

RESEARCH
ARTICLE

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**Cost Analysis of COPD: A Case Study in Düzce University Hospital****ABSTRACT**

Objective: The aim of the study is to analyze the costs of Chronic Obstructive Pulmonary Disease (COPD) from the perspective of the Social Security Institution (SSI).

Method: In the research, data obtained retrospectively using the qualitative method were subjected to document analysis. The study covers 241 COPD patients in 2022 in the Chest Diseases unit of Düzce University Health Application and Research Center/Hospital. No sample was selected in the research, but the entire population was used. Data were subjected to multivariate regression analysis. Costs include examinations, medical supplies, medications, imaging and laboratory tests.

Results: Of 130 outpatients, 110 (85%) were male, 20 (15%) were female, the mean age was 66.82 years, and outpatient treatment cost was 127.76₺ (\$7.72)/patient. Of the 111 inpatients, 88 (79%) were male, 23 (21%) were female, the mean age was 70.19 years, and the mean duration of hospitalization was 7.08 days. The average total treatment cost of the clinic was 2,319.64₺ (\$140.16)/patient. Of this, 1,059.97 ₺ (\$64.05) was for intervention, 267.62 ₺ (\$16.17) for medical supplies, 907.74 ₺ (\$54.85) for medication, and 499.98 ₺ (\$30.21) for investigations. It was determined that the gender, age, and hospitalization duration of the patients changed the treatment costs (p<0.05). In addition, it was determined that the SSI incurred an average annual drug cost of 6,321.84 ₺ (\$381.98). A total annual average cost of 9,184.90 ₺ (\$554.98) /patient was determined.

Conclusions: The study found that treating COPD is a significant economic burden per patient for the SSI. A significant portion of this cost is comprised of medication expenses. This increases the lifetime costs of COPD. In order to reduce the cost of the disease, both necessary measures should be taken to reduce the risk of developing the disease, and lower-cost methods should be followed in the treatment of the disease.

Keywords: Chest Diseases, COPH, Cost of Disease.

KOAH'ın Maliyet Analizi: Düzce Üniversitesi Hastanesinde Bir Vaka Çalışması**ÖZET**

Amaç: Kronik Obstrüktif Akciğer Hastalığının (KOAH) maliyetlerini Sosyal Güvenlik Kurumu (SGK) perspektifi açısından hesap etmektir.

Yöntem: Araştırmada, nitel yöntem kullanılarak retrospektif olarak elde edilen veriler doküman analizine tabi tutulmuştur. Çalışma, Düzce Üniversitesi Sağlık Uygulama ve Araştırma Merkezi/Hastanesi Göğüs Hastalıkları biriminde 2022 yılına ait 241 KOAH hastasını kapsamaktadır. Araştırmada örneklem seçilmemiş evrenin tamamı çalışmaya dahil edilmiştir. Veriler, çok değişkenli regresyon analizi yapılmıştır. Maliyetler, muayene, tıbbi malzeme, ilaç, görüntüleme ve laboratuvar testlerini içermektedir.

Bulgular: Ayaktan tedavi gören 130 hastanın 110'u (%85) erkek, 20'si (%15) kadın, yaş ortalaması 66,82 yıl olup poliklinik tedavi maliyeti 127,76₺(\$7.72)/hastadır. Yatarak tedavi gören 111 hastanın 88'i (%79) erkek, 23'ü (%21) kadın, yaş ortalaması 70,19 yıl olup ortalama yatış süresi, 7,08 gündür. Klinik toplam tedavi maliyeti ortalama 2.319,64₺(\$140.16)/hasta olmak üzere bunun 1.059, 97 ₺ (\$64.05)'si müdahale, 267,62 ₺(\$16,17)'si tıbbi malzeme, 907,74 ₺(\$54.85)'si ilaç ve 499.98 ₺(\$30.21)'si tetkik tutarından oluşmaktadır. Hastaların cinsiyeti, yaşı ve yatış sürelerinin tedavi maliyetlerini değiştiği belirlenmiştir (p<0,05). Ayrıca SGK'nın yıllık ortalama 6.321,84 ₺ (\$381.98) ilaç giderine katlandığı tespit edilmiştir. Hasta başına toplam yıllık ortalama 9.184,90 ₺ (\$554.98)/hasta maliyeti tespit edilmiştir.

Sonuç: Çalışmada KOAH'ın tedavi edilmesinde SGK açısından hasta başına önemli bir ekonomik yük olduğu tespit edilmiştir. Bu maliyetin önemli bir kısmını ilaç giderleri oluşturmaktadır. Bu da KOAH'ın ömür boyu maliyetlerini artırmaktadır. Hastalık maliyetinin düşürülmesinde hem hastalığa yakalanma riskinin azaltılması için gerekli tedbirlerin alınması hem de hastalığın tedavisinde daha düşük maliyetli yöntemler izlenmelidir.

Anahtar Kelimeler: Göğüs Hastalıkları, KOAH, Hastalık Maliyeti.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is one of the most important chronic diseases of the respiratory system, which is not fully reversible and usually progresses slowly. It comprises a spectrum of diseases, including chronic bronchitis, emphysema, long-standing and irreversible asthma, and small airway disease (1).

A complex interaction between environmental factors and genetic factors causes COPD. The most important cause of the disease is smoking, as well as indoor air pollution and occupational exposure. In addition, other risk factors such as malnutrition, poverty, and inactivity play a role in the development of the disease (2).

COPD is a significant cause of mortality and morbidity in the world and in our country, as well as imposing a significant burden on the health system and society. According to 2021 data from the World Health Organisation (WHO), COPD is the fourth leading cause of death worldwide, causing 3.5 million deaths in 2021, approximately 5% of all global deaths (3). It is estimated that there are 5 million COPD patients in Türkiye, but it should not be forgotten that there are many patients living without being diagnosed (4).

COPD cases in the chronic diseases group are gradually increasing worldwide and in our country. Early diagnosis of diseases and education for disease management are essential in reducing costs.

Chronic diseases are among the health problems that consume the most resources in health systems. While the global disease cost of COPD was 2.1 trillion dollars in 2010, this cost is estimated to be 4.8 trillion dollars in 2030 (5).

COPD, which is one of the leading causes of morbidity and mortality worldwide, constitutes a significant economic burden on individuals and society (6). The cost of COPD includes all medical and non-medical direct and indirect costs. Direct medical costs include examination, diagnosis, and treatment expenditures. Indirect costs include lost labor force, decreased productivity, and decreased quality of life.

Cost of illness aims to identify and measure all costs of a particular disease, including direct, indirect, and intangible dimensions (7). Knowing a disease's cost helps policymakers decide which diseases should be addressed primarily with health services and prevention policy (8).

Increases in disease costs are an economic burden for society regarding hospitals, reimbursement institutions (SSI and insurance companies), patients and their relatives, other state institutions, employers, and third parties. In analyzing the social cost of a disease, all perspectives should be considered, and all direct and indirect medical and non-medical costs incurred should be calculated.

This study aims to analyze the costs of examinations, medical supplies, medicines, and examinations and continuously used medicines arising from treating COPD from the perspective of SSI, the reimbursement institution, and to guide health policymakers in their decisions by calculating direct medical costs.

MATERIAL AND METHODS

Scope and Design of the Study: For this study, approval number 429 dated 20/10/2022 was obtained from the ethics committee. This retrospective study was conducted at the Düzce University Health Application and Research Centre/Hospital (DUHARH). DUHARH is the only tertiary education and research hospital in the province and has 316 beds. The scope of the study consisted of 241 COPD patients treated in outpatient (130 patients) and clinic (111 patients) at the DUHARH Chest Diseases unit in 2022. COPD patients in the intensive care unit were omitted. No sample was selected for the study, individuals who were reachable and volunteered to participate during the study were included in the study. In terms of SSI perspective, the study includes patients who benefit from health services free of charge within the scope of General Health Insurance (GHI), taking into account the pricing policy made according to the Health Practice Communiqué (HPC) price tariff.

This study was carried out in accordance with the Helsinki Declaration. Artificial intelligence (AI)-enabled technologies (such as Large Language Models [LLM], chatbots, or image generators) were not used in the production of the work.

Costs: In Türkiye, patients with health problems caused by COPD exacerbation can benefit from health services provided free of charge under the GHI. SSI finances expenditures related to the health care of these patients. In this context, expenses incurred by hospitals are collected from the SSI. Price regulation is applied in the collection process, and this regulation is realized through HPC. HPC prices are paid to hospitals for certain services determined by the SSI on condition that the methodology invoices them, and it is a detailed pricing practice determined on a package basis (9). Within this practice, the invoice amount, including direct medical costs, consists of medication, medical supplies, interventions, and examinations. In addition, the costs of medication for COPD, which is a chronic disease used continuously outside the hospital, were also included in the study. The prices in the study were calculated in Turkish Lira, and the average exchange rate of the Central Bank of the Republic of Türkiye for 2022 as \$1=16.55 ₺ and €1=17.36 ₺ (10).

The data obtained retrospectively through the hospital automation system were analyzed using

document analysis and a bottom-up approach (11). In this approach, detailed activity data are used to estimate unit costs. More accurate results are obtained since it is assumed that resources are considered more comprehensively when providing a particular service (12).

Statistical Analysis: The study's datas were conducted with the EViews 10.0 (Quantitative Micro Software) econometric analysis program (Timberlake Consultants Limited, The Loft, 2C Blake Mews, United Kingdom). In the study where multivariate regression analysis was performed, there are coefficients calculated by the maximum likelihood method. (OLS). In the study, multiple linear regression analysis was used if there were two or more independent variables such as gender. This analysis was conducted by correlating the cost factors of outpatient and inpatient patients admitted to the hospital due to COPD exacerbation with gender, age, and length of hospital stay. According to the regression analysis, if the p value obtained was below 0.05, it was accepted that there was a significant relationship between two variables. Additionally, validity and reliability analyses of the study were performed and shown in the tables.

The model of the study is as follows (13).

$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \dots + u_i$$

Y_i : total costs, medicine costs, intervention costs, material costs, examination costs

β_1 : Intercept/constant X_{2i} : gender X_{3i} : age X_{4i} : hospitalization duration

Research Limitations: The study's data is limited to a tertiary university hospital in Türkiye. This study is limited to the direct treatment costs of COPD incurred by SSI. This study covers the direct treatment costs of COPD incurred by SSI. From the SSI perspective, the cost of illness includes not only direct medical costs but also non-medical costs. Direct non-medical costs incurred by SSI, such as report fees, disability pension, funeral allowance, death benefit, incapacity income payment, part-time working allowance, traveling and daily expenses,

companion expenses, and unemployment payments, are not included in the scope of the study.

The study calculated as an approximate average the daily and per patient costs of the disease. Each patient hospitalized for the same disease consumes hospital resources (cost elements) in different ways. This criterion was not taken into account because the HPS pricing policy established by SSI is not suitable for this. In the study, the treatment of each patient's comorbidities was not considered.

Other limitations of the study are as follows: Firstly, the study was conducted in a tertiary university hospital. Secondly, the participants were selected from patients aged 18 years and over. Thirdly, the study focused on the data of outpatients and inpatients with COPD admitted to the hospital on the dates identified. More importantly, the data were obtained only from hospital records and included patients within the working hours of the study unit (excluding patients who underwent private examinations, especially after 17.00, and the fees charged for them). Finally, the study is limited to data for the year 2022.

RESULTS

In the study, there are two variables affecting cost factors in outpatient treatment, namely gender and age, and three variables affecting cost factors in inpatient treatment, namely gender, age, and length of stay.

Gender: The male 1, Female 0 hypothesis was used to analyze the effect of being male on costs.

There is a problem of varying variance in all models. This reduces the confidence in the coefficients. However, the results can be interpreted in terms of general trends.

The total amount invoiced to SSI for HPS, the costs of interventions, investigations (imaging and laboratory), drugs, and medical supplies, and the relationship between these cost elements and the variables are statistically shown in the tables below.

Table 1. The effect of gender and age of outpatients on the total invoiced amount

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Gender	23.70316	28.87159	0.820986	0.4132
Age	-3.449950	0.873893	-3.947793	0.0001
C	338.2181	65.62393	5.153884	0.0000
R-squared	0.116659	Prob(F-statistic)		0.000379
F-statistic	8.386158	Durbin-Watson stat		1.324420
F-statistic	7.624212	Prob. F(2,125)		0.0008
F-statistic	10.14427	Prob. F(2,127)		0.0001

The effect of gender on total cost is insignificant (Prob>0.05). In other words, gender discrimination does not affect the total invoice amount. On the other hand, a one-year increase in

the patient's age decreases the total invoice amount by 3.44 ₺ (Table 1). In addition, the effect of age on total billing costs of inpatients was found to be statistically insignificant (Prob > 0.05) (Table 7).

Table 2. Descriptive data of dependent and independent variables of outpatients

	Invoice amount (₺)	Gender	Age
Mean	127.7648	0.846154	66.81538
Median	99.00000	1.000000	67.00000
Maximum	627.7500	1.000000	95.00000
Minimum	7.820000	0.000000	27.00000
Std. Dev.	125.1019	0.362197	11.96622
Skewness	2.069837	-1.918806	-0.192898
Kurtosis	7.602594	4.681818	3.559259
Jarque-Bera	207.5708	95.09384	2.500377
Probability	0.000000	0.000000	0.286451
Sum	16609.43	110.0000	8686.000
Sum Sq. Dev.	2018913.	16.92308	18471.57
Observations	130	130	130
Total Cost (₺), (\$)	16.609,43 (\$1,008.49)		

In the pricing of outpatients, only the total invoice amount was considered in the calculation since the package price application (including examination, medication, and examination amounts) is according to the HPC price tariff. Of the 130 patients who applied to the hospital as

outpatients for COPD treatment, 110 (85%) were male and 20 (15%) were female. The average age of all patients was 66.82 years. The highest invoice amount was 627.75₺/patient, and the lowest was 7.82₺/patient. The average bill amount per patient was 127.76 ₺ (\$7.72) /patient (Table 2).

Table 3. The effect of gender, age, and hospitalization duration on the intervention amount of inpatients with COPD

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Gender	-744.7044	385.7297	-1.930638	0.0562
Age	5.744515	19.16385	0.299758	0.7649
Hospitalization Duration	231.1021	29.56506	7.816732	0.0000
C	-389.3445	1421.687	-0.273861	0.7847
R-squared	0.379938Prob(F-statistic)			0.000000
F-statistic	21.85448Durbin-Watson stat			1.945515
F-Statistic	1.287744Prob F(2,105)			0.2802
F-statistic	7.549110Prob. F(3,107)			0.0001

The effect of gender and age on the intervention cost is statistically insignificant (Prob > 0.05). However, hospital stays for an additional

day increase the intervention cost by 231.10₺/day (Table 3).

Table 4. The effect of gender, age, and hospitalization duration on the cost of intervention in inpatients with COPD

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Gender	-56.20540	100.8063	-0.557558	0.5783
Age	10.02319	5.008265	2.001330	0.0479
Hospitalization Duration	77.72980	7.726506	10.06015	0.0000
C	-709.4827	371.5425	-1.909560	0.0589
R-squared	0.511886Prob(F-statistic)			0.000000
F-statistic	37.40372Durbin-Watson stat			1.164403
F-statistic	11.97665Prob. F(2,105)			0.0000
F-statistic	9.560646Prob. F(3,107)			0.0000

The effect of gender on examination cost is statistically insignificant (Prob>0.05). On the other hand, an additional age increases the cost of

examination by 10.02₺/year. Staying in the hospital for an additional day increases the examination cost by 77.72₺/day (Table 4).

Table 5. The effect of gender, age, and hospitalization duration on the amount of medication in inpatients with COPD

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Gender	-41.14409	152.9289	-0.269041	0.7884
Age	8.132663	7.597825	1.070394	0.2869
Hospitalization Duration	142.7627	11.72155	12.17950	0.0000
C	-641.4555	563.6513	-1.138036	0.2576
R-squared	0.591898	Prob(F-statistic)		0.000000
F-statistic	51.72980	Durbin-Watson stat		1.662131
F-statistic	1.695032	Prob. F(2,105)		0.1886
F-statistic	1.890122	Prob. F(3,107)		0.1356

The effect of gender and age on drug cost is statistically insignificant (Prob > 0.05). However,

each additional day of hospitalization increases the medication cost by 142.76₺/day (Table 5).

Table 6. The effect of gender, age, and hospitalization duration on the cost of medical supplies in inpatients with COPD

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Gender	-25.09293	72.75752	-0.344884	0.7309
Age	-1.999486	3.614744	-0.553147	0.5813
Hospitalization Duration	32.09818	5.576651	5.755817	0.0000
C	200.5835	268.1630	0.747991	0.4561
R-squared	0.236578	Prob(F-statistic)		0.000002
F-statistic	11.05283	Durbin-Watson stat		1.301516
F-statistic	7.740272	Prob. F(2,105)		0.0007
F-statistic	6.858478	Prob. F(3,107)		0.0003

The effect of gender and age on the cost of medical supplies is statistically insignificant (Prob>0.05). However, each additional day of

hospitalization increases the cost of supplies by 32.09₺/day (Table 6).

Table 7. The effect of gender, age, and hospitalization duration on the invoice amount of inpatients with COPD

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Gender	-867.1468	432.9098	-2.003066	0.0477
Age	21.90088	21.50786	1.018274	0.3108
Hospitalization Duration	483.6928	33.18127	14.57729	0.0000
C	-1539.699	1595.579	-0.964978	0.3367
R-squared	0.675940	Prob(F-statistic)		0.000000
F-statistic	74.39539	Durbin-Watson stat		1.582319
F-statistic	2.496361	Prob. F(2,105)		0.0873
F-statistic	8.074784	Prob. F(3,107)		0.0001

Men reduce the total invoice amount by 867.14₺/patient compared to female patients. The effect of age on total invoice costs is statistically insignificant (Prob> 0.05). Duration of hospitalization increases the total invoice amount by 483.69₺/day for an additional day of hospitalization (Table 7).

Of the 111 patients hospitalized for COPD exacerbation, 88 (79%) were male, and 23 (21%) were female. The mean age of males was 79 years. The mean age of all hospitalized patients was 70.19 years, with a maximum age of 90 and a minimum of 47 years. The average length of stay of all inpatients was 7.08 days. The total invoice amount of all patients was 303,618.70 ₺ (\$18,345.54), of which the intervention amount was 117,656.30 ₺

(\$7,109.14), medical equipment amount was 29,705.76 ₺ (\$1,794.91), medication amount was 100,758.94 ₺ (\$6,088.15) and examination amount was 55,497.69₺ (\$3,353.33). The highest invoice amount per patient was 27,659.30₺/patient, and the lowest was 322.20₺/patient. The highest intervention amount is 21,019.56₺/patient; the lowest is 124.37₺/patient. The highest amount of medical equipment is 2,135.38₺/patient; the lowest is 11,83₺/patient. The drug amount is 5,169.59₺/patient; the lowest is 68,87₺/patient. The highest amount of examination was 3,371.86₺/patient, and the lowest was 8.21₺/patient (Table 8). The largest portion (40%) of the average invoice cost was intervention, and the lowest portion (10%) was medical equipment costs.

Table 8. Descriptive data of dependent and independent variables of inpatients with COPD

	Invoice amount	Intervention Amount	Medical Supplies Amount	Medicine Amount	Analysis and Inspection Amount	Gender	Age	Hospitalization Duration
Mean	2735.304	1059.967	267.6195	907.7383	499.9792	0.792793	70.19820	7.081081
Median	1834.007	644.5300	100.0000	571.2816	278.5400	1.000000	70.00000	6.000000
Maximum	27659.30	21019.56	2135.383	5169.590	3371.860	1.000000	90.00000	26.00000
Minimum	322.2011	124.3700	11.83300	68.87554	8.210000	0.000000	47.00000	1.000000
Std. Dev.	3160.675	2035.919	346.0912	994.9475	599.6833	0.407143	8.244910	5.288298
Skewness	4.901994	8.645481	2.332596	2.429160	2.672337	-1.444801	0.013539	1.615622
Kurtosis	36.51617	84.82004	10.24889	9.088780	11.51970	3.087451	3.083015	5.496536
Jarque-Bera	5639.965	32344.92	343.6859	280.6289	467.8223	38.65321	0.035264	77.11556
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.982522	0.000000
Sum	303618.7	117656.3	29705.76	100758.9	55497.69	88.00000	7792.000	786.0000
Sum Sq. Dev.	1.10E+09	4.56E+08	13175707	1.09E+08	39558208	18.23423	7477.640	3076.270
Observations	111	111	111	111	111	111	111	111
Total Cost (£), (\$)	303618.70 (\$18,345.54)	117656.30 (\$7,109.14)	29705.76 (\$1,794.91)	100758.94 (\$6,088.15)	55497.69 (\$3,353.33)			

Out-of-hospital Medicine Expenses: One of the most essential items of direct costs of COPD patients in terms of SSI is drug costs. COPD is a chronic disease, and SSI covers the costs of medicines used continuously outside the hospital within the scope of SSI. Since the medicines used by COPD patients are within the scope of HPC-4/D, all of the costs of these medicines are covered by the SSI according to the "List of Medicines to be Paid for" HPC Annex-4/A for the year 2022.

According to the information obtained from patient epicrisis reports and prescriptions written to patients, COPD patients routinely use drugs such as Spiriva, Ipravent, and Forpack. Assuming all

COPD drugs are used continuously by a patient annually, the average annual cost, according to HPC, is determined as 6,321.84₺ (\$381.98) /patient.

DISCUSSION

In our study, The total cost of COPD disease in terms of SSI is determined as 9,184.90 ₺ (\$554.98) /patient in addition to outpatient treatment costs of 127.76 ₺ (\$7.72) /patient, inpatient treatment costs of 2,735.30 ₺ (\$165.26) /patient and annual routine medication costs of 6,321.84 ₺ (\$381.98). Studies on the cost of COPD in the literature are given in the table below (Table 9).

Table 9. Studies on the cost of COPD

Writers	Place and Period of Research	Number of patients (Sample)	Average Age	Hospitalization Duration (days)	Total cost
Our study	Turkiye X University Health Practice and Research Hospital Chest Diseases unit (1 January 2022- 31 December 2022)	Outpatient 130, inpatient 111, (198 male, 43 female)	Outpatient : 66,82 Inpatient: 70,19	7,08	Clinic total average treatment cost 2.319,64₺(\$140.16) Examination: 1.059, 97 ₺ (\$64.05); Medical equipment: 267,62₺(\$16,17); Medicine: 907,74 ₺(\$54.85); Analysis and Inspection: 499.98 ₺(\$30.21) Annual outpatient medication: 6.321,84 ₺ (\$381.98) Total annual average cost per patient: 9.184,90 ₺ (\$554.98)
Hacıevliyagil vd., (2006)	Turkiye İnönü University Faculty of Medicine Chest Diseases Clinic (January 1 - April 30, 2005)	105	-	12.1	-Medicine: \$312.74 - Bed Fees: \$135.24 - Examination: \$19.11 - Analysis and Inspection: \$475.11 - Radiological Examination: \$54.97 Total Cost: \$997.18
Ozkaya vd., (2011)	Turkiye Samsun Chest Diseases and Thoracic Surgery Hospital (2005-2009)	7.832 (6.276 Male, 1.556 Female)	64,6±19,8	14.8±9.5	Costs by years 2005: \$668, 2006: \$765 2007: \$768, 2008: \$667 2009: \$682
Geitona, Vd., (2011)	Greece Thrace Region Alexandroupolis University Training Hospital (2006-2007)	142	71.2	8.4	Total cost € 242.944 Average cost per patient € 1.711. Of this amount, €621 is repaid by social security funds.
Ornek vd. (2012)	Turkiye Zonguldak Karaelmas University Faculty of Medicine, Department of Chest Diseases (September 2010- August 2011)	284 (168 Male, 74 Female)	70.35 ± 10.65	11,38 ± 6,94	Average cost \$889±533 - Lab \$167±140 - consumables \$56±73 - Medicines \$245±212 - Clinic \$422±262
Veettil vd., (2012)	India Government hospital in Kerala (January 2008-April 2008)	120	--	--	The average total cost calculated for the 7-day hospitalization period \$89,75 (INR 4128.36/-)
Varol vd., (2013)	Turkiye Dr. Suat Seren Chest Diseases and Surgery Training and Research Hospital (2005-2006)	376 (311 Male, 65 Female)	65,31	9.86	Cost per patient: \$1,368.54 - Medicine: \$392.94 - Hospital Care: \$949.20

Tanrıverdi (2013)	Türkiye Erzincan State Hospital Chest Diseases Clinic (January 1 - December 31, 2011)	236 (146 Male, 90 Female)	74±9	8.8±4.1	- Medicine Consumables: 390±313 ₺ (\$233.53±\$187.42) - Examination Treatment: 710±371 ₺ (\$425.14±\$222.15) Average total cost: 1.100±618 ₺ (\$658.68±\$370.05)
Çeldir Emre vd., (2014)	Türkiye Chest diseases clinic of a secondary care state hospital (September 2012 – February 2013)	241 (220 Male, 21 Female)	69.9±10.1	9.6±4.6	- Medicine: \$255.25 - Bed Cost: \$140.54 Total cost: \$503.74
Özdemir vd., (2015)	Türkiye Çorum Chest Diseases Hospital (1 January 2009 – 31 December 2010)	4.193 (2009: 2046, 2010: 2147)	-	2009: 9.8 2010: 10.6	Cost per patient (2009): \$762.80 (2010): \$927.5
Yıldırım vd., (2015)	Türkiye Gazi University Faculty of Medicine Hospital Chest Diseases Clinic (1 September 2013 – 1 September 2014)	99 (77 Male, 22 Female)	70 (64-77)	8 (6-13)	Total cost per patient: 1.064 ₺ (726-1.866) (\$485.84 (\$331.50- \$852.05); Medicine: 383 ₺ (134-689 ₺) (\$174.88 (\$61.18- \$314.61); Bed Fee: 270 ₺ (180-450 ₺) (\$123.28 (\$82.19-\$205.47); Examination: 230,1 ₺ (155,7-384,5 ₺) (\$105.06 (\$52.83-\$175.57); Consumables and Other Expenses: 169,2 ₺ (94,9-332,2 ₺) (\$77.26 (\$43.33-\$151.68)
Deniz vd., (2015)	Türkiye District State Hospital Chest Diseases Service (January 2013 - January 2014)	100 (69 Male, 31 Female)	73,7	7.8±6.1	Total cost: \$554 - Antibiotic Cost: \$95.99 - Medicine: \$95.9
Deniz vd., (2016)	Türkiye All public hospitals in Aydın province (1 January 2014 – 31 December 2014)	3.095 (2.434 Male, 661 Female)	71,9 ± 10,5	8.1 ± 6.3	Average cost = \$808.5±1,586 - hospitalizations: \$325.1±879.9 - Medicines: \$223.1±1,300.9 - Laboratory Expenses: \$46.3±\$49.6 - Other Expenses: \$214±1,068
Mulpuru vd., (2017),	Canada An academic hospital in Canada (September 2010- September 2014)	1.894	73±12,6	5	Total cost for 4 years: \$19.776.824 Average cost per case: \$5.121 (IQR \$2.853–10.731)
Baloch vd. (2018)	Pakistan Tertiary Care Ziauddin Hospitals in Karachi City (November 2016 - April 2017)	126	(41±95)	--	Total Direct Medical Costs (Rs.) Tip I: 430816.649 (\$2,744) Tip II: 609104.2883 (\$3,879) Tip III: 1339303.283 (\$8.530) Average:\$5.051
Peker (2019)	Türkiye A university intensive care unit (April 1, 2018 – January 1, 2019)	8 (4 Male, 4 Female)	71,2 (87±62)	20 (33±2)	Daily amount per patient: 1,233 ₺ (\$255.28) Total Invoice Amount: 199.894 TL (\$41,385.92)

According to the literature review, among the studies conducted on the treatment costs of COPD, Hacıevliyagil et al. (2006) calculated the total daily cost of 105 COPD patients hospitalized in a tertiary hospital as \$997. It was determined that approximately 1/3 of this cost was drug expenses (14). Although the cost per patient in our study was less, it was seen that the drug expenses were approximately 1/3 in our study. In a study

conducted by Ozkaya et al. (2011) in a 2-stage hospital, it was determined that the annual cost per patient (in 2009) was \$668 (15). Geitona, et al. (2011) calculated the annual cost per patient as €1,711 in a study conducted in a public hospital in Greece (16). It was seen that the cost amount obtained was much higher than our study. Ornek et al. (2012) calculated the average annual cost per patient as \$889±533 in a study conducted in a

tertiary hospital in Zonguldak. It was observed that approximately 1/3 of this cost was drug expenses (17). This rate obtained is the same as our study. Veettil et al. (2012) calculated the cost per patient as \$628 in a study conducted in a state hospital in India (18).

Varol et al. (2013) calculated the cost per patient in a second-level state hospital as \$1,368. It was determined that 2/3 of this was patient care and 1/3 was medication expenses (19). Özdemir et al. (2015) calculated the cost per patient in a second-level state hospital in Çorum as \$762 for 2009 and \$927.5 for 2010 (20). Yıldırım et al. (2015) calculated the annual drug, bed and examination expenses per patient in a third-level state hospital as \$1,064 (21). Deniz et al. (2016) calculated the annual average per patient as \$1,197 in a study in second-level state hospitals in Aydın (22). Mulpuru et al. (2017) calculated the average annual cost of \$5,121 in a public hospital in Canada (23). Baloch et al. (2018) calculated the average annual cost per patient in a public hospital in Pakistan as \$7,338 (24). In the studies mentioned above and conducted in the literature, it was determined that the average cost per patient calculated was higher than the cost amount calculated in our study.

Tanrıverdi (2013) calculated the average cost as \$514 in a second-level public hospital in Erzincan (25). Çeldir Emre et al. (2014) calculated the cost as \$503 in their study. Approximately ½ of this was drug expenses (26). Peker (2019) calculated the cost as \$255 per patient per day in a third-level public hospital (27). It has been observed that the costs calculated in these studies in the literature are less than the costs in our study. Deniz et al. (2015) calculated the cost per patient as \$554 in the study conducted in a second-level state hospital (28). This calculated amount is the same as the cost of our study.

CONCLUSION

In the study, the cost of COPD was analyzed from the SSI perspective. In the analysis, were taken into invoice amounts calculated by DUHARH according to HPS prices, which include direct medical costs. The invoice amount consists of medicines, medical supplies, interventions and tests. In addition, the costs of medicines constantly used by COPD patients and covered by SSI were also included in the study.

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Various costs must be incurred throughout life in the treatment and management of COPD, which is a chronic disease. To reduce these costs, it is important to increase the level of education and awareness among patients, healthcare professionals and the general public. In addition, factors that trigger the disease, such as smoking, air pollution and allergens in the home, should be eliminated.

In our study, drug costs were found to be high. The reason for this is that medicines are imported and priced based on exchange rate. In order to reduce drug costs, domestic production must be started. To reduce costs, more affordable pricing policies and expanded health insurance coverage for drugs and medical devices required for COPD treatment are required. In short, In order to reduce the cost of the disease, both necessary measures should be taken to reduce the risk of developing the disease, and lower-cost methods should be followed in the treatment of the disease. Smoking and air pollution are the most common causes of COPD. People with COPD are at higher risk of other health problems. COPD is not a curable disease, but symptoms can improve if people avoid smoking and exposure to air pollution and get vaccinated to prevent infections. It can also be treated with medications, oxygen, and pulmonary rehabilitation.

This study is limited to a tertiary care university hospital in Türkiye. Similar studies should be conducted in secondary care public and private hospitals throughout the country. Additionally, similar studies can be analyzed from different perspectives by considering the direct treatment costs incurred by SSI as well as the indirect non-medical costs.

Ethical Committee Approval: The research was approved by the Düzce University Graduate Education Institute Ethics Committee dated 20/10/2022 and numbered 2022/429, and Düzce University Health Application and Research Center permission letter dated 10/03/2023 and numbered 274375 and the permission letters of Düzce University Revolving Fund Management Directorate dated 16.03.2023 and numbered 276288.

Conflict of Interest: The authors of this case-analysis declare that they have no conflict of interest.

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