



# Economic Burden of Adult Asthma in Turkey: A Cost of Illness Study from Payer Perspective

Haluk Turktas<sup>1</sup>, Sevim Bavbek<sup>2</sup>, Bulent Sekerel<sup>3</sup>, Ergun Oksuz<sup>4</sup> and Simten Malhan<sup>4\*</sup>

<sup>1</sup>Department of Medicine, Gazi University, Ankara, Turkey

<sup>2</sup>Department of Medicine, Ankara University, Ankara, Turkey

<sup>3</sup>Department of Medicine, Hacettepe University, Ankara, Turkey

<sup>4</sup>Department of Medicine, Department of Family Medicine, Baskent University, Ankara, Turkey

## Abstract

**Objective:** To estimate economic burden of adult asthma in Turkey from payer perspective

**Methods:** This cost of illness study was based on identification of per patient annual direct medical costs for the management of adult asthma in Turkey from payer perspective. Average per patient direct medical cost was calculated based on cost items related to outpatient visits, laboratory and radiological tests, hospitalizations and interventions, drug treatment and equipment, and co-morbidities/complications.

**Results:** Overall, per patient annual direct medical cost of adult asthma was \$1,371.20 with hospitalizations (\$811.39, 59.2%) as the main cost driver, followed by drug treatment/equipment (\$252.42, 18.4%). Management of uncontrolled asthma was associated with higher per patient annual direct medical cost when compared to controlled asthma (\$1,213.09 vs. \$594.34), mainly due to higher hospitalization costs (\$653.28 vs. \$34.52; 51.97% vs. 5.81%). Based on estimated number of adult asthma patients (n=2,422,919) and prevalence of disease (4.5%) in Turkey, overall economic burden of asthma in Turkey was calculated to be \$2.2 billion.

**Conclusions:** In conclusion, our findings indicate that managing adult patients with asthma pose a considerable burden to health economics in Turkey, with hospitalizations identified as the main cost driver and two-fold cost increment in case of uncontrolled disease. In this regard, our findings emphasize the need for cost-effective prevention strategies to reduce the financial burden of adult asthma, and the likelihood of potential cost-savings by better disease control with reduced frequency of hospitalizations.

**Keywords:** Adult asthma; Asthma control; Practice patterns; Direct costs; Cost analysis; Turkey

## Introduction

Asthma is a chronic inflammatory respiratory disease estimated to affect 225 to 334 million individuals worldwide and considered to be a global problem with significant health, social and economic burden [1-5].

Despite the presence of international and national asthma guidelines and effective medications to achieve optimum control of the disease, suboptimal asthma control and poor adherence to existing guidelines is a world-wide problem and published reports consistently revealed a low level of disease control among asthma patients in many countries including Turkey [6,7].

The Asthma Insights and Reality in Turkey (AIRET) study, consistent with other international AIR surveys, demonstrated a low level of asthma control among asthmatics in Turkey, despite the availability of effective therapies [8].

In an analysis of asthma control by Turkish Asthma Control Survey Study Group in 2336 patients with asthma from seven geographical districts in Turkey, rates for controlled and uncontrolled asthma were reported to be 51.5% and 48.5%, respectively [9].

Asthma has been associated with significant economic burden in terms of both direct and indirect costs leading to considerable increase in medical expenditures and productivity loss in conjunction with the high prevalence of the disease [10,11]. Optimal control of asthma is of utmost importance in this regard given the association of control with increased burden of the disease on the society and health system [9,12-14].

Notably, better clinical control of asthma has been considered to be a feasible target to decrease economic burden of asthma given its association with cost savings in terms of direct costs of asthma [15-17].

This cost of illness study was therefore designed to determine economic burden of severe asthma in Turkey from payer perspective and with respect to disease control.

## Methods

### Design

This cost of illness study was based on identification of per patient annual direct medical costs for the management of adult asthma in Turkey based on national demographic/health data and literature data and/or expert panel opinion on practice patterns in clinical practice. Direct medical cost was calculated based on cost items related to outpatient visits, laboratory and radiological tests, hospitalizations/interventions/training, drug treatment/equipment and co-morbidities/complications.

**\*Corresponding author:** Simten Malhan, PhD, Baskent University Baglica Campus Faculty of Health Sciences Fatih Sultan Mah Eskisehir Road 18. Km Etimesgut/Ankara-Turkey, Tel: +90 3122466666; E-mail: [simtenmalhan1@gmail.com](mailto:simtenmalhan1@gmail.com)

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## Data on real life clinical practice

Data on real-life practice patterns in the management of adult patients with asthma in Turkey including outpatient clinic admission rates, laboratory and radiological investigations, selected medications, hospitalizations and interventions were obtained from the findings provided in the past studies in asthma patients in Turkey as well as expert panel opinion [18-31].

## Cost analysis

Average per patient direct medical costs were calculated based on cost items outpatient visits, laboratory and radiological tests, hospitalizations/interventions/training, drug treatment/equipment and co-morbidities/complications from payer perspective (only direct medical costs using prices of the public payer “Social Security Institution (SSI)” in Turkey), using cost of illness method developed by WHO [32]. For drugs, retail prices from the updated price list and updated institution discount list of SSI for May 2016 were taken into account in calculation of the unit costs [33]. Costs related to diagnostic tests were calculated considering the Health Implementation Notification by SSI [34]. Physician visits costs were calculated using unit prices also based on the same SSI notification [34]. Salaries and labor force of healthcare staff giving service to adult asthma patients was provided from the Healthcare Organization Questionnaire composed of Staff Inventory Form and Information Form on the Labor Force Spent during an intervention filled for each study center. Hospitalization costs were calculated using unit prices based on Healthcare Organization Price List in Health Practice Declaration and Treatment Assist Practice Declaration. Monetary results were converted by using 2.97 USD/TL May 2016 exchange rate. Direct non-medical costs of different origin (e.g. transfers of patient and caregivers for examinations and/or hospitalization, home care, etc.) and indirect costs were not included in the cost analysis.

## Statistical analysis

Descriptive statistics were used to summarize results on practice patterns for the asthma management in adult patients. Expenses related to management of adult asthma were the main cost-analysis related parameter of the study. Cost model was based on the following equation: “Cost=Σ (Frequency; %) X (Unit price; TL) X (patient ratio; %)”.

## Results

### Outpatient admission cost item

Per patient outpatient admission for chest diseases (5 times per year and in 60.0% of patients), emergency (twice a year and in 23.3%) and family medicine (5 times per year and in 10.0%) clinics were associated with highest costs, as followed by ENT (twice a year and in 37.5%), internal medicine and allergy-immunology (once a year and in 10% of patients for each) clinics (Table 1) [18-31].

Based on unit costs, total per patient annual cost related to outpatient admissions was calculated to be \$61.49 (Table 1).

### Laboratory and radiological tests cost item

Lung volume diffusing capacity, respiratory function test, bronchial provocation test, reversibility test and skin prick test were the most costly items as applied in 40.0%, 100.0%, 100.0%, 100.0% and 50% of adult asthma related admissions in Turkey, respectively (18-31) (Table 2).

Outpatient admissions	Annual admission rate (%)	Annual visit # per patient	Unit cost per admission (\$)	Total cost (\$)
Chest diseases	60.0	5	10.74	32.20
Emergency	23.3	2	37.01	17.26
Family Medicine	10.0	5	9.39	4.70
Ear Nose and Throat	37.5	2	2.02	1.52
Internal Medicine	10.0	1	11.53	1.15
Allergy-Immunology	10.0	1	11.20	1.12
Thoracic Surgery	10.0	1	10.61	1.07
Nutrition and Diet	7.50	1	11.20	0.84
Psychiatry	25.0	1	2.02	0.51
Gastroenterology	22.5	1	2.02	0.45
Endocrinology	7.50	1	2.02	0.15
Dermatology	7.50	1	2.02	0.15
Cardiology	15.0	1	2.02	0.30
Infectious Diseases	2.50	1	2.02	0.05
Gynecology and Obstetrics	2.50	1	2.02	0.05
<b>Per patient outpatient admission costs (\$)</b>				<b>61.48</b>

Table 1: Outpatient admission cost item: Clinical practice, unit costs and total cost.

Laboratory/radiological tests	Contribution to cost (%)	Annual test # per patient	Unit cost (\$)	Total cost (\$)
Lung volume diffusing capacity	40.00	1	78.59	31.44
Respiratory function test	100.00	3	8.42	25.26
Bronchial provocation test	100.00	1	12.91	12.91
Reversibility test	100.00	1	10.55	10.55
Skin Prick Test	50.00	1	20.21	10.11
Specific IgE measurement	30.00	1	7.14	2.14
Lung CT	5.00	1	18.52	.92
Arterial blood gas analysis	45.00	1	1.72	.77
Blood biochemistry	100.00	1	0.00	0.00
Complete blood count	100.00	1	0.00	0.00
PA/lateral chest X-ray	100.00	2	0.00	0.00
Serum total IgE measurement	30.00	1	0.00	0.00
Electrocardiography	85.00	1	0.00	0.00
Echocardiography	5.00	1	0.00	0.00
Oximetry	100.00	1	0.00	0.00
<b>Per patient laboratory and radiological tests cost (\$)</b>				<b>94.43</b>

CT: Computerized tomography; Ig: Immunoglobulin; PA: Posteroanterior

Table 2: Laboratory and radiological tests cost item: Clinical practice, unit and total cost

Based on unit costs, total per patient annual cost related to laboratory and radiological tests was calculated to be \$94.43 (Table 2).

### Hospitalizations and interventions/training cost item

Overall, 30.23% of patients with controlled asthma and 51.76% of patients with uncontrolled asthma were considered to be hospitalized at ward for once (for 2 days per admission) and 2.5 times (for 3 days per admission), respectively, whereas 51.76% of patients with uncontrolled was hospitalized at ICU for 2.5 times per year (for 7 days per admission) (Table 3) [18-31].

Based on unit costs, total per patient annual cost related to hospitalizations and interventions/training was calculated to be \$811.39 (\$653.28 vs. \$34.52; for uncontrolled and controlled asthma, respectively) (Table 3).

### Drug treatment and equipment cost item

Based on prescription rates in Turkey [18-31], maintenance doses and annual dose and unit cost per box for each drug regimen and unit costs of equipment, total per patient annual cost related to drug treatment and equipment was calculated to be \$252.42 (Table 4).

### Co-morbidities/complications cost item

Based on prevalence of comorbid disorders in adult asthma patients in Turkey and related unit costs, total per patient annual cost related to co-morbidities and complications was calculated to be \$151.46 (Table 5) [18-31].

### Per patient total annual direct medical cost

Based on total annual per patient costs calculated for outpatient admission (\$61.49), laboratory and radiological tests (\$94.43), hospitalizations and interventions/training (\$811.39), drug treatment/equipment (\$252.42) and co-morbidities/complications (\$151.46) cost items, total per patient annual direct medical cost related to

Hospitalization	Clinic	Contribution to cost (%)	LOS per admission (days)	Unit daily cost (\$)	Total cost (\$)
Controlled asthma	ward	30.23	2	204.97	34.52
Uncontrolled asthma	ward	51.76	3	204.97	653.28
	ICU	51.76	7	1,495.97	
<b>Per patient hospitalization/intervention cost (\$)</b>					<b>811.39</b>

ICU: Intensive care unit, LOS: Length of hospital stay

**Table 3:** Hospitalization/interventions cost item: Clinical practice, unit costs and total cost.

Equipment	Contribution to cost (%)	Unit cost (\$)	Total cost (\$)
Peak flow meter	0.00	16.83	0.00
Medical device	40.00	19.09	7.63
Drugs	Contribution to cost (%)	Unit cost (box/year; \$)	Total cost (\$)
SABA	100.00	7.30	7.30
LABA + ICS	85.00	145.64	123.79
Inhaled corticosteroids	15.00	90.58	13.59
Leukotriene antagonists	35.00	97.88	34.26
Antihistamines	15.00	47.58	7.14
Theophylline	12.20	20.25	2.47
Tiotropium	3.00	184.13	5.53
Oral corticosteroid	1.00	38.70	0.39
Omalizumab	1.00	2284.10	22.84
Calcium –vitamin D	5.00	41.41	2.07
Alendronate	3.00	71.27	2.14
Raloxifene	3.00	108.28	3.24
Risedronate	3.00	104.94	3.15
Strontium ranelate	3.00	158.69	4.76
Clarithromycin	7.50	6.92	.52
Moxifloxacin	7.50	14.39	1.08
Immunotherapy	1.00	508.66	5.08
INS	20.00	27.21	5.44
<b>Per patient drug/equipment cost (\$)</b>			<b>252.41</b>

ICS: inhaled corticosteroids LABA: Long-acting beta-2 agonists, SABA: Short-acting beta-2 agonists

**Table 4:** Drug treatment and equipment cost item: Clinical practice, unit costs and total cost.

**Table 5:** Co-morbidities/complications cost item: Clinical practice, unit costs and total cost.

Comorbidities / complications	Contribution to cost (%)	Unit cost (\$)	Total cost (\$)
Rhinitis	49.0	21.46	10.51
Sinusitis	33.3	25.95	8.64
Polyp	17.75	317.36	56.33
Reflux	34.0	190.85	64.89
Hypertension	6.0	184.20	11.05
<b>Per patient comorbidities/complications cost (\$)</b>			<b>151.43</b>

management of adult asthma was calculated to be \$1,371.20 (\$894.44 for weighted average cost) from payer perspective (Table 6).

Overall, hospitalizations (59.2%) was the main cost driver in the management of adult asthma in Turkey, as followed by drug treatment/equipment (18.4%) and co-morbidities/ complications (11.1%) (Table 6).

Management of uncontrolled asthma was associated with higher per patient annual direct medical cost when compared to controlled asthma (\$1,213.09 vs. \$594.34). Hospitalizations in uncontrolled asthma (51.97% vs. 5.81%) whereas drug treatment in controlled asthma (42.47% vs. 22.69%) were the main cost drivers, while the higher hospitalization costs in uncontrolled than in controlled asthma (\$653.28 vs. \$34.52) was the main difference between direct medical cost related to management of uncontrolled and controlled asthma (Table 6).

Based on estimated number of adult asthma patients (n=2,422,919) and prevalence of disease (4.5%) in Turkey, overall economic burden of asthma in Turkey was calculated to be \$2.2 billion (Table 6) [18-31].

## Discussion

Our findings revealed that per patient annual direct medical cost of adult asthma in Turkey was \$1,371.20 (\$894.44 for weighted average cost) with hospitalizations (\$811.39, 59.2%) as the main cost driver, followed by drug treatment/equipment (\$252.42, 18.4%) and co-morbidities/complications (\$151.46, 11.1%). Management of uncontrolled asthma was associated with higher per patient annual direct medical cost when compared to controlled asthma (\$1,213.09 vs. \$594.34), mainly due to higher hospitalization costs (\$653.28 vs. \$34.52; 51.97% vs. 5.81%).

Non-uniform data exist on country-based analysis of the per patient annual asthma costs in the literature including estimated costs of \$3,180.00-\$3,259.00 in USA, \$885.00-€1,533.00 in Spain, \$1,155.43 in Brazil, €658.46 in Portugal, €1,469.80 in Greece, €475.75 in Cyprus, \$598.00 in Thailand and 412,265 \$ in Vietnam and \$1,465.70 in Turkey. Data from cross-regional studies also revealed discrepancy in average per patient annual cost of asthma with estimated costs of €1,583.00 in an analysis of 11 studies in Europe, \$108-\$1,010.00 in Asia Pacific region, \$989-\$3,069.00 in an analysis of 29 studies in USA and to range from \$150 to more than \$3,000.00 in an analysis of 18 studies across Europe, the United States, Canada, the Middle-East, South-East Asia and Latin America [4,17,35-47].

Our findings on per patient direct cost of asthma in adult patients seem consistent with previous data from Turkey as well as most of European countries, whereas it seems to be higher than cost estimations in Asia Pacific region and lower than those reported in the USA.

Our findings support the higher average annual direct costs in

poorly controlled asthma as compared with controlled asthma reported in the past studies on economic burden of managing asthma [12,13,48].

Overall, hospitalization (\$811.39, 59.2%) was the main cost driver in our study. This seems consistent with data from a systematic review of 68 cost-of-illness studies of asthma, which indicated the largest amount of direct costs to be those allocated to in-patient hospitalization, accounting for 52 to 86% of the overall asthma-related, and 47 to 67% of total direct costs in studies [10].

However, a downward trend has been emphasized in rates and costs associated with hospitalization in asthma management due to effective drug usage in the maintenance phase, resulting in fewer exacerbations and hospitalizations [39,49-52]. Hence, prescription medications rather than hospitalizations have also been reported to comprise the largest percentage of total costs attributable to asthma in the adult population in several studies [53-56].

Notably, management of uncontrolled asthma was associated two-fold increase in per patient annual direct medical cost when compared to controlled asthma (\$1,213.09 vs. \$594.34) in our study. The difference was related to higher hospitalization costs in uncontrolled than in controlled asthma (\$653.28 vs. \$34.52; 51.97% vs. 5.81%). Likewise, in a past study from Turkey, the mean annual asthma cost per patient estimated to be €558.41 and €1,040.63 for controlled and uncontrolled asthma, respectively [48]. Authors also noted that contribution of hospitalizations and medication costs to the overall direct medical cost were 4% and 46% for controlled patient and 48% and 15% for uncontrolled patient, respectively [48]. Hence, given the association of high hospitalization costs with uncontrolled asthma our findings supports the reported increase in the percentage of total cost attributable to hospitalization (from 4% to 48%) and decrease in the percentage of total cost attributable to drugs (from 46% to 26%) with decrease in asthma control level in Turkey [48].

In addition, uncontrolled asthma was shown to be independently associated with higher direct costs than controlled asthma in two studies from Brazil [38,57] and this cost increment was shown to be due to increased frequency of emergency admission and hospitalization [57].

Moreover, in a past study on the economic burden of asthma in Asia-Pacific region maintenance costs (medication, physician visits) in controlled asthma, whereas higher urgent care costs (emergency care and hospitalizations) in case of poor asthma was reported to be the main driver of asthma-related costs [45].

Accordingly, identification of hospitalization as the key cost driver in uncontrolled asthma in our study supports the association of poor asthma control with increased healthcare resource utilization and consideration of hospitalization to account for a larger share of direct costs in case of uncontrolled asthma [10,45,58-60]. This also emphasizes the likelihood of more effective medication usage during the maintenance phase to result in cost-saving by reducing the number of exacerbations and hospitalizations [52].

The present cost of illness study was based on expert panel opinion regarding practice patterns in managing adult asthma in Turkey, including prevalence of asthma (4.5%) and the rates for controlled (51.5%) and uncontrolled (48.5%) disease. Given that the smaller proportion in hospital costs and the higher proportion in medication costs is considered suggestive of better control of asthma [10], our analysis seems to emphasize the likelihood of inappropriate treatment and failure to reach targeted treatment intensity recommended

by guidelines in a considerable portion of patients with asthma [61,62]. Our findings emphasize the likelihood of a cost-saving with appropriate hospitalization and better asthma control, since effective implementation of best practice results in significant cost savings in asthma management [63].

In accordance with recognition of asthma as a priority disorder in government health strategies due to significant economic burden [5], total annual cost of asthma was estimated to be to \$2.2 billion in the present study. This supports that asthma has a significant cost to health systems due to high prevalence with estimations of a total medical expenditure reported to be \$18 billion in the USA [11], €4.3 billion in European countries and €19.3 billion for the entire Europe region [44].

Although co-morbidities accounted for a smaller share of direct costs than hospitalizations and medications in our study, given the marked contribution of hospitalization cost item to the overall economic burden, it should be noted that co-morbidities have been associated with poor disease control [14,62] and associated cost-increment particularly in terms of hospital costs [10,64-66].

Certain limitations to this study should be considered. First, being focused only on direct costs, lack of data on indirect costs (loss of productivity due to the illness) or intangible costs of illness (costs of suffering for the patient and his/her family) seems to be the major limitation of the present study which likely to result in a downward bias in our estimates of the economic cost of severe asthma. Second, use of expert consensus based data rather than national database on practice patterns to identify direct medical costs might raise a concern with the validity and reliability of the data. Third, while a cost-of-illness study gives a perspective on the economic burden of asthma in a population, it does not reflect what is happening with the individual patient or family unit. Nevertheless, despite these certain limitations, our findings represent a valuable contribution to the literature by providing an updated estimate of asthma management costs in Turkey in relation to disease control.

In conclusion, our findings indicate that managing patients with adult asthma pose a considerable burden to health economics in Turkey with two-fold cost increment in case of uncontrolled disease. Hospitalizations were the main cost driver overall and also accounted for a larger share of direct costs of in case of uncontrolled asthma. In this regard, our findings emphasize the need for cost-effective prevention strategies to reduce the financial burden of adult asthma, and the likelihood of potential cost-savings by better disease control via improved adherence to evidence-based therapies and better management of maintenance period. Future studies addressing both direct and indirect costs of asthma in relation to disease control may help to extend the knowledge about the impact of disease control on economic burden to develop cost-effective strategies in the disease management.

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