WHAT IS THE COST OF ILLNESS OF TYPE II DIABETES MELLITUS IN A DEVELOPING ECONOMY?

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ABSTRACT

Objective: To determine cost of illness of Type II Diabetes Mellitus (DM) in a Developing Economy in 2010.

Methods: A one-year retrospective review of 960 prescriptions of 120 diabetic patients' case notes (10%) obtained by systematic random sampling from 1,200 case-notes of subjects that participated in this study was conducted. Sampling Interval =10. A Standardized data collection form was designed and used to collect and analyze data generated from the case notes. Cost of Illness was determined by prevalence rate method, using direct costs only.

Results: The annual cost of illness for the 96 diabetic patients on oral agents was N3, 678,384.95 ($24,579.68), with drug, diagnostic/monitoring tests, transport and personnel cost components of N2, 753,284.95 (74.9%), N150, 000 (4.1%), N525, 000 (14.3%) and N250, 100 (6.7%) respectively. The annual cost of illness for the 24 diabetic patients on insulin was N2, 072,538 ($ 13,817.59), with drug, diagnostic/monitoring tests, transport and personnel cost components of N1,739,538 (84.0%), N37, 500 (1.8%), N233, 000 (11.2%) and N62, 500 (3.0%) respectively.

Conclusions: The Annual National Cost of illness for diabetes mellitus in Nigeria, a developing economy may be about N226,152,196,630.00 ($1,521,014.644) i.e. about N225 billion annually while annual average cost of illness was N47, 924.95 ($319.50), representing 88% of annual *per capita* income.

Keywords: Cost of Illness Analysis, Type II Diabetes Mellitus, Developing Economy, Pharmaco-Economics.

INTRODUCTION

Allocation to health sector is increasing as a result of cost increment, not only because of growing population but also due to new health development, consequently, total healthcare spending and per capita spending is increasing. Furthermore, the advance in medical technology -"high-tech", diagnostic and therapeutic options have further complicated the financial picture. Although they offer the potential to improve quality of care, these advances have significantly increased hospitals operating costs.

Diabetes Mellitus is a chronic, incurable condition that affects 3% of Nigerian population [1]. There is evidence that prevalence of non-communicable diseases is increasing, including diabetes mellitus, which if not adequately managed, can result in a wide range of complications that have clinical, social and economic implications, especially due to decreasing age of onset. There exist impaired glucose tolerance (IGT) of 7.7% rate among Hausa-Fulani in North-Eastern Nigeria who has no history of diabetes mellitus. This would increase incidence of diabetes mellitus, as one in three individual with IGT will develop Type II diabetes mellitus [1]. Although, World Health Organization accorded priority status to diabetes mellitus, many public health planners remain largely unaware of its magnitude and the seriousness of its complications [2]. Of equal consequence, is the increasing prevalence of the disease and the long-term cost of therapy for both patients and the health sector, and its cost to nations in economic terms, due to the fact that use of anti-diabetic drugs in the management of diabetes mellitus is for lifetime of the patients from time of diagnosis. This translates into a substantial cost in drug therapy to the patients and government [3].

In addition, despite wide use of pharmaceuticals, few data exist regarding actual costs and benefits attributable to specific drug therapy. This problem may be attributed to lack of well defined methodologies to evaluate medical interventions. Lack of information on cost of illness of diabetes mellitus in literature prompted this study, which was aimed at determining cost of illness of Type II diabetes mellitus in University of Maiduguri Teaching Hospital, North-Eastern Nigeria, a developing economy in 2010.

Cost of illness Analysis is a form of pharmaco-economic tool. An illness consumes resources and, thus, it has a cost [4]. The cost of an illness is the sum of three components: The medical resources used to treat the illness (direct cost) e.g. hospital care, professional services, drugs and supplies, the non-medical resources associated with it (direct cost) e.g. transportation to treatment site and hiring of home care and lost productivity due to illness or disability (indirect cost). A fourth category, the intangible cost of pain and suffering, is often unquantifiable [4]. Pharmaco-economics has been defined as the description and analysis of cost of drug therapy to health care system and society [5].

MATERIALS AND METHODS

Choice and Description of Study Area

The study was conducted at the University of Maiduguri Teaching Hospital (UMTH), Maiduguri, Borno State, North-Eastern Nigeria. The Hospital was chosen because it was the only University Teaching Hospital in North-Eastern Nigeria, serving catchment states and 2010 projected population of Adamawa (3,551,898), Bauchi (5,345,611), Borno (4,859,516), Gombe (2,669,949), Taraba (2,556,750) and Yobe (2,664,076), representing 21,647,800 (14%) of 2010 projected national population (158,689,093) as at the time of this study.

Ethical Considerations

Ethical Approval was obtained from Research and Ethics Committee of UMTH.

Study Population and Sample Size

Type II diabetes mellitus patients that were registered with and attended the Diabetes clinic of UMTH were the subjects for the study. Their population from inception of UMTH in 1983 to December 2009 was obtained from Medical Record Department and was assumed /used as the estimate of the population size of serviced Type II diabetes mellitus patients. This was 2,528. Fischer's Formula [6] was applied to determine sample size from this estimate. The required sample size was 351. However, 1, 200 of estimated population were studied due to availability of resources and to reduce error.

Study Design

A one-year retrospective review of 120 (10%) randomly sampled case-notes out of a total of 1200 case-notes of the subjects that participated in this research work based on inclusion criteria was done.

Data Instrument

A pre-tested, standardized data collection form (Appendix I) was designed with columns for Code Number as the Patient's Hospital Number, date of visit, demographic data, detailed address, concurrent illness (s), fasting blood sugar on visit, blood pressure on visit, drugs prescribed with duration (generic/branded) on each visit and cost, diagnostic/monitoring tests on each visit and cost, transport cost on each visit (to and fro), personnel cost and total cost.

Data Collection

The study addressed Type II diabetic out-patients of the hospital. It involved review of 960 prescriptions. These were the prescriptions from case-notes of 120 Type II Diabetic Mellitus patients (10%) obtained by systematic random sampling (Sampling Interval=10) out 1, 200 case-notes initially obtained by systematic random sampling from case-notes of all registered diabetes mellitus patients (Sampling Interval=1). The review was over one year period (January to December, 2010).

The following data were noted and recorded from the case notes in to the data collection form (Appendix I): Date of Visit, demographic data, fasting blood sugar level at each visit, blood pressure at each visit, concurrent illness (s), number of visit and prescribed drugs (ant-diabetics and anti-hypertensives) at each visit as well as duration of therapy. Evidence of diagnostic/monitoring test were also noted and recorded.

Economic Perspective

Economic perspective of the subjects and the hospital were considered since the drug, diagnostic and transport costs were borne by the subjects while personnel costs were borne by the Hospital Management.

Cost Measure

Only the direct costs were considered. These include the cost of drugs, diagnostic/monitoring tests, transportation and personnel.

Drug costs were obtained from the pharmacy department of the hospital and the cost per defined daily dose (C/DDD) were calculated, taking the duration of therapy into consideration to obtain total cost of drug.

Cost per Defined Daily Dosage (C/DDD) units as recommended by World Health Organization (WHO) for analysis of drug use was applied. DDD represents usual dosage of a drug per day [7].

The costs of diagnostic/monitoring tests were obtained from the laboratory of the hospital. Time and motion studies were carried out to calculate the personnel costs for physicians, pharmacists and nurses. Average time for 15 random observations for completion of task such as consultation, dispensing and measurement of blood

pressure was determined and recorded.

The salary of health professionals were obtained form the accounts department of the hospital. The average was considered where necessary. The mean salary per minute was calculated as follow:

$$\text{Mean Salary/Minute} = \frac{\text{Annual Salary}}{\text{Hours/wk x no. of wks/annum x 60}} \quad \text{Equation 01}$$

[8], [9] and [10].

In the calculations, the respective number of visits were considered.

Cost of Illness Computation

• All these costs were added up for each subject, and for all the 120 subjects to obtain the total cost of illness for the 120 subjects. The average cost of illness (cost per subject) was then calculated and recorded.

• The average cost calculated is the annual average cost of illness for diabetes mellitus (DM).

• The annual cost of illness for diabetes mellitus in North-Eastern Nigeria =

Annual average cost of illness for DM X 21,647,800 (North-Eastern Nigerian Projected Total Population for 2010) X 3% (Prevalence Rate). equation 02

• The National (Nigeria) annual cost of illness for diabetes mellitus =

Annual average cost of illness for DM X 158,689,093 (National Projected Total Population for 2010) X 3% (Prevalence Rate). equation 03

Data Analysis

The collected data were analyzed and presented as frequency distribution tables.

RESULTS

Total Cost per year of Individual Drug for the 96 Diabetic Patients on Oral Agents

The total cost per year of individual drug for the 96 diabetics patients on oral agents and corresponding percentage of total drug cost to the 96 diabetic patients on oral agents are: N440, 780 (16.0%), N6, 768 (0.2%), N483, 560 (17.6%), N1, 185,730 (43.1%), N506, 863 (18.4%), N39, 900 (1.4%), N68, 000 (2.5%), N2, 550 (0.1%), N9,100 (0.3%) and N10, 033.95 (0.4%) for glibenclamide, chlopropamide, metformin, lisinopril, nifedipine, methyldopa, captopril, frusemide, hydrochloro-thiazide and aspirin respectively.

Annual Cost of Illness for the 96 Diabetic Patients on Oral Agents

The annual cost of illness for the 96 diabetic patients on oral agents was N3, 678,384.95, with drug, diagnostic/monitoring tests, transport and personnel cost components of N2, 753,284.95 (74.9%), N150, 000 (4.1%), N525, 000 (14.3%) and N250, 100 (6.7%) respectively.

Table 1: Total cost/year of individual drug for 96 diabetic patients on oral agents

Drug	Total Cost/Year Naira ($)	% of Total Drug Cost	% of Annual Cost of Illness	No. Patients involved	% of Patients involved
Glibenclamide	440,780 (2938.53)	16.0	12.0	94	97.9
Chlopropamide	6,768 (42.24)	0.2	0.2	2	2.1
Metformin	483,560 (3223.73)	17.6	13.1	90	93.8
Lisinopril	1,185,730 (7904.87)	43.1	32.2	84	87.5
Nifedipine	506,863 (3379.09)	18.4	13.8	37	38.5
Methyldopa	39,900 (266)	1.4	1.1	12	12.5
Captopril	68,000 (453.33)	2.5	1.8	11	11.5
Frusemide	2,550 (17)	0.1	0.1	10	10.4
Hydrochloro-thiazide	9,100 (60.67)	0.3	0.2	7	7.3
Aspirin	10,033.95 (66.89)	0.4	0.3	90	93.8
Total	**2,753,284 (18,352.35)**	**100.0**	**74.8**		

Table 2: Annual cost of illness for the 96 diabetic patients on oral agents

Cost Component	Total Cost Naira ($)	% of Annual Cost of Illness
Drug	2,753,284.95 (18,352.35)	74.9
Diagnostic/Monitoring Tests	150,000 (1,060)	4.1
Transport	525,000 (3,500)	14.3
Personnel	250,100 (1,667.33)	6.7
Total (Annual Cost of Illness)	3,678,384.95 (24, 579.68)	100.0

Total Cost per year of Individual Drug for the 24 Patients on Insulin

The total cost per year of individual drug for the 24 diabetics patients on insulin and corresponding percentage of total drug cost to the 24 diabetic patients on insulin are: N1, 636,000 (94.0%), N38, 560 (2.2%), N64, 100 (3.7%) and N978.00 (0.1%) for insulin, metformin, lisinopril and aspirin respectively.

Table 3: Total cost per year of individual drug for the 24 patients on insulin

Drug	Total Cost Naira ($)	% of Total Drug Cost	% of Total Cost of Illness	No. of Patients involved	% of Patients involved
Insulin	1,636,000 (10,906.67)	94.0	78.9	24	100.0
Metformin	38,560 (257.07)	2.2	1.9	18	75.0
Lisinopril	64,100 (427.33)	3.7	3.1	8	33.3
Aspirin	978 (6.52)	0.1	0.1	12	50.0
Total	1,739,538 (11,579.59)	100.0	84.0		

Annual Cost of Illness for the 24 Patients on Insulin

The annual cost of illness for the 24 diabetic patients on insulin was N2, 072,538, with drug, diagnostic/monitoring tests, transport and personnel cost components of N1,739,538 (84.0%), N37, 500 (1.8%), N233, 000 (11.2%) and N62, 500 (3.0%) respectively.

Table 4: Annual cost of illness for the 24 patients on insulin

Cost Component	Total Cost Naira ($)	% of Annual Cost of Illness
Drug	1,739,538 (11,597.59)	84.0
Diagnostic/Monitoring Tests	37,500 (250)	1.8
Transport	233,000 (1,553.33)	11.2
Personnel	62,500 (416.67)	3.0
Total (Annual Cost of Illness)	2,072,538 (13,817.59)	100.0

DISCUSSION

The annual average cost of illness (CI), N47, 924.36 ((**$319.50), represent about 88% of annual per capital income in the country (Nigeria), using report of per capita income of less than 1USD per day [11], [12]. This average CI takes into account only the direct costs of therapy: the procurement cost of drugs, transport cost, cost of diagnostic/monitoring test(s) and personnel cost. Spending 88% of per capital income on disease management is a great burden. In this case, we are even talking about diabetes mellitus only. The indirect cost, loss productivity was excluded in the analysis.

The total cost of drugs was N4, 492, 822.95 ((**$29,931.94) (78.1%) of total cost of illness. This is enormous. Therefore, any measure taken to promote more rational drug selection such as economic evaluation of therapy (CMA and CEA), provision of regularly up-dated formulary and evidence-based standard treatment guidelines will be invaluable in promoting efficient use of limited resources.

About 77% of the patient had hypertension as concurrent illness and were placed on antihypertensive drugs as well, which form part of the drug cost (N1, 876, 542.05; 41.8%). Out of this amount, the cost of lisinopril alone was N1, 249, 830 (66.6% of antihypertensive drug cost; 27.8 % of total drug cost). Lisinopril has a cost per /DDD of between N30 (2.5mg o.d.) to N180 (15mg o.d.) and was prescribed for 92 patients.

The fact that lisinopril has been shown to stabilize renal function in hypertensive diabetics might be responsible for its high degree of usage [13], [11]. Screening of patients for those at risk of nephropathy might be beneficial as well as subsequent regular monitoring of their renal function [13], [11]. High cost of therapy may lead to poor compliance by some patient, leading to other complication in addition to renal problems, which will adversely affect their quality of life. Affordability by patient may be the determinant of choice of therapy for core poor patient even if it is only moderately efficacious.

The total cost of anti-diabetic agents was N2, 605, 268.95 (57.99% of total drug cost and 45.30% of total diabetes cost) out of which insulin (for 24 patients; 20%) was N1, 636, 000 (36.41% of total drug cost). Insulin has a cost/DDD of between N230.00 (10 unit o.d.) to N700.00 (30 units o.d.).

Measures such a diabetic compatible life style, improved compliance to medication and dietary modification need to be taken in order to prevent complications of diabetes. Other modalities include possible home visits by social workers and pharmaceutical care by neighborhood registered pharmacy. These are not without costs, and should be weighed against the benefits as well as affordability by patients. It can equally be restricted to selected patients. Enlightenment of patients on grave implications of non-compliance is important. Patients and public enlightenment patient on dietary habits is of absolute necessity.

Aspirin was prescribed in 85% of the patients and cost just N11, 011.95. This is in order as it prevents/minimizes incidence of cardiovascular disease such as thrombo-embolic disorders [14].

With an annual average cost of N47, 924.36, the cost of treating

1000 cases will be N47, 924,360. Given a prevalence rate of about 3% in the country, with a projected 2010 population of 158, 689, 093 from 2006 census [15], About 4, 760, 672 people or more may be suffering from diabetes mellitus. The annual national cost of illness for diabetes may be about N226,152,196,630.00 ($1,521,014.644) i.e. about N225 billion annually. In North-Eastern Nigeria alone, with 2010 projected population of 21,647,800, The annual cost of illness for diabetes may be N31,123,708,812.00 ($207,491,392). This which is believed to be under estimated, because of prevalence rate of 3% used and the non inclusion indirect cost (cost due to morbidity, disability, premature mortality and loss of productive output etc) is a lot. Indirect costs are difficult to evaluate, but it may be as high as the direct cost [16].

Impaired glucose tolerance (IGT) of 7.7% rate among Hausa-Fulani in North-Eastern Nigeria who has no history of diabetes mellitus has been reported [1]. It was opined that this would increase incidence of diabetes mellitus, as one in three individual with IGT will develop Type II diabetes mellitus. Although World Health Organization accorded priority status to diabetes mellitus, many public health planners remain largely unaware of its magnitude and the seriousness of its complications [2]. Of equal consequence, is the increasing prevalence of the disease and the long-term cost of therapy for both patients and the health sector, and its cost to nations in economic terms, due to the fact that use of anti-diabetic drugs in the management of diabetes mellitus is for lifetime of the patients from time of diagnosis. This translates into a substantial cost in drug therapy to the patients and government [3].

Government need to do something urgently such as massive, intensive and sustainable public enlightenment, improved policy on diabetes care and feeding habits among others, not only because of the enormous cost associated with its therapy but also because of skyrocketing prevalence rate which will further compound the cost problems and affect productivity [17].

The fact that poverty is on the increase is no longer new and is another reason to be more proactive. The percentage of core poor, rising from 6.2% in 1980 to as high as 29.3% in 1997 and reaching 58.2% in 1999 is a cause for concern [18]. In United Nation Development report, about 70.18% (93.2 million) Nigerians live below the poverty line, earning less than 1US$ (about N149.00) per day [19]. This is worrisome.

Diabetes is widely known to be on increase world wide and Africa will be the most affected [17]. More so, low income, uneducated and poor people are more effected [20], [21], hence, instituted therapy should be as cost-effective as possible. Effective policy, adequate information education and communication (IEC) strategy must be put in-place to safe guard the health of the nation from ruin by diabetes mellitus among other chronic illnesses. About 8.7% of acute sector fund for diabetes mellitus in the UK has been reported with an average of £2,101 cost per year for resident with diabetes mellitus compared with £308 per year for resident without diabetes mellitus [22].

With increasing HIV/AIDS epidemics, hypertension, tuberculosis, malaria and their attendant costs, increase cost of therapy for other chronic condition like diabetes can further cripple the depressed economy, hence limited resources must be use more wisely through economic evaluation of therapeutic options among others [23], [24], [25], [26].

CONCLUSION

The Annual National Cost of illness for diabetes mellitus in Nigeria, a developing economy may be about N226,152,196,630.00 ($1,521,014.644) i.e. about N225 billion annually while annual average cost of illness was N47, 924.95 ($319.50), representing 88% of annual per capita income which is enormous. Developing Economy such as Nigeria require free or adequately subsidized diabetes management along with preventive promotion initiatives by Government.

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Appendix I: Data Collection Form for Cost of Illness Analysis

Visit S/N	Date of Visit	Patient's Code Number	Age	Sex	Detailed Address	Concurrent Illness	FBS (mmole/litre)	B.P. (mm Hg)	Prescribed drugs on visit (anti-diabetics & antihypertensives), Duration & Total Cost	Diagnostic/Monitoring	Transport Cost (To &	Personell Cost	Total Cost