

Anti-Diabetic Medication Cost of Type 2 Diabetic Patients at Tertiary Center in Malaysia

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ABSTRACT

Introduction: Diabetes mellitus is a chronic disease that has been recognized by the Malaysian government as a major public health problem with far reaching consequences not just for its adverse impact on the health of Malaysians, but also for the economic burden it places on the health care system.

Objective: To identify anti-diabetic medication cost of type 2 diabetes mellitus treatment for outpatient visit in a teaching hospital.

Methodology: Anti-diabetic medication cost was determined by conducting a retrospective audit on 1077 patient medical records at Universiti Sains Malaysia (HUSM) Teaching Hospital in Kelantan.

Results: Hospital Universiti Sains Malaysia (HUSM) spent approximately RM1, 102,738 for anti-diabetics medications for study population in 2008. The analysis show that average cost of medication per patient per year was RM 1, 023.8.

Conclusion: The cost of anti-diabetic drugs is the high. The most commonly prescribed anti-diabetic treatment regimen for type 2 DM was gliclazide in combination with metformin. Much attention and effort should be directed towards determining the burden of diabetes in the HUSM in economic terms.

Keywords: Type 2 diabetes mellitus, Cost diabetic medication treatment, Outpatient, HUSM

INTRODUCTION

Diabetes mellitus is a chronic disease that has been recognized by the Malaysian government as a major public health problem with far reaching consequences not just for its adverse impact on the health of Malaysians, but also for the economic burden it places on the health care system. Diabetes mellitus presents a high burden for individuals and society. This burden is not only related to health care costs, but also to indirect costs caused by loss of productivity from disability and premature mortality. Medical expenditures for people with diabetes are 2-3 times higher than that for those not affected by diabetes [1].

Effective disease management programmes that aim to prevent complications could potentially lead to cost savings in managed care settings [2]. Hayward et al. [3] found that patients taking insulin had 2.4 more diabetic outpatient visits, used 300 more glucose test strips, and had slightly higher laboratory costs per year than patients receiving sulphonyl ureas.

Johnson et al. [4] found that metformin, alone or in combination, was the most frequently dispensed oral anti-

diabetic medication. A longer duration of diabetes was associated with increased use of oral medications and insulin therapy. Insulin was used in approximately 12% of patients with type 2 DM and was associated with approximately three times higher expenditure on diabetes testing supplies compared with patients on oral anti-diabetic medications [4].

Objective of study to identify anti-diabetic medication cost of type 2 diabetes mellitus treatment for outpatient visit in a teaching hospital.

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MATERIAL AND METHODS

Medications cost

This was the cost of anti-diabetic medications used in treating diabetic patients either oral anti-diabetic medications or insulin or combination of oral anti-diabetic medications and insulin therapies.

Cost calculation for anti-diabetic medications among type 2 diabetes mellitus patients

All costs were valued in year 2008 constant RM (RM3.21=1 USD). Medications cost was the anti-diabetic medications cost used in treating type 2 DM. All the anti-diabetics medications used in type 2 DM treatments within one year period (2008) were recorded in terms of their daily dose and frequency and totaled-up for one year duration. Drugs cost was calculated multiplying by their unit cost based on price taken from inventory units, HUSM pharmacy department.

Data entry and Statistical analysis

Data entry and analysis were conducted using statistical packages for social sciences (SPSS) version 12.0.1 (SPSS Inc., 2003).

Data were checked and explored. First, editing process was done, which include preliminary data screening (observing missing values) and correcting data points. The original data were reviewed again and the required changes if any error were made during the editing phase. The data set was then explored for the outliers by histogram, box plot and by statistical test. To confirm the presence of all the outliers, the researcher checked for the possibility of recording error and data entry process.

Distributions and frequencies of the independent variable were examined. Data exploration was done including

Table 1. Socio-demographic characteristics of type 2 diabetic patients.

Variables	n (%)
Gender	
Male	476 (44.2)
Female	601 (55.8)
Age (years)	
≤ 35 years	15 (1.4)
35-50 years	194 (18)
50-65 years	626 (58.1)
>65 years	242 (22.5)
Race	
Malay	916 (85.1)
Chinese	150 (13.9)

descriptive statistics. All continuous variables were expressed as mean and standard deviation for normal distribution and median and interquartile range for skewed data. Frequencies and percentages for categorical variables were calculated. Meaningful combination of categories was done when it was indicated.

In current study the cost of anti-diabetic medications were calculated for one year. Descriptive analysis was used.

RESULTS

A total of 1077 type 2 diabetic patients were involved in this study. Descriptive statistics were used to describe the sociodemographic characteristics of patients as shown in **Table 1**. The health and clinical characteristics of the patients are shown in **Tables 2 and 3**, respectively.

A total of 476 (44.2%) of patients in this study were males and 601 (55.8%) were females. According to racial distribution, 916 (85.1%) were Malay, 150 (13.9%) were Chinese and 11 (1.0%) were Indians. This proportion of ethnic group is generally representative of the Kelantan population. The age of patients recruited in this study range was from 18 to 88 years and was categorized into four groups. Majority 626 (58.1%) of patients in this study were in age group more than 50-65 years. This was followed by the age group of >65 years and 35-50 years which consisted of 242 (22.5%) and 194 (18%), respectively. Furthermore, the least affected group was ≤ 35 years 15 (1.4%).

Concerning the level of education, the literacy level of the patients was moderate. More than half of the patients 580 (53.9%) in this study had a lower level of education, whereas 497 (46.1%) patients had a higher level of education.

Indians	11 (1.0)
Smoking History	
Current smoker	66 (6.1)
Previous smoker	81 (7.5)
Never smoked	930 (86.4)
Alcohol History	
Current drinker	10 (0.9)
Previous drinker	6 (0.6)
Never drink	1061 (98.5)
Physical activity	
Active ≥ 150 min/week	471 (43.7)
Non active<150 min/week	606 (56.3)
Level of education	
Lower level of education	580 (53.9)
Higher level of education	497 (46.1)
Family history of diabetes	
Yes	141 (13.1)
No	936 (86.9)

Table 2. Health characteristics of type 2 diabetic patients.

Variables	n (%)
BMI (kg/m²) ADA	
Underweight: <18.5 kg/m ²	20 (1.9)
Normal range: 18.5-22.9 kg/m ²	179 (16.6)
Preobese: 23-27.4 kg/m ²	457 (42.4)
Obese I: 27.5-35.9 kg/m ²	364 (33.8)
Obese II: 35-39.9 kg/m ²	39 (3.6)
Obese III: >40 kg/m ²	18 (1.7)
BMI (kg/m²) Asia pacific	
Target: ≤ 23 kg/m ²	199 (18.5)
Non target: >23 kg/m ²	878 (81.5)
Waist Circumference Category AP (cm)	
Target (Male): ≤ 90 cm	100 (9.3)
Non target (Male): >90 cm	376 (34.9)
Target (female): <80 cm	50 (4.6)

Non target (Female): ≥ 80 cm	551(51.2)
Diabetes duration (years)	
<5 years	273 (25.4)
5-10 years	294 (27.3)
10-15 years	256 (23.7)
15-20 years	136 (12.6)
>20 years	118 (11)
HPT duration category (years)	
Free from HPT	79 (7.3)
< 3 years	184 (17.1)
3-6 years	288 (26.7)
6-9 years	159 (14.8)
>9 years	367 (34.1)
Cardiovascular history	
No disease	79 (7.3)
Hypertension	810 (75.3)
Hypertension +IHD	137 (12.7)
Hypertension+Cerebrovascular accident	51 (4.7)

Type of anti-diabetic medications used in type 2 diabetes mellitus patients

In this study most of the patients, a total of 747 (69.4%) were on oral anti-diabetic medications for management of

diabetes mellitus, while 255 (23.8%) were on combination of oral anti-diabetic medications and insulin and only 75 (6.8%) were on insulin injection alone (**Table 4**).

Table 3. Characteristics of clinical variables of type 2 DM patients.

Variables	n (%)	Mean (± SD)
HbA1c (%)		
Optimal: <7%	252 (23.4)	8.72 (± 2.34)
Fair: 7-8%	258 (24)	
Poor: >8%	567 (52.6)	
Fasting plasma glucose (mmol/l)		
Optimal: <6.7 mmol/l	498 (46.3)	7.89 (± 3.72)
Fair: 6.7-7.8 mmol/l	163 (15.1)	
Poor: >7.8 mmol/l	416 (38.6)	
PPG (mmol/l)		
Control: <10.0 mmol/l	634 (58.9)	10.03 (± 4.38)
Uncontrolled: ≥ 10.0 mmol/l	443 (41.1)	

Hypertension control		
Systolic blood pressure (mm Hg)		
≤ 120 mm Hg	332 (30.8)	135.98 (\pm 19.78)
120-139 mm Hg	289 (26.8)	
140-159 mm Hg	296 (27.5)	
≥ 160 mm Hg	160 (14.9)	
Diastolic blood pressure (mm Hg)		
<80 mm Hg	753 (69.9)	80.62 (\pm 9.83)
80-89 mm Hg	33 (3.1)	
90-99 mm Hg	213 (19.8)	
>100 mm Hg	78 (7.2)	
LDL cholesterol (mmol/l) ADA		
Normal: <2.6 mmol/l (<100 mg/dl)	493 (45.7)	2.82 (\pm 1.08)
Border high: 2.6-3.3 mmol/l (100-130 mg/dl)	285 (26.5)	
High: 3.4-4.1 mmol/l (131-200 mg/dl)	186 (17.3)	
Very high: >4.1 mmol/l (>200 mg/dl)	113 (10.5)	
Total cholesterol (mmol/l) ADA		
Target: <5.2 mmol/l (<200 mg/dl)	681 (63.2)	4.98 (\pm 1.17)
Non target: ≥ 5.2 mmol/l (≥ 200 mg/dl)	396 (36.8)	
Triglycerides (mmol/l) ADA		
Normal: <1.7 mmol/l (<150 mg/dl)	625 (58)	1.74 (\pm 0.85)
Border high: 1.7-2.3 mmol/l (150-200 mg/dl)	223 (20.7)	
High: 2.4-5.7 mmol/l (200-500 mg/dl)	229 (21.3)	
HDL cholesterol (mmol/l) ADA		
Target (Male): >1.0 mmol/l (40 mg/dl)	384 (35.7)	1.40 (\pm 0.54)
Non-target (Male): ≤ 1.0 mmol/l (≤ 40 mg/dl)	92 (8.5)	
Target (Female): >1.3 mmol/l (>50 mg/dl)	348 (32.3)	
Non-target (Female): ≤ 1.3 mmol/l (≤ 50 mg/dl)	253 (23.5)	
Creatinine Clearance (CrCl ml/min)		
Normal (Male): 145-95 ml/min	22 (2.0)	55.81 (\pm 22.31)
Abnormal (Male): <95 ml/min	454 (42.2)	
Normal (Female): 115-75 ml/min	78 (7.2)	
Abnormal (Female): <75 ml/min	523 (48.6)	

Table 4. Type of antidiabetic medications used in type 2 DM patients.

Diabetes mellitus medications	n (%)
Oral anti-diabetic medications	747 (69.4)
Oral anti-diabetic medications and insulin	255 (23.8)
Insulin	75 (6.8)

Pattern of anti-diabetic medications used in type 2 DM patients

Out of 1077 type 2 diabetic patients, 325 (30.2%) were on combination of metformin and gliclazide, 144 (13.4%) were

taking metformin, gliclazide and NPH insulin, 116 (10.8%) were taking combination of metformin, gliclazide and acarbose, 111 (10.3%) were taking metformin and mixtard insulin injection, while 89 (8.3%) were taking gliclazide alone and 86 (8.0%) were taking metformin only (**Table 5**).

Table 5. Pattern of anti-diabetic medications used in type 2 DM patients.

DM medication	n (%)
Metformin	86 (8.0)
Gliclazide	89 (8.3)
Mixtard insulin	73 (6.8)
Metformin + Gliclazide	325 (30.1)
Metformin + Mixtard insulin	111 (10.3)
Gliclazide + Acarbose	54 (5.0)
Metformin + Gliclazide + Rosiglitazone	79 (7.3)
Metformin + Gliclazide +Acarbose	116 (10.8)
Metformin + Gliclazide + NPH injection	144 (13.4)
Total	1077 (100.0)

The use of anti-diabetic medications among type 2 diabetes mellitus patients

Out of 1077 type 2 DM patients, most of patients 747 (69.4%) were on oral anti-diabetes medications for managements of diabetes mellitus, while 255 (23.8%) were on combination of oral anti-diabetic medication and insulin, and only 73 (6.8%) were on insulin injection. The 248 (23.1%) were prescribed with single anti-diabetic agents; 490 (45.5%) were prescribed two drugs-class anti-diabetic agents and 339 (31.5%) were prescribed three combination of anti-diabetic medications.

Metformin was the main anti-diabetes drug class used, either as a single agent or in combination with gliclazide or insulin. Metformin was prescribed to 861 patients out of the 1077 subjects studied, which was about 80%. On the other hand, gliclazide was prescribed to 804 (75%) patients and emerged as the second main anti-diabetes drug class used in the present study. The use of anti-diabetic agents in HUSM was shown in **Table 6**.

Table 6. The use and cost patterns of anti-diabetic medications at HUSM.

Type 2 DM medications	n (%)	Cost of medications pattern
Metformin	86 (8.0)	97199.98
Gliclazide	89 (8.3)	95317.37
Mixtard insulin	73 (6.8)	76303.43
Metformin + Gliclazide	325 (30.1)	311832.58
Metformin + Mixtard	111 (10.3)	122221.09
Gliclazide + Acarbose	54 (5.0)	59233.13
Metformin + Gliclazide + Rosiglitazone	79 (7.3)	81522.51
Metformin + Gliclazide + Acarbose	116 (10.8)	109104.29
Metformine + Gliclazide + NPH insulin	144 (13.4)	150003.69
Total	1077 (100)	1,102,738.07

Cost analysis of anti-diabetic medications for type 2 diabetes mellitus

Hospital Universiti Sains Malaysia (HUSM) spent approximately RM1, 102,738 for anti-diabetics medications

Table 7. Total annual cost of anti-diabetic medications in 2008.

DM medication	Total Cost	%
Metformin	100827.49	9.1
Gliclazide	157287.49	14.3
Mixtard	414925.49	37.6
Acarbose	166511.12	15.1
Rosiglitazone	163563.83	14.8
NPH	99622.66	9.1
Total	1,102,738	100%

Type 2 DM is considered as one of the most prevalent and costly chronic conditions in the world. The costs and prevalence of this disease are increasing. The burden of diabetes on patients and the health care system is enormous and it is predicted that the incidence, prevalence, and costs associated with treating diabetes will rise [5-7]. The present study evaluated the annual direct medical costs for patients with type 2 DM during a follow-up period of one year. The current study provides valuable information to our health care providers and policy makers regarding the planning of health care programmes, particularly in the public sector. Furthermore, this is the first study in Malaysia to evaluate the annual direct medical costs in the HUSM. Diabetes causes a significant health burden for patients, and the care of this population is a substantial economic burden on society. A study by Al-Sadat [8] showed that medical expenditures for people with diabetes are two to three times

for study population in 2007. The analysis show that average cost of medication per patient per year was RM 1, 023.8 (**Table 7**).

higher than for those not affected by diabetes. In another study, Suhaiza et al. [9] reported that the annual costs of providing care were 2.4 times greater for diabetic members than for the non-diabetic group of the same age and sex.

DISCUSSION

The mean age of all of the patients was 58.3 years (\pm 9.8). This finding agreed with the study by King et al. [10], who found that most of the type 2 diabetic patients were older than 50 years. The onset of type 2 DM occurs at maturity, which is normally after age of 45 years. The major population in Malaysia consists of Malay people and the percentage of Malay diabetic patients was the highest in this study, located in the Malay populated state of Kelantan.

The use and cost of anti-diabetic medications patterns at HUSM

In this study, the most frequently used anti-diabetic medication was metformin (80%), which was used alone or in combination with other anti-diabetic medications, followed by gliclazide. The low cost of metformin might be the reason for the wide use of this drug. Gliclazide was prescribed to 75% of the patients and emerged as the second main anti-diabetes drug class used in the present study. Although the unit cost of gliclazide is expensive compared to other anti-diabetic medications, such as sulfonylureas and metformin, gliclazide was widely used either as a single agent or in combination therapy, probably because it was shown to increase insulin secretion, to be more protective against β -cell failure and to have anticytokine properties, and a study by Mamputu et al. [11] reported that gliclazide has anti-oxidative properties which might decrease vascular smooth muscle cell dysfunction and prevent cardiovascular diseases in type 2 DM patients.

For oral anti-diabetic combination therapy, the combination of metformin and gliclazide was used the most frequently. Out of all of the patients, 93% were on metformin or gliclazide alone or in combination and more than 61% were on combination therapy with gliclazide and metformin. The most commonly used combination therapy for type 2 diabetic patients in a study by DeFronzo et al. [12] was biguanide plus sulfonylurea. A found that the combination of gliclazide and metformin had the advantages of lipid lowering properties over the glibenclamide and metformin combination and that it was better in controlling the blood glucose level and reduced the risk of hypoglycaemia in comparison to glyburide. These might be the reasons why this combination therapy is used more frequently.

The cost of anti-diabetic medications

The anti-diabetic medication cost was as the dominant cost factor in the annual total treatment costs because it contributed to about 59.2% of the total treatment costs. The type of anti-diabetes agent used was the major factor affecting the annual treatment cost per patient. The use of expensive drugs such as mixtard insulin, acarbose and rosiglitazone caused the high annual treatment costs. Thus, the use of the treatment regimen depends on many other factors including the availability of the drugs, patient compliance, and the preference of the physician.

The results showed that insulin users incurred higher outpatient treatment costs per year per patient. This finding is similar to the findings of a previous study [13]. The use of insulin in patients in this study was limited. There were 6.8% who used insulin alone, and only 23.8% used insulin combined with oral anti-diabetic medications. It was found that the cost of anti-diabetic treatment in the present study was RM 1,102,738 and the cost of anti-diabetic medications per patient in 2008 was estimated to be RM 1023.9.

CONCLUSION

The cost of anti-diabetic drugs constitutes the highest proportion of the costs. The most commonly prescribed anti-diabetic treatment regimen for type 2 DM was gliclazide in combination with metformin. Thus, it is impossible to avoid the costs incurred in maintaining blood glucose control. Much attention and effort should be directed towards determining the burden of diabetes in the HUSM in economic terms. The present study recommends that more time, money and attention must be given to the treatment of diabetic patients.

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