



Impact of Severity of the Disease on Cost of Illness and Quality of Life of Patients with Chronic Obstructive Pulmonary Disease

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ABSTRACT

Objective: The objective of the study was to assess the cost of illness of COPD and the influence of severity of the disease over cost of illness and the quality of life. **Materials and Methods:** The study was conducted in 105 patients aged > 40 years and <70 years, diagnosed with stages II, III and IV COPD. Cost of illness (direct and indirect costs) was calculated in Indian rupees from the expenditures of the hospital visits, pharmacotherapy, oxygen therapy, biochemical investigations, diagnostic procedures, physiotherapy and hospitalization due to acute exacerbations by patient interview and review of patient's case history, medical and billing records. Quality of life of 50 patients in Stage III and Stage IV COPD was estimated using St. George's Respiratory Questionnaire (SGRQ) score. **Results:** The mean cost spent by the patients with stage II COPD was Rs.3179.62 ± 99.01 per visit to the hospital, stage III was Rs.16414.79 ± 8365.79 and stage IV was Rs.44077.16 ± 15686.21 per visit. As the severity of COPD increased both direct and indirect costs increased and the quality of life of the patient decreased significantly (P=0.000). Out of the total costs, highest was spent on direct medical costs (81.2%). Direct nonmedical costs contributed to 10.6% and indirect costs to 8%. The drivers of the total cost were found to be hospitalizations (36.2%) and length of stay. **Conclusion:** Since acute exacerbations are the main cause of hospitalization among COPD patients, strategies to prevent severe exacerbations could be very cost effective and may improve the quality of life.

Key words: Cost of illness, COPD, Medical costs, Quality of life, Smoking cessation.

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INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is the fourth leading cause of death and an ever increasing worldwide public health problem with its epidemiological,

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clinical, social and economic impact increasing in the near future making it the third most important cause of death in the next 10-15 years.¹ The economic impact of COPD varies widely and causes an enormous health problem for the patients and their families, the work place, health institutions and society as a whole.^{2,3} Exacerbations and hospitalizations due to COPD constitute the most important direct health care costs associated with COPD.⁴ The cost of COPD treatment and the quality of life of the patients is greatly influenced by the severity of the disease and the drugs used in its management.⁵

The economic costs of a disease comprises of direct costs which includes the cost spent for medical care; indirect costs which includes costs of lost productivity due to illness, loss of earning due to morbidity or premature mortality. The studies of direct medical care costs and indirect costs of COPD in developed countries^{2,3} may be less applicable to the developing world. COPD, in terms of productivity lost, may represent a serious threat to the economy of a developing country like India and data on the pharmacoeconomics of COPD in Indian population is scarce.⁶ Hence a study was conducted to estimate the direct and indirect health care costs of COPD and to determine the drivers of cost in COPD, the influence of severity of the disease over cost of illness and the quality of life of these patients.

MATERIALS AND METHODS

A prospective study was carried out in a tertiary care teaching hospital in South India with ethical approval and consent of the patients. The study population consisted of 105 male patients of age > 40 years and < 70 years with smoking history, diagnosed with stages II, III and IV COPD as per the definitions of the GOLD guidelines according to the severity of the disease as

- Stage II – FEV1/FVC < 70%, 50% ≤ FEV1 < 80% predicted
- Stage III – FEV1/FVC < 70%, 30% ≤ FEV1 < 50% predicted
- Stage IV – FEV1/FVC < 70%, FEV1 < 30% predicted or FEV1 < 50% predicted plus chronic respiratory failure and having stable co morbidities

Patients with cystic fibrosis, severe bronchiectasis, pneumonia, asthma and active co morbidities were excluded. The data including patient demographics, clinical findings and the costs incurred for drug therapy, oxygen therapy, laboratory tests including complete blood

counts, liver function tests, arterial blood gas (ABG) tests, blood glucose, and sputum Gram stains, diagnostic procedures including pulmonary function tests (PFT), chest radiographs, ECG and any other, clinic visits (cost of physician, traveling expenses), emergency department visits and hospital visits were collected by patient interview and review of patient's case history, medical and billing records. Cost of illness, which included the direct medical and non medical and indirect costs were calculated in Indian rupees from the expenditures of the hospital visits, pharmacotherapy, oxygen therapy given, laboratory tests, diagnostic procedures, physiotherapy and hospitalization due to acute exacerbations.

Quality of life (QOL) of 50 patients in Stage III and Stage IV COPD and hospitalized for management of acute exacerbations was assessed using the 2.3 version of St. George's Respiratory Questionnaire (SGRQ)⁷ after obtaining necessary permission from the author of the questionnaire. The score was calculated using SGRQ scoring excel sheet.

St. George's Respiratory Questionnaire

The St. George's Respiratory Questionnaire (SGRQ) is designed to measure and quantify health related status in patients with chronic air flow limitation. It has been shown to correlate well with established measures such as level of symptoms, disease activity and disability.

The first part (symptoms) evaluates clinical symptoms, including frequency of cough, sputum production, wheeze, dyspnoea and the duration and frequency of episodes of dyspnoea or wheeze. The second part has two components; "Activity" and "Impact". The "Activity" component addresses activities that leads to breathlessness or are limited due to breathlessness. The "Impact" component covers a range of factors including influence of the disease on employment, being in control of health, panic and stigmatization, the need for drugs, side effects of the drug therapies prescribed, expectations for a good health and disturbances of day to day life.

Statistical analysis

The statistical analysis was performed using SPSS version 10. The association between severity of the disease and cost of illness was assessed using ANOVA and post hoc tests. The relation between severity of disease and the QOL based on SGRQ score, the cost of illness and the QOL score were evaluated using student t-test. A P value of < 0.05 was considered significant.

Table 1: Severity of Copd Vs Hospitalisation

STAGES OF COPD	NO. OF PATIENTS (N=105)		TOTAL
	INPATIENTS	OUTPATIENTS	
STAGE II (50% ≤ FEV1 < 80%)	0	42(40%)	42(40%)
STAGE III (30% ≤ FEV1 < 50%)	34(32.4%)	13(12.4%)	47(44.8%)
STAGE IV (FEV1 < 30%)	16(15.2%)	0	16(15.2%)
TOTAL	50(47.6%)	55(52.4%)	105(100%)

Table 2: Distribution of Costs

Cost category	Cost drivers	Average cost per patient per hospital visit (rupees)	Percentage
DIRECT MEDICAL COSTS	Practitioner	1425.71	9.21
	Hospitalization	5603.81	36.20
	Laboratory investigations	1528.52	9.87
	Arterial blood gases	470	3.03
	Diagnostic procedures	1517.86	9.80
	Pulmonary function tests	500	3.23
	Drugs	685.42	4.42
	Oxygen therapy	23.57	0.15
	Nebulisation	262.04	1.69
	Nursing charges	471.42	3.04
DIRECT NON MEDICAL COSTS	Physiotherapy	780.95	5.04
	Nutrition	597.71	3.86
	Transportation	249.23	1.61
INDIRECT COSTS	Telephone	13.42	0.08
	Morbidity	1238.57	8.00
	Mortality	0	0
Total		15379.1	100

RESULTS

The mean age of the study patients was 58.6 ± 7.9 years and 48 (45.7%) patients were in age group of 51-60 years, followed by 41 (39.04%) in 61-60 years and 16 (15.2%) patients in 41-50 years. 47 (44.8%) patients were suffering from stage III COPD (44.8%), followed by 42 (40%) patients with stage II COPD (40%) and 16 (15.2%) with stage IV COPD.

Stable co morbidities were seen in 43 patients (40.95%) of which treated tuberculosis was seen in 15 (14.28%) patients. Other co morbidities like diabetes, hypertension, diabetes and hypertension and ischemic heart disease also accounted equally to 5.71% each.

The mean smoking history (number of pack years) of the patients was 48.26 ± 17.4 pack years. The number of pack years was higher for the patients with stage IV COPD (58.07 ± 14.7), followed by stage III (34.59 ± 9.3) and stage II COPD patients (26.04 ± 2.3).

All the patients suffering from stage II COPD were treated in the outpatient department. Out of 47 patients with stage III COPD, 34 (32.4%) were hospitalized and 13 (12.4%) were treated in the outpatient department. 16 patients with

stage IV COPD were admitted in the inpatient wards of pulmonology department (Table 1).

The mean length of hospital stay was found to be 9 ± 1.2 days for stage III patients and 11.75 ± 2.5 days for stage IV patients. As the severity of the disease increased the length of hospital stay increased.

Cost of illness of COPD

It was estimated that on an average a patient spent around 15379.1 rupees per visit to the hospital. The highest being spent for hospitalization (36.2%) followed by diagnostic procedures (9.8%), laboratory investigations (9.87%), for practitioner (9.21%), morbidity (8%), drugs (4.4%) and the rest accounted for 23.5% (Table 2). Out of the total costs, highest was spent on direct medical costs (81.2%). Direct nonmedical costs contributed to 10.6% and indirect costs to 8%.

The mean cost spent at various stages of disease is shown in Table 3. The mean cost spent by patients with stage II COPD was Rs.3179.62 \pm 99.01 per patient per visit, stage III was Rs.16414.79 \pm 8365.79 and stage IV was Rs.44077.16 \pm 15686.21 per patient per visit. The patients with stage IV spent nearly 13 times more than stage II and 2.3 times

Table 3: Cost Categories Vs Severity of COPD

Cost category	Cost drivers	Stage II (n=42)	Stage III (n=47)	Stage IV (n=16)
		(mean cost in rupees per patient per hospital visit)	(mean cost in rupees per patient per hospital visit)	(mean cost in rupees per patient per hospital visit)
Direct medical costs	Practitioner	200	1776.59	3612.5
	Hospitalization	0	5897.87	19450
	Laboratory investigations	1425	1549.78	1737.81
	Arterial blood gases	350	484.04	743.75
	Diagnostic procedures	375	2147.34	2668.75
	Pulmonary function tests	500	500	500
	Drugs	113.1	658.02	2232.47
	Oxygen therapy	1.78	27.12	70.31
	Nebulisation	42.85	353.19	569.68
	Nursing charges	0	651.38	1181.25
Direct non medical costs	Physiotherapy	150	1007.44	1771.87
	Nutrition	0	840	1455
	Transportation	20.57	297.36	708.12
	Telephone	4	16.69	28.75
Indirect costs	Morbidity	0	342.55	7121.37
	Mortality	0	0	0
Total		3179.62	16549.4	43852.16

Table 4: Direct and Indirect Health Care Costs of COPD

Cost category	Average cost per patient per hospital visit (in rupees) (n=105)	Percentage
Direct medical costs	12488.35	81.26
Direct non medical costs	1641.31	10.67
Indirect costs	1238.57	8.05
Total	15368.23	100

than stage III patients. In stage II a patient spent around 3179 rupees per hospital visit; the highest was spent for laboratory investigations, followed by pulmonary function tests, diagnostic procedures, arterial blood gases, practitioner charges and the rest of the cost drivers accounting to 330 rupees. In stage III a patient spent around Rs.16549 per hospital visit; the highest was spent for hospitalization (Rs.5897). Similarly in stage IV a patient spent around Rs.43852; the highest was spent for hospitalization (Rs.19450).

Out of the total costs, highest was spent on direct medical costs (81.2%). Direct nonmedical costs contributed to 10.6% and indirect costs to 8% (Table 4).

At every stage of COPD the cost spent by a patient was more for direct medical costs than direct non medical and indirect costs. There was a significant difference between direct and indirect health care costs in COPD. The severity of COPD increased with an increase in both direct and indirect costs (Table 5).

The mean cost spent by the patients with stage II COPD was Rs.3179.62 \pm 99.01, stage III was Rs.16414.79 \pm 8365.79 and stage IV was Rs.44077.16 \pm 15686.21. As the disease severity increased the cost spent for the illness also increased. The severity of disease highly correlated with cost of illness (P=0.000) (Table 6).

Quality of life of patients with stage III and stage IV COPD

The quality of life of inpatients was evaluated by using SGRQ. Out of 105 patients, 50 were inpatients, of which 34 were with stage III COPD and 16 with stage IV COPD. The mean SGRQ QOL score of the 50 patients was found to be 53.96 \pm 10.38. The SGRQ QOL score of the stage III COPD patients was found to be 44.69 \pm 9.27 and stage

Table 5: Direct and Indirect Health Care Costs Vs Stages of COPD

Cost category	Stage II (mean cost in rupees per patient per hospital visit)	Stage III (mean cost in rupees per patient per hospital visit)	Stage IV (mean cost in rupees per patient per hospital visit)
Direct medical costs	1467.85	13061.29	31522.77
Direct non medical costs	174.57	2161.49	3963.74
Indirect costs	0	342.55	7121.37
Total	1642.42	15565.33	42607.88

Table 6: Cost of Disease Vs Severity of COPD

Severity of COPD	Mean cost in rupees per patient per hospital visit	Standard deviation	Minimum cost (in rupees)	Maximum cost (in rupees)	F	P
Stage II (n=42)	3179.62	99.01	3014.0	3417.0		
Stage III (n=47)	16414.79	8365.79	3454.0	28398.71	143.74	<0.001**
Stage IV (n=16)	44077.16	15686.21	28740.4	77679.47		
Total	15379.10	15929.18	3014.0	77679.47		

Table 7: Comparison of Mean Cost of Illness At Different Stages of COPD and Cost of Smoking Cessation Therapy

Stages of COPD	Mean cost in rupees per patient per hospital visit
STAGE II	3179.62
STAGE III	16414.79
STAGE IV	44077.16
SMOKING CESSATION THERAPY	
WITH BUPROPION	2832 per therapy (6 months)
WITH VARENICLINE	9652 per therapy (3 months)

IV patients was 63.24 ± 11.49 . As the severity of the disease increased the quality of life of COPD patients significantly decreased ($P=0.000$). Cost of the disease negatively correlated with quality of life. As the quality of life decreased the cost of disease increased significantly ($P < 0.001$).

An attempt was made to compare the cost of illness of various stages of COPD and smoking cessation therapy. The amount spent on smoking cessation therapy was Rs. 2832 (for bupropion) and Rs. 9652 (for varenicline) per patient which was very less compared with the cost of COPD at every stage of disease (Table 7).

DISCUSSION

COPD represents a great health-care burden worldwide and the increasing prevalence and life time duration of the illness in those affected translates into increased direct and indirect medical expenditures. The findings of the present study shed light on the comprehensive cost expenditure of patients with COPD. The data obtained from this study demonstrated a strong correlation between the total cost incurred by patients for COPD management and the severity of the disease and which is in concordance with those found in international literature.⁸

The present study had demonstrated a positive relation between the presence of stable co morbidities and an increase in cost of illness. This is in consistence with the report given by Mary Geitona et al, which stated that there was a marginal significant relation between co morbidities and increased cost.⁹

In the present study, the cost of illness was found to be higher for patients in stages III and IV COPD as these patients were treated with more number of drugs both initially, during follow-up and also had greater number of hospital visits due to frequent acute exacerbations, leading to greater use of diagnostic procedures which had also contributed to higher cost of illness.

The data obtained from the present study had shed light to the cost variables that contributed to the total cost of illness at different stages of COPD. In stage II COPD, biochemical investigations were the most important cost variable. In stage III & IV, cost of hospitalization, cost for diagnostic procedures, physician costs and costs for drugs were the most important cost variables. This was due to increase in length of hospital stay and antibiotic usage in severe stages of COPD. A similar report was given by Daniel E Hilleman *et al.*¹

The increase in severity of the disease has a dramatic negative impact on the quality of life of the patients which was well established by a significant decrease in quality of life of COPD patients with an increase in SGRQ score. A multi centre 2-year follow up study by Claudio F Donner demonstrated that repeated exacerbations resulted in a permanent negative impact on health status.⁸

Patients with COPD experience poor physical functioning and live with distressing symptoms that require frequent hospitalization due to disease progression. They develop inability to work and may become socially isolated and often depressed. The current study had shown that the cost of illness increased as the quality of life of patients

decreased. Quality of life worsened with severity of disease and with exacerbations resulting in more hospitalization and increased cost of treatment.^{10,11} The focused on the decrease in health related quality of life with an increase in cost of therapy in COPD.

In the present study the direct cost was found to be 90% of the total cost. Majority of the cost was spent for hospitalization, laboratory investigations, diagnostic procedures, drugs and practitioner. This is in accordance with the reports given by other studies.^{1,12} Health care costs were higher in patients who were former smokers than current smokers. This may be because patients with severe disease may be more likely to stop smoking (as a result of ill-health) than patients with mild disease.

An attempt was made to compare the mean cost of treatment of stage II, stage III and Stage IV COPD and the cost that may be spent for smoking cessation therapy. It was found that cost of smoking cessation therapy would be significantly lesser than the cost spent for the treatment of the COPD. A supportive statement was given¹³ and suggested that patients with stage I COPD were expected to achieve a 30-40% smoking cessation by spending \$250 to \$500 for nicotine replacement and or bupropion therapy.¹ Smoking cessation is clearly a cost effective approach to reducing the medical consequences and costs of COPD as well as host of other disease status.¹⁴

Further, an increase in air pollution in the urban areas also increases the risk of COPD incidence and its severity in the city dwellers. Early detection of the symptoms of COPD in urban population with the history of recurrent breathing difficulty and motivating them towards breathing exercises may be very effective in lowering the severity of COPD and thus can reduce frequent exacerbations and

hospitalization. In this study, no attempt was made to assess the influence of area of residence and air pollution over the severity of COPD, the cost of illness and quality of life. A study done by Muaedjamal and Alomar DM reported a significant decrease in lung capacity and increased incidence of COPD in smoking and non smoking urban dwellers.¹⁵

CONCLUSION

The study demonstrated that the total cost of illness of COPD patients increased with severity of disease. The Quality of life of the patients decreased with increase in severity of the disease. The drivers of the total cost were found to be hospitalizations and length of stay. Since acute exacerbations are the main cause of hospitalization among COPD patients, strategies to prevent severe exacerbations could be very cost effective and improve the quality of life. By developing strategies to improve patients' awareness on nicotine replacement therapy, adherence to drug therapy and opting for physical rehabilitation, the direct medical and indirect costs can be reduced which in turn will lower the burden of cost of illness of COPD.

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CONFLICT OF INTEREST

Authors declared no conflict of interest.

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