

The Cost of COPD Exacerbations Managed in Hospital

Hastanede Tedavi Edilen KOAH Alevlenmelerinin Maliyeti

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Abstract

Özet

OBJECTIVES: Chronic obstructive pulmonary disease (COPD) is a common disease that has severe health and economic consequences. In this study we estimated the economic cost of COPD exacerbations requiring hospital stay in our hospital.

MATERIAL AND METHODS: The direct cost of 376 hospitalizations during one year with the diagnosis of COPD exacerbations were evaluated retrospectively in our hospital's chest diseases department.

RESULTS: Three hundred and eleven of the patients enrolled in the study were men while only 65 were women. The mean age of patients was 65.31 and median hospitalization time was 8 (mean: 9.86) days. The average medication cost per exacerbation was 526.55 Turkish Lira (TL) (\$392.94, €333.25), the average hospital care cost per exacerbation was 1271.94 TL (\$949.20, €805.02) and the average total cost per exacerbation was 1833.8537 TL (\$1368.54, €1160.66). The hospitalization time for patients with lung malignancy and sequelae of lung tuberculosis were found to be statistically longer. Antibiotic treatment increased the costs and hospitalization time. Treatment in intensive care units, nosocomial infections and necessity of long term oxygen treatment all increased the costs and hospital stay time.

CONCLUSION: This study shows that the cost of intensive care unit treatment, long term oxygen treatment, treatment of hospital acquired infections and use of antibiotics were higher than usual in COPD exacerbations requiring hospitalisations.

KEY WORDS: COPD, exacerbation, cost

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AMAÇ: Kronik Obstrüktif Akciğer Hastalığı (KOAH) belirgin sağlık ve ekonomik sonuçları olan ve sık görülen bir hastalıktır. Bu çalışmada, hastanemizde KOAH alevlenmesine bağlı yatış gerektiren hastaların maliyet analizi yapılmıştır.

GEREÇ VE YÖNTEMLER: Hastanemiz göğüs servisine, bir yıl boyunca, KOAH alevlenmesi nedeniyle yatışı yapılan 376 hastanın direk maliyet analizi değerlendirilmiştir.

BULGULAR: Çalışmaya alınan hastaların 311'i erkek, 65 tanesi kadındır. Hastaların median yatış süresi 8 (ortalama: 9.86) gündür ve ortalama yaşı 65.31'dir. Her atak başına düşen ilaç maliyeti 526.55 Türk Lirası (TL) (\$392.94, €333.25), hastane bakım maliyeti 1271.94 TL (\$949.20, €805.02) ve genel maliyet 1833.8537 TL'dir (\$1368.54, €1160.66). Akciğer kanseri ve sekel akciğer tüberkülozu ek hastalığı olan hastalarda hastane yatış süresi istatistiksel olarak daha uzundur. Antibiyotik kullanımı hastane yatış süresini ve maliyeti arttırmıştır. Yoğun bakımda tedavi görülmesi, hastane kökenli enfeksiyon varlığı ve uzun süreli oksijen ihtiyacı maliyeti ve hastane yatış süresini arttırmıştır.

SONUÇ: Bu çalışmada, hastane yatışı gerektiren KOAH alevlenmelerinde antibiyotik kullanımının, hastane kökenli enfeksiyon varlığının, uzun süreli oksijen tedavisinin ve yoğun bakımda tedavi görülmesinin maliyeti arttırdığı saptanmıştır.

ANAHTAR SÖZCÜKLER: KOAH, alevlenme, maliyet

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INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a common disease that has considerable health and economic consequences. COPD is a costly disease with direct and indirect costs. In the European Union, the total direct costs of the respiratory disease are estimated to be about 6% of the total health care budget, with COPD accounting for 56% (38.6 billion Euros) of this cost [1]. In the United States in 2002, the direct costs of COPD were \$18 billion and indirect costs totalled \$14.1 billion [1].

A significant portion of the economic burden of COPD is associated with exacerbations of COPD. Exacerbations are estimated to account for 50%-75% of the cost of healthcare services for COPD [2]. Results from the 'Confronting COPD Survey' showed that in five of the seven countries surveyed, the majority (52%-84%) of direct costs were due to hospitalisations [3]. The Global Initiative on Chronic Obstructive Lung Disease (GOLD) stated that the prevention and treatment of exacerbations should be a key goal of COPD management [4]. However, national data on hospitalisation costs of COPD exacerbation has not been reported.



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In this study, we estimated the economic cost of COPD exacerbations requiring hospital stay. Also, we determined the probable factors that lengthens the hospital stay and increases the cost of hospitalisation.

MATERIAL AND METHODS

This was a 12 month (2005-2006) retrospective observational study conducted at our hospital's pulmonary department. Our hospital's ethics committee gave approval for the study. Currently, there is no universally agreed method for identifying exacerbations. We used GOLD's exacerbation definition; an acute increase in symptoms beyond normal day-to-day variation. This generally includes an acute increase in one or more of the cardinal symptoms: cough, sputum production and dyspnea. We used Anthonisen's criteria for the antibiotic medication of COPD exacerbation [5]. The criteria include two of the three cardinal symptoms (increase in sputum purulence, increase in sputum volume and worsening of dyspnea) of which one has to be 'increase in sputum purulence'.

We analyzed the direct cost of 376 patients treated for exacerbations in our hospital's pulmonary department. We included the patients with a diagnosis of severe to-very severe COPD ($FEV_1 \leq 50$ of predicted) with an acute exacerbation requiring hospitalisation. Patients were aged over 40 and had a smoking history of at least 10 pack-years. Patients with a diagnosis of asthma and patients admitted for other reasons were excluded.

The costs were estimated as medication costs, hospitalisation costs, and total costs. The total cost of one hospitalisation was calculated using the number and type of bed days, medications, investigations (e.g. lung function tests, x-rays, arterial blood gases) and staff service (e.g. physiotherapy). The drugs used during hospitalisation were calculated as medication cost. The other costs (e.g. investigations, staff service) excluding medications were reported as the hospital care cost.

Cost data was taken from budget application instructions of the Turkish Ministry of Health. Cost data was calculated in Turkish liras and was converted to 2006 U.S. dollars and 2006 Euros using currency exchange rates. Hospitalisation time and the probable reasons that lengthen the hospitalisation time were reported. Hospital stay of over ≥ 11 days was taken as a 'long stay' [6].

All the continual variables and compared subgroups were analysed and tested for the normality of the data. The different averages were compared by means of the Student's t-test for parametric or Mann-Whitney U test for non-parametric as appropriate. Correlation coefficient was estimated for determining the relation between the numeric variables. A 5% significance level was used to determine the achievement of statistical significance. Ninety-five per cent confidence intervals were calculated where appropriate. All tests were two-tailed and statistical processing was carried out using the SPSS statistics pac version 12 for Windows.

RESULTS

Three hundred and eleven of the patients enrolled in the study were male while only 65 were female. The mean age

of the patients was 65.31 (SD10.32) (40-88). 56.3% of the patients were over the age of 65. The median PaO_2 was 53.0 (24-109) mmHg, the median $PaCO_2$ was 52.0 (25-106) mmHg. The mean PaO_2 of the patients over the age of 65 was 54.53 mmHg and the mean PaO_2 of the patients under the age of 65 was 53.56 mmHg. The mean $PaCO_2$ of older patients was 75.22 mmHg while younger patients have a mean of 52.23 mmHg. This difference is not statistically significant. The baseline characteristics of these 376 patients are shown in Table 1. Accompanying diseases are classified as diabetes mellitus (DM), atherosclerotic heart disease (AHD), congestive cardiac failure (CHF), hypertension (HT), sequelae of lung tuberculosis and lung cancer. The number of patients with concomitant diagnosis is shown in Table 2.

The median hospitalisation time was 8 (1-40) days (mean: 9.86 days, ± 6.36). One hundred and thirty-four patients had a long hospital stay. The hospitalisation time for the patients with lung malignancy ($p=0.025$) and sequelae of lung tuberculosis ($p=0.009$) were found statistically longer, while the other accompanying diseases have no effect on the hospitalisation time ($p>0.05$) (Table 3).

Of the patients, 41% had a frequent history of hospital admission. Patients with a history of frequent hospitalisation had no significant effect on hospital stay time ($p=0.63$). 92% ($n=346$) of the patients were treated with antibiotics during hospitalisation and the hospitalisation time was significantly longer in these patients ($p<0.001$). Twenty-five (6.6%) patients were treated in intensive care unit. Intensive care unit treatment increased the hospital stay time ($p<0.001$). The other factors that lengthen the

Table 1. The Baseline Characteristics of 376 patients

	Number of Patients (n)
Age	65.31 (± 10.32) (40-88)
Age ≥ 65	212 (56.3%)
Female	65 (17.4%)
Male	311 (82.7%)
Frequent hospitalisation	154 (41%)
ICU treatment	25 (6.6%)
Necessity of antibiotic treatment	346 (92%)
Long hospital stay	134 (35.6%)
Mortality	10 (2.65%)

ICU: Intensive care unit

Table 2. The number of patients with concomitant diagnosis

	Number of Patients (n)
Diabetes mellitus	49 (13%)
Hypertension	67 (17.8%)
Atherosclerotic heart disease	66 (17.5%)
Congestive heart failure	50 (13.2%)
Lung cancer	20 (5.3%)
Sequela lung tuberculosis	51 (13.5%)

Table 3. The values of hospitalisation time and costs

	Hospitalization time (day)	Medication cost (TL)	Hospital care cost (TL)	Total cost (TL)
Female	7	233	878	1164
Male	9	295	987	1380
DM	8	365	942	1369
AHD	9	309	1073	1474
CHF	9	268	1003	1334
Malignancy	10.5*	337	1386*	1623
Sequela TB	11 [†]	289	1193*	1696
Frequent Hospitalization	9	372 [†]	1101 [†]	1488*
Antibiotic Use	9 [†]	289*	985 [†]	1375 [†]
ICU	15 [†]	2038 [†]	3042 [†]	4879 [†]
HAI	13 [†]	598 [†]	1075 [†]	2742 [†]
LTOT	12 [†]	517 [†]	1394 [†]	1950 [†]

DM: Diabetes mellitus, AHD: Atherosclerotic heart disease, CHF: Congestive heart failure, ICU: Intensive care unit, HAI: Hospital acquired infection, LTOT: Long term oxygen treatment, ns= $p>0.05$, *correlation is significant at the 0.05 level, [†]correlation is significant at the 0.01 level

hospital stay time (Table 4) classified as hospital acquired infections ($p<0.001$) and long term oxygen treatment ($p<0.001$). Ten patients died during hospitalisation. Gender did not have any effect on hospitalisation time ($p=0.113$).

The overall mean total cost per exacerbation was 1833.85 TL (SD1708.92) (\$1368.54, €1160.66) with a mean of 526.55 TL (SD737.85) (\$392.94, €333.25) due to medications. The average hospital care cost per exacerbation was 1271.94 TL (SD1028.28) (\$949.20, €805.02) twice the medication cost. The mean total cost of a long hospital stay was 3070.67 TL (SD2135) (\$2291.54, €1943.46). A longer hospital stay had a mean hospital care cost of 2113.72 TL (SD1257.84) (\$1577.40, €1337.79) and a mean medication cost of 945.16 TL (SD1030.81) (\$705.34, €598.20).

The cost of hospital care was statistically higher for patients with lung malignancy ($p=0.043$) than for patients without lung malignancy. However, their total cost ($p=0.094$) and medication cost ($p=0.585$) were not significant. Patients with a history of frequent hospitalisation had a significantly high impact on the medication cost ($p<0.001$), hospital care cost ($p=0.003$) and total cost ($p=0.001$).

Patients with sequelae of lung tuberculosis had a higher hospital care cost ($p=0.035$) than the patients without sequelae of lung tuberculosis, although the total ($p=0.61$) and medication costs ($p=0.138$) did not change. The medication cost ($p=0.024$), hospital care cost ($p=0.002$) and total costs ($p=0.02$) were higher in patients treated with antibiotics than in patients treated without antibiotics. Intensive care unit treatment was more costly to the healthcare system than standard bed hospital stay (Table 3) for all costs including medication ($p<0.001$), hospital care ($p<0.001$) and total cost ($p<0.001$). Medication ($p<0.001$), hospital care ($p<0.001$) and total cost ($p<0.001$) were all higher for the patients with hospital acquired infections. The need for long term oxygen treatment increased the medication ($p<0.001$), hospital care ($p<0.001$) and total cost ($p<0.001$). There was no statistical

Table 4. The factors that increased the hospital stay time which is accepted as length of hospital stay over 11 days

	Number of Patients (n)
Sequelae of lung tuberculosis	51 (13.5%)
Lung cancer	20 (5.3%)
Intensive care unit treatment	25 (6.6%)
Hospital acquired infections	41 (10.9%)
Long term oxygen treatment	93 (24.7%)

significance for age, pO_2 , pCO_2 values in terms of total costs and hospitalisation time.

DISCUSSION

Chronic obstructive pulmonary disease is the fifth leading cause of chronic morbidity and mortality in the world and imposes a considerable economic burden [7]. Exacerbations of COPD are a significant contributor to the cost of illness. The American Thoracic Society (ATS) and European Respiratory Society (ERS) estimate that exacerbations account for 50%-75% of COPD-related costs [2].

In the literature, there are relatively few cost studies that have focused specifically on exacerbations. Toy et al. [8] analysed 11 original research articles on this topic. The range of costs per exacerbation varies substantially, ranging from \$88 to \$7,757. In these studies, hospitalisation was identified as the largest cost category, accounting for %38-%93 exacerbation related costs [8].

Simoens et al. [9], using a symptom-based exacerbation definition, followed 267 patients in Belgium and found the median cost of hospital treatment to be €5143 (7757\$) per exacerbation. Hospital stay was 75% of the total costs.

Oostenbrink et al. [10] studied 519 patients in two clinical trials in the Netherlands/Belgium and used a symptom based

exacerbation definition. Their overall mean cost of exacerbations was €720 (\$1257). Exacerbations associated with hospitalisation accounted for 90% of the total cost of exacerbations. General/pulmonary ward and intensive care unit costs accounted for approximately 77% of the total costs of treating an exacerbation.

O'Reilly et al. [6] studied 149 British patients whose COPD exacerbations were managed in hospital and found that the mean total cost of an admission was £2130.34. The median length of hospitalisation was 9 days (1-54, mean 11 days). The median length of stay was 1 day longer for those with a $FEV_1 < 50\%$ predicted compared with those with a $FEV_1 \geq 50\%$ predicted.

Jahnz-Rozyk et al. [11] followed 73 patients, treated for exacerbations in hospital pulmonary departments or in ambulatory care in Poland, and analyzed the direct and indirect costs. The mean cost of an exacerbation was €1397, while indirect costs accounted for 14% of the total cost.

In our study the mean total cost of a hospital stay was 1833.85 TL (\$1368.54, €1160.66). There is insufficient national data on the cost of exacerbations to compare with our study. Other studies contain cost estimates that vary substantially. These studies were performed in different countries, which may have different types of health care systems and different treatment patterns. Turkey has a lower price for medicines and a lower price for bed costs. So compared to the other studies, our hospitalisation cost is lower.

Another reason why such variability exists in the cost estimates is that these studies use different identification methods for exacerbations. ATS and ERS define a COPD exacerbation as "an event in the natural course of the disease characterized by a change in the patient's baseline dyspnea, cough and/or sputum from day to day variability sufficient to warrant a change in management" [2]. This definition is comprehensive and explains the fact that exacerbations have varied effects and symptoms. Exacerbation definitions fall into three groups: event-based, symptom-based and a combination of two. We used a symptom-based definition developed by GOLD.

Masa et al. [12] retrospectively analyzed 363 patients with COPD in Spain and reported exacerbation specific costs that did not require hospitalisation. They estimated cost per exacerbation at €54 (\$88). All patients in our study were having severe COPD exacerbation and required hospitalisation. Although this has not been studied before in Turkey, we believe that COPD exacerbations managed in outpatients settings would be on the low cost end of the spectrum.

Similar to previous studies, economic costs of hospitalisations due to exacerbations were high [6-10]. These findings indicate that the COPD exacerbations requiring hospitalisation have a great impact on healthcare costs. Another study has also found a positive association between exacerbation and mortality in patients with COPD [13]. Therefore, when managing COPD patients, the potential costs and advantages of preventing exacerbations deserve careful consideration. There is a need for further research into the impact of COPD

exacerbation related costs. It is also important to maintain the primary care costs and hospitalisation costs in order to reduce direct costs in Turkey.

Almagro et al. [14] studied 390 patients, with a mean age of 72 years hospitalized for COPD in the elderly and found the mean length of hospital stay as 11.4 days. Our hospital stay time was close to O'Reilly's study.

De La Iglesia et al. [15] studied 273 patients for the factors predicting a hospital stay of over 3 days in patients with acute exacerbation of COPD. Their mean length of hospital stay was 4.6 (SD5.1) days. Weekend admission, cor pulmonale, respiratory rate on admission had an independent effect on the prediction of a hospital stay. Frequent admission showed no independent effect. Our median hospitalisation time was 8 days (1-40). We believe that the reason we obtained a stay of 8 days for our patients is the severity of the exacerbations. In our study, the patients' median PaO_2 was 53.0 mmHg and the median $PaCO_2$ was 52.0 mmHg at admission. These patients require monitoring and parenteral treatment. Also, 25 (6.6%) patients were treated in the intensive care unit. As expected, intensive care unit treatment significantly increased the hospitalisation time. In our study, the other factors that lengthened the hospital stay (Table 4) classified as hospital acquired infections, long term oxygen treatment. Also, the patients who need long term O_2 treatment stayed longer in hospital, because having supplemental oxygen therapy for long term oxygen treatment may involve more hospital stay. Also these patients' chronic respiratory failure implies a slower recovery period from exacerbation. The patients who required supplemental oxygen therapy had a significantly higher cost, both for medication and hospital care. In our study, frequent hospitalisation or frequent ER visits had an impact on the costs but had a similar hospitalisation time.

In a prospective longitudinal study, Terzano et al. [16] studied 288 consecutive COPD patients admitted to respiratory medicine wards in four hospitals for acute exacerbation. Hypertension was the most common comorbidity (64.2%), followed by chronic renal failure (26.3%), diabetes mellitus (25.3%), and cardiac diseases (22.1%). They found the number and length of hospital admissions depended on the degree of dyspnea and REFI index. There was a high level of comorbidity among our patients but only the patients with sequelae of lung tuberculosis and lung cancer had a longer hospital stay. These comorbidities did not increase the total or the medication costs but did increase the hospital care costs. This may be because of a longer hospitalisation and necessity for more investigations and staff service. In our study, 51 patients had sequelae of lung tuberculosis. The combination of sequelae of lung tuberculosis and COPD may take a slower recovery time, requiring more hospitalisation time. In our opinion, in Turkey, sequelae of lung tuberculosis may play an important role in the costs of COPD exacerbations.

Saleh et al. [17] studied the cost impact of hospital-acquired conditions and found that total discharge and critical care costs, length of stay, and critical care length of stay were

consistently the highest among discharges where hospital-acquired complications occurred. As expected, in our study hospital acquired infections had a significant effect on the costs and hospitalisation time.

One limitation in our study is the absence of indirect costs. In Turkey we do not have enough data to obtain the indirect cost of a hospitalisation.

In conclusion, this study gives one of the first Turkish data on the costs of COPD exacerbations treated in hospital. Furthermore, this study has shown that the cost of intensive care unit treatment, long term oxygen therapy, treatment of hospital acquired infections and antibiotic application were higher than uncomplicated COPD exacerbations requiring hospitalization. Additional studies are required to understand the factors that lengthen hospital stay and health-care costs.

Conflict of Interest

No conflict of interest was declared by the authors.

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