

Financial Report of Medical Costs Associated with Type-2 Diabetes Mellitus in Vietnam using Hospital Administration Database, 2012-2015

TRUNG QUANG VO¹, QUYNH THI HONG HA², THUY VAN HA³, HA THI THU NGUYEN⁴

ABSTRACT

Introduction: Diabetes mellitus is among the top ten causes of death and disability, leading to a large economic burden worldwide.

Aim: To estimate the cost of treating Type-2 Diabetes Mellitus (T2DM) from both the third-payer and patient perspective in a public hospital in Vietnam for the period 2012 to 2015.

Materials and Methods: A study was conducted using retrospective data from District 9 Hospital in Ho Chi Minh City, Vietnam from January 2012 to December 2015. Demographic information and treatment costs were collected from medical records stored in the hospital's electronic databases. Treatment costs including the cost of medical examination, diagnosis, pharmaceuticals, procedures and medical supplements was performed by using descriptive statistics. Kruskal-Wallis test

and Mann-Whitney test were used to compare costs between patients groups.

Results: The average cost per patient for the period 2012 to 2015 was 49.02 (63.65) USD, of which third-payers disbursed 25.28 (33.27) USD, and patients paid 23.74 (36.48) USD. The patients who aged from 60 to 69 paid the highest cost (72.00 USD per patient). Female patients had a significantly higher average treatment cost than did male patients, 55.40 (68.27) USD and 36.57 (51.75) USD, respectively. Patients in the group with a blood glucose level ≥ 180 mg/dL had an average treatment cost of 69.93 (80.27) USD and were the highest in all groups of blood glucose levels.

Conclusion: This study estimated the cost of treatment for patients with T2DM in order to be a reference for the government to adopt more appropriate diabetes mellitus management policies.

Keywords: Cost-of-illness, Diabetes mellitus, Direct cost, Hospital, Vietnam

INTRODUCTION

Diabetes mellitus is a complex chronic disease that can cause deformation danger. Individuals with diabetes mellitus need regular health monitoring to minimize the risk of death [1]. If a patient does not pay attention to the disease, diabetes mellitus can lead to blindness, kidney failure, ulcers and other serious consequences, which greatly decrease the patient's quality of life [2]. Thus, the patient not only pays the treatment cost of diabetes mellitus but the necessary and expensive cost to treat its complications [3]. Diabetes mellitus listed as one of four non-communicable diseases that need to be prioritized (the others are cardiovascular disease, cancer and chronic obstructive pulmonary disease) in the Policy Declaration on the Prevention and Control of Non-Communicable Diseases (NCDs) [2,4].

In 2014, the prevalence of diabetes mellitus in Southeast Asia and the Western Pacific region was 8.6% and 8.4%, respectively, which accounted for about half of cases in the world [2,3]. According to records from 2000 to present, medical costs for treatment of diabetes mellitus and its complications in the world account for 12% of total healthcare costs and are increasing significantly. Most countries spend from five to 20% of total health expenditures for diabetes mellitus [2,3]. The International Diabetes Federation (IDF) estimates that total global healthcare spending for diabetes mellitus doubled between 2003 and 2013. Estimated Gross Domestic Product (GDP) by 2030 for treatment of diabetes mellitus is 1.7 trillion US Dollars (USD) for both direct and indirect costs, of which countries that have high-incomes is about 900 billion USD and low- and middle-income countries are about 800 billion USD [5].

Vietnam is a country with an alarmingly high rate of diabetes mellitus growth-almost doubling in 10 years (2006-2016), with an average

of one in every 20 people diagnosed with diabetes mellitus and one out of every seven people in pre-diabetes today [6,7]. The proportion of people with diabetes mellitus is estimated to increase to 7% and people with pre-diabetes mellitus will increase to 15.7% by 2035. In 2015, Vietnam spent an average of 162.7 USD per person with diabetes, more than the average monthly income per capita in Vietnam of 150 USD [2,7].

This study aimed to give a complete picture of the treatment cost of type-2 diabetes mellitus. This study is a basis for the government to develop effective diabetes management policies and balance the cost of the fund's support of third-payers to help patients in the best way.

MATERIALS AND METHODS

Study Design

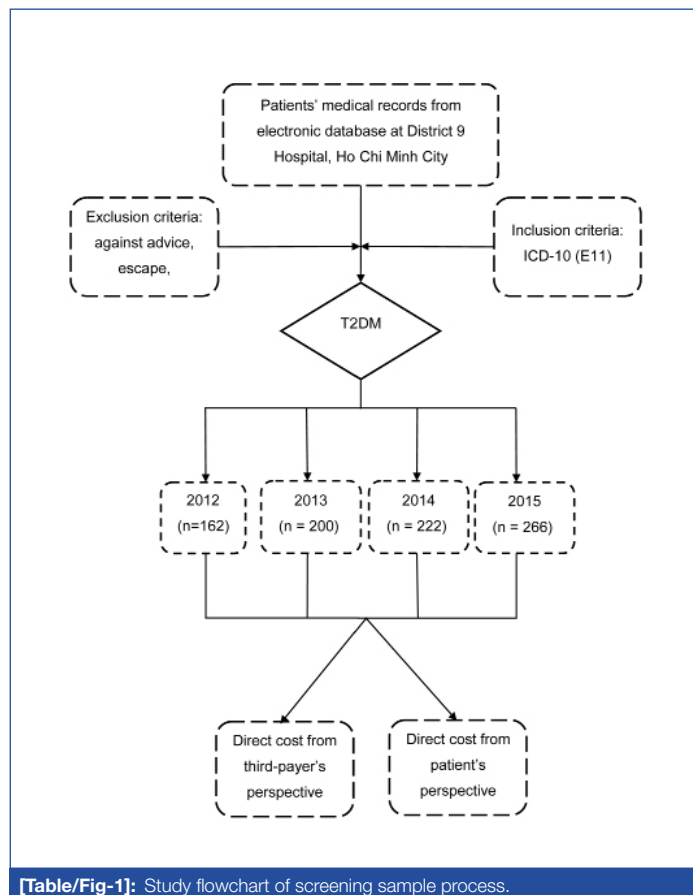
This was a retrospective cost study based on prevalence and focused on both patient and third-payer perspectives from January 2012 to December 2015 at District 9 Hospital in Ho Chi Minh City.

Data Collection

Data source: Patients' characteristics and cost data were collected from the hospital's electronic databases from 2012 to 2015. Patient characteristic included age (year), gender, third-party payer status (coverage percentage) and blood glucose level (mg/dL). In addition, the cost data included the discharge and the quantity of medical visits, pharmaceutical, laboratory/diagnosis test, procedures, medical supplements, and other administration medical activities of the hospital.

Inclusion and Exclusion Criteria

This study collected information records of patient treatment from the hospital's electronic database stored for the period 2012 to 2015, and then selected those following the assigned International Classification of Diseases, Tenth Revision (ICD-10) of E11. Outpatients with T2DM, patients with type-1 diabetes mellitus, women with gestational diabetes, patients who do not comply with the treatment protocol and voluntarily discontinued treatment, or those with unclear or missing medical record information were excluded [Table/Fig-1].



[Table/Fig-1]: Study flowchart of screening sample process.

Cost of Illness Measurement

Direct medical cost is defined as the medical care expenditures for diagnosis, treatment, and rehabilitation, and more. To investigate the distribution of costs across each cost component, resource utilization was divided into five categories including cost of visits to the medical employee, pharmaceutical costs, laboratory/diagnosis costs, procedure costs, and costs of medical supplements. All costs, which were from previous years, were converted to 2017 US dollar currency by using the Consumer Price Index (CPI) [8] and exchange rate of one USD for 22,698 Vietnam Dong (VND). The cost-of-illness estimates follow the sum-all cost method, and the annual cost per patient was measured [9].

STATISTICAL METHODS

Statistical analyses were performed using Microsoft Excel version 2010. Descriptive statistics (frequency, percentage, mean, median, standard deviation and 25-75th percentile) were used to summarize data on demographic characteristics, clinical status and cost components. Cost comparisons between groups were analysed by the Kruskal-Wallis test, and the Mann-Whitney test was applied to all pairwise comparisons. Statistical significance was considered when p-value < 0.05.

Ethical Statement

The research protocol was approved by the Biomedical Research Ethics Council at the District 9 Hospital in Ho Chi Minh City. Due to

the study's information running on the hospital's electronic record databases without patient contact, written informed consent from patients was waived. Data related to resources used were de-identified to minimize the risk of unintended disclosure of the individuals' identity and any information about them.

RESULTS

General Characteristics of the Study Population

From 2012 to 2015, 846 patients were included into analysis stage. The average age of people with diabetes treated at the hospital was 63.82±14.62 years. The youngest patient was 11-year-old, and the oldest was 95-year-old. The 60 to 69 age group had the most patients at 300 people (35.46%), and the group ≤39 years of age had only 25 people (2.96%). Overall, the proportion of people with diabetes in the survey aged ≥50 was much higher than age <50.

Research results showed clear differences between genders. Male patients accounted for 68.44%, nearly double the number of female patients (31.56%). All patient treatment at the hospital had third-party payers with three different support levels, while patients enjoyed the third-party payer 80% occupancy rate, with 76.24% at most (645 people), lower than the disease. The third-payer coverage was 100% for 22.81% (193 people), accounting for the lowest proportion of patients with 95% third-party payer coverage at 0.95% (eight people). All participants lived in Ho Chi Minh City, and the differences between age groups, gender, blood glucose level groups or third-payer groups were all statistically significant (p < 0.001) [Table/Fig-2].

Direct Medical Cost of Diabetes Episodes

Average annual direct medical cost of diabetes mellitus cases distributed by patient characteristics.

The average cost of treatment (presented consistently as Mean (SD) throughout the main text) was lowest in the ≤39 age group at a cost of 12.99 (10.03) USD, in which third-payer and patient costs were 6.55 (6.04) USD and 6.44 (6.02) USD, respectively. The 60 to 69 age group was significantly more likely to pay for the median treatment than was the ≤39-year-old group and was also the highest in the age group of 72.00 (75.18) USD, in which third-payer cost was 37.39 (39.68) USD, and the patient paid 34.62 (44.12) USD. The 70 to 79 age group patients also spent on average treatment location and the cost of treatment was 58.42 (72.28) USD. For the period 2012 to 2015, male patients treatment average cost was 36.57 (51.75) USD, including third-payer; the patient co-payment was 20.57 (28.38) USD and 16.00 (28.37) USD, respectively.

Female patients had a significantly higher average cost of treatment compared to male patients (p=0.003). The cost for the group of female patients was 55.40 (68.27) USD, of which third-payers paid 27.67 (35.38) USD, and the patient paid 27.70 (39.52) USD. Patients in the blood glucose level groups had a statistically significant difference (p < 0.001). The higher the blood glucose level, the higher the treatment cost. Patients with a blood glucose level of ≥180 mg/dL had an average treatment cost of 69.93 (80.27), of which third-payer and co-payments were 35.83 (34.10) USD and 34.10 (46.96) USD, respectively. The hypoglycaemic group was 131-179 mg/dL with 58.05 (62.31) USD, of which 29.12 (30.90) USD was third-payer and 28.94 (37.82) USD for patients. Patients with a blood glucose level of 70-130 mg/dL had the lowest mean cost of treatment at 57.24 (61.13) USD, of which 29.09 (30.91) USD was third-payer and 28.16 (37.00) USD for patients. The costs between age groups, gender, or blood glucose level groups were all statistically significant (p < 0.05) [Table/Fig-3].

Aggregate Direct Medical Cost of Diabetes

In general, from 2012 to 2015, patient at the hospital paid an average of 49.02 (63.65) USD, of which the third-payer pays more than the

	2012 (N=162)	2013 (N=200)	2014 (N=222)	2015 (N=262)	2012-2015 (N=846)	p-value
Age (years)						
Mean (SD*)	68.07 (12.08)	66.83 (12.64)	64.09 (14.04)	64.02 (13.17)	63.82 (14.62)	
Median (IQR**)	67.00 (61-76)	65.50 (59-75)	63.50 (56-73)	63.00 (57-73)	63.00 (55-74)	
Range	29-94	29-95	11-95	27-94	11-95	
≤39	1 (0.62)	2 (1.00)	10 (4.50)	12 (4.58)	25 (2.96)	<0.001
40-49	11 (6.79)	15 (7.50)	17 (7.66)	23 (8.78)	66 (7.80)	
50-59	23 (14.20)	35 (17.50)	45 (20.27)	56 (21.37)	159 (18.79)	
60-69	60 (37.04)	73 (36.50)	81 (36.49)	86 (32.82)	300 (35.46)	
70-79	35 (21.60)	41 (20.50)	38 (17.12)	46 (17.56)	160 (18.91)	
≥80	32 (19.75)	34 (17.00)	31 (13.96)	39 (14.89)	136 (16.08)	
Gender (%)						
Male	118 (72.84)	130 (65.00)	147 (66.22)	184 (70.23)	579 (68.44)	<0.001
Female	44 (27.16)	70 (35.00)	75 (33.78)	78 (29.77)	267 (31.56)	
Third-payer*** (%)						
80	123 (75.93)	155 (77.50)	172 (77.48)	195 (74.43)	645 (76.24)	<0.001
95	-	-	-	8 (3.05)	8 (0.95)	
100	39 (24.07)	45 (22.50)	50 (22.52)	59 (22.51)	193 (22.81)	
Accommodation						
Urban	162 (100.00)	200 (100.00)	222 (100.00)	262 (100.00)	846 (100.00)	
Blood Glucose Level (mg/dL)						
70-130	48 (29.63)	58 (29.00)	64 (28.83)	88 (33.59)	258 (30.50)	<0.001
131-179	82 (50.62)	99 (49.50)	112 (50.45)	140 (53.44)	433 (51.18)	
≥180	32 (19.75)	43 (21.50)	44 (20.72)	34 (12.98)	155 (18.32)	

[Table/Fig-2]: Type-2 diabetes mellitus patient characteristic (N=846, (%)).

(*): Standard Deviation

(**): Interquartile range

(***): These numbers represent the percentage of the total cost that is paid by governmental health insurance programme, the remain is co-paid by patients

Data is presented as Number (percentage)

Characteristic	Third-payer		Patient			Total	p-value
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	
Age (Year)							
≤39	6.55 (6.04)	5.46 (0.35-11.01)	6.44 (6.02)	4.97 (1.88-9.61)	12.99 (10.03)	13.83 (5.64-18.15)	<0.001
40-49	11.68 (18.01)	7.86 (1.26-20.92)	12.08 (21.06)	6.64 (3.10-20.04)	23.76 (38.44)	14.45 (5.96-37.97)	
50-59	18.13 (25.64)	13.65 (6.13-45.37)	21.98 (34.44)	10.48 (4.97-67.72)	40.12 (59.41)	24.10 (11.71-111.80)	
60-69	37.39 (39.68)	47.16 (10.90-117.48)	34.62 (44.12)	23.56 (6.66-107.26)	72.00 (75.18)	81.39 (20.68-228.11)	
70-79	29.97 (38.20)	28.84 (6.21-83.44)	28.45 (42.24)	11.95 (3.53-77.58)	58.42 (72.28)	48.45 (11.38-205.24)	
≥80	23.92 (28.03)	20.97 (7.54-69.97)	15.96 (22.58)	9.51 (1.65-50.33)	39.87 (43.43)	36.52 (12.63-139.78)	
Gender							
Male	20.57 (28.38)	14.09 (4.91-54.81)	16.00 (28.37)	9.09 (3.57-24.51)	36.57 (51.75)	21.75 (9.73-113.81)	0.003
Female	27.67 (35.38)	21.83 (7.03-82.33)	27.70 (39.52)	13.89 (4.45-83.42)	55.40 (68.27)	38.11 (12.67-189.36)	
Blood Glucose Level (mg/dL)							
70-130	29.09 (30.91)	36.78 (5.47-102.45)	28.16 (37.00)	15.86 (4.64-88.14)	57.24 (61.13)	56.49 (14.06-195.61)	<0.001
131-179	29.12 (30.90)	37.12 (5.41-102.46)	28.94 (37.82)	16.73 (4.66-89.49)	58.05 (62.31)	56.52 (13.81-196.82)	
≥180	35.83 (34.10)	43.59 (12.10-103.59)	34.10 (46.96)	20.57 (8.49-99.05)	69.93 (80.27)	85.25 (21.83-219.17)	

[Table/Fig-3]: Average annual direct medical cost of type-2 diabetes mellitus cases distributed by patient characteristic 2012–2015 (N=846, 2017 USD).

patient at 25.28 (33.27) USD and 23.74 (36.48) USD, respectively. The cost of treatment is increasing each year, but in 2014, the cost of treatment was reduced compared to 2013. Patients paid more than third-payers in 2012, 2013 and 2014, but in 2015, patient-paid costs were less than third-payer [Table/Fig-4].

Healthcare Expenditures for Treating Type-2 Diabetes Mellitus

Expenditures included health examination, diagnosis, pharmaceuticals, procedures, and medical supplies. For the third-

	2012 N=162	2013 N=200	2014 N=222	2015 N=262	2012- 2015N= 846	p- value
Third-payer	18.18 (16.35)	23.01 (21.69)	22.87 (24.92)	33.67 (34.07)	25.28 (33.27)	<0.001
Patient	21.60 (21.46)	26.63 (27.46)	22.97 (25.79)	23.48 (34.17)	23.74 (36.48)	0.002
Total	39.78 (32.12)	49.64 (42.38)	45.84 (43.78)	57.15 (59.71)	49.02 (63.65)	0.029

[Table/Fig-4]: Average annual direct medical cost of type-2 diabetes mellitus cases distributed by patient characteristics, third-payer's/ patient's perspective 2012–2015 (Mean±SD, 2017 USD).

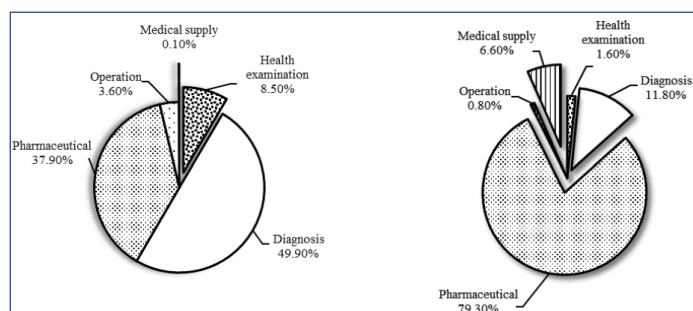
payer payment, pharmaceutical costs were the highest at 24,649.44 USD (57.90%), and the second-highest cost of 13,385.87 USD (31.50%) was for diagnosis. Those two costs alone account for 89.40% of the total cost. The remaining categories accounted for a low rate, 5.20% (2,197.39 USD), 3.20% (1,370.36 USD) and 2.20% (943.89 USD) for health examination, medical supply and operation, respectively [Table/Fig-5].

Cost component	Third-payer	Patient	Total
Health examination	1,871.89 (8.5)	326.73 (1.6)	2,197.39 (5.2)
Diagnosis	10,960.99 (49.9)	2,424.87 (11.8)	13,385.87 (31.5)
Pharmaceuticals	8,309.97 (37.9)	16,339.47(79.3)	24,649.44 (57.9)
Procedures	783.73 (3.6)	160.16 (0.8)	943.89 (2.2)
Medical Supplements	17.37 (0.1)	1,352.99 (6.6)	1370.36 (3.2)
Total	21,943.96 (100.0)	20,604.22 (100.0)	42,546.94 (100.0)

Data are presented as Cost (percentage)

[Table/Fig-5]: Healthcare expenditures for treating type-2 diabetes mellitus in the period 2012-2015 (Value (%), 2017 USD).

In all the expenses, third-payer assistance for diagnosis and pharmaceuticals costs accounted for 87.80% of the total to third-payers. In contrast to third-payer, the total amount paid for medicines by patients was the most in all costs. For the period 2012 to 2015, the total cost of medication was 16,339.47 USD, accounting for 79.30% of total costs. Expenses paid by patients, however, were much lower than the cost of drugs, accounting for 11.80% (2,424.87 USD). Of the five types of costs to be paid, three types of third-payer expenditures cover more than the costs of health examination, diagnosis and operation. Patients pay more cost than third-payer for medicine and medical supplement [Table/Fig-6].



[Table/Fig-6]: Healthcare expenditures for treating type-2 diabetes mellitus in the period 2012-2015 (Third-payer (left) and Patient (right)).

Medical Service Components	Cost {USD (%)}
Pharmaceuticals	
Praymetfo 850 mg (Metformin)	1,853.27 (7.52)
Telpil-H (Termsartan)	1,187.66 (4.82)
Dianorm-M (Metformin)	687.78 (2.79)
Albis (Ranitidine, bismuth, sucralfate)	683.88 (2.77)
Diamicon MR 60 mg (Glicrazide)	669.64 (2.72)
Tanatril 10 mg (Imidaprilchlohydrate)	624.88 (2.54)
Lipiroz 10 mg (Rosuvastatin)	551.97 (2.24)
Diamicon MR 30 mg (Glicrazide)	489.91 (1.99)
Lantus (Insulin glargine)	460.56 (1.87)
Zocor 10 mg (Simvastatin)	394.44 (1.60)
Laboratory tests	
Glucose	1,693.05 (12.65)
Triglyceride	1,229.32 (9.18)
SGPT(AST)	1,100.68 (8.22)
HbA1c	1,096.37 (8.19)
Creatinine	1,084.09 (8.10)
SGOT(ALT)	1,066.26 (7.97)
HDL-Cholesterol	935.10 (6.99)
Cholesterol	919.95 (6.87)
LDL-Cholesterol	488.92 (3.65)
Urea	398.66 (2.98)
Diagnostic examinations	
Body ultrasound	195.69 (20.73)
Coloured Doppler ultrasound	117.09 (12.40)
Coloured X-ray	110.89 (11.75)
Endoscopy of oesophagus, duodenal stomach	60.97 (6.46)
Digital X-ray	46.61 (4.94)
Vascular Doppler ultrasound	36.02 (3.82)
Electrocardiogram (ECG)	36.00 (3.81)
Direct lung-heart X-ray	31.54 (3.34)
Abdominal ultrasound (liver, pancreas, spleen, kidneys, bladder)	29.87 (3.16)
General X-ray	28.79 (3.05)

[Table/Fig-7]: Top-ten pharmaceuticals, diagnoses and procedures with the highest cost of treatment.

Health Services Effect on Total Cost of Treating Diabetes Mellitus

The top-ten drugs used in the treatment of T2DM ranked in descending include Praymetfo 850 mg, Telpil-H, Dianorm-M, Albis, Diamicon MR 60 mg, Tanatril 10 mg, Lipiroz 10 mg, Diamicon MR 30 mg and Zocor 10 mg. Among the highest-cost drugs out there, five drugs are used to control blood sugar in the treatment of T2DM, including Praymetfo 850 mg, Dianorm-M, Diamicon MR 60 mg, Diamicon MR 30 mg and Lantus. Five drugs are designated to have different uses, including drug Telpil-H (treatment of hypertension), Albis (treatment of gastric ulcers), Tanatril 10 mg (treatment of hypertension), Lipiroz 10 mg (drug for dyslipidemia), and Zocor 10 mg (drug for dyslipidemia).

In the period 2012 to 2015, the total cost of testing glucose was 1,693.05 USD (accounting for 12.65% of the total cost of laboratory test), which was the highest in the test costs. The total cost to pay for triglyceride laboratory tests was second at 1,229.32 USD (accounting for 9.18%). SGPT, HbA1c, creatinine, SGOT, HDL-cholesterol, cholesterol, LDL-cholesterol and urea tests were also included in the list of highest-cost tests.

Similarly, the study results also show that ten types of procedures had the highest cost. The total cost of all kinds, in descending order are general body ultrasound, coloured Doppler ultrasound, coloured X-ray, endoscopy, digital X-ray, Vascular Doppler ultrasound, Electrocardiogram (ECG), Direct lung-heart X-ray, abdominal ultrasound and general X-ray [Table/Fig-6].

DISCUSSION

This study population was patient suffered from T2DM treated at the hospital. Their average age was 63.82±14.62 years. lower than those in Singapore (69.0±9.4) [10], but higher than Thai patients (59.34±11.40) [11]. The 60-69 age group had the greatest number of patients, accounting for 35.46%, while the proportion of patients aged from 50 to 59 was the highest (35.80%) in Iran [12]. In general, the proportion of people diagnosed with diabetes aged ≥50 years was significantly higher than the age ≤50-year-old, at 70.1% [13]. Patients with blood sugar levels between 131 and 179 mg/dL had the highest percentage at 51.18%; patients in the group with blood glucose levels 70 to 130 mg/dL represented 30.50%, and the proportion of patients with blood glucose level ≥180 mg/dL group was 18.32%. This was similar to studies in Thailand, where the rate of blood glucose levels is 24.57%, 53.88%, and 21.55%, respectively, among which the highest number of people in the blood group is 131-79 mg/dL [11].

Direct medical costs of treatment for a patient at the hospital were 49.02 (63.65) USD, and costs were lower than those of other countries in Southeast Asia [10,13]. In a study in Singapore in 2015, estimated direct medical costs averaged 1,575.6 USD for hospital admissions and in Thailand, this cost is 199.75 USD [10,13]. More note worthy, direct medical costs in the United States and Europe are much higher than estimated by the study [14-17]. This difference can be explained by better facilities as well as higher visit costs than Vietnam. In direct costs of medical care, patient and third-payer payment rates were similar, indicating third-payer has not covered the cost of treatment of patients, although all patients have third-payer greater than 80%. This could explain why third-payers donot cover some high-cost services such as the HbA1c test (8.19% of the total cost of the test) or the cost of medical supplies. This leads to the same cost of treatment paid by health insurers and patients in the same cohort (51.6% and 48.4%, respectively). However, costs paid by third-payers are increasing year by year, showing third-payers' efforts to cover the full cost of treatment. The study also found that the similarity in average treatment cost increases among groups of blood glucose levels was not controlled, much the same as in Thailand [11]. Alternatively, there is a difference in treatment costs in this study compared to studies in Thailand [11] and Iran [18]. In terms of total cost of treatment, the majority of costs are

for drugs, followed by the cost of testing (57.90% and 31.50%). This result is somewhat different compared to other countries, Singapore, Thailand, Germany and US, where the majority of costs are related to healthcare [10,11,15,16].

LIMITATION

In addition, the researcher found some limitations when doing research. First, the study did not capture patient complications and comorbidities to analyse the rates and treatment costs for each group. Complications and associated illnesses are important factors that affect the cost of treating the disease. Next, the retrospective data from the hospital should not have been generalized to the entire South. Finally, some information about patients had not been fully updated in the hospital's electronic database, which may cause some errors in the study. The implementation of larger projects in the future will help mitigate these limitations.

CONCLUSION

The results show the large economic burden of T2DM for the patient as well as the government. A broader study of the impact of policies on medical services should be undertaken to help managers list the costs of these services.

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