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Original Research Article

Direct cost of patients with type 2 diabetes mellitus healthcare and its complications in Lithuania

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ABSTRACT

Objective: The main objective of this study was to estimate the annual direct healthcare cost of type 2 diabetes mellitus healthcare and its complications in Lithuanian population.

Material and methods: The study uses a prevalence-based top-down approach. The random sample of study participants was formed using the database of the National Health Insurance Fund under the Lithuanian Ministry of Health. 762 patients with diabetes mellitus type 2 data were analyzed in this research. The data on healthcare costs was recorded between January 1, 2011 and December 31, 2011.

Results: Ambulatory care cost mean per patients with diabetes mellitus type 2 in 2011 was EUR 156.14 (95% CI, 147.05–165.24). 34.4% patients had at least one hospitalization during the 2011 year. Mean annual cost per patients of hospitalization was EUR 1160.16 (95% CI, 1019.60–1300.73). Covered drugs and diabetes supplies annual direct cost mean per patients was EUR 448.34 (95% CI, 411.14–485.54). The more expensive treatment was with oral and non-insulin injectable hypoglycemic medications ($P < 0.001$). 65.1% participants were diagnosed one or more diabetes-related chronic complications. Average annual cost per person, increased gradually with the numbers of complications from EUR 671.94 (95% CI, 575.03–768.86) in patients without complications to EUR 1588.98 (95% CI, 1052.09–2125.86) in patients with 3 and more complications ($P < 0.001$).

Conclusions: The largest part of direct costs in diabetes mellitus healthcare composes hospital inpatient care and covered drugs expenditures. In our study we observed that the presence of microvascular, macrovascular chronic complication increased the direct cost per patient, compared with patients without complications.

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1. Introduction

The prevalence of diabetes for 2011 has risen to 366 million, representing 8.5% of the world's adult population, with a prediction that by 2030 the number of people with diabetes will have risen to 552 million [1].

The costs of diabetes mellitus type 1 and 2 are growing in all world countries. The disease management of patients with diabetes-related chronic complications is very expensive. In previous study of American Diabetes Association estimated a total cost diabetes mellitus in United States of America (USA) in 2002 and 2007 was 132 billion United States dollars (USD) (including USD 91.8 billion for direct medical costs and comprised USD 24.6 billion for chronic complications attributable to diabetes and USD 39.8 billion for indirect medical costs) and 174 billion (including USD 116 billion for direct medical costs and comprised \$58 billion for chronic complications attributable to diabetes and USD 58 billion for indirect medical costs) USA dollars, respectively [2–4]. A recent study estimated the increased cost for the same disease in 2012, compared with previous estimations of earlier periods – USD 245 billion (including \$176 billion in direct medical costs and USD 69 billion in reduced productivity) [2–4].

The CODE-2 (Cost of Diabetes in Europe – Type 2) study revealed the cost of Type 2 diabetes in the eight European countries (Belgium, France, Germany, Italy, Netherlands, Spain, Sweden, the United Kingdom) – it was estimated at Euro (EUR) 29 billion a year (1999 values). The calculated average annual cost per patient was EUR 2834 a year [5]. Total cost for the diabetes mellitus type 1 and 2 in Sweden in 1987 and 2005 were EUR 439 million and EUR 920 million, respectively. The increase of 110% was as a result of a 69% growing in the estimated prevalence from 150 000 (1.8% of the population) to 254 000 (2.8%) and of an increase in the estimated annual cost per person diagnosed with diabetes by 24% [6].

The annual cost per person in USA and Europe is different because the cost value is related to treatment strategies and estimation methods. The higher estimated annual mean cost per patient in the USA can be explained by higher prevalence rate, compared to other eight European countries as well [2–6].

Scientific research has demonstrated that resources for treating diabetes-related chronic complications are much bigger than resources allocated for management and compensation of the disease itself [2–4,7,8].

Direct costs to the healthcare sector include hospital services, physician services, lab tests and the daily management of diabetes mellitus supplies (insulin, syringes, oral hypoglycemic agents and blood-testing equipment). Costs range from relatively low-cost items, such as primary-care consultations and hospital outpatient episodes, to very high-cost items, such as long hospital inpatient stays for the treatment of complications [9].

It is the first research performed in Lithuania and its obtained results set preconditions for further full economic evaluation of patients with type 2 diabetes mellitus management in Lithuanian healthcare system. The main aim of this

study was to estimate the annual direct healthcare cost of type 2 diabetes mellitus healthcare and its complications in Lithuanian population.

2. Materials and methods

2.1. Study designs and data collection

The study uses a prevalence-based top-down approach. The random sample of study participants was formed using the database of the National Health Insurance Fund under the Lithuanian Ministry of Health. This database covering about 95% of Lithuanian population. Study participants were selected according these inclusion criteria: diagnosed diabetes mellitus type 2 (ICD-10 diagnosis codes E11.0–9), age 18 years and older (gestational diabetes mellitus was excluded). A total of 797 patients with diabetes mellitus type 2 were randomly selected from the National Health Insurance Fund under the Ministry of Health database. 35 participants were excluded from this study because were not diagnosed with diabetes mellitus type 2. The data of 762 patients were analyzed in this study. Patients who were diagnosed with the disease in the study year and died during 2011 with this diagnosis were included in the study sample as well. All the patients with these inclusion criteria attending Lithuanian primary healthcare centers had the same probability to be recruited in this study. Sample size of participants was determined on the basis of diabetes mellitus type 2 prevalence rates. The prevalence of diabetes mellitus in Lithuania according to the European health for all Database was 2.62% in 2011 year [10].

The data on resources utilized and costs between January 1, 2011 and December 31, 2011, was obtained from the same National Health Insurance Fund database “Sveidra.” The database included information about these patients' data: treatments, ambulatory and hospital inpatient care costs, as well sociodemographic and disease variables (age, living place, chronic diabetes-related complications, comorbidity). All costs are given in 2011 prices and presented in Lithuanian currency Litas (LTL), the costs are expressed in euros (in the study year the rate of exchange was approximately EUR 1 = LTL 3.45).

2.2. Methods of evaluation direct healthcare costs

The analysis of direct healthcare costs of patients with type 2 diabetes mellitus included these variables: type of treatment, diabetes-related chronic complications (microvascular and macrovascular), consultations of general practitioners and specialists, laboratory tests, covered drugs and diabetes supplies, ambulatory procedures, hospitalization, nursing services, healthcare at home costs. Direct cost on patients with type 2 diabetes mellitus healthcare was calculated per person in 2011.

2.2.1. Healthcare service costs

Ambulatory and hospital inpatient care prices were presented in National Health Insurance Fund database “Sveidra” and national legal documents. Database “Sveidra” does not include data about primary healthcare services prices,

identification and adoption of these prices were based on Ministry of Health of Republic of Lithuania legal acts.

2.2.2. Costs of covered drugs and diabetes supplies

All prescribed medications for study participants were recorded. Reliable data on the type and quantity of drugs and diabetes supplies used in the ambulatory settings were available through retrospective analysis. Drugs used in hospital settings are included in the costs of medical services.

2.2.3. Total direct healthcare costs

The estimation direct cost type 2 diabetes mellitus and its complications was done by identifying the resources utilized and cost for management and treatment of disease and its complications (ambulatory care, hospital inpatient care, covered drugs in ambulatory settings). We distributed the overall direct costs of healthcare through three groups by diabetes-related chronic complications numbers (0, 1, 2, 3>). Chronic diabetes-related complications microvascular and macrovascular were considered in this study analysis [11–14]. The complications were identified based on International classification of Diseases, version 2010 (ICD-10) codes:

Microvascular:

- Retinopathy: proliferative retinopathy, macular edema (E11.3) and blindness (H54.0, H54.4);
- Nephropathy (E11.2) and renal failure (N18);
- Neuropathy (E11.4).
- Macrovascular:
- Cardiovascular disease: acute myocardial infarction (I21), chronic ischemic heart disease (I25), angina pectoris (I20), diabetic cardiomyopathy (E11.53);
- Cerebrovascular disease: stroke (I64, I63, I69.3, I69.4), transient ischemic attack (G45);
- Peripheral vascular disease: peripheral artery disease (E11.51, E11.52), diabetic foot (E11.73), chronic ulcer of skin (L97, L98.4); lower-extremity amputation (Y83.5).

2.3. Ethical approval

Approvals for this study which were given by Lithuanian Bioethics Committee (No. BE-2-56 was received with issue date December 27, 2011) and State Data Protection Inspectorate (permission No. 2R-978 was received with issue date March 13, 2012).

2.4. Statistical analysis

A statistical data analysis was performed with Statistical Package for the Social Sciences (SPSS) 17.0 software packages. For descriptive statistical analysis means, standard deviation (SD), 95% confidence interval (95% CI) and frequencies were calculated. For quantitative variables the hypothesis concerning normal distribution was checked using Kolmogorov-Smirnov test. When the normality was denied, the differences between mean values of the variable in three and more independent samples were compared using Kruskal-Wallis test. The difference between the results was considered statistically significant, if $P < 0.05$.

3. Results

3.1. Characteristics of the study populations

The all of socio-demographic and disease-related characteristics are shown in Table 1. A total number of 762 patients with diabetes mellitus type 2 participated in this study. 62.3% of participants were women and 37.7% were men. The mean age

Table 1 – Characteristics of study participants (N = 762).

Variables	No. (%)
Gender	
Male	287 (37.7)
Female	475 (62.3)
Living area	
Urban	457 (60.0)
Rural	305 (40.0)
Age group (years)	
<40	13 (1.7)
40–49	46 (6.0)
50–59	117 (15.4)
60–70	277 (36.4)
>70	309 (40.6)
Treatment type	
Diet alone	98 (12.9)
Oral hypoglycemic medication	483 (63.4)
Oral and non-insulin injectable hypoglycemic medication	7 (0.9)
Oral hypoglycemic medication and insulin	72 (9.4)
Insulin	102 (13.4)
Oral hypoglycaemic medication groups	561 (73.6)
Monotherapy	383 (68.3)
Double therapy	156 (27.8)
Triple therapy	22 (3.9)
Diabetes-related chronic complications	
No/Without complications	266 (34.9)
One or more complications	496 (65.1)
Diabetes-related chronic complications	
Microvascular	289 (37.9)
Retinopathy	35 (4.6)
Blindness	3 (0.4)
Nephropathy	23 (3.0)
Renal failure	13 (1.7)
Neuropathy	240 (31.5)
Macrovascular	342 (44.9)
Cardiovascular disease	232 (30.4)
Acute myocardial infarction	7 (0.9)
Chronic ischemic heart disease	66 (8.7)
Angina pectoris	205 (26.9)
Diabetic cardiomyopathy	2 (0.3)
Cerebrovascular disease	148 (19.4)
Stroke	137 (18.0)
Transient ischemic attack	20 (2.6)
Peripheral vascular disease	32 (4.2)
Peripheral artery disease	15 (2.0)
Diabetic foot	8 (1.0)
Chronic ulcer of skin	12 (1.6)
Lower-extremity amputation	1 (0.1)
Comorbidity	
Arterial hypertension	670 (87.9)
Dyslipidemia	60 (7.9)
Obesity	69 (9.1)
Heart failure	200 (26.2)
Depression	27 (3.5)

Table 2 – Direct cost of diabetes mellitus ambulatory care, mean annual cost per person, 2011.

Variables	No. (%) of patients	Ambulatory care					
		Mean annual cost per person				Time/per years	
		Mean		95% CI		Mean	Range (min-max)
		LTL	€	LTL	€		
General practitioner	761 (99.9)	128.38	37.21	125.22–131.54	36.30–38.13	9.42	1–39
Endocrinologist	253 (33.2)	74.02	21.45	68.23–79.81	19.78–23.13	2.04	1–13
Ophthalmologist	273 (64.2)	67.23	19.49	59.73–74.72	17.31–21.66	2.30	1–24
Nephrologist	18 (2.4)	113.62	32.93	85.49–141.75	24.78–41.09	2.67	1–6
Neurologist	176 (23.1)	54.00	15.65	49.04–58.97	14.21–17.09	1.84	1–12
Cardiologist	132 (17.3)	91.06	26.39	78.25–103.86	22.68–30.10	2.23	1–8
Internist	78 (10.2)	46.06	13.35	40.52–51.61	11.74–14.96	1.28	1–4
Diabetes specialist nurse	1 (0.1)	23.31	6.76	–	–	1.00	1–1
Foot care	4 (0.5)	27.72	8.03	–	–	1.00	1–1
Surgeon	131 (17.2)	52.44	15.2	45.14–59.75	13.08–17.32	2.37	1–19
Psychiatrist	73 (9.6)	10.72	3.12	10.57–10.86	3.06–3.15	4.84	1–50
Rehabilitation specialist	97 (12.7)	133.55	38.71	116.71–150.39	33.83–43.59	2.71	1–8
Dentist	162 (21.3)	33.46	9.70	33.15–33.76	9.61–9.78	3.37	1–23
HbA1c test	559 (73.4)	83.65	24.25	80.35–86.96	23.29–25.21	2.07	1–5
Outpatient day care	24 (3.1)	986.22	285.86	618.82–1353.63	179.37–392.36	5.25	1–27
Prescribed nurse visits	61 (8.0)	26.99	7.82	16.94–37.04	4.91–10.74	5.46	1–44
General practitioner visits at home for disable patients	45 (5.9)	149.55	43.35	114.66–184.44	33.23–53.46	6.04	1–13
Nurse visits at home for disable patients	26 (3.4)	59.07	17.12	34.58–83.56	10.02–24.22	4.00	1–12
Other	563 (73.9)	275.48	79.85	251.41–299.55	72.87–86.83	7.21	1–64
Total	762 (100)	538.70	156.14	507.33–570.08	147.05–165.24	21.79	1–98

was 67.07 years (SD 11.5, range 32–97). 60.0% patients are living in urban areas.

13.4% of the participants were exclusively treated with insulin, 63.4% were treated with oral hypoglycemic medication and 9.4% received oral hypoglycemic medication and insulin. 65.1% participants were diagnosed one or more diabetes-related chronic complications. It was identified that the most frequent diabetes-related chronic complications were cardiovascular disease (30.4%) and neuropathy (31.5%).

The majority of participants (87.9%) had diagnosed arterial hypertension.

3.2. Direct healthcare costs

Mean annual type 2 diabetes mellitus direct healthcare costs per patient accounted to EUR 955.73 (95% CI, 879.79–1031.67). Ambulatory care resource utilization is shown in Table 2. On average, patients had 9.42 (range 1–39) general practitioner

Table 3 – Direct cost of diabetes mellitus hospital inpatient care, mean annual cost per person, 2011.

Variables	No. (%) of patients	Hospital inpatient care					
		Mean annual cost per person				Time/per years	
		Mean		95% CI		Mean	min-max
		LTL	€	LTL	€		
Endocrinology	23 (3.0)	1511.06	437.99	1220.10–1802.02	353.65–522.32	1.17	1–3
Therapy	127 (16.7)	1435.81	416.18	1304.48–1567.13	378.11–454.24	1.36	1–4
Nephrology	3 (0.4)	1736.05	503.20	966.03–2506.07	280.01–726.40	1.33	1–2
Neurology	36 (4.7)	1499.87	434.74	1343.16–1656.58	389.32–480.17	1.19	1–2
Ophthalmology	6 (0.8)	1143.33	331.4	899.00–1387.65	260.58–402.22	1.33	1–2
Hemodialysis	1 (0.1)	5631.46	1632.31	–	–	14.00	–
Cardiology	37 (4.9)	2719.27	788.19	1977.32–3461.23	573.14–1003.25	1.70	1–4
Heart, thoracic and vascular surgery	8 (1.0)	3456.70	1001.94	745.72–6167.68	216.15–1787.73	2.38	1–7
Day surgery	45 (5.9)	1327.99	384.92	1114.72–1541.25	323.11–446.74	1.58	1–4
Surgery	26 (3.4)	2997.21	868.76	2102.14–3892.28	609.32–1128.20	2.23	1–7
Angiology	9 (1.2)	3225.38	934.89	264.37–6186.39	76.63–1793.16	1.67	1–5
Psychiatrics	9 (1.2)	5936.06	1720.60	4565.69–7306.44	1323.39–2117.81	1.22	1–2
Nursing and palliative care	19 (2.5)	3613.69	1047.45	2142.82–5084.57	621.11–1473.79	2.58	1–7
Reanimation and intensive care	97 (12.7)	1916.81	555.60	1516.22–2317.39	439.48–671.71	1.39	1–5
Rehabilitation	17 (2.2)	2453.10	711.04	1976.61–2929.58	572.93–849.15	1.06	1–2
Other:	75 (9.8)	1622.71	470.35	1067.43–2177.98	309.40–631.30	1.72	1–8
Total	262 (34.4)	4002.56	1160.16	3517.61–4487.51	1019.60–1300.73	3.19	1–18

Table 4 – Direct cost of covered drugs and diabetes supplies, mean annual cost per person, 2011.

Variables	Number of patients n (%)	Mean annual cost per person	
		Mean (95% CI)	
		LTL	€
Antidiabetic medication	664 (87.14)	615.88 (550.50–681.26)	178.52 (159.56–197.47)
Oral hypoglycemic medication	483 (63.4)	257.82 [*] (224.49–291.14)	74.73 [*] (65.07–84.39)
Oral and non-insulin injectable hypoglycemic medication	7 (0.9)	2022.88 [*] (1031.22–3014.54)	586.34 [*] (298.90–873.78)
Oral hypoglycemic medication and insulin	72 (9.4)	1755.84 [*] (1469.04–2042.63)	508.94 [*] (425.81–592.07)
Insulin	102 (13.4)	1410.20 [*] (1241.16–1579.24)	408.75 [*] (359.76–457.75)
Diagnostics strips	549 (72.1)	177.32 (168.86–185.78)	51.40 (48.94–53.85)
Other medication	629 (82.5)	869.74 (760.75–978.71)	252.10 (220.51–283.68)
Total	681 (89.4)	1546.78 (1418.44–1675.13)	448.34 (411.14–485.54)

^{*} $P < 0.001$ difference between mean values of antidiabetic medication groups were compared using Kruskal–Wallis test.

and 2.04 (range 1–13) endocrinologist consultations per years. Nevertheless, only 33.2% and respectively 64.2% patients was consulted by endocrinologist and ophthalmologist. The HbA1c test was not performed for 26.6% patients, within 2011. All ambulatory care cost mean per patients in 2011 was EUR 156.14 (95% CI, 147.05–165.24).

Hospitalization cost mean annual per patients was EUR 1160.16 (95% CI, 1019.60–1300.73) in 2011 (Table 3). 34.4% patients had at least one hospitalization during the 2011 year. It was identified that the most frequently 16.7% and 12.7% respectively patient with diabetes mellitus type 2 was treated in therapy and reanimation and intensive care units.

Total costs mean annual per person covered drugs and diabetes supplies in ambulatory settings for studied population were estimated at EUR 448.34 (95% CI, 411.14–485.54) (Table 4). The cost distribution by treatment type showed, that more expensive treatment was with oral and non-insulin injectable hypoglycemic medications (mean annual cost per person, EUR 586.34; 95% CI, 298.90–873.78; $P < 0.001$). Only for 72.1% of the patients, one or more time was prescribed diagnostics strips in 2011.

Table 5 shows the distribution of direct healthcare costs by diabetes-related chronic complications numbers groups. The average cost per person, increased gradually with the numbers of complications from EUR 671.94 (95% CI, 575.03–768.86) in patients without complications to EUR 1588.98 (95% CI, 1052.09–2125.86) in patients with 3 and more complications (Table 5). Though mean cost per person of ambulatory care and covered drugs increased statistically significantly with number of diabetes-related chronic complications ($P < 0.001$ and $P < 0.001$). But we did not find the significant relationship between hospital inpatient care cost and number of complications ($P = 0.124$).

4. Discussion

The analysis of healthcare costs set preconditions for further full economic evaluation of patients with type 2 diabetes mellitus management. Evaluation of the economic cost of diabetes mellitus and its predictive factors helps to inform policymakers and to motivate their change and reduce healthcare resources.

The largest part of direct costs in diabetes mellitus healthcare composed hospital inpatient care and covered drugs expenditures. Our study results confirm the previous cost of diabetes studies data. American Diabetes Association study data (2012) showed that the largest components of medical expenditures are hospital inpatient care (43% of the total medical cost), prescription medications to treat the complications of diabetes (18%), antidiabetic agents and diabetes supplies (12%) [3]. These results also confirm Schmitt-Koopmann et al., their accounted that total direct costs consisted of 53% hospitalization and 30% medication costs [15].

In our study we observed that the presence of microvascular, macrovascular chronic complication increased the direct cost per patient. The CODE-2 European multicenter study observed that the presence of microvascular, macrovascular, or both types of complication increased the direct cost per patient by 1.7, 2.0, and 3.5 times, respectively, compared with patients without complications [16]. The same results were presented in earlier study performed in Switzerland, researchers found that direct medical expenditures growing is strongly related with diabetes mellitus complication presence [15].

In our study was identified that the most frequent diabetes-related chronic complications were neuropathy (31.5%) and cardiovascular disease (30.4%). In Poland study the biggest part of diabetes-related complications costs goes to heart disease (84.4%) care [11]. Likewise Sweden researchers found, that the most important diabetes-related chronic complication was cardiovascular disease, contributing 33% of the healthcare cost, 27% of the productivity loss and 82% of deaths in 1987 and respectively 34%, 24% and 65% in 2005 [6].

Nevertheless, only 33.2% and respectively 64.2% patients was consulted at least one time per year by endocrinologist and ophthalmologist. The HbA1c test was not performed for 26.6% patients, within 2011. The same results were presented in earlier studies performed in Federation of Bosnia and Herzegovina [17], Norway [18] and Australia [19].

Results from our study demonstrate that the quality of this disease care is not insufficient.

4.1. Study strength and limits

It was the first research performed in Lithuania which evaluated the patients with type 2 diabetes healthcare direct

Table 5 – Relationship between diabetes-related chronic complications number and direct cost of their healthcare, 2011.

Diabetes-related chronic complications N (%)	Ambulatory care		Hospital care		Covered drugs and diabetes supplies		Total	
	Mean annual cost per person							
	Mean (95% CI)		Mean (95% CI)		Mean (95% CI)		Mean (95% CI)	
	LTL	€	LTL	€	LTL	€	LTL	€
0	423.28 [*]	122.69 [*]	3755.37	1088.51	1200.08 [*]	347.85 [*]	2318.21 [*]	671.94 [*]
N = 266 (34.9)	(385.80–460.75)	(111.83–133.55)	(2734.62–4776.13)	(792.64–1384.38)	(1056.91–1343.25)	(306.35–389.35)	(1983.85–2652.57)	(575.03–768.86)
1	536.85 [*]	155.61 [*]	3723.08	1079.15	1410.83 [*]	408.94 [*]	3146.03 [*]	911.89 [*]
N = 315 (41.3)	(491.36–582.34)	(142.42–168.79)	(2958.81–4487.35)	(857.63–1300.68)	(1279.38–1542.28)	(370.83–447.04)	(2793.19–3498.88)	(809.62–1014.17)
2	704.38 [*]	204.17 [*]	4692.19	1360.05	2023.05 [*]	586.39 [*]	4853.50 [*]	1406.81 [*]
N = 139 (18.2)	(602.18–806.59)	(174.54–233.79)	(3682.93–5701.45)	(1067.51–1652.59)	(1648.06–2398.04)	(477.70–695.08)	(4088.99–5618.01)	(1185.21–1628.41)
3 >	735.34 [*]	213.14 [*]	4053.08	1174.80	3060.87 [*]	887.21 [*]	5481.98 [*]	1588.98 [*]
N = 42 (5.5)	(585.67–885.00)	(169.76–256.52)	(2779.90–5326.26)	(805.77–1543.84)	(1685.97–4435.76)	(488.69–1285.73)	(3629.73–7334.23)	(1052.09–2125.86)
P	P < 0.001		0.124		P < 0.001		P < 0.001	

^{*} P < 0.001 difference between mean values of ambulatory care, hospital care, covered drugs, total direct healthcare costs and diabetes-related chronic complications groups were compared using Kruskal–Wallis test.

* P < 0.001 difference between mean values of ambulatory care, hospital care, covered drugs, total direct healthcare costs and diabetes-related chronic complications groups were compared using Kruskal–Wallis test.

costs. The random sample was constituted using the database of the National Health Insurance Fund under the Lithuanian Ministry of Health (this database covering about 95% of Lithuanian population). The results of this study can be used for evaluation of management type 2 diabetes mellitus in Lithuanian healthcare system.

5. Conclusions

The largest part of direct costs in diabetes mellitus healthcare composes hospital inpatient care and covered drugs expenditures. In our study we observed that the presence of microvascular, macrovascular chronic complication increased the direct cost per patient, compared with patients without complications.

Conflict of interest

The authors state no conflict of interest.

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