



A Comprehensive Analysis of the Financial Burden of Diabetes Mellitus at Rafik Hariri University Hospital: The Economic Implications from the Public Sector Perspective in Lebanon

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Abstract

Background and Aim: Diabetes Mellitus (DM) is a pandemic health problem with an unprecedented number of patients reaching hundreds of millions, and characterized by the vascular complications and premature mortality incurring a high cost of management. The aim of this study was to assess the economic burden of DM management and its complications in Beirut through comparing the hospitalization cost for patients with DM to that of patients not suffering from DM.

Methods: Data were extracted from the electronic records of patients admitted to the largest public hospital in Beirut between January and March of 2009.

Results: A total of 3626 patients with an average age of 45.9 years were admitted, of which 679 (18.7%) were suffering from DM according to the records. The prevalence of hospital re-admission was higher among patients with DM as compared to patients without DM. Moreover, the duration of stay in the hospital was almost twice as much among patient with DM as compared to patients without DM. The average cost of admission for patient with DM \$2,804 was higher than that of patients not suffering from DM \$1,641.

Conclusion: Higher cost of hospitalization among patients with DM can be attributed to the lack of disease control which might have results in more complications. Public Health interventions should target patients and health care workers in order to improve the management of the disease and prevent complications and thus reduce cost.

costs” (reduced labor force, absenteeism, chronic disability, premature death) but also owed to the intangible cost of the suffering and reduced quality of life of the patients, and their families [1].

Worldwide, the cost of DM management in 2013 as per the International Diabetes Federation (IDF) [2] is \$548 billion with a mean expenditure of \$1,436 in adults between 20 to 79 years of age. The estimated cost in the Middle East and North Africa (MENA) region was \$14 billion with a mean expenditure of \$684 in the same age group. This burden of DM management has been confirmed in several studies. Kirigia et al. (2009) [3] estimated the economic burden of DM in the countries of the World Health Organization (WHO) African Region to be \$25.51 billion covering 7.02 million cases of DM in 2000. This is equivalent to an average of \$3,633 per patient with huge direct costs (mainly due to insulin treatment) as well as indirect costs (manifested mainly by permanent disability).

Analysis of medical expenditures in several countries showed that the costs of managing people with DM are substantially higher than those associated with non-DM individuals. This is due to the costs resulting from the increased likelihood of the development of further complications among DM patients [4].

The annual direct cost, to control the disease and to prevent chronic DM complications, paid by DM patients in Sudan, a low-income country, was estimated to be around \$175 including the cost of drugs and ambulatory care visits [5]. In Al-Ain City, United Arab Emirates (UAE), Al-Maskari et al. [6] estimated the mean direct annual treatment costs of DM management and its related complications to be \$7,025 per Gulf Cooperation Council (GCC) patient compared to \$5,645 per UAE patient and \$4,304 per Asian patient. The presence of micro-vascular complications alone, macro-vascular complications alone, or both accounted to 2.2, 6.4, and 9.4 times higher annual treatment costs, respectively, than

Background on the burden of Diabetes Mellitus

Diabetes Mellitus (DM) imposes a pronounced socio-economic burden to any healthcare system [1]. This is not only owed to the tangible medical expenditure defined as “direct costs” (hospital inpatient care, ambulatory visits, medication...); and as “indirect

Table 1: General Demographics and Clinical Characteristics of all Patients

Characteristics of Admitted Patients			
	Patients with DM	Patients without DM	All Patients
Number of Patients (%)	679 (18.7)	2947 (81.3)	3626 (100)
% of Female Patients	47.3	53.6	52.4
Mean Age in years	64.9	41.6	46.0
% of Previously Admitted Patients	51.1	35.4	38.4
Mean Number of Previous Admissions	1.62	1.46	1.49
Mean LOS in days	9.3	5.6	6.3
% of Patients with FBS Obtained	52	21.7	27.4
Mean FBS mg/dl	165.1	100.9	123.7
% of Patients with HbA1C Obtained	42	1.6	9.2
Mean HbA1C %	8.57	5.9	8.19

Table 2: Length of Stay in Groups

LOS	Patient without DM	Patients with DM	All Patients
0 to 7 Days	80.70%	60.10%	76.90%
8 to 14 Days	12.00%	24.30%	14.30%
15 to 21 Days	3.40%	8.20%	4.30%
22 to 28 Days	1.50%	2.70%	1.70%
29 to 35 Days	1.00%	1.80%	1.10%
36 to 42 Days	0.40%	1.00%	0.50%
43 to 49 Days	0.30%	0.40%	0.40%
More than 50 Days	0.70%	1.50%	0.90%
Total	100.00%	100.00%	100.00%

without complications mainly due to hospitalization cost and overall complicated treatments.

Data describing the burden of DM management and healthcare expenditures on DM in the countries in the Eastern Mediterranean and North African Region are sparse. In Tunisia, Rekik et al (1994) [7] found that DM patients used health resources more than non-DM patients with 2.6 times higher total annual cost (US\$179 versus US\$68) covering medication and outpatient care expenses. Patients with DM visited the department of general medicine twice as often as non-DM patients, underwent more laboratory tests, received more treatment procedures, and even spent about three times more money on medications (\$62 per year).

The Situation of Diabetes Mellitus in Lebanon

In Lebanon the prevalence of DM is relatively high. In 2005, Hirbli et al. [8] reported a combined prevalence of DM of 15.8% (95% CI: 14.5%-17.1%) among people 40 or more years and living in Greater Beirut. The IDF estimated the comparative prevalence of DM in Lebanon to be 14.99% in 2013 [2]. This high prevalence might be due to large increase in the sedentary life style and change in diet among people living in the city. But despite this relatively high prevalence of the disease there are no studies on the cost of DM management in Lebanon whether direct or indirect cost.

The aims of this study are to quantify the economic burden of DM management and its complications based on hospital admissions and their cost for those patients and compare it to patients not suffering from DM.

Study Design

This is a retrospective, cross sectional, descriptive study that was conducted at Rafik Hariri University Hospital (RHUH) in Beirut. RHUH is considered the biggest public hospital in Lebanon. Electronic charts of all patients admitted to RHUH between January 1st 2009 and March 31st 2009 were utilized. The only inclusion criterion was being admitted to RHUH during the months of January, February, and March of 2009. Each admission was considered as a new patient.

Source of Data

Data were extracted, with the help of the information technology department, from the electronic medical records of 3626 patients admitted to RHUH between January 1st and March 31st 2009.

The following variables were recorded: patient's medical record number, age, gender, dates of admission and discharge, reason for admission, final primary diagnosis, other current medical diagnoses (up to four major and five minor). In addition, past medical history including DM status, Fasting Blood Sugar (FBS) and Glycated Hemoglobin (HbA1c), family history of DM, number of previous hospital admissions, and the direct cost of hospitalization (total bill) were obtained. Length of stay in the hospital was computed as the time between admission and discharge. Direct costs were not available for 34 (< 0.1%) of the patients. Medical diagnoses were coded according to International Classification of Diseases 10th Revision (ICD-10) [9].

Statistical Analysis

Demographic and clinical characteristics of patients were summarized using means and standard deviations for numeric variables such as age and HbA1c and frequency distributions for categorical data such as gender. The Chi-squared test was used to compare categorical variables such as the rate of previous readmission between patients with and without DM while the independent t-test was used for numeric variables such as length of stay. Results from FBS and HbA1c are only summarized with no statistical comparisons due to the large number of missing values. The average cost of hospitalization was compared between patients with DM and those not suffering from DM using the independent t-test. All analyses were carried out using the Statistical Package for Social Sciences (SPSS, version 17, Chicago, USA). Significance was set at the 5% level.

Results

Patients

The mean age of the admitted patients was 45.95(± 24.70) years with majority females (52.4%). The mean age of the 679 (18.7%) patients with DM was 64.87 (± 13.47) with majority being males (52.7%). DM was prevalent among 20.7% of the male and 16.9% of the female patients. Among the 2350 patients with available data on family history of DM, 394 (16.8%) reported it as positive. Positive family history of DM was higher among patients with DM (28%). More than half (51.1%) of the patients with DM had been previously admitted to the hospital as compared to only 35% of the patients with no DM. Patients with DM had significantly higher rate of previous admissions as compared to patients with no DM (51.1% vs. 35.4%, $p < 0.001$). General characteristics of the patients are shown in table 1.

Length of stay

The mean length of the hospitalization stay for all the patients was 6.25 ± 10.39 days. It was significantly higher among patients with DM as compared to those without DM (9.32 ± 13.74 vs. 5.55 ± 9.31 days, $p < 0.001$). The percentage of patients with DM who were discharged within 7 days of hospitalization was significantly lower than that of patients not suffering from DM (60.1% vs. 80.7%, $p < 0.001$) table 2. For longer durations of stays at the hospital, the percentage of patients with DM was significantly higher than that of patients not suffering from DM (for example 24.3% vs. 12.0% $p < 0.001$ for 8-14 days of stay).

Table 3: Primary diagnosis for patients with DM

Disease grouping	N
Diseases of the nervous system (G00-G99)	13
Diseases of the skin and subcutaneous tissue (L00-L99)	11
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00-R99)	23
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (D50-D89)	7
Endocrine, nutritional and metabolic diseases (E00-E90)	126
Diseases of the musculoskeletal system and connective tissue (M00-M99)	24
Certain infectious and parasitic diseases (A00-B99)	10
Diseases of the respiratory system (J00-J99)	73
Diseases of the genitourinary system (N00-N99)	39
Diseases of the circulatory system (I00-I99)	163
Diseases of the digestive system (K00-K93)	34
Injury, poisoning and certain other consequences of external causes (S00-T98)	24
Factors influencing health status and contact with health services (Z00-Z99)	31
Mental and behavioural disorders (F00-F99)	1
External causes of morbidity and mortality (V01-Y98)	1
Neoplasms (C00-D48)	48
Pregnancy, childbirth and the puerperium (O00-O99)	5
Congenital malformations, deformations and chromosomal abnormalities (Q00-Q99)	1
Diseases of the eye and adnexa (H00-H59)	45
Diseases of the ear and mastoid process (H60-H95)	0
Certain conditions originating in the perinatal period (P00-P96)	0

Laboratory Studies

Recorded values of FBS and HbA1c were only available for 27.4% and 9.2% of all admitted patients respectively. For patients suffering from DM the values were available for only about half of the patients (52.0% FBS and 42.0 HbA1c). Among patients where data was available, the mean levels of FBS and HbA1c were significantly higher among patients suffering from DM as compared to those not suffering from DM (FBS 165.1 ± 85.4 vs. 100.9 ± 29.4 and HbA1c 8.57 ± 2.29 vs. 5.94 ± 0.95). Although their records didn't report it but according to the available lab tests, some of the patients who didn't have a DM diagnosis were suffering from high levels of FBS and HbA1c (2.51% according to FBS being $> 130\text{mg/dl}$ and 0.07% according to HbA1c being $> 7\%$). Finally among patients with DM and available HbA1c records, the majority (63%) have values above 7% indicating uncontrolled disease.

Primary Diagnosis

Patients with DM were admitted to the hospital for the following main reasons: diseases of the circulatory system, endocrine, nutritional, and metabolic diseases, followed by neoplasm and diseases of the eye and adnexa (Table 3).

Cost of Diabetes Mellitus Management

The average cost of admissions, serving as a proxy for cost of disease management, was significantly higher among patients with DM as opposed to those not suffering from DM ($\$2,804 \pm 4146$ and $\$1,641 \pm 2984$ $p < 0.001$).

Discussion

The study showed that among patients admitted to the largest public hospital in Beirut; those suffering from DM had longer duration of stay and an average cost higher than that of those not suffering from DM. This large economic burden of DM management in Lebanon is similar to that reported in other developing countries where treating DM patients was reported to be more expensive than of patients not suffering from DM [10].

The calculated mean cost of hospitalization for DM patients was much higher than the estimated healthcare spending per DM patient in low- and middle-income countries at $\sim \$200$ [2]. It was even more than IDF reported cost per DM patient both worldwide, $\$1,436$, and the MENA region, $\$684$ ($\$14$ billion for 34.5 million DM patients), in 2013. However, studies in the region revealed higher annual treatment costs of DM and its related complications at $\$7,025$ per GCC patient, $\$5,645$ per UAE patient, and $\$4,304$ per Asian patient [6] living in the

UAE. Also, in the countries of the WHO African Region the cost per patient was estimated to be $\$3,633$ [3].

In this study, the majority of DM patients with reported lab results didn't have their disease under control. This might have led to micro and macro-vascular complications thus explaining the higher admission rates, longer lengths of stay, and further resource use by diabetic patients [4].

The increased number of admissions and longer duration among the patients with DM has also been reported in the literature. According to the International Diabetes Management Practice Study (IDMPS) by Ringborg et al. (2009) [4], Patients with DM in the MENA had on average 2.6 ± 13.5 inpatient hospitalization days per year. In the same region, the expected annual rate of hospitalizations for patients with micro vascular complications was 2.4 times greater than those without micro vascular complications. Resource use was highly associated with uncontrolled HbA1c levels of $\geq 7\%$. Also the expected annual rate of hospitalizations among inadequately controlled patients was 4.6 more than among those with controlled HbA1c. Similarly, uncontrolled HbA1c was associated with increased rates of inpatient hospitalization days and absenteeism.

Limitations and Strength

The study was done in only one hospital and one region in Lebanon and hence results might not be representative of the whole Lebanese population. However, RHUH is the largest public hospital in Lebanon and caters to a wide range of patients from different regions. Moreover, the prevalence of DM among the admitted patients was 18.73% slightly higher than those reported in other studies in Lebanon maybe due to the fact that patients attending public hospitals tend to be of lower socioeconomic levels where previous studies indicated higher prevalence of DM [10,11]. Moreover, the difference observed between males and females (20.74% among males and 16.89% among females) is in alignment with the results of previous studies [11,12]. The burden of DM management covered in this study is only a part of the total burden since the cost of disease management paid by the patients and their families outside the hospital setting were not accounted for. Even more, estimation of indirect costs could not be done. Since each admission was considered as an independent patient prevalence of DM obtained from this study might be overestimated since those patients are more likely to be admitted more than once (as per this data). On the other hand, the lack of available data on FBS and HbA1c might even cause an underestimation of such prevalence. The duration of the study of only 3 months might have rendered some of the results not accurate and a more comprehensive larger duration

might be needed to get a more accurate results. The large number of unavailable values of FBS and HbA1c in the records rendered it impossible for us to validate the status of patients being suffering from DM or not and hence we only relied on what is recorded by the physician in the records and not the lab tests.

Despite all limitation, this is the first study of its kind in Lebanon. It utilized data available from electronic data bases of patients. This study can serve as a baseline for future studies and for evaluating trends over time. This study also highlighted the status of the disease in those patients where the majority need help in controlling the disease so that we decrease co morbidities and hence cost.

Conclusion

The higher number of admissions, longer duration of hospitalization and higher cost for disease management among DM patients are indicative of the high burden those patients put on the health system. In order to improve the situation, intervention should target those patients to help them control the disease better and thus lower admissions and repeated admissions to the hospitals. Also research should target a better estimate for the cost per patients in order to see if there is a misuse of the public health system in Lebanon in terms of maybe unnecessary longer durations of stay, unnecessary readmissions, and non-evidence based hospital services or other possible factors. Interventions should also target better monitoring and control of DM status through regular FBS and HbA1c tests. Almost half of the patients admitted were missing the results of those tests which imply variability in providing care for patients, as well as, in following the treatment protocols by the treating physicians. Hence, standardization of care is a must for better control and future evaluation of diabetes mellitus.

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Ethical consideration

Extraction of the data was done only after the approval of the medical administrator, and the patients were only identified by their medical number, with no access of the research team to their names or any personal data.

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