SECONDARY PREVENTION PRACTICES AMONG ADULT PATIENTS WITH TYPE 2 DIABETES MELLITUS AT MERU LEVEL FIVE HOSPITAL AND CONSOLATA HOSPITAL NKUBU KENYA

DENNIS MUGAMBI NGARI

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DECLARATION AND RECOMMENDATIONS

Declaration

This research is my original work and has not been presented for an award in any other university or institution.

Signature _____ Date: 12/9/2019

Dennis Mugambi Ngari

SM 20/29115/17

Recommendations

The research has been examined, passed and submitted with our approval as the University Supervisors.

Signature _____ Date: 12/9/019

Dr. Lucy Gitonga, PhD

Chuka University

Signature _____ Date: 12/9/019

Dr. Silas. Kiruki, PhD

Chuka University

iii

DEDICATION

I dedicate this work to my family members who have been a source of inspiration, engine of courage and secret to my achievements since my childhood. I also dedicate it to my dad, mother and sisters and for their endless love, moral support and encouragement.

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ABSTRACT

Diabetes is chronic metabolic disorder characterized by states of hyperglycemia with disturbances of carbohydrates, fat and protein metabolism. Diabetes affects millions of people globally every day and the prevalence of the disease is on the rise due to unhealthy diet and lifestyle. The ailment is associated with significant disability, premature deaths, and enormous medical costs. The disorder usually results to chronic complications including cardiovascular diseases, diabetic nephropathy, diabetic neuropathy, foot ulcers and diabetic eye diseases that are all preventable through secondary preventive measures. Once an individual has been diagnosed with T_2DM, secondary preventive approaches are essential in preventing the occurrence of chronic complications. However, lack of awareness of these measures has been cited as the common reasons for the development of complications. The study aimed to assess the practice and factors influencing secondary prevention among patients with Type 2 Diabetes Mellitus (T2DM) at Consolata Hospital Nkubu and Meru Level Five Hospital. A descriptive correlational study design was adopted to collect data from 357 purposively sampled participants with T_2DM using questionnaires and Focus Group Discussion Guide. Quantitative data was analyzed using SPSS version 25 at 95% confidence interval and a significance level $p \leq 0.05$. Frequency tables, bar graphs and pie charts were used for descriptive statistics while Chi squares and logistic regression were used for inferential analysis. Most respondents attended Meru Teaching and Referral Hospital. Majority of the respondents were aged between 40-60 years. Most respondents 31.6% had secondary level of education and majority 67% was employed. Concerning secondary prevention, majority did foot examination on every visit 70.6% and BP monitoring 69.5% while 56.5% did annual eye screening. Most respondents were married and did not engage in harmful social habits such as smoking and alcohol use. The following factors were significantly predicting practice of secondary preventive measures among diabetes patients at a p value ≤ 0.05; knowledge on complications for diabetes, distance to the facility, availability of drugs, good staff reception, receiving health education and counseling, good care-giver communication, availability of DM services, availability of supplies for screening DM complications, and client satisfaction all significantly influenced DM secondary prevention. Affordability of services, health insurance cover of the patients, monthly cost of DM management and traditional beliefs in managing DM all significantly influenced DM secondary prevention. The level of secondary prevention was poor which was influenced by a number of factors that needs be addressed to reduce the global burden posed by the disease.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ADA   American Diabetes Association

CVD   Cardiovascular Disease

DM   Diabetes Mellitus

DR   Diabetic Retinopathy

GFR   Glomerular Filtration Rate

HDL   High-Densitpoproteins

IDDM   Insulin Dependent Diabetes Mellitus

IDF   International Diabetes Federation

IFG   Impaired Fasting Glucose

IGT   Impaired Glucose Tolerance

LDL   Low-Density Lipoproteins

NIDDM   Non-Insulin Dependent Diabetes Mellitus

T2DM   Type 2 Diabetes Mellitus

SPSS   Statistical Package for Social Science

WHO   World Health Organization

CHAPTER ONE
INTRODUCTION

1.1 Background Information

Diabetes mellitus (DM) is a chronic metabolic disease of multiple etiology that is characterized by states of hyperglycemia with disturbances of carbohydrates, proteins and fat metabolism. This results from a disorder in insulin production, insulin action or both (International Diabetes Federation, IDF, 2017). The condition is one of the most significant public health problems that is faced in the 21st century. Diabetes mellitus is among the chronic diseases that take a huge toll on human health as well as resources, and regardless of this, the condition continues to face neglect by individuals, communities and states (Kenya Demographic Health Survey, KDHS, 2016). There are two different types of diabetes mellitus; Type 1 Diabetes Mellitus (DM) and Type 2 diabetes mellitus. Type 1 diabetes mellitus (also termed to as juvenile type of DM) accounts for 5-10% of diabetes mellitus cases while type 2 DM (also referred to as maturity-onset DM) accounts for the remaining 90-95% cases (World Health Organization, WHO, 2016).

According to an observational research that involved 1746 respondents with type 1 DM and 272 respondents with type 2 DM with their onset being individuals who were younger than 20 years, it was evident from the findings that the prevalence of diabetic retinopathy, kidney disease, and neuropathy was significantly greater in patients with type 2 DM. This was even after respondent's adjustment for differences in Body Mass Index (BMI), mean arterial blood pressure, hemoglobin A_{1c} levels, and waist-height ratio. Persons with Type 2 DM are at risk of developing chronic complications that include diabetic nephropathy, eye diseases and neuropathy (Dabelea *et al.,* 2017). Currently, Diabetes mellitus has become an epidemic globally that is associated with significant disability, premature deaths and enormous medical costs often resulting from the chronic complications (WHO, 2016).

Patients with diabetes mellitus present with elevated sugar levels in the blood and in urine. A fasting level of glucose of 7.0-mmol/L or higher suggests presence of diabetes mellitus. As well random glucose levels of 11.0-mmol/L indicate the presence of DM (Brunner & Suddarth, 2010). Uncontrolled DM significantly increases risks of heart diseases, diabetic neuropathy, foot ulcers, kidney failures and

diabetic eye diseases (glaucoma, cataract and retinopathy).The current trends of DM indicate a disproportionate rise in the prevalence rate in developing nations due to changes in demographic transitions from the old traditional ways to the modern urban lifestyle. A decade ago, the disease was not a significant public health threat in the developing nations like Kenya, but recently the situation has drastically changed (Fatema *et al*., 2017).

Global trends in diabetes indicate that the number of individuals suffering from the ailment was estimated to be 171 million which is nearly 2.8 percent of the world's population a figure that has been postulated to rise to 366 million which is 6.5 percent of the world's population in 2030 (IDF, 2017). By 2030 Fatema *et al*., (2017) indicates that DM type 2 is expected to be the 7th leading cause of death globally due to the chronic complications resulting from the disease. In another study, worldwide, the number of individuals with DM has quadrupled in the last three decades. More so, DM was established to be the ninth major cause of mortality with one in eleven adults globally having the condition, ninety percent of whom suffer from type 2 diabetes mellitus (T2DM).

From the recent statistics from WHO, the global prevalence of DM among individuals who are 18 years and above is 8.5 percent and increasing (WHO, 2016). Majority of the patients suffering from T2DM have been epidemic for several decades and have been found to suffer from various complications. This includes microvascular and macrovascular disorders affecting the kidneys, eyes, heart, and the circulation. In addition, the condition is a significant cause of mortality and morbidity, with 1.5 million deaths being reported in 2012 that were directly linked to diabetes (Julie *et al*., 2016). According to Samuel *et al* a lower or normal systolic blood pressure is associated with a decreased risk of cardiovascular events in individuals with T2DM. It was reported in the same study that, the correlation between a low blood pressure and patient's mortality was due to a concomitant disease accompanying diabetes (Samuel *et al*., 2016).

Asia has been identified as a major continent of the rapidly emerging T2DM, with India and China the top two epicentres. Although genetics significantly determines

a person's susceptibility to T2DM, a sedimentary lifestyle coupled with unhealthy diet and lack of exercise are crucial drivers of the current global disease epidemic (Zheng *et al*., 2018). In the nation of Sweden between the years 1998 to 2014, the incidence and mortality rates of cardiovascular complications from DM declined substantially, although the fatal outcomes were less among those with T2DM than among persons with type 1 diabetes mellitus (Rawshani *et al.*, 2017)

The situation is not different in Africa where diabetes mellitus poses a significant health and socio-economic challenge in the continent, a continent facing simultaneously other healthcare problems that include infectious diseases such as HIV, respiratory infections such as tuberculosis, and malaria. In the Africa continent, the number of individuals ailing from the disease is at 14.2 million. This number is expected to double to 34.2 million by the year 2040 implying that diabetes mellitus is a common chronic disease with an escalating prevalence globally (International Diabetes Association, 2015). Kenya being one of the sub-Saharan African countries is no exception to these challenges. The largest burden of diabetes mellitus results from the chronic complications, yet a majority of the individuals suffering from the ailment lack inadequate knowledge on diabetes and the secondary preventive approaches thus, end up not utilizing the services (Wu *et al.,* 2014).

The burden of T2DM complications and comorbidity is substantial among sub-Saharan Africans. Interventions to reduce T2DM morbidity and mortality in SSA need to prioritize early detection, the maintenance of healthy blood pressure, weight and lipid levels, as well as strengthen health delivery system capacities in providing treatment and care for neurological and ophthalmological complications of T2D (Ekoru, 2019).

The Diabetes International federation estimated the DM prevalence in Kenya to be at 3.3 percent in the year 2007. However, recent studies have indicated a rise in prevalence to 4.2 percent in the general population and of this, as high as 12.2 percent being in the urban areas. Chronic complications of DM can be controlled effectively through the diabetic secondary preventive measures that include eye examinations, cardiovascular care, kidney care and foot care. However, these services are

underutilized due to inadequate knowledge by the patients coupled with other influencing factors that include social- cultural, economic and health facility factors (Rahaman, *et al.,* 2017).

Among patients with type 1 or type 2 diabetes mellitus improvements in glycaemic control significantly reduces the incidences and the cost of macro vascular and, micro vascular complications (Baxter *et al*., 2016). This provides clear evidence for support of prioritized and sustained measures during early diabetes diagnosis to prevent the development of diabetes complications (Baxter *et al*., 2016). In a study on T2DM microvascular complications, Urine albumin creatinine ratio, (ACR) significantly decreased in the surgical group but on the other hand it increased in the medical group. However, there were no differences between the medical and surgical groups in their retinopathy changes while there were no changes either in the nerve conduction variables among participants in the surgical group (Alexander *et al*., 2015).

More so, Kenya being a developing nation a number of factors affects the utilization of the secondary prevention approaches worsening the situation. These include health facility factors such as the unavailability of facilities and services, distance to the facilities, communication barriers and the unavailability of skilled practitioners. Social-economic factors also play an essential role in influencing the practice of secondary prevention (IDF, 2017). Among these factors are the patient's level of education, employment and income status, cost of services, beliefs and values of the individuals. In light with the increasing global burden of the disease, the research study aims at assessing the practice of secondary prevention among patients with Type 2 Diabetes Mellitus at Consolata Nkubu hospital and Meru level five Hospitals in Meru County.

1.2 Statement of the Problem

The prevalence of type 2 diabetes is on the rise globally, more so in the developing nations with Kenya not being an exception due to rapid urbanization contributing to unhealthy lifestyles. Chronic complications of diabetes mellitus are the major reason for the increased global burden of the disease. Once an individual has been diagnosed

with T2DM, secondary preventive approaches such as eye, kidney, cardiovascular and foot care are essential in preventing the occurrence of chronic complications. Yet, a majority of the patients do not utilize the secondary diabetes prevention approaches thus, leading to an increased disease burden. More so, a number of factors influence the utilization of these preventive approaches aggravating the problem. Common citied factors include health facility factors, socio-cultural factors and economic factors. Secondary prevention is the most efficient way of lessening the complications of diabetes. Given the high prevalence of diabetes in Kenya as high as 12.2 percent in the urban areas, there is a need to improve on the practice of secondary prevention.

1.3 Objectives of the Study
1.3.1 Broad Objective
To assess secondary prevention practices among adult patients with Type 2 Diabetes Mellitus (T2DM) at Consolata Hospital Nkubu and Meru Level Five Hospital in Meru County.

1.3.2 Specific Objectives
  i. To assess the level of knowledge and practice of the secondary prevention among patients with type 2 diabetes mellitus at Consolata Nkubu and Meru Level Five Hospital in Meru County.
  ii. To determine health facility factors influencing the practice of secondary diabetes prevention among the patients with type 2 diabetes mellitus at Consolata Nkubu and Meru Level Five Hospital in Meru County.
  iii. To assess the effect of social cultural and economic factors on the practice of secondary diabetes prevention among the patients with type 2 diabetes mellitus at Consolata Nkubu and Meru Level Five Hospital in Meru County.

1.4 Research Hypothesis

H_{01}: There is no statistical significance on the level of knowledge and practice of the secondary prevention among patients with type 2 diabetes mellitus at Consolata Nkubu and Meru Level Five Hospital in Meru County

H_{02}: Health facility factors do not statistically influence the practice of secondary diabetes prevention among the patients with type 2 diabetes mellitus at Consolata Nkubu and Meru Level Five Hospital in Meru County.

H_{03}: Social cultural and economic factors do not statistically influence the practice of secondary diabetes prevention among the patients with type 2 diabetes mellitus at Consolata Nkubu and Meru Level Five Hospital in Meru County.

1.5 Justification of the Study

The complications resulting from diabetes are preventable with appropriate secondary prevention measures. Among the approaches, diabetic retinopathy screening at primary health care for early detection and management can prevent blindness by up to 90%. Regular screening for cardiovascular and coronary artery diseases as well as monitoring the kidney function for diabetic patients are effective approaches to preventing the diabetic complications (Wu *et al.,* 2014). Diabetic neuropathies, especially in extremities and foot examinations, need to be done on a regular basis (Fatema*et al*., 2017). Type 2 diabetes mellitus, despite its status as one of the most significant diseases causing high morbidity and mortality rates globally; patients have inadequate knowledge on the secondary preventive approaches used in the management of the disease leading to poor adherence to the self-care practices (Wu *et al.,* 2014). Several factors also influence the practice of secondary prevention that need to be addressed (Laws *et al.,* 2012).

In any future disease development, detection and early prevention knowledge plays a pivotal role. Effective self-management of T2DM is essential in reducing the risk of diabetes-specific complications. In both the developing and developed nations, DM is a leading cause of lower limb amputations, cardiac diseases, kidney failure, and eye problems such as blindness. Among persons with diabetes the risk of death is twice when compared to those without the ailment (Wu *et al*., 2014). Thus, necessary measures need to be put in place; otherwise, the burden of T2DM care will continue

6

having a negative impact on the patients and healthcare delivery system. More so, currently there are few studies and information on the secondary preventive measures on diabetes in Kenya, despite the disease rising prevalence. In Meru County, no such research has been done before, thus the study generates information needed by health care providers and policy makers on the practice and the possible barriers that hinder T2DM patients from utilizing the secondary preventive measures.

1.6 Operational Definitions of Terms

Diabetes Mellitus: A chronic metabolic disease of multiple etiology that is characterized by states of hyperglycemia with disturbances of carbohydrates, proteins and fat metabolism. This results from a disorder in insulin production, insulin action or both.

Secondary Prevention: Measures taken to prevent development of further complications after a patient has been diagnosed with a disease. In the study they are measures undertaken to prevent the development of chronic complications among patients with type 2 diabetes mellitus.

Hyperglycemia: An excess of glucose in the bloodstream often associated with diabetes mellitus. A fasting level of glucose of 7.0-mmol/L or higher or random glucose levels of 11.0-mmol/L indicate hyperglycemic state thus the presence of DM.

Diabetic Retinopathy: A disorder of the retina of the eye that is caused by diabetes which damages the blood vessels of the retina causing blindness.

Diabetic Neuropathy: This is nerve damage that results from DM leading to numbness, pain and weakness on the arms, hands, feet, and legs.

Diabetic Nephropathy: Damage to the kidneys caused by diabetes that presents as urinary excretion of albumin more than 300 mg in a 24-hour period.

2.1 Overview of Diabetes Mellitus

Diabetes mellitus is a chronic metabolic disease of multiple etiology that is characterized by states of hyperglycemia with disturbances of carbohydrates, proteins and fat metabolism. This results from a disorder in insulin production, insulin action or both (IDF, 2017). Diabetes is a chronic disease because it is non-communicable disorder unlike diarrhea, malaria, polio, etc. It is characterized by elevated sugar levels in the blood and urine. Diabetes mellitus is characterized by elevated sugar levels in the blood and in urine. A fasting level of glucose of 7.0-mmol/L or higher suggests presence of diabetes mellitus. As well random glucose levels of 11.0-mmol/L indicate the presence of DM. The normal sugar level in the blood is regulated by the insulin hormone that is produced by B-cells in the islets of Langerhans in the pancreas (Brunner & Suddarth, 2010).

Diabetes is classified into two primary classes that are Type 1 diabetes, also referred to as juvenile onset diabetes or insulin-dependent diabetes mellitus (IDDM). This type of DM accounts for 5 percent to 10 percent of all DM diagnosed cases. Risk factors are less well defined for Type 1 DM as compared to Type 2 DM. Among the defined risk factors for Type 1 DM include autoimmune disorders, genetic predisposition, defects as well as environmental factors. On the other hand, Type 2 DM also reffered to as adult onset DM or non-insulin-dependent diabetes mellitus (NIDDM) is responsible for 90 percent to 95 percent of all DM diagnosed cases (Brunner & Suddarth, 2010). Risk factors for T2DM include genetic predisposition, advanced age, overweight and obesity, prior history of diabetes during pregnancy, impaired glucose tolerance, sedimentary lifestyle, and race or ethnicity. Another type of DM gestational diabetes usually develops in 2 percent to 5 percent of pregnant women but often disappears when the pregnancy is over is considered the third type of DM (Chatterjee, *et al.,* 2017).

Diabetes Mellitus can cause serious health complications if hyperglycemia state continues overtime which includes heart diseases, diabetic neuropathy, foot ulcers,

kidney failures and diabetic eye diseases such glaucoma, cataract and diabetic retinopathy which are all vision-threatening (Wu, Ding *et al.,* 2014).

According to the American Diabetes Association (ADA) DM criteria of evaluation, diagnosis of DM is based on one of four abnormalities in diabetic patients. Among them include the glycated hemoglobin (A1C) with an A1C level of 6.5 percent or higher on more than two separate testing indicating diagnosis of DM. Fasting plasma glucose (FPG) test is also indicated for DM diagnosis with a fasting glucose plasma levels of 126 mg/dl (7.0 mmol/l) or more indicating the presence of DM. Random elevated glucose levels with an abnormal oral glucose tolerance test (OGTT) after a two hour postprandial meal with glucose levels of 200 mg/dl (11.1 mmol/l) or more for more than one occasion, warrants the diagnosis of DM. Patients with impaired fasting glucose (IFG) or impaired glucose tolerance (IGT) are referred to as having increased risk for DM (WHO, 2016).

2.2 The Burden of Diabetes Mellitus

The prevalence of DM is escalating at an alarming rate globally as demonstrated by published reports by International Diabetes Federation (IDF). In 2009, IDF estimated a global burden of DM at 285 million by 2010 and further projects it to 438 million by 2030. Another report in (2014) had even higher estimation of 382 million cases by 2014 and a projection of 554 million by 2030 and the most recent report by International Diabetes Federation (2017) on global burden of diabetes, has an estimation of 415 million people currently suffering from diabetes and a projection of up to 642 million by 2040. Western Pacific region reports to have the highest prevalence of 153.2 million followed by Southeast Asia at 78.3 million. Europe and North America and the Caribbean regions are third and fourth with 59.8 million and 44.3 million burden of diabetes respectively (IDF, 2017).

Africa continent is the region with the lowest prevalence rate of diabetes at 4.9 percent, having Seychelles at 12.1 percent, Country Reunion at 15.4 percent and Gabon at 10.7 percent as the top three nations with the highest DM prevalence (IDF, 2013). However, according to reports of various studies in Africa, the rate of increasing incidence of diabetes is much higher, this has been attributed to urbanization and changing lifestyles. In Sub-Saharan Africa, the International

Diabetes Federation has estimated that the number of adults with DM will more than double from 14.2 million that was in 2015 to over 34.2 million by the year 2040 (International Diabetes Federation, 2017).

A research on macrovascular and microvascular DM complications that was conducted in China found out that, DM leads to microvasculature changes that cause synthesis in extracellular matrix protein, as well as thickening of the capillary basement membrane that are the key pathognomic features of DM microangiopathy (Chawla, 2016). These developed changes coupled with advanced glycation end products; inflammation, oxidative stress, and neovascularization of vasa vasorum lead to the development of macrovascular complications on large blood vessels. Hyperglycemia is the key cause of microvasculopathy and it has also been stipulated to play an essential role in development of macrovasculopathy. Research indicates an intersection and a strong interconnection between macro and microvascular complications. In addition microvascular disorders have been linked to promote the development of atherosclerosis through processes such as changes in vasa vasorum and hypoxia. Thus it is fundamental to understand whether microvascular DM complications distinctly precede macrovascular disorders or whether both progress in continuum simultaneously (Chawla, 2016).

2.3 Pathophysiology of DM complications
2.3.1 Acute Complications
Diabetes mellitus complications often result from uncontrolled sugar levels. This implies that the sugar levels in the blood can either be higher than normal as state referred to as hyperglycemia or the sugar level can be abnormally low referred to as hypoglycemia that is brought about by a mismatch in the insulin that the pancreases releases and the amount need (Orban, Van Obberghen, & Ichai, 2017). Thus, acute complications can be as a result of either taking a lot of DM medication leading to hypoglycemia or taking too little leading to hyperglycemia (LeRoith, *et al.,* 2004).

Hypoglycemia occurs when the body has a deficit in the sugar levels. Sugar is need for the body's energy production to sustain the body cells including the brain. As indicated above, the disorder can also arise from taking a lot of anti-diabetic drugs or

insulin therapy. Other causes include delayed meals or skipping meals, alcohol intoxication and unplanned exercise among DM patients without adjustments in medication (Orban, Van Obberghen, & Ichai, 2017). Patients with T2DM who are on treatment with insulin releasing pills or synthetic insulin are at a greater risk of hypoglycemia without adequate management. It is almost unlikely for persons with T2DM who are managing the condition with either blood sugar normalizing drugs or lifestyle medication to have hypoglycemia (Brunner & Suddarth, 2010).

On the other hand symptoms of high blood sugar levels resulting from T2DM include the 3 Ps that are polyphagia, polyuria, polydipsia, nocturia, blurred vision, and weight loss (Orban, Van Obberghen, & Ichai, 2017). Increased urine production among DM patients results when the blood glucose levels rises significantly above 180 mg/dL (10 mmol/L). This exceeds the kidneys threshold for glucose leading to an increased excretion of glucose. Increased blood glucose levels causes osmotic diuresis and hypovolemia, that causes increased patients thirst (polydipsia) resulting to hyperosmolar hyperglycemic nonketotic coma (Brunner & Suddarth, 2010). Hyperglycemic hyperosmolar states is a condition where the patient's presents with excessive urination while at the same time dehydrated resulting from the high sugar levels in the body. The hypovolemia in the body makes the blood to become thicker and concentrated with an increased body sugar level. As a result of high blood sugar levels, the body compensates by trying to dispose of the excess sugars in urine worsening the condition further. However, the patient presents with enough insulin preventing the formation of ketone bodies (LeRoith, *et al.,* 2004).

Due to the hyperglycemia and severe dehydration, the patient becomes confused or even goes to a coma. At this stage, the disorder progress to a very serious medical emergency that can ultimately lead to death. Prompt medical management with insulin and IV fluid therapy with close patient monitoring is crucial. Often hyperosmolar hyperglycemic states happen to individuals who are not aware that they have DM or persons who mismanage their condition and do not take enough fluids or check their blood glucose levels (Brunner & Suddarth, 2010). In addition, it is important for DM patients to understand their condition as those who rush to replete

their lost volume losses with concentrated sugary drinks, further exacerbate their osmotic diuresis and hyperglycemia state (LeRoith, *et al.,* 2004).

In Karachi, Pakistan, hypertriglyceridemia and hypercholesterolemia states were linked to the development of neuropathy and kidney disease, whereas there was no significant association of high low density lipoproteins found with any complication. There was a high prevalence of microvascular complications that was observed among T2DM patients who were first time visitors at the tertiary care hospital. Early identification and effective management of DM complications in the general population is thus paramount to prevent the development of the associated complications in combating the situation (Abro *et al*., 2018).

The chronic and acute complications of DM are responsible to the high rates of morbidity and mortality associated with this disease. Patients do not succumb to DM disease rather they die as a result of the DM complications. Acute complications of DM are hypoglycemia, DKA (diabetis ketoacidosis), and hyperosmolar hyperglycemic nonketotic coma. Hyperosmolar hyperglycemic state is characterized by high levels of hyperglycemia marked with severe dehydration without ketoacidosis which is a common feature observed in DKA. Low insulin levels from DM causes the liver to turn fatty acid to ketones for energy leading to the production of ketone bodies and if the process is sustained DKA results (Brunner & Suddarth, 2010).

2.3.2 Chronic Complications

The hyperglycemic state in T2DM leads to long lasting damage of various body organs that is; the eyes, nerves, blood vessels and kidneys in approximately a third to a half of the individuals diagnosed with the condition. Poorly controlled T2DM is associated with an array of neuropathic, macrovascular and microvascular complications. Macrovascular complications entail peripheral vascular diseases, cardiovascular diseases (CVD) and coronary artery ailments while the microvascular complications include neuropathic, renal and retinal diseases (Gray & Jandeleit-Dahm, 2014).

In a study examining the relationship between micro and macrovascular disorders and metabolic syndrome (MetS) among T2DM, the results revealed a significant trend for stepwise increases in nephropathy, peripheral artery disease, retinopathy, coronary artery disease and cerebrovascular disease in correspondence to the number of MetS components. From the study associated risk factors include; metabolic syndrome, dyslipidemia, advanced age, increased haemoglobin levels, sex, wide pulse pressure and decline renal function. These risk factors were greatly associated with the development of both macrovascular and microvascular conditions. Similarly metabolic syndrome and the number of its components were greatly associated with micro- and macrovascular complications among participants with DM resulting in a higher risk of cardiovascular disease. Therefore, screening programs that enable early detection of these pathologies ought to be established to decrease the risk of cardiovascular diseases and other complications (Lee & Shin, 2017).

In the nation of Ethiopia, T2DM burden including the burden imposed by macrovascular and microvascular diseases has been on the rise among the diabetic patients. The increased duration that patient suffer from the diseases since it is chronic, the lower socio economic status among residents, existence of other comorbidities as well as old age complicate the situation further making DM a public health burden. Thus, follow up and close monitoring of the T2DM patients is important in an effort of reducing the incidences and prevalence of diabetic related complications (Bayu, 2019).

Insulin resistance in T2DM leads to increased lipid accumulation in the liver, smooth muscles, and blood vasculature. This predisposes the individual to cardiovascular diseases. According to Alaboud *et al*., (2016), the pathology of vascular diseases in DM is as a result of the pathological effects of impaired vasodilatory response due to nitric oxide inhibition, glycation accumulation, the dysfunction of smooth muscles, associated chronic inflammation in DM, the overproduction of endothelial growth factors, enhanced aggregation of platelets as well as the impaired fibrinolytic activity (Alaboud *et al*., 2016). In Saudi Arabia, DM patients who had a poor control of their glucose levels and had suffered from the condition for a longer duration had higher prevalence of both microvascular and macrovascular disease (Alaboud *et al.,* 2016).

Coronary heart disease (CHD) is one of the most severe complications of DM. CHD is the main cause of death because it increases the risk of developing a cerebrovascular disease (stroke), heart attack, heart failure and peripheral vascular disease. Atherosclerosis in diabetes is attributed to causing 80 percent of deaths in DM patients. Thus, it has become increasingly essential for physical therapists to be aware of these complications in an effort of improving the disease management (M. J. Fowler, 2011). However, since treatment of hyperglycemia has not been associated with the reduction of cardiovascular risk among DM patients, more aggressive primary and secondary prevention interventions need to be put in place among these patients. The chronic complications of T2DM include; diabetic nephropathy, diabetic neuropathy, diabetic retinopathy and diabetic foot ulcers.

Most of DM patients succumb to cardiovascular complications. While these patients have other risk factors to cardiovascular diseases such as drug abuse and smoking the individual contribution of high blood sugar is clearly established. There is a correlation between the development of macrovascular disorders and high glycaemic levels in T2DM patients (Lee & Shin, 2017). On the contrast for microvascular complications to occur, there must be a glycaemic threshold for these conditions to occur. Multifactorial DM risk management measures are key in the reduction of cardiovascular comorbidities but smoking cessation among the DM patients is ultimately important among the smokers. Blood pressure management and regulation are essentially critical and easier to achieve than good glycemic control in T2DM, but glycemic-lowering has a sore independent effect in cardiovascular disease reduction (Snell-Bergeon & Wadwa, 2012).

For all DM patients, it is essential to assess the cardiovascular risk factors during the hospital visits. Common risk factors for cardiovascular pathology include high body fat levels, presence of albumin in urine, hypertension, presence of a cardiovascular illness in the family and lifestyle behaviors such as smoking and drug abuse. Once identified these risk factors need to be managed appropriately (Lee & Shin, 2017). Patients with T2DM suffer from an ally of other diseases that result from dyslipidemia such as hypertension and coronary vascular diseases. DM has been established as an independent risk factor to cardiovascular disorders (Snell-Bergeon &

Wadwa, 2012). Not surprisingly, most of the DM patients ailing from cardiovascular disorders; from their medical history, it is clear that DM was the first disorder to be diagnosed. Consequently, due to poor management of diabetes other cardiovascular comorbidities gave in. Numerous researches have indicated the efficacy of controlling DM in preventing hypertension and other cardiac disorders (Arguedas *et al*., 2013).

For the hypertensive patients and other cardiovascular diseases, the blood pressure should be assed at every routine patients visit. Hypertension is a common DM comorbidity affecting numerous patients globally, with the severity and prevalence being dependent on other individual factors such as the race, stage of diabetes, body mass index of the patient and age. Furthermore uncontrolled hypertension is a major risk factor for both coronary artery disease and other micro vascular complications (Snell-Bergeon & Wadwa, 2012). While in T2DM, hypertension results from cardiometabolic risk factors, in type 1 DM, it is as a result of an underlying kidney disorder. Assessment of the blood pressure should be done by a trained healthcare provider and should follow the established BP monitoring standards. This involves ensuring that the patient has rested for 5 minutes and is not under any stimulant, the patient needs to be in a seated position with the feet on the floor, their arm should be on the heart level supported and an appropriate cuff size should be used. When confirming hypertension diagnosis, an average of two or more blood pressure readings is considered with the values taken on individual separate days. It is vital noting that postural changes in the blood pressure and pulse may indicate neuropathy therefore; appropriate measures need to be undertaken. Home based blood pressure monitoring provides the best evidence of existing hypertension other than the office based blood pressure diagnosis (Sega *et al*., 2005). However, most of the diagnosis and hypertension treatment management in individuals with DM is based on office measurements that are not very accurate.

2.3.2.1 Diabetic Neuropathy

The pathophysiology in the development of diabetes neuropathy is poorly understood, though the disorder is linked with damage to the nerve small vessels. There are two forms of neuropathy established; peripheral neuropathy and autonomic neuropathy. The peripheral type affects the peripheral sensory nervous system leading to loss

sensitivity or pain sensations on the patient's hands and feet (Brunner & Suddarth, 2010). Autonomic neuropathy affects the functioning of body systems such as gastro-intestinal, urinary, and cardiovascular systems resulting to disorders such as orthostasis, diarrhea, erectile dysfunction and gastroparesis. These disorders interfere with the individual normal functioning of the patients adding to the burden of DM (Tumbo and Kadima, 2013).

Diabetic peripheral neuropathy is a common disorder that is estimated to affect 30 to 50% of diabetic patients (Deli *et al*., 2013). The prevalence of neuropathy vary across countries with 68.5% in Pakistan, 27.3% in Cameroon, 27.6% in South Africa, 13.2% in India, 17.8% in China and 44% in Nigeria (Osuji *et al*., 2012; Tumbo and Kadima, 2013; Ali *et al*., 2013a). Among newly diagnosed diabetic patients, the prevalence of diabetic neuropathy is 17.8%, 13.2% and 68.5% in China, India and Pakistan respectively.

Diabetic neuropathy that is the damage to the nerves of the body affects both the peripheral and autonomic nerves, is one of the most common DM complications. Symptoms include tingling sensations, numbness in the affected area, and altered sensation of pain which can lead to skin damage. As a result, diabetic-related foot complications may arise such as diabetic foot ulcers that are quite difficult to treat and often lead to amputations. More so, neuropathy from DM causes muscle atrophy and weakness (Deli *et al*., 2013). T2DM has been linked to atrophy of the hippocampal, frontal, temporal, and limbic gray-matter. Besides that research has also associated it with temporal and frontal white-matter atrophy. Therefore, individuals with T2DM are likely to suffer from gray-matter atrophy that is similar to the cortical atrophy seen in Alzheimer disease resulting to cognitive problems (Amutha, 2017). Symptomatic treatments of neuropathy are often inadequate and the modest management option is improving on the glycemic control among DM patients.

2.3.2.2 Retinopathy

High blood sugar levels damages the ocular lens of the eye leading to blurred vision among DM patients especially with increased hyperglycemia. With increased hyperglycemia patients suffer from cataract that impairs normal vision (Heydari *et al*.,

2010). However, according previous studies on retinopathy, the actual damage of the eye that result to retinopathy begins with retinal changes but the disorder leads to vision loss during the advanced proliferative phase. This happens as a result of vitreous bleeding that is accompanied by retinal detachment and eventually there is visual loss giving a rise to Diabetes Retinopathy (DR) (Brunner & Suddarth, 2010).

Fortunately, screening is available for DM patients where they are required to do a dilated annual exam annually to detect early changes as part of preventive therapy. Not surprisingly, over 40 percent of patients with DM suffer from diabetes retinopathy which has an increasing prevalence among patients who have suffered longer with DM (Fowler, 2011). Notably, as high lipid levels and hypertension markedly contribute to the development of the macro-vascular disorders as well as nephropathy and can cause the disorders even when the patient is not diabetic, DR results solely from high glycemic levels and without hyperglycemia it cannot occur. The relationship of high glycemic levels and DM is very tight such that the current diagnostic criterion for DM diagnosis is largely based on the glycemic levels (Tumbo et. al., 2013).

In a research in China among the newly diagnosed diabetic patient, Liu and colleagues found a 4.8% prevalence of retinopathy (Liu et al., 2010). This was almost similar to the findings by Heydari et al (2010) in Pakistan who found the prevalence to be 6% of the respondents (Heydari et al., 2010). However, Tumbo et.al (2013) and Thomas RL et.al (2013) found the prevalence at 19.5% and 55.4% in hospital based studies (Tumbo and Kadima, 2013). Retinopathy is thus the most citied micro vascular complication of diabetes in newly diagnosed patients. In a systematic review on association between diabetic retinopathy (DR) and other diabetic complications according to a review of 70 studies, DR was consistently linked to other complications of DM. The review linked DR to a higher risk of the presence of, or in the development of other macro and microvascular disorders. In particular, diabetes retinopathy increased the likelihood of having or development of nephropathy and it was also a strong predictor of stroke and cardiovascular disease development (Thomas et al., 2013).

Diabetic retinopathy which is the damage to the eyes occurs when the blood vessels in the retina of the eye are destroyed or when the lens of the eye is damaged. This results in gradual vision loss and without appropriate DM management blindness. The retina at the back of the eye is the part that is sensitive to light which transmits images focused to the brain (Hendrick, *et al.*, 2015). Diabetic retinopathy is categorized into four stages based on the degree of retina lesions which maybe micro-aneurysms, a small dot and blot hemorrhages, splinter hemorrhages, intraretinal-microvascular abnormalities and cotton wool spots (Forbes & Cooper, 2013). The condition may cause vision loss either through proliferative retinopathy or macular edema. Macular edema occurs there is a leak of fluid into the center of the macula where sharp straight vision normally occurs in the eye. The fluid accumulates making the macula to swell eventually resulting in a blurred vision. This happens at any stage of the DR disease progresses (Chawla, 2016).

Progressive DR is a strong risk predictor for acquiring peripheral arterial disease that carries an increased risk for the development of foot ulcers and amputation. Additionally, further research suggests that patients with DR have an overall worse prognosis of DM than persons without DR. In conclusion, this analysis stipulates the need for enhanced and coordinated approaches to patient management. Given cost effectiveness of diabetes retinopathy screening that can be performed outside of an ophthalmology office, the screening can be used in identification of patients with an increased risk for other micro- and macrovascular complications. This will enable earl detection, management as well as referrals in an effort of reducing morbidity and mortality among patients with type 2 diabetes mellitus. It is important to note that without early interventions diabetes retinopathy can cause blindness among DM patients. Thus, healthcare practitioners that are involved in the management and care of DM should encourage regular DR screening (Pearce *et al*., 2018).

2.3.2.3 Nephropathy
Diabetic nephropathy that involves the kidneys is one of the leading causes of chronic kidney disease (CKD) and end-stage renal disease (ESRD) (Viswanathan *et al*., 2012). The initial sign of diabetic nephropathy is the presence of small quantities of albumin in the urine. When detected early, the further progression of the disease can

be reversed or slowed down with appropriate management. However, once the albumin loss in urine exceeds 300mg in a day, it is often impossible to stop the progression of the ailment (Brunner & Suddarth, 2010). Eventually, the kidney stops functioning completely necessitating renal replacement modalities such as kidney transplantation or dialysis (Gray & Jandeleit, 2014).

In both the developing and developed nations, DM is one of the most prevalent causes of chronic kidney failure. This occurs when the kidney nephrons are overworked due to the massive polyuria that is characteristic of the disease. Diabetic nephropathy, also termed to as intercapillary glomerulonephritis or Kimmelstiel-Wilson disease, is a nephron disorder that is characterized by albuminuria of more than 300 mg/day and a permanent or decreased glomerular filtration rate (GFR). An increased size of the kidney and a change in the Doppler indicators are the initial manifestations of renal damage while massive proteinuria and a further decline in the GFR signify an extensive progression of renal damage possibly to chronic kidney damage (Gray & Jandeleit, 2014).

Diabetes screening for damage of the kidney is performed by checking the Urinary Albumin and Creatine Ratio (UACR) in the urine at random checkups. This needs to be done at least once annually in all the patients with T2DM as well as those with comorbid elevated blood pressures (Klausen et al., 2004). Taking a twenty four hour urine collection has been indicated as cumbersome as it also adds little to the accuracy or prediction of nephropathy. However, for the random check, two or three specimens of urine need to be collected in a three to six months period for diagnosis to be made. Abnormal values confirm the diagnosis of the condition. Important noting is that, infection, hyperglycemia, exercise, fever and the presence of other diseases such as heart failure and hypertension may elevate the UACR levels therefore, adequate patient's assessment is a pre-liquescent. Persistently elevated urinary albumin and creatine ratio in ranges of UACR 300 mg in a day is an early warning sign of damage of the kidney among patients with type 1 diabetes mellitus and it is considered to be a marker for the development of nephropathy in T2DM. It is also associated with the development of cardiovascular diseases such as hypertension and congestive heart failure (Krolewski et al., 2014). Conversely, those DM patients with an increased

renal function decline couple with decreased glomerular filtration rate, increased lipid profile levels and elevated blood pressures are more likely to experience a progression of the kidney damage to end-stage renal disease (ESRD) (Klausen *et al*., 2004).

Historically, nearly 40 percent of type 1 DM patients developed kidney damage. However, with the introduction of insulin which improved the glycemic control as well as the use other therapies such as hypertension drugs in treatment of other accompanying diseases, the incidence of nephropathy in type 1 DM has reduced to less than 10 percent. However, in T2DM where other risk factors such as increased lipid levels are common, the chances of developing nephropathy still remains high at 20-50 percent depending on the ethnic background of the patient. In regardless to the increased prevalence of T2DM due to change of lifestyle and urbanization, the need for advanced renal treatment such as dialysis and renal replacement modalities will continue to be a public health burden (Sosale *et al*., 2014). Nephropathy was present in 20.2% of newly diagnosed diabetic patients. The prevalence was 1.06% in India, 1.11% in South Africa and 10.7% in China. In Pakistan, the prevalence was 56.2%, which is higher compared to other countries (Ali *et al*., 2013a).

2.3.2.4 Diabetic Foot /Ulcers

From the disease pathogenesis, the metabolic changes that are a consequence of hyperglycemia result to structural as well functional damage to nearly all the body tissues. The most significant damage occurs on the cells endothelium that plays a crucial role in the development of macro and micro vascular disorders. In the foot, damage on the connective tissues occurs resulting to DM foot problems. This disorder is difficult to treat and it is one of the most feared chronic DM chronic complications often resulting to foot amputations (Fortington *et al*., 2013). In a majority of the patients, connective tissue destruction deforms the feet, making it more vulnerable to the development of foot ulcers. The ulcers are difficult to recognize because of the sensory loss neuropathy that precedes ulcer formation. The diabetic wounds result more readily as a result of vascular pathology that prevents tissue oxygen supply and eventually the wounds become colonized and infected with bacteria and other organisms making the quite difficult to treat. To avert microbial spread to the rest of the body, the patient gets an amputation coupled with multidisciplinary prompt

management measures in an effort of saving the life of the patient (Kadima and Tumbo, 2013).

According to Brunner & Suddarth, (2010) foot ulcer is as a result of loss of leg sensation and poor blood circulation or it can be as a result of a combination of both. When DM patients loose the normal sensation that results from neuropathy, they will not realize that they have a cut or a bruise on their legs. More so, the loss of sensation can also affect the way the patient walks or can even go to an extent of damaging the joints and bones. This often delays the treatment while inadequate perfusion to the lower limbs means that few blood cells will be unavailable to help fights germs in the developing wound. When medications are administered they are also less effective because they will not be able to get in to the tissues due to poor blood circulation (Richard, & Schuldiner, 2008). DM has also been linked to slow wound healing among the patients. This indicates the need for early diagnosis through doing regular foot examinations during every patients visit. In the management of impared circulation, blood vessels bypass is indicated for these patients with antibiotic treatment and wound dressing being done concomitantly. DM persons ought to take good care of their feet to avoid foot ulcer complications. This includes wearing foot protective gear, avoiding walking barefoot, not wearing very tight shoes, washing, drying and doing feet inspection, maintain the nails short to prevent ingrown and avoiding electric blankets and hot water baths that may easily damage the skin on the feet (Mbanya & Sobngwi, 2003).

Foot wounds that result to amputation are a significant burden among DM patients representing a major cause of mortality and morbidity among T2DM individuals. Therefore, the early recognition and management of DM patients with feet ulcers is crucial in adverse outcomes. All persons diagnosed with DM should do frequent foot evaluations and should be aware of the proper management of foot care. This is achieved through patient education when they visit the diabetic clinic (Chantal Nanfack *et al*., 2012). At the hospital, vascular evaluation, musculoskeletal and skin integrity evaluation is done at every visit. Patient education then follows about DM wound ulcer risk factors and appropriate care to be adhered to. These individuals need to understand the implications of would ulcer development, the proper foot and skin

care practices. The importance of selecting the appropriate footwear should be emphasized where at home or at the work places. It is vital also for health care providers to assess the patients understanding to foot care practices as well as their ability to conduct proper foot management. Those individuals with physical disabilities such as cognitive, visual or musculoskeletal difficulties will require assistance from others in an effort of instituting appropriate foot care modalities (Fortington *et al*., 2013).

Globally the prevalence of diabetes is on the rise with a respective rise in its associated complications such as diabetic foot wounds as well as lower limb amputations imposing a greater disease burden. Diabetic foot is the main chronic disorder of diabetes affecting the foot. It is 20% prevalent in a South African Study (Kadima and Tumbo, 2013). However, it is 0.8% in China and 13% in Cameroon (Liu *et al*., 2010). Richard, & Schuldiner (2008) states that the risk of a patient with DM to the development of diabetes foot wound is 25 percent and in addition the risk of amputation is 15-40 times greater in persons with DM than the non-diabetic population. Studies done in the African continent indicates that nearly 12 percent of DM patients have a foot ulcer (Mbanya & Sobngwi, 2003). In the United States over 16 million individuals have been diagnosed with DM. Of these 10 to 15 percent develop foot wounds (Reiber, 2001). Foot ulcerations are very costly to manage and presents as a disturbing condition for DM patients. These patients are prone to stigma, social discrimination, isolation and consequently unemployment due to the resulting physical disability. Also, it has been established that the patient's mortality rate following amputation within a five year period varies from 39 to 80 percent indicating the burden imposed by diabetic foot wounds (Fortington *et al*., 2013). Lower limb amputations results to loss of productivity among the patients, a distorted body image, increase in the medical care cost of treatment and increased dependency. Foot deformities and previous history of foot ulcers are determinants of diabetic foot ulceration. Therefore improving the quality of care in DM management and in particular, lower limb wounds is important in reducing the unnecessary burden posed by DM (Chantal Nanfack *et al*., 2012).

2.4 The Practice of Diabetes Mellitus Secondary Preventive Measures

There are effective measures available for lowering the blood glucose levels for DM patients thus, delaying the onset of overt diabetes. T2DM is associated with an array of serious health problems. It is a significant risk factor for the development of cardiovascular disorders such as coronary artery disease and stroke. DM is also a leading cause of blindness due to diabetes retinopathy, kidney failure, as well as amputations of the lower limbs (Wu *et al*., 2014).

Among the elderly and middle aged population suffering from diabetes, DM retinopathy is a leading cause of vision loss globally. The disorder can be detected early through screening that allows for prompt treatment preventing DM related visual impairment. Patients ailing from DM will require close follow-up with healthcare providers to optimize their glucose levels, lipid control as well as their blood pressure in preventing the development and progression of diabetes retinopathy and other complications. However, few patients receive this follow up or seek screening services. With the rising cases of DM and related complications such as retinopathy, health systems in both developing and developed countries will be faced with increasing costs of implementation and maintenance of promotive programs such as diabetes retinopathy screening program for people with diabetes. In an effort of lessening the impact of retinopathy related eye damage and visual loss, it is essential that all the relevant stakeholders continue looking out for better innovative measuress of managing and preventing DM while optimizing cost-effective programs for screening in the communities (Daniel *et al*., 2015).

According to Psaltopoulou *et al.,*(2010) the prevention approaches for DM just like any other chronic disease can be categorized in four stages that are primordial strategies, primary and secondary prevention and tertiary prevention strategies. Primordial prevention methods entail adapting strategies during the period of normal glucose tolerance in an effort of halting the emergence of DM risk factors before they appear. The preventive measures include the maintenance of a healthy normal body weight through the adoption of healthy nutritional habits and adequate physical exercise (Brunner & Suddarth, 2010).

Primary prevention is done during the phase of pre-diabetes where the patient presents with an impaired glucose tolerance (IGT) before the development of DM. During this phase diet and lifestyle modifications (LSM) is of paramount importance (Brunner & Suddarth, 2010). Secondary prevention refers to preventing complications in those who already have diabetes with the aim of delaying or preventing development of long-term complications of the disease such as DR, diabetes neuropathy and cardiovascular complications. On the other hand, tertiary prevention is carried out when the complications have already set in with an aim of preventing the progression of these complications (Ahmad & Crandall, 2010).

Secondary prevention interventions include screening for diabetic retinopathy annually which is paramount as most patients do not experience any disease symptoms until they reach the advanced stages of DR. If the patient recognized early, the threatening vision side-effects of retinopathy prevention is feasible with appropriate management. For T2DM it is recommended that patients should have annual dilated eye examinations. Screening should commence immediately after DM diagnosis is made. Notable is the fact that many patients with T2DM have retinopathy problems at the time of diagnosis. Very few patients do their annual dilated eye examinations due to the cost of the services and the unavailability of the services in some regions (Fowler, 2011).

In the prevention of diabetic nephropathy, it is crucial to detect and treat microalbuminuria (albumin in urine) as early as possible. Diabetes mellitus patients should have their urine examined for the presence of proteins annually (Dornhorst & Merrin, 1994). Once nephropathy has been established, then management should be initiated promptly including that of coexisting disorders such as hypertension that accompany the disease. A rise in the systolic blood pressure is linked with a decline of the renal function. Thus, hypertension treatment and regular checkups of the blood pressure are necessary for these patients (Fowler, 2008).

Amputations of the lower limbs are about 15 times more among the diabetic patients, and 85 percent of these cases are avoidable with appropriate foot care practices. Peripheral neuropathy and vascular diseases are predisposing factors to lower limb

amputation. Yearly screening of DM neuropathy and feet for wounds at every visit is crucial for early and appropriate management to be undertaken. This is essential in lessening the burden that amputations cause among individuals and the community (Wu *et al*., 2014). T2DM is associated with abnormalities in the concentration of lipoproteins and serum lipids. Changes include an increased circulation of very low-density lipoproteins (LDL) and a reduction in high-density lipoproteins (HDL) levels that lead to the occurrence of coronary heart and peripheral vascular diseases. Therefore; it is essential for DM patients to do screening for lipid abnormalities (Ahmad & Crandall, 2010). Lack of awareness on the importance of cholesterol screening and the asymptomatic state of diabetic neuropathy, has led to the underutilization of secondary preventive measures among diabetic mellitus patients.

2.5 Knowledge on the Secondary Preventive Measures

Proper management of DM requires lifestyle modifications as well as adequate knowledge on the condition that are crucial components of management. Patients have different levels of knowledge depending on their level of education, their social class as well as their gender. According to a research study conducted by Al Sarihin, *et al*., (2012) to assess the level of knowledge on DM among the diabetic patients, men had a higher score on knowledge as compared to the female gender but there was a knowledge deficit about the disease limiting the patient's involvement in disease management.

Positive attitude, knowledge, as well as practice (KAP) are all critical for DM patients in the utilization of the secondary preventive approaches. Newly diagnosed type 2 diabetes (T2DM) patients who don't receive proper diabetes education on the secondary preventive approaches have poor knowledge on these DM approaches, and their practices about diabetes are inadequate and need improvement. Insufficient knowledge, poor attitude as well as inadequate DM secondary preventive practices are associated with the development of diabetes mellitus complications (Rahaman, *et al.,* 2017). In assisting patients to live a positive, productive life, structure educational programs on DM and measures to prevent complications are vital.

According to a study conducted by Herath, *et al.,* (2017) to assess the knowledge and practice related to DM patients, even though 77 percent of the study subject had moderate information regarding DM, their attitudes towards the management of the disease was poor. The research study revealed that a higher level of knowledge on DM does not necessarily translate into good management practices as nearly 50 percent of the participants did not carry any secondary preventive measures. Increased awareness among communities is a significant determinant in the prevention of DM and its complications.

Learning about DM risk factors and preventive approaches is the initial step in DM management since it enables the patients to make informed decisions to adopt a healthy lifestyle. However, most of these patients have poor knowledge on the risk factors as well as the complications preventive measures (Aljoudi & Taha, 2009). Further expansion of DM educative programs is a necessity to improve the self-regulatory awareness of diabetic complications to be able to combat the associated disease morbidity and mortality (Obirikorang *et al*., 2016). In a study conducted by Al-Mutairi, *et al.,* (2015) to determine the beliefs associated to DM prevention among youths in Saudi Arabia, quite a number of the subjects were unaware of T2DM related risk factors. Female students were unaware of the preventive approaches as compared to their male counterparts. Raising awareness of secondary preventive approaches among the adolescents is thus essential.

2.6 Health Facility Factors affecting Secondary Diabetes Prevention Methods Utilization

The main challenges to increasing the utilization of the secondary preventive measures in an effort preventing the occurrence of the diabetic chronic complications include lack of treatment facilities leading to unavailability of services, inadequate supplies and equipment, distance to facilities as well as the unavailability of skilled practitioners. Health deliver systems play a critical role in health response in solving the growing problems imposed by diabetes and its complications (Selhy *et al*., 2007). This is in synergy with a study by Selby (2010) that revealed that health system factors such as cost containment strategies, access to services, physicians reminders

and effective communication greater influences the processes of secondary diabetic care such as retinal examinations and periodic microalbuminuria testing.

Structured diabetic care management systems that strictly adhere to diabetic management guidelines while advocating for proper DM education are strongly associated with better care processes. Patients receiving services in these facilities experience greater satisfaction and are more likely to go back for follow up and screening services. This implies higher foot and eye rates of examination, frequent checkups for albuminuria, and better glucose control. Thus, it is important for practitioners to provide the best available care to their patients (Selby, 2010). Moreover, health facility incentive pay related factors have been associated with greater patient satisfaction. According to Ettner *et al*., (2006) patients having full coverage for services will be more likely than those without to have an examination done such as retinal examination.

Patient's assessment of the provider's competence and the ability to respect, listen, explain, and spend adequate time with patients also significantly influences the utilization of the diabetic services. Greater trust is created between the provider and the patient if they pose the above attribute. This positively influences the utilization of the secondary preventive approaches. Thus, the practitioner's level of knowledge and experience are significant clinical factors in diabetes chronic complications prevention. According to a study done by Selhy *et al*., (2007), greater trust between physicians and patients lead to increased control of cardiovascular risk factors through blood pressure and cholesterol level screening.

2.7 Social-cultural and Economic Factors affecting Secondary Diabetes Prevention Methods Utilization

Empirical surveys on the utilization of diabetic care and the health care outcomes for DM patients have indicated that a better continuity of care is achieved with the use of diabetic services that leads to earlier diagnosis of DM complications, higher patient's satisfaction and better quality of life (Laws *et al*., 2012). Economic factors influencing the utilization of the secondary preventive measures include the employment status of the individuals, level of education as well as the cost of

services. High cost of the screening services offered in DM management has an adverse effect on health care services utilization including those that may be useful for the prevention of chronic diabetes mellitus complications. This is greatly affected by the employment and income status of the individual that often depends on the individual's level of education.

Gregg *et al*., (2010) conducted a study to access the socio-economic factors that influence the utilization of diabetes mellitus secondary prevention measures. The results revealed that high household incomes and high levels of education greatly influenced type 2 DM care. Higher education levels and income were independently associated to the DM patients being in full control of the associated risk factors. Poor management was evident among the respondents who expressed concerns about affordability and cost as a barrier to medical care access (Selhy *et al*., 2007). In a similar study the rates of dilated eye examinations as part of the secondary preventive measures was lower among the poor and less educated respondents compared with the more educated ones or those who earned over $75,000 annually (Brown *et al*., 2005).

Several health models have been used to study healthcare utilization. These models and theoretical approaches have given different views as to why some patients may or may not utilize healthcare services efficiently. From the social demographic approach, healthcare utilization differs depending on the patient's economic status. The approach looks at variations in healthcare utilization in terms of age, education level, occupation and socio-economic status as the major influences as to why patients seek hospital care. On the other hand, the socio-psychological approach identifies the cultural beliefs, knowledge, values, and attitude towards the benefits of the services offered and their importance as the primary influences to decision making in healthcare-seeking behavior (Stoeckle, *et al.,* 1964).

According to the health belief model postulated by Rosenstock, Stretcher and Becker, an individual's action to treat or prevent disease progression is influenced by the individual's perception and attitude in relation to the illness severity, their perceived susceptibility to the disease, their rational understanding of the costs versus benefits of care and the influencing factors for seeking care (Carpenter, 2010). Diabetes

secondary preventive approaches utilization can be enhanced if the practitioners utilize the models in curbing the factors influencing negatively the utilization of the secondary preventive measures.

2.8 Summary of the Literature Review

The literature reviewed showed that the prevalence of diabetes mellitus was escalating at an alarming rate globally as demonstrated by published reports by International Diabetes Federation (IDF). Effective measures are available to lower the blood glucose levels for diabetic patients thus, delaying the onset of overt diabetes. T2DM is associated with an array of serious health problems. T2DM is a significant risk factor for the development of cardiovascular conditions such as coronary artery disease and stroke. Diabetes is also the leading cause of blindness due to diabetes retinopathy, kidney failure, as well as lower limb amputations. Proper management of Diabetes requires lifestyle modifications as well as adequate knowledge on the condition that are crucial components of management. Patients have different levels of knowledge depending on their level of education, their social class as well as their gender. The main challenges to increasing the utilization of the secondary preventive measures in an effort preventing the occurrence of the diabetic chronic complications include lack of treatment facilities leading to unavailability of services, inadequate supplies and equipment, distance to facilities as well as the unavailability of skilled practitioners. Empirical surveys on the utilization of diabetic care and the health care outcomes for DM patients have indicated that a better continuity of care is achieved with the use of diabetic services that leads to earlier diagnosis of DM complications, higher patient's satisfaction and better quality of life

2.9 Conceptual Framework

The framework indicates various inter-relationships between the study variables. The dependent variable is utilization of the diabetic secondary preventive approaches. The independent variables include the level of knowledge on the secondary preventive approaches, health facility factors and social cultural and economic factors.

Health Facility Factors

- Distance to the hospital
- Waiting time at the hospital
- Availability of drugs
- Staff reception at the hospital
- Health education on the practices
- Availability of supplies and services
- Client satisfaction
- Communication with patients

Level of knowledge on the secondary preventive measures

Practice of Secondary Prevention

Social Cultural and Economic Factors

- ✓ Employment status
- ✓ Level of education
- ✓ Affordability of services
- ✓ Type of insurance cover
- ✓ Cultural factors (beliefs/myths)

Independent Variable   Dependent Variable

Figure 1: Conceptual Framework

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Study Area

The study was conducted at Consolata Hospital Nkubu and Meru Level Five Hospital in Meru County. Meru Level Five Hospital is a public hospital located in MirigaMieru East Division, North Imenti Constituency in Meru County while Consolata Hospital Nkubu is a private hospital located in Kathera Sub-location Nkuene location, Nkuene Division, South Imenti Constituency Meru County. The facilities offer both basic and emergency care including diabetic care services thus suitable for the research study. The diabetic services offered include diabetes screening, diabetes treatment diabetes counseling including methods of preventing diabetes complications such as foot care, cardiovascular screening, nephropathy screening and eye care. The map of Meru County is attached in appendix.

3.2 Research Design

A descriptive correlational study design was employed to assess the practice of secondary preventive approaches used in the prevention of diabetes complications among adult patients with T2DM at Consolata Nkubu Hospital and Meru Level Five Hospital in Meru County. This study design allowed the description of the practice and correlation of the factors and DM secondary prevention practice.

3.3 Population of Study

The study targeted diabetic patients attending diabetic clinic at Consolata Hospital Nkubu and Meru Level Five Hospital in Meru County, Kenya. From the hospital records during the year 2017, patients attending diabetic clinic (new and revisit) totaled 2460 clients at Meru Level Five Hospital and 2140 at Consolata Nkubu Hospital.

3.3.1 Eligibility Criteria
3.3.1.1 Inclusion Criteria

This study included adult patients with the diagnosis of T2DM attending diabetic clinics at Consolata Hospital Nkubu and Meru Level Five Hospital who were willing to participate in the study.

3.3.1.2 Exclusion Criteria

This study excluded patients who were not willing to take part in the study and the patients who were critically ill at the time of study.

3.4 Sampling Procedure

3.4.1 Sample Size Determination

The total populations of the patients with T2DM who attend diabetic clinics in the aforementioned facilities were 4600.

The study sample size was calculated using the fisher *et al* (1998) formula which is

$$n = \frac{Z^2 \times P(1-P)}{(d^2)}$$

Where;

n=Desired sample size.

Z= Standard error of the mean which corresponds to 95% confidence level. (1.96)

P= Prevalence of diabetes. Since prevalence of T2DM both in the rural and urban areas is not available 50% (0.5) is assumed to get the maximum sample size.

d=level of significance which is 0.05 for 95% confidence level.

Therefore by substitution;

$$n = \frac{Z^2 \times P(1-P)}{(d^2)}$$

$$n = \frac{1.96^2 \times 0.5(0.5)}{(0.05^2)}$$

$$n = 384$$

Cochran's Formulae (1963) of population less than 10,000 was used as below:

$$n = \frac{n_0}{[1 + \{\frac{n_0 - 1}{N}\}]}$$

Where,

    n is the sample size when population is $< 10,000$

    n$_0$ is the desired sample size when the population is $<10,000$

    N is the estimate of the population size

$$n = \frac{n_0}{[1 + \{\frac{n_0 - 1}{N}\}]}$$

$$n = \frac{384}{[1 + \{\frac{384-1}{4600}\}]}$$

The formula gives a sample size (n) of 356.19 Thus; the sample size was 357 respondents.

3.4.2 Sample Matrix

Table 1: Sample Matrix

Meru Level 5 Hospital	2460	191
Consolata Nkubu Hospital	2140	166
Totals	4600	357

3.4.3 Sampling Method

Purposive sampling method was used to sample type 2 DM patients in both hospitals. Stratified sampling was then used to get both representation of men and women in the study. Simple random sampling was then used to get the actual respondents as they attended diabetic clinic. A total of 357 patients were sampled.

3.5: Data Collection Tools/Instruments

3.5.1: Interviewer Administered Questionnaires

The questionnaire (Appendix II) was filled by the sampled diabetic clients with the assistance of the trained interviewer. This was to ensure that the participants correctly understood the questions asked. The trained interviewer administered the questionnaires to the patients as they attended their diabetic clinic for a period of two months until the desired sample size was attained. The questionnaire assessed the level of knowledge and practice of secondary preventive measures, health facility, social cultural and economic factors influencing diabetes secondary prevention.

3.5.2 Focus Group Discussion Guide

Focus group discussion was conducted to collect qualitative data. The researcher conducted two focus group discussions. One group consisted of 6 members and the other had 8 members who were diabetic patients. The researcher had a pretested focus group questionnaire guide which was used in the discussion. The trained research assistant guided and controlled the discussion and ensured that the discussion was

confined to the study objectives. Note taker forms were used to record the qualitative data. The data was later organized into themes in preparation for analysis,

3.6 Pretesting of Instrument

The instrument used for data collection was pretested using 38 diabetic patients that represented 10% of the sample size prior to actual data collection in Tharaka Nithi County, Presbyterian Church of East Africa (P.C.E.A) Mission Hospital Chogoria. After pre-testing the relevant corrections and modifications were made. This made the tool focus on the study objectives only.

3.6.1 Validity and Reliability

Validity was ensured by expert review of the instruments (questionnaires) before commencement of the study for content validity. Peer proof reading and constant consultation with the supervisors ensured face and content validity. The researcher ensured that all the questions in the instrument were clear, properly grouped and easy to understand. Training of research assistants was done to ensure a proper understanding of the operational definitions of the study and uniformity in the questioning skills. To avoid more than one interview being done on the respondents during subsequent visits, interviewed respondents were assigned codes which were marked against their names in the clinic records after the interview.

In ensuring reliability a pretest was done before the actual study using 10% of the sample size. This was important in checking out the data collection tools by finding out if sufficient questions were included that addressed the research study objectives adequately and whether the meaning of the questions asked were similar to all the respondents. After which relevant adjustments were made. Adequate supervision throughout the data collection process was also ensured. The test re-test technique was used to estimate the reliability of the instruments. This involved administering the same test twice to the same group of respondents. A reliability coefficient of 0.78wasobtained and was considered acceptable.

3.7 Data Analysis

Quantitative and qualitative data was generated. Quantitative data was cleaned, coded and entered into SPSS version 25 for analysis at a significance $p \leq 0.05$. Frequencies and percentages were used to describe the quantitative data. Chi squares was used to test the relationship between dependent and independent variables at 95% significance level. Variables with statistical significance were then subjected to logistic regression to check for the degree of association. For qualitative analysis, data was categorized into emerging themes and analyzed using N-Vivo Version 11. The study results were presented inform of bar graphs, narrations, tables, and pie charts.

3.8 Ethical Considerations

The permission of conducting the research study was sought from National Commission for Science, Technology and Innovation (NACOSTI) through the Chuka University Ethics and Research Committee for review and approval. Permission was also sought from Consolata Hospital Nkubu and Meru Level Five Hospital before commencement of data collection. The main ethical issues that were addressed during the research process included ensuring privacy and confidentiality in the data collection period. In maintaining confidentiality, the study participants information provided was not divulged to any other person unless when authorized by the participants when necessary. Informed consent was also sought from the participants as they were informed to fill an informed consent form as a prove of their acceptance as well as their availability to take part in the research study. After consent was obtained, the researcher urged the participants to feel free and express their discontent anytime they feel like as well as withdraw from the study when they wished to do so. The names of participants were kept anonymous by writing their unique codes on the questionnaire instead of their names in maintaining anonymity.

CHAPTER FOUR
RESULTS PRESENTATION
4.1 Demographic Characteristics of the Respondents

The demographic characteristics were divided into two categories; non-illness related and illness related. Table 2 presents non-illness related characteristics while table 3 presents illness related characteristics.

Table 2 : Non-illness Related Demographic Characteristics of the Respondents

Characteristic	Frequency (n)	Percentage (%)
Facility		
• Meru Level 5 Hospital	189	53.4
• Consolata Nkubu Hospital	165	46.6
Total	354	100
Age in years		
• Below 40	6	1.7
• 40-50	104	29.4
• 51-60	105	29.7
• 61-70	72	20.3
• 71-80	55	15.5
• Above 80	12	3.4
Total	354	100
Gender		
• Male	178	50.3
• Female	176	49.7
Total	354	100
Level of Education		
• No formal education	66	18.6
• Primary	68	19.2
• Secondary	112	31.6
• College	108	30.5
Total	354	100
Occupation		
• Employed	92	26
• Self-employed	146	41.2
• Not employed	116	32.8
Total	354	100
Marital status		
• Single	17	4.8
• Married	197	55.6
• Separated	42	11.9
• Divorced	19	5.4
• Widowed	79	22.3
Total	354	100
Occupation of spouse		
• Employed	75	21.2

• Self-employed	85	24
• Not employed	36	10.2
• Not applicable	158	44.6
Total	354	100
Spouse education level		
• No formal education	6	1.7
• Primary	46	13
• Secondary	70	19.8
• College	74	20.9
• Not applicable	158	44.6
Total	354	100

Table 2 shows that 189 (53.4%) were seeking treatment at Meru hospital while 165 (46.6%) were being treated at Consolata Nkubu Hospital. Six respondents i.e. 6 (1.7%) were aged below 40, 104 (29.4%) were aged 40-50, 105 (29.7%) were aged 51-60, 72 (20.3%) were aged between 61-70 years, 55 (15.5%) were aged 71-80 and 12 (3.4%) were aged above 80 years.

Most respondents i.e. 178 (50.3%) were males while 176 (49.7%) were females. Sixty six respondents (18.6%) had no formal education, 68 (19.2%) had primary level of education, 112 (31.6%) had secondary education level and 108 (30.5%) had college level of education. Ninety two respondents i.e. 26% were employed, 146 (41.2%) were self-employed, and 116 (32.8%) were not employed. Concerning marital statuses, 17 (4.8%) were single, 197 (55.6%) were married, 42 (11.9%) were separated, 19(5.4%) were divorced and 79 (22.3%) were widowed.

Concerning the spouses' occupations, 75 (21.2%) were employed, 85 (24%) were self-employed, and 36 (10.2%) were not employed. In terms of education, 6 (1.7%) had no formal education, 46 (13%) had primary level, 70 (19.8%) had secondary education and 74 (20.9%) had college level of education.

Table 3: Illness related demographic characteristics of the respondents

Characteristic	Frequency (n)	Percentage (%)
Duration of illness		
➢ Less than 5 years	117	33.1
➢ 5-10 years	125	35.3
➢ More than 10 years	112	31.6
Total	354	100
Co-morbidities		
➢ Hypertension	283	79.9
➢ Asthma	8	2.3
➢ Heart failure	4	1.1
➢ None	59	16.7
Total	354	100
BMI(Kg/M$^{2)}$)		
➢ 18-24	164	46.3
➢ 25-29	166	46.9
➢ 30 and above	24	6.8
Total	354	100
Last BP measurement (mmHg)		
➢ 100/60-130/80	74	20.9
➢ 131/81-140/90	62	17.5
➢ Over 140/90	218	61.6
Total	354	100
Last blood sugar measurement (mmol/L)		
➢ 7.8 and below	23	6.5
➢ Above 7.8	331	93.5
Total	354	100
Evidence of DM complication		
➢ Leg ulcer	73	20.6
➢ Nerve problem	1	0.3
➢ Renal disease	2	0.6
➢ Eye disease	6	1.7
➢ Cardiovascular disease	209	59
➢ Arthritis	1	0.3
➢ None	62	17.5
Total	354	100
Harmful social habits		
➢ Cigarette smoking	51	14.4
➢ Harmful alcohol use	11	3.1
➢ Both smoking and alcohol use	11	3.1
➢ None	281	79.4
Total	354	100

Table 3 shows that 117 (33.1%) had been sick for less than 5 years, 125 (35.3%) had been sick for 5-10 years and 112 (31.6%) had been sick for more than 10 years. Concerning diabetes co-morbidities, 283 (79.9%) had hypertension, 8 (2.3%) had asthma, 4 (1.1%) had heart failure and 59 (16.7%) had no co-morbidities. The body

mass indices ranged from 18 to greater than 30 whereby, 164 (46.3%) had BMI of 18-24, 166 (46.9%) had BMI of 25-29 while 24 (6.8%) had BMI of over 30kg/m^2.

Concerning the last blood pressure measurements, 74 (20.9%) had a BP of between 100/60-130/80mm/Hg, 62 (17.5%) had BP of between 131/81-140/90 mm/Hg and 218 (61.6%) had BP of over 140/90mm/Hg. Most respondents i.e. 330 (93.2%) had the last blood glucose levels above 7.8 mmol/L while 23 (6.5%) had 7.8 mmol/L and below.

After assessing the respondents for any evidence of DM complications, 73 (20.6%) were found to have leg ulcers, 1(0.3%) had nerve problems, 2 (0.6%) had renal disease, 6 (1.7%) had eye disease, 209 (59%) had cardiovascular disease, 1 (0.3%) had arthritis and 62 (17.5%) did not have evidence of any complication. With regard to harmful social habits, 51 (14.4%) were cigarette smokers, 11(3.1%) were using alcohol, 11 (3.1%) were using both cigarettes and alcohol while majority i.e. 281 (79.4%) did not engage in any harmful social habits.

4.2 Relationship between demographic characteristics of the respondents and practice of secondary preventive measures
4.2.1.   Age and practice of secondary preventive measures

From the research findings, it was evident that age of the respondent was significantly affecting the practice of secondary preventive measures. The respondents between the ages of 40-50 years old were found to have good practice compared to those the aged 60 years and above. There was a strong association between age of the respondent and practice of secondary preventive measures with Cramer's V of 0.341. Table 4 shows a summary of the results.

Table 4: Relationship between age of the respondent and practice of secondary preventive measures

Variable	Years	Level of practice of secondary preventive measures		
Age of the respondent		Good	Poor	Total
	<40	5	1	6
	40-50	63	41	104
	51-60	57	48	105
	61-70	24	48	72
	71-80	10	45	55
	>80	2	10	12
Total		161	193	354

$$\chi^2 (5, N=354) = 41.142, p \leq 0.000$$

4.2.2. Marital status and practice of secondary preventive measures

It was evident from the results that significantly associated with practice of secondary preventive measures. Those who were married were found to have good practice of secondary preventive measures compared to those having other marital status as shown in Table 5.

Table 5: Marital status and practice of secondary preventive measures

Variable	Years	Level of practice of secondary preventive measures		
		Good	Poor	Total
	Single	10	7	17
Marital status of the respondent	Married	104	93	197
	Separated	20	22	42
	Divorced	12	7	19
	Widowed	15	64	79
Total		161	193	354

$$\chi^2 (4, N=354) = 30.302, p \leq 0.000$$

4.2.3. Level of education and practice of secondary preventive measures

The respondents had different levels of education in this study. On analysis, it was found that their level of education influenced their practice of secondary preventive measures. The respondents who had secondary level of education and higher were found to have good practice of secondary preventive measures compared to those who had informal level of education. Therefore, level of education was significantly affecting practice of secondary preventive measures as shown in table 6.

Table 6 Level of education and practice of secondary preventive measures

Variable	Years	Level of practice of secondary preventive measures		
		Good	Poor	Total
Level of education of the respondent	No formal education	9	57	66
	Primary	15	53	68
	Secondary	61	51	112
	College	76	32	108
Total		161	193	354

$$\chi^2 (4, N=354) = 74.680, p\leq 0.000$$

4.3 Knowledge and practice of diabetes secondary prevention

Practice was assessed through a set of practice questions that touched on what respondents were using to manage their current conditions, whether they were doing foot examination and the frequency, whether they ever went for eye screening, urine check, lipid profile and blood pressure monitoring.

4.3.1 How respondents were using to manage their current conditions

The researcher found out that patients used varied practices to manage their conditions. The practices included; insulin injections, diet control, use of oral diabetic drugs and a combination of oral diabetic drugs with diet control.
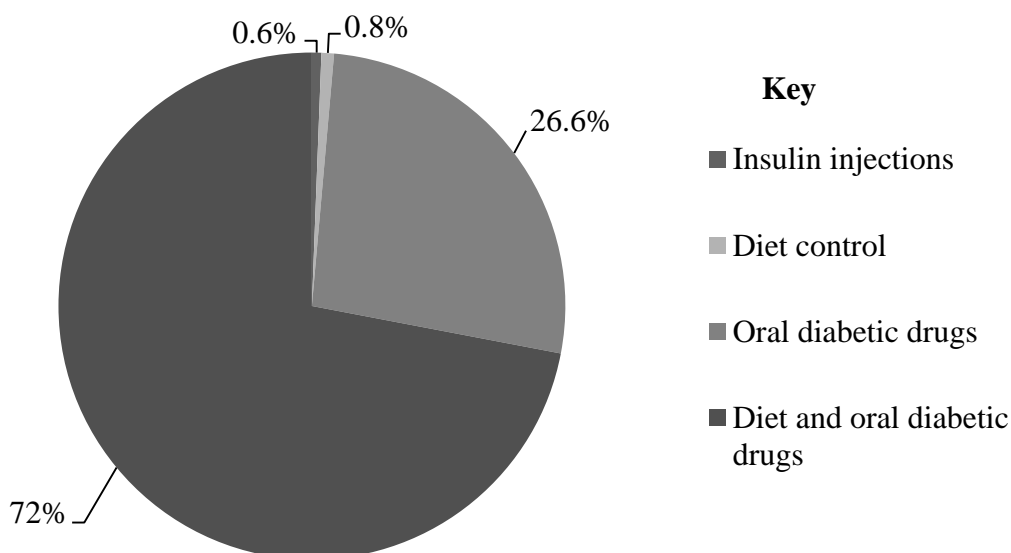
Figure 2: How respondents were managing their conditions

Figure 2 shows that 2(0.6%) were using insulin injections, 3 (0.8%) were using diet control, 94(26.6%) were using oral diabetic drugs while 255 (72%) were using both diet and oral diabetic drugs. The other practices were collapsed into two i.e. correct practices and incorrect practice based on what the respondents reported.

4.3.2 Secondary preventive measures practiced among patients

The patients reported to practice varied secondary preventive measures as shown in table 7

Table 7: Diabetic secondary preventive practices of the respondents

Practice item	Correct practice (%)
Foot examination every visit	70.6%
Eye screening annually	56.5%
Urine check-up annually for albumin	26%
Body cholesterol level check-up	18.9%
Blood pressure monitoring	69.5%

Table 7 shows that 70.6% (n=250) of the respondents did foot examination during every visit to the clinic, 56.5% (n=200) had their eyes examined annually, 26% (n=92) had urine checks annually, 18.9% (n=67) had body cholesterol level check-up regularly and 69.5% (n=246) had regular blood pressure monitoring. The mean score was 48.3% and SD was 30.1

4.3.3 Level of practice of secondary preventive measures

The level of practice was determined by the number of practice items that respondents adhered to. Those respondents who adhered to at least three items were considered to have good secondary prevention practice while those who adhered to less than three were considered to have poor secondary prevention practice.
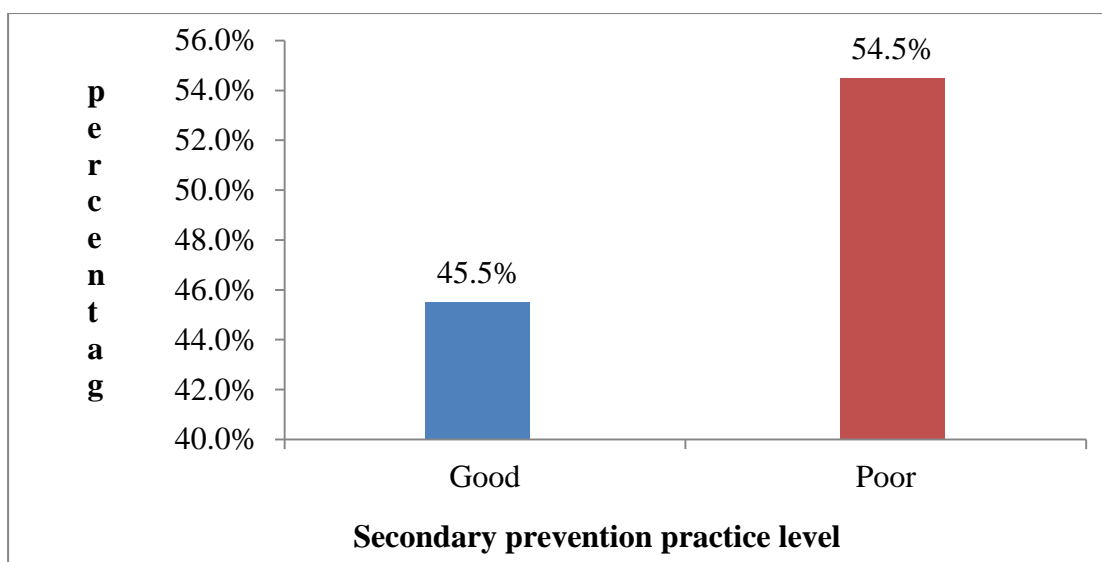
Figure 3: Practice level of secondary preventive measures for Diabetic complication

Figure 3 shows that 45.5% (161) had good secondary prevention practice while 54.5% (193) had poor secondary prevention practice. The level of practice was the dependent variable in this study and all independent variables were cross-tabulated against it to check for any statistical significance.

4.3.4 Knowledge on secondary prevention practice among respondents

Knowledge was assessed through a set of six knowledge items, and based on the responses given; they were categorized as either "correct response" or "incorrect response".

Table 8: Knowledge on secondary prevention practice of diabetes complications

Knowledge item	Correct response (%)
What is your understanding of self-care secondary prevention practices?	2.3%
Which complications are associated with diabetes?	97.2%
How frequent should you go for eye check-up?	45.8%
How frequent should you go for urine check-up?	33.1%
Why do you think it is necessary to have regular blood pressure check-up?	53.7%
Do you think diabetic patients should have their cholesterol levels checked?	54.8%
Mean score	47.8%
Standard deviation	26.4

Table 8 shows that only 2.3% (n=8) understood what secondary prevention practices were all about. Most of them were talking about living positively with DM and general management of diabetes rather than secondary prevention. Majority of the respondents i.e. 97.2% (n=344) knew the complications of DM, 45.8% (n=162) knew how frequent eye check-ups should be done, 33.1% (n=117) knew how frequent urine check-ups should be done, 53.7% (n=190) knew the importance of regular blood pressure check-ups and 54.8% (n=194) knew that cholesterol levels should be checked regularly. The mean score was 47.8% and standard deviation was 26.4

4.3.5 General level of knowledge on secondary preventive measures

Knowledge level was determined based on the number of items respondents answered correctly, whereby, those who answered at least 4 items correctly were considered as having good knowledge while those who answered 3 items and below correctly were considered as having poor knowledge.
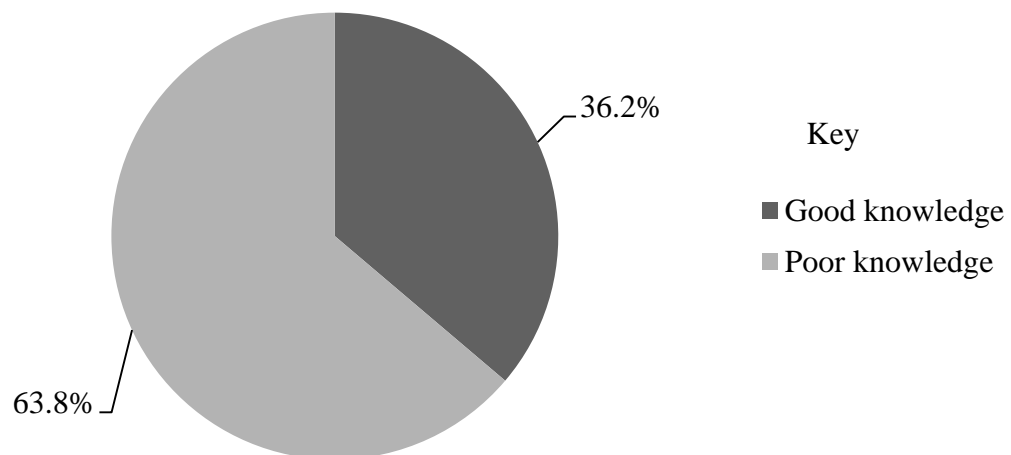
Figure 4: Knowledge levels of respondents on secondary prevention practices

Figure 4 show that 36.2% (n=128) had good knowledge of secondary preventive practices while 63.8% (n=226) had poor knowledge. It is evident that majority of the respondents knew what diabetes is, and its complications. However, less than half of the respondents had the knowledge on secondary preventive measures for diabetic complications. This squarely affected the level of practice of the secondary preventive measures for diabetic mellitus type 2 complications.

4.3.6 Influence of knowledge on diabetic secondary prevention practice

Knowledge level was cross-tabulated against the practice levels and chi squared tests performed.

Table 9: Association between knowledge and secondary prevention practice

| | | Good vs poor knowledge | | Total |
		Good knowledge	Poor knowledge	
DM complications secondary prevention practice	Good	94	67	161
	Poor	34	159	193
Total		128	226	354

χ^2 (1, N=354) = 63.2, p=0.000

Table 9 shows that knowledge significantly influenced the practice level for DM secondary prevention (χ^2 (1, N=354) =63.20, p=<0.001, OR=6.56) whereby, those with good knowledge were 6.561 times more likely to practice secondary prevention. Therefore, the level of knowledge had statistical significance on practice of the secondary prevention among patients with type 2 diabetes mellitus at Consolata Nkubu and Meru Level Five Hospital in Meru County.

Hypothesis H_0: There is no statistical significance on the level of knowledge and practice of the secondary prevention among patients with type 2 diabetes mellitus at Consolata Nkubu and Meru Level Five Hospital in Meru County was therefore rejected.

4.4 Health Facility Factors Affecting Diabetes Secondary Prevention

The health facility factors under investigation included distance to the facilities, waiting time, availability of drugs, staff reception, health education and counseling after service delivery, caregiver communication skills, availability of services, availability of equipment and supplies, satisfaction with care, and confidence with care giver.

4.4.1 Distance to the facility and practice of secondary diabetes prevention

Most respondents i.e. 44.6% (n=158) were travelling for more than 5km to access the health facilities, 37.9% (n=134) travelled for 2-5km and 17.5% (n=62) travelled for less than 1km. Distance was collapsed into two categories namely ≤5km and >5km and cross-tabulated against practice.

Table 10 shows that distance to the clinic/facility significantly influenced secondary diabetes prevention (χ^2 (1, N=354) =6.483, p=0.011, OR=1.74) whereby, those who travelled for 5km and below were 1.74 times more likely to practice DM secondary prevention.

Table 10: Association between distance to hospital and practice secondary DM prevention measures

		What is the distance to the clinic/facility?		Total
		5km and below	Over 5km	
DM complications secondary prevention practice	Good	101	60	161
	Poor	95	98	193
Total		196	158	354

χ^2 (1, N=354) = 6.483, p=0.011

In this study it was evident that the distance the patient travelled and means of transport were determining the actual practice or screening for the risks for diabetic complications.

4.4.2 Waiting time and practice of diabetes secondary prevention

Most of the respondents i.e. 59.9% (n=212) spent less than or equal to six hours from arrival at the facility to the time they departed, while 40.1% (n=142) spend more than 6 hours.

Table 11 shows that waiting times did not significantly influence DM secondary prevention practice (χ^2 (1, N=354) =3.49, p=0.062).

Table 11: Association between waiting time at the hospital and practice of secondary preventive measures for complications of DM

		How much time do you spend in the clinic from arrival to departure when seeking the services?		Total
		≤6hours	>6 hours	
DM complications secondary prevention practice	Good	105	56	161
	Poor	107	86	193
Total		212	142	354

χ^2 (1, N=354) = 3.493, p=0.062

4.4.3 Availability of drugs and practice of diabetes secondary prevention

Twenty seven point seven percent of the respondents (n=98) reported that they have ever lacked drugs at the hospital while 72.3% (n=256) reported to had never lacked drugs.

Table 12 shows that availability of drugs significantly influenced diabetes secondary prevention (χ^2 (1, N=354) =15.626, p=<0.001, OR=0.370) whereby, those who had ever lacked drugs at the facilities were less likely to practice DM secondary prevention.

Table 12: Association between availability of drugs for DM at the hospital and practice of secondary preventive measures for DM complications

		Have you ever lacked drugs at the hospital?		Total
		Yes	No	
DM complications secondary prevention practice	Good	28	133	161
	Poor	70	123	193
Total		98	256	354

χ^2 (1, N=354) = 15.626, p=0.000

4.4.4 Staff reception and practice of diabetes secondary prevention

Majority of the respondents i.e. 82.2% (n=291) reported that the hospital staffs were friendly to them while 17.8% (n=63) reported that the staffs were not friendly. Table 13 shows that staff reception for patients significantly influenced DM secondary prevention (χ^2 (1, N=354) =10.574, p=0.001, OR=2.65) whereby, those who felt that the staffs were friendly were 2.6 times more likely to practice secondary prevention.

Table 13: Association between staff reception and practice of secondary preventive measures for DM complications

| | | Are the hospital staffs friendly to you? | | Total |
		Yes	No	
DM complications secondary prevention practice	Good	144	17	161
	Poor	147	46	193
Total		291	63	354

$$\chi^2 \text{ (1, N=354) = 10.574, p=0.001}$$

4.4.5 Health education and diabetes secondary prevention

Most respondents i.e. 79.4% (n=281) reported that health care providers gave health education and counseling after service delivery, while 20.6% (n=73) said that health education and counseling was not provided.

Table 14 shows that provision of health education and counseling after service delivery significantly influenced DM secondary prevention (χ^2 (1, N=354) =34.30, p=<0.001, OR=6.45) whereby, those who reported that health education and counseling was offered were 6.4 times more likely to practice diabetes secondary prevention.

Table 14: Association between health education and practice of secondary preventive measures for DM complications

| | | Do health care providers give health education and counseling after service delivery? | | Total |
		Yes	No	
DM complications secondary prevention practice	Good	150	11	161
	Poor	131	62	193
Total		281	73	354

$$\chi^2 \text{ (1, N=354) = 34.302, p=0.000}$$

49

4.4.6 Care giver communication skills and DM secondary prevention

Most respondents, i.e.55.1% (n=195) rated caregiver communication skills as fair to poor while 44.9% (n=159) rated them as good to excellent.

Table 15 shows that the rating of care giver communication skills significantly influenced DM secondary prevention (χ^2 (1, N=454) =4.32, p=0.038, OR=1.56) whereby, those who rated the communication as either good or excellent were 1.6 times more likely to practice secondary prevention.

Table 15: Association between care giver communication and practice of secondary preventive measures for DM complications

		How do you rate health worker communication skills?		Total
		Good-excellent	Fair-poor	
DM complications secondary prevention practice	Good	82	79	161
	Poor	77	116	193
Total		159	195	354

χ^2 (1, N=354) = 4.320, p=0.038

4.4.7 Availability of diabetic services and secondary prevention

Majority of the respondents i.e. 91% (n=322) reported that diabetic services were always available when needed while 9% (n=32) reported that services were not always available when needed. Table 16 shows that availability of DM services significantly influenced secondary prevention practice (χ^2 (1, N=354) =10.14, p=0.001, OR=4.02) whereby, those who reported that the services were always available were 4 times more likely to practice secondary prevention.

Table 16: Association between availability of services and practice of secondary preventive measures for DM complications

		Are diabetic services always available when needed?		Total
		Yes	No	
DM complications secondary prevention practice	Good	155	6	161
	Poor	167	26	193
Total		322	32	354

χ^2 (1, N=354) = 10.137, p=0.001

4.4.8 Availability of supplies and diabetes secondary prevention

Most respondents i.e. 76.8% (n=272) reported that supplies and equipment for diabetes care were always available while 23.2% (n=82) reported that they were not always available.

Table 17 shows that availability of supplies and equipment for DM care significantly influenced secondary prevention (χ^2 (1, N=354) =29.02, p=<0.000, OR=4.71) whereby, those who reported that equipment and supplies for DM care were always available, were 4.7 times more likely to practice secondary prevention.

Table 17: Association between availability of supplies and practice of secondary preventive measures for DM complications

		Are supplies and equipment for diabetes care always available?		Total
		Yes	No	
DM complications secondary prevention practice	Good	145	16	161
	Poor	127	66	193
Total		272	82	354

χ^2 (1, N=354) = 29.023, p=0.000

4.4.9 Client satisfaction and DM secondary prevention

Majority i.e. 82.2% (n=291) agreed that the services provided were satisfactory while 17.8% (n=63) did not.

Table 18 shows that satisfaction with service delivery significantly influenced DM secondary prevention (χ^2 (1, N=354) =16.72, p=<0.000, OR=3.57) whereby, those who reported satisfaction with services were 3.6 times more likely to practice secondary prevention.

Table 18: Association between client satisfaction and practice of secondary preventive measures for DM complications

| | | Are the services provided satisfactory? | | Total |
		Yes	No	
DM complications secondary prevention practice	Good	147	14	161
	Poor	144	49	193
Total		291	63	354

χ^2 (1, N=354) = 16.719, p=0.000

4.4.10 Confidence with care giver and DM secondary prevention

Most respondent's, 87.3% (n=309) felt confident under the care of the health providers while 12.7% (n=45) did not.

Table 19 shows that confidence with health workers significantly influenced DM secondary prevention practice (χ^2 (1, N=354) =5.723, p=0.017, OR=2.26) whereby, those who felt confident under the care of health workers were 2.3 times more likely to practice secondary prevention

Table 19: Association between confidence with the care giver and practice of secondary preventive measures for DM complications

| | | Do you feel confident under the care of health providers? | | Total |
		Yes	No	
DM complications secondary prevention practice	Good	148	13	161
	Poor	161	32	193
Total		309	45	354

χ^2 (1, N=354) = 5.723, p=0.017

Most respondents 77.7% (n=275) would recommend another person for the services while 22.3% (n=79) would not. The main reasons why clients would not recommend others for the services were summarized in themes as follows:

a. Time management

The waiting time was too long and some respondents had to wait for the whole day to be served. Delay was witnessed at the waiting bay as clients waited to be seen by the

doctor and they ended up going home late and hungry. This delay was also witnessed at the pharmacy department where patients had to queue for long waiting for drugs. Even the patients who reported to the facilities early in the morning ended up going home late. Elderly patients expected to be given first priority but this was not forthcoming. Despite patients arriving at 8am in the morning, service delivery started at 11.00am because health workers arrived on duty late.

b. Staff attitude

Staffs were somewhat hostile to the clients especially when clients insisted on knowing anything, or when they forgot what they had been taught. Staffs were rude and some told the respondents "*you are wasting our time*". The teachings were shallow and the service delivery was done hurriedly. Doctors for instance, did not take time to explain to patients on how to take the drugs or the kinds of foods to eat. Someone narrated,

"*I am happy with what the doctors tell us to do. However, it would be better if they could write down for us the specific foods we need to eat so that our children and grandchildren can prepare them for us.*"

(Respondent 2 from Nkubu Hospital)

The results in this study revealed that majority of health related factors had statistically significant effects on practice of secondary prevention practices among T2DM patients. Therefore, the hypothesis H_0: Health facility factors do not statistically influence the practice of secondary diabetes prevention among the patients with type 2 diabetes mellitus at Consolata Nkubu and Meru Level Five Hospital in Meru County was rejected.

4.5 Economic and Social Cultural Factors Influencing DM Secondary Prevention

The economic and socio-cultural factors under investigation included level of income, affordability of services, health insurance cover, and monthly cost of DM management, traditional beliefs and myths in the society.

4.5.1 Level of income and DM secondary prevention

The level of income was categorized into three categories; this was done after collecting data in which the patients had reported specific monthly income. The respondents had indicated the lowest level of income to be Kshs. 3000 and the highest had an income of Kshs. 42, 000. This was categorized for easy analysis.
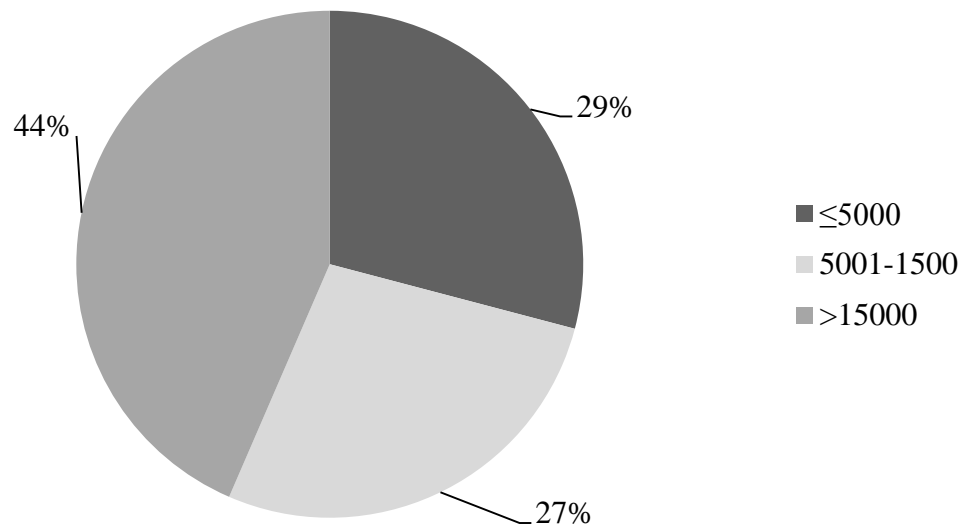
Figure 5: Income levels of respondents

Figure 5 shows that 43.5% (n=154) earned above 15000, 27.4% (n=97) earned between 5001-15000 shillings while 29.1% (n=103) earned less than 5000 Kenya shillings per month.

The researcher further categorized the income as above Kshs 15, 000 and below Kshs. 15, 000. This was used to carry out binary regression analysis between level of income and practice of secondary preventive measures. The results are shown in table 17.

Table 20 shows that the level of monthly income significantly affected DM secondary prevention (χ^2 (1, N=354) =66.79, p=<0.001, OR=0.154) whereby, those earning 15000 or less were less likely to practice secondary prevention.

Table 20: Association between monthly income and practice of secondary preventive measures for DM complications

		What is your level of monthly income?		Total
		15000 and below	Above 15000	
DM complications secondary prevention practice	Good	53	108	161
	Poor	147	46	193
Total		200	154	354

χ^2 (1, N=354) = 66.794, p=0.000

4.5.2 Affordability of services and DM secondary prevention

Majority i.e. 77.1% (n=273) reported that DM services were affordable while 22.9% (n=81) reported that they were not.

Table 21 shows that affordability of services significantly influenced DM secondary prevention practice (χ^2 (1, N=354) =61.40, p=<0.001, OR=16.419 whereby, those who reported that services were affordable were 16 times more likely to practice secondary prevention.

Table 21: Association between affordability of services and practice of secondary preventive measures for DM complications

		Are the services affordable?		Total
		Yes	No	
DM complications secondary prevention practice	Good	155	6	161
	Poor	118	75	193
Total		273	81	354

χ^2 (1, N=354) = 61.402, p=0.000

4.5.3 Health insurance cover and DM secondary prevention

Some health insurance covers were catering for all the expenses for diabetic management while others were not. This made the researcher to identify and establish the health insurance cover each respondent had. The results are tabulated in figure 6
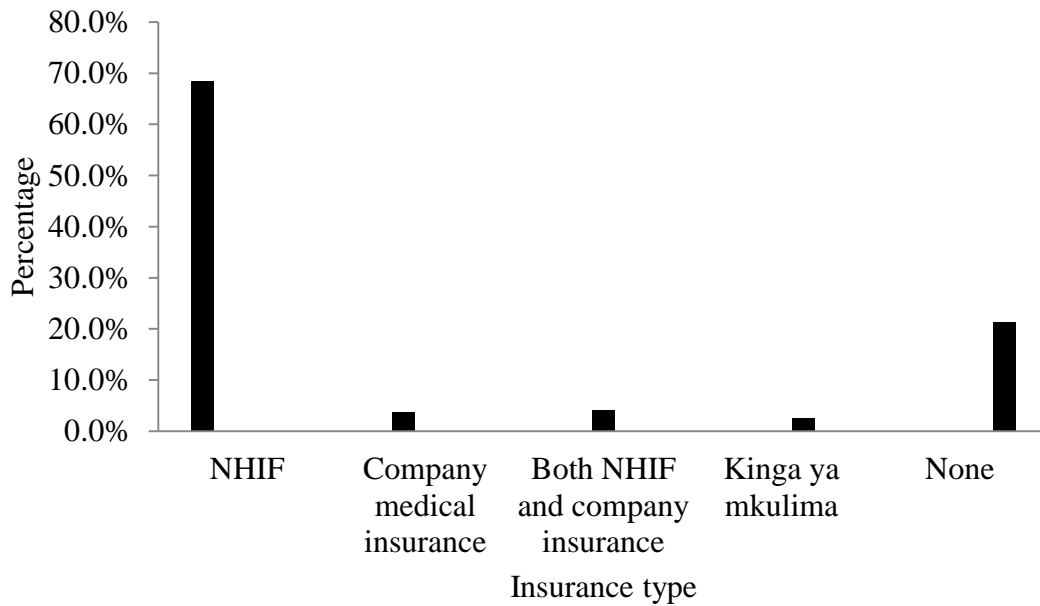
Figure 6: Types of insurance covers for the respondents

Figure 6 shows that majority of the respondents i.e. 68.4% (n=242) were members of NHIF, 3.7% (n=13) had company insurance cover, 4.2% (n=15) had both NHIF and company insurance, 2.5% (n=9) had Kinga ya mkulima while 21.2% (n=75) had no health insurance cover at all.

However it emerged from the results that some patients had health insurance covers regardless of which while others never had the health insurance cover. The researcher computed a Chi-squaire between having or not having a health insurance cover and practice of secondary preventive measures in diabetic management. The results are shown in Table 19.

Table 22 shows that availability of health insurance cover influenced practice of DM secondary prevention (χ^2 (1, N=354) =46.51, p=<0.001, OR=10.17) whereby, those who had some form of health insurance cover were 10 more times likely to practice secondary prevention.

Table 22: Association between health insurance cover for the respondent and practice
of secondary preventive measures for DM complications

| | | Do you have any health insurance cover? | | Total |
		Yes	No	
DM complications secondary prevention practice	Good	153	8	161
	Poor	126	67	193
Total		279	75	354

χ^2 (1, N=354) = 46.514, p=0.000

4.5.4 Monthly cost of DM management and secondary prevention

Figure 7 shows that 68.6% (n=243) spent less 5000 shillings in DM management,
29.4% (n=104) spent 15000 and below while 2% (n=7) spent over 15000 shillings.
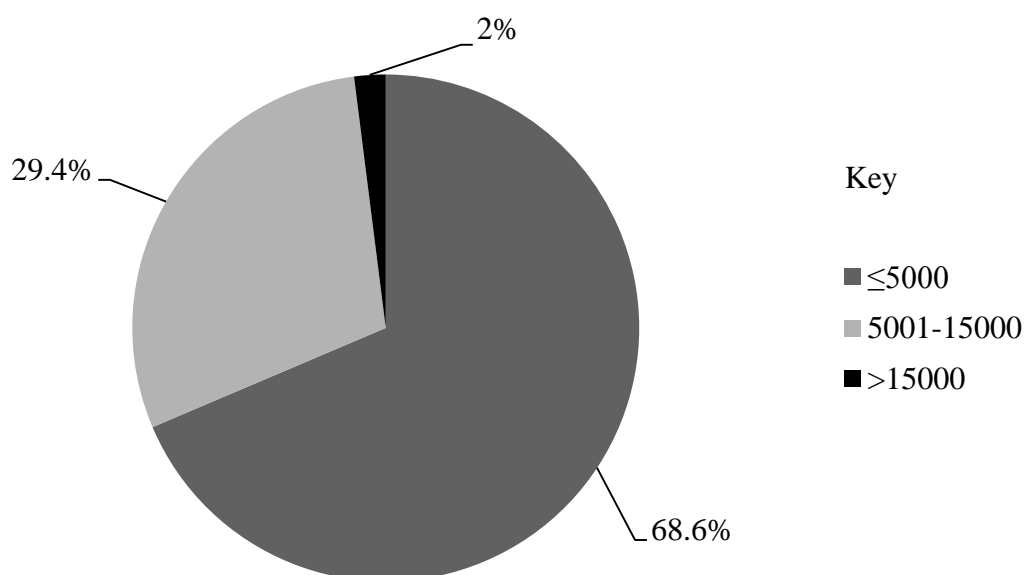
Figure 7: Estimated monthly DM costs for respondents

Table 23 shows that the estimated cost of DM management significantly influenced
secondary prevention (χ^2 (1, N=354) =35.78, p=<0.001, OR=0.242) whereby, those
who estimated the monthly costs to be 5000 or less were less likely to practice
secondary prevention.

Table 23: Association between estimated DM management costs and practice of secondary preventive measures for DM complications

| | | What is your estimated general cost of diabetes management per month? | | Total |
		5000 and below	Above 5000	
DM complications secondary prevention practice	Good	84	77	161
	Poor	158	35	193
Total		242	112	354

χ^2 (1, N=354) = 35.778, p=0.000

4.5.5 Cultural and traditional beliefs/myths and DM secondary prevention

Few respondents i.e. 27.1% (n=96) reported that there were cultural and traditional beliefs that could potentially hinder utilization of diabetes services, while 72.9% (n=258) reported that such beliefs did not exist. The main traditional beliefs/myths were summarized as follows:

a. Diabetes etiology and management

Some respondents 10.2% (n=36) believed that diabetes was associated with curses and witchcraft and that one with DM ulcer was bewitched. As such, remedies such as prayers, witchcraft, traditional healers and herbal medicine could cure DM. When one had hyperglycemia, bitter herbs were very effective in lowering the blood sugars. DM patients should not eat sugary things because sugar levels would go high and easily accessible foods e.g. potatoes and cassava were restricted. There was no need of attempting to spend money to manage a life-long disease whose management was too expensive. People did not die as a result of DM but rather from the harmful effects of the drugs they took. DM drugs made people grow fat and others ended up becoming obese. Women of childbearing age for instance should not take drugs, because these drugs ended up affecting their unborn children. During blood glucose monitoring, the pricking of fingers led to loss of too much blood and patients could die of anemia. Others believed that DM drugs should be taken for a short time because the disease was curable.

b. Diabetes epidemiology

Diabetes is preserved only for fat people, the elderly and the rich; this was suggested by majority of the respondents 5.1% (n=18). It affects more males than females; this was reported by 2.8% (n=10). Therefore, the young and the slim could rest assured that whatever they might be suffering from could not in any way be diabetes.

c. The rights of women

Women couldn't go anywhere unless accompanied by their husbands. Men had a big say in the family and major decisions especially those touching on the health of women came from men; this was indicated by 9% (n=32). If the man was not in a position to accompany the wife to clinic, the wife would rather wait until it was convenient for the husband.

Table 24 shows that cultural and traditional beliefs/myths significantly influenced DM secondary prevention practice (χ^2 (1, N=354) =14.14, p=<0.001, OR=0.387) whereby, those who reported the existence of traditional beliefs were less likely to practice secondary prevention.

Table 24: Association between traditional beliefs/myths and secondary prevention measures for DM complications

| | | Are there cultural and traditional beliefs that hinder utilization of diabetic services? | | Total |
		Yes	No	
DM complications secondary prevention practice	Good	28	133	161
	Poor	68	125	193
Total		96	258	354

χ^2 (1, N=354) = 14.138, p=0.000

The results from the research show that various social, economic and traditional beliefs had a statistically significant association with the practice of secondary preventive practices among T2DM patients. Therefore, H_0: Social cultural and economic factors do not statistically influence the practice of secondary diabetes

prevention among the patients with type 2 diabetes mellitus at Consolata Nkubu and Meru Level Five Hospital in Meru County was rejected.

Regression analysis was performed using forward stepwise method whereby all the independent variables with p values of <0.05 from bivariate analysis (chi square) were included in the regression analysis as covariates.

Knowledge was the strongest predictor which accounted for 35.6% change in secondary practice, monthly income contributed to 10.3%, health education contributed 3.6% and affordability of services contributed 1.2%. Collectively, these four variables contributed to 50.7% of the overall change in the dependent variable and this change was statistically significant (p=<0.001). The null hypothesis that there were no statistically significant factors affecting DM secondary prevention practice was therefore rejected.

CHAPTER FIVE
DISCUSSION
5.1 Association between Social Demographic Factors and Practice of Secondary Preventive Measures for Diabetic Complications

From the research findings, it was evident that age of the respondent was significantly affecting the practice of secondary preventive measures. The respondents between the ages of 40-50 years old were found to have good practice compared to those the aged 60 years and above. Majority of the respondents were aged between 40-60 years and male gender constituted of the majority of the respondents. According to a study conducted by Al Sarihin, *et al*., (2012) to assess the level of knowledge on DM among the diabetic patients, men had a higher score on knowledge as compared to the female gender but there was a knowledge deficit about the disease limiting the patient's involvement in disease management.

Those who were married were found to have good practice of secondary preventive measures compared to those having other marital status. The respondents had different levels of education in this study. On analysis, it was found that their level of education influenced their practice of secondary preventive measures. The respondents who had secondary level of education and higher were found to have good practice of secondary preventive measures compared to those who had informal level of education. A study was conducted in Nigeria by Ekpenyong *et al*., (2013) among 3,500 participants determining the specific prevalence of gender of respondents and age as well as factors associated with DM. The results showed that the total prevalence of diabetes was at 10.51 per cent; which was low among male than the female gender at 9.60 percent and 11.20 percent respectively. When the prevalence was associated to age and sex of the respondents; 2.74% were in the ages of 18-25, 8.50% in 26-35, 16.54% in 36-45 and 23.70% in 46-60 among the males. Among the females of the same age groups, the prevalence was 3.95% for 18-25 years, 9.70% for 26-35 years, 13.01% for 36-45 years and 29.39% for 46-60 years, respectively (Ekpenyong, *et al*., 2013).

Most respondents had DM for 5-10 years and the main co-morbidity that affected 79% of the respondents was hypertension. According to lee & Shin (2017), one of the macrovascular complications that affect T2DM patients after several years of

diagnosis is hypertension a cardiovascular comorbidity. Not surprisingly, the last BP measurements for most respondents was over 140/90mmHg indicating the presence of hypertension. Majority had BMI of more than 25kg/m2 thus they were obese which is a risk factor to T2DM (Chatterjee, *et al*., 2017). Most of DM patients succumb to cardiovascular complications. While these patients have other risk factors to cardiovascular diseases such as drug abuse and smoking the individual contribution of high blood sugar is clearly established as there is a strong correlation between the development of macro vascular disorders and high glycemic levels in T2DM patients thus the high number of persons who had developed a cardiovascular disorder (Lee & Shin, 2017). DM has been established as an independent risk factor to the development of cardiovascular disorders (Snell-Bergeon & Wadwa, 2012). Thus, patients suffering from T2DM should have regular assessment of their blood pressure levels as well as their body fat levels.

Significantly the second complication evidenced from the study was the occurrence of lower limb ulceration by 20.6 percent of the respondents. Diabetic foot is the main chronic disorder of diabetes affecting the foot. Richard, & Schuldiner (2008) states that the risk of a patient with DM to the development of diabetes foot wound is 25 percent and in addition the risk of amputation is 15 to 40 times greater in persons with DM than the non-diabetic population. Studies done in the African continent indicates that nearly 12 percent of DM patients have a foot ulcer (Mbanya & Sobngwi, 2003). The incidence was found to be even more illustrating the importance of proper foot care practices among patients with type 2 diabetes mellitus. Therefore; improving the quality of care in DM management and in particular, lower limb wounds is important in reducing the unnecessary burden posed by diabetes mellitus disease (Chantal Nanfack et al., 2012). Eye complication accounted for 1.7 percent while nerve and renal problems accounted for 0.3 percent and 0.6 percent respectively that arise from high sugar levels that damage the nerves and retina of the eye (Brunner & Suddarth, 2010). Notably from the findings, most respondents did not engage in harmful social habits such as smoking and alcohol use decreasing the occurrence of other comorbidities.

5.2 Association between Knowledge and Practice of Secondary Preventive Measures for Diabetic Complications

In this study, having good knowledge on the specific secondary preventive measures for diabetic complications was associated with good practice of the measures. This is supported by Herath, *et al.* (2017) who states that increased awareness of diabetes is a major determinant for the prevention of diabetes related complications. Unfortunately, the proportion with good knowledge was less than half of the respondents. This clearly indicates that most of the T2DM patients in Meru County have knowledge deficit on secondary preventive measures for diabetic complications. The respondents knew about the complications but lacked in-depth knowledge on the prevention of the complications indicating a need for strengthening knowledge especially on the secondary preventive measures in DM care. These results agree with the findings of a study done in Ghana where the respondents knew individual complications of T2DM, which included; heart disorders, eye disease, foot ulceration, arousal disorder, neuropathy, and renal disease. The same study reported that the respondents had a deficit in knowledge on specific measures to be taken in prevention of diabetic complications (Obirikorang *et al*., 2016).

The results in this study are also in line with another study conducted in Saudi Arabia, where the diabetic patients had diabetic complications and were aware of the complications but had little knowledge on prevention of the complications as evidenced in the research study. This was reported in a study on awareness of diabetic mellitus complications and perceived knowledge on the complications in Saudi Arabia (Fatani *et al*., 2018; Menezes *et al*., 2015). Positive attitude, knowledge, as well as practice are all critical for DM patients in the utilization of the secondary preventive approaches. Newly diagnosed type 2 diabetes patients who don't receive proper diabetes education on the secondary preventive approaches have poor knowledge on these DM approaches leading to poor practice. Insufficient knowledge as well as inadequate DM secondary preventive is associated with the development of diabetes mellitus complications (Rahaman, *et al.,* 2017). In assisting patients to live a positive, productive life, structure educational programs on DM and measures to prevent complications are vital.

In the current study in Meru County, 45.8% of the patients had knowledge on diabetic retinopathy (DR), this was less than average. Similar results were revealed in a study on diabetes retinopathy in St Elizabeth clinic in Jamaica. The patients from the study had moderate knowledge on diabetic retinopathy and positive attitude towards the importance of diabetic care practices. However, in this study patients' attitude was not assessed (Zahra, 2015). In Ethiopia, a study on diabetic complications among adult DM patients of a tertiary healthcare center showed high prevalence of diabetic complications (59.7%) which were associated with non-compliance to medication. These results differ with the findings of the current study. This may be due to assumptions made in the current study that the patients were compliant to medication (Abejew *et al.*, 2015).

5.3 Association between Health Facility Related Factors and Practice of Secondary Preventive Measures for Diabetic Complications

In the current study the distance to the health facility was significantly associated with practice of secondary preventive measures for diabetic complications. The patients who came from nearby the facility were reported to be practicing more of the secondary prevention screening measures compared to those who travelled long distances. Therefore the distance between the patients' home and the health facility was found to be a determinant in receiving the screening measures. According to Selhy *et al.*, (2007) healthcare delivery systems play a significant role in the health response to the growing problems of DM and its complications with distance to the facilities and unavailability of services being significant challenges as cited in the study.

Compliance to medication is crucial in management of diabetes. Non-compliance to medication has been reported to influence and lead to diabetic complications; both microvascular and macrovascular (Rahaman, *et al.,* 2017). In this study, the patients reported to get the diabetic drugs in the hospital pharmacy most of the time. However, those who missed the drugs were associated with poor practice of secondary preventive measures for diabetic complications. In Ethiopia, physicians were advised to work on drug related problems and prevent side effects to promote compliance to

diabetic treatment. This will in turn promote the prevention of diabetic complications (Ayele *et al.*, 2018).

From the study findings, the staffs were reported to receive the patients in a friendly manner according to the majority of the respondents 82.2%. These patients who received good reception were 2.6 times more likely to practice secondary preventive. This made the patients to adhere and follow up on the scheduled diabetic clinics. In the process, on analysis it was evident that staffs reception significantly influences practice of secondary preventive measures for diabetic complications. The patient's assessment of the provider's competence and the ability to respect, listen, explain, and spend adequate time with them also significantly influences the utilization of the diabetic services as it creates greater trust between the provider and the patient which as attributes of good reception (Selhy *et al.*, 2007).

The patients reported that they are grouped into support groups in both hospitals. In these groups they are given health messages on preventive measures for diabetic complications. The provision of health education following service delivery significantly influenced DM secondary prevention. In the groups, health care provider communication skills were good. This is in synergy with a study by Selby (2010) that revealed that effective communication influences the processes of secondary diabetic care such as retinal examinations and periodic microalbuminuria testing. This helped the patients understand the preventive measures. Those patients with informal level of education were taught in "Kimeru", their local language. This improved level of knowledge on diabetic complications. Health education was key in this group. These results replicate the findings revealed in a study on patient's experiences of diabetes education in Ontario. The respondents cited support group education and follow up by community health workers to have promoted practice of preventive measures for diabetes complications (Grohmann *et al.*, 2017).

Diabetic services and supplies needed for delivery of the services were readily available in both the facilities under study. Majority of the respondents, were appreciating the effort made by the county government in provision of the supplies and services. These two factors promoted the practice of secondary preventive

measures for diabetic complications. However, some respondents cited lack of drugs, services and unavailability of supplies affecting diabetes complication prevention. Selhy *et al.*, (2007) identifies some of the challenges to DM secondary prevention as unavailability of services, inadequate supplies and equipment, as well as the unavailability of skilled practitioners.

Client satisfaction from the findings was reported to improve practice of secondary preventive measures among diabetic patients. The respondents revealed that they were satisfied with the services provided by health care practitioners, and this promoted the practice of preventive measures. The health workers are well trained and working hand in hand with community health workers in ensuring practice of the recommended practices. These results concur with those reported in India, that combined effort between community workers and training health workers promotes prevention of diabetes complications (Yasobant *et al.*, 2016).

Those clients who reported to have confidence in the health care workers who served them at the two facilities, showed more practice of secondary preventive measures than those who didn't have confidence in the health workers. These results agree with those in a study in USA where the patients trusted the health care workers and practiced all the recommended strategies to prevent diabetic complications (Hafez, 2017).

5.4 Association between Socio-Economic and Cultural Factors Affecting Practice of Secondary Prevention Measures for Diabetic Complications.

The income of the respondents was significantly affecting the practice of secondary preventive measures for diabetic complications. Those who earned more were found o practice the secondary preventive measures than those who earned less, or were poor. These results are in agreement with those reported in the city of Isfahan. In Isfahan, the patients' economic status was found to determine the services; the patient can receive in a hospital. Those patients who were economically stable received all screening tests for diabetic complications (Tol, 2013). In another study, patients who belonged to low social economic status were associated with T2DM complications (Funakosh, *et al.*, 2017). Similar findings were shown in a study in Thailand, where

patients with low socio economic status were associated with complications of diabetes mellitus (Suwannaphant, 2017). The patient individual income was found not to determine the diabetic complications in Chiba, there was no association between patients economic status and development of diabetic complications (Emoto, *et al*., 2016).

Affordability was a key indicator of the practices; those patients who were affording the cost of screening tests were more often screened compared to those who were unable to afford the screening tests. These results concur with those revealed in Korea on socioeconomic status of patients on their health behaviours, metabolic control, and chronic complications in T2DM. It was revealed that women with lower income were associated with higher stress level. This increased the chances of developing diabetic retinopathy (Kim, *et al*., 2018; Peykari, 2015). In the United Kingdom, low social and economic status was linked with high rates of death and morbidity as a result of diabetic related complications (Scott *et al*., 2017).

The patients who had the National Health Insurance Fund (NHIF) cover were more likely to receive the screening test compared to those who had other insurance covers. In this study the insurance cover that a patient had, was associated with the practice of secondary preventive measures. In China, it was also found that different respondents had different insurance covers, each cover had limited range of services to cover. This was associated with management of diabetes type 2 (Wu *et al*., 2017*)*. Another research done in Germany revealed that the cost of diabetes management differed between age groups and insurance cover for all helped cut the costs (Kahm *et al*., 2018).

The results revealed that the management costs for screening tests were high. Those patients whose screening tests cost was covered by the insurance scheme, were more likely to practice secondary preventive measures than those whose insurance scheme was not covering the screening tests. Patients from low socioeconomic status need to be catered for in terms of drug costs, these helps in maintenance of glycemic levels within normal ranges. They should be screened for stress and depression. This was

found to be associated with preventive measures for diabetes complications (Houle *et al*., 2016).

The study reported that there were some patients who believed in traditional healing methods for diabetes. Others had myths about the diabetes disease; some believed it was a curse and others believed it was witchcraft. Those patients who believed in the medical pathology of diabetes, and that diabetes can be modified were more likely to practice secondary preventive measures for diabetic complications. In Chicago, diabetic patients had a negative perception about insulin use in management of the disease. Inaccurate information about complications of insulin in Diabetes management led to the negative perceptions (Julio, 2016). Some religion, especially on fasting occasions, they affect both positively and negatively on management of diabetes. In Lamu town, ritual obligations observed especially attending wedding ceremonies which last for weeks affect the management of diabetes. These occasions affected dietary restrictions of the diabetic patients (Abdulreman *et al*., 2016). The results in this study revealed that in this era some patients still belief in herbal remedies for treatment and management of diabetes, these results concur with those found in a study in South Asia. In South Asia, patients with diabetic and cardiovascular diseases were found to prefer use of home remedies and poorly sought health care services from the hospital (Kumar, 2016).

CHAPTER SIX
SUMMARY, CONCLUSSION AND RECOMMENDATIONS

6.1 Summary of Major Findings

Most respondents attended Meru Level 5 Hospital. Majority of the respondents were aged between 40-60 years and male gender constituted of the total respondents. Most respondents 31.6% had secondary level of education and majority 67% were employed. Most respondents were married. Most respondents had DM for 5-10 years and the main co-morbidity that affected 79% of the respondents was hypertension. The last BP measurements for most respondents was >140/90mmHg and blood glucose level of >7.8mmol/L. Majority had BMI of more than 25kg/m^2 and 59% had evidence of cardiovascular disease. Most respondents did not engage in harmful social habits such as smoking and alcohol use. Concerning secondary prevention, majorities were able to do foot examination every visit and did BP monitoring while did annual eye screening. Most respondents though had poor overall secondary prevention practice. Concerning knowledge, knew the complications associated with DM. Most respondents had overall poor knowledge of prevention practices. Knowledge level significantly influenced DM secondary prevention.

Health facility factors, distance to the facility, availability of drugs, staff reception, health education and counseling, care-giver communication, availability of DM services, availability of supplies, and client satisfaction all significantly influenced DM secondary prevention. Concerning socio-cultural and economic factors, monthly income, affordability of services, health insurance cover monthly cost of DM management and traditional beliefs all significantly influenced DM secondary prevention. Regression analysis of all the independent variables revealed that significant predictors of DM secondary prevention were knowledge, monthly income health education and counseling and affordability of services.

6.2 Conclusion

Based on the study findings the following conclusions were made;

i. The level of knowledge was poor because the mean score was 47.8% which meant that a lot was yet to be learnt by the respondents. Knowledge was the main predictor of secondary prevention practice.

ii. The level of secondary prevention was poor since the mean score was 48%.

iii. The main health service factors that affected secondary prevention were; health education and counseling distance to the health facility, staff reception, offering health education counseling to patients, communication skills of the health worker, availability of services and supplies necessary for screening the patients, client satisfaction and confidence of the patient on health workers' proficiency.

iv. The main socio-economic factor was monthly income, patients' type of insurance cover, management cost per for diabetes per month, traditional beliefs about the cause and management of diabetes and affordability of services.

6.3 Recommendations

6.3.1 Recommendation for policy making

i. The government of Kenya, through the county government to champion for campaigns on educating the public on secondary preventive measures for diabetic complications. These will include; retinopathy screening, kidney care and screening, cardiovascular care and screening, as well as foot care and ensuring medical services availability among the diabetic patients.

ii. The government of Kenya, through the county government, to establish diabetic support groups in all hospitals to boost the management of diabetes.

6.3.2 Recommendations for practice

All the nurses in all facilities in Meru County, to champion for screening tests for both macrovascular and microvascular complications among patients in each clinic that diabetic patients attend.

6.3.3 Recommendation from the patient's suggestions

Respondents gave several recommendations for improvement of services:

i. Empowerment of more health staffs in hospitals to cater for large numbers of patients at once to minimize long queues.

ii. Make services free or cheaper and available at dispensaries to reduce the distance covered.

iii. Health-educate and remind patients on preventive practices especially the elderly and organize grass root campaigns and seminars for all.

iv. Increase the number of clinic days for efficient service delivery

v. NHIF card should be comprehensive enough to cover all the DM related tests and managements.

vi. More doctor rooms should be constructed and waiting bays expanded to avoid overcrowding.

6.4 Suggestion for Further Research

A qualitative study should be done on health care workers perception on the practice of secondary preventive measures for diabetic complications in Kenya

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APPENDIX I
LETTER OF SELF INTRODUCTION

DENNIS MUGAMBI NGARI,

P.O. BOX 24-60114

EMBU.

EMAIL:DENNISNGARE@GMAIL.COM

TEL: 0700172740

C/O CHUKA UNIVERSITY
FACULTY OF SCIENCE, EDUCATION &TECHNOLOGY
DEPARTMENT OF NURSING
P.O BOX 109-60400
CHUKA.

Dear Respondent,
I am a post graduate student at the School of Science, Engineering and Technology in the University of Chuka, undertaking a course in Masters of Science in Nursing. I am carrying out an academic research on secondary prevention practices among adult patients with type 2 diabetes mellitus at Consolata Hospital Nkubu and MeruLevel 5 Hospital. This is a partial fulfillment of my masters in Science Nursing. Participation is voluntary and the information provided is for academic purposes and will be kept confidential. The study will provide important information necessary for improvement of diabetes services in an effort of curbing the development of type 2 diabetes mellitus complications.

Dennis Mugambi- Researcher
REG. NO: SM20/29115/17

APPENDIX II
PARTICIPANTS CONSENT FORM

My name is Dennis Mugambi. I am a graduate student at Chuka University pursuing Masters of Science in Nursing. I am carrying out a research study to assess the secondary preventive approaches used in the prevention of diabetes complications among patients with type 2 diabetes mellitus.

I have developed a questionnaire and I am kindly requesting you to participate in the study by filling the questionnaire. Participation is voluntary and there is no penalty for declining to participate. There are no risks involved. The information provided will be treated with total confidentiality as permitted by law. You are free to withdraw from the study at any stage without victimization. In case of any issue/clarifications, kindly contact the people/offices below.

Researcher: Dennis Mugambi- 0700172740

Institution: Chuka University

Respondent's Declaration

I have read and understood the above details about the research. I voluntarily agree to participate in the study.

Respondent's sign……………………………..

Date………………………………..

QUESTIONNAIRE FOR THE STUDY PARTICIPANTS

Instructions
1. Do not write your name.
2. Fill all the relevant sections
3. Use a tick (√) where applicable

Serial No………….

Part A: Demographic Information

1) Age (Years): ………..

2) Gender: Male [   ] Female [   ]

3) Level of Education
   a) No formal education   [   ]
   b) Primary   [   ]
   c) Secondary   [   ]
   d) College   [   ]

4) Occupation
   a) Employed   [   ]
   b) Self-employed   [   ]
   c) Not employed   [   ]

5) Marital status
   a) Single   [   ]
   b) Married   [   ]
   c) Separated   [   ]
   d) Divorced   [   ]
   e) Widowed   [   ]

6) If married, spouse occupation
   a) Employed   [   ]
   b) Self-employed   [   ]
   c) Not employed   [   ]
   d) Not Applicable   [   ]

7) Spouse level of education completed
   a) No formal education   [   ]
   b) Primary   [   ]
   c) Secondary   [   ]
   d) College   [   ]
   e) Not Applicable   [   ]

Part B: Health Status

1) Duration of illness
   a) Less than 5 years   [   ]
   b) 5-10 years   [   ]
   c) More than 10 years   [   ]

2) Other diseases/conditions
   a) Hypertension [   ]
   b) Arthritis   [   ]
   c) Asthma   [   ]
   d) Heart failure [   ]
   e) Other (Specify)…………………

3) Anthropometrics
   a) Weight (Kgs)…………   b) Height (Meters)…………..
4) Physiological Measurements:

Blood Pressure (mm/hg)……..   d) Latest Blood sugar(mmol/L)…………

5) Do you have any evidence of diabetes complication?
   a)   Leg ulcer   [   ]
   b)   Nerve problems   [   ]
   c)   Renal disease   [   ]
   d)   Eye diseases (diabetic retinopathy, glaucoma and cataract) [   ]
   e)   Cardiovascular disease (HTN) [   ]
   f)   Any other (specify)………………
6. Do you engage in any of the following social habits?
   a) Cigarette smoking[   ]
   b) Harmful alcohol use[   ]
   c) Drug and substance abuse [   ]

Part C: Knowledge and Practice on the Secondary Preventive measures
1) Have you ever heard of self-care practices to prevent diabetes complications?
Yes [   ] No [   ]
2) If Yes in 1 above, what is your understanding on self-care secondary preventive

practices?

……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………
3) Following the diagnosis, were you taught about the self-care management for
people living with T2DM?   Yes [   ] No [   ]
4) If yes, in 1 above, what were you taught?
……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………
5) Currently what are you doing to prevent diabetes related complications?
……………………………………………………………………………………
……………………………………………………………………………………
…………………………………………………………………………………....
6) What do you use in managing you condition?
   a) Insulin injections   [   ]
   b) Diet control   [   ]
   c) Oral diabetic drugs   [   ]
   d) Complementary and alternative medicine [   ]
7) Which of the following complications is associated with diabetes?
   a) Foot ulcers   [   ]
   b) Nerve problems   [   ]

c) Kidney failures   [   ]

d) Diabetic eye diseases (diabetic retinopathy, glaucoma and cataract) [   ]

e) Hypertension (Elevated Blood pressure) [   ]

f) Any other (specify)………………

8) Do you do Foot examinations?

a) Yes   [   ]   b) No   [   ]

9) If yes, how often do you do them?

a) Every visit   [   ]

b) Yearly   [   ]

c) Every two years   [   ]

d) Don't know   [   ]

10) Do you think Diabetic patients need to visit eye doctor?

b) Yes   [   ] b) No   [   ] c) Don't know[   ]

11) How frequent should you go for eye checkup?

a) Yearly   [   ]

b) every two years   [   ]

c) Depend with eye condition   [   ]

d) Don't know   [   ]

12) Have you ever had eye screening since you were diagnosed with diabetes?

a) Yes   [   ]

b) No   [   ]

13) Do you think DM patients should visit a doctor to do urine check?

a) Yes   [   ]

b) No   [   ]

c) Don't know   [   ]

14) Haveyou ever done a urine check before?

a) Yes   [   ]

b) No   [   ]

15) How frequent should a person do the urine check?

a) Yearly   [   ]

b) every two years   [   ]

c) Don't know   [   ]

16) Do you think diabetic patients should have check-ups on their body's fat levels (Cholesterol)?

a) Yes   [   ]

b) No   [   ]

c) Don't know   [   ]

17) Do you have any check-ups on your body's fat levels?

a) Yes   [   ]

b) No   [   ]

18) Do have regular check-ups on your blood pressure levels?

a) Yes   [   ]

b) No   [   ]

c) Don't know   [   ]

19) If yes, why do you think it is necessary?

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

Part D: Health Facility Factors

1) Indicate the distance to the clinic/hospital?

     d) Less than 1km   [   ]

     e) 2-5 Km   [   ]

     f) More than 5km   [   ]

2) Is the distance to the hospital a hindrance to you from seeking services?

   Yes [   ] No [   ]

3) How much time do you spend in the clinic from arrival to departure when seeking the services? ………………………………………………………………….

4) Is the waiting time at hospital when you go for the service long?

Yes [   ] No [   ]

5) Have you ever lacked diabetes treatment drugs at the hospital?

    Yes [   ] No [   ]

6) If yes did the lack of diabetes treatment drugs affect your self-care secondary preventive practices?

    Yes [   ] No [   ]

7) Are the hospital staffs friendly to you?

    Yes [   ] No [   ]

8) Do health care providers provide health education and counseling following service delivery?

    Yes [   ] No [   ]

9) If Yes in 8, above how would you rate the communication/health education?

     a) Excellent   [   ]

     b) Good   [   ]

     c) Fair   [   ]

     d) Poor   [   ]

10) Please mark one or more if you agree or not agree with the following statements

		Strongly agree (1)	Agree (2)	Not sure (3)	Disagree (4)	Strongly Disagree (5)
11)	The diabetic services are always available when required					
12)	The supplies and equipment for diabetes care are always available					
13)	The services provided by the health care providers are satisfactory					
14)	I feel confident under the care of the health care providers and I seek clarifications where need be					

15) Would you recommend another person for the services?

Yes [ ] No [ ]

16) If No in 15 above Why?

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

Part D: Social Cultural and Economic Factors

1) What is your level of income in Kenyan shillings?

    a) Below or 5000   [   ]

    b) Between 5001-15000 [   ]

    c) Above 15001   [   ]

2) Are the services affordable at the hospital?

Yes [ ] No [ ]

2) Do you currently have any health insurance cover? Yes [   ]   No [   ]

3) If yes in 2 above, what type?

    a) NHIF   [   ]

    b) Company medical insurance [   ]

    c) Both   [   ]

    d) Any other   [   ]

4) What is your estimated general cost on the management of diabetes per month in Kenyan shilling?

    d) Below or 5000   [   ]

    e) Between 5001-15000 [   ]

    f) Above 15001   [   ]

5) Can you comfortably take care of the diabetes services costs?

Yes [ ] No [ ]

6) Are there cultural and traditional beliefs that hinder the utilization of diabetic services?

Yes [ ] No [ ]
7) If Yes in 6 above which ones?

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

8) Are there Myths in the society that prevent individuals from seeking diabetic care?

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

9) Do you have a negative attitude towards the secondary preventive services offered?

Yes [ ] No [ ]
10) What are some of the measures that you propose to be undertaken to improve the practice of secondary prevention in diabetes management?

………………………………………………………………………………………………

THANK YOU

APPENDIX IV
FOCUS GROUP DISCUSSION GUIDE

1. Have you been taught/trained on the special self-care because you are diabetic?
2. What are the elements of that special care or secondary preventive approaches?
3. What factors encourage you to perform the special care?
4. What factors/barriers do you face as you take care of your illness?
5. What would encourage you to attend eye screening, kidney screening, BP screening, body fat level screening and foot examinations in an effort of preventing DM complications?

APPENDIX V
NACOSTI CERTIFICATE

**NATIONAL COMMISSION FOR SCIENCE,
TECHNOLOGY AND INNOVATION**

Telephone:+254-20-2213471,
2241349,3310571,2219420
Fax:+254-20-318245,318249
Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref No: **NACOSTI/P/19/69903/27120**

Date: **17th January, 2019**

Dennis Mugambi Ngari
Chuka University,
P. O. Box 109-60400
CHUKA.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on *"Secondary prevention practices among adult patients with type 2 diabetes mellitus at Meru and Nkubu Hospitals Kenya"* I am pleased to inform you that you have been authorized to undertake research in **Meru County** for the period ending **17th January, 2020.**

You are advised to report to **the County Commissioner, the County Director of Education and the County Director of Health Services, Meru County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

**GODFREY P. KALERWA MSc., MBA, MKIM
FOR: DIRECTOR-GENERAL/CEO**

Copy to:

The County Commissioner
Meru County.

The County Director of Education
Meru County.

CONSOLATA HOSPITAL - NKUBU
P.O BOX 205 0708153912, 0788720984.
Email: consolatahospitalnkubu@gmail.com
MERU, KENYA

8/3/2019

DENIS MUGAMBI
SM220/29115/17
CHUKA UNIVERSITY

Dear Mugambi

RE: RESEARCH AUTHORIZATION

This this to confirm that you have been allowed to carry out the research study at Consolata Hospital Nkubu.

After completion you are expected to submit the research findings and discuss with the relevant authorities in the institution.

Thank you.

Yours faithfully,

Dr. Gilford Mutwiri.
Director of Medical Services

COUNTY GOVERNMENT OF MERU
DEPARTMENT OF HEALTH

Telegrams: "HEALTH" Meru
Telephone: Meru 064-32370/1
Fax: 31242
Email: hospitalmeru@gmail.com
When replying should be to:
County Director Medical Services

Ref: MRU/MED/MRU/C.50

COUNTY DIRECTOR MEDICAL SERVICES
MERU COUNTY
P.O. BOX 8 – 60200
MERU

Date: 5th March, 2019

DENNIS MUGAMBI NGARI
SM20/29115/17
CHUKA UNIVERSITY

RE: APPROVAL FOR YOUR REQUEST TO COLLECT YOUR RESEARCH DATA

Your request to collect data for your Research on **"Secondary prevention practices among adult patients with Type 2 Diabetes Mellitus at Meru and Nkubu Hospitals"** has been approved.

You will stick to the approved timelines by Chuka University and NACOSTI.

Upon completion of your data collection, you are requested to submit One (1) copy of hardcover bound report and discuss the findings with Director of Medical Services.

Congratulations and wish you the best

Dr. Lilian Karoki
Director of Medical Services
County Government of Meru