Analysis of Direct Medical Costs on Type 2 Diabetes Mellitus Outpatient with Cardiovascular Disease

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ABSTRACT: T2DM is a chronic disease characterized by high blood glucose levels due to insulin resistance or insufficient insulin production. Aim of this study was to analyze the direct medical costs of outpatient T2DM management with cardiovascular disease complications. 58 T2DM patients at the Universitas Sumatera Utara Hospital, in Sumatera Utara, Indonesia were recruited in this study in April-May 2023. This study analyze based on payer prespective named as Badan Penyelenggara Jaminan Sosial (BPJS). This quantitative research was carried out by collecting data retrospectively. Result of this study show that phycian service IDR 8,715,000, drug acquisition cost IDR 13,081,242, laboratory examination IDR 2,531,000, medical execution IDR 410,000, and administration IDR 1,425,000. Conclusion of this study, that drug acquisition cost was the highest cost IDR 13,081,242.

KEYWORDS: Cardiovascular, Direct Medical Cost, Outpatient, T2DM

I. INTRODUCTION

Diabetes mellitus is a metabolic condition where there are consistently elevated levels of glucose in the blood (called hyinglycemia) due to either a lack of insulin, resistance to insulin, or both. This condition can result in severe complications that raise the risk of illness and death. In Saudi Arabia, the prevalence of type 2 diabetes mellitus (T2DM) was 18.3%, making it a significant health issue (Badedi et al., 2020).

According to the International Diabetes Federation (2019), the global prevalence of Diabetes Mellitus in 2019 is estimated at 9.3% (463 million people). The Diabetes Federation (IDF) projects that the number of diabetes sufferers in several countries in the world, namely China, India and the United States, is in the top three rankings with the number of sufferers at 116.4 million, 77 million and 31 million. Indonesia is in 7th place with a total of 10.7 million sufferers.

The highest prevalence of DM diagnosed by doctors in residents aged ≥15 years was in DKI Jakarta (3.5%), Bangka Belitung (2.6%), Central Sulawesi (2.3%), Riau (2.0%), Islands Riau (1.9%), North Maluku (1.5%), and Bengkulu. According to the South Sumatera Province health report (2018), South Sumatera is ranked 10th with the highest number of diabetes mellitus cases at 33,566 people, with the area with the most sufferers being Palembang City with 6,590 people, while the area with the lowest number of sufferers is Pagar Alam Regency with 553 people (Lukman et al, 2023).

In 2021, the number of diabetes mellitus sufferers will increase very rapidly to 81.8% and show a total of 19.47 million sufferers, which makes Indonesia the fifth-ranked country with the highest number of diabetes patients throughout the world (Safitri et al, 2023).

Type 2 diabetes is defined by high levels of glucose in the blood, which occurs due to a gradual decline in the function of insulin-producing beta cells, often accompanied by different levels of resistance to insulin. These two main disease-causing processes are often accompanied by other disruptions in glucose regulation, such as abnormal high levels of glucagon and a decreased response to incretin hormones. Merely having insulin resistance is generally not enough to cause Type 2 Diabetes because the pancreas can initially counteract this by increasing insulin production in proportion. Nevertheless, prolonged high levels of insulin can put pressure on beta cells, leading to a disruption in the immediate release of insulin in response to changes in blood glucose levels and ultimately (Bellary et al., 2021).

DMT 2 subgroups are as follows. Firstly, DMT 2 is obesity, namely around 85% of DMT 2 sufferers are obese. In these patients, there is insensitivity to insulin, which is endogenous, which is related to a pattern of abdominal fat distribution, where the ratio of waist to hip circumference is above normal values. Second, non-obese DMT 2 is around 15% of patients, DMT 2 is in this group. Most patients show impaired insulin action at the post-receptor level as well as loss or delay in insulin release in the initial

phase in response to glucose. Other insulinogenic stimuli such as acute infusion of amino acids, intravenous tolbutamide or intramuscular glucagon are still effective in stimulating acute insulin secretion (Setiawan, 2021).

Cardiovascular disease is the leading cause of death in women and men, and its incidence continues to rise as the obesity epidemic and cardiometabolic diseases increase. Adults under 65 years of age, men have a higher than women, but in Europe and the United States, thefastest relative increase in mortality from cardiovascular disease occurs in middle-aged women (45 to 64 years old). Therefore, it is important to focus on the risk of cardiovascular disease in women (Roeters et al., 2023).

Cardiovascular disease is one of the factors that causes the burden of disease globally. Diet and nutrition have been extensively researched as major risk factors for cardiovascular diseases, such as coronary cardiovascular disease (CHD), stroke, diabetes mellitus (DM), hyintension, and obesity. Diet can influence cardiovascular risk by increasing or decreasing cardiovascular disease risk factors such as cholesterol levels, blood pressure, body weight, and diabetes mellitus. The biggest challenge in cardiovascular disease prevention is to develop effective strategies so that patients can change their diet (quantitatively and qualitatively) and to maintain a healthy diet and normal body weight (Ardiana, 2022).

Medical expenses are taken into consideration during discussions about financial protection and reducing out-of-pocket payments, as well as other expenses that patients pay directly. Official statistics often do not account for expenses related to the hospitalization, such as transportation and meals. Although it had a significant influence on the utilization of healthcare services, this important aspect of expenditures has been neglected in many cases (Sabermahani et al., 2021).

Direct medical costs are all kinds of costs that are directly related to treatment and medical care provided to patients. Direct medical costs consist of drug acquisition cost, phycian service, laboratory tests, medical procedures, and administration (Wahyuni et al., 2023).

Data complications in Indonesia show the same increasing trend. SKRT data shows an increase in the prevalence of cardiovascular disease from 1980 to 1986 (from 5.2% to 6.3%). The death rate due to cardiovascular disease also increased from 1986 to 1992 (from 9.7% to 16.5%), including Diabetes Mellitus sufferers who died due to cardiovascular disease (Setiawan, 2021). In 2020, in North Sumatera Province, the prevalence of diabetes mellitus sufferers reached 1.39%, almost close to the national prevalence figure of 1.5%. of the 249,519 diabetes sufferers, around 57.92% received health services many as 104,998 people did not go to health services (Sinurat et al, 2023).

Hyintension is an abnormal and insistent increase in blood pressure in the arteries over a predetermined iniod of time is known as, or high blood pressure. Blood pressure in the arteries over a predetermined iniod of time is known as hyintension, or high blood pressure. When the arterioles arterioles narrow, this happened. blood flow is obstructed and pressure and pressure on the arterial walls increases when the arterioles narrow on the arterial walls increases when the arterioles narrow. If hyintension continues, this can cause damage to the heart and blood arteries because it increases the pressure on the heart. because it increases their tension (da Costa Nunes et al., 2022).

Based on the introduction above, researchers are interested in conducting research on " Analysis of Direct Medical Costs on Type 2 Diabetes Mellitus Management with Cardiovascular Disease". The case study will be carried out at the Universitas Sumatera Utara Hospital, Sumatera Utara, Indonesia.

II. METHOD

This research uses a quantitative research design with data collection carried out retrospectively. The data collected in this study included patient characteristics, disease diagnoses and complications taken from the hospital information system (SIRS) while data on patient management costs was obtained from the finance department. This research takes the inspective of the social security administering body BPJS so that the data analyzed is only directly medical. This research was carried out in May 2023 by collecting data on direct medical costs for April-May 2023 at the Universitas Sumatera Utara Hospital, in Sumatera Utara, Indonesia. A total of 58 patients who met the inclusion criteria were recruited using a simple random sampling technique. The inclusion criteria in this study were that they were T2DM patients, had cardiovascular complications, were >18 years old, and were willing to be respondents.

III. RESEARCH RESULT

In this study, the characteristics of patients summarized by age at the Universitas Sumatera Utara Hospital, in Sumatera Utara, Indonesia include ages 24 years to 74 years, presented in the following table:

Table 1. Patient Characteristics Summarized by Age

Age	Male	%	Female	%
24-30	0	0.00	2	3.44
31-40	1	1.72	0	0.00
41-50	2	3.44	1	1.72
51-60	13	22.41	14	24.13

61-70	5	8.62	18	31.03
>70	1	1.72	1	1.72
Total	**22**	**37.93**	**36**	**62.06**

Based on this table, it was found that from 58 patients with indications of cardiovascular disease with DMT 2 with an age range of 24-30 years, there were 0 men with a incentage of 0.00 and 2 women with a incentage of 3.44. In the age range of 31-40 years, the number of men is 1 with a incentage of 1.72 and the number of women is 0 with a incentage of 0.00. In the age range of 41-50 years, there are 2 men with a incentage of 3.44 and 1 for women with a incentage of 1.72. In the age range of 51-60 years, there were 13 men with a incentage of 22.41 and 14 women with a incentage of 24.13. In the age range of 61-70 years, there were 5 men with a incentage of 8.62 and 1 woman with a incentage of 1.72. In the age range >70 years, there is 1 for men with a incentage of 1.72 and for women there is 1 with a incentage of 1.72. The total characteristics of the 58 patients summarized by age for men was 22 with a incentage of 37.93 and for women it was 36 with a incentage of 62.06. Based on this table, the majority of patients suffering from T2DM with cardiovascular complications are men, namely the age range 51-60, while for women the age range is 61-70.

In this study, the drugs given before the intervention and after the intervention at the Universitas Sumatera Utara Hospital, in Sumatera Utara, Indonesia included several drugs along with the number of patients given, presented in the following table:

Table 2. Outpatient T2DM Management at USU Hospital

Medication Given	n
Glimepiride+ Metformin	13
Inj. Novorapid+Inj. Lantus	9
Novorapid+Lantus	8
Glimepiride	6
Metformin	6
Apidra+Levemir	2
Inj. Aprida+Inj.Lantus	2
Inj. Apidra+Inj. Levemir	2
Inj. Novorapid+Lantus	2
Novorapid+ Glimepiride	1
Glimepiride+Metformin+Acarbose	1
Glikuidon	1
Acarbose+Metformin+ Glikuidon	1
Inj. Novorapid+Inj.Levemir	1
Inj. Lantus	1
Diamicron+Metformin+Pioglitazon	1
Ryzodeg+Metformin	1
Ryzodeg	1

Based on the table of drugs given to 58 cardiovascular patients, it was found that the drug most frequently given was a combination of Glimepiride+Metformin for 13 patients.

In this study, there are details of the average direct medical costs/patient/year at the Universitas Sumatera Utara Hospital, in Sumatera Utara, Indonesia which are presented in the following graph:

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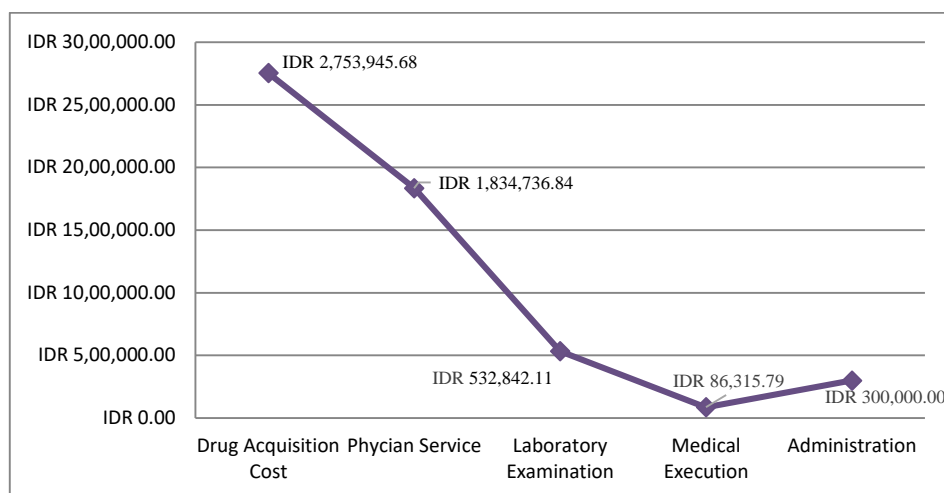

Figure 1. Graphic of Average Component Details of Direct Medical Costs/Patient/Year

Based on the graph detailing the average components of direct medical costs/ patient/year above, it is known that the cost of medicines/patient/year is IDR 2,753,945.68, phycian service/patient/year costs IDR 1,834,736.84, laboratory examinations/patient/year amounting to IDR 532,842.11, medical procedures/patient/year costs IDR 532,842.11, and administration costs / patient / year amount to IDR 300,000.00.

In this study, direct costs at the Universitas Sumatera Utara Hospital in Sumatera Utara, Indonesia include drug acquisition cost, doctor service costs, lab tests, medical procedures, administration, total costs, and total costs/year, presented in the following table:

Table 3. Direct Medical Costs

Component	Total	Mean/ Patient	Standard Deviation
Drug Acquisition Cost	13,081,242	229,495	264,121.5
Phycian Service	8,715,000	152,895	33,473.7
Laboratory Examination	2,531,000	44,404	65,535.66
Medical Execution	410,000	7,193	31,651.24
Administration	1,425,000	25,000	0
Total Cost/Month	**26,162,242**	**458,987**	**252,069.395**
Total Cost/Year	**313,946,904**	**5,507,840**	**302,4832.74**

Based on this table, the largest to smallest total costs for 58 patients who indicated cardiovascular disease with DMT 2 were obtained starting from the drug cost of IDR 13,081,242, total cost of doctor's services IDR 8,715,000, total laboratory examination costs IDR 2,531,000, total cost of medical procedures IDR 410,000, and total administration IDR 1,425,000. The total cost/month is IDR 26,162,242 while the total costs/year are IDR 313,946,904. Based on all these total costs, the largest expenditure for diabetes patients is the total cost of medication.

Based on this table, the largest to smallest average costs for 58 patients who were diagnosed with cardiovascular disease with DMT 2 were obtained, starting from the average drug cost of IDR 229,495, the average cost of phycian service is IDR 152,895, average laboratory examination cost IDR 44,404, the average cost of medical procedures is IDR 7,193, and the administrative average is IDR 25,000. The average total cost/month is IDR 458,987 while the total costs/year are IDR 5,507,840. Based on all these averages, the largest expenditure for diabetes patients is the average cost of medicine.

Based on this table, the largest to smallest standard deviation was obtained for 58 patients who were indicated to have cardiovascular disease with DMT 2 starting from the standard deviation of drug acquisition cost 264121.5, the standard deviation of doctor service costs 33473.7, the standard deviation of laboratory examination costs 65535.66631, the standard deviation of costs medical procedures 31651.24608, and administrative standard deviation 0. The standard deviation of all costs/month is IDR 252069.395 while the total standard deviation/year is IDR 3024832.74. Based on all these standard deviations, the largest expenditure for diabetes patients is the standard deviation of drug acquisition cost.

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IV. DISCUSSION

Based on table 1, it shows that the 13 male respondents showed an average age of 51-60 years, while 18 female respondents with an age range of 61-70 years exinienced more cardiovascular complications from T2DM. Previous research stated that The complications suffered by DMT 2 patients consist of microvascular (neuropathy, retinopathy and nephropathy), macrovascular (hyintension, dyslipidemia, hyinuricemia, asthma, heart) and a combination of both complications (microvascular and macrovascular). After reaching the age of 30 years, blood glucose levels will increase by 1-2 mg/dL in year (when fasting) and increase by 5.6-13 <mg/dL in year 2 hours after eating), resulting in high blood glucose levels. Continuously can result in complications of diabetes mellitus. The main complications of diabetes mellitus are macrovascular complications, which constitute cardiovascular disease, accounting for 65% of diabetes mellitus complications and are the macause of death in patients with T2DM (Putri & Inwitasari, 2019). Exints also agree that the risk of developing T2DM increases from age 45 years and above. As individuals get older, they will exinience progressive shrinkage of pancreatic cells, so that too little hormone is produced and causes glucose levels to rise (Masruroh, 2018).

Meanwhile, in terms of gender, the results showed that those most affected by T2DM were women with 36 respondents compared to only 22 men. This is in line with previous research which found that most female respondents exinienced T2DM. Apart from age, body mass index can also be influenced by gender. Women are more likely to be overweight or obese, where men have more muscle mass and use more muscle mass than women due to more activity and the burning of calories by muscles in men compared to women (Masruroh, 2018).

Complication drug acquisition cost are drug acquisition cost incurred by patients to treat complications from the disease they suffer from. Drugs that are often used for cardiovascular disease based on this research are Amlodipine, Novorapid, and Metformin. However, in several other situations drugs that are not widely used are generally also widely used, such as Levemir and Glimepiride (Rahayuningsih et al, 2018).

Based on graph 1 in the breakdown of the average components of direct medical/patient costs in annual terms, it is known that drug acquisition cost are the largest expenditure with an amount of IDR 2,753,945.68. This is in accordance with research by Anjani & Harlianti (2019) which states that direct medical costs for using drugs are the largest expenditure, because drug use varies according to the comorbidities suffered by each patient.

Direct medical costs for outpatient T2DM patients increase in year with the complications exinienced. Previous research states that direct medical costs in using drugs are the largest expenditure due to the use of drugs for each patient which varies according to the comorbidities they suffer, but it is also influenced by the patient's hospitalization costs according to the length of time the patient is treated (Anjani & Harlianti, 2019).

Length of treatment is a factor that influences the medical costs of diabetes mellitus, because medical costs at the hospital are calculated in day, the length of treatment will increase medical procedures or actions so that the longer the patient is treated, the costs increase. The length of treatment has a significant relationship with the total cost of diabetes mellitus, because the longer the patient is treated, the higher the drug acquisition cost will be (Tandah et al, 2023).

The costs calculated in the research are direct medical costs. The inspective used in this research is the hospital inspective (health service inspective). Costs from a hospital inspective are the costs required to provide health services for patients (Fitria et al, 2023).

In this study, the largest component spent by respondents was drug acquisition cost amounting to IDR 13,081,242 with an average cost/patient of IDR 229,495. The research is in line with previous research which states that drug acquisition cost are the largest expense for diabetes mellitus sufferers. For the results of the analysis of the quality of life of T2DM patients with heart disease, it was found that the factor that influenced the patient's quality of life was the length/duration of the illness. Patients who have suffered from DM for a long time but are accompanied by other diseases have low self-efficacy. So the length of suffering accompanied by other diseases will affect the patient's quality of life (Sari, 2017).

V. CONCLUSIONS

The highest direct medical cost for outpatient T2DM management with complications of cardiovascular disease from 58 patients was the drug cost of IDR 13,081,242 and the lowest cost is medical execution amounting to IDR 410,000.

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