

**ASSOCIATION BETWEEN DIRECT COST OF CARE AND GLYCAEMIC  
CONTROL AMONG DIABETES TYPE 2 PATIENTS IN TWO MISSION  
HOSPITAL CLINICS IN KENYA**

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**A Thesis Submitted to the Institute of Postgraduate Studies of Kabarak University  
in Partial Fulfillment of the Requirements for the Award of Master of Medicine in  
Family Medicine Degree**

**KABARAK UNIVERSITY**

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## RECOMMENDATION

To the Institute of Postgraduate Studies,

This thesis titled '**Assessment of Direct Cost of Care and Glycaemic Control among Diabetes Type 2 Patients in Two Mission Hospital Clinics in Kenya**' and written by **Lakasia Kefa**, is presented to the Institute of Postgraduate Studies of Kabarak University. We have reviewed the thesis and recommend it be accepted in partial fulfilment of the Degree of Master of Medicine in Family Medicine.

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## **ACKNOWLEDGMENT**

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## **DEDICATION**

I dedicate this thesis to God and my family who supported me throughout this academic program.

## ABSTRACT

It is estimated that 463 million people were living with diabetes in 2019. This number is estimated to increase in two folds by 2045. Diabetes, being a chronic disease, needs frequent hospital visits and follow up by clinicians. These contacts mean costs to the patient. The increase in cost limits the hospital visits, medications purchase and laboratory investigations which leads to poor management and prognosis. The objective of this study was to assess the association between direct cost of care and glycaemic control of diabetes mellitus type 2 patients attending diabetic clinics in two mission hospitals in Kenya. We used a cross-sectional study design for this study. A Kirkwood formula was used to determine the sample size for this study which was 384 participants. Random sampling technique was used to obtain the study subjects. A structured cost of care questionnaire having questions on direct medical and direct-non-medical costs was used to collect data. Obtained data was analyzed using Microsoft excel and SPSS. Descriptive statistics entailed Frequency counts, mean median and percentages interquartile range while inferential statistics employed were. correlational and regression analysis. Most participants were aged over 60 with 21.6% being over 80 years. Mean total direct costs per visit was Kshs. 9,496.90  $\pm$  Kshs. 4,631.53 with drugs accounting for the larger proportion. Mean HbA1c and RBS values were established at 9.231%  $\pm$  2.4920% and 10.075 mmol/l  $\pm$  4.6503 mmol/l respectively. The direct cost of care of T2DM is still relatively high with a wide variation yet the levels of glycaemic control are yet to be fully achieved in a larger proportion of diabetic type 2 patients. We recommend that Government should come up with ways to cushion patients with diabetes against high cost of medical care.

**Keywords:** *Direct cost of care, Glycaemic control, Diabetes Mellitus Type 2.*

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## **ABBREVIATIONS AND ACROYNMS**

ADA	American Diabetes Association
COI	Cost of illness
GOK	Government of Kenya
IDA	International Diabetes Association
IDF	International Diabetes Foundation
IHME	Institute for Health Metrics and Evaluation
LMIC	Low and Middle Income Countries
MoH	Ministry of Health
NACOSTI	National Commission for Science, Technology and Innovation
NCD	Non- Communicable Disease
NGO	Non- Governmental Organization
NHIF	National Hospital Insurance Fund
SDG	Sustainable Development Goal
UHC	Universal Health Coverage
WHO	World Health Organization
USD	United States Dollar

## OPERATIONAL DEFINITION OF TERMS

**Diabetes Mellitus:** It is a chronic medical condition in which the pancreatic cells responsible for producing insulin are not able to produce enough or are unable to produce insulin completely, or when body cells stop responding to the produced insulin.

**Direct Cost:** These are costs which the patient spends on money and are attributed directly to the care of patients. Examples include the cost of medication, laboratory and imaging costs, and transport costs to the hospital.

**Glycaemic Control:** It is a medical term which means the typical amount of blood glucose in diabetic patients. Random blood sugar and HbA1c are used to assess the levels of glycaemic control in diabetic patients. Random blood sugar of below 10 mmol/l and HbA1c of 7 or 8 is acceptable as good glycaemic control.

**Mission Hospitals:** These are private nonprofit making hospitals which are sponsored by religious organizations. This study was conducted in Chogoria and Maua mission hospitals.

## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 Introduction**

This chapter entails the background of the study, statement of the problem, the purpose of the study, the objectives, research question, justification of the study, the scope, limitations of the study, and the pre-understanding.

#### **1.2 Background of the Study**

Non-communicable diseases (NCDs) are fast becoming the leading cause of premature death worldwide (WHO, 2017). In 2019, the international diabetes federation (IDF) reported that approximately 463 million adults and 1.1 million children were living with diabetes and 374 million people were at risk of developing diabetes type 2 (IDF, 2021). By 2045, the number of people living with diabetes is projected to reach 700 million (IDF, 2021). IDF estimates show that 79 percent of diabetic adults live in low and middle-income countries (LMICs). In a study to find the prevalence of diabetes in Kenya, Muhamed (2018) found that the adjusted prevalence of diabetes in Kenya in 2018 was 3.1 percent; with approximately 552400 adults having diabetes (IDF, 2021). This prevalence is consistent with reports from other sub-Saharan countries (Muhamed 2018). Kingori et al. (2021) reported the prevalence of diabetes in Meru County to be 15.4 percent in 2021. This figure is higher than the national rates. He reported that diabetes was more common in women than men at 16.35 percent and 13.95 percent respectively (Kingori et al., 2021).

In 2016, diabetes was the 7<sup>th</sup> leading cause of death worldwide (Arokiasamy, Salvi&Selvamani, 2021), and the number nine leading cause of death in LMICs (WHO, 2020). Diabetes caused 1.6 million deaths in 2016 and close to 2.2 million died from

high blood sugar in the same year (WHO, 2020). In 2009, diabetes was the leading cause of death in Kenya and the 11<sup>th</sup> cause of disability in 2017 (IHME, 2019). Institute of Health Metric and Evaluation reports that diabetes was the number nine cause of disability and death in TharakaNithicounty in 2019 (IHME, 2019). These figures show thatKenyahasa highermortality rates when compared to Uganda and Zimbabwe among people living with diabetes (IDF, 2019).

Reportedly, people living with diabetesspend five times in terms of total annual costs compared to non-diabetic people (ADA, 2020). World Bank reported that in 2017, the majority of Kenyans spent a third of their income on healthcare. In a study done in 2019 in Nyeri, Kenya (one of the piloted counties in Kenya for UHC), Githua(2019)foundthe direct cost of managing diabetes was Kshs 16,349 per year. This expensive medical care affects the poor the more (World Bank, 2021). World Bank (2021) adds that if this continues, close to 5 billion people will not be able to access health care.

In 2019, out of pocket spending was 33 percent (Geordan et al., 2019), yet the insurance uptake remains low and full of inequity (Kazungu&Barasa, 2017). Figures from Kenya health demographic survey (KDHS) show that insurance coverage in Kenya was 20 percent, and 26-27% according to Kenya demographic and health survey of 2022 (KDHS, 2022). Higher rates have been reported in some counties. An example is a study done by Gathua who found out that insurance coverage rates were at 69.9 percent in Nyeri in 2019 (Gathua, 2019). Kipkalom(2019) reported that the majority of the diabetes patients in Thika level 5 hospitals did not have National Hospital Insurance Fund (NHIF) and that providing access to health care by reducing out of pocket spending was more likely to decrease the burden of managing diabetes. Nevertheless, there is more need to encourage enrollment in insurance schemes to reduce out of pocket spending.

Diabetes patients in LMICs face many challenges in seeking health care, among them include the high cost of medicine, long distance to the health care facilities and diagnostic tests (Atun, 2017). According to Mutyambizi et al (2019), costs of drugs took a bigger part of total health care costs. Insulin for example was noted to be a recurrent barrier to the control of blood sugars among diabetes patients (Herkert et al., 2019, Cefalu et al., 2018). A study done by Kabia (2018) indicated that transport costs were an access barrier to diabetes patients seeking health care.

Studies done in Kenya's public health facilities have shown that the cost of medicines reduced compliance with medication (Oyando et al., 2019). Patients in private hospitals pay more than half the patients in public hospitals on investigations, consultations and medicines (Masis, 2022). On 25<sup>th</sup> October, one of the popular newspapers in Kenya reported that people living with diabetes spent KSHS 2772 and 11086 on insulin depending on the brand (Mwita, 2021). Furthermore, 25 percent of patients on insulin for the management of diabetes do not get prescribed insulin due to the high cost. This leaves many diabetes patients not able to afford the adequate care and follow up they need (Geordan et al., 2019). Therefore, Oyando et al. (2019) suggested that there should be a reduction or removal of medical costs to increase access to care.

Achieving glycemic targets not only lowers the risk of diabetes-related complications but also reduces associated healthcare costs (Tachkov et al., 2019). An analysis of diabetes healthcare costs in 2010 demonstrated that reducing HbA1c levels was associated with a lower increase in health expenditures (Bansal et al., 2018). Juarez et al. (2020) highlighted that while the immediate cost benefits of lowering HbA1c may not be apparent, maintaining control over the long-term results in significant cost saving over time. Despite the well-established benefits of glycemic control (UKPDS Group, 2002), many patients still struggle to achieve optimal targets (Sanal et al., 2011).

### **1.3 Statement of the Problem**

In 2019, IDF stated that approximately 463 million people were living with diabetes worldwide. This number is expected to double by the year 2045, (IDF, 2021). Muhamed (2018) found that the prevalence of diabetes in Kenya in 2018 was 3.1 percent; with approximately 552400 adults having diabetes (IDF, 2021). This prevalence is consistent with reports from other sub-Saharan countries (Muhamed 2018). Kingori et al. (2021) reported the prevalence of diabetes in Meru County to be 15.4 percent in 2021. This increase in the prevalence will lead to an increase in the economic burden (Mutiyambizi et al., 2018). Estimates for Sub-Saharan Africa (SSA) are based on sparse data, but projections indicate increases in NCD's caused by demographic and epidemiologic transitions (Ayah et al., 2013). As the prevalence of diabetes in Africa is expected to rise, the economic burden on individuals will also continue to increase (Mutiyambizi et al., 2018). It is estimated that, in 2015, the overall cost of diabetes in sub-Saharan Africa was US\$19.45 billion or 1.2% of cumulative gross domestic product (GDP). Around \$10.81 billion (55.6%) of this cost arose from direct costs which included expenditure on diabetes treatment (eg, medication, hospitalization, and treatment of complications), with out-of-pocket expenditure likely to exceed 50% of the overall health expenditure in many countries (Atun, 2017).

Kenya spent Kshs. 11, 232 per person on health in 2019. This is expected to double by 2050 (IHME, 2020). In her study in Nyeri, at the level 5 hospital, Githua (2019), found out that the average total direct cost of managing diabetes was Kshs. 16,349 per capita per month. This was way higher than what most people earn per month (KSH 6,498). In Kenya, the health sector is predominantly financed by private sector sources (including by households' out-of-pocket (OOP) spending (MoH, 2015). The interaction of diabetes with infectious diseases increases the burden of illness on resource-constrained health

systems (Atun, 2017). People living with diabetes spend the biggest part of their healthcare costs on drugs, (Mutymbizi, 2018). The exorbitant costs of NCDs, including often lengthy and expensive treatment and loss of breadwinners, are forcing millions of people into poverty annually and stifling development (MoH, 2015). In low-resource settings, health-care costs for cardiovascular diseases, cancers, diabetes or chronic lung diseases can quickly drain household resources, driving families into poverty.

Diabetic patients do not afford added costs of sugar monitoring consultation in terms of random blood sugars and regular HbA1c tests, and medicines, (Geordan *et al.*, 2019). We need to have a self monitoring of blood glucose and continuous blood glucose monitoring to address glucose variability, which is missed out when we do HbA1c which is an average. Thus, in people living with diabetes, blood sugar is not only monitored by HbA1c and random glucose but also with continuous glucose monitoring thus increasing diagnostic costs. They may also meet the following costs; renal assessment through Egfr, albumin and creatinine, annual funduscopy for checking retinopathy, macrovascular complications by doing liver function test, lipid profile, and eeg. They may also need vaccinations such as varicella, pneumococcal and influenza. Thus Intensive management and monitoring of diabetics is crucial with matched diagnostic and medical availability (Tiffany, 2013).

If unchecked, expensive healthcare will make close to 5 billion people to fail to get access to health services, according to World Bank (World Bank, 2020). Given the fact that diabetes is a chronic medical condition that needs constant evaluation and monitoring of patients in and out of the hospital, there is a need to cushion patients by the government and other players in the health sector from the very erroneously expensive medical costs. To do so, there is a need to ascertain what is spent per patient on health. Therefore, the need to determine the relationship between the average cost of

care and glycaemic control. Data from this study is of benefit to the government, NGOs and diabetic patients.

#### **1.4 Purpose of the Study**

The purpose of this study was to assess the association between direct cost of care and glycaemic control of diabetes mellitus type 2 patients attending diabetic clinics in two mission hospitals in Kenya.

#### **1.5 Justification of the Study**

Most of the studies have been done outside Kenya, and those done in Kenya have been done in public facilities. Gathua (2019) did her study in Nyeri Level Five Hospital, while Kipkalom (2019) did it in Thika Level Five Hospital and Oyando et al. (2019) did it in five public health care facilities. Therefore, data on mission hospitals are lacking. Secondly, patients attending public health facilities get health services at subsidized costs. Also, a significant number of these patients will not get prescribed medicines. They end up buying these medicines outside of the health facility they attend, hence the estimates in public hospitals could be lower when compared to mission hospitals which tend to have most of these medicines. This could consequently mean that their total cost of care are most likely to be lower compared to mission hospitals. Studies done by Oyando, Gathua and Kipkalom were done in a government hospital and cannot be inferred to the entire population. Lastly, Gathua did a retrospective study. Patients had to recall events of one year. Her study was subjected to recall bias. There is a need for a prospective study to get the actual direct cost of care and glycaemic control of diabetes type two attending outpatients' clinics in two mission hospitals in Kenya. This study looked at direct costs that affect glycaemic control because direct costs are easy to determine and intervene through government subsidies, as opposed to indirect costs which are hard to determine.

## **1.6 Objectives of the Study**

### **1.6.1 General Objective of the Study**

To determine the association between direct cost of care and glycaemic control among diabetes mellitus type 2 patients attending diabetic clinics in two mission hospitals in Kenya.

### **1.6.2 Specific Objectives of the Study**

- i. To evaluate the direct cost of care for diabetes mellitus type 2 patients attending diabetic clinics in two mission hospitals in Kenya.
- ii. To assess the levels of glycated haemoglobin of diabetes type 2 patients attending diabetic clinics in two mission hospitals in Kenya.
- iii. To determine the association between the direct cost of care and glycated haemoglobin among diabetes type 2 patients attending diabetic clinics in two mission hospitals in Kenya.

## **1.7 Research Questions**

The following were the research questions for this study;

- i. Direct cost of care for diabetes mellitus type 2 patients attending diabetic clinics in two mission hospitals in Kenya?
- ii. What are the levels of glycated haemoglobin of diabetes type 2 patients attending diabetic clinics in two mission hospitals in Kenya? What is the association between the direct cost of care and glycated haemoglobin of diabetes type 2 patients attending diabetic clinics in two mission hospitals in Kenya?

## **1.8 Research Hypothesis**

H<sub>01</sub>: There is no association between direct cost of care and glycaemic control of diabetes mellitus type 2 patients attending diabetic clinics in two mission hospitals in Kenya.

H<sub>02</sub>: There is association between direct cost of care and glycaemic control of diabetes mellitus type 2 patients attending diabetic clinics in two mission hospitals in Kenya.

## **1.9 Significance of the Study**

Having seen the global, regional and local burden and the fast increasing prevalence of diabetes, the determined relationship between the direct cost of care and glycaemic control among diabetic patients in mission hospitals is of great value to the government, counties, and hospitals and diabetes patients. Information from this study may help policy makers in the country and counties to focus and work towards holistic and sustainable solutions to reduce the high economic burden that diabetes has on the healthcare systems and patients' households. Also, it will add to the available data on the cost of managing chronic illnesses, and what the government could do to offset this in order to increase access to essential quality health services without suffering financial hardship (aims of UHC), and to prevent needless suffering from premature death by focusing on targets that boost the health of the country (SDGs on health).

Additionally, the cost of diabetes affects glycaemic levels helps counties to identify and come up with cost-effective ways to plan and mobilize available resources to cushion the patients that cannot afford long term diabetes care and those that are on the verge of being impoverished by the daily and increasing cost of care. Lastly, the study results add

to the available data (which is mostly from public health facilities) on the cost of diabetes which has been done in public and private hospitals.

### **1.10 Scope of the Study**

This study was done in two mission hospitals in Kenya. Chogoria Hospital is found in Tharaka Nithi County, 200km from Nairobi while Maua Methodist Hospital is found in Meru County, approximately 277km from Nairobi. The study was conducted in the medical outpatient diabetic clinic on diabetes type 2 patients, at least 6 months after diagnosis was made. This study was conducted to find the relationship between the direct cost of care and glycemic control ( HbA1c and random blood glucose).

### **1.11 Limitations of the Study**

The information collected from the questionnaire relied on self-report and could have been influenced by recall bias and social desirability bias since the questionnaires needed to know how much they spent on transport and meals. Secondly, diabetes type two patients are usually elderly who may not have their memory intact. The researcher overcame this limitation by asking patients to keep records of what they spent.

The researcher also experienced language barrier because the majority of the patients in these two counties speak the *Meru* dialect. However, the researcher used translators ( relatives to patients and research assistants who were fluent in kimeru) to pass on the message on the questionnaire to the study subjects. Maua Methodist Hospital is approximately 78km from Chogoria Hospital where the research is located; hence time to travel between the two hospitals was a barrier, in terms of cost and time. Our study used RBS done on that clinic day and an HbA1c done in the last 3-9 months, which may not have given a direct relationship between the two.

Also, this study used hypertension as the comorbidity, and did not consider diabetic complications. This could have underestimated the cost of care. We however included the cost they spent on that clinic day.

Finally, some of the patients did not have a recent HbA1c due to the expensive medical cost. We however used one done in the last 3-6 months since this is what is recommended by the guidelines most patients we interviewed reported inability to afford HbA1c cost as the reason they had no current HbA1c. we were however compelled to use the most recent available HbA1c. We do not think this could have affected the outcome on cost. We also found out that 3.1 percent of the participants did not have any HbA1c. We think this could have affected the total medical cost.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter carried out an in-depth literature review of scholarly literature on diabetes, epidemiology, economic burden, cost of illness and the direct costs of diabetes, Random Blood Glucose Levels, and levels of Glycated Haemoglobin of Diabetes. Further, this chapter elaborated on the conceptual framework upon which the study is hinged.

#### **2.2 Empirical Literature Review**

##### **2.2.1 Diabetes**

The World Health Organization (WHO) defines diabetes mellitus as a set of syndromes characterized by hyperglycemia and disturbance of the carbohydrate metabolism that are associated with absolute or relative deficiencies in insulin action and- /or insulin secretion. (WHO 2018) different subgroups of diabetes mellitus have been named. The most prevalent are type 1, diabetes type 2 and gestational diabetes. Diabetes type 2 is twenty times more common than type 1 diabetes, with almost 90% of patients having diabetes type 2 and approximately 10% diabetes type 1, Janka, &Michaelis, (2002).

Diabetes type 1 is an autoimmune T-cell mediated destruction of Beta cells, leading to in total deficiency in insulin production. Diabetes type 1 is often diagnosed in young age, Palicka, (2002).

Diabetes type 1 is possess a challenge to diagnose without good laboratory equipment which can detect autoantibody. Hence, there is no exact data on the prevalence of diabetes type 1. Studies have shown that genetic factors strongly influence, together with environmental factors such as infections and gut flora, Korsgren et al., (2012).

Type 2 diabetes mellitus (T2DM), which is the subject of the thesis work, is one of the most common chronic endocrine diseases which has a disorder with insulin secretion and uptake by cells. Diabetes mellitus type 2 is a metabolic disorder where insulin resistance and Beta cell dysfunction are the pathological defects. Even though the disease is a life-long, it is feasible to manage for patient without many difficulties in daily life. (WHO 2018.)

Glucose is the primary stimulus for insulin secretion. Insulin and glucagon play a counter-regulatory role and are the major controlling hormones in the glucose hemostasis in the body, (Wilco, 2005). Insulin release depends on the type form of carbohydrate which is eaten. Diet which is high in a certain carbohydrate stimulates the release of more insulin, and may with time lead to hyperinsulinemia and subsequently, insulin resistance (Ludwig, 2002). Resistance to Insulin occurs when the target tissue has a decreased response to the produced insulin (Palicka, (2002).

The long-term demand of insulin and chronic hyperglycemia, results in a progressive loss of beta cell function. The defect in beta cell function is caused by loss of glucose-induced insulin release. The extent of the Beta cell dysfunction relates to both sugar concentration and the time of hyperglycemia, (Ashwood&.Bruns, 2001). Low insulin response leads to a characteristic state of hyperglycemia which is seen in people with diabetes.

Diabetes is a chronic endocrine disorder, which if not properly managed will lead to increased risk of developing long term microvascular complications like renal failure, retinopathy, microvascular diseases and neuropathy. Patients with diabetes are usually prone to communicable diseases like as pneumonia, bacteremia and other non-communicable diseases like as cardiovascular diseases, (Hall et al., 2011). A population-based study showed a significant relationship between high blood sugar levels and acute

myocardial infarction, (Tancredi et al., 2019). Diabetes is one of the main causes of kidney failure, making patients to undergo dialysis, if available or more severe outcomes like death in low income countries. The damage in the microvascular level are caused by high sugar in the blood, (Ashwood & Bruns, 2001).

Polyneuropathic symptoms are symptom that are caused by demyelination of nerve cells, causing nerve signals to slowly weaken, which leads to loss of sensation in the limbs. Polyneuropathy and macrovascular loss of circulation in limbs increases the risk of limb wounds and infections [5].

Foot ulcers can lead to limb amputation. Diabetic foot wounds are a major cause of hospital admissions and subsequent hospital costs. A cohort study of patients living with diabetes in Muhimbili Hospital, found out that 70% of lower limb amputation occur in patients with diabetes, and the deaths associated with leg wounds is reported to be 50%, (GulamAbbas et al., 2002).

### **2.2.2 Epidemiology**

Non communicable diseases (NCDs) are fast becoming the leading cause of premature death worldwide (WHO, 2017). Studies have showed that almost 39 percent of all deaths are due to NCDs (Murray 2019). In 2019, diabetes was number 9 leading cause of death in LMICs (WHO, 2020). In Africa, WHO estimates that there will be a 27% increase in the number of NCDs in the next 10 years and 28 million deaths from these conditions (WHO, 2020). In Kenya, NCDs similarly pose a great health problem.

LMICs are currently facing a double challenge from both non infectious and infectious diseases, with a more paradigm shift towards NCDs. WHO estimates that 41 million people die from cancer, diabetes, stroke, cancer and respiratory diseases annually. Out of these, approximately 36 percent die prematurely between 30-70 years, and majority of

these are in low income countries (WHO, 2020). Estimates from 2016 showed that diabetes was the seventh leading cause of death worldwide (Arokiasamy et al., 2021). In the same year, 1.6 million people died from diabetes. In 2021, IDF indicated that diabetes lead to 4.2 million deaths annually (IDF, 2021). In his study, study, Muhamed (2018) found out that Kenya had 8700 diabetes related deaths.

In 2020, WHO reported that the number of people living with diabetes increased from 108 million in 2008 to 422 million in 2014 (WHO, 2020). In the same period, WHO noted that the number of people above 18 years of age who had diabetes rose by two folds i.e., 4.7% to 8.7% (WHO, 2020). In 2021, IDF estimates showed that 1 in 5 people above 65 years had diabetes, and that 1 in 2 people have undiagnosed diabetes (IDF, 2021). The adjusted prevalence of diabetes in Kenya in 2018 was 3.1 percent and this number is expected to rise to 4.4 percent by 2035 if no intervention is put forward (Muhamed, 2018). The prevalence has been consistent with what has been reported in other sub-Saharan countries (Muhamed, 2018). Among East African countries, Kenya has the highest number of diabetes related deaths compared to Uganda, and Zimbabwe (IDF, 2019). In Meru, Kingori et al (2021) found prevalence rates of 15.4 percent in 2021. They reported that diabetes was more common in women than men at 16.35 percent and 13.95 percent respectively.

### **2.2.3 Direct Cost of care for Diabetes Mellitus Type 2 Patients**

Based on theories such as Andersen's behavioral model 1, economic factors are among the major important factors which influence the utilization of healthcare services,(Andersen et al., 1999). However, the need for healthcare services has an unpredictable nature. The failure to afford important costs can harm patients and their families seriously. Direct non-medical costs among others include patients' and their attendants' transportation, cost on meals, and costs on accommodation, (Sabermahani,

2021). Indirect costs would refer to the income lost by patients or of their next of kin due to absence from work during the time they are in the hospital (Hennessee et al 2012).

According to the Pan American Health Organization (PAHO), non-communicable diseases related chronic costs have been rising in recent years, both for health systems, businesses and individuals. Governments, and communities are also affected by the costs of treatment and care for patients with NCDs, as well as by their premature death and disability (Organización Mundial de la Salud, 2011). This poses a significant risk of economic loss to health systems, as well as a decrease in life expectancy and quality of life of individuals (World Economic Forum, 2016). In general, research addresses direct costs related to health care and out-of-pocket expenditure or expenses directly borne by patients since neither public nor private insurance covers the full costs of health goods or services (Páez et al., 2020). The ability of countries to estimate private spending on long-term care varies widely.

Access to primary healthcare is extensively known to decrease the global burden of morbidity and mortality (Jamison et al., 2019). In 1978, the WHO began the Alma Ata declaration in an effort to promote access to essential healthcare services while acknowledging health as “the a foremost human right” (WHO, 2000). While this agreement was endorsed by a many of low and middle-income countries, time has showed that these resolutions remain unfulfilled (Ji&Chen., 2016). In low and middle-income countries, access to primary care remains low (Kruk et al., 2010). Understanding the factors associated with access to healthcare in resource limited-settings is a very important undertaking, moreover, following the mirage of universal health coverage in the sustainable development goals (Moreno et al., 2012). In addition, access to primary healthcare services serves as an important surrogate measure of UHC and therefore can

be used to assess the performance of a healthcare system and determine the untapped potential for propelling UHC (Fullman et al., 2018).

The rising trend in the prevalence of diabetes across the world predicts the burden that diabetes will cause in the near future (Arokiasamy et al., 2021). From the estimates of total economic burden of diabetes from 180 countries around the world, Bommer et al (2018) noted that costs of managing diabetes would double from \$1.3 trillion in 2015 to \$2.1-\$2.5 trillion by 2030. In 2019 people with diabetes spent over \$760 billion dollars on health which accounted for 10% of all amount spent on adults (IDF, 2021). In 2021, WHO stated that 10% of household income was spent on health care. Consequently close to 100 million people ended up in extreme poverty every year due to out of pocket spending on health care (WHO, 2021).

In a systematic review done in 2021, Kazibwe, Tran & Annerstedt found out that in LMICs, the annual total cost of NCDs, that is, chronic obstructive airway disease, cardiovascular diseases, cancers and diabetes was USD 7386.71, 6055.99, 3303.81, and 1017.05 respectively (Kazibwe et al., 2021). South Africa had the biggest expenditure on health in Africa in 2017. It spent \$188 per person on diabetes (IDF, 2017). IDF projects that health expenditure in Africa is expected to double to \$12.33 billion by 2045 (IDF, 2017). Kenya spent KSH50.6 billion (\$494.34 million) on NCDs as total health expenditure in 2017/18 financial year, representing a total of 11.0 percent spent on NCDs (Njuguna & Pepela, 2019). The World Bank says that an average household spends over 10 percent of their annual budget on health care (World Bank, 2017). This is much higher compared to 3 percent spent in outpatient costs in India (Ghosh et al., 2021). On average, Households in Kenya spend \$413 every year on health (Subramanian et al., 2018). Subramanian et al further asserted that most NCDs management costs even in government centers pose a substantial financial burden to patients which could result into

catastrophic expenditure. Catastrophic spending on health makes households spend resources meant for other essential commodities, thereby ending up in poverty (Hsu et al., 2018).

However, in July this year NTV Kenya reported that 38 per cent of Kenyans don't have a monthly income, with only 13% of Kenyan earning a monthly income of KES. 20,000-50,000 and above KES. 50,000), and 38% earning nothing (NTV Kenya, 2023). Early this year, Trends and Insights For Africa (TIFA) reports showed that the significant disparity in income distribution across the country with only 3% of Kenyans earning above KES 50,001 (TIFA., 2023). The correlation between monthly income and the ability to save at the end of each month has not been as strong as anticipated and only 28% of those in the lowest income category earning below KES 5,000 are able to save, while 50% of those in the highest income category of above KES 50,001 claim to do save (NTV Kenya 2023). Unfortunately, Kenya National Bureau of Statistics data in April, showed that the number of jobless Kenyans has risen to 2.97 million (KNBS., 2023).

Hsu et al (2018) further reported that patients with NCDs like cancer and diabetes need many tests of which many of them are way expensive. She says that many (36.1percent) of the Kenyans are poor and just 19 percent of Kenyans afford health insurance cover (KNBS, & KNBS, 201. Kazungu & Barasa, 2017).

Close to 1.3 percent of Kenyans are forced into poverty annually due to the expensive health care purchase (World Bank, 2017). In 2019, Eshwari et al., (2019) and Thakur et al., (2019) found out that insulin significantly increased the cost of health care expenses. So they suggested that policies directed towards reduction of market costs and their availability needed to be instituted (Eshwari et al., 2019. Thakur et al., 2019).

Some of the modifiable factors identified to influence expenditure are price of medicines, low social economic factors, seeking care in private hospitals and burden of complications (Ghosh et al., 2021). So Gosh et al., (2021) opines that it is these factors that need to be controlled in order to mitigate these high costs. ADA (2021) argues that there is need for ongoing health strategies in order to cut costs of diabetic care and provide optimum care. Through their study, Mutyambizi et al (2019) recommended that through commitment, SDG3 should protect diabetic patients against catastrophic health care spending in order to eliminate health care cost inequalities, yet Kenya still is lagging behind in protecting its citizens from financial risks associated with disease and healthcare seeking behavior ( Salari et al., 2019). More attention is needed in targeting subsidies to the poorest and ensuring government facilities are equipped (Rodovich et al., 2019).

Further, Mutyambizi suggests that health financing of diabetic patients should focus on the poor and to improve access to health care centers (Mutyambizi et al., 2019). Therefore, in the perspective of increasing prevalence of NCDs, in LMICs, there is need to increase access to health care (Geordan et al., 2019) by reducing costs.

It is therefore evident that diabetes and its complications cause a great economic loss to patients and their households. Patients spend a huge amounts in terms of direct and indirect costs (Arokiasamy et al., 2021). Direct costs include medical care expenditure in form of investigations, treatment and rehabilitation costs, while indirect costs include non-medical costs including food costs, transport costs and accommodation costs among others (Nakhaei et al., 2021). Studies on Cost of illness are useful in assessing the effects that chronic diseases have on health expenditure and this information can be used for resource allocation (Zemedikun et al., 2021). Aun (2017) reported that patients with diabetes in LMICs face many challenges in receiving healthcare related to diabetes

among them including the long distances they travel to healthcare facilities, costly medicines and affordability of laboratory tests. With the high level of poverty in Kenya, many people with diabetes face difficulties in spending the little resources they have on health care. This leaves many of them not able to afford adequate diabetes care (Geordan et al., 2019).

In a study done in five public health facilities in 2019, Oyando et al. (2019) reported that medicine contributed to the greatest portion of direct medical costs. He found out that the average cost of medicines was USD 150.4 (KSHs 15340.8). And transport costs took 25% of the total direct cost of diabetes care. Other studies have found that transport costs took a considerable amount of the direct cost of health care (Mutymbizi et al., 2019). In their study to evaluate the extent to which the Base of the Pyramid (BoP) in Kenya was scalable and sustainable, Geordan et al. (2019) reported that non-medical costs like transport costs and lost wages contributed to the high economic burden of diabetes health care. Oyando et al. (2019) reported that in government health facilities, the cost of medicines reduced compliance and adherence to medication. He suggested that the removal or reducing costs of medicines could increase access to diabetes care (Oyando et al., 2019).

Studies have reported that many diabetes patients are not able to afford medical consultation fees, frequent sugar monitoring laboratory tests and the cost of medicine and that access (Geordan et al., 2019). The cost of diabetes medicines more so insulin is a continuous barrier to the management of diabetes. A quarter of diabetes patients who do not get the prescribed insulin reported price as the reason why they did not get insulin (Herkert et al., 2019). ADA has previously recommended that for there to be insulin access and affordability, there should be among others; lower prices for insulin and those people with diabetes should get insulin with no excessive costs and administrative

burden (Cefalu et al., 2018). A better understanding of the average direct cost of diabetes is therefore needed because of the unavoidable trade-offs that have to be looked into (Erzse et al., 2019).

#### **2.2.4 Levels of Glycated Haemoglobin and Blood Glucose Monitoring among Diabetes Type 2 Patients**

Diabetes type 2 patients get frequent blood glucose monitoring to assess the risk of complications. Glycated haemoglobin (HbA1c) is one of the tests done and is more stable. It is used as a marker of long term control of blood glucose (Imai et al., 2021). It determines the average blood glucose in the last 3 months. HbA1c is considered the gold standard for treatment monitoring (Schnellet al., 2017), and diabetes is diagnosed when the measured HbA1c is greater than 6.5 percent (ADA, 2020). According to Pohanka et al. (2021), HbA1c is a marker that is reliably more important in the diagnosis of diabetes when compared to random glucose measurements.

According to the WHO, the gold standard measure of glycemic control is HbA1c (WHO, 2006). However, a cross sectional study done in Karnataka showed that a direct correlation between FBG, post-prandial blood sugar (PPBS) and HbA1c, in both controlled and poorly diabetic patients. PPBS showed better sensitivity (79% vs 74%) than FBG, whereas FBG showed higher specificity of (84% vs 74%) and positive predictive value of (87% vs 80%) compared to PPBS (Swetha, 2014). A cross sectional studies conducted in Ghana (Tengey, 2012), Tanzania (Mwera, 2013) and Ethiopia (Angamo, Melese and Ayen, 2013) also used FBG as a measure of glycemic control due to the resource-poor setting.

The advantages of good glycemic control are well known (UKPDS Group, 2002). However, despite this evidence, majority of diabetic patients fail to reach optimal glycemic target (Sanal et al., 2011). Even with the many advances in medicine, modern

drugs availability and health care facilities, diabetes management has been a challenge all over the world (Selim et al., 2016). Glycemic control poses a challenge even in countries with highest levels of health awareness and best health care systems; for instance, 36.5% of adults with diabetes in the USA had poorly controlled HbA1c levels (Walker et al., 2018). A recent retrospective cohort study reported the risk of glycemic variability as a predictor of mortality in older people especially in the United States of America (Kaze et al., 2020).

Although the primary recommended assessment of glycaemic control is HbA1c (Laiterapong et al., 2019). An observational study was done in Jaipur, India among diabetes type 2 patients and found that random blood glucose monitoring helps achieve optimal sugar control and curb long term complications than fasting blood glucose levels (Paliwal et al., 2019). Therefore, Laiterapong et al. (2019) add that patients monitoring their blood glucose more so than those using insulin can help them in managing their illness and adjusting their medicines accordingly. An observational study in India showed that a sugar level did 2 hours after a meal predicted the average glucose control as compared to fasting blood glucose (Begum et al., 2018). Another study found that self-monitored blood glucose in diabetes type 2 patients seemingly gave a better glycaemic control (Machry et al., 2028). CDC adds that effective glycaemic control can lower long term risk for diabetic complications (CDC, 2019). However, suboptimal control will unchangeably rise in the development of these complications (Kibirge et al., 2017).

The main goal of diabetes type 2 is to achieve glycaemic control and delay the onset of diabetes associated complications (Davies, 2018). Also, it is important in predicting the risk of complications in people with diabetes (Camargos et al., 2018). However, several studies have shown that more than 50 percent of diabetes patients do not attain good

glycaemic control, (Dedefo et al., 2020; Kibirige et al., 2017; Reza et al., 2020), partly due to high cost and lack of access to diabetes medicines. In a study done at Kenyatta National Hospital (KNH), Muringo et al., (2021) found out that a high proportion of T2DM patients getting treatment at KNH had poor glycaemic control. Therefore, anti-diabetic medications adherence is crucial to attaining metabolic control because non-adherence is associated with increased levels of HbA1c and other adverse outcomes like increased LDL levels, frequent admissions to hospital, and mortality (Kamuhabwa & Charles, 2014).

When targets are met, good glycaemic control lowers the risk of getting diabetes related complications and reduces the costs that come with them (Tachkov et al., 2019). Poorly controlled diabetes has been widely associated with macrovascular and microvascular organ damage and premature death (IDF, 2017; Mohammad, 2018). Further, a study done in Mexico in 2020 found that HbA1c levels above 8 percent were associated with worse cognitive function in adult diabetic patients, (Mimenza-Alvarado et al., 2020). There is an association between high blood pressure and poor glycaemic control among diabetic patients that we studied (Yogal et al., 2022). In fact, HbA1c and RBS are an independent risk factor for patients with diabetes to develop hypertension (Si et al., 2021). One systematic review in 2018 showed that an increasing HbA1c is associated with a high risk of first ever stroke and suggested that tight glycaemic targets and HbA1c could be needed to prevent stroke (Mitsios et al., 2018). Al-Eitan et al. (2016) noted that lowering HbA1c reduced complications due to diabetes to a great extent. Diabetes complication severity index shows that poor control of blood glucose over 10 years and HbA1c of more than 8 percent increased microvascular and macrovascular complication risk to 16 percent (Pantalone et al., 2018).

Also, uncontrolled diabetes has been found out to be among the risk factors for diabetic foot (Nduati et al., 2022). Notably, studies have shown that benefits of using anti-diabetic drugs are most apparent during the first 6 months averagely with the HbA1c levels unlikely to fall more than 1.5% on average by sole use of drugs (Fang et al., 2022; Sherifali et al., 2010). Uncontrolled diabetes puts the patients at an increased risk of diabetes-related complications like cardiovascular events (Wan, 2016), renal insufficiency (Orsi, 2018 and Li, 2020), and microalbuminuria (Dorajoo, 2017). Compelling evidence shows that the risk of diabetes-vascular-related complications rises exponentially as HbA1c levels increase (Akselrod, Friger, & Biderman, 2021). Prentice et al., (2016) demonstrated that HbA1c variability during follow up is a risk factor for patients to develop diabetic complications and mortality. Akselrod et al., (2021). Furthermore, uncontrolled Diabetes mellitus increases the risk for perioperative complications such as wound infection (Jämsen, 2012), acute kidney injury prolonged and hospitalization (Kubal, 2005), even mortality (Carson, 2002). A 1% increase in HbA1c is associated with an increase in likelihood of ICU admission, hospital length of stay (LOS) and greater risk of major complications (Yong et al., 2018). Therefore, in patients with  $HbA1c \geq 8.0\%$ , elective surgery should be delayed, if possible to allow enhancement of glycaemic control (Teo et al., 2020). Also, HbA1c variability has also been identified as a marker of disease severity and complexity and should be taken seriously in diabetic patients' follow up (Akselrod et al., 2021).

Although MoH recommends HbA1c measurement 2 to 4 times in a year, there is limited data to show that the trends exist (Kenya National Clinic Guidelines for Management of Diabetes Mellitus, 2012). ADA guidelines recommend HbA1c as the most appropriate and recommended laboratory test to monitor glycaemic state (ADA, 2018). It is an established way of measuring glycaemic control and studies have shown that keeping it

within normal limits could lower medical costs for diabetic patients (Shetty et al., 2005), and higher hospitalization costs (Menzin et al., 2010).

HbA1C allows clinicians to identify patients who need medication review intending to prevent overtreatment (Hirst et al., 2017). Current ADA diabetes guidelines recommend HbA1c levels below 7.0 percent in non-pregnant diabetic adult patients (ADA, 2016). Reasonable glycemic control has been defined as having values of HbA1c  $\leq 6.5\%$  and poor glycemic control of HbA1c  $> 6.5\%$  (Canadian Diabetes Association, 2013). Nonetheless, getting these glycaemic targets is not easy to achieve because it depends on how adherent the patients are to their medications and the co morbidities they have (ADA, 2018). The low access to medication due to high cost of care limits adherence to medicines, hence higher HbA1c.

Boye et al., (2022) found out that individuals whose index HbA1c was below the ADA target of  $< 7\%$  had significantly lower 1-year diabetes-associated costs when compared to patients with glycemic control HbA1c levels of  $\geq 7\%$ . They stated that Well controlled diabetes was associated with significant reductions in annual diabetes-related component and total costs. Results suggest economic benefits associated with having HbA1c at or lower target, (Boye et al., 2022). In a separate study, Lage&Boye, (2020) reported that patients with an HbA1c index above ADA target, 1% reduction in HbA1c was associated with a reduction in all-cause, total, and one-year costs. Their results indicated that good glycemic control are associated with savings on costs. Dealing with comorbidities and addressing glycemic control among long-standing diabetes type 2 patients receiving 3 or more oral anti-diabetes medicine is very key to delaying onset or preventing diabetes complications (Muringo et al., 2021).

This is because achieving these targets go in hand with proper use of medicines, frequent and sometimes regular glucose monitoring, and periodic HbA1c monitoring (Karkare et

al., 2019). A study done on type 2 diabetes in Spain, by Mata-Cases et al., (2020) found that diabetic patients with poor glycaemic control incurred more health care costs and had more hospitalization when compared to patients who had well glycaemic control. In 2010, an analysis of healthcare costs of diabetes patients and their HbA1c showed that the reduction of HbA1c in diabetes patients was related to the low increase in health expenditure (Bansal et al., 2018). Juarez et al. (2020) asserted that while HbA1c lowering to acceptable values may not immediately lead to a decrease in cost long term and that HbA1c control was associated with reduced costs in 3 years' duration.

Type 2 diabetes is a significant and costly public health epidemic (Boyle et al., 2010). Blood sugar control is a strong pillar in reducing diabetes associated complications and mortality (Ma et al., 2021). A random blood sugar test has historically been used to monitor sugar levels. In areas where HbA1c can not be readily obtained, routine use of random blood sugar levels may be used to identify diabetic patients who are likely to have uncontrolled type 2 diabetes (Gunda et al., 2020). Although the ADA does not recommend random glucose as a screening test for diabetes and does not provide guidance to interpret RBG values (ADA, 2014), random glucose is commonly used as an opportunistic screen for diabetes in clinical practice (Tabak et al., 2012).

A random blood glucose test is done at any time and does not need much planning (Diabetes, 2022). However, frequent activities like RBS measure on every clinic day would still cost less than HbA1c (Masis, 2022). According to Diabetes (2022), knowing blood glucose readings is a major part of patients managing their disease. CDC notes that blood sugar levels of 200mg/dl or above show that some have diabetes (CDC, 2021). Reading above 200mg/dl of random blood glucose requires further testing, and intervention measures in people who are at risk of diabetes (Rhee et al., 2019).

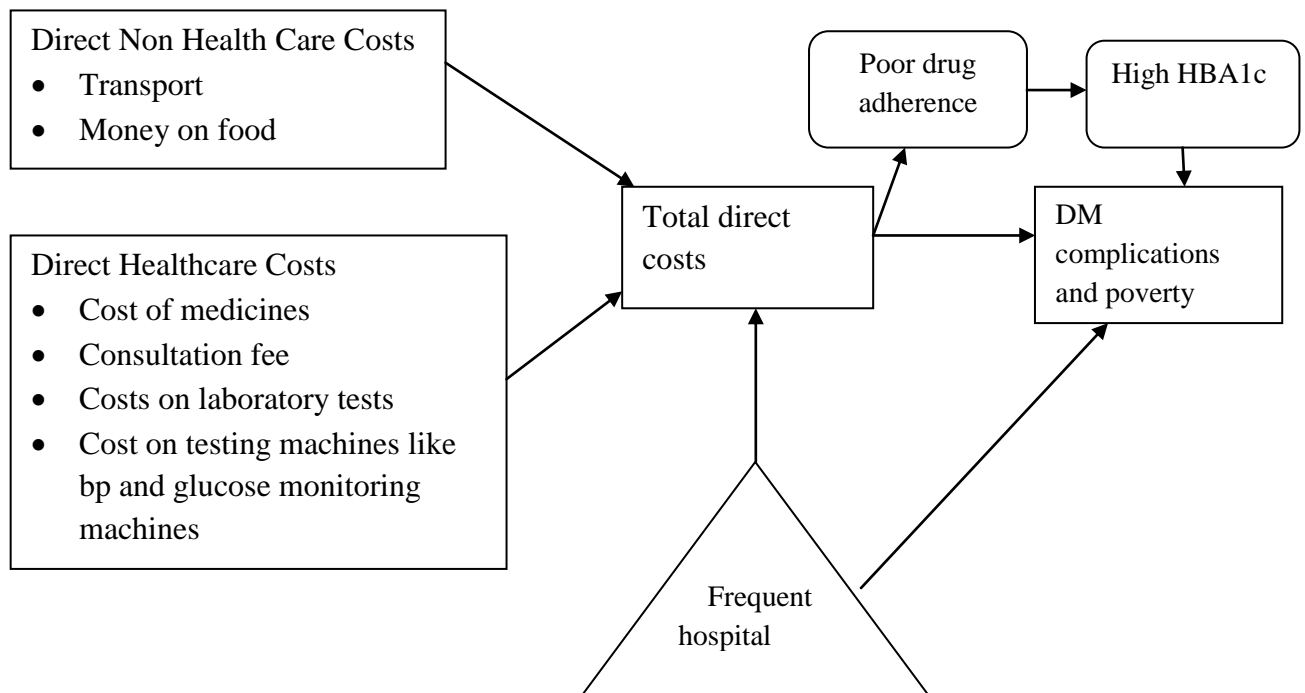
Therefore, mitigating the worsening of diabetes and its complication needs good control of blood sugar while making sure that these patients don't get hypoglycemia and this call for time to time measurement of their sugar levels (Tsuji et al., 2020).

### 2.3 Conceptual Framework

There are various frameworks used in the determination of the economic burden of public health problems like diabetes. Examples include; willingness-to-pay (Kirigia, Sambo&Kainyu, 2000), cost of illness(Kirigia et al., 2000) and production function approaches (Kirigia et al., 2000). This study used the cost of illness approach this is because it is easier to determine direct coststhan indirect costs, this study focused on determining the direct cost of care for diabetes.

**Figure 1**

*Conceptual Framework of the Direct Cost of Diabetes*



Source: Authoru (2024)

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

This chapter captures the research design, the study region, the study population, the selection criteria, the sampling method, and the sampling size, the data collection procedure, ethical consideration, and the data analysis procedures.

#### **3.2 Research Design**

A cross-sectional study was used for this study. This design entailed collecting data from research participants at a point in time over a specified period. This particular study design was used because it allowed collection of data from participants quickly, over a short period of time and in time. It was also easy to conduct for this study, and get information from diabetic patients as they got the treatment they came for.

#### **3.3 Study Variables**

##### **3.3.1 Dependent Variable**

The dependent variables for this study was the glycemic control achieved by Diabetes Mellitus type 2 patients (HbA1c).

##### **3.3.2 Independent Variables**

The independent variable for this study was the cost of managing Diabetes Mellitus type 2 among patients attending Chogoria Mission Hospital in Tharaka Nithi County, and Maua Methodist Hospital in Meru County.

#### **3.4 Location of the Study**

This study was done in Chogoria Mission and Maua Methodist Hospitals in the diabetes outpatient settings. Chogoria Hospital is a faith based mission hospital located in Tharaka Nithi County, Kenya. It is a 294 bed capacity hospital founded in 1922. Its

medical outpatient and diabetic clinics run concurrently from Monday to Friday, 8am to 5pm. Maua Methodist Hospital is 200 bed capacity faith-based hospital found in Meru County, Kenya. It was founded in 1928 in Maua town.

### **3.5 Population of the Study**

The study was done among people living with diabetes with a diagnosis made 6 months or more from the time this study was done. This time frame was enough for a definitive diagnosis of diabetes to be made. It was conducted in outpatient clinics. The patients were 18 years or older. Chogoria Hospital had about 480 diabetic patients, while Maua Methodist Hospital had approximately 380 diabetic patients as at the time of this study. Out of these, 20-30 patients attended a diabetic clinic per day for each hospital.

#### **3.5.1 Inclusion Criteria**

All patients who had diabetes, diagnosed 6 months before the start of this study were included in this study. The participants were 18 years or more and able to give informed consent. Patients who had their HbA1c in the last 3 months and a clinic day random blood sugar were included. These two tests are routine tests done on all diabetic patients, so patients usually meet these costs.

#### **3.5.2 Exclusion Criteria**

Patients coming to the clinic for the first time, and unstable patients (patients who are to be stabilized first, patients who are for admission) and, patients with no known RBS and HbA1c were excluded from this study.

### **3.6 Sampling Procedure and Sample Size**

#### **3.6.1 Sampling Procedure**

Since selection of participants is a very important step in data collection and research, the selected participants had to be a sample that would be representative of the bigger general

population. So this had to be carefully selected such that the findings could be generalized. Therefore, simple random sampling was used to recruit participants. This involved choosing randomly the diabetic patients among a population of diabetic patients that attended the clinic. A diabetic clinic in Maua and Chogoria hospitals has approximately 20-30 diabetic patients attending in a day. Out of these, about 10 participants who met the criteria were randomly chosen.

### **3.6.1 Sample Size Determination**

The sample size was determined by the following formula;

$$N = \frac{Z^2 \times P(1-P)}{e^2}$$

Where

Z= Z-score, which was set at 1.96

e= margin of error, which was set at 0.05

p=population of study

N=384

### **3.7 Data Collection Tools**

A cost of illness assessment questionnaire that had direct medical and non-medical costs of care incurred by diabetic patients, during that outpatient visit was used for data collection. The questionnaire also had questions on HbA1c levels done in the last 3 months and RBS for that visit. Data on HbA1c was got from the HMIS of the respective hospitals after results were ready in laboratory. Direct medical costs included: charges on registration and consultation fee, medicines, laboratory fees, and any devices patients bought to aid in the management of their disease like blood pressure machines and glucometers. The direct non medical costs included: one way transport costs that patients

incurred and the cost of meals while in the hospital. We used one way transport cost because it is easy to get since patients already know what they used as opposed to two way transport costs, which the patients have not spent yet. Also, return transport cost could be different or even cheaper.

### **3.7.1 Recruitment Procedure and Process**

We used a simple random sampling method to recruit study subjects. We used computer generated numbers to develop a sequence. Diabetes type 2 patients from a population of diabetic patients attending the clinic were randomly chosen. Diabetes type 2 patients who met the inclusion criteria, attending the clinic were approached in person. The entire process was explained to them and consent signed prior to data collection. Participants were recruited until the sample size was reached. Patients who declined were left out of the study.

### **3.7.2 Validity and Reliability of Instrument**

The research instrument used in this study is similar to a validated cost of illness questionnaire used by Oyando et al. (2019) used to assess the cost of medical care in five public health care facilities in Kenya. In their study, Oyando et al., (2019) collected data from both inpatient and outpatient settings. Because our study looked at both direct and indirect costs in outpatient settings, we edited it by removing questions that did not meet objectives of this study, to address and meet our study objectives.

We therefore piloted our questionnaire with a group of 10 diabetes type 2 in each of the two different outpatient clinics. The feedback from the 10 patients was used to refine the questionnaire for validity and reliability. We employed the test and retest method. We found out that all our questions on cost of care were clear and were understood. Our questions took 10-15 minutes instead of the projected 40 minutes in the proposal. All our

questions were appealing and attractive to the respondents. We also found out that some patients could not afford HbA1C and did not have an HbA1C done in the last 3 months. We opted to use this since this is supported by the guideline. The results obtained from the pretests were similar. We made a decision to have any HbA1C the patient has done in recent 3 months. This is listed down in the limitation section. We noted patients used in these tests that were not interviewed in the main study to avoid bias.

### **3.8 Data Collection Procedures**

Study approval was sought from the institute of postgraduate studies. After the defense, a research permit from the National Commission for Science, Technology, and Innovation (NACOSTI/P/23/29890), which is the national governing body for research activities in Kenya was sought and obtained. Ethical approval from Chogoria and Maua Methodist Hospitals, and Kabarak University Research and Ethics Committee (KUREC-020923) were also obtained prior to data collection. Research Participation was fully voluntary and consent was obtained from each study participant that met the criteria. Any participant who was uncomfortable at any point during the study was free to exit as participation in this research study was entirely voluntary.

Two research assistants, who are clinical officers by training and fluent in Kimeru were recruited for data collection. One was responsible for data collection in Maua Methodist Hospital and the other in Chogoria Mission Hospital. They were trained and the researcher reviewed the questionnaires with them for two days on data collection and ethical issues that may arise in this study.

Participants were approached, greeted, and permission sought from them. The whole process and time that the interview took was explained to each participant before consenting. Interviews took place in a separate consultation room in the outpatient

department after patients had consented. The interviews took at most 15 minutes. Questionnaires did not bear the names of participants in order to keep anonymity. At the end of the interview, the questionnaires were reviewed for any mistakes and kept for analysis.

### **3.8.1 Data Management and Analysis**

Data was analyzed using Microsoft excel version 2016 and statistical package of social sciences (SPSS) version 25. Variable data was categorized into ordinal and continuous variables. Descriptive statistics entailing frequency counts, mean median and percentages and interquartile range was used to analyze categorical data. Correlational and regression analysis were used to check for association and test for statistical significance at 0.05 significance level. We used conceptual frame work approach to include predictors in the regression model. Linear regression assumptions were checked by Pearson regression analysis while independence through ANOVA. Only the researcher research assistants and statistician had access to data. Computers were secured with passwords and only accessed by the researcher.

### **3.9 Ethical Consideration**

This study had no major risks or harm that it posed to the participants. The only risk was time spent on the interview. To reduce this risk, the researcher gave participants first priority to be seen in clinic before or immediately after the interview. In order to maintain anonymity of participants, questionnaires did not bare names of participants. Also, participants were interviewed individually in private consultation rooms.

There was no extra direct expenditure participants incurred by participating in this study. Also, there were no direct benefits that the researcher received from this study. This study had minimal or potential risk to the patients. But just incase one arose, the

researcher had planned to compensate participants from his pocket. Those found with uncontrolled sugars were linked to the physician. Also, there was a counselor for participants who needed counseling as a result of this study. We did not get any participants needing this service. Data from this study will be communicated to the Ministry of Health, county governments, published in journals and Kabarak University Library. Questionnaires were locked in lockers. Only the researcher and research assistants accessed the data. Computers were secured with passwords and were to be accessed by the researcher. Questionnaires will be destroyed after six months from the date of data collection.

## **CHAPTER FOUR**

### **DATA ANALYSIS, PRESENTATION AND DISCUSSION**

#### **4.1 Introduction**

This section presented the results and data analysis and discussion of this study, which is titled "Assessment of Direct Cost of Care and Glycaemic Control among Diabetes Type 2 Patients in Two Mission Hospital Clinics in Kenya." The study aimed to investigate the relationship between the direct cost of healthcare and the level of glycaemic control among individuals diagnosed with type 2 diabetes in Maua Methodist and Chogoria hospitals. The two Mission Hospitals had equal number of participants (n=192) totaling to 384. All questionnaires and questions were filled by participants corresponding to a 100% response rate. In this section, we present results of descriptive and inferential analysis.

#### **4.2 Demographic Characteristics**

Age, gender and occupation of participants were the main socio-demographic characteristics that were analyzed. Table 1 below shows that majority of participants (21.6%) were 80 years and older and were closely followed by those aged 60 to 69 years (21.4%). In third place were those aged 50 to 59 years (20.3%) followed by those aged 70 to 79% (17.7%). Least number of participants in terms of age were those from 40 to 49 years (13.3%) and 30 to 39 years (5.7%). Notably, there was no participant below the age of 30 years. Participants were nearly equally distributed in terms of gender. Correspondingly, 52% of the participants were female while 48% were male.

**Table 1***Age & Gender Distribution of Study Participants*

	Demographic characteristic	Frequency (%)
Age	<30 years	0.0%
	30 – 39 years	5.7%
	40 – 49 years	13.3%
	50 – 59 years	20.3%
	60 – 69 years	21.4%
	70 – 79 years	17.7%
	≥80 years	21.6%
Gender	Male	48.0%
	Female	52.0%

**4.2.1 Main Occupation and Source of Income of Study Participant**

Table 2 below shows that the majority of primary income earners in the study were patients themselves, accounting for 30.99% of the sample. The second-largest group consisted of sons or daughters, making up 22.14% of the participants. Spouse/parent represented 16.15% and 15.89% of the sample, respectively. Extended family members contributed to the primary income of 14.84% of the participants.

Among the reported main occupations, farming was the most prevalent, with 41.41% of participants engaged in this occupation. The next most common occupation was retired teaching, accounting for 17.19% of the sample. Other notable occupations included business (7.80%), accounting (5.47%), and casual work (5.21%). A smaller proportion of participants reported occupations such as driving (2.34%), security officer (3.90%), and teaching (3.13%). Approximately 5.99% of participants reported having no current or previous occupation.

**Table 2***Current/Previous Main Occupation and Primary Income Earner in the Household*

Primary Income Earner	N 384	%
Patient	119	30.99%
Spouse/parent	61	15.89%
Spouse/parent	62	16.15%
Extended family	57	14.84%
Son/Daughter	85	22.14%
Previous/current main occupation		
Accountant	21	5.47%
Business	30	7.80%
Casual worker	20	5.21%
Driver	9	2.34%
Farmer	159	41.41%
Housewife	22	5.73%
Retired teacher	66	17.19%
Security officer	15	3.90%
Teacher	12	3.13%
None	23	5.99%

**4.3 Direct Cost of Care for Type 2 Diabetes Mellitus**

Table 3 presents a comprehensive overview of direct medical expenditures related to the treatment and management of diabetes. The cost of prescribed drugs ranged from Kshs. 160 to Kshs. 26,022 with a mean value of Kshs. 2,219.82 and a standard deviation of Kshs. 1,634.87. The consultation cost and cost of RBS test were capped at Kshs. 200 and Kshs. 150 respectively for all cases. Cost of diagnostic tests ranged from Kshs. 150 to Kshs. 4,650 with a mean cost of Kshs. 216.5 and a standard deviation of Kshs. 353.82. The cost of glucometers ranged from Kshs. 500 to Kshs. 6,000 with a mean cost of Kshs. 3,499.16 and a standard deviation of Kshs. 836.91. Further, the cost of BP monitors ranged from Kshs. 4,000 to Kshs. 10,000 with a mean cost of Kshs. 4,044.81 and a

standard deviation of Kshs. 439.86. Finally, the cost of glucometer stripes ranged from Kshs. 750 to Kshs. 2,000 with a mean cost of Kshs. 1,341.14 and a standard deviation of Kshs. 331.35. The total costs per visit for treatment/services ranged from Kshs. 350 to Kshs. 30,522 with a mean cost of Kshs. 1,206.86 and a standard deviation of Kshs. 734.56. Additionally, the total cost of monthly lab/diagnostic test ranged from Kshs. 150 to Kshs. 2,650 with a mean cost of Kshs. 1,111.77 and a standard deviation of Kshs. 816.

**Table 3**

*Direct Medical Cost Associated with Type 2 Diabetes( Objectie 1)*

Item (Direct Medical expenditure)	Amount (Kshs.)			
	Min	Max	Mean	SD
Cost of drugs	160	26,022	2,219.82	1,634.87
Consultation cost	200	200	200	0
Cost of diagnosis tests	150	4,650	216.5	353.82
Total costs spent per visit on treatment/services received	350	30,522	2,626.85	1,799.99
Monthly cost of HBAIC	250	2,500	1,206.86	734.56
Cost of RBS test	150	150	150	0
Total Monthly lab/diagnostic test cost	350	2,650	1,356.86	734.56
Glucometer cost	500	6,000	3,499.16	836.91
BP Monitor cost	4,000	10,000	4,044.81	439.86
Cost of other related instrument/devices	750	2,000	1,341.14	331.35

SD = Standard Deviation

Table 4 below provides an account of direct non-medical expenditures incurred by diabetic patients. Among the patients, 33.9% were accompanied by friends or family

members, while 66.1% were not. In terms of cost distribution; one-way transport cost for patients ranged from Kshs. 50 to Kshs. 2,000 with a mean cost of Kshs. 326.46 ± Kshs. 224.67 and interquartile range of Kshs. 300. Additionally, one-way cost of food for family or friends accompanying the patients ranged from Kshs. 100 to Kshs. 2,000 with a mean cost of Kshs. 287.03 ± Kshs. 194.20 and interquartile range of Kshs. 207.5. In summary, per visit, the total cost incurred by family or friends accompanying the patients ranged from Kshs. 200 to Kshs. 8,000 with a mean total cost of Kshs. 609.68 ± Kshs. 701.86 and interquartile range of Kshs. 250.

**Table 4**

*Direct Non-Medical Cost Associated with Type 2 Diabetes*

	Yes	No
Accompanied by friend/family	130 (33.9%)	254 (66.1%)

Item (Direct Non-medical expenditure)	Amount (Kshs.)				
	Min	Max	Mean	SD	IQR
One Way Transport Cost (Patient)	50	2000	326.46	224.67	350
One way transport cost (Family/friend)	50	6000	331.00	547.98	300
One way cost of food (Family/friend)	100	2000	287.03	194.20	207.5
Total cost (family/friend)	200	8000	609.68	701.86	250

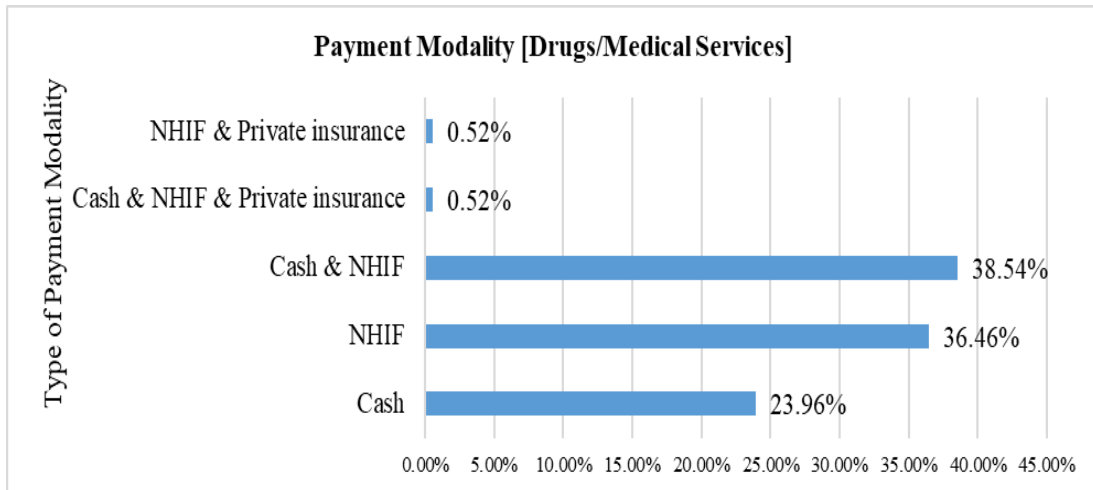
#### **4.3.1 Different Modalities of Payment for Drugs/Medical Services**

Often, cash, National Health Insurance Fund (NHIF) and private insurance are commonly employed by patients to pay for medical and associated costs. Correspondingly, in this study, majority of participants (38.56%) used both cash and NHIF to pay for drugs/medical services associated with type 2 diabetes mellitus. They were followed closely at 36.46% by those who used only NHIF as a payment modality while 23.96% reported using only cash as their payment modality. The combined use of

NHIF & private insurance or use of cash, NHIF & private insurance were least reported at 0.52%.

**Figure 1**

*Different Payment Modalities for Drugs/Medical Services Associated with Type 2 Diabetes*



**4.4 Distribution of Levels of Glycated Hemoglobin in Diabetes Type 2 Patients**

In terms of blood sugar control over a period of three months using glycated hemoglobin levels, Figure 2 shows that only 21.6% of participants had their sugar levels controlled within normal values (<7%). In contrast, blood sugar levels of majority of participants (48.4%) had HbA1c of more than 9% while 26.8% of participants had HbA1c of 7%-9%. About 3.1% of participants neither knew their current nor last glycated hemoglobin levels.

**Figure 2**

*Different Sugar Control Levels as Indicated by HbA1c Level of Study Participants (Objective 2)*

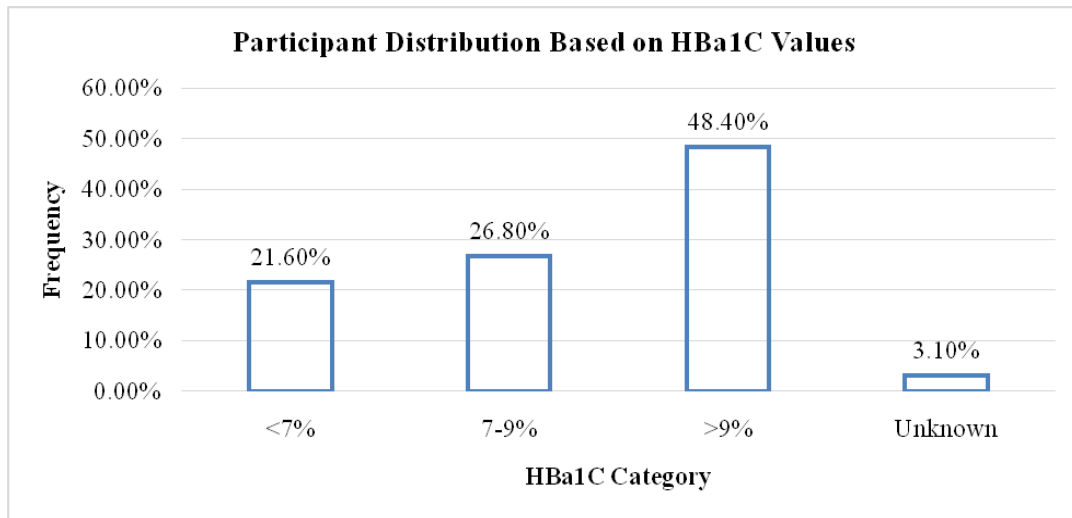
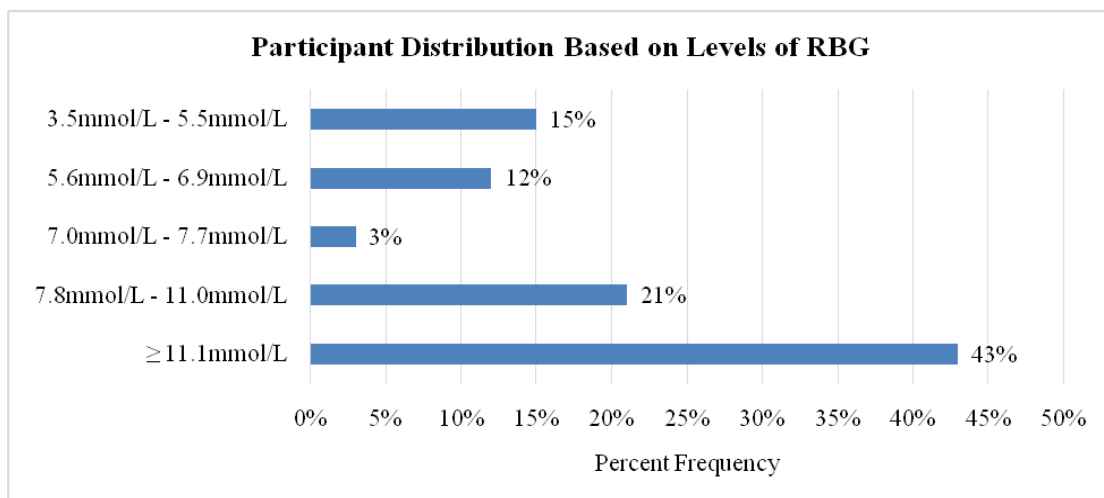


Figure 3 below shows that in terms of random blood sugar (RBS) levels, majority of participants (43%) had a high level of 11.1mmol/l and above. They were followed by those whose RBS readings of 7.8-11.0 mmol/l at 21%. Notably, in third place, were those whose RBS reading of 3.5-5.5 mmol/l. The least group at 3% were those whose RBS was 7.0-7.7 mmol/l as shown in figure 6 below.

**Figure 3**

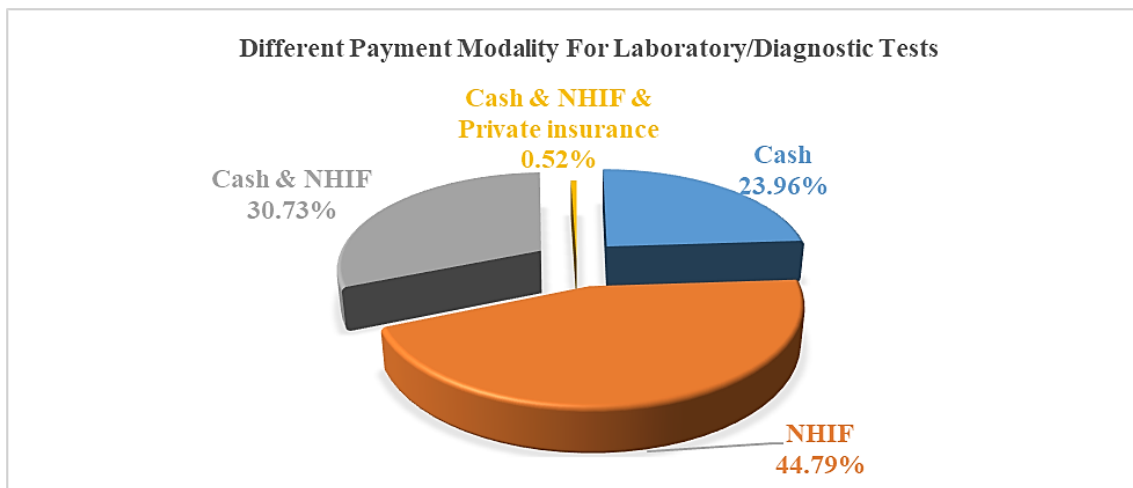
*Different Random Blood Sugar Levels of Study Participants (Objective 2)*



Similar to paying for drugs/medical services, cash, NHIF and private insurance were also employed to pay for laboratory/diagnostic tests. Figure 7 shows NHIF was used by a majority of participants (44.79%) to pay for laboratory/diagnostic tests followed by those who used both cash & NHIF (30.73%). Use of cash only as a payment modality came in third place (23.96%) while the least employed was a combined use of cash, NHIF and private insurance as shown in Figure 4 below.

**Figure 4**

*Different Payment Modalities for Laboratory/Diagnostic Tests Associated with Type 2 Diabetes*



#### **4.5 Association Between Direct Cost of Care, Glycated Hemoglobin and Random Blood Glucose in Diabetes Type 2 Patients**

##### **4.5.1 Correlational Analysis**

Table 5 below shows that the mean total direct cost of care for the study participants was approximately Kshs. 9,496.90 ± Kshs. 4,631.53 while the mean HbA1c value was approximately 9.231% ± 2.4920%. Additionally, the mean RBS reading for the participants was approximately 10.075 mmol/l ± 4.6503 mmol/l.

**Table 5***Descriptive Statistics of Total Direct Costs, HbA1c and RBS Values*

	Mean	Std. Deviation	N
Total Direct Costs	9496.90	4631.528	384
HbA1c value (%)	9.231	2.4920	372
RBS reading (mmol/l)	10.075	4.6503	384

Table 6 presents the results of a correlational analysis, examining the relationships among the three important variables: total direct costs, HbA1c reading, and RBS values. Pearson Correlation coefficient between total direct costs & HbA1c reading was approximately 0.088 although the correlation for both was found not to be statistically significant [ $P=0.089$ ] at 0.05 level. In contrast, the Pearson Correlation coefficient between total direct costs and RBS reading was approximately 0.435 and the correlation was statistically significant [ $P=0.000$ ]

**Table 6***Correlational Analysis of Total Direct Costs, HbA1c and RBS Values*

		Total direct costs	HbA1c reading	RBS reading
Total Direct Costs	Pearson Correlation	1	.088	.435**
	Sig. (2-tailed)		.089	.000
	N	384	372	384
HbA1c reading	Pearson Correlation	.088	1	-.009
	Sig. (2-tailed)	.089		.868
	N	372	372	372
RBS reading	Pearson Correlation	.435**	-.009	1
	Sig. (2-tailed)	.000	.868	
	N	384	372	384

\*\* . Correlation is significant at the 0.01 level (2-tailed).

Table 7 and 8 below show the relationship between glycemic control, cost and the possible confounding variables of gender and duration of treatment. It shows a weak positive relationship between the confounding variable and cost of care and glycemic control.

**Table 7**

*Correlational Analysis When Confounding Variables are Controlled*

Correlations					
Control Variables			Total direct costs	RBS value	HbA1c reading
Gender & Duration of treatment	Total direct costs	Correlation	1.000	.063	-.016
		Significance (2-tailed)	.	.222	.757
		df	0	380	380
	RBS value	Correlation	.063	1.000	-.032
		Significance (2-tailed)	.222	.	.536
		df	380	0	380
	HbA1c reading	Correlation	-.016	-.032	1.000
		Significance (2-tailed)	.757	.536	.
		df	380	380	0

**Table 8**

*Correlational Analysis When Confounding Variables are Controlled*

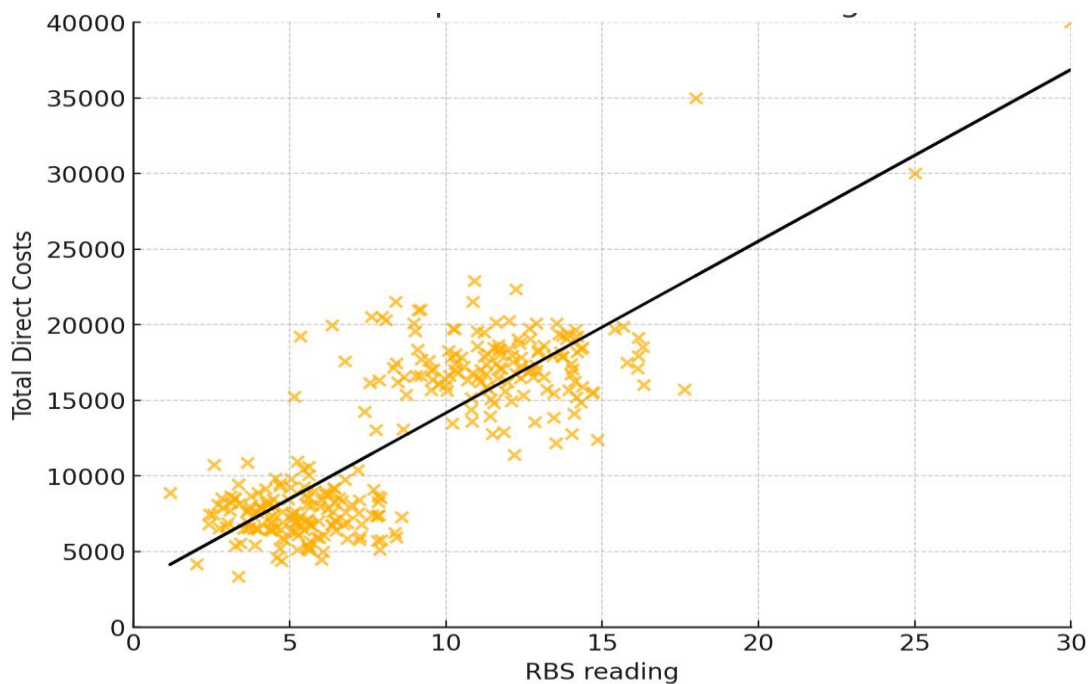
Correlations					
Control Variables			Total Direct Costs	RBS value	HbA1c reading
Age	Total direct costs	Correlation	1.000	-0.061	-0.027
		Significance (2-tailed)	.	1.939	1.846
		df	0	379	379
	RBS value	Correlation	-0.061	1.000	-0.038
		Significance (2-tailed)	1.939	.	1.880
		df	379	0	379
	HbA1c reading	Correlation	-0.027	-0.038	1.000
		Significance (2-tailed)	1.846	1.880	.
		df	379	379	0

#### 4.5.2 Scatter Plot Visualization of Association between RBS Reading and Total Direct Costs

Since only total direct costs and RBS had a meaningful relationship based on the correlation analysis above, we plotted a scatter plot of the two variables. Figure 8 below shows there may be a positive relationship between total direct costs and RBS, i.e. as the reading of RBS continues to rise, there is also a rise in total direct costs associated with type 2 diabetes mellitus. The coefficient of determination ( $R^2$ ) was reported at 0.190 as shown in Figure 5 below.

**Figure 5**

*Scatter Plot Visualization of Association Between RBS Reading and Total Direct Costs*



#### 4.5.3 Regression Analysis

Table 8 provides a summary of the regression analysis conducted to examine the relationship between total direct costs and two predictor variables: HbA1c reading and RBS values. There was a moderate positive correlation between dependent variable (total direct costs) and the combination of predictor variables (HbA1c reading and RBS

reading) [ $R=0.461$ ]. Further, 20.8% of the variation in total direct costs can be accounted for by the linear relationship with HbA1c reading and RBS reading as noted by the value of adjusted R square [ $adjusted R^2=0.208$ ].

**Table 9**

*Model Summary for the Regression Analysis for the Relationship Between Total Direct Costs, HbA1c and RBS Values*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.461 <sup>a</sup>	.212	.208	4103.211

a. Predictors: (Constant), RBS reading, HbA1c reading

Table 9 above presents the results of an Analysis of Variance (ANOVA) performed to assess the relationship between total direct costs and the two predictor variables: HbA1creading and RBS values.

**Table 10**

*Coefficients of the Regression Analysis of Relationship Between Total Direct Costs, HbA1c and RBS Values*

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	3523.698	943.317		3.735	.000	1668.746	5378.650
	HbA1c reading	170.529	85.489	.092	1.995	.047	2.423	338.635
	RBS reading	452.617	46.243	.452	9.788	.000	361.685	543.550

independentVariable: Total Direct Costs

## 4.6 Prevalence, Incidence and Treatment Duration of Type 2 Diabetes Mellitus

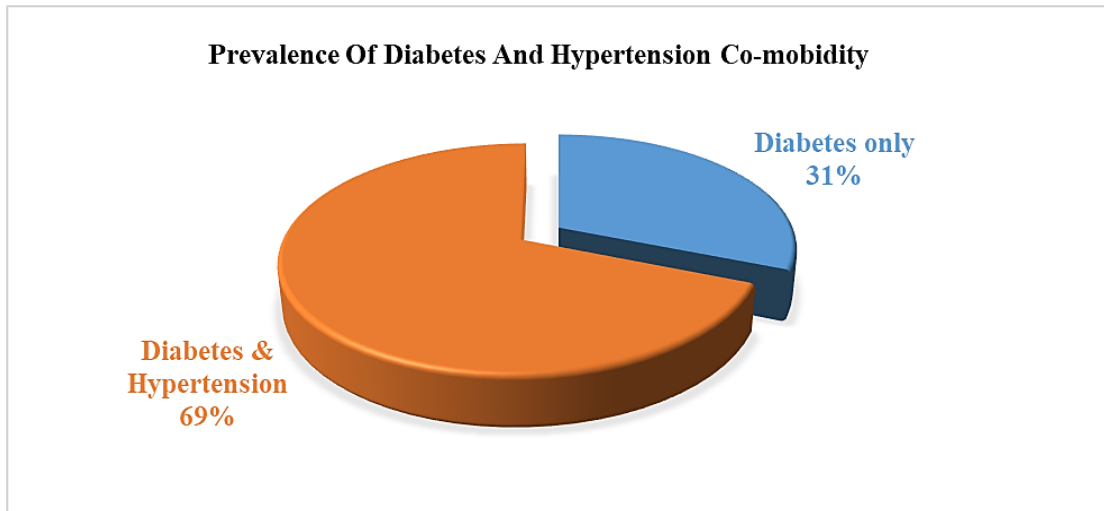
### 4.6.1 Prevalence of Hypertension Co-morbidity among Diabetic Patients

All participants in this study had to have been diagnosed with type 2 diabetes mellitus and on treatment. Figure 6 below shows that 69% of the participants in addition to

diabetes had been diagnosed with hypertension. Only 31% of study participants were diagnosed with diabetes only.

**Figure 6**

*Prevalence of Diabetes and Hypertension Co-Morbidity among Study Participants*

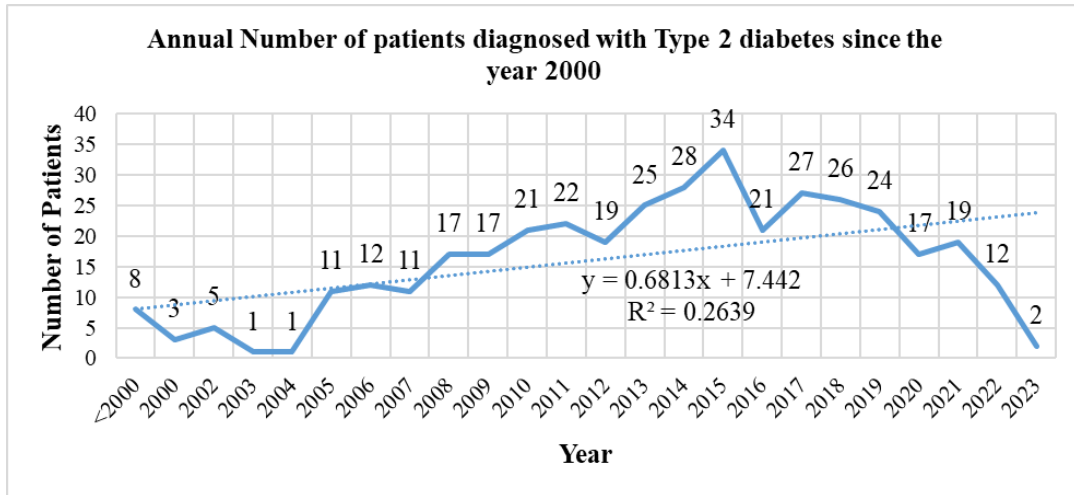


#### **4.6.2 Number of New Type 2 Diabetes patients over the Years, in Maua Methodist and Chogoria Hospitals among Participants of this Study**

Among this study participants in the two hospitals, the yearly occurrences of new patients receiving a type 2 diabetes diagnosis over a period of many years are shown in Figure 7 below. The number of new patients diagnosed with type 2 diabetes varied from year to year. The year 2015 saw the greatest annual incidence, with 34 new cases. Several years showed relatively high numbers of new cases, including 2011 (22 new patients), 2014 (28 new patients), and 2017 (27 new patients). There were years with lower incidence, such as 2000 (3 new patients), 2003 (1 new patient), and 2004 (1 new patient). The most recent years, 2022 and 2023, saw a decline in new cases, with 12 and 2 new patients, respectively.

**Figure 7**

*Number of Patients by Year of Diagnosis of Type 2 Diabetes Within the Two Mission Hospitals among the Participants*

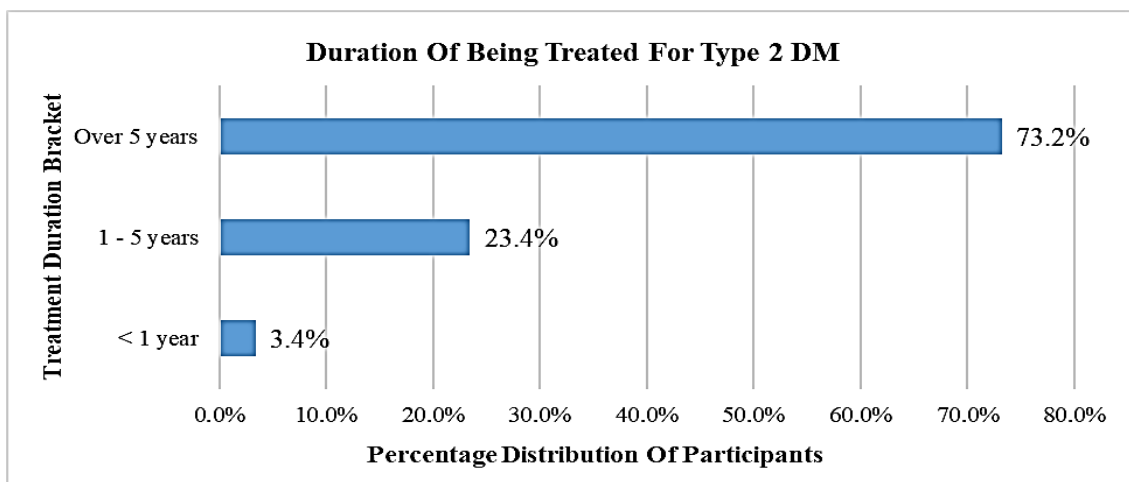


**4.6.3 Duration of being Treated for Type 2 Diabetes Mellitus**

Figure 8 below shows that majority of participants (73.2%) have been on treatment for type 2 diabetes mellitus for over 5 years. Additionally, 23.4% of study participants have been on treatment for 1 to 5 years. Those who have been on treatment for less than one year formed 3.4% of total participants.

**Figure 8**

*Duration of Being in Treatment for Type 2 Diabetes*



## **4.7 Discussing Findings**

### **4.7.1 To Evaluate the Direct Cost of Care for Diabetes Mellitus Type 2 Patients**

#### **Attending Diabetic Clinics in Two Mission Hospitals in Kenya**

Diabetes mellitus is a chronic lifelong disease which puts significant economic burden on patients. Out of pocket spending and insurance cover are almost not sustainable in cushioning these patients from catastrophic spending. Majority of these individuals exhausts their outpatient insurance coverage before a financial year ended. They eventually end up spending out of their pockets. Consequently, patients don't access proper care or cannot afford to get medications, increasing the risk of complications and hospitalizations. Therefore, effective management of Type 2 Diabetes Mellitus (T2DM) is a major challenge in the field of healthcare, especially in resource-constrained countries like Kenya.

An essential component of healthcare planning and policy creation is the evaluation of direct expenses related to the care of T2DM patients. Additionally, for creation of targeted interventions and informed decision-making, understanding the financial burden endured by patients and how it affects glycemic control is pivotal. Consequently, this study evaluated the intricate relationship between direct cost of care and glycemic control among Type 2 Diabetes patients attending clinics in Maua Methodist Hospital and Chogoria hospital in Kenya.

The main findings of this study are that the patient's direct medical cost for diabetes type 2 patients is mainly driven by medicine expenses (Table 3). Similar findings have been reported in South Africa by Mutyambizi et al., (2019). The cost of drugs for diabetes management exhibits a wide range, from Kshs. 160 to Kshs. 26,022, with a mean cost of Kshs. 2,219.82 with a considerable standard deviation ( $\pm$  Kshs. 1,634.87). This indicates significant variability in drug expenses among individuals and facilities. The variability

was attributed to various factors, such as the choice of medications, the severity of diabetes, the varying price of the same medications based on location, complications from the disease, and the availability of generic or branded drugs. This study reported capped costs for consultation and RBS tests at Kshs. 200 and Kshs. 150, respectively, with no variability ( $SD=0$ ). Regarding the cost of diagnostic tests, the data shows a range from Kshs. 150 to Kshs. 4,650, with a mean cost of Kshs. 216.5. The costs of medical devices, specifically glucometers and BP monitors, exhibit more variability.

The total costs per visit for treatment and services show a wide range from Kshs. 350 to Kshs. 30,522, with a mean cost of Kshs. 1,206.86. This substantial variation underscores the unpredictable potential financial burden faced by individuals with diabetes. Several studies have showed variations in the estimated cost of managing diabetes (Marsanutto et al., 2006, Kesekek et al., 2014). For example, Alouki et al., (2015) found wide variation in out of pocket spending (OOP) cost of care in different African countries and between private and public hospitals. They found out that presence of complication and co morbidity increased the cost significantly.

The total cost of monthly lab and diagnostic tests shows a moderately narrow range from Kshs. 150 to Kshs. 2,650 with a mean cost of Kshs. 1,111.77 demonstrating some variability in these expenses as well. However, it is important to note that the cost of monthly tests can accumulate significantly over time and impact the overall financial burden on patients. Ultimately, the summation shows that the mean total direct cost of care per visit was approximately Kshs. 9,496.90  $\pm$  Kshs. 4,631.53 [table 5], which is lower than the cost in public hospitals as per the study findings from, Oyando et al., (2019) even in the face of inflation and changes in strength of currency. In comparison to this study findings, they reported that the mean annual direct patient cost was Kshs. 53,907 in public health care facilities in Kenya; of which medicines accounted for 52.4%

and transport accounted for 22.6%. Similarly, Butt et al., (2022) reported that the annual total cost for diabetes care in Pakistan was USD 740.1 mostly being constituted for by medicine (USD 274.5) followed by hospitalization (USD 319.7). Furthermore, Moucheraud et al. (2019) in their systematic review on costs of diabetes treatment in low- and middle-income countries, estimated that per visit outpatient costs ranged from under \$5 to over \$40 while annual laboratory costs ranged for under \$5 to over \$100. Our study shows that treatment costs are higher than average monthly income of most Kenyans.

This could have an impact on treatment and glycemic control. One lancet report on diabetes reported that costs of diabetes treatment are high for majority of patients (Atun et al., 2017). A household expenditure and utilization survey in 2013 showed that 20% of Kenyans cannot access health care because the treatment costs are prohibitive (MOH, 2013). In July this year, NTV Kenya reported that 38 per cent of Kenyans ‘*don't have*’ a monthly income, with only 13% of Kenyan earning a monthly income of KES. 20,000-50,000 and 38% earning nothing (NTV Kenya, 2023). Early this year, Trends and Insights For Africa (TIFA) reports showed that the significant disparity in income distribution across the country with only 3% of Kenyans earning above KES 50,001. Any reductions in medicine costs is likely to increase access to diabetes health care services.

This study reports that 33.9% of diabetes patients were accompanied by friends or family members, while 66.1% were not. Evidently, support from family and friends has been positively associated with management of type 2 diabetes mellitus (Mphasha et al., 2022; Ojewale et al., 2019; Baig et al., 2015). In terms of one-way transport costs for patients, the study finds a range from Kshs. 50 to Kshs. 2,000, with a mean cost of Kshs. 326.46 and an interquartile range of Kshs. 300. This data suggests that transportation expenses for patients can vary widely, potentially due to factors such as distance to healthcare

facilities, mode of transportation used (e.g., public transport or private car), and the geographical location of patients. The relatively high standard deviation ( $\pm$  Kshs. 224.67) indicates substantial variability in these costs among patients.

Additionally, the study reports the one-way cost of food for family or friends accompanying the patients, ranges from Kshs. 100 to Kshs. 2,000, with a mean cost of Kshs. 287.03 and an interquartile range of Kshs. 207.5. The presence of family or friends often leads to additional expenses, including meals, which can significantly contribute to the overall economic burden on patients and their support networks. Expensive health related costs have been a barrier to health seeking behavior (WHO, 2019), and patients with chronic illnesses will reduce clinic visits in an effort to cut costs. This will make patients to seek for health services only when necessary or when they are very sick (Tarus, 2022).

Our study found out that the total cost incurred by family or friends accompanying patients has a wide range, from Kshs. 200 to Kshs. 8,000, with a mean total cost of Kshs. 609.68 and an interquartile range of Kshs. 250. This total cost encompasses both transportation and food expenses incurred by accompanying relatives. The variability in these costs highlights the potential financial strain experienced by diabetes patients and their support systems. There is need for health costs to be made affordable to those seeking for them (Tarus, 2022).

We found out that 38.56% of the study participants used a combination of cash and the National Health Insurance Fund (NHIF) for payment and 36.46% exclusively relied on NHIF for payment, while 23.96% reported used cash only. In comparison, Oyando et al. (2019) in a similar study reported that only 31.9% of diabetic patients had enrolled to a health insurance scheme thus majority were paying for medical services out of cash. Study from national demographic and health survey of last year showed insurance

coverage of 26 to 27% (KDH, 2022). This means that majority of Kenyans are paying for this expensive healthcare out of their pockets.

We further found out that within households of patients, majority of primary income earners were patients themselves (30.99%) followed by sons/daughters. Evidently, since a larger proportion of the patients were elderly people, it suffices to say they relied on their own savings or health insurance but if not possible, remained reliant on their children. It is likely that these elderly and retired patients are using their savings and therefore not possible for these to meet their health costs fully.

Farming (41.41%) was the main economic activity followed by teachers who had retired. Seemingly, this reflects and emphasizes more on the elderly population that formed a larger proportion of the study participants. Contrary to this, a study by Elrayah-Eliadarous et al. (2010) reported that among male patients, being a casual worker (66%) was the main occupation while most women were housewives (87%) (table 2).

#### **4.7.2 To Assess the Levels of Glycated Haemoglobin of Diabetes Type 2 Patients**

##### **Attending Diabetic Clinics in Two Mission Hospitals in Kenya**

We found the mean HbA1c value at approximately  $9.231\% \pm 2.4920\%$  as shown in Table 5. A relatively small proportion of participants, specifically 21.6%, achieved optimal blood sugar control with HbA1c levels below 7%. In contrast, a significant majority, 48.4%, had uncontrolled blood sugar levels, indicated by HbA1c levels exceeding 9%. Additionally, 26.8% of participants fell into the less optimal control range, with HbA1c levels between 7% and 9%. A prospective, observational single-centre study at the Preoperative Assessment Centre (PAC) of Singapore found 20.8% of the study population had  $HbA1c \geq 6.1\%$  (Teo et al., 2020). Kulkarni et al (2020) found a 76.0% poor glycemic control and Mean HbA1c of 9.55% in type 1 diabetes in

India. Muhamed et al., (2018) found glycemic control for patients on treatment at 33%. In their meta-analysis Azevedo & Alla (2008) reported that high diabetes treatment cost was associated with poor glycemic control in sub-Saharan Africa.

In terms of RBS reading, we found the mean RBS reading at approximately 10.075 mmol/l  $\pm$  4.6503 mmol/l. Majority of participants, specifically 43%, had high RBS levels. High RBS levels can indicate impaired glucose regulation and a potential risk for diabetic complications. Additionally, 21% of participants fell into 7.8 to 11.0 mmol/l of random blood glucose category, based on their RBS readings. Also, a smaller proportion of participants were categorized as having low-normal RBS levels, while the smallest group, at 3%, had RBS values falling within the high-normal range. Our poor glycemic control findings could have led to the high cost of medicines in patients in mission hospitals. Both HbA1c and RBS readings indicate there is still need for intervention since majority of the diabetic patients have uncontrolled blood sugar levels. Sugar control is very important in preventing diabetic complications and premature death (Mohamed et al., 2018). One study at Kenyatta National Hospital found out that patients had diabetic ketoacidosis due to uncontrolled diabetes had a high fatality rate (Mbugua et al., 2005).

#### **4.7.3 To Determine The Association Between the Direct Cost of Care and Glycated Haemoglobin among Diabetes Type 2 Patients Attending Diabetic Clinics in Two Mission Hospitals in Kenya**

This study went ahead and conducted inferential analysis (table 6). We found out that the correlation coefficient between total direct costs and HbA1c reading was approximately 0.088, suggesting a nonsignificant weak positive correlation ( $p=0.089$ ). This indicates that patients who had better glycemic control spend less on their diabetic management and vice versa. This finding is similar to study among type 1 diabetes patients in India

which found a negative correlation between cost of care and HbA1c levels (Kulkarni et al., 2020).

The correlation between total direct costs and RBS reading was moderate (approximately 0.435) and statistically significant ( $p=0.000$ ), indicating a meaningful relationship between these two variables. As such, a further analysis was carried using scatter plot (Figure 5) to illustrate the association between RBS reading and total direct costs. The plot depicted a positive relationship, indicating that as RBS levels rise, there is a corresponding increase in total direct costs and 19% of the variation in total direct costs indicated by the linear relationship with RBS readings ( $R^2=0.190$ ). High random blood glucose resulted into a direct increase in total cost. Clinicians responded more to high random blood glucose than a high hba1c, in terms of adding an additional drug to control glucose, or sent a patient for investigations or to casualty to get insulin injection or normal saline, which all increased the cost to the patient. We however noted that such reactions were not so with a high HbA1c.

Regression analysis (Table 7) was further conducted to model the relationship between total direct costs and two predictor variables: HbA1c reading and RBS readings. Evidently, a moderate positive correlation ( $R=0.461$ ) between total direct costs and the combination of HbA1c and RBS readings was established, with 20.8% of the variation in total direct costs explained by these variables. Moreover, analysis of variance showed that at least one of the predictor variables (HbA1c reading and RBS readings) significantly contributes to explaining the variance in total direct costs echoing the results of the initial correlational analysis in Table 6. Finally, the coefficients and statistics for the regression analysis showed that a one-unit increase in HbA1c reading is associated with a change of Kshs. 170.529 in total direct costs when RBS reading is held constant. Similarly, a one-unit increase in RBS reading causes a change of Kshs. 452.617

in total direct costs when HbA1c reading is held constant, again showing how clinicians were easy to respond to a high RBS than a high HbA1c. Notably, both HbA1c reading and RBS reading were statistically significant predictors of total direct costs ( $p=0.047$  and  $p=0.000$ , respectively). Lage&Boye, (2020) found out that patients with an HbA1c index above ADA target, a reduction of 1% in HbA1c resulted in a reduction in all-cause, total, and one-year costs. Their results further indicated that good glycemic control is associated with savings on costs (Lage&Boye, 2020). This study finding suggests a statistically significant association between total direct costs and RBS readings among type 2 diabetes patients. The cost of HbA1c testing has been found to be 2.5 times that of blood glucose testing and routine HbA1c screening for all patients may not be cost-effective (Teo et al., 2020).

In contrast, a very weak negative correlation was found between control variables and HbA1c reading, and between RBS value and HbA1c reading which was also not statistically significance as indicated in Table 7. The variation in HbA1c reading could not be reliably predicted by patient's gender, duration of treatment and RBS values. Lage et al., (2020) found percentage reduction in HbA1c was associated with significant reduction in healthcare cost. However, percentage reduction in HbA1c was beyond the scope of this study. A comparative studies by Boye et al., (2022) found out that good glycemic (HbA1c <7) control was associated with lower cost when compared to poor glycemic control (HbA1c>7).

#### **4.7.4 Confounders**

We went ahead and analysed possible confounding variables including age of participants, gender and duration of treatment to check if they affected the cost of care and glycemic control. Including the potential confounding variables (age, gender &

duration of treatment) in the model showed that, there was a weak positive correlation between confounding variables and total costs and between control variables and RBS levels. The correlation in both was not statistically significant as indicated in Table 7 and 8. This study also found that variation in total direct costs, HbA1c and RBS values cannot be independently affected by patient's gender and duration of diabetes treatment.

Additionally, it has been noted that hypertension is almost twice as prevalent among the diabetic population as compared to the non-diabetic population (Nouh et al., 2017). The systematic review and meta-analysis done by Haile et al. (2022) carried out in Ethiopia found the prevalence of hypertension among T2DM patients to be at 55%; slightly lower than our finding. Similarly, Unadike et al. (2011) found a prevalence of 54.2% of hypertension among patients with diabetes mellitus. Reflectively, this places diabetic patients at a higher risk of become hypertensive. In this study, analysis data from our study participants, we found out that incidences of T2DM in both Maua Methodist and Chogoria hospitals showed that the year 2015 had the highest reported cases. Overall, the data indicated fluctuations in the annual incidences of new type 2 diabetes cases, with some years experiencing higher rates of diagnosis than others.

Generally, the trend in reported cases depicts an upward trajectory with more cases expected to be reported in coming years. Similarly, Sun et al. (2022) noted that across the BRICS countries, the number of diabetic patients continually increased from 1990 to 2019 in their age-period-cohort analysis. Correspondingly, with the expected continued rise in incidence rates, the need for further investments into healthcare financing to make it more affordable to chronic diseases and an exploration into treatment modalities and disease pathophysiology is becoming paramount so as to reduce morbidity and mortality from diabetes.

Figure 7 shows that within the two mission hospitals, new cases of diabetes have been reported since the 1990s. Majority of participants have been on treatment for more than 5 years-some having been placed on treatment for up to 18 years. This reflects upon the effectiveness of anti-diabetic medications and their usefulness in prolonging a patient's life even after being diagnosed with T2DM.

## CHAPTER FIVE

### SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Introduction

This chapter covered the summary of the findings of this study, the conclusions and the recommendations.

#### 5.2 Summary of Findings

We found out that the mean total direct cost of care per visit was approximately Kshs. 9,496.90  $\pm$  Kshs. 4,631.53. Evidently, the costs varied, with drugs constituting the larger contributor whose expense ranged from Kshs. 160 to Kshs. 26,022. The direct medical expenditures included costs of drugs, consultation, diagnosis tests, glucometers, BP monitors, and glucometer strips while direct non-medical costs included one-way transport costs and costs of food for accompanying family or friends. Study participants used different payment modalities, including cash, National Health Insurance Fund (NHIF), and private insurance, was used to pay for drugs, medical services, and laboratory/diagnostic tests. The majority of participants had uncontrolled blood sugar levels (>9%). The mean HbA1c value was established at 9.231%  $\pm$  2.4920% while the mean RBS reading was approximately 10.075 mmol/l  $\pm$  4.6503 mmol/l. Only 21.6% of participants had well-controlled blood sugar levels (HbA1c <7%). Our correlational analysis showed a statistically significant positive relationship between total direct costs and RBS readings (Pearson Correlation approximately 0.435, p=0.000). Regression analysis indicated a moderate positive correlation (R=0.461) between total direct costs and a combination of HbA1c and RBS readings. And finally, approximately 20.8% of the variation in total direct costs could be explained by the linear relationship between HbA1c and RBS readings.

### **5.3 Conclusions of Study**

There is significant direct cost incurred by diabetes type two patients in mission hospitals and poor glycemic control among diabetes type two patients in mission hospitals out patient clinics. These high costs compared to monthly earning of these patients are evidently unaffordable to majority of them. There is need to improve financial risk protection in order to achieve glycemic control. Access to diabetes treatment should be made a priority in order to prevent diabetes related complications and deaths.

### **5.4 Recommendations**

#### **5.4.1 Recommendation for Policy**

We recommend exploration of strategies to manage the costs of T2DM care, with a particular focus on drug costs, which constitute a significant portion of direct expenses. This could involve promoting the use of cost-effective generic medications when available or initial management with non-pharmacologic alternatives. More T2DM patients need to be encouraged to enroll in health insurance schemes, such as the National Health Insurance Fund (NHIF), to alleviate the financial burden associated with diabetes care. Healthcare providers should tailor treatment plans based on individual HbA1c and RBS readings. Patients with consistently high readings may require more intensive interventions or medication adjustments, lead to good glycemic control and lowering cost in the long run. Government and county governments should come up with ways to cushion patients with diabetes and other chronic diseases against high direct cost of medical care in order to prevent poor management and follow up.

This could be done through NHIF for NCDs. This will encourage patients to attend clinics, afford drugs. This will create a healthy and productive population and eventually reduce 30 percent premature deaths from non communicable disease by 2030. And

finally, we found out that some of patients did not have a recent HbA1c due to the expensive medical cost. Most patients we interviewed reported inability to afford HbA1c cost as the reason they had no current HbA1c. We also found out that 3.1 percent of the participants did not have any HbA1c. We recommend and emphasize the importance of HbA1c that clinicians should monitor their patients with this important test and adjust treatment accordingly.

#### **5.4.2 Recommendation for Further Research**

This study used hypertension as the only comorbidity among diabetic patients. We however know about many other comorbidities which could affect the cost of care among diabetic patients. We also didn't consider diabetic complications in this study. This could have underestimated the cost of care. We however included the cost patients could have spent on that clinic day. We therefore recommend studies to estimate cost of care including other comorbidities. Also, our study used RBS done on that clinic day and an HbA1c done in the last 3-9 months, which may not have given a direct relationship between the two. A study using the two parameters done on same day is highly recommended. Finally, we recommend similar studies in other settings, like private hospitals whose cost of managing diabetes could be higher than in mission hospitals.

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## APPENDICES

### Appendix I: Questionnaire

Time Interview Started.	Hour [ ][ ] Minute [ ][ ] Date.....
<i>Part 1: Patient Information</i>	
1.Age (Circle)	Male B. Female
2.Do you have (circle)	A. Diabetes only B. Both (Co-morbidity of both Hypertension and Diabetes)
3.What was the date of your diagnosis?	DD..... MM..... YR.....
4.How long have you been on your treatment?	1. Under 12 months 2. 1 – 5 years 3. Over 5 years

The questions in Part 1 should be filled in before proceeding with the questionnaire.

The patient should have been on diabetes treatment (or both) for a minimum of 6 months to proceed further in this questionnaire.

<b><i>Part 2 A, B, C: Cost of current care seeking event</i></b>	
<i>The following questions are about this current visit. Please fill in these questions appropriately.</i>	
<b><i>Please fill in the facility name here</i></b> .....	
5. How much money have you spent on this visit on the treatment/service received? Registration/Card..... Drugs ..... Consultation ..... Administration fees..... Diagnosis tests..... Medical check-up.....Others (Specify).....	Total costs.....Kshs .....

6. From your home to this facility, how much did it cost you on Transport (one way)?	.....Kshs								
7. a) Did any family/friend accompany you on this visits to this health facility?	1. Yes      2. No								
b) <i>If YES</i> ,How much money did they spend while accompanying you? Costs by family/friend for this visit: Transport (one way) Food .....	Total costs.....								
8.How did you pay for the services received? <i>(Circle all that apply)</i>	Cash Community health insurance scheme Given an opportunity to pay later (credit) National Hospital Insurance Fund (NHIF) Private health insurance Other (Specify).....								
<b>Part 6 A, B, C: Cost of Chronic care lab/diagnostic services</b>									
<i>This section collects costs on the usual lab/diagnostic services regularly done by the patient at a health facility.</i>									
<b>26. How much does it cost you to go for your lab/diagnostic test per month?</b> (This is the actual lab/diagnostic costs paid to the health provider)	<table border="1"> <thead> <tr> <th>Test 1 (in Kshs)</th> <th>Test 2 (in Kshs)</th> <th>Test 3 (in Kshs)</th> <th>Test 4 (in Kshs)</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Test 1 (in Kshs)	Test 2 (in Kshs)	Test 3 (in Kshs)	Test 4 (in Kshs)				
Test 1 (in Kshs)	Test 2 (in Kshs)	Test 3 (in Kshs)	Test 4 (in Kshs)						
<b>28. what were the results of your lab test</b>	HbA1c    HbA1c <b>RBS</b> <b>RBS</b>								
<b>29. How did you pay for each diagnostic/lab test which you take regularly?</b> <i>(Please fill in the visit based on the list below)</i>	<table border="1"> <thead> <tr> <th>Test 1 (in Kshs)</th> <th>Test 2 (in Kshs)</th> <th>Test 3 (in Kshs)</th> <th>Test 4 (in Kshs)</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Test 1 (in Kshs)	Test 2 (in Kshs)	Test 3 (in Kshs)	Test 4 (in Kshs)				
Test 1 (in Kshs)	Test 2 (in Kshs)	Test 3 (in Kshs)	Test 4 (in Kshs)						

Cash	1.....	1.....	1.....	1.....
Community health insurance scheme	2.....	2.....	2.....	2.....
Waived/exempted	3.....	3.....	3.....	3.....
National Hospital Insurance Fund (NHIF)	4.....	4.....	4.....	4.....
Private health insurance	5.....	5.....	5.....	5.....
Other (Specify)	6.....	6.....	6.....	6.....

**Part 7 A, B, C: Cost of Diagnostic equipment**

*This section collects costs about any equipment you have purchased for your <chronic illness>.*

<p><b>30. Since being diagnosed with your illness, have you bought any of the following types of equipment to help manage your &lt;chronic illness&gt;?</b></p> <p>(Please respond with either a yes or no to each device and the cost for which you bought the device)</p> <p>a. A glucose meter (glucometer).....Kshs</p> <p>b. Blood pressure monitors.....Kshs</p> <p>c. Other (Specify).....Kshs</p>	<p>1. Yes</p> <p>2. No</p>
---	----------------------------

**Part 9 A, B, C: Socioeconomic Information and Productivity losses Individual Situation and Income**

**31. Who is the primary income earner in the household? Circle most appropriate**

1. Patient    2. Wife/mother    3. Husband/father    4. Extended family

5. Son/daughter

6. Other (specify)

<p><b>b) What was your main occupation (or job)?</b></p>	<p>.....</p>
--	--------------

**Date:** \_\_\_\_\_

**Signature by**

**Interviewer:** \_\_\_\_\_

**Appendix II: Consent Form**

My name is **LakasiaKefa**. I am a master's student of family medicine at Kabarak University, Kenya.

I am doing a research titled: **Assessment of Direct Cost of Care and Glycaemic Control of Diabetes Mellitus Type 2 Patients Attending Diabetic Clinics in two Mission Hospitals in Kenya**. I am doing in two mission hospitals and I will be interviewing patients from each facility. For each patient, I will be asking questions about the cost of receiving diabetes services as a person from a health provider and it will take about 40 minutes. There is minimal risk of harm and no direct benefit associated with this study. However, your participation will help in knowing the cost associated with managing diabetes type two and measures that can be taken to cushion patients from governments.

Your involvement is voluntary confidential. If you sign now and later you decide to withdraw from this study, we will respect that.

Contact me in case of any on: 0708238814, email; [lakasiakefeldp12@gmail.com](mailto:lakasiakefeldp12@gmail.com).

Thank you.

**Participant:** I confirm that the purpose, benefit, risk and procedure of this study have been explained to me, all questions answered and i have voluntarily accepted to participate in this study.

Sign.....

## Appendix III: KUREC Clearance Certificate



### KABARAK UNIVERSITY RESEARCH ETHICS COMMITTEE

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Tel: 254-51-343234/5  
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OUR REF: KABU01/KUREC/001/02/09/23

Date: 7<sup>th</sup> September, 2023

Kefa Wanyonyi,  
REG No. GMMF/M/2693/09/18  
Kabarak University,

Dear Kefa,

**RE: ASSESSMENT OF DIRECT COST OF CARE AND GLYCAEMIC CONTROL OF DIABETES MELLITUS TYPE 2 PATIENTS ATTENDING DIABETIC CLINICS IN TWO MISSION HOSPITALS IN KENYA**

This is to inform you that *KUREC* has reviewed and approved your above research proposal. Your application approval number is *KUREC-020923*. The approval period is *7/09/2023 – 7/09/2024*.

This approval is subject to compliance with the following requirements:

- i. All researchers shall obtain an introduction letter to NACOSTI from the relevant head of institutions (Institute of postgraduate, School dean or Directorate of research)
- ii. The researcher shall further obtain a RESEARCH PERMIT from NACOSTI before commencement of data collection & submit a copy of the permit to *KUREC*.
- iii. Only approved documents including (informed consents, study instruments, MTA Material Transfer Agreement) will be used
- iv. All changes including (amendments, deviations, and violations) are submitted for review and approval by *KUREC*.
- v. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to *KUREC* within 72 hours of notification;
- vi. Any changes, anticipated or otherwise that may increase the risk(s) or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to *KUREC* within 72 hours;
- vii. Clearance for export of biological specimens must be obtained from relevant institutions and submit a copy of the permit to *KUREC*;
- viii. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal and;
- ix. Submission of an executive summary report within 90 days upon completion of the study to *KUREC*

Sincerely,

*for [Signature]*  
**Prof. Jackson Kitetu PhD.**  
KUREC-Chairman




Cc Vice Chancellor  
DVC-Academic & Research  
Registrar-Academic & Research  
Director-Research Innovation & Outreach  
Institute of Post Graduate Studies


*As members of Kabarak University family, we purpose at all times and in all places, to set apart in one's heart, Jesus as Lord.*  
(1 Peter 3:15)



Kabarak University is ISO 9001:2015 Certified


Appendix IV: NACOSTI Reserach Permit

  
REPUBLIC OF KENYA

  
NATIONAL COMMISSION FOR  
SCIENCE, TECHNOLOGY & INNOVATION

Ref No: 893252  
Date of Issue: 28/September/2023


**RESEARCH LICENSE**




This is to Certify that Dr. Jakasia Wanyonyi Kefa of Kabarak University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in on the topic: **ASSESSMENT OF DIRECT COST OF CARE AND GLYCAEMIC CONTROL AMONG DIABETES TYPE 2 PATIENTS IN TWO MISSION HOSPITAL CLINICS IN KENYA for the period ending : 28/September/2024.**

License No: NACOSTI/P/23/29890

Applicant Identification Number  
893252

  
Director General  
NATIONAL COMMISSION FOR  
SCIENCE, TECHNOLOGY &  
INNOVATION

Verification QR Code



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Scan the QR Code using QR scanner application.

See overleaf for conditions

**Appendix V: Evidence of Conference Participation**



## Appendix VI: List of Publication

*Kabarak Journal of Research & Innovation*  
[www.kabarak.ac.ke](http://www.kabarak.ac.ke)

RESEARCH ARTICLE

### **Assessment of Direct Cost of Care and Glycaemic Control among Diabetes Type 2 Patients in Two Mission Hospital Clinics in Kenya**

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#### **ABSTRACT**

Non communicable diseases are fast becoming the leading cause of mortality and morbidity worldwide. It is estimated that 463 million people were living with diabetes in 2019. This number is estimated to increase by two folds by 2045. Diabetes mellitus, being a chronic disease, needs frequent hospital visits and follow up by clinicians. These contacts mean costs to the patient. The increase in cost limits the hospital visits, medications purchase and laboratory investigations which leads to poor management and prognosis. This study objective was to assess the direct cost of care and glycaemic control of diabetes mellitus type 2 patients attending diabetes clinics in two mission hospitals in Kenya. We used a cross-sectional study design was employed for this study. A Kirkwood formula was used to determine the sample size for this study at 384 participants. Random sampling technique was used to obtain the study subjects. A structured cost of care questionnaire having questions on direct medical and non-medical costs was used to collect data. Obtained data was analyzed using Microsoft excel and SPSS. Descriptive statistics entailed Frequency counts, mean median and percentages interquartile range while inferential statistics employed were- correlational and regression analysis. Most participants were aged over 60 with 21.6% being over 80 years. Mean total direct costs per visit was Kshs. 9,496.90 ± Kshs. 4,631.53 with drugs accounting for the larger proportion. Mean HbA1c and RBS values were established at 9.231% ± 2.4920% and 10.075 mmol/l ± 4.6503 mmol/l respectively. The direct cost of care of T2DM is still relatively high with a wide variation yet the levels of glycemic control are yet to be fully achieved in a larger proportion of diabetic type 2 patients.

**Keywords:** *Direct cost of care, Glycaemic control, Diabetes Mellitus Type 2*