Research Article

Pharmacoeconomic Evaluation of Anti Diabetic Treatment at Ayder Referral Hospital, Mekelle, Ethiopia

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ABSTRACT

Diabetes mellitus (DM) is a chronic disorder that poses huge health and economic burden on society. Unfortunately, there is lack of such evidences in Ethiopia. To estimate direct cost of illness of DM in Ayder Referral Hospital in 2012. Cost of illness method was used to determine the economic burden of DM from societal perspective. The direct cost of illness of DM in the year 2012 was estimated using prevalence approach. All patients who were being followed-up for at least a year in the DM clinic of the hospital were included in the study. Data on patients' demographic characteristics, clinical characteristics, and treatment profile were collected from patients' case notes. A total of 130 DM patients were enrolled in the study, of which 51.54% were females and 48.46% were males. The total cost of illness of diabetes was estimated to be USD 11530.68 in 2012. Of this, 92.48% was direct medical cost and 7.52% was direct non-medical cost. The cost of illness per patient/year is USD 88.70. Most of the costs were spent on drugs (73.10%). Insulin accounted 88.19% of drug cost and 64.45% of the total cost of illness of DM. The mean cost for DM patients with complications (USD 125.78) was significantly higher (P < 0.05) as compared to those without complications (USD 76.08). Numbers of visits to DM clinic, type of DM and residence area were also found to affect the cost significantly. The cost associated with diabetes is enormous and it presents a considerable burden to the society. Hence, policy makers should give emphasis for the prevention of the disease and its complications.

Keywords: Complication, Cost of illness, Diabetes Mellitus, Direct medical cost, Direct non-medical cost.

INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder characterized by resistance to the action of insulin, insufficient insulin secretion, or both. The clinical manifestation of these disorders is hyperglycemia. The vast majority of diabetic patients are classified into one of two broad categories: type 1 diabetes caused by an absolute deficiency of insulin, or type 2 diabetes defined by the presence of insulin resistance with an inadequate compensatory increase in insulin secretion.[1]

DM is a chronic disorder with potentially devastating complications that affect all age groups worldwide. In 1985, an estimated 30 million people around the world were diagnosed with diabetes; in 2000, that figure rose to over 150 million; and, in 2012, the International Diabetes Federation (IDF) estimated that 371 million people had diabetes.[2] That number is projected to rise to 552 million (or 1 in 10 adults) by 2030, which equates to three new cases per second.[2] It is also reported that more than 80% of the diabetes deaths occur in low- and middle-income countries.[3]

It is now recognized that it is the low- and middle-income countries that presently face the greatest burden of diabetes. However, many governments and public health planners still remain largely unaware of the current magnitude, or, more importantly, the future potential for increases in diabetes and its serious complications in their own countries.[4]

Diabetes exerts a heavy economic burden on society. This burden is related to health system costs incurred by society in managing the disease, indirect costs resulted from productivity losses due to patient disability and premature mortality, time spent by family members accompanying patients when seeking care, and intangible costs (psychological pain to the family and loved ones).[5]

Cost-of-illness (COI) studies describe the resources used and potential resources lost as a result of a disease. Together with prevalence, incidence, morbidity, and mortality data, these studies help to portray the impact of a disease on society.[6] It is important to perform cost-of-illness studies in order to inform clinical decision making, develop policies and guidelines, and effectively allocate resources.[7] Despite its importance, cost of illness study of DM is very scarce in Ethiopia. Therefore, the aim of this study is to estimate the cost of illness of DM in Ayder Referral Hospital (ARH), Mekelle, Northern Ethiopia.

METHODOLOGY

Study setting

The study was conducted in ARH located in Mekelle city, the capital of Tigray region, which is 783 km away from the capital of Ethiopia, Addis Ababa. ARH is the only referral hospital in the region. The hospital is 400 bed teaching and referral hospital. It provides general outpatient, inpatient and emergency services for about five million people in Tigray and neighboring regions. DM ambulatory clinic, one of the specialty units of the

hospital, was established in 2011 and since then it has been providing medical service for more than four hundred registered DM patients.

Study design

A prevalence-based COI study was conducted focusing on measuring direct cost of illness over the course of one year (January 1st to December 31st, 2012). The study presented a societal perspective of cost of diabetes.

Data collection

The data were collected from the patient's case note of each study participant and the collected data included demographic characteristics as well as treatment and clinical profile of the patients. Information about the cost of laboratory services and drugs was obtained from laboratory and pharmacy department of the hospital. Data abstraction format was used as data collection tool. All patients who have been followed-up in DM clinic for at least one year were included in the study.

Cost calculation

In this study the cost component consisted of direct medical cost and direct non-medical cost. The direct medical cost included cost for drug, laboratory tests and personnel (nurses, pharmacists, and laboratory technologists). The cost was calculated as a function of total quantity of medical services and the corresponding unit cost in ARH. The cost of generic medication is considered when various brands are available.

In order to calculate the personnel costs for laboratory technician, pharmacists and nurses; the average time for 15 random observations for completion of tasks such as consultation, dispensing, and diagnostic test was determined and recorded. The salaries of health professionals were obtained from the human resource management team of the hospital; the average was considered where necessary and the mean salary per minute was calculated.

$$\text{Mean salary/min} = \frac{\text{Annual salary}}{\text{Hours/wk. x no of wks. /annum x60}}$$

In the calculation, the respective number of visit was considered.

Direct non-medical costs included cost of transportation to Mekelle city and calculated for each patient for all the visits using the standard tariff of Tigray region road and transport authority and the patients' destination.

Statistical analysis

Statistical analysis was done by using SPSS for windows (version 16). Statistical significance was considered when p value is less than 0.05.

RESULTS AND DISCUSSION

Demographic characteristics

A total of 130 patients were enrolled in this study; 75.38% were residents from Mekelle city and 24.62% were out of

Mekelle. Of the total sample 51.54% were females and 48.46% were males. The mean age of the study participants was 39.73 ± 19.31 years (Table 1).

Table 1: Demographic characteristics of diabetic patients in ARH, 2012

Categories	Number (n=130)	Percent (%)
Age (Years)		
<35	56	43.08
36-44	12	9.23
45-54	22	16.92
55-64	28	21.54
65-74	8	6.15
≥75	4	3.08
Gender		
Male	63	48.46
Female	67	51.54
Residence area		
Mekelle	98	75.38
Out of Mekelle	32	24.62

Table 2: Treatment profile and clinical characteristics of DM patients in ARH, Ethiopia, 2012

Categories	Number (n=130)	Percent (%)
Duration of the disease (years)		
1-5	92	70.78
6-10	26	20
11-15	7	5.38
16-20	2	1.54
≥21	3	2.31
Type of diabetes		
Type 1	70	53.85
Type 2	60	46.15
Fasting blood sugar level (mg/dl)		
< 70	9	6.92
70 -130	32	24.62
131 -179	29	22.31
180 -299	42	32.31
≥ 300	18	13.85
Co-morbidity		
With co morbid	23	17.69
Without co morbid	107	82.31
Complications		
With Complication	33	25.38
Without Complication	97	74.62
Annual patient visit to DM clinic		
1-2 visits	4	3.08
3-6 visits	68	52.31
7 - 11 visits	56	43.08
12 or more visits	2	1.54

Treatment profile and Clinical Characteristics

The treatment profile and clinical characteristics of the DM patients is presented in Table 2. Seventy (53.8%) and 60 (46.2%) patients were found to have type-1 and type-2 diabetes, respectively. The mean duration of the disease was 4.76 ± 4.93 years. Ninety-two patients (70.78%) had DM for 1-5 years; and the current fasting blood sugar level of sixty patients (46.15%) were >180 mg/dl. The number of patients' visits to the DM clinic in the year 2012 varied; for instance, 52.31%, 43.08%, 3.08%, 1.54% of patients visited the clinic 3-6 times, 7-11 times, 1-2 times and more than 12 times, respectively. The table also shows that 17.69% of the study participants had co-morbidity and 25.38% of the study participants developed one or more diabetic complications.

The prevalence of diabetic complications is presented in Figure 1. In this figure it is shown that Diabetic ketoacidosis (DKA) was frequently observed in 40.5% of the study participants. The second highest prevalent complication was diabetic neuropathy (24.3%) followed by hypoglycemia (16.2%), diabetic nephropathy (8.1%), cardiovascular disease (5.4%), retinopathy (2.7%) and sexual dysfunction (2.7%), respectively.

The prevalence of diabetic complications particularly diabetic retinopathy, cardiovascular disease and nephropathy among the study participants in the present study was lower as compared to the study done in Iran,[8] but it was comparable with that of the study done in Thailand.[9] The reason for lower report of the prevalence of cardiovascular disease and retinopathy in the present study could be partly due to lack of diagnostic facility (Retinal camera) and laboratory test (HbA1c) in ambulatory DM clinic to confirm the existence of such complications.
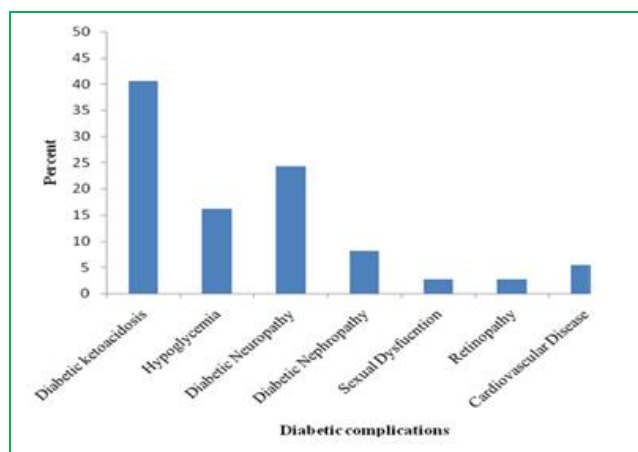

Figure 1: Prevalence of various complications of DM patients in ARH, Ethiopia, 2012

The prevalence of DKA in this study was comparable to the study conducted in Sudan[10] but lower than that of Tanzania.[11] The prevalence's of DKA and Hypoglycemia in this study were higher than those of studies done in United Arab emirate[12] and Thailand.[9] This clearly indicates that DKA is still a common diabetic complication in developing countries[13] even though it is one of the acute complications of DM which can be prevented through appropriate outpatient management,[14] High prevalence of DKA in this study might be explained from the basis of unaffordability of insulin, lack of device for self-monitoring of blood glucose level and inadequate health education.

Cost of illness of diabetes

As indicated in Table 3, total cost of illness of diabetes was estimated to USD 11530.68 in 2012. Of which, 92.48% was direct medical cost and 7.52% was direct non-medical cost. The average cost of illness per patient per year was USD 88.70. Range of cost of illness was USD 5.66 to 363.73. The highest value was obtained in a type 1 female diabetic patient on insulin treatment who developed DKA as complication, resides out of Mekelle and visited the DM clinic more than 12 times in the year 2012.

While looking at the components of different costs, the major component in direct medical cost was the drug cost, which accounted 73.1% of total cost of illness.

Table 3: Cost of illness of DM in ARH, Ethiopia, 2012

Type of costs	Total cost (USD)	Percent (%)
Direct Medical Cost	10663.74	92.48
Drugs	8426.29	73.10
Laboratory tests	1190.81	10.33
Personnel	422.44	3.66
Bed Occupancy	624.20	5.41
Direct Non-Medical Cost	866.94	7.52
Transportation	866.94	7.52
Total Cost of illness	11530.68	100.00

As clearly indicated in Table 4, insulin took lion's share of the direct medical cost of DM. It accounted 88.19% of the total drug cost and 64.45% of the total cost of illness of diabetes. Mean annual treatment costs of patients on insulin were about 4 times higher than the costs of those on non-insulin treatment (Table 5).

Demographic characteristics and cost of illness

Table 6 shows the costs of diabetes by various patient demographic characteristics. The average cost of illness for the male patients was USD 95.56 which is lower as compared to the average cost for female patients (USD 82.25). This result is in line with other study done in United Arab Emirates[12] and Thailand.[9]

The cost of illness varies significantly among different age groups (P < 0.05). The highest average cost of illness was found for the age group less than 35 years (USD 119.11) followed by age group 36-44 years (USD 79.56) while the lowest was for the age group 65-74 years (USD 44.47). This confirmed that the burden of the disease is highest for young population who are the most economically productive age group. This was in concordant with the

result obtained in Thailand.[9] The mean treatment cost of patient from out of Mekelle was calculated to be USD 121.53 compared to USD 77.98 for those from Mekelle (P < 0.05).This may be attributed to the additional cost of transportation that should be paid by patients from out of Mekelle and development of complications due to possible interruption of prescription re-fill.

Table 4: Total cost of drugs consumed by DM patients in ARH, Ethiopia, 2012

Drug	Total cost (USD)	% Total drug cost	% Total cost of illness
Insulin	7430.97	88.19	64.45
Metformin	443.46	5.26	3.85
Glibenclamide	82.13	0.97	0.71
Enalapril	247.95	2.94	2.15
Hydrochlorothiazide	49.79	0.59	0.43
Furosemide	26.19	0.31	0.23
Amitriptyline	7.22	0.09	0.06
Aspirin	30.21	0.36	0.26
Others*	108.37	1.29	0.94
Total	8426.29	100	73.1

*Others include Nifedipine, Atenolol, Propranolol, Aspirin, 40% Dextrose, Normal saline, 5%DNS, Amitriptyline, Multivitamin, Potassium chloride (KCl)

Table 5: Mean COI of DM patients on insulin treatment in ARH, Ethiopia, 2012

Treatment including insulin	n	Percent	Mean cost of illness (USD) ± SD	P- value
No	34	26.15	27.77 ± 11.18	< 0.001
Yes	96	73.85	110.28 ± 53.88	
Total	130	100	88.69 ± 59.11	

Table 6: Mean COI of DM by patients demographic characteristics in ARH, Ethiopia, 2012

Categories	Number (n=130)	Percent	Mean cost of illness (USD) ± SD	P-value
Age (Years)				
<35	56	43.08	119.11 ± 62.56	< 0.001
36-44	12	9.23	79.51 ± 59.96	
45-54	22	16.92	66.49 ± 46.61	
55-64	28	21.54	65.1 ± 40.39	
65-74	8	6.15	44.47 ± 29.11	
≥75	4	3.08	66.27 ± 32.18	
Gender				
Male	63	48.46	95.56 ± 56.36	0.201
Female	67	51.54	82.25 ± 61.30	
Residence area				
Mekelle city	98	75.38%	77.98 ± 53.29	< 0.001
Out of Mekelle	32	24.62%	121.53 ± 64.77	

Clinical Characteristics and cost of illness

The mean cost of illness by various clinical characteristics is presented in Table 7. The average costs were compared for sub groups of the duration of the disease and highest average cost was found for those who suffered from the disease for 16-20 years (USD 100.25). The mean cost of type-1 diabetes (USD 117.63) was significantly higher than (P < 0.05) that of type-2 diabetes (USD 54.95).

The cost of illness was also calculated for different fasting blood sugar levels. The highest mean cost was found for those whose current fasting blood sugar level was 300 mg/dl and above during-the study period. This is in agreement with the data presented somewhere else.[9]

The average cost for patients with co-morbid illness was lower (USD 79.34) as opposed to those without co-morbidities (USD 90.71). This result is unexpected; because co-morbidity is likely to increase the COI. This

could be due to the fact that most of the patients without co-morbid illness were on insulin treatment (82.3%) than those with co-morbid illness (17.7%) (Table 8). Cost of

illness of DM, in turn, was highly affected by insulin treatment as it is evidenced in Table 5.

Table 7: Mean COI of DM by patient clinical characteristics in ARH, Ethiopia, 2012

Categories	Number(n=130)	Percent	Mean cost of illness (USD) ± SD	P-value
Duration of the disease (years)				
1-5	92	70.78	89.99 ± 64.45	0.967
6-10	26	20.00	87.87 ± 45.89	
11-15	7	5.38	72.15 ± 48.39	
16-20	2	1.54	100.25 ± 60.59	
≥21	3	2.31	83.74 ± 8.55	
Type of diabetes				
Type 1	70	53.85	117.63 ± 58.11	< 0.001
Type 2	60	46.15	54.95 ± 39.25	
Fasting blood sugar level (mg/dl)				
< 70	9	6.92	94.13 ± 35.00	0.198
70 -130	32	24.62	69.54 ± 46.53	
131 -179	29	22.31	87.63 ± 71.84	
180 -299	42	32.31	83.97 ± 48.78	
≥300	18	13.85	132.78 ± 70.21	
Co-morbidity				
With co morbid	23	17.69	79.314 ± 37.78	0.405
Without co morbid	107	82.31	90.71 ± 62.72	
Complications				
With complication	33	25.38	125.78 ± 77.49	< 0.001
Without complication	97	74.62	76.08 ± 45.39	
Hospitalization				
Hospitalized	14	10.77	181.70 ± 82.00	< 0.001
Not hospitalized	116	89.23	77.47 ± 44.49	

Table 8: Treatment including insulin and co-morbid illness of DM in ARH, Ethiopia, 2012

			Co-morbid of DM		Total
			With co-morbid illness	Without co-morbid illness	
Treatment including insulin	No	Number	6	28	34
		Percent	17.6	82.4	100.0
	Yes	Number	17	79	96
		Percent	17.7	82.3	100.0

DM is a complex chronic illness that is associated with multiple complications which involve diverse organ system. Treatment of complications is a major part of the medical care of patients accounting for a large proportion of health care costs. In this study, the mean annual treatment costs of patients with complications were 1.65 times higher than the costs of those without complications (P < 0.05). This clearly indicates that, cost of illness was significantly affected by diabetes related complications. Similar conclusions have been drawn by other studies.[8, 12]

This study also revealed that 10.77% of DM patients were admitted to the hospital at least once for DM related complications in the study period and the mean cost for hospitalized patients (USD 181.7) was found to be significantly higher (p < 0.05) as compared to those of non- hospitalized ones (USD 77.47) (Table 7). This result is in concordance with the finding obtained in the study done in United Arab Emirate.[12]

CONCLUSION

The present study found that cost of illness of DM per patient/year is USD 88.70 and insulin accounted most of the drug cost and total cost of illness of the DM. It is also

indicated that diabetes with complications resulted about 1.65 times higher cost of illness than that of without complications. Type of diabetes, age, residence area of the patients, number of visit to diabetic clinic, and hospitalization due to diabetic complication were also found to affect the cost of illness. Generally, it can be concluded that diabetes presents a considerable burden to society in terms of health care costs. It is needless to say that emphasis should be given for the prevention of the disease and its complications.

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