



Pharmacoeconomic Analysis of Acute Exacerbation of Chronic Obstructive Pulmonary Disease

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Authors' contributions

This work was carried out in collaboration among all authors. Authors MSI and MZI designed the study, performed the initial statistical analyses and wrote the protocol. Authors FIA and MSI wrote the first draft of the manuscript. Authors NJA and MZI managed refined analyses. Authors FIA and MSI revised the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Chronic obstructive pulmonary disease (COPD) imparts a substantial economic burden on an individual and society. Exacerbation of COPD (ECOPD) is the primary cost driver for this burden as it usually associated with hospital admissions of COPD patients. The present study aimed to determine the direct costs of acute ECOPD among COPD patients.

Methods: A total of 90 eligible patients with acute ECOPD who were admitted to the hospital were involved in this study. A convenient sampling technique was used during data collection. Cost data were collected according to the expenditures and existing information. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 23.0. The Spearman's rank test was used to observe the differences (correlations) between the Govt perspective and the patient perspective.

Results: The direct costs per episode of acute ECOPD were determined according to the Anthonisen criteria for evaluating acute ECOPD. The mean direct costs for severity III, severity II

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and severity I were 89.1, 134.8 and 178.2 USD respectively. The cost of acute ECOPD was positively associated with disease severity, length of hospital stay and the number of co-morbidities.

Conclusion: Acute ECOPD patients consume a considerable amount of healthcare resources and pose a significant economic burden on the government.

Keywords: COPD; exacerbation; cost; pharmacoeconomics; acute ECOPD.

1. INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is currently the 4th leading cause of morbidity and mortality worldwide. [1] Approximately 6% of the total healthcare budget of the European Union is usually allocated for respiratory diseases where more than 50% just for COPD [2] Therefore, it is undeniable that COPD brings a substantial economic as well as societal burden, especially in developing countries [1,3]. This may be because the prevalence of COPD is expected to increase rapidly soon due to the persistence of the risk factors of COPD and the aging of the population [1,4,5]. Individuals suffering from COPD frequently experience acute exacerbation which may require hospital admission [1]. Recent studies indicated that the hospitalization cost accounted for the largest portion (40-84%) of the total COPD treatment expenditures [6-10] for this reason, acute ECOPD is the major cost driver for the significant economic burden on patients with COPD.

Given the rising prevalence as well as the extensive economic impact of acute ECOPD, the pharmacoeconomic evaluations of acute ECOPD are of great importance. The information will be further useful for decision-makers to rationally allocate the healthcare resources so that the healthcare budget can be utilized effectively. Besides, both healthcare professionals and policy-makers should have better recognition of acute ECOPD as a major healthcare problem and hence more healthcare policy interventions should be designed to reduce the incidence and impact of acute ECOPD [11-16]. In recent studies, the cost for acute ECOPD per exacerbation episode was calculated to be 718 USD in Turkey, 2319 USD in Greece, 1571 USD in Poland and 89.75 USD in India [17-21]. To date, there has been no published study on the cost of acute ECOPD in Pakistan. Although, until today, the actual prevalence of COPD in Pakistan is also not exactly evident smoking prevalence is about 29% in males and 4% in females [22,23]. Hence, the prevalence of

moderate to severe COPD in adults aged 45 years or above could be estimated at around 3-4% of the overall population [5,11]. In an attempt to fill in the gaps in the current literature, this study was designed to estimate the direct cost per episode of acute ECOPD. The present study investigated the total direct medical costs and direct non-medical costs among acute ECOPD patients.

2. MATERIALS AND METHODS

2.1 Study Design

This cross-sectional study aimed at identifying different direct costs in the treatment of acute ECOPD. Economic data was obtained through the medication bills, and the information available while relevant clinical and relevant data were collected from the recruited patients. A newly designed data collection tool was used to collect the data. The data collection tool was validated for reliability using Cronbach alpha.

2.2 Study Subjects

A total of 90 patients with acute ECOPD were enrolled in this study. Patients with cystic fibrosis, asthma, eosinophilic lung disease, bronchiectasis, tuberculosis, pregnant or lactating women as well as patients who were unwilling to provide written consent were excluded from the study. Patients were divided into three different categories based on disease severity as proposed by Anthonisen et al. [12]. Anthonisen criteria divided acute ECOPD patients into 3 different categories based on the presence of 3 major symptoms of COPD i.e. dyspnea, sputum volume, and sputum purulence. The severity level III which is least severe represents the presence of any 1 symptom, severity level II is moderately severe and shows the presence of any 2 symptoms whereas severity level I which is the most severe and shows the presence of all 3 symptoms among COPD patients.

2.3 Cost Analysis

Cost analysis was based on the estimation of both the direct medical costs and direct non-medical costs per exacerbation episode. Direct medical cost is comprised of investigation cost, medication cost and unit cost per treatment episode while the direct non-medical cost is the sum of expenses like transportation, food and other expenses that are directly related to the patient's disease. All of the expenditures were calculated in Pakistani Rupees (PKR) and the exchange rate at the time of the study was 138 PKR against one United States Dollar (USD).

2.4 Statistical Analysis

Statistical analysis was performed using SPSS version 23.0 and descriptive statistics were applied. The cost was analyzed for normality distribution and expressed as mean. The Spearman's rank correlation coefficient test was applied to observe the differences (correlations) between the Govt perspective and the patient perspective. A p-Value ≤ 0.05 was considered statistically significant.

3. RESULTS

3.1 General Characteristics

The demographic characteristics of the study population, classified according to the disease severity are summarised in Table 1. A total of 90 patients with acute ECOPD were enrolled in the study and the majority of patients were men (86.6%), smokers (94.4%) and non-working (50%). Additionally, the patients were relatively

old (mean age of 62.1 ± 11.4) and the mean length of hospitalization stay was 8.8 ± 3.9 days.

Table 2 depicts the patients' chief complaints. Among acute ECOPD patients, the cough was 90%, shortness of breath (SOB) was 80%, expectoration was 72.2% and wheezing was also 72.2% as presenting problems.

Table 3 represents the list of major comorbidities patients had while on acute ECOPD. Among them, mainly were coronary artery disease (CAD) which accounted for 74.4%, hypertension 72.2, and diabetes 71.1%.

3.2 Cost Analysis

The cost analysis according to the Anthonisen criteria for acute ECOPD severity is demonstrated in Table 4. The mean direct costs for severity III, severity II and severity I were 89.1, 134.8 and 178.2 USD respectively.

Medication cost is the leading cost driver accounting for 53.3 USD in the direct medical cost, followed by the treatment cost (other than medicines) was 14.3 USD and lab investigation cost was 7.8 USD for severity III. On the other hand, for the severity II, medication cost was 67.3 USD, treatment cost (other than medicines) was 35.7 USD and lab investigation cost was 8.2 USD. All costs were increased significantly with the severity of the disease.

In Table 5, the estimated sum of direct medical costs is considered as the Govt perspective while direct non-medical costs are taken as the patients' perspective. The sum of the direct

Table 1. Demographic characteristics of the study participants

Patients' characteristics (n=90)	Severity of exacerbation		
	III	II	I
Gender			
Male	44	26	8
Female	5	4	3
Age (mean+SD)	53.4 (11.3)	61.4 (9.8)	71.6 (13.3)
Working			
Yes	33	11	1
No	16	19	10
Smoking			
Yes	48	28	9
No	1	2	2
Comorbidities			
Yes	40	25	11
No	9	5	0
Days in hospital stay (mean+SD)	4.2 (3.3)	9.2 (5.3)	13 (3.2)

medical cost and direct non-medical costs for all three severity patients are presented. The sum of direct medical costs as Govt's perspective was estimated to be for severity III, severity II and severity I was 75.4, 121.6 and 166.9 USD respectively. The sum of direct non-medical costs as patients' perspective was estimated to be for severity III, severity II and severity I was 13.7, 13.2, and 11.3 USD respectively. Up to 93.2% of the direct medical cost for these 90 patients had been supported by the government.

Table 2. Chief complaints among patients

Chief complaints	N (%)
SOB	72 (80)
Cough	81 (90)
Expectoration	65 (72.2)
Dyspnea	57 (63.3)
Wheezing	65 (72.2)
Chest pain	42 (46.6)
Fever	17 (18.8)
Chest tightness	34 (37.7)

Table 3. List of major comorbidities

Comorbidities	N (%)
Lung Cancer	2 (2.2)
CAD	67 (74.4)
Hypertension	65 (72.2)
Diabetes	64 (71.1)
Osteoporosis	32 (35.5)
GERD	42 (46.6)
Hepatitis	13 (14.4)

The costs of acute ECOPD were positively correlated with disease severity, length of hospital stay and the number of co-morbidities.

3.3 Statistical Analysis

Table 6 shows the Spearman's rank correlation coefficient test, and there are statistically significant differences (correlations) were observed (p-Value <0.05) between the Govt perspective and the patient perspective.

4. DISCUSSION

COPD is a major societal burden that results in a significant increase in direct medical costs and direct non-medical costs, especially in developing countries. However, it is worth stating that the mean costs of acute ECOPD vary considerably among various countries [6,16-24]. In this study, the estimated cost of acute ECOPD

per admission of severity I was estimated to be 178.2. The differences in cost between countries might be due to various organizational structures of the healthcare systems, the degree of development as well as factors that are related to the economic conditions in each country [17-20]. As Pakistan is a developing country it is not surprising that the cost of acute ECOPD is lower than those studied in developed countries [17-20].

Great variations are also observed in the costs of acute ECOPD which are done in various studies. [16-25] the present study indicates that medication costs accounted for the greatest proportion of the direct medical cost. These findings of this study are in concordance with the previous studies done in Turkey and China, where the drug costs represent the largest proportion i.e. 53.5%, 71.2%, respectively of the mean cost [16-21]. However, in India, the drug cost contribution was only 9.1% [17]. These differences in each country may be due to the variations in drug prices, generic drug availability, laboratory investigation techniques, and overall healthcare systems.

The present study also highlighted the differences between direct medical costs and direct non-medical costs which are usually borne by the patients in Pakistan. These findings reflect the fact that the healthcare costs of the patients of acute ECOPD in government hospitals in Pakistan are highly subsidized. For instance, the sum amount borne by the severity I patients was somehow negligible (11.3 USD) compared to the total sum of the actual direct medical cost of acute ECOPD per episode (166.9 USD) and more than 93% of this cost is supported by the government. Other expenses such as transportation costs and the food costs were only borne by the patients which were almost negligible.

Studies performed in Greece and China indicated that direct hospitalization costs of acute ECOPD increase with disease severity [16,20]. Andersson et al. also reported that the average healthcare costs per episode of COPD with mild, mild/moderate, moderate, and severe exacerbation were 11.56, 34.10, 203.36 and 2105.10 USD, respectively [26]. Similarly, a study conducted by Hilleman et al. also determined the direct relationship between severity and the cost of acute ECOPD [27]. The Results of these studies resemble the results of our study indicating that direct medical costs

Table 4. Direct medical and direct non-medical costs among acute ECOPD patients

Severity of exacerbation	Number of patients (%)	Lab investigation cost	Medication cost	Treatment cost (Oxygen, Neubilizer, etc)	Transportation cost	Food cost	Total costs
III	49 (54.4)	7.8	53.3	14.3	7.7	6	89.1
II	30 (33.4)	18.6	67.3	35.7	8.2	5	134.8
I	11 (12.2)	21.3	87.3	58.3	7.3	4	178.2

The cost values are represented as mean and in USD

Table 5. Govt perspective vs patient perspective costs among acute ECOPD patients

Severity of exacerbation	Number of patients (%)	Govt perspective	Patient perspective	Percentage of costs supported by Government
		Sum of direct medical costs	Sum of direct non-medical costs	
III	49 (54.4)	75.4	13.7	81.8
II	30 (33.4)	121.6	13.2	89.1
I	11 (12.2)	166.9	11.3	93.2

The cost values are represented as mean and in USD

Table 6. Correlation between Govt perspective and patient perspective

	Govt perspective	Patient perspective
Severity III		
Spearman's rho	0.452	0.109
P-value	0.001	0.001
Severity II		
Spearman's rho	0.577	0.198
P-value	0.001	0.001
Severity I		
Spearman's rho	0.336	0.309
P-value	0.001	0.001

increase with disease severity. In the light of data of the previous studies and the data of our study, it is confirmed that the increased direct medical cost in the more severe patients was probably due to more and complex lab investigation procedures, length of stay in hospitals, and use of more number of medications to treat acute ECOPD.

There are some limitations in this study like fewer study participants (n=90) as compared to other studies. However, that is because most of these studies were merely based on data from healthcare databases. But this study is purely based on the estimation of the direct medical and non-medical costs which were determined prospectively by follow-ups during the hospital stay of the patients. Longer study duration and also multi-center studies are recommended to acquire a larger sample size. Despite these potential limitations, this study provides a preliminary baseline estimation of the per-episode cost of acute ECOPD in Pakistan.

5. CONCLUSION

In conclusion, acute ECOPD considerably consumes much of the healthcare resources. In addition to providing high subsidization on healthcare costs for the citizens, the government should also give high priority for interventions that should aim for preventing the emergence

and progression of COPD to alleviate the huge economic burden of acute ECOPD.

6. LIMITATIONS OF THE STUDY

Despite the small sample size, the study has provided some preliminary findings. Larger sample size in future studies would allow a better exploration of the actual burden of disease among patients. Besides, subjects are selected via convenient sampling which might lead to bias in population selection. For future research, the study could be repeated in hospitals of other cities or private hospitals to compare the differences.

CONSENT AND ETHICAL APPROVAL

Written consent was taken from each patient. Ethical approval was obtained from the concerned authorities.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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