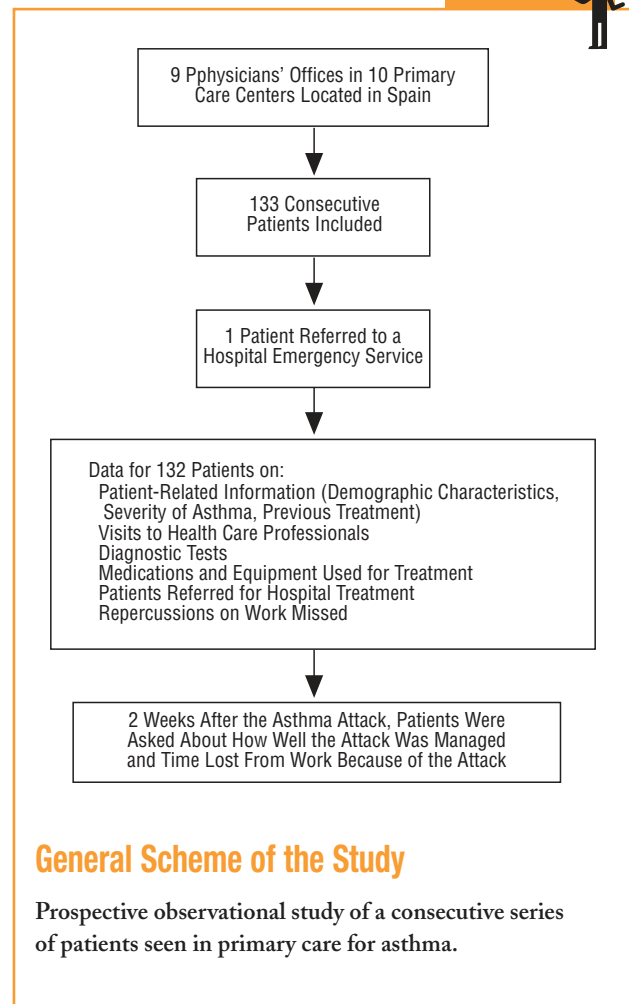
Variables Recorded
1. Patient-related variables: demographic information, severity of asthma, exacerbation according to GINA criteria, maintenance medication, other respiratory diseases.
2. Resource-related variables:

– Visits to health care professionals: visits, actions taken as a consequence of exacerbation (medications and tests done, home visits, visits to the health center as a consequence of exacerbation).
– Diagnosis: pulmonary function tests (spirometry, maximal expiratory flow [MEF], pulse oximetry). Other tests (ECG, x-ray, blood gases, etc).
– Medications and equipment used to treat exacerbations of asthma (type, route, frequency, apparatus used, pharmaceutical form and duration of treatment, spacers, flow meters, nebulizers).

9 Pphysicians' Offices in 10 Primary Care Centers Located in Spain

133 Consecutive Patients Included

1 Patient Referred to a Hospital Emergency Service

Data for 132 Patients on:
  Patient-Related Information (Demographic Characteristics, Severity of Asthma, Previous Treatment)
  Visits to Health Care Professionals
  Diagnostic Tests
  Medications and Equipment Used for Treatment
  Patients Referred for Hospital Treatment
  Repercussions on Work Missed

2 Weeks After the Asthma Attack, Patients Were Asked About How Well the Attack Was Managed and Time Lost From Work Because of the Attack

General Scheme of the Study

Prospective observational study of a consecutive series of patients seen in primary care for asthma.

– Consultations that resulted in referral to hospital care.

3. Actions taken by the patient to control the exacerbation.
4. Repercussion of the exacerbation of asthma on work absenteeism
5. Number of hours of work lost because of exacerbation.

The criteria for considering the attack resolved were return to habitual medication for the treatment of asthma and/or use of fewer than 4 puffs or blisters per day during at least 2 consecutive days on rescue medication.

Subjects
One hundred and thirty three consecutive patients followed at the participating offices (between 10 and 14 patients per physician). Inclusion criteria were prior diagnosis of asthma in the patient's medical record, age older than 14 years, and asthma attack motivating an unscheduled visit to the primary care center. Participation in other asthma studies also made the patient ineligible for inclusion. Exclusion criteria were second or subsequent episodes of asthma attack, and visit to the emergency service for asthma attack.

TABLE 1
Severity of the Asthma Attack According to Previous Level of Severity of Asthma*

	Severity of the Attack				
	Mild (n=58)	Moderate (n=58)	Severe (n=17)	IRD	Total (n=133)
Previous level of severity					
Intermittent	15 (51.7%)	9 (31%)	5 (17.2%)	0	29 (21.8%)
Mild persistent	28 (65.1%)	13 (30.2%)	2 (4.6%)	0	43 (32.3%)
Moderate persistent	15 (30%)	28 (56%)	7 (14%)	0	50 (37.6%)
Severe persistent	0	8 (72%)	3 (27%)	0	11 (8.3%)
Total	58 (43.6%)	58 (43.6%)	17 (12.8%)	0	133 (100%)

*IRD indicates immediate risk of death.

TABLE 2
Maintenance Medication According to Level of Severity Before the Attack

	Classification of Asthma				
Pharmacological Group	Intermittent (n=29)	Mild Persistent (n=42)	Moderate Persistent (n=50)	Severe Persistent (n=11)	Total (n=132)
Oral corticosteroids	0	1 (2%)	0	3 (27%)	4 (3%)*
Inhaled glucocorticoids	2 (7%)	26 (62%)	35 (70%)	9 (82%)	72 (55%)*
Short-acting beta-2 agonists	21 (72%)	29 (69%)	42 (84%)	10 (91%)	102 (77%)
Long-acting beta-2 agonists	1 (3%)	9 (21%)	19 (38%)	7 (64%)	36 (27%)†
Anticholinergic agents	0	3 (7%)	1 (2%)	0	4 (3%)
Other drugs	1 (3%)	5 (12%)	3 (6%)	4 (36%)	13 (10%)

*$P<.0001$. †$P=.0002$.

Two weeks after the initial consultation the patient was asked whether the attack had been managed successfully and how much time had been lost from work because of the attack. The GINA criteria[1] were used to classify patients according to degree of severity of asthma prior to the attack and severity of the attack itself.

Ethical issues: all patients were managed according to habitually used treatment measures. No predetermined pharmacological interventions were used.

Data Analysis
Costs were analyzed in relation to the severity of the attack and the severity of the disease before the attack, in terms of costs[7] to the Spanish National Health System (direct costs [DC]) and in terms of costs to society (DC plus indirect costs [IC]).[8] We used data from official sources available at the time of analysis (year 2000).

The costs of exacerbation of asthma were estimated per patient for this study.

Direct costs were defined as the following: medication for the attack, visits to the family physician, visits to specialists, diagnostic tests, and equipment used. Indirect costs were recorded here as time lost from work.

Data Processing
All data were entered into an Excel spreadsheet and processed with the Statistical Analysis System (SAS) statistical package.

Descriptive statistics are reported for the variables studied here. Normal distribution was verified with the Kolmogorov-Smirnov test. Nonparametric tests were used to compare costs. Bivariate analysis with two-by-two comparisons was used to contrast independent variables with the dependent variable, with the Kruskal-Wallis and Mann-Whitney U nonparametric tests. A bootstrapping technique was used to calculate confidence intervals.[9]

A 5% level of confidence was used.

Univariate sensitivity analysis was used to analyze the robustness of the results for the fundamental variables and facilitate extrapolation.[10]

The data used as a reference to calculate costs of an asthma attack treated in primary care were obtained from the database maintained by the Consejo General de Colegios Oficiales de Farmacéuticos (General Council of the Official Colleges of

TABLE 3
Medication Used According to Severity of the Exacerbation

	Degree of Exacer							
	Mild (n=57)		Moderate (n=58)		Severe (n=17)		Total (n=132)	
	Treatment		Treatment		Treatment		Treatment	
Pfarmacological Group	Previous	Attack	Previous	Attack	Previous	Attack	Previous	Attack
Antibiotics	0	7(12%)	0	6(10%)	0	3(18%)	0	16(12%)
Oral corticosteroids	1 (2%)	15 (26%)	3 (5%)	26 (45%)	0	16 (94%)	4(3%)	57 (43%)*
Inhaled glucocorticoids	34 (60%)	37 (65%)	32 (55%)	50 (86%)	6 (35%)	14 (82%)	72 (55%)	101 (77%)†
Short-acting beta-2 agonists	49 (86%)	48 (84%)	39 (67%)	45 (78%)	14 (82%)	16 (94%)	102 (77%)	109 (83%)
Long-acting beta-2 agonists	16 (28%)	15 (26%)	19 (33%)	23 (40%)	1 (6%)	8 (47%)	36 (27%)	46 (35%)
Anticholinergics	2(4%)	0	2(3%)	1 (2%)	0	3(18%)	4(3%)	4 (3%)
Other drugs	6 (11%)	9 (16%)	6 (10%)	8 (14%)	1 (6%)	3 (18%)	13 (10%)	20 (15%)

*$P<.001$. †$P=.02$.

TABLE 4 Management of Asthma Attacks*

| | Severify of the Attack | | | |
	Mild (n=58)	Moderate (n=58)	Severe (n=17)	Total (n=133)
Change in medication only	14 (24%)	13 (22%)	5 (29%)	32 (24%)
Medication + diagnostic tests	44 (76%)	45 (78%)	12 (71%)	101 (76%)
Number of diagnostic tests	1.6	2.2	1.8	1.9
Patients referred to specialist	1 (2%)	0	0	1 (<1%)
MEF	36 (62%)	35 (60%)	10 (59%)	81 (61%)
Spirometry	12 (21%)	24 (41%)	7 (41%)	43 (32%)
x-rays	1 (2%)	1 (2%)	0	2 (2%)
ECG	0	0	0	0
Number of visits	2.6	3.2	3.5	3
Duration, days	14.1	19.4	17.3	16.9
Days of work lost†	2.8	5.3	5	4.4

*MEF indicates maximal expiratory flow; ECG, electrocardiogram.
†P=.615

Pharmacists), the database of health care costs maintained by SOIKOS, and from the Instituto Nacional de Estadística de España (Spanish National Institute of Statistics).[11-13]

Results

Of the total sample of 133 patients with an asthma attack, 35 (26%) were men and 98 (74%) were women. Mean age was 47.8 years. One third (44 patients, 33%; 15 men and 29 women) were employed at the time of the exacerbation. One patient was referred to a hospital emergency service, so costs were calculated here for a total sample of 132 patients.

Table 1 shows the figures for severity of the attack according to previous degree of severity of asthma; 21.8% of all attacks occurred in patients with intermittent asthma. Table 2 summarizes the maintenance treatments used before the exacerbation. The figures show that the more severe the attack, the less frequent prior treatment was with inhaled corticosteroids (Table 3).

Table 4 and Figure 1 illustrate how asthma attacks were managed. The most habitual form of management was "change in treatment, diagnostic tests and more than 2 appointments with the doctor."

Mean total cost of an asthma attack treated in primary care was €166.7 euros (95% CI, 146.5-192.3). Direct costs represented almost 80% of the total cost, with 20% of the DC arising from prescription medication and use of medications and equipment, and 80% from consultations and diagnostic tests. In relative terms, more severe exacerbations were associated with lower costs for consultations and diagnostic tests, and higher costs for medication and equipment (Table 5).

Direct costs were also higher for unemployed patients (140.8; 95% CI, 127.1-156.3). Although the number of patients who were employed was small (44), we noted that in this group DC (53%) tended to be more similar to IC (47%).

Because of the variability in costs arising from visits to the primary care center and the influence of this expense on the total costs of asthma attacks, we performed a sensitivity analysis of this variable to determine the consistency of the results. Sensitivity analysis showed that the cost of an asthma attack treated in primary care ranged from €103.2 to €166.7.

Discussion

Asthma attacks account for 70% of all costs arising from illness, especially because of the IC involved.[5,6] Although one earlier study has appeared on the costs of asthma in Spain,[14] and one other study investigated the costs of asthma attacks,[15] no studies have appeared to date on the costs of the exacerbation of asthma in primary care in Spain. We thus felt there was a need to calculate the utilization of resources as an initial step toward studying how to reduce the incidence of asthma attacks and the health costs they originate.
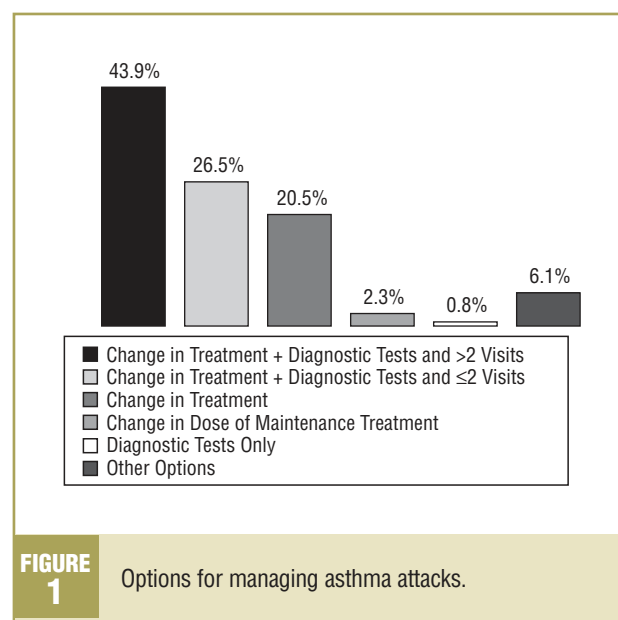
FIGURE 1 Options for managing asthma attacks.

TABLA 5 **Direct (DC) and Indirect Costs (IC) of Exacerbation According to Severity of the Attack***

	Severity of the Attack							
	Mild (n=57)			Moderate (n=58)			Severe (n=17)	
	Emp (n=20)	Unemp (n=37)	Mean (n=57)	Emp (n=18)	Unemp (n=40)	Mean (n=58)	Emp (n=6)	Unemp (n=11)
DC (med + equipment)	11.8 (6.1-18.2)	25.4 (15.9-39.4)	20.7 (13.7-29.2)	24.9 (15.9-36.1)	31.7 (22.3-42)	29.6 (22.5-37.3)	46.7 (27.6-66.5)	36.5 (21.6-53.6)
DC (dg test + visits)	77.5 (70.8-84.6)	99.3 (85.2-114.8)	91.6 (82.3-102.7)	110 (92.1-132.2)	120 (104.9-138)	116.9 (104.9-130.5)	98.8 (72.6-126.3)	118.7 (100.3-137.8)
Total direct costs	89.3 (79.5-100.3)	124.7 (102.7-149.9)	112.3 (97.8-130.7)	134.9 (114.6-159)	151.7 (131.2-175.4)	146.5 (130.8-162.3)	145.4 (108-183.7)	155.2 1(133.1-175.2)
Indirect costs	47.4 (21.6-77.6)	0	16.6 (5.3-28.7)	150.9 (50.3-280.3)	0	46.8 (14.1-91.4)	143.7 (35.9-273.1)	0
Total (DC+IC)	136.8 (108.9-169.2)	124.7 (102.7-149.9)	128.9 (110.5-146.5)	285.8 (173.6-432)	151.7 (131.2-175.4)	193.3 (155.8-242.3)	289.2 (165.1-452.7)	155.2 (133.1-175.2)

*Emp indicates employed; Unemp, unemployed.

Studies published thus far on the costs of asthma are not comparable owing to differences in cultural and economic characteristics and differences in health and social service coverage between the countries where these studies have been done. Moreover, these studies did not consider the same variables (different components of the costs, different costs of the components, different populations, etc). Many studies referred to the costs of asthma in the hospital setting, whereas others[16-19] pooled costs without distinguishing between primary and hospital care. Some have examined the impact of a given intervention (for example, patient education[20-23]) on total costs, while others have looked at the benefits of introducing preventive treatments[24-26] (especially inhaled corticosteroids) in decreasing the costs related with asthma. Other studies have analyzed costs according to specific features of the disease[4,27,28] (degree of severity, age, etc).

The present study attempts to determine the mean cost of an asthma attack treated in primary care within the Spanish National Health System. The high percentage of patients with intermittent asthma who had severe attacks (17.2%, Table 1) deserves particular mention. This may be related with denial of the disease, initial underestimation of the symptoms of an attack, or overestimation of self-control of the disease. Moreover, physicians may misdiagnose the disease or provide inadequate follow-up, or adherence with recommendations and prescribed treatments may be insufficient.[28,29] We note that patients with severe persistent asthma did not have mild attacks. In this case, regardless the suitability of and adherence to the prescribed treatment, these patients may underestimate mild symptoms they are accustomed to because of their already severe illness.

When we looked at treatment prior to the attack, we found that the more severe the attack, the less likely it was that the patient had been using previous treatment with inhaled corticosteroids and/or long-acting beta-2 agonists (Table 3). This may be why attacks in these patients were often more severe, and the finding corroborates the results of earlier studies that found that continued treatment with antiinflammatory drugs was effective in reducing the number of asthma attacks, thereby reducing costs associated with this disease.[24,26]

For most patients (90.9%) the treatment they had been using before the asthma attack was changed (Figure 1). In most cases (77%) the maintenance treatment based on short-acting beta-2 agonists was judged inadequate, and this figure was higher than in the AIRE study (66%).[29] The difference supports the notion suggested by Barnes et al[6] that the cost of rescue treatment is greater than the cost of effective maintenance treatment.

Mean total cost of the management of an asthma attack in primary care was €166.7, 80% of which reflected DC. The higher proportion of DC in our study (80%) reflects the cost of diagnostic tests and doctor's visits, and is similar to the figure found by Hoskins et al[15] (90%). To improve these results, the solution may lie in preventing the appearance of asthma attacks with effective maintenance treatment. In employed patients, total costs were 1.5-fold as high (€218.5) as in patients who were unemployed, and DC (53%) and IC (47%) tended to be similar in the former, particularly for moderate and severe attacks. Employed patients probably wait until their symptoms are more severe than unemployed patients would before seeking medical care. One limitation of this study is that we were not able to consider intangible costs, i.e., the time lost in patients who were unemployed. Although these costs may be considerable, they are difficult to measure reliably and objectively.

	Total (n=132)		
Mean (n = 17)	**Emp** (n = 44)	**Unemp** (n=88)	**Mean** (n=132)
40.1 (28.3-53.1)	21.9 (15.5-29.5)	29.7 (23.5-36.7)	27.1 (22.4-33.1)
111.6 (96.4-129.1)	93.7 (83.8-103.8)	111.1 (101.1-122.1)	105.3 (98.2-113.2)
151.8 (132.5-170.8)	115.6 (103.2-129.4)	140.8 (127.1-156.3)	132.4 (122.7-143.8)
50.7 (7.6-114.1)	102.9 (56.8-160.7)	0	34.3 (17-56.2)
202.5 (153.7-274.1)	218.5 (167-282.4)	140.8 (127.1-156.3)	166.7 (146.5-192.3)

As found in earlier studies,[14,16] costs increased with the severity of the attack. However, costs arising from doctor's visits and diagnostic tests were lower for severe than for moderate attacks. This may be a result of the fact that for severe attacks, more aggressive treatment with oral corticosteroids is begun without waiting for complementary tests. Oral corticosteroids are cheaper than inhaled treatments, and this approach to management obviates or reduces the need for the doctor´s visits and diagnostic tests which can arise from inappropriate or more conservative management.

The management option involving the lowest costs was to change pharmacological treatment, perform diagnostic tests and have the patient attend 2 follow-up appointments with the physician, mainly because IC are lowest with this option.

It is therefore necessary to emphasize the importance of appropriate management of the disease, with the use of effective continued treatment in accordance with the level of severity. This approach would probably improve the patient's quality of life and decrease the number and severity of attacks. This would probably result, in turn, in considerable reductions in the personal and social costs of asthma.

Future studies should be designed to obtain information on the factors that influence differences in costs according to the severity of the attack. This information may suggest ways to improve the distribution and use of resources in order to decrease the incidence of asthma attacks, and to reduce the costs they give rise to when they do occur.

Acknowledgments

Discussion Key points

What Is Known About the Subject

- Most of the costs from asthma arise from causes that could be prevented with appropriate management of the disease.

- Inadequate control of asthma can lead to the appearance of more attacks, and thus greater use of emergency services, hospitalizations, visits to the doctor, and more days of work lost for the patient and his or her family.

- The relatively few patients whose asthma is severe and/or poorly controlled give rise to the greatest percentage of costs.

What This Study Contributes

- The cost of an asthma attack treated in primary care is greater when severity of the attack is greater, with most costs being direct costs.

- A considerable proportion of patients with intermittent asthma experience severe attacks, which underlines the importance of patient education in the integral management of this disease.

- Patients with severe attacks used less antiinflammatory medication for maintenance treatment of asthma.

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COMMENTARY

Evaluation of the Resources and Their Costs in the Management of Patients in Primary Care

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The economic evaluation of medicines is increasingly being included in the taking of decisions by primary care doctors. The need to establish priorities in health spending, due to the progressive constraints on resources, has given rise to a greater number and diffusion of these studies all encompassed under the heading of *pharmacoeconomy*. For this reason, it is now inevitable that the term *efficiency* will be incorporated into medical language as the last link after efficacy and effectivity.[1,2]

Any economic evaluation requires the identification of the resources most relevant to the different options that are being compared and the estimation of the cost of each resource. The usual resources for obtaining this information come from the medical literature or in the carrying out of *ad hoc* studies. In any case, the better the quality of the information obtained, the more value the results will have.[3] In the management of patients and attributing their costs can be very different between areas, comparable in principle, and also, depending on the analysis perspective which

has been taken into account. Basically there are two ways of analysing these aspects in the context of normal clinical practice: retrospectively by access to databases and prospectively by means of observational clinical trials and studies. Both cases are not exempt from biases and possible confusion factors.[3,4]

Although the randomised clinical study may be the better method of analysing the efficacy of an intervention, in the economic evaluation it has great limitations, such as the lack of external validation of the results obtained on the use of resources, in many cases conditioned by the protocol of the study itself. The obtaining of data by observational studies allows data nearer to clinical practice to be obtained, but it has as a disadvantage, the lower level of quality of the data obtained. Lastly, a much used third option are decision analysis models which give rise to greater disadvantages than the two previous options by being based on suppositions and, particularly when they lack transparency, they are normally more questionable.[5]

Therefore, the identification of the resources employed in approaching an illness constitutes an important limitation in economic evaluation studies and this study contributes to supporting the data on the seriousness of asthmatic crises treated by primary care and its diagnostic and therapeutic management. The assigning of costs to each process also presents with difficulties, although minor, since there are resources more or less agreed by consensus in our country, although they may not be official.[3]

Without a doubt it is of interest to carry out evaluations on the management of illnesses in the primary care environment and on the costs attributed to them, but we should move forward to a global evaluation, taking into account the interaction between primary care and specialised care, to obtain data from a wider health perspective.

Lastly, despite the limitations of the study, some data are pointed out which shows the economic impact that can be attributed to the cost of ineffectiveness in the approach to an illness. An incorrect maintenance treatment in an asthmatic patient can give rise to a more serious crisis and as a consequence higher costs for the health system.

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