Economic analysis of the Confronting COPD survey: an overview of results

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Abstract An economic analysis of data from a large-scale international survey, Confronting COPD in North America and Europe, was conducted in seven countries (Canada, France, Italy, the Netherlands, Spain, the U.K. and the U.S.A.), to investigate the burden of chronic obstructive pulmonary disease (COPD). The results demonstrated the high economic impact of COPD on the healthcare system and society in each country. The mean annual direct costs of the disease were particularly high in the U.S.A. (US$4119 per patient) and Spain (US$3196 per patient) but relatively low in the Netherlands (US$606) and France (US$522). Lost productivity due to COPD had a particularly high impact on the economy in France, the Netherlands and the U.K., accounting for 67%, 50% and 41% of overall costs, respectively. The total societal cost of COPD per patient ranged from over US$5646 in the U.S.A. to US$1023 in the Netherlands. In five out of seven countries, the majority (52–84%) of direct costs associated with COPD were due to inpatient hospitalizations. As acute exacerbations of COPD are a key driver of secondary care costs, interventions aimed at preventing and treating exacerbations effectively could significantly reduce the economic impact of this disease. In all of the participating countries, COPD was underdiagnosed and undertreated. Between 9% and 30% of patients were undiagnosed despite having symptoms consistent with COPD, and up to 65% of patients did not receive regular prescribed medication. Patients reported poor symptom control and considerable use of healthcare resources. Therefore, reducing the burden of COPD will involve better evaluation and diagnosis of patients with COPD, as well as improved management of chronic COPD symptoms by healthcare professionals. The survey also demonstrated that the societal costs of COPD were 4–17 times higher in patients with severe COPD than in patients with mild COPD. Patients with comorbid conditions (accounting for 30–57% of patients in each country) were also particularly costly to society. These results suggest that a high priority should be given to interventions aimed at delaying the progression of disease, preventing exacerbations and reducing the risk of comorbidities, in order to alleviate the clinical and economic burden of COPD in North America and Europe.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a disease state characterized by progressive airflow limitation that is not fully reversible. The most important cause of COPD is a long-term smoking history (1). The global prevalence of COPD has been estimated at 9.3 per 1000 males and 7.3 per 1000 females (all ages) (2). These rates are likely to rise in the future, due to the long-term impact of increased smoking behaviour over recent decades, and population aging (3). Morbidity and mortality from COPD are considerable, and increasing. By the year 2020, COPD is predicted to become the third leading cause of death and the sixth leading cause of disability worldwide (2). Society has to bear the economic impact of COPD, resulting from the direct costs of healthcare resource utilization and the indirect costs of lost productivity (4).

Although the burden of COPD is considerable, the disease appears to be poorly recognized by patients and sub-optimally managed by physicians and healthcare decision makers (4). Consequently, patients may fail to seek healthcare when experiencing symptoms, and when they do seek contact with healthcare professionals, the condition is often underdiagnosed and undertreated. COPD is also underfunded in comparison with other serious and chronic conditions, particularly given the morbidity and mortality associated with this disease (4).
Reducing the burden of COPD may necessitate raised awareness about the impact of this disease on the patient, the healthcare system and the economy.

To date, few studies have attempted to quantify the impact of COPD in individual countries. Yet obtaining information on the country-specific impact of COPD is important not only for increasing the recognition of COPD as a major health problem, but also for identifying effective interventions that may be targeted to reduce the burden of the disease on the patient and society overall. In an attempt to fill gaps in current knowledge, a large-scale international survey, Confronting COPD in North America and Europe, was conducted in eight countries (Canada, France, Germany, Italy, the Netherlands, Spain, the U.K. and the U.S.A.). This summary paper presents data on healthcare resource utilization, patient work loss, and associated direct and indirect costs due to COPD in the seven countries that participated in the economic analysis of the survey results. Issues relating to the differential management and burden of COPD between countries are discussed. Detailed results for each country participating in the survey are presented elsewhere (5–11).

METHODS

The methodology for the Confronting COPD survey has been described in detail (12–13). Briefly, telephone interviews were conducted with 3265 patients and 905 physicians to assess the impact of COPD on clinical outcomes, the healthcare system and the economy. Patients included in the survey had been diagnosed with COPD, chronic bronchitis or emphysema, or had symptoms consistent with chronic bronchitis (persistent coughing with phlegm production for the last 2 years or more). In addition to clinical outcomes, patient responses were used to derive measures of healthcare resource utilization (including inpatient hospitalizations, emergency room visits, contacts with healthcare professionals, treatment and laboratory investigations), and lost productivity due to COPD. Local unit costs were applied to estimate the direct, indirect and total societal costs of COPD in seven of the eight participating countries (Canada, France, Italy, the Netherlands, Spain, the U.K. and the U.S.A.). A sub-analysis was conducted to investigate the relationships between the annual societal cost of COPD and disease severity, comorbidity, gender, smoking status and educational level in each of these countries.

To compare the costs of COPD between countries, the Canadian and European results were converted to US dollars using 2002 exchange rates. A sensitivity analysis of total societal costs was also conducted, in which national currencies were converted into US dollars using Gross National Product (GNP) Purchasing Power Parities (PPPs) (1997 values) instead of exchange rates (14). GNP PPPs are currency conversion rates that offer the advantage of equalizing the price of the same services in all countries (exchange rates tend to overestimate costs in relatively 'rich' countries and underestimate costs in relatively 'poor' countries) (15).

RESULTS

Patient demographics

A summary of the demographics and clinical characteristics of the patients included in the Confronting COPD survey in each country are summarized in Table 1. The mean age ranged from 61–66 years, and 38–52% of patients were current smokers. There were considerable differences between samples in mean pack year smoking history, the percentage of patients diagnosed with COPD, and the percentage of patients diagnosed with other serious or chronic health conditions. The majority of patients in each country considered themselves to have mild or moderate COPD, and most patients believed that their condition was at least somewhat controlled with current medication.

Healthcare resource utilization

The results of the Confronting COPD survey revealed that the majority of patients in each country normally received care from their primary care practitioner (PCP) for this condition. The proportion of patients who contacted a PCP or specialist differed between countries (Fig. 1). While only 13% of patients in the U.K. saw a specialist, this type of contact was reported by around two-fifths of patients in Spain, Italy, and the Netherlands.

The frequency of contact with healthcare professionals is summarized in Table 2. The highest numbers of PCP visits was reported in the U.K. and the U.S.A. Patients in the U.S.A. also reported the most specialist visits, with a mean of 1.8 visits per patient past year. In all countries, the majority of PCP and specialist visits were scheduled. The proportion of patients reporting unscheduled visits ranged from 6% in Italy to 22% in the U.K. An estimated 4% of patients in each country had unscheduled specialist visits in the year prior to the survey (Fig. 2). Patients with COPD also reported inpatient hospitalizations and visits to the emergency room (ER) as a result of their condition in the past 12 months (Fig. 3). The Spanish survey sample reported the highest numbers of both inpatient stays and ER visits (Table 3).

Medication use

The survey results showed the proportion of patients in each country who received regular prescribed medication for COPD (Fig. 4). The pattern of prescribing varied between countries. Table 4 ranks each country according to the proportion of patients receiving the five most commonly prescribed drug classes (short-acting...
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FIGURE 1. The percentage of patients reporting primary care practitioner (PCP) or specialist care in each country.

\[\beta_2\text{-agonists, inhaled corticosteroids, anticholinergics, long-acting \(\beta_2\text{-agonists and theophylline). Between 1\% and 8\% of patients were treated with leukotriene receptor antagonists, and fewer than 6\% of patients were treated with systemic corticosteroids. Non-steroidal anti-inflammatory drugs were received by up to 4\% of patients.}\]

In addition to regular prescribed medication, the survey assessed the percentage of patients who had received an influenza vaccination, antibiotics for the treatment of respiratory infection, or had used home oxygen therapy in the previous year (Fig. 5). The highest rates of antibiotic use were reported in the U.K. and the U.S.A. (57\% and 54\% of patients respectively). Only half (51\%) of the patients in France had been vaccinated against influenza, compared with 71\% of patients in the Netherlands. The percentage of patients reporting a requirement for home oxygen use ranged from 4\% in the Netherlands to 26\% in the U.S.A.

**Direct costs**

The annual direct cost of COPD per patient was calculated for each country participating in the Confronting COPD survey, and ranged from US$522 in France to US$4119 in the U.S.A. (Fig. 6). Although the breakdown of direct costs differed between countries,
Table 2. Frequency of contact with healthcare professionals during the previous 12 months

<table>
<thead>
<tr>
<th>Healthcare professional contacts</th>
<th>Canada (n = 401)</th>
<th>France (n = 400)</th>
<th>Italy (n = 400)</th>
<th>Netherlands (n = 415)</th>
<th>Spain (n = 402)</th>
<th>U.K. (n = 400)</th>
<th>U.S.A. (n = 447)</th>
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<tr>
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<td></td>
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<td>PCP visits</td>
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<tr>
<td>Total no. of visits</td>
<td>1506</td>
<td>1514</td>
<td>1301</td>
<td>1301</td>
<td>2045</td>
<td>2322</td>
<td>2026</td>
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<tr>
<td>Mean per patient (SD)</td>
<td>3.79 (7.20)</td>
<td>3.79 (7.81)</td>
<td>3.25 (8.61)</td>
<td>2.04 (5.71)</td>
<td>5.10 (11.44)</td>
<td>5.80 (9.83)</td>
<td>4.55 (9.26)</td>
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<td>Specialist visits</td>
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<tr>
<td>Total no. of visits</td>
<td>295</td>
<td>275</td>
<td>458</td>
<td>496</td>
<td>444</td>
<td>227</td>
<td>672</td>
</tr>
<tr>
<td>Mean per patient (SD)</td>
<td>0.74 (2.24)</td>
<td>0.69 (2.21)</td>
<td>1.14 (2.83)</td>
<td>1.44 (2.78)</td>
<td>1.11 (2.59)</td>
<td>0.57 (2.07)</td>
<td>1.51 (3.12)</td>
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<td>PCP visits</td>
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<tr>
<td>Total no. of visits</td>
<td>175</td>
<td>423</td>
<td>217</td>
<td>58</td>
<td>94</td>
<td>317</td>
<td>184</td>
</tr>
<tr>
<td>Mean per patient (SD)</td>
<td>0.44 (1.52)</td>
<td>1.06 (3.92)</td>
<td>0.15 (0.76)</td>
<td>0.52 (4.76)</td>
<td>0.23 (1.34)</td>
<td>0.79 (0.79)</td>
<td>0.41 (1.26)</td>
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<tr>
<td>Specialist visits</td>
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<td></td>
</tr>
<tr>
<td>Total no. of visits</td>
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<td>106</td>
<td>106</td>
<td>106</td>
<td>106</td>
<td>106</td>
<td>106</td>
</tr>
<tr>
<td>Mean per patient (SD)</td>
<td>0.27 (2.12)</td>
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</table>

PCP: Primary care practitioner

Figure 2. Percentage of patients reporting scheduled and unscheduled contacts with healthcare professionals during the 12 months prior to the survey.

Figure 3. Percentage of patients reporting inpatient stays and ER visits during the 12 months prior to the survey.

more than half of costs in Canada, Italy, Spain, the U.K. and the U.S.A. resulted from inpatient hospitalizations (Fig. 7). In France, oxygen therapy accounted for the highest proportion of direct costs (25%), while in the Netherlands, almost half of direct costs (49%) were for regular prescribed medication.
Lost productivity in patients with COPD

The percentage of patients in the Confronting COPD survey who were of working age ranged from 41% in Spain to 82% in the U.S.A. (Table 1). A number of patients in the Confronting COPD survey reported that they were completely prevented from working during the previous year, were limited in the work they were able to do, or were absent from work as a result of their condition (Fig. 8). Patients in the U.S.A. reported greater productivity loss than any patients in any other country.

Societal costs

The annual cost of lost productivity in patients with COPD was calculated in each country, to provide an estimate of the indirect cost of the disease. Indirect costs ranged from US$47 per patient in the Italian survey sample (with a total of 158 days of work absence) to US$1527 per patient in the U.S.A. sample (6838 working days lost). The estimated annual societal cost of COPD per patient in each country is shown in Fig. 9. The direct cost of COPD was higher than the indirect cost of the
Figure 5. Use of antibiotics, influenza vaccination and home oxygen therapy during the previous year.

Figure 6. Annual direct per patient costs of COPD in each country.

Figure 7. Percentage breakdown of the annual direct per patient costs of COPD in each country.

disease in all countries except France, where the cost of patients' work loss was almost double the cost of healthcare resource use due to COPD. The proportion of societal costs resulting from healthcare resource utilization varied considerably between countries, from 33% in France to 95% in Italy.

**Sub-analysis of societal costs and patient variables**

In each country, a sub-analysis of the total per patient costs calculated from the Confronting COPD survey revealed that patients who perceived themselves to have
severe COPD were considerably more costly to the healthcare system and the economy than patients with mild or moderate COPD (Fig. 10). Similar results were gained when disease severity was assessed according to patient score on the Medical Research Council Dyspnoea Scale (mild: 0–2, moderate: 3–4, severe: 5) (5–11). Annual societal costs in all countries were also higher in patients who reported comorbidities than in patients who had not been diagnosed with other serious or chronic conditions (Fig. 11).

The total societal costs of COPD were also assessed in terms of sex, smoking status and educational level (Table 5). The per patient cost of COPD was higher in males than in females in Italy, the Netherlands, Spain and the U.K., but higher in females than in males in the remaining countries. Former smokers were more costly to the healthcare system and the economy than current smokers in all countries except France. Patients who had no education beyond leaving school (i.e. no further or higher education) were associated with higher per
patient societal costs than more educated patients in Canada, France, the Netherlands, Spain and the U.S.A.

**Sensitivity analysis**

The sensitivity analysis converted local currency values into US dollars using between-country differences in GNP PPPs, rather than exchange rates. This increased the per patient cost of COPD in all countries outside the U.S.A., as shown in Fig. 12. Patients in Spain were now associated with the highest per patient costs of COPD, followed by the U.S.A. and Canada. The Netherlands continued to have the lowest per patient cost.

**DISCUSSION**

The Confronting COPD survey provided a picture of the healthcare resource utilization and lost productivity due to COPD in patients from eight countries in North America and Europe. The survey included patients with physician-diagnosed COPD, chronic bronchitis and emphysema and those with undiagnosed chronic bronchitis, as defined by persistent cough with sputum production for at least 2 years. Direct, indirect and total societal costs were calculated from the survey data.

The results demonstrated the high economic burden placed by COPD on the healthcare system and society in
each country. The mean annual direct costs of the disease were high in the U.S.A. (US$41,119 per patient) and Spain (US$31,196 per patient), with relatively low costs in the Netherlands (US$6,066) and France (US$5,522). Lost productivity due to COPD had a particularly high impact on the economy in France, the Netherlands and the U.K., accounting for 67%, 50% and 41% of overall costs, respectively. The total societal cost of COPD per patient ranged from over US$56,466 in the U.S.A. to US$10,231 in the Netherlands.

**Organization of COPD care**

In each country, more than half of patients in the survey were under the care of a primary care practitioner for the management of their condition, and up to two-fifths of patients were seeing a specialist. Although the majority of contacts with healthcare professionals were scheduled, a number of patients in each country required unscheduled emergency care for COPD, including visits to the hospital emergency room. This suggests that although patients were visiting a professional for treatment, many patients were experiencing poor symptom management. Indeed, 26%–65% of patients in the individual countries reported that their symptoms were only somewhat controlled, poorly controlled or not at all controlled. The highest rates of poor symptom control were reported in the U.S.A., which also had the highest per patient costs of COPD. These results may suggest that reducing the impact of COPD on the healthcare system and society is likely to require improvements in the management of chronic symptoms.

**Diagnosis and treatment**

The Confronting COPD survey provided insights into the reasons for the sub-optimal management of COPD in North America and Europe. Many patients with COPD in the participating countries remained undiagnosed (ranging from 9% of patients in the U.S.A. to 30% of patients in the U.K.). Underdiagnosis may be partly due to the underutilization of spirometry (recommended by treatment guidelines to confirm diagnosis) (1): only 45% of patients in the Confronting COPD survey reported that their lung function had been assessed using this method (13). The under-recognition of early symptoms of the disease by patients (particularly smokers, who may fail to appreciate the significance of chronic cough and sputum production) may also be a contributory factor (16).

The underdiagnosis of COPD is likely to represent a barrier to optimal management, as patients without a diagnosis may be less likely than diagnosed patients to receive regular prescribed medication. However, in each country, the proportion of patients who were not receiving regular medication exceeded the number of patients without a diagnosis, suggesting that undertreatment may also be a factor in patients who have been diagnosed with COPD. The smallest discrepancy between the proportion of patients diagnosed and treated for COPD was observed in the Netherlands (81% and 73% of patients, respectively). Dutch patients reported the highest levels of symptom control (with 72% of patients reporting that their condition was well-controlled or completely controlled), some of the lowest rates of hospitalizations, emergency room visits, and unscheduled contacts with healthcare professionals, and lower per patient societal costs than patients in any other country. Although relatively low differences between the percentage of patients diagnosed and treated were also seen in Canada and Spain (difference of 12%), the proportion of patients reporting good or optimal symptom control was much lower than in the Netherlands (60% in each country), and the direct and societal costs of COPD were considerably higher. These results suggest that even when the majority of diagnosed patients are receiving treatment for COPD, sub-optimal management remains a significant problem, with associated healthcare resource utilization and lost productivity.

Looking at patients who received regular prescribed medication for COPD in more detail, the results of the Confronting COPD survey suggested that prescription patterns differed considerably between countries. This may reflect uncertainty among healthcare professionals about which medications are most effective for the treatment of this disease. Indeed, physicians who were questioned as part of the Confronting COPD survey revealed a need for further education on the effectiveness of varying approaches to COPD management (13). Uncertainty surrounding the optimal choice of interventions exists despite the recent publication of international consensus guidelines for COPD, which recommend bronchodilators as the mainstay of therapy for COPD, with consideration of inhaled corticosteroids in patients with moderate to severe COPD who suffer from frequent exacerbations (1). The undertreatment seen in the survey suggests that the implementation of guideline recommendations is limited in practice. Implementation of international guidelines may be limited by the availability of country-specific guidelines (e.g., in France, the Netherlands, the U.K., and the U.S.A.) with different recommendations. Other factors that may limit the impact of guidelines may include country-specific preferences among patients or physicians for particular drugs, resource limitations or budget constraints (17). Whatever the reasons for the differential treatment of COPD between countries, the uncertainty surrounding optimal management strategies is likely to result in inadequate disease control, thus contributing to the high costs of the disease to the healthcare system and society.
COPD hospitalization

In Canada, Italy, Spain, the U.K. and the U.S.A., the majority (52–84%) of direct costs associated with COPD were due to inpatient hospitalizations. The only exceptions to the major role of hospitalization costs were France, where the main direct cost was due to oxygen therapy, and the Netherlands, where medication costs represented a major proportion (49%) of the relatively low cost of COPD to the healthcare system. One of the main causes of hospitalization in patients with COPD is acute exacerbations of the disease. Although the number of exacerbations was not directly assessed by the survey, the extent of antibiotic use reported during the previous year (ranging from 38% in the Netherlands to 57% in the U.K.) suggests that exacerbations caused by respiratory infection were a frequent occurrence. As acute exacerbations of COPD are a key driver of hospital costs (18), interventions aimed at preventing exacerbations may reduce the economic impact of the disease. International treatment guidelines recommend influenza vaccination for the prevention of respiratory infections (1), yet 29–60% of patients in each country had not been vaccinated in the previous year. It is interesting to note that the lowest hospitalization rates were observed in the Netherlands, where patients reported higher rates of influenza vaccination than in any other country.

Medications that may reduce the rate and frequency of exacerbations by acting on underlying lung inflammation (which is triggered and worsened by infection) may also have a role to play in reducing the number of patients with COPD who require a hospital stay for the management of acute symptoms. There was some indication of a relationship between the use of medication in the survey and the rate of hospitalization. Patients in the Netherlands reported the lowest number of hospitalizations and the highest reported use of regular prescribed medication of any country in the survey. Almost half of the patients in the Netherlands received inhaled corticosteroids, and a quarter of patients were treated with long-acting β2-agonists. In Spain, where the number of hospitalizations reported was particularly high, patients reported the lowest utilization of long-acting β2-agonists of any country in the survey, and less than one-fifth of patients were treated with inhaled corticosteroids.

Impact of patient characteristics on costs

Patients with severe COPD may be more likely to suffer frequent exacerbations and poor symptom control than patients with mild or moderate COPD (18), resulting in substantial use of healthcare resources, lost productivity and associated direct and indirect costs. The substantial impact of patients with severe COPD was highlighted by the sub-analysis of costs from the Confronting COPD survey, which showed that the societal cost of severe COPD per patient was 4–17 times higher than the cost per patient with mild COPD.

Consequently, interventions aimed at delaying the progression of disease could reduce the economic impact of COPD in North America and Europe. The only intervention known to reduce the progressive lung function decline in COPD is smoking cessation (1), which has been shown to lead to fairly rapid improvements in pulmonary function (19). However, smoking cessation is likely to be delayed if patients do not contact a healthcare professional for symptoms of COPD, and remain undiagnosed. Even when patients do succeed in quitting, the societal benefits of smoking cessation intervention are unlikely to be seen for a number of years, due to the long-term cumulative impact of tobacco smoking on patient health (20).

In almost every country in the survey, former smokers were more costly to the healthcare system and the economy than current smokers. This may be due to the 'quitting ill' effect, in which smokers quit upon developing disease symptoms or immediately after diagnosis of smoking-related diseases (21–22). Therefore, encouraging patients to stop smoking before they develop COPD, or preferably discouraging the general population from taking up tobacco smoking at all, are likely to be important strategies for reducing the future impact of this disease on society.

In addition to delaying the progression to severe disease, smoking cessation may help to reduce the risk of comorbidity in patients with COPD. The importance of reducing comorbidity was demonstrated by the survey, which showed that in all countries, the combined direct and indirect per patient costs of COPD were considerably higher in patients with COPD and other serious or chronic health conditions than in patients with COPD alone, supporting the results of previous studies (23–24).

Reasons for cost differences between countries

Overall, the economic impact of COPD differed between countries in the Confronting COPD survey. Some of the inter-country variability in costs may have been due to local differences in unit costs for healthcare services and time lost from work. To test whether this was indeed the case, a sensitivity analysis used GNP PPPs (which equalize prices according to purchasing power) to convert local currency values into US dollars. This method of currency conversion increased the per patient societal cost of COPD in all countries outside the U.S.A., and Spain moved from second to first in the highest-lowest ranking of costs. However, the overall
The disparities in COPD costs between countries enrolled in the Confronting COPD survey may be due to between-country differences in the characteristics of the patients with COPD who were enrolled in the survey samples, or variability in the management of COPD by individual healthcare systems. Factors that may influence the economic impact of COPD may be highlighted by considering patient characteristics, management approaches and healthcare resource use in the countries with high (U.S.A. and Spain) and low direct and societal costs per patient (France, Italy and the Netherlands) (Table 6). High costs in the U.S.A. and Spain were associated with high rates of severe COPD, while low costs in Italy and the Netherlands were associated with low rates of severe disease. However, the direct and societal costs of COPD were also low in France, where the proportion of patients with severe disease was relatively high. In addition, there appeared to be little relationship between costs and the percentage of patients reporting comorbidity (high in the U.S.A. and France, but low in Spain, Italy and the Netherlands). These results suggest that reasons other than between-country differences in patient characteristics (i.e. variability in COPD management) must contribute to the observed differences in costs. Patients in Spain and the U.S.A. reported a relatively low use of long-acting β₂-agonists, with a high requirement for inpatient hospitalization and emergency room visits. In contrast, low direct and societal costs in Italy, the Netherlands and France were associated with relatively high use of long-acting β₂-agonists, and low rates of hospitalization and emergency room care for COPD. Although further work is required to clarify the association between management strategies and COPD costs at a population level, these results suggest that long-acting β₂-agonists may have a role to play in reducing the burden of COPD. Previous studies have shown that treatment with long-acting β₂-agonists reduces healthcare costs in patients with this disease (23-24).

CONCLUSION

The results of the Confronting COPD survey showed that COPD places a high economic burden on the healthcare system and society in all countries studied, with a particularly pronounced impact in Spain and the U.S.A. Reducing the burden of this disease in North...
America and Europe will necessitate improvements to diagnosis rates, the management of chronic symptoms by healthcare professionals, the prevention and treatment of acute exacerbations, and the employment of interventions aimed at delaying the progression of disease, preventing exacerbations and reducing the risk of comorbidities in patients with COPD.

REFERENCES