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# Costs of type 2 diabetes mellitus from payers' perspective: a study from real-world evidence of district hospital in Vietnam

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## SUMMARY

**Objective.** Estimate yearly treatment cost of type 2 diabetes mellitus (T2DM) from payers' perspective and its influencing factors.

**Method.** A cross-sectional descriptive study has been conducted based on real-world evidence from Thu Duc district hospital from January 2017 to April 2018. Cost of T2DM was estimated based on payers' perspective and included direct medical, direct non-medical and indirect costs.

**Result:** Analyzing the sample of 206 patients with men: women rate of 1: 2.81 and mean age of 61.76±9.74, it has been shown that the average costs of T2DM per patient was accounted for US \$ 1,038.3 (95% CI 951.4–1,125.2) with high proportion for direct costs (93.7%) and drugs cost (68.4% of direct medical costs and 60.6% of total costs). Costs per patient with complication was accounted for US \$ 1,677.2 (95% CI 1,541.3–1,813.1), which is higher than those without complications (US \$ 306.3 (95% CI 295.7–316.9)). Patients with comorbidities incurred higher average cost than those without them ( $p<0.05$ ). Patients with previous inpatient hospitalization for T2DM or longer number of years for treating T2DM incurred higher cost ( $p<0.05$ ). Patients with more risk factors or high HbA1c level also incurred higher costs ( $p<0.05$ ).

**Conclusion:** The average cost of T2DM was reported an estimate of US \$ 1,038.3; in which average cost for patients with complication was 5 times higher than those without complication. HbA1c level, comorbidities and complication were the first 3 factors influencing average cost of T2DM.

**Key word:** Costs, Type 2 diabetes mellitus, Payer's perspective, Vietnam

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## ЗАТРАТЫ НА САХАРНЫЙ ДИАБЕТ ТИПА 2 С ТОЧКИ ЗРЕНИЯ ПЛАТЕЛЬЩИКОВ: ИССЛЕДОВАНИЕ НА ОСНОВЕ РЕАЛЬНЫХ ДАННЫХ В РАЙОННОЙ БОЛЬНИЦЕ ВЬЕТНАМА

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## РЕЗЮМЕ

**Цели.** Оценить ежегодную стоимость лечения сахарного диабета типа 2 (СД2) с точки зрения плательщиков и влияющих факторов.

**Метод.** Перекрестное описательное исследование было проведено на основе реальных данных (больница района Тху Дук с января 2017 г. по апрель 2018 г.). Стоимость СД2 была оценена с точки зрения плательщиков и включала прямые медицинские, прямые немедицинские и косвенные расходы.

**Результаты.** При анализе выборки из 206 пациентов (соотношение мужчины : женщины составило 1:2,81; средний возраст – 61,76±9,74) показано, что средние затраты на лечение 1 пациента с СД2 составляли 1038,3 доллара США (95% ДИ 951,4–1125,2) с высокой долей прямых затрат (93,7%) и стоимости лекарств (68,4% прямых медицинских расходов и 60,6% общих затрат). Расходы на 1 пациента с осложнениями составили 1677,2 долл. США (95% ДИ 1541,3–1813,1), что выше, чем таковые без осложнений (306,3 долл. США; 95% ДИ 295,7–316,9). Средняя стоимость лечения пациентов с сопутствующими заболеваниями была более высокой по сравнению с таковой у пациентов без сопутствующих заболеваний ( $p<0,05$ ). Отмечены также более высокие затраты на лечение пациентов, ранее госпитализированных по поводу СД2 ( $p<0,05$ ), так же, как и таковые при большем количестве факторов риска или более высоком уровнем HbA1c ( $p<0,05$ ).

**Заключение.** Средняя стоимость T2DM была оценена в 1 038,3 долл. США; в котором средняя стоимость для пациентов с осложнениями была в 5 раз выше, чем без осложнений. Уровень HbA1c, сопутствующие заболевания и осложнения были первыми 3 факторами, влияющими на среднюю стоимость затрат на ведение больных СД2.

**Ключевые слова:** затраты, сахарный диабет 2 типа, взгляд плательщика, Вьетнам.

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## Introduction

Diabetes mellitus (DM) is a progressive, chronic disease characterized by frequent episodes of hyperglycemia [10]. Type 2 diabetes mellitus (T2DM) is the most prevalent form of the disease, accounted for nearly 90% of all cases worldwide [18, 21]. Globally, an estimated 422 million adults were living with diabetes in 2014. The incidence of diabetes had almost doubled since 1980, rising from 4.7% to 8.5% of adults [17]. According to a study of the International Diabetes Federation (IDF) in 2015, from diabetes and its complications there was up to 5 million deaths, which is 8.3 times of death number from malaria and 3.3 times of death number from HIV/AIDS and tuberculosis [3]. DM treatment is a long-term and complex process with low efficiency and high cost. DM is considered as the large economic burden for individual as well as the whole society. In 2014, the economic burden of diabetes is US \$ 612 billion in the whole world. In the United States, the economic burden on DM has risen to US \$ 245 billion in the same year 2014 [11, 19].

Vietnam, a developing country with low-medium income, has doubled raising incidence of T2DM in 10 years (from 2.7% in 2002 to 5.4% of the population in 2012) [16]. According to IDF, the diabetes related expenditures in Vietnam are on average 162.7 USD per patient per year in 2015. This is more than the average monthly salary of 150 USD in Viet Nam [23].

According to another study, the annual cost per T2DM patient was estimated around US \$246.1 for both direct and indirect costs [13]. However, up to now the analysis of costs for T2DM in Vietnam were only conducted on DM without considering cost of its complications. Starting from that situation, the study aimed to estimate yearly treatment cost of both T2DM and its complications as well as its relating factors.

## Method

**Study design.** A descriptive cross-sectional study was conducted based on the real-world evidence data from a district hospital in Ho Chi Minh city from Jan. 2017 to Apr. 2018. Cost of T2DM and its complications was estimated based on payers' perspective and included direct medical costs (for medicine, medical supplies, test, diagnostic test, blood, surgery, high tech medical equipment, medical examination, bed), direct non-medical costs (for transportation, nutrition, accommodation, visitation and other costs) and indirect costs (patient's or relative's productivity losses).

**Data collection.** Data of direct medical costs of T2DM and its complications were obtained from the patient's medical records from Jan. 2017 to Apr. 2018. Data of direct non-medical costs and indirect costs was retrieved from face-to-face interview with patients, whose medical records were chosen for

study. Interview was taken place at Thu Duc district hospital in Ho Chi Minh City from Jan. 2018 to Apr. 2018 when patient came to hospital for inpatient or outpatient treatment. We classified complications into 4 categories: acute complication; microvascular complications (diabetic retinopathy, diabetic nephropathy, diabetic neuropathy); macrovascular (heart failure, myocardial infarction, stroke); both microvascular and macrovascular.

Patients with T2DM are identified using the International Classification of Diseases 10<sup>th</sup> Revision (ICD-10 code) with disease diagnosis code E11. To calculate the average cost of T2DM per patient, we assessed patient who adhered treatment for 1 year period from Jan. 2017 to Apr. 2018 and satisfied criteria of inclusion and exclusion.

*Criteria of inclusion:*

- Patient who treated at Thu Duc district hospital in Ho Chi Minh City
- Patients diagnosed with type 2 diabetes mellitus with ICD-10 code (E11)
- Patients adhere to treatment with monthly treatment at least once and throughout the 1 year period from January 2017 to April 2018.
- Patients has a medical record with all necessary information
- Patients agreed to participate in the study.

*Criteria of exclusion:*

- The patient was not a Vietnamese citizen or not living and working in Vietnam
- Patients are transferred to another hospital or died during treatment
- Patients with gestational diabetes
- Patients who did not comply with the treatment for one year at the time of the survey from January 2017 to April 2018.

**Statistical analysis.** All cost were measured in terms of Vietnamese currency (dong [₫]) for year 2018 and converted into USD using the exchange rate of \$1 USD=422,788.0 VND [6]. Other currencies are converted into USD without taking into account inflation over the years when have comparison with other studies.

Collected data was coded and transferred into a specially designed format to be suitable for the IPM SPSS Statistic 20.0 software. Describing and summarizing variables were presented by frequency and percentages. The distributions of average costs between subgroups were evaluated using the Mann-Whitney U test (2 subgroups) and Kruskal-Wallis test (multiple subgroups) with the 95% confidence intervals. The correlations of average expenses with various variables were examined using

the Spearman rank correlation. With nonparametric tests, the differences between groups should be interpreted by the median and interquartile range values. Multivariate linear regression analysis was performed to determine the relationships between average cost and the selected variables.

## Result

This study was conducted from study sample of 206 patients T2DM with collected data from January 2017 to April 2018.

**Sample profile.** The demographic and pathological characteristics of study sample are shown in table 1. According to table 1, the sample has men:women rate of 1:2.81 with mean age of 61.76±9.74. The majority of patients had lower high school education (85.0%), followed by 11,2% of high school education and a small fraction of patients (3.9%) finished University/College/Intermediate or Post-graduate. Most patients were retired (50.3%), followed by housewife (18.4%), manual work (9.2%), business/free trade (9.2%) and a small proportion of other occupations (12.9%). 85% patients from Ho Chi Minh City, 10.2% from neighboring provinces of Ho Chi Minh City and of the rest from other places (4.8%). The majority of patients had 80% of health insurance benefits (73.3%), 18% had 100% of health insurance benefits and 8.7% had 95% of health insurance benefits. Patients with marital status accounted for 97.6% and of the rest 2.4% with single or divorce status.

Mean disease duration of study sample was 7,84±5,87 years with more than 50% patients had previous inpatient hospitalization for T2DM. Patients having two comorbidities accounted for 31.0%, followed by patients had no or one comorbidity (24.8%), and 19.4% from patients had more than three comorbidities. Patients with complications of T2DM accounted for 53.4%; among which, acute complication occupied 3.9% and chronic complication – 49.6% (microvascular 17.0%; macrovascular 18.0% and both microvascular and macrovascular 14.6%). Considering over frequently risk factors including historical, high age, obesity, hypertension, cardiovascular disease, dyslipidemia and unhealthy lifestyle (alcohol, beer, cigarette ...); the only 11.2% of the patients had no relevant risk factors. The group of patients with more than 3 risk factors had the highest rate (35.4%); followed by patients with 2 risk factors (34.5%) and 18.9% with 1 risk factor. Most patients had HbA1c level from 6.5 – 7.0% (45.1%), followed by HbA1c level of more than 8.0% (28.2%) and 26.7% with HbA1c level of 7.0 – 8.0%. For one year of treatment, the average number

of outpatient visit for T2DM was 20,140±4,815 times and the number of inpatient hospitalization was 0,16 times.

*Average cost of Type 2 Diabetes mellitus*

Average cost of T2DM including direct medical, nonmedical and indirect costs has been analysed with the results shown in Table 2.

According Table 2, the study recorded the average cost of T2DM for each patient per year in Thu Duc district hospital, which was accounted for US \$ 1,038.3 (95% CI 951.4–1,125.2). Direct medical costs were US \$ 919.7 which was many times higher than the direct non-medical costs and indirect costs (US \$ 53.5 and US \$ 65.1, respectively). In direct medical costs, medicine costs was US \$ 629.4, which was 2 times higher than the medical service costs (US \$ 290.3). In structure of medical service costs, test costs were accounted for US \$ 103.6 and was highest costs, followed by surgery costs (US \$ 60.9). The above two types of costs were much higher than the other costs, including high tech medical equipment costs (US \$ 38.6), diagnostic test image costs (US \$ 34.2), medical examination costs (US \$ 30.2), blood costs (US \$ 15.6), medical supplies costs (US \$ 4.4), bed costs (US \$ 3.0). Direct non-medical costs was US \$ 53.5, in the structure of which transportation costs were highest with US \$ 40.0, followed by nutrition costs (US \$ 13.3). Visitation costs and other costs were only occupied a small fraction in direct non-medical costs. All patients didn't loss fees for accommodation. Patient's productivity losses cost were US \$ 36.8, which is higher than relative's productivity losses cost (US \$ 28.3).

Average cost for patients with complication was accounted for US \$ 1,677.2 (95% CI 1,541.3–1,813.1) and 5 times higher than those without complications (US \$ 306.3 (95% CI 295.7–316.9)). Direct medical costs, direct non-medical costs, indirect costs of patients with complication were US \$ 1,504.5; US \$ 81.3; US \$ 91.4, which were many times higher than those of patients

without complication (US \$ 249.6, US \$ 21.8, US \$ 34.9; respectively). In direct medical costs of patients with complication, medicine costs was US \$ 1,018.3 which was 2 times higher than the medical services costs (US \$ 486.2), while medicine costs in patients without complication was approximately 3 times higher than medical services costs (US \$ 183.8 vs 65.8, respectively). In medical services costs, the difference between patients with complication and without complication recorded at costs for blood, high tech medical equipment and medical supplies; these costs in patients with complication were US \$ 29.2, US \$ 72.2, US \$ 8.1 while these costs were absent in patients without complication. Surgery costs in patients with complication (US \$ 111.2) was

Table 1

**Characteristics of study sample**

Characteristic	Category	N (%) / Mean (SD)	
Demography	Gender	Male	54 (26.2)
		Female	152 (73.8)
	Education	< High school	175 (85.0)
		High school	23 (11.2)
		University/College/ Intermediate	7 (3.4)
		Post-graduate	1 (0.5)
	Occupation	Officials	0 (0.0)
		Officer	2 (1.0)
		Manual work	19 (9.2)
		Retired	104 (50.5)
		Housewife	38 (18.4)
		Business/Free trade	19 (9.2)
		Unemployed or underwork	14 (6.8)
		Other job	10 (4.9)
	Place of living	Ho Chi Minh city	175 (85.0)
		The neighboring provinces of Ho Chi Minh City	21 (10.2)
		Other place	10 (4.8)
	The rate of health insurance benefits	80%	151 (73.3)
		95%	18 (8.7)
100%		37 (18.0)	
Marital status	Single	4 (1.9)	
	Married	201 (97.6)	
	Divorce/Separation	1 (0.5)	
Age		61.76 (9.74)	

also 34 times higher than that in patients without complication (US \$ 111.2 vs 3.2, respectively). The component of direct non-medical costs in patient with complication were higher than those without complication. Costs for accommodation, visitation and others accounted for significant value in both patient with and without complication.

In types of complication, the highest average cost recorded at patients with acute complication (US \$ 2,569.1), followed by patients with both microvascular and macrovascular complication (US \$ 1,820.7) and with macrovascular complication (US \$ 1,642.1). The lowest average cost was US \$ 1,387.3

in patients with microvascular complication. Direct medical costs in all types of complication accounted for majority (84.7–93.8%), therein medicine costs occupied approximately 60% in every type of complication. The incidence of medical services costs in patients with acute complication (35.2%) and macrovascular complication (35.1%) were higher than those in patients with microvascular complication (22.3%) and both microvascular – macrovascular complication (25.8%). However, the highest rate of direct non-medical costs and indirect costs were recorded at patients with microvascular complication (7.9 and 7.4%, respectively).

Continuing of Table 1

Characteristic	Category	N (%) / Mean (SD)	
Pathology	Had previous hospitalization for T2DM	Yes	104 (50.5)
		No	102 (49.5)
	Number of comorbidity	0	29 (14.1)
		1	63 (30.6)
		2	52 (25.2)
		3	51 (24.8)
		≥4	11 (5.3)
	Complications	Without complication	96 (46.6)
		Acute complications	8 (3.9)
		Chronic complications	
		Microvascular	35 (17.0)
		Macrovascular	37 (18.0)
	Number of risk factors	0	14 (6.8)
		1	28 (13.6)
		2	69 (33.5)
		3	49 (23.8)
		4	32 (15.5)
		≥ 5	14 (6.8)
	Average number of years for treating T2DM		7.84 (5.866)
Average number of hospitalization		1.56 (2.523)	
Number of outpatient treatment per year		20.14 (4.875)	
Number of inpatient treatment per year		0.16 (0.600)	

Generally, direct medical costs were the most proportion of average costs of T2DM (88,6%). Direct non-medical costs and indirect cost accounted for small fraction in average costs with 5.2% and 6.2%, respectively. Medicine costs were approximately 60% of costs (60.6% of average costs of T2DM, 60.0% of T2DM patients without complication and 60.7% of T2DM patient with complication) and 68.4% of direct medical costs, followed by medical services costs with 28.0% of average cost of T2DM. In structure of medical services costs, test costs was reported higher than the others and occupied 10.0% in average cost, followed by surgery costs (5.9%); the above two types of costs were more many times than the others. The other costs were sorted in decreasing order in the following: high tech medical equipment costs (3.7%), diagnostic test image costs (3.3%), blood costs (1.5%), medical supplies costs (0.4%), the lowest cost in structure of medical services costs was bed costs with 0.3%. Direct non-medical costs and indirect costs accounted for small fraction ratio in structure of average cost of T2DM. The components of direct non-medical costs such as transportation, nutrition occupied 3.9% and 1.3%; respectively. The others of direct non-medical costs had significant proportion. Patient's productivity losses costs were 3.5% while relative's productivity losses accounted for 2.7%.

**Average cost of Type 2 Diabetes mellitus**

	Costs (VND)	Costs (US \$)	± SE (VND)	± SE (US \$)	(%)
Average cost (n=206)	10,051,374.0	441.1	± 322,499.7	± 14.2	100.00
Direct medical costs	8,550,277.6	375.2	± 314,839.5	± 13.8	85.06
Medicine	6,694,468.6	293.8	± 280,999.6	± 12.3	66.60
Medical services	1,855,809.4	81.4	± 72,821.9	± 3.2	18.45
Medical supplies	2,907.0	0.1	± 815.6	± 0.0	0.02
Testing	784,327.6	34.4	± 35,016.1	± 1.5	7.80
Diagnostic test image	200,920.2	8.8	± 22,104.1	± 1.0	2.00
Surgery	88,070.2	3.9	± 11,423.1	± 0.5	0.88
Medical examination	663,945.5	29.1	± 17,881.6	± 0.8	6.60
Bed	115,638.9	5.1	± 32,948.3	± 1.4	1.16
Direct non-medical costs	679,573.2	29.8	± 67,657.8	± 3.0	6.76
Transportation	450,583.3	19.8	± 64,732.7	± 2.8	4.49
Nutrition	228,181.8	10.0	± 14,074.5	± 0.6	2.27
Accommodation	0	0.0	± 0	± 0.0	0.00
Medical visits	606.1	0.0	± 450.8	± 0.0	0.01
Others	202.0	0.0	± 142.5	± 0.0	0.00
Indirect costs	821,523.2	36.1	± 89,163.9	± 3.9	8.18
Patient's productivity losses	573,560.6	25.2	± 75,712.4	± 3.3	5.71
Relative's productivity losses	247,962.6	10.9	± 54,177.5	± 2.4	2.47

*Factors effected on average cost of Type 2 Diabetes mellitus.* Factors effecting on average costs of T2DM in sample of 206 patient has been analyzed with the results shown in Table 3.

From table 3, relating factors to the average cost of Type 2 Diabetes mellitus included age ( $p=0.027<0.05$ ), comorbidities ( $p=0.000<0.05$ ), complication ( $p=0.000<0.05$ ), HbA1c level ( $p=0.000<0.05$ ), risk factors ( $p=0.000<0.05$ ), previous inpatient hospitalization for T2DM ( $p=0.000<0.05$ ), number of years for treating T2DM ( $r=0.250$ ;  $p=0.000<0.05$ ), number of outpatient visit ( $r=0.365$ ;  $p=0.000<0.05$ ) and number of outpatient hospitalization per year. Patients with the age of more than 60 had higher treatment cost than those with the age less than 60. Patients with comorbidities incurred higher average cost than those without them. The more number of inpatient and outpatient hospitalization per year, the higher treatment costs were. Patients with complication incurred higher average cost than those without them. Patients had previous inpatient hospitalization for T2DM or longer number of years for treating T2DM incurred higher cost. Patients with

more risk factors or high HbA1c level also incurred higher costs.

Using standardized coefficients (table 4), we found that HbA1c level (Standardized Coefficients= $0.516$ ;  $p=0.000<0.05$ ), comorbidities (Standardized Coefficients= $0.462$ ;  $p=0.000<0.05$ ), complication (Standardized Coefficients= $-0.272$ ;  $p=0.041<0.05$ ) were the first 3 factors influencing average cost of T2DM.

### Discussion

This study involved a targeted-group population that was generated from cost and administrative data retrieved from the Thu Duc District Hospital on patients with T2DM and its complication in Ho Chi Minh City, Viet Nam. The average cost of T2DM for each patient (include patients with and without complication) per year in Thu Duc district hospital was US \$ 1,038.3 (95% CI 951.4–1,125.2). Direct medical costs (88.6%) accounted for the majority of the average expenditure in the study compare to direct non-medical costs (5.2%) and indirect costs (6.2%); therein, medicine costs occupied major

Table 3

**Average cost of both Type 2 Diabetes mellitus and its complication**

	N	Mean (VND) (US \$)	±SD (VND) (US \$)	±SE (VND) (US \$)	Max (VND) (US \$)	Min (VND) (US \$)
T2DM	206	10,051,374.0 (441.1)	4,537,973.5 (199.1)	322,499.7 (14.2)	22,376,347 (981.9)	2,462,375 (108.1)
T2DM + Complication	110	42,921,808.87 (1,883.5)	38,067,730.44 (1,670.5)	3,629,615.683 (159.3)	293,998,447.1 (12,901.5)	10,688,441.27 (469.0)
T2DM+Acute Complication	8	35,606,644.73 (1,562.5)	9,677,568.448 (424.7)	3,421,537.188 (150.1)	57,110,536.86 (2,506.2)	25,649,938.25 (1,125.6)
T2DM+Microvascular	35	34,968,002.47 (1,534.5)	34,905,437.44 (1,531.7)	5,900,095.793 (258.9)	212,916,687.7 (9,343.4)	10,688,441.27 (469.0)
T2DM+Macrovascular	37	36,987,466.46 (1,623.1)	28,360,063.78 (1,244.5)	4,662,365.765 (204.6)	116,807,437.9 (5,125.8)	13,320,439.72 (584.5)
T2DM+Microvascular + Macrovascular	30	61,470,982.41 (2,697.5)	50,053,326.28 (2,196.5)	9,138,445.294 (401.0)	293,998,447.1 (12,901.5)	16,881,761.20 (740.8)

proportion (68.4% of direct medical costs and 60.6% of average cost). Similar to the findings of other studies, pharmaceuticals is the first most expensive component in our study [2, 15]. Test costs (35.7% of medical services costs) and surgery costs (21.0% of medical services costs) occupied major percentages in medical services costs. Transportation expenses accounted for the majority in direct non-medical cost (74.8% of direct non-medical costs); patient's productivity losses expenses occupied 56.5% of indirect costs.

The average cost of T2DM without complication for each patient per year in Thu Duc district hospital was US \$ 306.3 (95% CI 295.7–316.9). This result seems to be lower than the cost reported in other Asian countries and Southeast Asian countries. Studies in India and Iran reported an estimate of US \$ 628.3 and US \$ 544.0 per patient, respectively [9, 22] while another study in Thailand reported an estimate of US \$ 881.47 [8]. However, average cost of T2DM of the study was higher than a study in Viet Nam (US \$ 306.3 compare to US \$ 246.10) [13]; the difference can be explained by different year study and classification of hospital. Direct costs in the study recording at US \$ 271.4 was lower than those of study in China (US \$1,501.7) [24] and Singapore (US \$1,575.6) [15] and much lower than high-income country such as US, Germany, Norway [1, 12, 20]. In addition, indirect costs in the study was US \$ 34.9, lower than a study in India (US \$ 102.8) [22] and another study in Viet Nam (US \$ 84.40) [13].

The average cost for patients with T2DM and complication was reported of US \$ 1,677.2 (95% CI 1,541.3–1,813.1). Assessing on specific complication, average cost for patients who had

both T2DM and acute complication was reported of highest cost with US \$ 2,569.1. US \$ 1,820.7; US \$ 1,387.3; US \$ 1,642.1 for patients with microvascular and macrovascular complication, microvascular complication and macrovascular complication, respectively. Our average cost for patients who had both T2DM, microvascular and macrovascular was lower than Bahia's study in Brazil (US \$ 3,199) [4]. Average cost of T2DM + microvascular (US \$ 1,387.3) and T2DM + macrovascular (US \$ 1,642.1) of the study was also lower cost than Bahia's study (US \$ 2,062; US \$ 2,517; respectively) [4]. Direct medical costs for patients with microvascular complication (US \$ 1,175.1), with macrovascular complication (US \$ 1,515.8) and with both two complication (US \$ 1,633.1) were lower than Lee's study in Australia (US \$ 2,270.6; US \$ 4,335.8; US \$ 4,416.9, respectively)\* [14] (\* 1 USD = 1,3437 AUD) [5]. Average cost for patients who had both T2DM and its complication was higher approximately 5 times than those without complication. This result showed that cost of diabetes complication had affected economic burden in patient and society. Therefore, authorities and healthcare system should have policies to support patients who had diabetes complication to decrease cost of complication.

Our study indicated HbA1c level, comorbidities, complication were the first 3 factors influencing average cost of T2DM. This was different from findings in Ping Cao's study in China [7], in which hospital stay, forms of payment, and presence of complications were the first 3 factors influencing hospitalization costs in Ping Cao's study. The difference can be explained by the different year study or period time to survey and sample size.

Costs in the Selected Variables

Variables	Costs (VND)							
	T2DM (n=206)				T2DM + Complications (n=110)			
	N	Median	Interquartile Range	P Value	N	Median	Interquartile Range	P Value
Gender				0.667				0.406
Male	54	8,706,753.0	8,033,853.5		28	38,167,938.6	35,315,886.5	
Female	152	9,351,734.0	6,446,550.5		82	31,211,450.1	30,477,868.7	
Age				0.132				0.768
≥ 60	120	9,501,283.0	7,345,526.8		72	31,617,197.4	30,610,357.6	
< 60	86	8,706,753.0	6,615,998.0		38	30,737,853.4	33,533,659.4	
The rate of Health Insurance benefits				0.740				0.609
80%	151	9,220,718.0	6,740,679		79	31,830,566.5	32,259,842.1	
95%	18	9,209,928.0	4,613,114.5		10	37,679,670.2	41,437,463.9	
100%	37	9,169,624.0	8,254,485.5		21	30,519,536.7	30,770,015.4	
Place of living				0.286				0.224
Ho Chi Minh City	175	9,220,718.0	6,958,804.0		94	31,741,869.4	30,864,517.0	
The neighboring provinces of HCMC	21	8,114,144.0	5,408,708.0		9	38,211,668.0	39,393,827.9	
Other places	10	11,652,107.0	7,690,124.5		7	19,301,545.1	13,879,830.7	
Occupation				0.554				0.272
Officials	0	–	–		0	–	–	
Officer	2	–	–		1	–	–	
Manual work	19	8,680,534.0	7,883,944.0		8	38,262,713.19	68,785,075.24	
Retired	104	9,501,283.0	4,459,258.3		64	31,555,778.96	33,600,119.60	
Housewife	38	7,833,292.0	5,282,687.0		15	31,159,961.09	21,117,081.84	
Business/Free trade	19	8,112,598.0	6,624,483.0		9	23,312,729.28	12,003,760.37	
Unemployed or underwork	14	10,137,637.0	7,958,469.8		8	44,888,542.41	26,977,256.02	
Other jobs	10	9,458,502.0	5,998,326.3		5	31,159,961.09	21,117,081.84	
Number of outpatient treatment per year	206	r=0.534;p<0.001			110	r=0.057;p=0.182		
Number of inpatient hospitalization	206	r=0.418;p<0.001			110	r=0.132;p=0.169		
Comorbidities				<0.001				<0.001
0	54	5,958,669.3	2,233,899.8		1	–	–	
1	60	8,715,179.5	2,604,423.0		22	23,151,360.0	22,141,831.8	
2	43	12,341,724.5	4,968,053.8		38	21,641,367.9	14,947,887.3	
≥ 3	49	16,837,309.7	9,418,651.0		49	44,138,285.5	29,160,807.3	
Complications				<0.001				
With complication	110	12,843,256.0	6,741,723.0					
Without complication	96	6,721,302.0	2,715,063.0					
Complication								<0.001
Acute complication					8	32,798,469.1	8,873,633.9	
Microvascular					35	22,602,125.1	21,458,387.0	
Macrovascular					37	25,946,110.4	17,588,414.7	
Microvascular+ Macrovascular					30	45,268,580.6	31,056,437.7	
Had previous inpatient hospitalization for T2DM				<0.001				0.274
Yes	104	10,421,136.0	6,714,642.0		67	31,581,222.4	33,084,205.2	
No	102	8,019,348.0	5,470,829.5		43	30,956,170.2	26,961,280.0	
Number of years for treating T2DM	206	r=0.295;p<0.001			110	r=0.081;p=0.399		



Table 5

**Analysis of relating factors to average cost for patients with Type 2 Diabetes mellitus and its complications**

Variables	T2DM				T2DM+Complications			
	Standardized Coefficients	Unstandardized Coefficients	t Value	P Value	Standardized Coefficients	Unstandardized Coefficients	t Value	P Value
Intercept	0.000	-1,130,942.647	-0.370	0.711	0.000	85,811,331.17	1.525	0.130
Complication <sup>a</sup>	0.134	1,473,179.429	2.102	<0.05				
Complication <sup>b</sup>					0.269	771,785.952	2.616	<0.05
Comorbidities <sup>c</sup>	0.425	2,093,110.898	6.249	<0.001	0.114	5,445,593.411	1.006	0.317
Number of outpatient hospitalization per year	0.306	345,743.402	6.666	<0.001	-0.055	-420,278.463	-0.512	0.610
Number of inpatient hospitalization per year	0.273	2,503,306.543	6.273	<0.001	-0.035	-1,667,944.494	-0.326	0.745
Had previous inpatient hospitalization for T2DM <sup>d</sup>	-0.011	-123,035.547	-0.256	0.798	0.019	1,452,010.861	0.179	0.859
Number of years for treating T2DM	0.101	95,030.867	2.321	<0.05	-0.047	-287,644.947	-0.448	0.655
Gender <sup>e</sup>	-0.050	-628,105.999	-1.229	0.220	-0.206	-17,894,300.02	-2.080	<0.05
Age <sup>f</sup>	-0.003	-37,192.842	-0.071	0.943	-0.036	-2,899,686.736	-0.330	0.742
The rate of health insurance <sup>g</sup>	0.003	2,266.366	0.083	0.934	0.029	132,721.828	0.287	0.775
Place of living <sup>h</sup>	0.047	504,303.209	1.109	0.269	-0.138	-9,662,860.306	-1.354	0.179
Occupation <sup>i</sup>	0.018	76,174.902	0.396	0.693	-0.112	-3,364,737.928	-0.975	0.332

<sup>a</sup> – Without complication was set as the standard

<sup>b</sup> – Acute complication was set as the standard

<sup>c</sup> – Without comorbidity was set as the standard

<sup>d</sup> – Patient did not have previous inpatient hospitalization for T2DM was set as the standard

<sup>e</sup> – Male was set as the standard

<sup>f</sup> – <60 age was set as the standard

<sup>g</sup> – Patient who had 80% the rate of health insurance was set as the standard

<sup>h</sup> – Patient living in HCMC was set as the standard

<sup>i</sup> – Patient being manual work was set as the standard

As a descriptive cross-sectional study based on real-world evidence data from payer’s perspective, the strength of this study was to estimate the average yearly T2DM treatment cost per case, as well as the cost of treatment for diabetes complication, especially those with different complication while this types of study hadn’t been conducted in Vietnam. The study also provided the heading factors relating on average cost of T2DM patient. Nevertheless, this research study has several limitations that must be improved.

Firstly, the real-world evidence was based on the data of district hospital, which is not representative for the whole Vietnam. Secondly, the difference in treatment cost between treatment regimen has not been analyzed. Thirdly, the study focused on the average annual treatment costs per diabetes patient and did not assess the economic burden of diabetes for the whole society. Future research on public health facilities will help to minimize these limitations.

### Conclusion

The average cost of T2DM was reported an estimate of US \$ 1,038.3; in which average cost for patients with complication was 5 times higher than those without complication. HbA1c level, comorbidities and complication were the first 3 factors influencing average cost of T2DM.

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### Конфликт интересов

Авторы заявляют об отсутствии конфликта интересов

### Conflict of interest

The authors declare no conflict of interest

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