Background: The aim of this study was to describe the distribution of the direct costs of asthma in Estonia by the type of treatment received and to differentiate the costs by age of patients. Methods: Data were obtained from the databases of national health insurance offices. Persons who had been in a hospital or visited a doctor because of asthma and who also purchased anti-asthmatic drugs during 1997 were identified. The bills of all direct costs of health insurance for each asthma patient could thus be summarised. The data on all purchases of drugs were used to follow the patterns of drug treatment of asthma. Results: The mean annual treatment costs of one asthma patient were 118 EUR. The costs of hospital care accounted for 27%, costs of ambulatory care for 20% and costs of pharmacotherapy for 53% of all treatment costs. Beta-agonists and corticosteroids for inhalation accounted for more than 80% of prescriptions and 90% of pharmacotherapy costs in patients under 45 years. The users of oral corticosteroids had twice as high per capita annual asthma treatment costs as compared to non-users. Conclusions: The frequency of out-patient visits, hospital admissions, number of prescriptions, total costs and costs of pharmaceuticals increased in parallel with age. The total estimated direct costs of asthma diagnosis and treatment during 1997, as extrapolated from the study population, were 2.1 million EUR, and accounted for 1.4% of direct health care costs in Estonia.

Keywords: asthma, costs, Estonia, pharmacotherapy

Asthma is one of the most common chronic health disorders requiring medical care and medication in both adults and in children. Mortality from asthma is low, but the importance of asthma in terms of health care and social welfare expenditure has increased dramatically and continues to do so. The reported prevalence for asthma from Western countries ranges from 2 to 8% of the population and there are indications, that asthma has become more prevalent as a disease in both adults and children. Asthma prevalence in Estonia was estimated to be 2–4% among the adult population in a study carried out in 1994. Contemporary asthma treatment is based on out-patient pharmacotherapy and in many patients enables them full participation in major activities of everyday life. Continuous pharmacotherapy with anti-inflammatory drugs has been shown not only to increase the efficacy of treatment, but also to decrease the need for hospitalisation and, thus, the costs of in-patient care. It is known for Estonia, that anti-asthmatic drugs were used in quantities per capita of up to ten times less than in Finland and Sweden in the 1980s and approximately five times less often in the 1990s. Thus, a question arises: what would be the impact of less use of anti-asthmatic drugs on the distribution of costs of asthma treatment in Estonia?

The single study on asthma treatment costs in Estonia estimated that in-patient costs accounted for 57% of direct expenditure on asthma in 1994, similar to the 56% reported for the US in 1990 and 54% in 1994. The aim of the present study was to summarise the real costs to the national insurance system which paid for asthma treatment in Estonia in 1997 and evaluate the impact of different treatment components on costs in different age groups.

MATERIAL AND METHODS

Since 1992, compulsory national health insurance has covered all in-patient costs and the majority of out-patient health care costs (including prescription medicines) of 95% of the population of Estonia (1.5 million). Data for this study were obtained from the databases of two regional health insurance offices in Tartu and Rakvere counties, which include a population of 225,000 inhabitants and which have computerised files of bills for all hospitalisations, out-patient visits, investigations, procedures and prescriptions filled in pharmacies for all their members. In 1997, 0.98 million bills for medical treatment at a total value of 20 million EUR and 0.43 million prescriptions at a total value of 2.9 million EUR were paid for the population of Tartu and Rakvere counties by the national insurance system. The study population consisted of any person who was diagnosed as having asthma as a primary diagnosis (ICD-9 code 493 or ICD-10 codes J45–J46) either in a hospital or during an out-patient visit between 1 January 1997 and 31 December 1997. The study population was
further restricted to persons who had also purchased anti-asthmatic drugs during 1997 in order to exclude patients, whose asthma was not treated. Anti-asthmatic drugs were defined as inhaled or oral preparations of \( \beta \)-agonists, anticholinergic drugs and corticosteroids, inhaled cromolyn and oral theophylline.

In this study the costs of asthma treatment include the direct expenditure of the national health insurance for medical care, including in-patient hospitalisation, out-patient services, emergency visits to clinics and prescribed medication. The data is individualised and all major diagnostic procedures and treatment measures can be followed as well as detailed information on drug use. All cost data is presented in Euros (EUR), according to the average exchange rate between Estonian kroon (EEK) and Euros of 1 EUR = 15.7 EEK during 1997. Student’s t-test was used to evaluate the statistical significance of differences between groups and Spearman correlation analysis was used to describe the distribution of costs.

RESULTS

The costs of asthma treatment were evaluated separately for children (persons younger than 18 years) and the adult population, which was divided into age groups of 18-44 years and 45-65 years. In order to minimise bias from the increasing prevalence of chronic obstructive lung disease in older age groups, the adult population was limited to persons until the age of 65 years. Asthma diagnosis was assigned to 2,715 persons and anti-asthmatic drugs were purchased by 3,651 persons in the population of 225,000 persons under 45 years. At the same time, theophylline was most often and accounted for 90% of all drug costs in Indiana and oral corticosteroids were considerably more frequently used in the 45-65 years age group.

The summarised costs of the study group were 46,709 EUR on in-patient care (27%), 34,981 EUR on out-patient care (20%) and 89,756 EUR (53%) on anti-asthmatic medication. The number of different cost items and mean costs per patient are presented in Table 1. The patients from the 45-65 years age group had more out-patient visits and, thus, had higher out-patient costs than younger age groups. As for hospital treatment, the oldest age group were more frequently in hospital, but the in-patient costs were smallest in the 18-44 years age group.

Anti-asthmatic medication was significantly less often prescribed to the youngest age group and more frequently to the oldest age group. This is probably also the reason for significantly smaller per capita prescription costs and total asthma treatment costs among asthmatic children. The increase in age of the treated asthma patients increased in parallel with the total per capita costs (figure 1). The Spearman correlation coefficient between age and total costs was 0.195 (p<0.001) and between age and drug costs 0.331 (p<0.01). As expected, the higher drug costs were related to higher total costs (Spearman correlation coefficient 0.147 and p<0.001). The costs for prescription pharmaceuticals for all 1,423 asthma patients is broken down by major drug groups in Table 2.

There were considerable differences in the frequency of drug use in different age groups. The \( \beta \)-agonists and corticosteroids for inhalation were the drugs used most often and accounted for 90% of all drug costs in persons under 45 years. At the same time, theophylline and oral corticosteroids were considerably more frequently used in the 45-65 years age group.

### Table 1: Direct costs of asthma treatment in Estonia in 1997

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Number of Patients</th>
<th>Per Capita Cost in EUR</th>
<th>Per Capita Cost in EUR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>95% CI</td>
<td>mean</td>
</tr>
<tr>
<td>Children 0-17 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Out-patient visits</td>
<td>469</td>
<td>3.70</td>
<td>3.45-3.95</td>
</tr>
<tr>
<td>Hospital admissions</td>
<td>107</td>
<td>0.26</td>
<td>0.21-0.31</td>
</tr>
<tr>
<td>Prescriptions</td>
<td>484</td>
<td>2.90</td>
<td>2.69-3.11</td>
</tr>
<tr>
<td>Total</td>
<td>484</td>
<td>na</td>
<td>85*</td>
</tr>
<tr>
<td>Adults 18-44 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Out-patient visits</td>
<td>338</td>
<td>3.90</td>
<td>3.35-4.25</td>
</tr>
<tr>
<td>Hospital admissions</td>
<td>78</td>
<td>0.33</td>
<td>0.24-0.42</td>
</tr>
<tr>
<td>Prescriptions</td>
<td>349</td>
<td>4.70</td>
<td>4.18-5.22</td>
</tr>
<tr>
<td>Total</td>
<td>349</td>
<td>na</td>
<td>117</td>
</tr>
<tr>
<td>Adults 45-65 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Out-patient visits</td>
<td>562</td>
<td>5.00</td>
<td>4.60-5.40</td>
</tr>
<tr>
<td>Hospital admissions</td>
<td>169</td>
<td>0.48</td>
<td>0.40-0.56</td>
</tr>
<tr>
<td>Prescriptions</td>
<td>590</td>
<td>6.70</td>
<td>6.16-7.24</td>
</tr>
<tr>
<td>Total</td>
<td>590</td>
<td>na</td>
<td>153*</td>
</tr>
</tbody>
</table>

a: p<0.05 as compared to age group 0-17 years
b: p<0.001 as compared to age group 18-44 and 45-65 years
c: p<0.05 as compared to age group 18-44 and 45-65 years
d: p<0.05 as compared to age group 18-44 years
As an indicator of seriousness of disease we divided the study group into two according to whether the patients had been using or did not use oral corticosteroids during the study period. The 112 asthma patients using oral corticosteroids were significantly older (mean age 53 years and 95% CI 50–56 years), and had twice as high per capita asthma treatment costs (mean 229 EUR and 95% CI 189–269 EUR) than the 1,311 non-users (mean age 33 years and 95% CI 31–35 years and mean cost 112 EUR and 95% CI 104–120 EUR).

DISCUSSION

This study has summarised all direct costs of national health insurance on asthma treatment. In 1997, the total budget for medical care of national health insurance for the study population of 225,000 was 20 million EUR and for the reimbursement of prescription medicines 2.9 million EUR. From this, asthma costs accounted for 0.8 and 5.6% respectively. The total estimated direct costs on asthma diagnosis and treatment during 1997, extrapolated from the study population, were 2.1 million EUR in Estonia. This accounted for 1.4% of total direct health care costs in Estonia, somewhat higher than the 1% reported for Canada and the USA. In our study 1,423 persons from the population of 225,000 had been diagnosed with asthma and had purchased anti-asthmatic medication during 1 year. Despite the fact that billing data is not a proper source for assessing the prevalence of disease, we can estimate the prevalence of treated asthma as 0.63% in Estonia in 1997.

This study was conducted from the perspective of the payer, the national insurance scheme and does not estimate the total burden of disease to society. Not all direct costs of asthma treatment were included, i.e. purchases of non-anti-asthmatic drugs and over-the-counter drugs or devices (nebulisers, etc.). These were not included as the costs of other than anti-asthmatic drugs are difficult to relate to the specific disease. In addition, the compensation for lost days from work to employed patients, which is paid by national insurance, was excluded from the analysis, because leave from work is only relevant to a relatively small subgroup of asthma patients (12% from our study group). In addition, the costs of using the ambulance services could not be included, because these services are not paid for by the national health insurance scheme and do not record individualised data. Thus, our study presents a conservative estimate of costs which are directly related to the diagnosis and treatment of asthma. Because asthma hospitalisations are strongly associated with socioeconomic status, our study population probably underestimates asthma morbidity and costs in Estonia, as the national insurance scheme does not cover the costs of non-insured persons (5% of total population), i.e. those who do not pay taxes or are not registered in the social insurance scheme.

Our study was based entirely on billing and prescription data. Therefore, two important questions arise:

- Are users of anti-asthma medication true asthmatics?
- Does the study population cover all asthmatic patients from the geographical area?

To answer the first question, we tried to capture all treated patients, whether in a hospital or using anti-asthmatic medication at home. To answer the second question, we collected data from a population where access to the health service is free of charge and independent of income, employment or social status. The price of all anti-asthmatic medication is 90% covered by the national health insurance scheme and does not record the compensation for lost days from work to employed patients (12% from our study group). In addition, the costs of using the ambulance services could not be included, because these services are not paid for by the national health insurance scheme and do not record individualised data. Thus, our study presents a conservative estimate of costs which are directly related to the diagnosis and treatment of asthma. Because asthma hospitalisations are strongly associated with socioeconomic status, our study population probably underestimates asthma morbidity and costs in Estonia, as the national insurance scheme does not cover the costs of non-insured persons (5% of total population), i.e. those who do not pay taxes or are not registered in the social insurance scheme.

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patient could stop some patients from purchasing anti-asthmatic medication. Nevertheless, drug costs were by far the single largest component (53%) of the direct costs in our study, followed by hospital in-patient care and physician out-patient services. The proportion of drug costs in Estonia is higher than the 45% reported for Spain, 13 42% for Canada 3 and 16% in the USA. 11 This can be explained by the considerably lower salary rates of medical professionals in Estonia, whereas the prices of pharmaceuticals are at the same level with the world market.

The study population for this investigation was heterogeneous with respect to duration and severity of disease: individuals with new-onset as well as prevalent disease were included. As an indicator of seriousness of disease we divided the study group into two according to whether the patients had been using oral corticosteroids during the study period. The asthma patients on oral corticosteroids were significantly older and had twice as high per capita asthma treatment costs than the non-users. In our study the 10% of most costly patients accounted for 64% of all direct costs, similar to the 80% of resources used by the 20% of the population reported for the USA. 11 This indicates the need for further detailed analysis of the use of health care by high-cost patients, both for cost containment and quality of care purposes.

When it is well controlled, asthma rarely leads to hospitalisation. Inhaled steroids have been shown to decrease the risk of asthma hospitalisation. 5-7 Our study revealed that 70-80% of asthma patients in Estonia were using β-agonists and/or steroids for inhalation in 1997, a rise from 37% in 1994 9 and, thus, could be considered to have adequate pharmacotherapy for their disease. However, the relatively short observation period and the type of data used in our study did not allow us to estimate the cost-effectiveness of different strategies of asthma treatment in Estonia, which remains to be evaluated in further studies.

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REFERENCES