

**BURDEN OF DIABETES MELLITUS AMONG PATIENTS IN THIKA LEVEL  
FIVE HOSPITAL, KIAMBU COUNTY, KENYA**

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## DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

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## **DEDICATION**

This research work is dedicated to all patients with Diabetes Mellitus in Kenya including my father Joseph K. Rotich who is also a diabetic patient.

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## TABLE OF CONTENTS

<b>DECLARATION</b> .....	ii
ABBREVIATIONS AND ACRONYMS .....	ix
DEFINITION OF OPERATIONAL TERMS.....	xi
LIST OF TABLES.....	xii
LIST OF FIGURES .....	xv
ABSTRACT.....	xvi
<b>CHAPTER ONE: INTRODUCTION</b> .....	<b>1</b>
1.1 Introduction.....	1
1.2 Background to the study .....	1
1.3 Problem Statement .....	3
1.4 Justification .....	5
1.5 Research Questions.....	7
1.6 Objectives .....	7
1.6.1 Broad objective .....	7
1.6.2 Specific Objectives .....	7
1.7 Significance of the Study .....	8
1.8 Anticipated Output.....	8
1.9 Limitations .....	8
1.10 Delimitations.....	9
1.12 Conceptual Framework.....	11
<b>CHAPTER TWO: LITERATURE REVIEW</b> .....	<b>12</b>
2.1 Introduction.....	12
2.2 Burden of Disease .....	12
2.2.1 Type 1 diabetes .....	13
2.2.2 Type 2 diabetes .....	13
2.3 Direct Costs.....	14
2.4 Indirect Cost.....	15
2.5 DALYs and YLD.....	15
2.6 Years of Life Lost (YLL).....	17
2.7 Health Related Quality of Life (HRQoL) .....	17
2.8 Comorbidity .....	18

2.9 Diagnosis and treatment.....	20
2.10 Healthcare Financing .....	20
2.12 Summary of Literature Review.....	22
<b>CHAPTER THREE: MATERIALS AND METHODS.....</b>	<b>24</b>
3.1 Introduction.....	24
3.2 Study Design.....	24
3.3 Study Variables.....	24
3.3.1 Dependent Variable .....	24
3.3.2 Independent Variables .....	24
3.4 Location of the Study.....	25
3.5 Target ad Study Population.....	25
3.6 Inclusion Criteria .....	25
3.7 Exclusion Criteria .....	25
3.8 Sampling Techniques.....	25
3.9 Sample Size Determination.....	26
3.10 Construction of Research Instruments .....	26
3.11 Pre-testing of Study Tools .....	26
3.12 Validity .....	27
3.13 Reliability.....	27
3.14 Data Collection Techniques .....	27
3.15 Data Analysis.....	27
3.15.1 Analytical model for Calculation of Costs.....	28
3.15.2 Direct costs.....	28
3.15.3 Indirect costs .....	28
3.15.4 Total cost of productive time lost due to diabetes-related temporary disability (CTD)..	29
3.15.5 Cost of diabetes-related permanent disability (CPD) .....	29
3.15.6 Cost of premature diabetes-related mortality (CPM).....	30
3.15.7 Cost of productive time lost by caregivers (CPV) .....	30
3.15.8 Summary measures of population health.....	30
3.15.9 Quantifying time lived with disability .....	31
3.15.10 Calculation of DALYs with discounting and age weighting (YLD) .....	31
3.15.11 Calculation of DALYs with discounting and age weighting (YLL).....	31

3.16 Logistical and Ethical Considerations.....	32
CHAPTER FOUR: RESULTS .....	33
4.1 Introduction.....	33
4.2 Demographic characteristics of respondents response rate.....	33
4.2.1 Comorbidities.....	34
4.2.2 Financing .....	35
4.2.3 Diabetic Coma .....	36
4.2.4 Body Mass Index (BMI) .....	37
4.2.5 Consultations .....	37
4.2.6 Treatment .....	38
4.4 Cost of Insulin (TCI) and Cost of Syringes (TCS) .....	39
4.5 Monthly cost of diabetes drugs .....	39
4.6 Monthly costs of hypertension drugs .....	40
4.7 Monthly costs of other drugs used by the respondents .....	41
4.8 Cost of diabetes drugs.....	42
4.4 Indirect Costs .....	48
4.4.1 Total cost of Temporary Disability (CTD) in six months.....	49
4.4.2 Total cost of Permanent Disability (CPD) in six months.....	49
4.4.3 Total cost of Premature Diabetes-related Mortality (CPM) in six months .....	50
4.4.4 Cost of productive time lost by caregivers (CPV) .....	51
4.4.5 Total Costs and Type of Diabetes .....	53
4.5.1 Years of Life Lost (YLL).....	55
4.5.2 Years Lived with Disability (YLD) .....	56
4.7 Visual Analogue Scale (VAS) .....	60
4.7.1 Visual Analogue Scale and the age group of respondents .....	61
4.7.2 The Visual Analogue Scale and Gender .....	61
4.7.3 Visual Analogue Scale and Mobility .....	62
4.7.4 Visual Analogue Scale and Self-Care.....	63
4.7.5 Visual Analogue Scale and Usual Activities .....	64
4.7.6 Visual Analogue Scale (VAS) and Pain/Discomfort .....	64
4.7.7 Visual Analogue Scale and Anxiety/Depression .....	65
4.7.9 Visual analogue scale (VAS) & incidence of hypoglycemia.....	66

4.6.10 Visual Analogue Scale (VAS) and Type of Diabetes Mellitus.....	66
4.7.11 Visual Analogue Scale (VAS) and level of education.....	67
4.7.12 Visual Analogue Scale (VAS) and those with NHIF cover.....	67
4.7.13 Visual Analogue Scale (VAS) and Complications.....	69
CHAPTER 5: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS.....	71
5.1 Introduction.....	71
5.2 Socio-demographic Characteristics of respondents.....	71
5.3 Costs.....	73
5.4 DALYs (YLL+YLD).....	76
5.5 Health Related Quality of Life (HRQoL).....	77
5.6 Conclusion.....	78
5.7 Recommendation.....	79
5.8 Areas for further research.....	80
REFERENCES.....	80
APPENDICES.....	84
Appendix 1: Consent Form.....	85
Appendix 2: Questionnaire.....	87
Appendix 3: Estimated Costs per Drugs.....	90
Appendix 4: EQ-5D-5L Questionnaire.....	91
Appendix: 5 Map of Study Area.....	94
Appendix 6: Ethics Review.....	95
Appendix 7: NACOSTI Permit.....	96
Appendix 8: Research Authorization, County Commissioner, Kiambu.....	98
Appendix 9: Research Authorization, Ministry of Education, Kiambu County.....	99
Appendix 10: Clearance to conduct Research, Dept. of Health Service.....	100
Appendix 11: Approval to carry out Research.....	101

**ABBREVIATIONS AND ACRONYMS**

**ADA:** American Diabetes Association

**BoD:** Burden of Disease

**COI:** Cost of Illness

**CPD:** Cost of productive time lost due to permanent disability

**CPM:** Cost of productive time lost due to diabetes-related premature mortality

**CPV:** Cost of productivity loss due to the work time lost by relatives accompanying patients

**CTD:** Cost of productive time lost due to diabetes-related Temporary Disability

**DALYs:** Disability Adjusted Life Years

**DC:** Direct Costs

**DM:** Diabetes Mellitus

**DW:** Disability Weight

**GBD:** Global Burden Disease

**GDP:** Gross Domestic Product

**GNI:** Gross National Income

**GNIPC:** Gross National Income per Capita

**HRQoL:** Health Related Quality of Life

**ICD:** International Classification of Disease

**IDF:** International Diabetes Federation

**LIC:** Low Income Countries

**LMIC:** Low Middle Income Country

**MoH:** Ministry of Health

**NACOSTI:** National Commission for Science, Technology and Innovation

**NCDs:** Non-Communicable Diseases

**OoPE:** Out-of-Pocket Expenses borne by patients, family members and relatives

**TCD:** Total Cost of oral Drugs

**TCH:** Total Cost of Hospitalization

**TCI:** Total Cost of Insulin

**TCOC:** Total Cost of OPD Consultations

**TCR:** Total Cost of Reagent strips

**TCS:** Total Cost of Syringes

**UN:** United Nations

**USD:** United States Dollars

**WHO:** World Health Organization

**YLD:** Years Lived with Disability

**YLL:** Years of Life Lost

## DEFINITION OF OPERATIONAL TERMS

**Burden of Disease:** is the impact of a health problem as measured by financial cost, mortality, morbidity, or other indicators. It is often quantified in terms of quality-adjusted life years (QALYs) or disability-adjusted life years (DALYs), both of which quantify the number of years lost due to disease (YLDs).

**Comorbidity:** any distinct clinical entity that has co-existed or that may occur during the clinical course of a patient who has the index disease under study.

**Diabetes Mellitus:** is a condition in which the pancreas no longer produces enough insulin or cells stop responding to the insulin that is produced.

**Disability:** a condition which may restrict a person's mental, sensory and mobility functions to undertake or perform a task in the same way as a person who does not have a disability.

**Incidence:** is a measure of rate or frequency of occurrence of a disease or a given medical condition in a population within a specified period of time.

**Morbidity:** Departure from a state of physical or psychological well-being, resulting from disease, illness, injury, or sickness, especially where the affected individual is aware of his or her condition.

**Mortality:** the state or condition of being subject to death; mortal character, nature, or existence.

**Prevalence:** The proportion of individuals in a population having a disease or characteristic.

**LIST OF TABLES**

Table 4.1 Demographic characteristics of the respondents.....	34
Table 4.2 Number of comorbidities.....	35
Table 4.3 Number of times respondent had experienced hypoglycemia since diagnosis.	36
Table 4.4 Body Mass Index of the respondents.....	37
Table 4.5 Number of consultations within the six months.....	38
Table 4.6 Monthly cost of diabetes drugs.....	40
Table 4.7 Monthly cost of hypertensive drugs.....	41
Table 4.8 Monthly cost of other drugs.....	42
Table 4.9 Cost of diabetic drugs semiannually.....	43
Table 4.10 Costs of TCD semiannually.....	44
Table 4.11 Cost of TCOC semiannually.....	45
Table 4.12 Cost of TCH semiannually .....	46
Table 4.13 Cost of O0PE Semiannually.....	46
Table 4.14 Total Direct Costs semiannually.....	47
Table 4.15 Total Direct Costs (TDC) for six months.....	48
Table 4.16 Cost of Temporary Disability.....	49
Table 4.17 Cost of Permanent Disability.....	50

Table 4.18 Cost of Premature Mortality (CPM).....	51
Table 4.19 Cost of Productive time lost by caregivers (CPV) in six months.....	52
Table 4.20 Indirect costs for 6 Months.....	52
Table 4.21 Total Direct Costs incurred in six months .....	53
Table 4.22 Type of Diabetes and total costs incurred.....	53
Table 4.23 Years of Life Lost, YLL – males.....	55
Table 4.24 Years of Life Lost, YLL – Females.....	56
Table 4.25 Years Lived with Disability, YLD – Males .....	57
Table 4.26 Years Lived with Disability, YLD – Females .....	57
Table 4.27 Disability Adjusted Life Years, DALYs=Total YLLs + Total YLDs.....	58
Table 4.28 Domains of Health according to EQ-5D-5L instrument.....	60
Table 4.29 Visual Analogue Scale and the age group of respondents.....	61
Table 4.30 showing Visual Analogue Scale and gender of the respondent.....	62
Table 4.31 Visual Analogue Scale (VAS) and mobility dimension of health.....	63
Table 4.32 Visual Analogue Scale (VAS) and self-care dimension of health.....	63
Table 4.33 Visual Analogue Scale (VAS) and usual activities dimension of health.....	64
Table 4.34 Visual Analogue Scale (VAS) and pain/discomfort dimension of health.....	65
Table 4.35 Visual Analogue Scale (VAS) & anxiety/depression dimension of health....	65
Table 4.36 ANOVA between Visual Analogue Scale (VAS) & Dimensions of health...66	66

Table 4.37 Visual Analogue Scale (VAS) & incidence of hypoglycemia .....	66
Table 4.38 Visual Analogue Scale (VAS) and Type of Diabetes Mellitus.....	67
Table 4.39 Visual Analogue Scale (VAS) and highest level of education.....	67
Table 4.40 Visual Analogue Scale (VAS) and those with NHIF cover.....	68
Table 4.41 Visual Analogue Scale (VAS) and those who are dependent on others.....	68
Table 4.42 Visual Analogue Scale (VAS) and BMI.....	69
Table 4.43 Visual Analogue Scale (VAS) and Complications.....	70

**LIST OF FIGURES**

Figure 1.1 Conceptual framework.....11

Figure 1.2 Progressive Health States of Diabetes Mellitus.....21

Figure 1.3 Showing respondents who subscribe to NHIF.....36

Figure 1.4 A pie chart showing type of treatments for respondents.....38

## ABSTRACT

The burden of diabetes is reflected not only in the increasing numbers of people with diabetes, but also in the growing numbers of premature deaths due to diabetes. One measure of burden of disease is disability-adjusted life years (DALYs), which combines estimates of years of life lost due to premature death (YLL) and years lived with disability (YLD) to count the total years of healthy life lost from disease and injury. In Kenya, Non-Communicable Diseases (NCDs) accounts for more than 50% of total hospital admissions and over 55% of hospital deaths. The major NCDs are cardiovascular conditions, cancers, diabetes, and chronic obstructive pulmonary diseases. In Kenya there were 1,976,337 NCDs cases in 2012. Nairobi and Kiambu led all other counties in NCDs with 155,899 and 126,754 cases respectively. The Kenyan health sector is predominantly financed by private sector sources (including out-of-pocket Expenses (OoPE) borne by patients, family members and relatives). However, there are only sparse data available from developing countries on the expenditure on diabetes care. Knowing the medical cost of diabetes is critical to understanding the long-term economic consequences of diabetes prevention. The broad objective of the study was to quantify the burden of Diabetes Mellitus among patients attending Thika level 5 Hospital, Kiambu County, Kenya. The study employed prospective prognostic study design and was carried out in Thika level 5 Hospital, Kiambu County. The study population comprised of diabetic patients attending outpatient diabetic clinic. The respondents were recruited into the study till saturation of 594 respondents. Data was collected for YLL, YLD, Direct costs and Indirect costs. EQ-5D-5L tool was used to measure HRQoL. Data analysis was done using SPSS, Microsoft Excel Worksheet and DISMOD II. The results showed that diabetic patient incurs a mean of KSHs 28,433 within six months (translating to approximately KSHs 56,866 per annum). According to the results from this study, 43% was attributed to direct costs while 57% for indirect costs spent by a diabetes patient. A total of 805/1000 DALYs was lost as a result of premature mortality and disability associated with diabetes. Most of the diabetes patients in the study had a reduced Health Related Quality of Life (HRQoL) as per the EQ-5D-5L tool with a mean VAS of 0.55. Knowledge on burden of diabetes especially medical cost of diabetes is critical to understanding the long-term economic consequences of diabetes prevention. Thus, assuming prevention costs can be kept sufficiently low, effective diabetes prevention efforts would likely lead to a reduction in long-term medical costs. The results of this study informs policy makers in Kiambu County and Ministry of Health on need to work towards comprehensive and sustainable solutions in regard to diabetes. Based on the study findings, it is recommended that the National government and Kiambu County government of Kiambu to give priority to diabetes disease by providing free insulin and oral glycaemic drugs to diabetes patients. It also recommends that the National government and Kiambu County government to prioritize diabetes care by ensuring all patients subscribe to NHIF and to cover management costs of diabetes, both for outpatient and in-patient services through NHIF, thereby reducing the economic burden of a diabetic patient and also improve HRQoL and reduce DALYs.

## **CHAPTER ONE: INTRODUCTION**

### **1.1 Introduction**

This chapter entails background to the study, statement of the problem, justification, research questions, null hypothesis, significance of the study, limitations of the study and conceptual framework.

### **1.2 Background to the study**

Burden of Disease (BoD) analysis quantifies loss of health in any of the important domains of health which include: mobility, self-care, participation in usual activities, pain and discomfort, anxiety and depression, and cognitive impairment. BoD is the impact of a health problem as measured by financial cost. A BoD study also aims to quantify the burden of premature mortality and disability for major diseases or disease groups (GBD, 2013). The World Health Organization (WHO) estimates that Non-Communicable Diseases (NCDs) will cause 73% of global deaths and 60% of the burden of disease by 2020. Sixteen million of NCD deaths occur before the age of 70 with 82% of these "premature" deaths occurs in low- and middle- income countries. Cardiovascular diseases account for most NCD deaths, or 17.5 million people annually, followed by cancers (8.2 million), respiratory diseases (4 million), and diabetes (1.5 million) (WHO, 2014).

According to International Diabetes Federation's (IDF) most recent estimates indicate that 382 million people globally (8.3%) have diabetes and the number of people with the disease is set to rise beyond 592 million in less than 25 years (IDF, 2014). The burden of diabetes is reflected not only in the increasing numbers of people with diabetes, but also in the growing numbers of premature deaths due to diabetes. Poorly managed diabetes leads to serious complications and early death and every six seconds a person dies

from diabetes, with more than 80% of diabetes deaths occur in low- and middle-income countries (IDF, 2014). Globally the number of patients with diabetes has increased from 180 million in 1980 to 422 million in 2014 (Roglic, 2016). It is estimated that 19.8 million adults in the African region have diabetes, a regional prevalence of 4.9% with the prevalence increasing rapidly in sub-Saharan Africa (IDF, 2014).

Despite the burden of deaths, NCDs pose a greater social and economic burden to the economy. NCDs threaten progress in the post-2015 development agenda as poverty is closely linked with NCDs. The rapid rise in NCDs is predicted to impede poverty reduction initiatives in low-income countries, particularly by increasing household costs associated with health care (MoH, 2015). The competing demands of increased burden of infectious diseases and other diseases associated with poverty, makes it unlikely for health systems in sub-Saharan Africa to have adequate financing to deal with diabetes and its consequences (Atun, 2017). Besides the economic burden on the health-care system and national economy, diabetes often imposes catastrophic personal expenditures from out-of-pocket payments and loss of income due to disability and premature death (Roglic, 2016). The vulnerable and socially disadvantaged patients in the society are prone to morbidity and mortality than people of higher social positions (MoH, 2015).

Complications due to diabetes are a major cause of disability, reduced quality of life, and death thus diabetes complications are very common, with at least one present in a large proportion of people with diabetes at the time of diagnosis (IDF, 2014). Meeting the goals of the UN high-level meeting on NCDs (to reduce premature mortality from NCDs by 25% by 2025) and Sustainable Development Goals (SDGs; to reduce premature mortality from NCDs by a third by 2030) requires a coordinated approach within countries,

which starts with a firm consideration of disease burden, needs, and priorities (Atun, 2017). There remains inadequate funding for the effective implementation of an effective strategy for the prevention, detection and management of diabetes (Tiffany, 2013).

Nearly 60% of the global costs are borne by low and middle-income countries, where substantial parts of treatment costs are paid out-of-pocket, which affects treatment utilization and adherence and leads to financial hardship for patients and their families (Seuring, 2015). Data re-emphasize the importance of intervention to reduce complications and Health Resource Use (HRU) associated with diabetes (Gagliardino *et al.*, 2017).

In Kenya, Non communicable diseases accounts for more than 50% of total hospital admissions and over 55% of hospital deaths. The major NCDs in Kenya are cardiovascular conditions, cancers, diabetes, and chronic obstructive pulmonary diseases with their sequelae and their shared risk factors (MoH, 2015). Kenya can reduce the burden of diabetes by allocating more funds to health promotion activities and also primary healthcare interventions. This will in turn require change in population behaviors to adopt healthy lifestyles (Tiffany, 2013).

### **1.3 Problem Statement**

Diabetes imposes high, direct and indirect costs in all nations. All countries rich and poor are suffering the impact of the diabetes. Diabetes disproportionately affects low and middle income countries in terms of prevalence, mortality and morbidity. Disease estimates for Sub-Saharan Africa (SSA) are based on sparse data, but projections indicate increases in NCD's caused by demographic and epidemiologic transitions (Ayah *et al.*, 2013). As the prevalence of diabetes in Africa is expected to rise, the economic burden on individuals will also continue to increase (Mutymbizi *et al.*, 2018). It is estimated that, in

2015, the overall cost of diabetes in sub-Saharan Africa was US\$19.45 billion or 1.2% of cumulative gross domestic product (GDP). Around \$10.81 billion (55.6%) of this cost arose from direct costs, which included expenditure on diabetes treatment (eg, medication, hospital stays, and treatment of complications), with out-of-pocket expenditure likely to exceed 50% of the overall health expenditure in many countries (Atun, 2017).

Uncontrolled diabetes leads to complications in many organs. Damage to small and large blood vessels and nerves leads to loss of vision and kidney function, heart attacks, strokes, and lower limb amputations. Diabetes causes disability and shortens lives (Roglic, 2016). According to data from Center for Disease Control and Prevention (2017) diabetes was the seventh leading cause of death in the United States in 2015. This finding is based on 79,535 death certificates in which diabetes was listed as the underlying cause of death (crude rate, 24.7 per 100,000 persons).

Intensive management and monitoring of diabetics is crucial with matched diagnostic and medical availability (Tiffany, 2013). If left untreated, diabetes leads to a plethora of complications, both microvascular and macrovascular, that affect multiple physiological systems (Atun, 2017). Lifetime medical costs of diabetes remain substantial, despite people with diabetes having shorter life expectancies than those without diabetes. The interaction of diabetes with infectious diseases increases the burden of illness on resource-constrained health systems (Atun, 2017). In low-resource settings, health-care costs for cardiovascular diseases, cancers, diabetes or chronic lung diseases can quickly drain household resources, driving families into poverty. The exorbitant costs of NCDs, including often lengthy and expensive treatment and loss of breadwinners, are forcing millions of people into poverty annually, stifling development (MoH, 2015).

Kenya has a challenging health landscape with the burden of diabetes and other NCDs adding to the existing challenge of communicable diseases (Tiffany, 2013). Diabetes complications can affect various parts of the body, manifesting in different ways in different people (IDF, 2014). In Kenya, the health sector is predominantly financed by private sector sources (including by households' out-of-pocket (OOP) spending (MoH, 2015). In Kenya, there were 1,976,337 NCDs cases in 2012. Nairobi and Kiambu led all other counties in NCDs with 155,899 and 126,754 cases respectively (MoH, 2013). Based on regional projections, the Kenya prevalence of diabetes in adults is estimated to be 4.56% according to IDF, amounting to almost 750,000 persons and 20,000 annual deaths. There is a disparity in distribution with an estimate of approximately 10.7% among urban and 2.7% among rural dwellers (IDF, 2014). The diabetes prevalence range from 3.3%-6% in Kenya (Nkatha *et al.*, 2015). This indicates that a diabetic patient is burdened in managing and achieving glycemic control and facing both microvascular and macro vascular complications. There was need to conduct this study in Thika Level 5 Hospital because there is no documentation about the burden of diabetes in Kiambu County.

#### **1.4 Justification**

By 2030, prevalence of diabetes globally is estimated to be 7.7% with 439 million adults affected (IDF, 2014). The cost of diabetes care is high and is escalating worldwide. Annual per capita medical spending for people with diabetes is more than two times that for those without diabetes (American Diabetes Association, 2012). The high cost associated with diabetes suggests that reducing incidence through prevention might lower lifetime medical spending and alleviate some of the future economic burden of treating diabetes. In low and middle income countries, awareness of diabetes and access to

healthcare are low or non-existent in many rural areas (IDF, 2014). If left unchecked, however, the adverse outcomes of diabetes and other cardiovascular risk factors could overwhelm health systems in sub-Saharan Africa and leave many of those affected with substantial morbidity and mortality (Atun, 2017).

The management of diabetes and its risk factors is reasonably simple and inexpensive. Treating complications, however, is costly, requiring providers with a high level of skill and specialized equipment. Prevention of complications is therefore crucial (Atun, 2017). More national-based surveys with precise separation of Health Resource Use (HRU) for prevention and treatment of late complications will be needed to inform healthcare providers and policymakers regarding the socioeconomic burden of diabetes and its complications (Gagliardino *et al.*, 2017). In Kenya the current disease burden indicates a need for more resources for prevention and health promotion, with primary healthcare taking greater responsibility for chronic diseases. Effective primary care should lower hospital admissions and reduce overall cost (WHO, 2012). With the transformation in lifestyles in both the sprawling urban centres and in rural areas, obesity and diabetes have become a new priority for health in Africa region. Global and regional estimates are documented but rarely County data available.

A study was carried on prevalence of depression among diabetes patients attending diabetic clinic at Thika Level 5 Hospital (Kaleli, 2013). This warrants more research to be done on burden and comorbidities associated with diabetes mellitus in Thika Level 5 Hospital. There was also need to determine quality of life and the costs incurred by diabetic patients attending Thika 5 Hospital because Kiambu County is 2<sup>nd</sup> to Nairobi County in terms of NCDs prevalence. Thika Level 5 Hospital is also the main referral hospital within

Kiambu County and has an extensive catchment area including the neighboring counties like Murang'a and Machakos. The findings of this study provides an important input to the government of Kiambu County on the need to prioritize policies affecting costs associated with management of diabetes patients.

### **1.5 Research Questions**

1. What are the direct and indirect costs associated with Diabetes Mellitus among patients attending Thika Level 5 hospital Kiambu County, Kenya?
2. What are the Years of Life Lost (YLL) and Years Lived with Disability (YLD) associated with Diabetes Mellitus among patients attending Thika Level 5 hospital Kiambu County, Kenya?
3. What is the Health Related Quality of Life (HRQoL) among patients with Diabetes Mellitus attending Thika Level 5 hospital Kiambu County, Kenya?

### **1.6 Objectives**

#### **1.6.1 Broad objective**

To quantify the burden of Diabetes Mellitus among patients attending Thika level 5 hospital, Kiambu County, Kenya

#### **1.6.2 Specific Objectives**

1. To determine the direct & indirect costs associated with Diabetes Mellitus among patients attending Thika Level 5 hospital Kiambu County, Kenya.
2. To find out Years of Life Lost (YLL) and Years Lived with Disability (YLD) associated with Diabetes Mellitus among patients attending Thika Level 5 hospital Kiambu County, Kenya

3. To determine Health Related Quality of Life (HRQoL) among patients with Diabetes Mellitus attending Thika Level 5 hospital Kiambu County.

### **1.7 Significance of the Study**

Data provided in study would advise policy in County on need to work towards comprehensive and sustainable solutions in regard to diabetes. The data provides a foundation for further assessments, such as in relation to health interventions aiming to prevent or treat the condition, and address disease related expenditure. Knowledge on medical cost of diabetes is critical to understanding the long-term economic consequences of diabetes prevention. Thus, assuming prevention costs can be kept sufficiently low, effective diabetes prevention efforts would likely lead to a reduction in long-term medical costs (Xiaohui, 2014).

### **1.8 Anticipated Output**

This study has generated data on direct and indirect costs incurred by diabetes patients and also YLL, YLD, HRQoL for diabetes. This information will help policy makers and healthcare providers to put more emphasis on health promotion and prevention of diabetes. Which will in turn reduce diabetes prevalence hence reduce medical lifetime costs for diabetes. This will also help to ensure proper management of diabetes thereby reducing the microvascular and macrovascular complications and also a reduction in the costs associated with the complications

### **1.9 Limitations**

The results of this study will not be inferred to the entire population because it is a hospital based study. Longitudinal design over long period of time like 10yrs would have been most suitable for this study so as to quantify costs associated with management of complications

associated with diabetes. DALYs calculation considered diabetes only leaving out the comorbidities associated with diabetes and also intangible costs were not considered.

### **1.10 Delimitations**

Since there is sparse data on the burden of diabetes in Kenya the findings of the study has generated information to inform policy makers especially on the high costs incurred in treatment and management of diabetes. Despite DALYs on comorbidities, the diabetes DALYs from this study is adequate for strategies to put in place to reduce morbidity and mortality associated with diabetes.

### **1.11 Theoretical Framework**

Betty Neuman's systems model (1974) is a theoretical framework for this study. Neuman's systems model views the diabetic patient as a holistic system that could be influenced by several factors including environmental stressors. Neuman's model focused on each individual's perception of stress, the reactive components of stress, and each individual's reaction to the stressor. Wellness was defined as a stable condition in which the patient was able to interrelate in synchronization within the whole system.

In Neuman's model, the patient system was impacted by internal and external stressors, which Neuman labeled interpersonal, intrapersonal, and extrapersonal. Stressors could disturb the stability of system, and the system had to adjust to the stressor by using energy to acclimate to the situation. The stressors strained the patient's normal and flexible lines of defense. The lines of defense were supple and protected the client in a normal response or wellness state. In the diabetic patient in particular, the lines of defense served as a barrier to protect the diabetic client from complications. Eventually, if the client

continually was exposed to stressors, a change in wellness occurred, as the lines became weakened or broken, resulting in a negative effect on systems in the body.

In a person with diabetes, common stressors might include the intrapersonal stressor of hyperglycemia, the interpersonal stressor of low social support, and the extrapersonal stressor of limited financial resources. Diabetic patients may have multiple stressors that could negatively impact well-being and overall health. The interrelationship of physiological, psychological, sociocultural, developmental, and spiritual variables could affect how an individual with diabetes viewed quality of life.

Quality of life is impacted by one's physical restrictions and mental and social wellbeing. Unknown stressors may exist, which also may lead to disease progression in the diabetic client. The diabetic patient's normal and flexible lines of defense may be weakened by glycemia and its possible effect on organs of the body. Once the flexible lines of defense are weakened, it is essential to assist the diabetic patient in retaining, attaining, or maintaining stability. When a diabetic patient's flexible line of defense is weakened or broken, perceived quality of life can be affected. A diabetes management program that focused on the diabetic patient as a whole and examined all stressors could potentially impact how quality of life was perceived. A tailored diabetes management program could strengthen the lines of defense for the diabetic. In summary, this study aims to determine HRQoL in diabetic patients so as to help health care workers gain knowledge in patient's perception of Health Related Quality of Care and thereby provide holistic care which will improve quality of life

### 1.12 Conceptual Framework

The independent variables in the study include the direct, indirect costs, YLL, YLD and determinants of Health Related Quality of Life (HRQoL). The dependent variable in the study is the burden of diabetes mellitus. Measurement approaches for variables is as shown in figure 1.1.

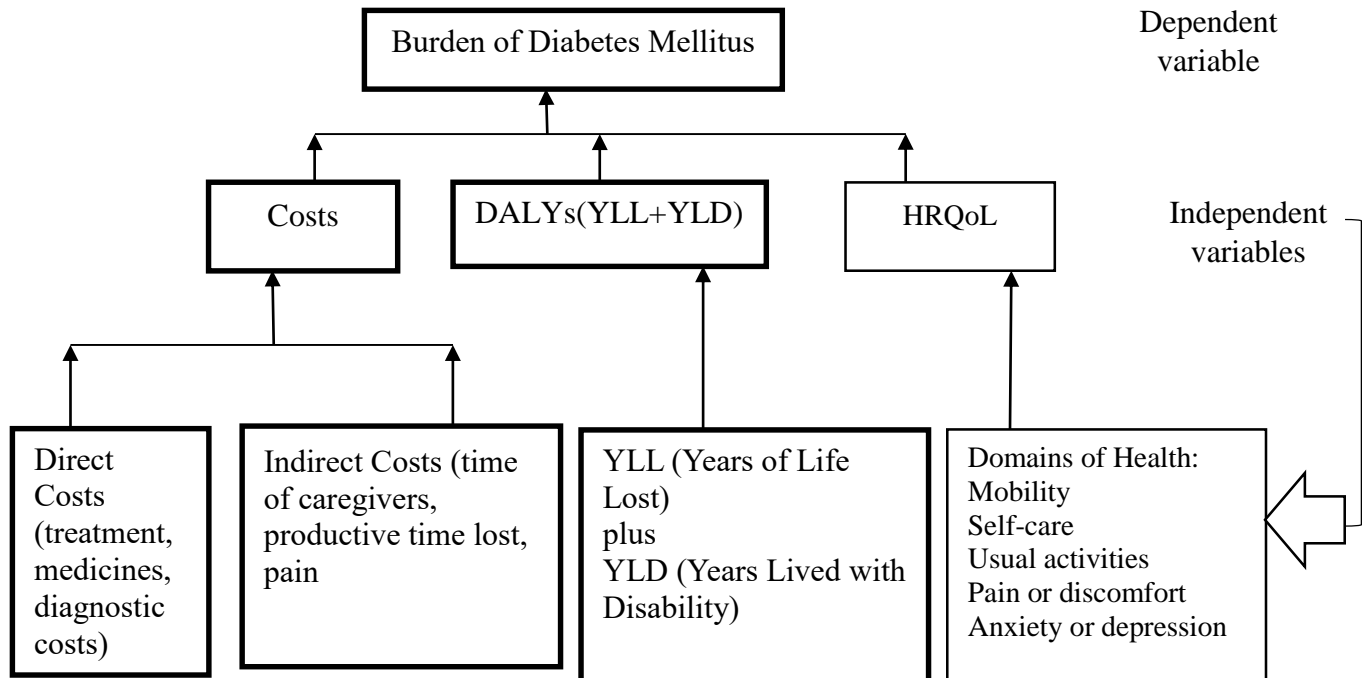


Figure 1.1 Conceptual framework. Source: Adopted from Kirigia *et al.*, 2009.

## CHAPTER TWO: LITERATURE REVIEW

### 2.1 Introduction

This chapter provides an extensive review of the literature of disease burden, direct and indirect costs, mortality, morbidity and Health Related Quality of Life.

### 2.2 Burden of Disease

One measure of burden of disease is Disability-Adjusted Life Years (DALYs), which combines estimates of years of life lost due to premature death (YLL) and years lived with disability (YLD) to count the total years of healthy life lost from disease and injury. Globally, there has been a continuous shift in disease burden away from infectious diseases to non-communicable diseases and from premature death to years lived with disability (Murray *et al.*, 2013). The world's population which is ageing has led to a considerable increase in the numbers of individuals with sequelae of diseases and injuries. The Years Lived with Disabilities are declining much more slowly than Years of Life Lost. Therefore, the non-fatal illnesses and injury will require more and more attention from health systems (GBD, 2013). There has been a marked increase in the proportion of Years Lived with Disability globally from 21.1% in 1990 to 31.2% in 2013 (GBD, 2013).

The increasing burden from diabetes, mental disorders and musculoskeletal disorders has created new challenges on health care systems. The regional diversity signifies the importance of understanding local burden of disease and setting goals and targets for the post-2015 agenda taking such patterns into account (Murray *et al.*, 2013). By 2014, the prevalence of diabetes has risen higher in low-income (7.4%) than in high-income (7.0%) countries. The prevalence of diabetes has risen faster in low- and middle-income countries and is currently highest in upper middle-income countries (9.3%).

Among the WHO regions, the prevalence is highest in the Eastern Mediterranean region (13.7%) and lowest in the African region (7.1%) (Roglic, 2016). During the past three decades, the number of Americans with diagnosed diabetes has more than tripled, from 6 million in 1980 to 21 million in 2010. According to IDF 5<sup>th</sup> edition, 366 million people had diabetes in 2011. Kenya is among six African countries with the highest number of diabetes with 1.8 million people living with the disease. The biggest challenge facing the country today is that the number of young people living with the disease is on the rise (National Diabetes fact sheet, 2011). It is estimated that about 14% of the population in Kenya have impaired glucose (MoH, 2015).

### **2.2.1 Type 1 diabetes**

Type 1 diabetes (which was known as insulin-dependent, juvenile or childhood-onset) is characterized by lack of insulin being produced by the pancreas and requires daily administration of insulin. The cause of Type 1 diabetes is not known and it is not preventable with current knowledge (WHO, 2018). During 2011–2012, the estimated annual number of newly diagnosed cases in the United States included: 17,900 children and adolescents younger than age 20 years with type 1 diabetes, 5,300 children and adolescents age 10 to 19 years with type 2 diabetes (Mayer, 2017).

### **2.2.2 Type 2 diabetes**

Type 2 diabetes (previously known as non-insulin-dependent, or adult-onset) results from the body's ineffective use of insulin. Type 2 diabetes comprises the majority of people with diabetes around the world, and mostly affected the elderly. Symptoms may be similar to those of Type 1 diabetes, but may not be evident and as a result, the disease may be diagnosed several years after onset, once complications have

already arisen. Until recently, this type of diabetes was seen only in adults but it is now also occurring increasingly frequently in children which could be associated obesity and lifestyle changes (WHO,2018).

### **2.3 Direct Costs**

Direct costs include all expenditures for management of diabetes, including medication, hospital stays, and treatment of comorbidities. The disparities in the world's response to the increase in diabetes prevalence are huge, only 20% of global health expenditure on the disease was in LMIC (IDF, 2014). The costs associated with diabetes include increased use of health services, productivity loss and disability, which can be a considerable burden to the individual, families and society. With its increasing prevalence and high cost of treatment, diabetes places an enormous demand on the economic resources of the U.S. Approximately 20% of the nation's health care dollars go to treating people with diabetes. Patients with diabetes are known to have reduced life expectancy and substantially higher lifetime medical expenditures due to complications (Xiaohui, 2014).

Globally, diabetes caused at least USD 465 billion in healthcare expenditure in 2011; 11% of total healthcare expenditure in adults (IDF, 2011). In Sub-Saharan Africa it is estimated that the total cost will increase to between \$35.33 billion (1.1% of GDP) and \$59.32 billion (1.8% of GDP) by 2030. Putting in place systems to prevent, detect, and manage hyperglycaemia and its consequences is therefore warranted from a health economics perspective (Atun, 2017). Diabetes inadequacies result in a substantial drop off of patients along the diabetes care cascade, with many patients going undiagnosed and with those who are diagnosed not receiving the advice and drugs they need (Atun, 2017). In East Africa the average total annual cost for care of a type 1 diabetic is 229US\$ with 60-70%

of this being used to purchase insulin (Mcferran, 2012). In 2006 Kenya's Total Health Expenditure (THE) was 4.6% of gross domestic product with 29US\$ per capita being spent on health (WHO, 2009), below the WHO recommended 34US\$ for provision of a minimum health package (CSIS, 2012). Kenya does not have adequate funds for diabetes prevention or care (WHO, 2010).

## **2.4 Indirect Cost**

Indirect costs are defined as productivity or production losses associated with morbidity and premature mortality (Seuring, 2014). The indirect costs consist of opportunity cost of time lost due to morbidity (temporary disability and permanent disability) and premature mortality. The morbidity-related component includes the productivity losses of time invested by patients in outpatient department consultations, travel to and from hospitals, waiting for admission, and during institutionalized treatment; by relatives accompanying patients during pre-admission consultations, travel to and from hospitals accompanying patients, waiting for patients to be admitted, and visiting patients after admission. The premature mortality-related cost component is equal to the lost work-years due to premature death (i.e. retirement age minus age at death) times average remuneration per year. Intangible costs refer to welfare losses due to the physical and psychological pain. Due to the stigma attached to chronic diseases, the related psychic and social costs to the affected families can be profound.

## **2.5 DALYs and YLD**

Disability-adjusted life-years (DALYs) are a widely used gap measure representing the sum of years of life lost (YLLs) due to premature mortality and years lived with disability (YLDs). YLLs quantify the gap between observed mortality and a normative life

expectancy and YLDs capture the prevalence of conditions that lead to non-fatal health loss while accounting for the severity of those conditions. Health gap measures can be easily disaggregated to examine contributions of relative morbidity and mortality, individual diseases, injuries, and attributable risk factors (GBD, 2015). Diabetes related complications include microvascular diseases (for example, retinopathy, blindness, nephropathy, and kidney failure) and macro vascular diseases (coronary heart disease, stroke, peripheral vascular disease and lower-extremity amputation). These complications or comorbidities will result into the various disabilities. Foot ulcers are seen frequently at many tertiary clinics in Kenya and are associated with poor glycemic control, infection, hypertension and dyslipidemia (Kenya National Diabetes Strategy 2012).

YLDs for both sexes increased from 537.6 million in 1990 to 764.8 million in 2013 due to population growth and ageing, whereas the age-standardized rate decreased little from 114.87 per 1000 people to 110.31 per 1000 people between 1990 and 2013. Leading causes of YLDs included low back pain and major depressive disorder among the top ten causes of YLDs in every country. YLD rates per person, by major cause groups, indicated the main drivers of increases were due to musculoskeletal, mental, and substance use disorders, neurological disorders, and chronic respiratory diseases; however, HIV/AIDS was a notable driver of increasing YLDs in sub-Saharan Africa (GBD, 2013). The increasing impact of diabetes in sub-Saharan Africa is reflected in results from the 2015 GBD study, which estimated that diabetes in the region caused an average of 145 189 deaths and 5 556 560 DALYs; DALYs attributable to diabetes increased by 88% between 1990 and 2010 (GBD,2017).

## **2.6 Years of Life Lost (YLL)**

One and a half million people died directly from diabetes in 2012. However, blood glucose levels that are higher than optimal but are below the diagnostic threshold for diabetes also increases the risk of death, particularly from CVD, and have caused an additional 2.2 million deaths (Roglic, 2016). YLLs typically account for about half of disease burden in more developed regions (high-income Asia Pacific, Western Europe, high-income North America, and Australia), rising to over 80% of DALYs in sub-Saharan Africa (Murray *et al.*, 2013). Diabetes caused 4.6 million deaths in 2011 (IDF, 2011). In 2010, nearly 7,750 Australians died from diabetes and causes related to diabetes. This is 5.4% of all deaths in that year. In 2010, the diabetes-related death rate was 55% higher among males than females (the rate for males was 39 per 100,000 males and for females, 25 deaths per 100,000 females).

In Kenya 15,523 people died as a result of diabetes in 2014 (IDF, 2014). Inevitably, there is considerable imprecision in such estimates and other groups have produced different figures. For example, the IDF estimated that, in 2015, around 321 000 deaths in sub-Saharan Africa were attributable to diabetes, and that 79% of those deaths occurred in people aged 60 years or younger—a proportion higher than in any other region in the world (IDF, 2017).

## **2.7 Health Related Quality of Life (HRQoL)**

EQ-5D used to measure HRQoL has been used extensively in economic evaluation, and is recommended for use in cost-effectiveness analyses by institutions such as the National Institute for Clinical Excellence (NICE) in the UK and the Health Care Insurance Board in the Netherlands (Solli, 2018). In a Finnish study which used the 15D instrument

on 1,023 patients with Type 1 diabetes, was to assess HRQoL and its association with diabetic complications. The mean 15D score 0.899. By means of a Tobit regression model, reduction in HRQoL was explained by microalbuminuria, dialysis, renal transplant, poor glycemic control, aging and longer diabetes duration with utility decrements of -0.036, -0.082, -0.053, -0.006, -0.002 and -0.001 respectively. The authors concluded that the 15D scores decreased with increasing age. Reduced HRQoL was observed in persons with nephropathy. This was not the case for retinopathy (Ahola, 2010).

A study in the US aimed to examine and quantify the differences in HRQoL of diabetic patients with and without macrovascular comorbid conditions. After controlling for age, sex, race, ethnicity, education, income, employment status, health insurance, smoking status, diabetes severity and comorbidities, a two-part model was used to identify the relationship between macrovascular conditions and the EQ-5D index. The authors found that patients with macrovascular comorbid conditions had significantly lower EQ-5D index of 0.062 compared to diabetic patients without these complications (Fu, 2011).

## **2.8 Comorbidity**

Uncontrolled diabetes leads to complications in many organs. Damage to small and large blood vessels and nerves leads to loss of vision and kidney function, heart attacks, strokes, and lower limb amputations. Diabetes causes disability and shortens lives (Roglic, 2016). Comorbidity rose substantially with age and in absolute terms from 1990 to 2013. Incidence of acute sequelae were predominantly infectious diseases and short-term injuries, with over 2 billion cases of upper respiratory infections and diarrheal disease episodes in 2013, with the notable exception of tooth pain due to permanent caries with more than 200 million incident cases in 2013. Conversely, leading chronic sequelae were largely

attributable to non-communicable diseases, with prevalence estimates for asymptomatic permanent caries and tension-type headache of 2.4 billion and 1.6 billion, respectively. The distribution of the number of sequelae in populations varied widely across regions, with an expected relation between age and disease prevalence (GBD, 2013). Adequate management of hyperglycemia and other risk factors, and regular assessment for early evidence of complications, are the cornerstones of successful strategies to prevent microvascular and macro vascular complications (WHO, 2017).

Rapid demographic changes have set the scene for ever-greater challenges to the countries that are least equipped to tackle the global diabetes burden (IDF, 2014). Comorbidities and sequelae in many instances result in catastrophic or impoverishing health-care expenditures, sinking many patients and their families beneath the poverty line. Low levels of public funding, low income levels, and high out-of-pocket expenditures have adversely affected the uptake and provision of care for patients with diabetes, increasing the likelihood of long-term complications.

In the United Arab Emirates (UAE), the prevalence for type 2 diabetes is 23%, with hypertension, obesity, and dyslipidemia as common type 2 diabetes comorbidities. Hypertension (83.40%), obesity (90.49%) and dyslipidemia (93.43%) were common type 2 diabetes comorbidities. Most of the patients had relatively poor glycemic control and presented with multiple complications (83.47% of patients had one or more complication), with frequent renal involvement. (Jelinek *et al.*, 2017). Among comorbidities, the most frequent complication was retinopathy (13.26%). However, the pattern of complications varied based on age, where in patients <65 years, a single pattern presented, usually

retinopathy, while multiple complications was typically seen in patients >65 years old. (Jelinek *et al.*, 2017).

Over time, diabetes can damage the heart, blood vessels, eyes, kidneys, and nerves (WHO, 2018). Adults with diabetes have a two- to three-fold increased risk of heart attacks and strokes (Sarwar, 2010). Combined with reduced blood flow, neuropathy (nerve damage) in the feet increases the chance of foot ulcers, infection and eventual need for limb amputation (WHO, 2018). Diabetes is among the leading causes of kidney failure (USRDS, 2014).

## **2.9 Diagnosis and treatment**

Early diagnosis can be accomplished through relatively inexpensive testing of blood sugar. There are several ways of managing diabetes which involves diet and physical activity to achieve glycemic control and to lower the levels of other known risk factors that damage blood vessels. Emphasis on Tobacco use cessation is also important measure to avoid complications associated with diabetes. Interventions that are both cost-saving and feasible in low income countries include: blood glucose control, particularly in type 1 diabetes. People with type 1 diabetes require insulin, people with type 2 diabetes can be treated with oral medication, but may also require insulin; blood pressure control; and foot care (WHO,2018).

## **2.10 Healthcare Financing**

Several countries, such as Cameroon, Botswana, and Seychelles, have introduced earmarked taxation to influence health behaviours, with revenues allocated to health promotion activities in order to increase health financing for NCDs. Others have launched reforms to increase public funding for health systems and to achieve

universal health coverage, but large informal sectors hinder effective tax collection to invest in health systems (Atun, 2017). NHIF in Kenya registers all eligible members both employed and self-employed and upon registration one is issued with NHIF membership card. For the employed the employer submits their monthly contributions while the self-employed submits their contributions monthly. Membership is compulsory for the employed and voluntary for the self-employed. Universal health coverage schemes should ensure access to screening, regular follow-up, access to medicines so that no patient has to pay direct costs of care out of pocket (Atun, 2017).

### 2.11 Progressive Health States of Diabetes Mellitus

According to figure 1.2, it shows the progressive health state of diabetes mellitus with the initial diagnosis followed by treatment if a patient is confirmed to be having the diabetes that is being in remission. Over time the patient may develop complications resulting to terminal illness and thereafter death. Alternatively, other patients may be clinically free of diabetes and termed as cured.

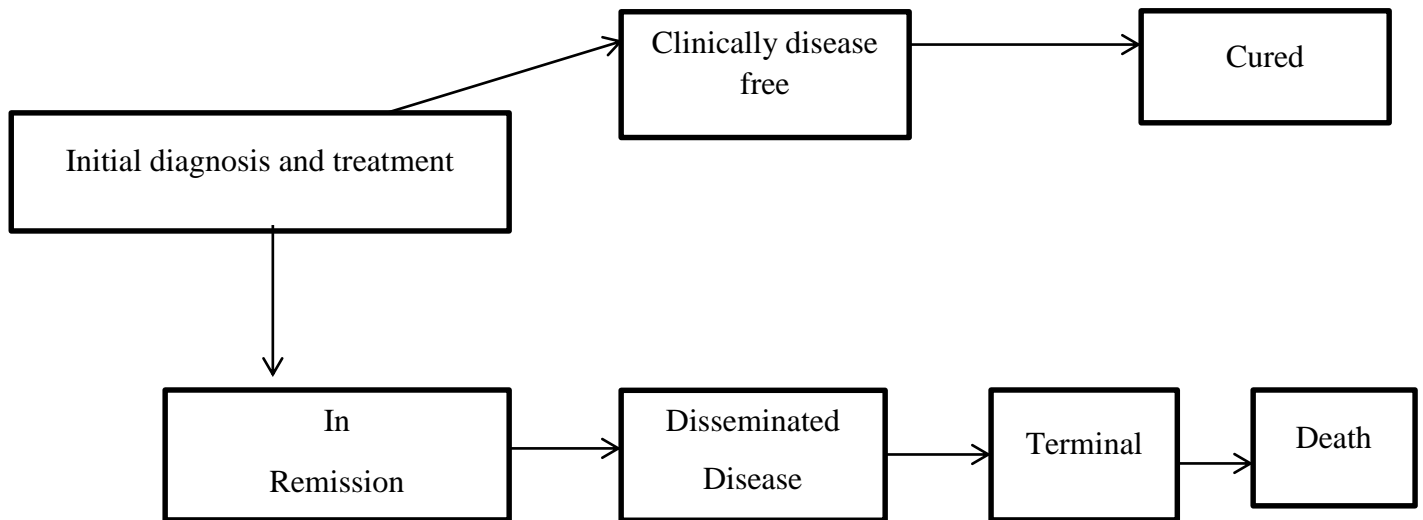


Figure 1.2. Source: Adapted from Australian Burden of Disease Studies (2013)

## 2.12 Summary of Literature Review

A Burden of Disease study aims to quantify the burden of premature mortality and disability for major diseases or disease groups (GBD, 2013). Global disease burden has continued to shift away from communicable to non-communicable diseases and from premature death to years lived with disability (Murray *et al.*, 2013). Rates of Years Lived with Disability (YLDs) are declining much more slowly than mortality rates (GBD, 2013). YLLs typically account for about half of disease burden in more developed regions (high-income Asia Pacific, Western Europe, high-income North America, and Australia), rising to over 80% of DALYs in sub-Saharan Africa (Murray *et al.*, 2013). The prevalence of diabetes has risen faster in low- and middle-income countries and is currently highest in upper middle-income countries (Roglic, 2016). Having diabetes is associated with substantially higher lifetime medical expenditures despite being associated with reduced life expectancy.

In Sub-Saharan Africa it is estimated that the total cost will increase to between \$35.33 billion (1.1% of GDP) and \$59.32 billion (1.8% of GDP) by 2030. Besides the economic burden on the health-care system and national economy, diabetes often imposes catastrophic personal expenditures from out-of-pocket payments and loss of income due to disability and premature death (Roglic, 2016). In Kenya, Non communicable diseases accounts for more than 50% of total hospital admissions and over 55% of hospital deaths. The major NCDs are cardiovascular conditions, cancers, diabetes, and chronic obstructive pulmonary diseases with their sequelae and their shared risk factors (MoH, 2015). In Kenya 15,523 people died as a result of diabetes in 2014. Diabetes complications can affect various parts of the body, manifesting in different ways in different people (IDF, 2014).

In Kenya, the health sector is predominantly financed by private sector sources (including by households' out-of-pocket (OoPE) expenses (MoH, 2015). According to a study by Solli (2018) the findings indicate that complications may have an impact on many dimensions of health-related quality of life, and the impact may be substantial for a patient with diabetes. The strongest determinants of reduced HRQoL, as assessed with the EQ-5D index, were ischemic heart disease, stroke and neuropathy.

## **CHAPTER THREE: MATERIALS AND METHODS**

### **3.1 Introduction**

This chapter outlines the study area, research design, study variables, the population under study, the sampling techniques, sample size determination, data collection methods and ethical considerations. This chapter also contains details on data processing and statistical analysis, reliability and validity of the research instruments as well as the pre-testing of the data collection tools.

### **3.2 Study Design**

This was prospective prognostic study design in which patients were followed up over 6 months and outcomes were measured. This study design was most appropriate because it helped to determine Disability-Adjusted Life Years (DALYs) among patients attending Thika level 5 hospital, Kiambu County. It encompassed both the Years of Life Lost (YLL) due to premature mortality and Years Lived with Disability (YLD) due to Diabetes Mellitus for 6 months.

### **3.3 Study Variables**

#### **3.3.1 Dependent Variable**

The dependent variable for this study was the burden of Diabetes Mellitus among patients attending Thika level 5 Hospital, Kiambu County.

#### **3.3.2 Independent Variables**

The independent variables for this study were the direct and indirect cost incurred by Diabetes Mellitus patients. Other independent variables measured include Years of Life

Lost (YLL) and Years Lived with Disability (YLD) as a result of Diabetes Mellitus among patients attending Thika level 5 Hospital, Kiambu County.

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

The study was carried out in Thika level 5 Hospital which is a 300-bed government hospital situated in Thika Sub-county, Kiambu County (Appendix 1). The sub-county lies between latitudes 3' 53" and 1' 45" South of the Equator and longitudes 36' 35" and 37' 25" East.

### **3.5 Target ad Study Population**

#### **3.5.1 Target Population**

The study population comprised of diabetic patients attending Thika Level 5 Hospital Kiambu County, Kenya.

#### **3.5.2 Study Population**

The sampled diabetes respondents were 594 and were followed up for 6 months.

### **3.6 Inclusion Criteria**

Patients diagnosed or had in the past been diagnosed with Diabetes Mellitus including both Type I and Type II patients.

### **3.7 Exclusion Criteria**

Patients with gestational diabetes were excluded from the study. This is because diagnosis is done between 24<sup>th</sup> to 28<sup>th</sup> weeks of pregnancy making it impossible for a follow up to be executed among them. Those with mental disorders and very ill diabetic patients were excluded from the study.

### **3.8 Sampling Techniques**

The sample size for this study was 594. Therefore, purposive sampling was used to recruit respondents till saturation.

### 3.9 Sample Size Determination

The study sample was estimated as for One-Sample Binomial Test (Two Sided Alternative) as by Rosner (2011).

$$n = \frac{P_o q_o (Z_{1-\alpha/2} + Z_{1-\beta} \sqrt{\frac{P_1 q_1}{P_o q_o}})^2}{(P_1 - P_o)^2}$$

n=540

Where

$P_1$

Prevalence of diabetes in diagnosed population =53 cases per 1000

$q_1$      1 -  $P_1$  = 0.947

$P_o$      Prevalence of diabetes in undiagnosed population =26 cases per 1000

$q_o$      1 -  $P_o$  = 0.973

$Z_{1-\alpha/2}$      Standard Normal Deviate at 95% level of confidence =1.96

$Z_{1-\beta}$      Standard Normal Deviate at the power of 1-  $\beta$ (80%) = 0.842

n=540

Addition of 10% for non-response to the sample size. Therefore, the sample size was 594 respondents

### 3.10 Construction of Research Instruments

Technical defects were minutely scrutinized and removed after re-examination. The questionnaire contained simple and straightforward questions that the respondents did not face any difficulty in answering the question

### 3.11 Pre-testing of Study Tools

The research tool was pretested in Mbagathi Level 5 Hospital, which is located in Nairobi County. This is because they also have patients diagnosed with Diabetes Mellitus who are treated and followed up in their outpatient clinics. Pretesting was done to ensure that the

research tools test what it is intended to measure and that they consistently measure the variables in the study.

### **3.12 Validity**

Validity is the test of degree of accuracy of a result or a test of how well the designed tool would measure what they were supposed to measure in the study. The questionnaires used were standardized tool which included the EQ-5D-5L and clearly formulated to avoid ambiguity.

### **3.13 Reliability**

Reliability is the test of repeatability/consistency of results of a study. Since standardized tools were being used reliability was guaranteed and also Cronbach's alpha was used to test the reliability of the data collection method. Variables tested included the five domains of health and demographics variables which had an alpha of not less than 0.77. The research assistants were also trained on how to collect data.

### **3.14 Data Collection Techniques**

Data was collected on YLD where disability incidence, disability duration, age at onset, & distribution by severity class (be disaggregated by age & sex).

Data was also collected on YLL where deaths tabulated by ten-year age groups

The EuroQol was used in measurement and valuation of health status.

The 2015 ICD-10-CM Codes was used to analyze comorbidities and the local pattern of cause of death.

### **3.15 Data Analysis**

Microsoft Excel Worksheet was used for calculating YLD and YLL as provided by [www.who.int/evidence/nbd](http://www.who.int/evidence/nbd)

Disease Modeling Software: DISMOD II was used to ensure internal consistency of epidemiological estimates (of incidences, prevalence, duration and death).

The Bennett-Horiuchi Method was used to assess the completeness of death registration.

### **3.15.1 Analytical model for Calculation of Costs**

The total cost (TC) incurred by diabetes patients and family members can be expressed as follows as adopted by Kirigia *et al.*, 2009:

$$TC = DC + IC + ITC$$

where:

DC is direct cost,

IC is indirect cost (which is value of productivity time lost)

ITC is intangible cost (including physical and psychological pain).

### **3.15.2 Direct costs**

The total direct costs (DC) was estimated using following equations:

$$DC = TCI + TCS + TCD + TCOC + TCH + OoPE$$

where:

TCI is total cost of insulin

TCS is total cost of syringes

TCD is total cost of oral drugs

TCOC is total cost of OPD consultations

TCH is total cost of hospitalization

OoPE is the out-of-pocket expenses borne by patients, family members and relatives.

### **3.15.3 Indirect costs**

The total indirect costs (IC) of the respondents were obtained using the following algorithm:  $IC_n = CTD_n + CPD_n + CPM_n + CPV_n$

where:

CTD<sub>n</sub> is the total cost of productive time lost due to diabetes-related temporary disability

CPD<sub>n</sub> is the total cost of productive time lost due to permanent disability

CPM<sub>n</sub> is the total cost of productive time lost due to diabetes-related premature mortality

CPV<sub>n</sub> is the productivity loss due to the work time lost by relatives accompanying patients.

### **3.15.4 Total cost of productive time lost due to diabetes-related temporary disability (CTD)**

The cost of productive time lost due to diabetes-related temporary disability among persons of various age groups was obtained by multiplying the total number with temporary disability due to diabetes  $NTD_n^i$ , days of disability (DD) and daily gross national income per capita (DGNIPC<sub>n</sub>). Symbolically, can be expressed as:

$$CTD_n^i = NTD_n^i \times DD^i \times GNIPC_n$$

### **3.15.5 Cost of diabetes-related permanent disability (CPD)**

The total cost of productive time lost due to permanent disability (CPD<sub>n</sub>) is the sum of cost of productive time lost due to permanent disability among the respondents. The cost of productive time lost due to permanent disability among persons of various age groups was obtained by multiplying the total number of permanently disabled diabetics ( $NPD_n^i$ ), discounted average duration lived with diabetes (DAD) per person, and gross national income per capita per year (GNIPC). In symbolic terms, CPD for respondents can be expressed as follows:

$$CPD_n^i = NPD_n^i \times DAD \times DGNIPC_n$$

### 3.15.6 Cost of premature diabetes-related mortality (CPM)

The productive life years lost (PLYL) for respondents were obtained by subtracting the sum of the average age of onset and average duration of life lived with diabetes from the maximum life expectancy in Kenya. The cost of premature diabetes-related mortality among the respondents is the product of number of deaths, total number of productive discounted life years lost and gross national income per capita per year.

NDD is the number of diabetes associated deaths among the respondents, DPYLi is the total number of discounted productive life years lost among respondents; and GNIPC<sub>n</sub> is the annual gross national income per capita in PPP. The productive life years lost were discounted at a rate of 3%. In symbolic terms, CPM for respondents age bracket can simply be expressed as:

$$\text{CPM} = \text{NDD} \times \text{DPYL} \times \text{GNIPC}_n$$

### 3.15.7 Cost of productive time lost by caregivers (CPV)

The cost of the work time lost by accompanying relatives is a product of the number of diabetes cases (ND), number of persons travelling to a health facility (i.e. the accompanying relatives) (VR), number of days spent visiting a health facility per person per year (NV) and daily gross national income per capita per day

(DGNIPC). Symbolically, CPV for respondents can simply be expressed as:

$$\text{CPV}_n^i = \text{ND}_n^i \times \text{VR} \times \text{NV} \times \text{GNIPC}_n$$

### 3.15.8 Summary measures of population health

$$\text{DALY} = \text{YLL} + \text{YLD}$$

Where:

YLL = years of life lost due to premature mortality

YLD = years lived with disability

$DALY(c,s,a,t) = YLL(c,s,a,t) + YLD(c,s,a,t)$  for given cause c, age a, sex s and year t

$YLL = N \times L$

Where:

N = number of deaths

L = standard life expectancy at age of death (in years).

### 3.15.9 Quantifying time lived with disability

$YLD = I \times DW \times L$

Where:

YLD = years lived with disability

I = number of incident cases

DW = disability weight

L = average duration of disability (years)

### 3.15.10 Calculation of DALYs with discounting and age weighting (YLD)

$$YLD = \frac{I \times DW \times L (1 - e^{-rL})}{r}$$

where:

I = number of incident cases).

DW= disability weight.

L = duration of disability (years).

r = discount rate.

e = natural base – which is constant

### 3.15.11 Calculation of DALYs with discounting and age weighting (YLL)

$$YLL = \frac{N}{r} (1 - e^{-rL})$$

where:

N = number of deaths

L = standard life expectancy at age of death (years)

r = discount rate (usually 3%)

### **3.16 Logistical and Ethical Considerations**

Approval to conduct the study was granted by Graduate School and ethical clearance was granted from Kenyatta University Ethics and Research Committee. Permission to carry out the study was granted by the National Commission for Science, Technology and Innovation (NACOSTI). Permission to carry out the study was also granted by Thika Level 5 Hospital Kiambu County.

Each study respondent was provided with a written explanation as to the purposes and methods of the study and asked to give consent to participate. Each respondent was informed about their right to decline or withdraw any time from participating in the study without feeling constrained. Respondents were informed that the information will not be made available to persons outside the study team.

Emphasis was put on issues of confidentiality and privacy by restricting access to the information collected and coding of questionnaires.

## CHAPTER FOUR: RESULTS

### 4.1 Introduction

This chapter presents the findings of this study which was conducted in Thika Level 5 Hospital. The results presented in this chapter include the demographic characteristics, costs, Disability Adjusted Life Years (DALYs) and Health Related Quality of Life (HRQoL) of diabetes patients.

### 4.2 Demographic characteristics of respondents

A total of 594 diabetes mellitus patients attending Thika Level 5 Hospital were recruited into the study. Among the 594 respondents 18 (3%) had Type I diabetes mellitus while 576 (97%) had Type II diabetes mellitus.

Table 4.1 shows a summary of demographic characteristics of the respondents included in the study. There were 192 (32%) males and 402 (68%) female respondents. Majority of the respondents were within the age group of 60-70 years with 173 (29%) respondents, followed by 50-60 years with 159 (27%) and 70-80 years with 113(20%) respondents. A majority of respondents 474 (79.8%) were married and the widowed were 88 (14.8%) respondents.

The main occupation for the respondents in this study shows that 347 (58.4%) were farmers and 160 (26.9%) were operating their businesses or traders. Those employed were 46 (7.7%) respondents and 25 (4.2%) were unemployed.

Most of the respondents, 321 (54%) of the respondents had attended primary school, while 181 (30.5%) had completed secondary school, 69 (11.6%) respondents had no formal education, and a few 23 (3.9%) had attended university. The majority of respondents (71.7%) earned a monthly income of less than KSHs 10,000.

**Table 4.1: Demographic characteristics of the respondents**

Characteristics		Frequency (n)	Percent (%)
Sex	Males	192	32
	Females	402	68
Age groups	<10	1	0.2
	10-20	12	2.0
	20-30	8	1.3
	30-40	40	6.7
	40-50	85	14.3
	50-60	159	26.8
	60-70	173	29.1
	70-80	113	19.1
Marital status	Single	29	4.9
	Married	474	79.8
	Divorced	9	1.5
	Widowed	82	13.8
Main Occupation	Farmer	347	58.4
	Business/trader	160	26.9
	Clergy	4	0.7
	Employed	46	7.7
	Not employed	25	4.2
	Others	12	2.1
Highest level of education	University	23	3.9
	Secondary	181	30.5
	Primary	321	54.0
	None	69	11.6
Income (KSHs)	None	77	13.1
	<10,000	426	71.7
	10,001-20,000	63	10.6
	20,001-30,000	18	3.0
	>30,001	10	1.6

#### 4.2.1 Comorbidities

Diabetes is associated with several comorbidities including hypertension, retinopathy, neuropathy, nephropathy, cardiovascular diseases etc. The data for comorbidities associated with diabetes was obtained from the patient's clinic file within the study period.

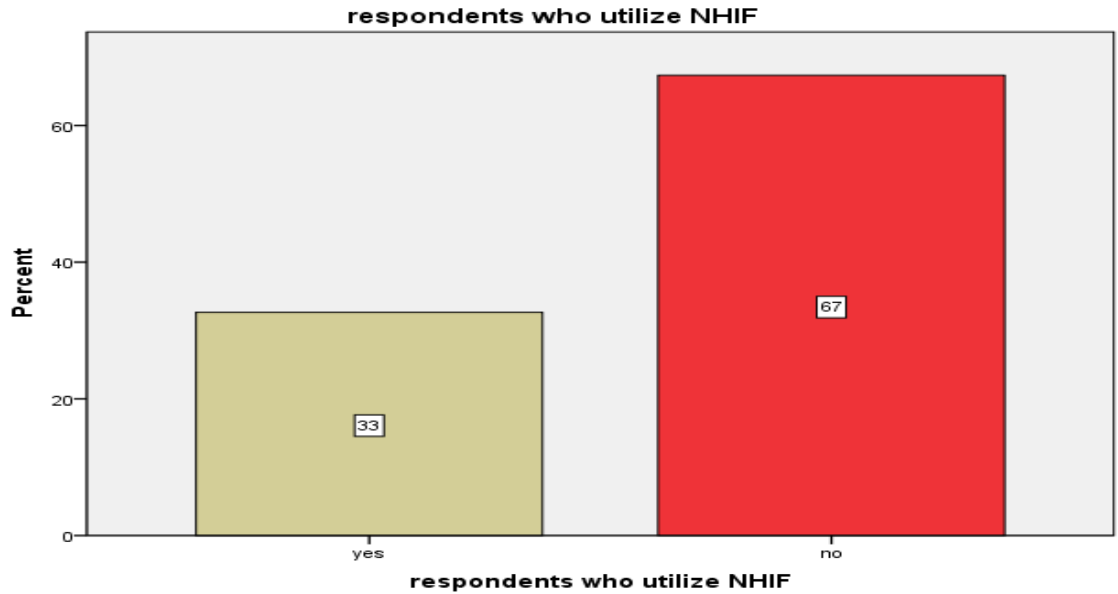
From the study findings on table 4.2, hypertension was one of the common comorbidity associated with diabetes with respondents who were diagnosed with Hypertension being 282 (47%) and those without hypertension were 312 (53%). The mean age for those with hypertension was 65years. Majority of the respondents, 166 (28%) had diabetic retinopathy while 28 (4.7%) respondents had neuropathy. The other comorbidities and complications are summarized in table 4.2

**Table 4.2 Comorbidities for diabetes**

Comorbidities and complications		n	percent
Hypertension	Yes	282	47%
	No	312	53%
Diabetic Retinopathy	Yes	166	28%
	No	428	72%
Cardiac infarction	Yes	12	2%
	No	582	98%
Chronic Kidney Disease	Yes	9	1.5%
	No	585	98.5%
Angina	Yes	7	1.8%
	No	587	98.2%
Diabetic foot	Yes	5	0.8%
	No	589	99.2%
Stroke	Yes	11	1.9%
	No	583	98.1%
Neuropathy	Yes	28	4.7%
	No	566	95.3%
Limb Amputation	Yes	3	0.5%
	No	591	99.5%

#### 4.2.2 Financing

National Health Insurance Fund (NHIF) in Kenya registers all eligible members both employed and self-employed. Those diabetic patients who are registered with NHIF are exempted from paying consultations fees every time they visited the hospital for Doctors review. According to figure 1.3, a few of the respondents 194 (33%) were using NHIF while 400 (67%) respondents had not registered to utilize NHIF services.



**Figure 1.3 showing respondents who subscribe to NHIF**

#### 4.2.3 Diabetic Coma

A diabetic coma is a life threatening diabetes complication that causes unconsciousness. Several factors can cause diabetic coma including hyperglycaemia (high blood sugar) and hypoglycaemia (low blood sugar levels).

Table 4.3 shows that 494 had never experienced diabetic coma since diagnosis of diabetes. However, 53 (8.9%) respondents had experienced one episode of diabetic coma and 26 (4.4%) respondents had experienced more than 5 times episodes of diabetic coma since diagnosis of diabetes.

**Table 4.3 Number of times respondent had experienced diabetic coma since diagnosis**

No of diabetic coma episodes	Frequency	Percent
Never	494	83.2
Once	53	8.9
Twice	15	2.5
Thrice	5	0.8
Four times	1	0.2
Five times or more	26	4.4
<b>Total</b>	<b>594</b>	<b>100</b>

#### 4.2.4 Body Mass Index (BMI)

Body Mass Index is a measure of body fat based on height and weight. The BMI is defined as the body mass divided by the square of the body height, and is universally expressed by in units of  $\text{kg}/\text{m}^2$  resulting from mass in kilograms and height in metres.

Table 4.4 it shows that (2.7%, n=16) of the respondents were underweight, (30.3%, n=180) respondents had normal weight, (38.2%, n=227) respondents were overweight, (27.9%, n=166) respondents were obese.

**Table 4.4 Body Mass Index of the respondents**

	<b>Frequency</b>	<b>Percent</b>	<i>BMI values</i>
Underweight	16	2.7	<i>below 18.5 underweight</i>
Normal	180	30.3	<i>18.5-24.9 healthy(normal)</i>
Overweight	227	38.2	<i>25-29.9 overweight</i>
Obese	166	27.9	<i>30 or higher is obese</i>
Total	589	99.2	
Missing	5	0.8	
<b>Total</b>	<b>594</b>	<b>100</b>	

#### 4.2.5 Consultations

Diabetes patients who are treated with pills and insulin should be seen by a physician at least every four to six months. However, more frequent visits may be necessary if the blood sugar levels are not controlled within the normal range. The visits captured in the study are only inclusive of visits within the diabetic clinic

According to table 4.5, visits to the diabetes clinic within the six months for Doctors consultations in regard to blood glucose monitoring were as follows: most of the respondents (n=489, 85.8%) visited the clinic two times, while (n=67, 11.8%) respondents had three visits to the clinic.

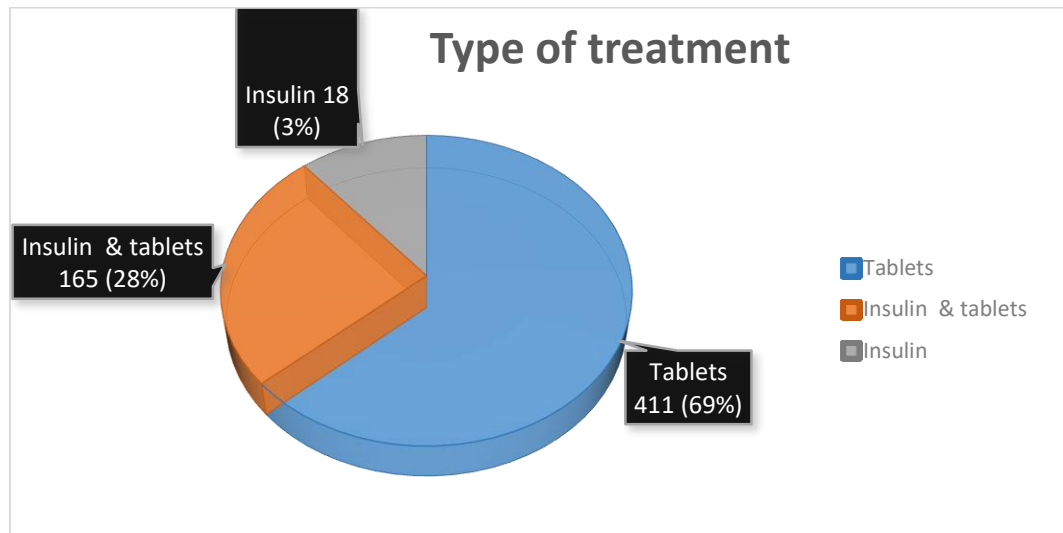
**Table 4.5 Number of consultations within the six months**

No of consultations	n	Percent
2	489	85.8
3	67	11.8
4	13	2.3
5	1	0.2
<b>Total</b>	<b>570</b>	<b>100.0</b>

#### 4.2.6 Treatment

According to this study the commonly used oral drugs to treat diabetes were Glucophage, Nogluc, Glucomet. Mixtard Insulin was also used which is a mixture of fast-acting insulin and long-acting insulin.

According to figure 1.4, most of the respondents, 411 (69%) were using tablets as the form of treatment while 18 (3%) were using insulin injection. However, among the 594 respondents 165 (28%) were using both tablets and insulin.



**Figure 1.4 A pie chart showing type of treatments for respondents**

### **4.3 Objective 1: To determine the direct costs associated with Diabetes.**

The costs incurred on management of diabetes for all the respondents in the study was characterized by total cost of insulin, total cost of syringes, total cost of reagent strips, total cost of oral drugs, total cost of OPD consultations, total cost of hospitalization and the out-of-pocket expenses borne by patients, family members and relatives.

$$DC = TCI + TCS + TCD + TCOC + TCH + OoPE$$

where:

TCI is total cost of insulin

TCS is total cost of syringes

TCD is total cost of oral drugs

TCOC is total cost of OPD consultations

TCH is total cost of hospitalization

OoPE is the out-of-pocket expenses borne by patients, family members and relatives.

### **4.4 Cost of Insulin (TCI) and Cost of Syringes (TCS)**

Insulin remains the main treatment for patients with Type1 diabetes. Insulin is also important therapy for patients with Type 2 diabetes when blood glucose levels cannot be controlled by diet, weight loss, exercise and oral medications. The mean monthly cost of insulin was KSHs 700 and the mean monthly costs of syringes was KSHs 600.

### **4.5 Monthly cost of diabetes drugs**

The estimated costs per drugs prescribed to the respondents are summarized in Appendix 3. Table 4-6 shows the mean monthly costs incurred for diabetes drugs for the respective age groups as follows: between the age group of 40-50 years with 83 respondents a mean cost of KSHs 1,267 was incurred, 50-60 years with 158 respondents incurred a mean cost

of KSHs 1,237, 60-69 years with 165 respondents incurred a mean cost of KSHs 1,206. This is evident that the average mean monthly cost of oral diabetes drugs was approximately KSHs 1,200 and that the cost increases with age.

**Table 4.6 Monthly cost of diabetes drugs**

Agegroup of respondents	n	Sum (KSHs)	Mean	Std. Deviation
<10	1	700	700.00	.
10-20	12	11,040	920.00	746.92
20-30	6	4,120	686.67	351.83
30-40	38	42,920	1,129.47	777.46
40-50	83	105,200	1,267.47	762.62
50-60	158	195,580	1,237.85	748.37
60-70	165	199,100	1,206.67	755.50
70-80	104	104,960	1,009.23	717.38
80-90	3	1,680	560.00	295.97
<b>Total</b>	<b>570</b>	<b>560,340</b>	<b>983</b>	<b>643.8</b>

#### **4.6 Monthly costs of hypertension drugs**

Hypertension is one of the common comorbidity associated with diabetes. According to the study respondents below 30 years did not have hypertension. Table 4-7 shows that the mean of costs of antihypertensive range between KSHs 400-500 per month.

**Table 4.7 Monthly cost of antihypertensive drugs**

Agegroup of the respondents	n	Sum (KSHs)	Mean	Std. Deviation
30-40	12	4,890	407.50	284.74
40-50	25	12,925	517.20	464.38
50-60	71	39,362	554.37	402.10
60-70	91	44,399	487.91	348.51
70-80	67	32,608	486.72	324.11
80-90	3	1,200	400.00	341.17
<b>Total</b>	<b>282</b>	<b>134,006</b>	<b>475.2</b>	<b>360.5</b>

Most of the respondents between 50-80 years were hypertensive and were being managed clinically to ensure they have a normal blood pressure. Based on data in table 4.6 and table 4.7 it is evident that the costs of antihypertensive are cheaper compared to diabetic drugs.

#### **4.7 Monthly costs of other drugs used by the respondents**

A few of the respondents had been prescribed for other drugs for long term use such as lasix, cardiocare, artovastatin, cabaline, meloxicam. Some of these drugs were for treating heart conditions, neuropathy.

**Table 4.8 Monthly cost of other drugs**

Agegroup of the respondents	n	Sum (KSHs)	Mean	Std. Deviation
30-40	4	4,800.00	1,200.0	1,385.64
40-50	6	6,050.00	1,008.3	833.32
50-60	17	26,850.00	1,579.4	1,068.74
60-70	24	44,400.00	1,850.0	999.57
70-80	8	16,800.00	2,100.0	848.53
80-90	1	0.00	0.00	0.00
Total	60	98,900	1,547.4	1,026.6

Table 4.8 shows that the respondents between 30-80 years spent a mean range of KSHs1,850-2,100 in purchasing other drugs monthly. Those below 30 years did not have chronic diseases hence no medication for long term use as illustrated from this study. This implies more cost burden on a diabetic patient who has to purchase more drugs for treating chronic diseases.

#### **4.8 Cost of diabetes drugs**

The common oral medications for treating diabetes were mainly Glucophage, Nogluc, Glucomet and NAT. Respondents are prescribed different drugs depending on individual glycemic control.

**Table 4.9 Cost of diabetic drugs semi annually**

Age group of the respondents	cost of glucophage	cost of nogluc	cost of glucomet	cost of NAT
<10 n	0	0	0	0
10-20 n	2	1	0	0
mean cost	3,600.00	1,440.00	0.00	0.00
20-30 n	1	2	0	0
mean cost	3,600.00	2,160.00	0.00	0.00
30-40 n	19	12	4	0
mean cost	7,484.21	1,440.00	2,160.00	0.00
40-50 n	50	36	14	1
mean cost	7,956.00	1,720.00	2,082.86	5,400.00
50-60 n	110	82	26	0
mean cost	7,625.45	1,395.61	2,201.54	0.00
60-70 n	114	80	23	2
mean cost	7,452.63	1,386.00	2,113.04	5,400.00
70-80 n	58	33	24	0
mean cost	6,672.41	1,483.64	2,475.00	0.00
80-90 n	2	1	1	0
mean cost	3,600.00	720.00	2,160.00	0.00

The commonly prescribed pill was Glucophage followed by Nogluc and Glucomet.

The mean costs varied from various age groups because of the varied dosages prescribed.

**Table 4.10 Total Costs of Oral Drugs (TCD) semiannually in KSHs**

age group of the respondents and costs		n	Minimum	Maximum	Sum	Mean	Std. Deviation
<10	diabetes drugs	1	4200	4200	4200	4200.00	
	hypertension drugs	0	0	0	0	0.00	
	other drugs	1	0	0	0	.00	
10-20	diabetes drugs	12	4200	17640	66240	5520.00	4332.255
	hypertension drugs	0	0	0	0	0.00	
	other drugs	0	0	0	0	.00	.000
20-30	diabetes drugs	6	1440	7800	24720	4120.00	2111.000
	hypertension drugs	0	0	0	0	0.00	
	other drugs	0	0	0	0	.00	.000
30-40	diabetes drugs	38	1440	16440	257520	6776.00	4592.755
	hypertension drugs	12	0	6120	29240	2445.00	1836.891
	other drugs	4	0	14400	28800	7200.00	3258.638
40-50	diabetes drugs	83	1440	21840	631200	7604.00	4637.232
	hypertension drugs	25	120	9540	77550	3102.00	2316.635
	other drugs	6	0	14400	36300	6050.00	1589.781
50-60	diabetes drugs	158	720	20400	1173480	7427.00	4507.325
	hypertension drugs	71	30	10440	236172	3326.00	2112.982
	other drugs	17	0	14400	161100	9476.00	3515.385
60-70	diabetes drugs	165	720	20400	1194600	7240.00	4503.464
	hypertension drugs	91	60	8100	266394	2927.00	1907.441
	other drugs	24	0	14400	266400	11100.00	4501.329
70-80	diabetes drugs	104	720	21840	629760	6055.00	4304.273
	hypertension drugs	67	30	9000	195648	2920.00	1862.072
	other drugs	8	0	14400	100800	12600.00	3625.451
80-90	diabetes drugs	3	2160	5400	10080	3360.00	1775.838
	hypertension drugs	3	120	4680	7200	2400.00	2306.166
	other drugs	0	0	0	0	.00	.000

The findings on table 4.11 shows the costs incurred when the respondents visit the diabetic clinic for consultations. The mean costs for consultations within six months was KSHs 364. This translate to approximately KSHs 728 spent in one years just for consultations costs in the diabetic clinic.

**Table 4.11 Cost of TCOC Semiannually**

Agegroup of respondents	n	Sum (KSHs)	Mean
<10	1	600.00	600.00
10-20	12	6,000.00	500.00
20-30	6	3,200.00	533.00
30-40	38	17,400.00	457.00
40-50	83	36,200.00	436.00
50-60	158	68,000.00	430.00
60-70	165	71,200.00	432.00
70-80	104	40,200.00	387.00
80-90	3	1,200.00	400.00
Total	570	207,800.00	364.00

From time to time some patients are hospitalized because of not achieving glycemic controls either with hypoglycemia, hyperglycemia or due to other conditions related to diabetes. Within the six months 33 respondents were hospitalized and incurred a mean cost of KSHs 12,273 as shown in table 4.12

**Table 4.12 Cost of TCH Semiannually**

Agegroup of respondents	n	Sum (KSHs)	Mean
<10	0	0.00	0.00
10-20	0	0.00	0.00
20-30	1	13,000.00	13,000.00
30-40	2	29,000.00	14,500.00
40-50	3	36,000.00	13,000.00
50-60	5	83,000.00	16,500.00
60-70	8	159,000.00	19,875.00
70-80	4	85,000.00	21,250.00
80-90	0	0.00	0.00
Total	33	405,000.00	12,273.00

During the visits to diabetic clinic for Doctors consultations the respondents always incur costs in regard to transport costs to the hospital and buying snacks/food. Table 4.13 shows that upon a visit to the diabetic clinic, a diabetic patient spends a mean cost of KSHs 624.

**Table 4.13 Cost of OoPE Semiannually**

Agegroup of respondents	n	Sum (KSHs)	Mean
<10	1	1,800.00	1,800.00
10-20	12	7,350.00	613.00
20-30	6	4,950.00	825.00
30-40	38	20,600.00	542.00
40-50	83	43,350.00	522.00
50-60	158	94,420.00	598.00
60-70	165	113,060.00	685.00
70-80	104	68,990.00	663.00
80-90	3	1,400.00	467.00
Total	570	355,920.00	624.00

Direct Costs incurred by diabetes patients within the six months are summarized in table 4.14. These costs include costs of Insulin, costs of syringes, costs of drugs, costs of hospitalization and costs of Out of Pocket Expenditures incurred within six months.

**Table 4.14 Total Direct Costs Semiannually**

age group of the respondents		TCI	TCS	TCD	TCOC	TCH	OoPE
<10	n	1	1	1	1	0	1
	Mean	4,200.00	3,600.00	4,200.00	600.00	0.00	1,800.00
	Sum	4,200.00	3,600.00	4,200.00	600.00	0.00	1,800.00
10-20	n	9	9	12	12	0	12
	Mean	4,200.00	3,600.00	5,520.00	500.00	0.00	612.50
	Sum	37,800	32,400.00	66,240.00	6000.00	0.00	7,350.00
20-30	n	4	4	6	6	1	6
	Mean	4,200.00	3,600.00	4,120.00	533.00	13,000.00	825.00
	Sum	16800	14,400.00	24,720.00	3200	13,000.00	4,950.00
30-40	n	21	21	38	38	2	38
	Mean	4,200.00	3,600.00	8,251.58	457.00	14,500.00	542.00
	Sum	88200	75,600.00	315,560.00	17400.00	29,000.00	20,600.00
40-50	n	34	34	83	83	3	83
	Mean	4,200.00	3,600.00	8,708.55	436.00	13,000.00	522.00
	Sum	142800	122,400.00	745,050.00	36200.00	36,000.00	43,350.00
50-60	n	40	40	158	158	5	158
	Mean	4,200.00	3,600.00	9,675.70	430.00	16,500.00	598.00
	Sum	168000	144,000.00	1,570,752.00	68000	83,000.00	94,420.00
60-70	n	42	42	165	165	8	165
	Mean	4,200.00	3,600.00	10,297.45	432.00	19,875.00	685.00
	Sum	176400	151,200.00	1,727,394.00	71200.00	159,000.00	113,060.00
70-80	n	32	32	104	104	4	104
	Mean	4,200.00	3,600.00	8,719.90	387.00	21,250.00	663.00
	Sum	134400	115,200.00	926,200.00	40200.00	85000.00	68,990.00
80-90	n	0	0	3	3	0	3
	Mean	0.00	0.00	5,560.00	400.00	.00	466.00
	Sum	0	0	17,280.00	1200.00	0	1,400.00

Table 4.15 shows that the lowest direct cost was within the age group of 80-90 years with a mean cost of KSHs 6,426 incurred in six months. The highest expenditure was observed among the 60-70 age group with a mean cost of KSHs 13,316 incurred in six months.

**Table 4.15 Total Direct Costs (TDC) for six months**

Agegroup of respondents	n	Mean (KSHs)	Std. Deviation
<10	1	10,200.00	.
10-20	12	9,728.33	3,388.66
20-30	6	10,045.00	8,441.92
30-40	38	11,909.47	7,359.27
40-50	83	11,575.42	6,513.40
50-60	158	12,155.57	7,326.03
60-70	165	13,316.00	7,566.72
70-80	104	11,729.42	7,464.53
80-90	3	6,426.67	4,229.25
<b>Total</b>	<b>570</b>	<b>10,786.67</b>	<b>6,535.75</b>

#### 4.4 Indirect Costs

These included: Cost of Temporary Disability, Costs of Permanent Disability, cost of Premature Mortality and Costs of Productivity loss by caregivers.

#### 4.4.1 Total cost of Temporary Disability (CTD) in six months

Temporary disability associated with diabetes included illness that affected the respondents for a short period of time and eventually resulted in recovery from the disabling condition eg hypoglycemia, foot ulcers, hyperosmolar hyperglycemic nonketotic syndrome. The total cost of productive time lost due to diabetes related temporary disability was derived using the following formula:

$$CTD_n^i = NTD_n^i \times DD_n^i \times GNIPC_n$$

Table 4.16 shows that total cost of productive time lost due to diabetes related temporary was KSHs 28,980 among 35 diabetes within six months.

**Table 4.16 Cost of Temporary Disability**

age group of the respondents	N	Sum (KSHs)
20-30 CTD	1	828.00
30-40 CTD	5	4,140.00
40-50 CTD	6	4,968.00
50-60 CTD	11	9,108.00
60-70 CTD	6	4,968.00
70-80 CTD	4	3,312.00
80-90 CTD	2	1,656.00
Total	35	28,980.00

#### 4.4.2 Total cost of Permanent Disability (CPD) in six months

Permanent or long term disability is an illness or injury that results in permanent impairment of which the respondents are usually not expected to recover and will live with the disability for the remainder of their lives eg diabetic retinopathy, nephropathy, amputation and macro vascular problems. The total cost of productive time lost due to permanent disability (CPD<sub>n</sub>)

is the sum of cost of productive time lost due to permanent disability among the respondents.

The cost of productive time lost due to permanent disability among persons of various age groups was obtained by the following formula:

$$CPD_n^i = NPD_n^i \times DAD \times DGNIPC_n$$

It is observed that the total cost of productive time lost due to permanent disability was KSHs 8,097,040 for diabetes within six months as shown in table 4.17.

**Table 4.17 Cost of Permanent Disability**

age group of the respondents	N	Sum (KSHs)
10-20 CPD	3	127,848.00
20-30 CPD	1	42,616.00
30-40 CPD	9	383,544.00
40-50 CPD	25	1,065,400.00
50-60 CPD	47	2,002,952.00
60-70 CPD	62	2,642,192.00
70-80 CPD	42	1,789,872.00
80-90 CPD	1	42,616.00
Total	190	8,097,040.00

#### 4.4.3 Total cost of Premature Diabetes-related Mortality (CPM) in six months

The productive life years lost (PLYL) for respondents were obtained by subtracting the sum of the average age of onset and average duration of life lived with diabetes from the maximum life expectancy in Kenya. In symbolic terms, CPM for respondents age bracket can simply be expressed as:  $CPM = NDD \times DPYL \times GNIPC_n$

Table 4.18 shows that the total cost of Premature Diabetes-related Mortality was KSHs 86,417 among diabetes within six months.

**Table 4.18 Cost of Premature Mortality (CPM)**

age group of the respondents	N	Sum (KSHs)
10-20 CPM	1	3,356.00
50-60 CPM	2	15,102.00
60-70 CPM	4	26,848.00
70-80 CPM	3	41,111.00
Total	10	86,417.00

#### 4.4.4 Cost of productive time lost by caregivers (CPV)

The cost of the work time lost by accompanying relatives. Symbolically, CPV for

respondents can simply be expressed as:  $CPV_n^i = ND_n^i \times VR \times NV \times GNIPC_n$

Table 4.19 shows that the cost of the work time lost by accompanying relatives was KSHs 1,037,004. It also shows indicate that all the age groups have at least some expenditure incurred as a result of being supported by caregivers especially during the visits to hospital for consultations.

**Table 4.19 Cost of Productive time lost by caregivers (CPV) in six months**

age group of the respondents	N	Sum (KSHs)
<10 CPV	1	2,517.00
10-20 CPV	12	25,170.00
20-30 CPV	6	13,424.00
30-40 CPV	38	72,993.00
40-50 CPV	83	151,859.00
50-60 CPV	158	285,260.00
60-70 CPV	165	298,684.00
70-80 CPV	104	182,063.00
80-90 CPV	3	5,034.00
Total	570	1,037,004.00

Table 4.20 shows that most of the indirect costs was as a result of permanent disability accounting for KSHs 8,097,040 followed by cost of productivity loss at KSHs1,037,004.

**Table 4.20 Indirect costs for 6 Months = Cost of Temporary Disability(CTD) + Cost of Permanent Disability (CPD) + Cost of Premature Mortality (CPM) + Cost of Productivity Loss (CPV)**

age group of the respondents	CTD (KSHs)	CPD (KSHs)	CPM (KSHs)	CPV (KSHs)
<10 Sum	0.00	0.00	0.00	2,517.00
10-20 Sum	0.00	127,848.00	3,356.00	25,170.00
20-30 Sum	828.00	42,616.00	0.00	13,424.00
30-40 Sum	4,140.00	383,544.00	0.00	72,993.00
40-50 Sum	4,968.00	1,065,400.00	0.00	151,859.00
50-60 Sum	9,108.00	2,002,952.00	15,102.00	285,260.00
60-70 Sum	4,968.00	2,642,192.00	26,848.00	298,684.00
70-80 Sum	3,312.00	1,789,872.00	41,111.00	182,063.00
80-90 Sum	1,656.00	42,616.00	0.00	5,034.00
Total	28,980.00	8,097,040.00	86,417.00	1,037,004.00

According to table 4.21 a diabetic patient incurs a mean of KSHs 28,433 within six months (translating to approximately KSHs 56,866 per annum). The direct costs accounted for 43% while indirect costs 57% within the six months of the follow study.

**Table 4.21 Total Costs (TC) incurred in six months**

age group of the respondents	n	TDC (KSHs)	TIC (KSHs)	TC (KSHs)	TC/n
<10	1	10,200	2,517	<b>12,717</b>	12,717
10-20	12	116,740	156,374	273,114	22,760
20-30	6	60,270	56,868	117,138	19,523
30-40	38	452,560	456,537	909,097	23,924
40-50	83	960,760	1,222,227	2,182,987	26,301
50-60	158	1,920,580	2,312,422	4,233,002	26,791
60-70	165	2,197,140	2,972,692	5,169,832	31,332
70-80	104	1,219,860	2,016,358	3,236,218	31,117
80-90	3	19,280	47,650	66,930	22,310
<b>Total</b>	<b>570</b>	<b>6,957,390</b> (43%)	<b>9,249,441</b> (57%)	<b>16,206,831</b> (100%)	<b>28,433</b>

#### 4.4.5 Total Costs and Type of Diabetes

The respondents who had Type 1 diabetes patients had incurred a mean cost of KSHs 28,624 while Type 2 patients incurred KSHs 28,416 for treatment of diabetes within the six months as shown in table 4.22.

**Table 4.22 Type of Diabetes and total costs incurred**

Type of diabetes	Mean	N	Std. Deviation
Type 1	28,624.61	18	23,593.75
Type 2	28,416.29	552	21,968.44
<b>Total</b>	<b>28,422.87</b>	<b>570</b>	<b>21999.50</b>

#### 4.4.6 Effects of diabetes to family

The following are quotations from sampled respondents which clearly shows that diabetes is a burden to the respondents and their families and also impacts negatively on their social well-being.

*“saddened because most of my family members have been diagnosed with diabetes”*

*“not easy coping because i had to change my lifestyle after being diagnosed with diabetes”*

The economic burden is evident from their responses *“my family is affected financially because they have to ensure my wellbeing, in terms of diet and medications”*

*“it’s a challenge because of cost of living is high and the need to feed well and look after my family”*

*“the medicines are costly and I lack financial support from family members”*

*“it has affected my family financially because am not able to stand as the head of family and provide for my family”*

*“the drugs are too expensive and my family are not capable of buying all the medicines”*

*“I must be accompanied to hospital by my wife”*

*“my family members are disturbed by me having diabetes disease”*

*“I cannot perform my daily chores”*

#### 4.5 Objective 2: To establish YLL and YLD associated with Diabetes

Years of life lost (YLL) years, of life lived with disability (YLD), and disability adjusted life years (DALY) was a convenient method of assessing disability due to Diabetes. DALY's are computed by taking sum of YLL and YLD. Complications and comorbidities were not factored in measuring disability burden of diabetes.

##### 4.5.1 Years of Life Lost (YLL)

Years of Life Lost refers due to diabetes patients which was achieved using this formula:

$$YLL = N \times L \quad \text{Where: } N = \text{number of deaths}$$

$$L = \text{standard life expectancy at age of death (in years).}$$

Table 4.23 shows that among 192 male respondents, 152/1000 YLL was the highest for males within 60-69 age group. It also shows that Years of Life Lost by males was 363/1000 years.

**Table 4.23 Years of Life Lost, YLL - males**

Males	pop	No of deaths	deaths/1000	av age at death	std LE	YLL/1000
<10	1	0	-	0	76	0
10_20	6	0	-	0	66	0
20-30	1	1	0.00100	25	56	56
30-40	10	1	0.00010	34	47	47
40-50	28	1	0.00004	45	36	36
50-60	44	1	0.00002	57	24	24
60-70	61	8	0.00013	62	19	152
70-80	40	6	0.00015	73	8	48
80-90	1	0	-	0	0	0
<b>Total</b>	<b>192</b>	<b>18</b>	<b>0.00144</b>	<b>33</b>	<b>37</b>	<b>363</b>

Table 4.24 shows that the Years of Life Lost for females was highest between 10-20 years with YLL of 64/1000. Years of Life Lost for those in between 50-60 and 60-70 years were 58/1000 and 72/1000 respectively.

**Table 4.24 Years of Life Lost, YLL - Females**

<b>Females</b>	<b>pop</b>	<b>No of deaths</b>	<b>deaths/1000</b>	<b>av age at death</b>	<b>std LE</b>	<b>YLL/1000</b>
<10	0	0	0	0	76	0
10_20	6	1	0.00017	17	64	64
20-30	7	1	0.00014	28	53	53
30-40	30	1	0.00003	30	51	51
40-50	57	1	0.00002	48	33	33
50-60	115	2	0.00002	52	29	58
60-70	112	4	0.00004	63	18	72
70-80	73	6	0.00008	75	6	36
80-90	2	0	-	0	0	0
<b>Total</b>	<b>402</b>	<b>16</b>	<b>0.00050</b>	<b>35</b>	<b>37</b>	<b>367</b>

#### **4.5.2 Years Lived with Disability (YLD)**

$$YLD = I \times DW \times L$$

Where:

YLD = years lived with disability

I = number of incident cases

DW = disability weight

L = average duration of disability (years)

Males between 60-70 years had 9 Years Lived with Disability (YLD), those 70-80 years had 9 Years Lived with Disability, (YLD) as shown in table 4.25.

**Table 4.25 Years Lived with Disability, YLD – Males**

<b>Males</b>	<b>Pop</b>	<b>I</b>	<b>L</b>	<b>DW</b>	<b>YLD/1000</b>
<10	1	1	1	0.015	0.02
10_20	6	6	2	0.015	0.14
20-30	1	1	1	0.015	0.02
30-40	10	10	6	0.015	0.96
40-50	28	28	6	0.015	2.52
50-60	44	44	5	0.015	3.41
60-70	61	61	10	0.015	8.72
70-80	40	40	14	0.015	8.10
80-90	1	1	5	0.015	0.08
<b>Total</b>	<b>192</b>	<b>192</b>	<b>5</b>	<b>0.135</b>	<b>23.94</b>

Table 4.26 shows that women had more Years Lived with Disability as compared with their male counterparts in their respective age groups with males having 24/1000 YLD while females had 51/1000 YLD.

**Table 4- 26 Years Lived with Disability, YLD – Females**

<b>Females</b>	<b>pop</b>	<b>I</b>	<b>L</b>	<b>DW</b>	<b>YLD/1000</b>
6<10	0	0	0	0.015	0.00
10_20	6	6	3	0.015	0.27
20-30	7	7	5	0.015	0.50
30-40	30	30	4	0.015	1.97
40-50	57	57	7	0.015	5.67
50-60	115	115	7	0.015	11.99
60-70	112	112	10	0.015	16.52
70-80	73	73	13	0.015	14.21
80-90	2	2	6	0.015	0.18
<b>Total</b>	<b>402</b>	<b>402</b>	<b>6</b>	<b>0.135</b>	<b>51.29</b>

Table 4.27 shows that Total Disability Adjusted Life Years lost was 805/1000. It also shows that the YLL for both males and females was 363 and 367 respectively and was higher than the YLD for both males and females with 23.94 and 51.29 respectively.

**Total 4.27 Disability Adjusted Life Years, DALYs=Total YLLs + Total YLDs**

Age-Group	Males			Females			Total DALYs/1000
	YLL	YLD	DALYs	YLL	YLD	DALYs	
<10	-	0.02	0.02	-	-	-	0.02
10-20	-	0.14	0.14	64	0.27	64.27	64.41
20-30	56	0.02	56.02	53	0.50	53.50	109.51
30-40	47	0.96	47.96	51	1.97	52.97	100.93
40-50	36	2.52	38.52	33	5.67	38.67	77.19
50-60	24	3.41	27.41	58	11.99	69.99	97.39
60-70	152	8.72	160.72	72	16.52	88.52	249.23
70-80	48	8.10	56.10	36	14.21	50.21	106.31
80-90	-	0.08	0.08	-	0.18	0.18	0.26
<b>TOTAL</b>	<b>363</b>	<b>23.94</b>	<b>386.94</b>	<b>367</b>	<b>51.29</b>	<b>418.29</b>	<b>805.23</b>

#### **4.6 Objective 3: To determine HRQoL among patients with Diabetes Mellitus**

EQ-5D-5L tool is used to measure Health Related Quality of Life of a patient. The EQ-5D-5L tool comprises the following 5 dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Each dimension has 5 levels as shown in table 4-28.

Mobility dimension shows that 46% of the respondents had no problem with walking about, 16.3% had slight problem in walking about, 25.8% had moderate problem in walking about, 11.1% had severe problem in walking about and 0.8% were unable to walk about.

Self-care dimension shows that 91.2% of the respondents had no problem washing/dressing themselves, 3.2% had slight problems washing/dressing themselves, 2.7% had moderate problem washing/dressing themselves, 0.7% had severe problem washing/dressing themselves and 2.2% were unable to wash or dress themselves.

Usual activities dimension shows that 73.9% of the respondents had no problems doing their usual activities, 8.8% had slight problems doing their usual activities, 7.9% had moderate problems doing their usual activities, 4.9% had severe problems in doing their usual activities and 4.5% were unable to do their usual activities.

Pain/discomfort dimension indicates that 40.4% of the respondents had no pain or discomfort, 22.7% had slight pain or discomfort, 26.6% had moderate pain or discomfort, 9.9% had severe pain or discomfort and 0.3% had extreme pain or discomfort.

Anxiety or depression dimensions shows that 48.3% of the respondents were not anxious or depressed, 40.4% had slight anxiety or depression, 9.3% had moderate anxiety or depression, 1.7% had severe anxiety or depression and 0.3% were anxious or depressed.

**Table 4-28 Domains of Health according to EQ-5D-5L instrument**

Dimension	Levels of dimensions	AGE GROUPS									Total
		<10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	
Mobility	no problem	0.2%	1.9%	1.2%	4.5%	8.2%	14.1%	11.8%	4.0%		<b>46.0%</b>
	slight problem		0.2%	0.2%	0.8%	1.7%	4.9%	5.2%	3.4%		<b>16.3%</b>
	moderate problem				0.8%	3.5%	5.6%	8.2%	7.1%	0.5%	<b>25.8%</b>
	severe problem				0.3%	0.8%	2.0%	3.9%	4.0%		<b>11.1%</b>
	unable to walk				0.2%		0.2%		0.5%		<b>0.8%</b>
Self-care	no problem	0.2%	2.0%	1.3%	6.1%	14.0%	26.1%	26.8%	14.6%	0.2%	<b>91.2%</b>
	slight problems				0.3%	0.2%	0.3%	1.2%	1.2%		<b>3.2%</b>
	moderate problems				0.2%	0.2%		0.5%	1.7%	0.2%	<b>2.7%</b>
	severe problems						0.2%	0.2%	0.3%		<b>0.7%</b>
	unable to wash/dress				0.2%		0.2%	0.5%	1.2%	0.2%	<b>2.2%</b>
Usual activities	no problem	0.2%	2.0%	1.3%	5.7%	13.5%	21.9%	20.7%	8.4%	0.2%	<b>73.9%</b>
	slight problems				0.7%	0.3%	2.0%	3.2%	2.5%		<b>8.8%</b>
	moderate problems				0.2%	0.2%	2.0%	2.5%	2.9%	0.2%	<b>7.9%</b>
	severe problems					0.3%	0.7%	1.3%	2.5%		<b>4.9%</b>
	unable to do usual activities				0.2%		0.2%	1.3%	2.7%	0.2%	<b>4.5%</b>
Pain/discomfort	no pain/discomfort	0.2%	2.0%	1.2%	4.0%	6.7%	10.8%	10.9%	4.4%	0.2%	<b>40.4%</b>
	slight pain/discomfort			0.2%	1.2%	3.4%	5.9%	6.9%	5.1%	0.2%	<b>22.7%</b>
	moderate pain/discomfort				1.3%	3.2%	7.7%	7.9%	6.2%	0.2%	<b>26.6%</b>
	severe pain/discomfort					1.0%	2.2%	3.4%	3.4%		<b>9.9%</b>
	extreme pain/discomfort				0.2%		0.2%				<b>0.3%</b>
Anxiety/depressed	not anxious/depressed	0.2%	1.9%	0.7%	3.9%	6.7%	13.5%	13.3%	8.1%	0.2%	<b>48.3%</b>
	slightly anxious/depressed		0.2%	0.5%	2.0%	5.9%	10.9%	13.1%	7.6%	0.2%	<b>40.4%</b>
	moderate			0.2%	0.7%	1.7%	2.0%	2.0%	2.5%	0.2%	<b>9.3%</b>
	severe						0.3%	0.5%	0.8%		<b>1.7%</b>
	extreme				0.2%			0.2%			<b>0.3%</b>

#### 4.7 Visual Analogue Scale (VAS)

The EQ VAS records the respondent's self-rated health on a vertical, visual analogue scale where the endpoints are labeled 'Best imaginable health state' and 'worst imaginable health state'. The values of VAS are summarized in table 4.29 below.

#### 4.7.1 Visual Analogue Scale and the age group of respondents

According to table 4.29 the mean VAS values for all the age groups in the study range from 0.60-0.54. The observed results show that the younger respondents below 40years had a higher mean VAS values of 0.60 to 0.56 while the older respondents between the age of 50 to 90 years had a mean VAS values of 0.55 and 0.54.

**Table 4.29 Visual Analogue Scale and the age group of respondents**

Age group of the respondents	Mean	Std. Deviation	Minimum	Maximum
<10	0.60	-	-	-
10-20	0.58	0.092	0.50	0.80
20-30	0.58	0.146	0.45	0.90
30-40	0.56	0.117	0.20	0.75
40-50	0.56	0.087	0.30	0.80
50-60	0.55	0.092	0.20	0.85
60-70	0.54	0.116	0.01	0.85
70-80	0.54	0.104	0.20	0.85
80-90	0.55	0.132	0.40	0.65
<b>Total</b>	<b>0.55</b>	<b>0.103</b>	<b>0.01</b>	<b>0.90</b>

#### 4.7.2 The Visual Analogue Scale and Gender

According to table 4.30, the mean VAS values for females were lower compared to the males. The age groups 10-20 (males mean VAS values at 0.62, females mean VAS values at 0.54), 50-60 age group (males mean VAS values was 0.59 while females had a mean of 0.54), 60-70 age group (males mean VAS values at 0.58 while females at 0.52) and 70-80 age group (males mean VAS values at 0.56 while females means at 0.53).

However, for the following age groups females had a higher mean VAS values as compared to the males:20-30 age group (males mean VAS values at 0.50, while females mean values at 0.59), 30-40 age group (males mean VAS of 0.53, females 0.58), 40-50 age group (males mean VAS 0.55, females 0.56), 80-90 age group (males mean VAS was 0.40, while females mean VAS was 0.63).

**Table 4.30 showing Visual Analogue Scale (VAS) and gender of the respondent**

age group of the respondents	gender of the respondent	n	Visual analogue scale			
			Minimum	Maximum	Mean	Std. Deviation
<10	Male	1	0.60	0.60	0.60	-
10-20	Male	6	0.50	0.80	0.62	0.113
	Female	6	0.50	0.60	0.54	0.050
20-30	Male	1	0.50	0.50	0.50	-
	Female	7	0.45	0.90	0.59	0.155
30-40	Male	10	0.20	0.75	0.53	0.155
	Female	30	0.30	0.75	0.58	0.102
40-50	Male	28	0.35	0.75	0.56	0.085
	Female	57	0.30	0.80	0.56	0.089
50-60	Male	44	0.45	0.85	0.59	0.090
	Female	115	0.20	0.80	0.54	0.089
60-70	Male	61	0.20	0.85	0.58	0.128
	Female	112	0.01	0.70	0.52	0.105
70-80	Male	40	0.20	0.75	0.56	0.099
	Female	73	0.25	0.85	0.53	0.106
80-90	Male	1	0.40	0.40	0.40	-
	Female	2	0.60	0.65	0.63	0.035

#### 4.7.3 Visual Analogue Scale and Mobility

Comparison of VAS values and mobility dimensions indicates that the VAS values decrease based on the severity of mobility levels as shown in table 4.31.

Majority of the respondents (273) who had no problem walking about had a mean VAS value of 0.57, those who had a slight problem in walking about had a mean VAS value of 0.58, those with moderate problem in walking about had a mean VAS value of 0.53, those who had severe problem walking about had a mean VAS value of 0.51 while those unable to walk about had a mean VAS value of 0.38.

**Table 4.31 Visual Analogue Scale (VAS) and mobility dimension of health**

Mobility	Mean	n	Std. Deviation
no problem with walking about	0.57	273	0.109
slight problem in walking about	0.58	97	0.081
moderate problem in walking about	0.53	153	0.092
severe problem in walking about	0.51	66	0.099
unable to walk about	0.38	5	0.160
<b>Total</b>	<b>0.55</b>	<b>594</b>	<b>0.103</b>

**4.7.4 Visual Analogue Scale and Self-Care**

Table 4.32 shows that 542 respondents had no problem washing/dressing themselves with a mean Visual Analogue Scale of 0.56, 19 respondents had slight problems washing/dressing themselves with a mean VAS of 0.55, 16 respondents had moderate problems washing/dressing themselves with a mean VAS of 0.47, 4 respondents had severe problems washing/dressing themselves and a mean VAS of 0.36 and 13 respondents were unable to wash/dress themselves with a mean VAS of 0.45.

**Table 4.32 Visual Analogue Scale (VAS) and self-care dimension of health**

Self-care	Mean	n	Std. Deviation
I have no problem washing/dressing my self	0.56	542	0.098
I have a slight problems washing/dressing myself	0.55	19	0.104
I have moderate problems washing/dressing myself	0.47	16	0.158
I have severe problems washing/dressing myself	0.36	4	0.138
I am unable to wash/dress myself	0.45	13	0.120
<b>Total</b>	<b>0.55</b>	<b>594</b>	<b>0.103</b>

#### 4.7.5 Visual Analogue Scale and Usual Activities

Table 4.33 shows that 439 respondents had no problems doing their usual activities with a mean VAS of 0.57, 52 respondents had slight problems doing their usual activities with a mean VAS of 0.51, 47 respondents had moderate problems doing their usual activities with a mean VAS of 0.51, 29 respondents had severe problems doing their usual activities with a mean VAS of 0.49 and 27 respondents were unable do their usual activities with a mean VAS of 0.48.

**Table 4.33 Visual Analogue Scale (VAS) and usual activities dimension of health**

usual activities e.g work, study, housework, leisure activities	Mean	n	Std. Deviation
I have no problems doing my usual activities	0.57	439	0.093
I have slight problems doing my usual activities	0.51	52	0.127
I have moderate problems doing my usual activities	0.51	47	0.100
I have severe problems doing my usual activities	0.49	29	0.052
I am unable to do my usual activities	0.48	27	0.157
<b>Total</b>	<b>55.16</b>	<b>594</b>	<b>0.103</b>

#### 4.7.6 Visual Analogue Scale (VAS) and Pain/Discomfort

According to table 4.34, 240 respondents had no pain or discomfort with a mean VAS of 0.58, 135 respondents had slight pain or discomfort with a mean VAS of 0.56, 158 respondents had moderate pain or discomfort with a mean VAS of 0.53, 59 respondents had severe pain or discomfort with a mean VAS of 0.48 and 2 respondents with extreme pain or discomfort had a mean VAS of 0.30.

**Table 4.34 Visual Analogue Scale (VAS) and pain/discomfort dimension of health**

pain or discomfort	Mean	n	Std. Deviation
I have no pain or discomfort	0.58	240	0.098
I have slight pain or discomfort	0.56	135	0.093
I have moderate pain or discomfort	0.53	158	0.100
I have severe pain or discomfort	0.48	59	0.097
I have extreme pain or discomfort	0.30	2	0.141
<b>Total</b>	<b>0.55</b>	<b>594</b>	<b>0.103</b>

**4.7.7 Visual Analogue Scale and Anxiety/Depression**

Table 4.35 shows that 287 respondents were not anxious/depressed with a mean VAS of 0.56, 240 respondents were slightly anxious/depressed with a mean VAS of 0.55, 55 respondents were moderately anxious/depressed with a mean VAS of 0.52, 10 respondents were severely anxious/depressed with a mean VAS of 0.42 and 2 respondents were extremely anxious/depressed with a mean VAS of 0.35.

**Table 4.35 Visual Analogue Scale (VAS) and anxiety/depression dimension of health**

anxiety or depression	Mean	n	Std. Deviation
I am not anxious/depressed	0.56	287	0.107
I am slightly anxious/depressed	0.55	240	0.092
I am moderately anxious/depressed	0.52	55	0.087
I am severely anxious/depressed	0.42	10	0.147
I am extremely anxious/depressed	0.35	2	0.212
<b>Total</b>	<b>0.55</b>	<b>594</b>	<b>0.103</b>

#### 4.7.9 Visual analogue scale (VAS) & incidence of hypoglycemia

Among the 594 respondents, 494 of them had never experienced an incidence of hypoglycemia with a mean Visual Analogue Scale of 0.56. Those respondents who had experienced hypoglycemia episode once were 53 and had a mean VAS of 0.55. Some 15 respondents had experienced two episodes of hypoglycemia and had a mean VAS of 0.50, those with three episodes of hypoglycemia had a mean VAS of 0.49 while those with more than 5 episodes of hypoglycemia had a mean VAS of 0.51.

There was a significant difference between VAS values and the number of times the respondent had experienced hypoglycemia since diagnosis of diabetes with  $F=2.171$  and  $p=0.056$ .

**Table 4.36 Visual Analogue Scale (VAS) & incidence of hypoglycemia since diagnosis**

number of times the respondent had experienced hypoglycemia since diagnosis	Mean	n	Std. Deviation
Never	0.56	494	0.105
Once	0.55	53	0.075
Twice	0.50	15	0.163
Thrice	0.49	5	0.055
Four times	0.50	1	-
Five times or more	0.51	26	0.071
<b>Total</b>	<b>0.55</b>	<b>594</b>	<b>0.103</b>

#### 4.6.10 Visual Analogue Scale (VAS) and Type of Diabetes Mellitus

Table 4.37 shows that 18 respondents with Type I diabetes had a mean VAS values of 0.55 while 576 respondents had a mean VAS value of 0.55.

**Table 4.37 Visual Analogue Scale (VAS) and Type of Diabetes Mellitus**

Type of diabetes	Mean	N	Std. Deviation
Type 1	0.55	18	0.090
Type 2	0.55	576	0.104
<b>Total</b>	<b>0.55</b>	<b>594</b>	<b>0.103</b>

#### 4.7.11 Visual Analogue Scale (VAS) and level of education

Those who had attained university education had a mean VAS value of 0.59, those with secondary education had a mean VAS value of 0.56, those who had attained primary education had a mean VAS value of 0.55 and those without any formal education had a mean VAS value of 0.53 as shown in table 4.38.

There was no statistical difference between VAS values and level of education  $F=3.180$ ,  $p=0.24$ .

**Table 4.38 Visual Analogue Scale (VAS) and level of education**

Highest level of completed education of the respondents	Visual analogue scale (VAS)
University	0.59
Secondary	0.56
Primary	0.55
None	0.53
<b>Total</b>	<b>0.55</b>

#### 4.7.12 Visual Analogue Scale (VAS) and those with NHIF cover

The mean VAS value for those who had subscribed for NHIF was 0.56 while those not using NHIF had a mean VAS value of 0.55. There was no statistical difference between VAS values and those respondents who had NHIF cover  $F=2.663$ ,  $p=0.103$ .

**Table 4.39 Visual Analogue Scale (VAS) and those with NHIF cover**

respondents who utilize NHIF	Visual analogue scale
Yes	0.56
No	0.55
<b>Total</b>	<b>0.55</b>

Table 4.40 shows that those respondents who were dependent on their friends/relatives had a mean VAS of 0.48 which was lower compared to those respondents who were not dependent on others with a mean VAS of 0.56.

**Table 4.40 Visual Analogue Scale (VAS) and those dependent on others**

respondents who depend on their next of kin/family/close friends in regard to particular activities	Visual analogue scale (VAS)
Yes	0.48
No	0.56
<b>Total</b>	<b>0.55</b>

According to table 4.41, respondents who were underweight had a mean VAS of 0.53, those with normal weight had a mean VAS of 0.55, those who were overweight had a mean VAS of 0.56 and those obese had a mean VAS of 0.55. There was no statistical difference between VAS values and respondent's BMI with  $F=0.599$ ,  $p=0.616$ .

**Table 4.41 Visual Analogue Scale (VAS) and BMI**

Body Mass Index	Visual Analogue Scale (VAS)
Underweight	0.53
Normal	0.55
Overweight	0.56
Obese	0.55
<b>Total</b>	<b>0.55</b>

#### 4.7.13 Visual Analogue Scale (VAS) and Complications

Table 4.42 shows the mean VAS values and complications associated with diabetes.

**Table 4.42 Visual Analogue Scale (VAS) and Complications**

Complications	n		VAS values
Impaired vision	166	Yes	0.55
	428	No	0.55
Cardiac infarction	12	Yes	0.57
	582	No	0.55
Chronic Kidney Disease	9	Yes	0.53
	585	No	0.55
Angina	7	Yes	0.46
	587	No	0.55
Diabetic foot	5	Yes	0.53
	589	No	0.55
Stroke	11	Yes	0.51
	583	No	0.55
Neuropathy	28	Yes	0.56
	566	No	0.55
Amputation	3	Yes	0.53
	591	No	0.55

According to table 4.43 it shows that Visual Analogue Scale and angina had a significant statistical difference with  $F=5.079$  and  $p=0.025$ . the rest of the complications were not statically significant.

**Table 4.43 Visual analogue scale (VAS) and complications**

		Sum of Squares	Df	Mean Square	F	Sig.
Visual analogue scale * impaired vision	Between Groups(Combined) Within Groups Total	3.683 63430.756 63434.439	1 592 593	3.683 107.147	.034	.853
Visual analogue scale * Cardiac infarction	Between Groups(Combined) Within Groups Total	93.303 63341.137 63434.439	1 592 593	93.303 106.995	.872	.351
Visual analogue scale * chronic kidney disease	Between Groups(Combined) Within Groups Total	30.378 63404.062 63434.439	1 592 593	30.378 107.101	.284	.595
Visual analogue scale * angina	Between Groups(Combined) Within Groups Total	539.604 62894.835 63434.439	1 592 593	539.604 106.241	5.079	.025
Visual analogue scale * diabetic foot	Between Groups(Combined) Within Groups Total	23.451 63410.988 63434.439	1 592 593	23.451 107.113	.219	.640
Visual analogue scale * stroke	Between Groups(Combined) Within Groups Total	161.235 63273.204 63434.439	1 592 593	161.235 106.880	1.509	.220
Visual analogue scale * amputation	Between Groups(Combined) Within Groups Total	10.023 63424.416 63434.439	1 592 593	10.023 107.136	.094	.760
Visual analogue scale * neuropathy	Between Groups(Combined) Within Groups Total	24.595 63409.845 63434.439	1 592 593	24.595 107.111	.230	.632

## **CHAPTER 5: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS**

### **5.1 Introduction**

This chapter entails discussion of the results in relation to findings from other studies on burden of diabetes in regard to direct and indirect costs, DALYs and Health Related Quality of Life in the management of diabetes mellitus. The chapter also presents the conclusion and recommendations of the study on burden of diabetes.

### **5.2 Socio-demographic Characteristics of respondents**

This study was hospital based and the study subjects were diabetes patients who were sampled from the Outpatient Diabetic clinic in Thika Level 5 Hospital. Most of the respondents (97%) had Type 2 form of diabetes. Majority of the diabetic patients were overweight and obese. This is also reported by Hall (2011) that Type 2 diabetes is typically associated with increasing age and overweight or obesity. A higher prevalence of Type 2 diabetes was evident between the age of 60-70 years. However, according to a study by Ayah (2013) the highest age category prevalence was 40-50 years for Type 2 diabetes. The findings of the study indicate that Type 1 diabetes respondents were mainly below 20 years with the form of treatment being Insulin. This is supported by a study that, for Type 1 diabetes, the essential therapy is insulin (Ogle *et al.*, 2016). It is also reported that Type 1 occurs most frequently in children, adolescents, and young adults (Roglic, 2016).

In this study more than half of the diabetes patients were female (68%), which is not agreed upon by a study which concluded that there was no sex differential among diabetes patients (Ayah, 2013). The study found that most of the respondents (79.8%) were married. Farming (58%) was the main occupation of the respondents in this study. Primary

education was the highest level of education attained by the respondents which accounted for 54%.

The study point to the high-risk of various comorbidities affecting the diabetes patients with hypertension affecting 282 (47%) of the diabetes patients in this study. Recent studies show that hypertension was significantly associated with the presence of diabetes mellitus (Ayah, 2013).

This study reveals that among other comorbidities, retinopathy (28%) affected more diabetes patients followed by neuropathy at 4%. Recent studies reveal that diabetic complications are present in over 80% of an investigated cohort, where nearly 50% of the patients had two or more complications with retinopathy being the most common single complication, followed by Coronary Artery Disease (CAD) (Jelinek *et al.*, 2017). Diabetes is a major cause of blindness, kidney failure, heart attacks, stroke and lower limb amputation (WHO, 2018). According to Bourne (2013) Diabetic retinopathy is an important cause of blindness, and occurs as a result of long-term accumulated damage to the small blood vessels in the retina, with 2.6% of global blindness being attributed to diabetes. Adults with diabetes have a two-to three-fold increased risk of heart attacks and strokes (Sarwar, 2010).

According to this study majority of the diabetes patients (86%) had been reviewed twice within the six months. This means that the annual visits is approximately 4 visits in a year for a diabetic patient.

The study shows that most diabetes patients (83%) had never experienced episodes of diabetic coma since diagnosis of diabetes. However, 4% of the patients reported to have five or more episodes of diabetic coma.

The study shows that 83% of the diabetes patients were using the oral diabetic drugs. Based on this study a few of the respondents had purchased their own glucometers. This could be

associated with cost of buying one yet a glucometer is very important when managing diabetes. A study reports that limited access to home blood glucose monitoring equipment adversely affects patient education and empowerment, which is a mainstay of diabetes management (Chinenye,2012). It was reported in some study that many people with diabetes in sub-Saharan Africa fail to achieve adequate glycaemia control, although studies specifically addressing this issue have been small. Glycaemia control is most likely to be achieved when a patient has reliable access to clinical services, when the availability of equipment to monitor control is good, when patients and health-care professionals have good knowledge about diabetes management, and when efficacious and affordable treatment is available and backed by adequate and effectively deployed measures of glucose control (Atun, 2017).

### **5.3 Costs**

Treating diabetes and its comorbidities is costly as noted from this study. Out of pocket expenditures in management of diabetes was the norm for the diabetic patients in this study. The hospital did not provide all diabetic drugs and the few that were to be given to the patients were not reliable and only those who subscribe to NHIF could be given when available. The patients had to purchase their own drugs for which the costs varied from one pharmacy outlet to another. This was supported by a study that noted supply-chain problems and price mark-ups are such that simple therapies are often unavailable or unaffordable at the patient level (Atun, 2017).

Atun, 2017 concluded that although unknown, it is assumed out-of-pocket expenditures to be high for diabetes and often prohibitive, producing financial barriers to access and leading many individuals with diabetes to not seek care (and thus avoiding short-term

treatment costs but potentially accumulating larger health deficits, leading to even higher long-term direct costs through more severe sequelae due to target organ damage, such as amputations, blindness, stroke, or kidney failure, in addition to decreased lifespan). For example, in Malawi in 2012, families spent 22% of their monthly per-capita budget on out of pocket expenditures related to NCDs (Atun, 2017).

A study reported that Kenya has an opportunity to reduce the burden of diabetes but funding needs to be concentrated on public health and primary healthcare interventions. In turn this requires changing population behaviours to adopt healthy lifestyles (Tiffany, 2013). A common conclusion in some studies included under the review is that diabetes imposes a considerable economic burden on individuals and that amongst the cost components included in cost calculation, the cost of drugs imposed the largest burden on total costs incurred (Mutumbizi *et al.*, 2018).

This study estimated total costs in managing diabetes was approximately KSHs 56 000 per annum (approximately US\$ 560 per patient per annum). Total direct costs accounted for 43% while indirect cost was 57%. However, in some study in 2015 estimated, the overall cost of diabetes in sub-Saharan Africa to be US\$19.45 billion or 1.2% of cumulative gross domestic product (GDP). Around \$10.81 billion (55.6%) of this cost arose from direct costs, which included expenditure on diabetes treatment (Atun, 2017). A study showed a large and increasing burden of diabetes in the African region. This burden will increase with aging and growth of the population unless effective programs for control and prevention are put in place. Diabetes is a costly disease and most countries in the region spend a large percentage of their health resources on the disease. The region's financial and manpower resources are already stretched. Hence, there is an urgency to deal with

diabetes and its consequences, and these efforts should be at the forefront of disease prevention and health promotion (Atun, 2017).

It is estimated in this study that a patient with Type 1 diabetes spend approximately US\$ 150 annually on insulin and consumables. Other studies show that the median cost of a blood glucose strip in seven African nations was US\$0.50 (range \$0.20–\$1.20), and the yearly cost of consumables for minimal reasonable care to families with a child or young person with diabetes in these countries ranged from 74% to 377% (median 126%) of per-capita gross national income (Ogle, 2016). For patients with type 1 diabetes, high out-of-pocket expenditures and the unaffordability of care have grave consequences; these patients have a high mortality because regular insulin injections are not always affordable.

It was noted in the study that the commonly prescribed drug was metformin and that insulin was also prescribed for those who could not achieve glycemic control. This finding is in support of a study that observed that most people with type 2 diabetes require drug treatment, with the most commonly available drugs being metformin and sulfonylureas, or insulin for those who do not respond to treatment with these drugs (Atun, 2017). Managing hyper glycaemia in sub-Saharan Africa and ensuring effective glycaemia control is essential for short-term wellbeing and long-term protection against complications. The ability to monitor glycaemia control per se in sub-Saharan Africa is difficult, even in hospital settings (Manne-Goehler *et al.*, 2016).

The results show a considerable impact of diabetes in terms of costs to society, health systems, individuals and employers and in terms of a reduction in the productive workforce and productivity in general. Studies on the costs of diabetes now provide evidence from HICs as well as LMICs, using a variety of study designs to estimate the costs of diabetes.

The evidence indicates a particularly strong and direct economic impact of type 2 diabetes on people's livelihoods in lower income settings (Seuring *et al.*, 2015).

#### **5.4 DALYs (YLL+YLD)**

Disease burden attributed to diabetes, was measured by Disability-Adjusted Life-Years (DALYs). This study found that 805/1000 DALYs was lost as a result of premature mortality and disability as a result diabetes. In 2015, an estimated 1.6 million deaths were directly caused by diabetes (WHO, 2018). The largest number of deaths due to high blood glucose occurred in upper middle-income countries. In low-income countries, more than half of the deaths attributable to high blood glucose are premature, in contrast to high-income countries where about one-fifth of deaths are premature (Roglic, 2016). Almost one-half of all deaths attributable to high blood glucose are premature - before the age of 70 years (WHO, 2018).

In this study it was noted that the Years of Life Lost (YLL) due to diabetes by males was 363/1000 years while the YLL for females was 367/1000 years. This means that mortality is high among males compared to females yet more females had been diagnosed with diabetes in this study.

This study shows that women had more Years Lived with Disability (YLD) as compared with their male counterparts in their respective age groups with males having 24/1000 YLD while females had 51/1000 YLD. This is evident that females diagnosed with diabetes live long than males. Another reason could be that the prevalence of females is higher than the males. Few studies have been done on DALYs therefore posing a challenge in terms of comparison and discussion of results.

### **5.5 Health Related Quality of Life (HRQoL)**

According to this study it shows that the Health Related Quality of Life (HRQoL) of a diabetes patient is low with a mean VAS values ranging from 0.50-0.60. This concurs with findings of a study review which showed that people with diabetes had a lower HRQoL than healthy people (Kiadaliri *et al.*,2013). A study findings suggest there is a significant, moderate negative relationship between diabetes and HRQOL in comparison with non-diabetic people (absolute value of the coefficient ranges between  $-0.04$  and  $-0.054$  points on a scale of 1) (Oliva, 2012).

The study findings also showed a low HRQoL for patients who are obese which is supported by a study which observed that Lower level of HRQoL was found among people with higher Body Mass Index (Kiadaliri *et al.*,2013).

A study concluded that the HRQOL of a person who has diabetes is not necessarily lower than for a non-diabetic. Control of risk factors associated to vascular diseases is a key factor for an enhanced quality of life. Vascular disease or risk factors for vascular disease, on the other hand, are associated with a significantly diminished quality of life for diabetic persons (Oliva,2012).

Other findings indicated that diabetes related complications have a significant negative impact on HRQoL among the diabetic patients in Iran (Kiadaliri *et al.*,2013).

According to Solli (2018) study showed that complications may have an impact on many dimensions of health-related quality of life, and the impact may be substantial for a patient with diabetes. The strongest determinants of reduced HRQoL, as assessed with the EQ-5D index, were ischemic heart disease, stroke and neuropathy. This is evident from the

findings of this study which showed that diabetes patients with Angina had the lowest HRQoL followed by stroke.

The results from this study shows that there was no difference in HRQoL and type of diabetes. however, according to Solli study, individuals with diabetes-related complications had reduced HRQoL, though the impact on HRQoL was somewhat different for type 1 and type 2 diabetes. Stroke and neuropathy had a negative impact on overall HRQoL in both types of diabetes, while ischemic heart disease and social limitations had an impact on those with type 1 diabetes, and fear of hypoglycemia and limitations at work had an impact on those with type 2 diabetics.

According to this study, the observed difference in mean values and the various age groups could that more patients with diabetes are normally from 50 years and above. Another reason could the young respondents may not be having comorbidities as compared to the elderly ones who could be having one or more complications.

## **5.6 Conclusion**

i) Majority of the patients had Type 2 diabetes mellitus which affected mainly the elderly population while Type 1 diabetes affected the adolescents and the young adults. Overweight and obesity was observed in most of the diabetes patients. The most common comorbidities were hypertension, retinopathy, neuropathy. Oral medications, Insulin and other consumables of care were often unavailable in health facility to patients.

ii) Most of the patients did not subscribe to NHIF and had to pay through out of pocket for treatment and management of diabetes in the hospital. Providing access to affordable

health care and reducing out of pocket expenditure for the poor will reduce the burden of treating diabetes.

iii) A diabetic patient incurs a mean of KSHs 28,433 within six months (translating to approximately KSHs 56,866 per annum). The direct costs accounted for 43% while indirect costs 57% within the six months of the follow study.

iv) A total 805/1000 DALYs was lost as a result of premature mortality and disability as a result diabetes.

v) The Health Related Quality of Life (HRQoL) of a diabetes patient is low with a mean VAS values ranging from 0.50-0.60

## **5.7 Recommendation**

1. It is recommended that the National government and Kiambu County government of Kiambu to give priority to diabetes disease by providing free insulin and oral glyemic drugs to diabetes patients.
2. It is recommended that the National government and Kiambu County government to prioritize diabetes care by ensuring all patients subscribe to NHIF and to cover management costs of diabetes, both for outpatient and in-patient services through NHIF. This is because of the many comorbidities associated with diabetes and thereby reducing the economic burden of a diabetic patient and also improve HRQoL and reduce DALYs.
3. It is recommended that Kiambu County government to prioritize resource allocation for diabetes management so as to reduce the economic burden suffered by diabetes patients.

### **5.8 Areas for further research**

To determine DALYs for comorbidities associated with diabetes and estimate the costs of various comorbidities associated with diabetes.

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## APPENDICES

### Appendix 1: Consent Form

My name is ..... I am a PhD student from Kenyatta University. I am conducting a study on “Burden of diabetes mellitus among patients attending Thika Level Five Hospital, Kiambu County, Kenya.” The information will be used by the County and Ministry of Health.

#### Procedures to be followed

Participation in this study will require that I ask you some questions. I will record the information in a questionnaire. You have the right to refuse participation in this study. Please remember that participation in this study is voluntary. You may ask questions related to the study at any time.

You will get the same care and medical treatment whether you agree to join the study or not and your decision will not change the care you will receive from the clinic today or that you will get from any other clinic at any other time.

You may refuse to respond to any questions and you may stop an interview at any time. You may also stop being in the study at any time without consequences to the services you receive from this clinic or any other organization now or in future.

#### Risks

There are no risks whatsoever for participating in this study.

#### Benefits

If you participate in this study you will help the Ministry of Health to know how to address the burden of diabetes mellitus among patients attending Thika Level Five Hospital, Kiambu County, Kenya.

#### Confidentiality

You will fill the questionnaire on your own and your name will not be recorded on the questionnaire. The questionnaire will also be kept safe and everything will be kept private.

#### Contact information

If you have any questions you may contact Ms. Rosebella Kipkalom on 0721593173 or Dr. P. Warutere on 0721993833 or the Kenyatta University Ethical Review Committee Secretariat on [kuerc@ku.ac.ke](mailto:kuerc@ku.ac.ke).

#### Participant's statement

The above information on my participation in the study is clear to me. I have been given a chance to ask questions and my questions have been answered to my satisfaction. My participation in this study will be entirely voluntary. I understand that my records will be kept private and that I can stop participation at any time.

Name of the participant .....

-----

Signature

-----

Date

**Investigators statement**

I, the undersigned, have explained to the volunteer in a language s/he understands the procedures to be followed in the study and the benefits involved.

Name of the interviewer: \_\_\_\_\_

-----

Interviewer signature

-----

Date

## Appendix 2: Questionnaire

I am a postgraduate student at Kenyatta University undertaking research on Assessment of burden of diabetes mellitus among patients attending Thika Level Five Hospital, Kiambu County, Kenya. The results of the study will be used for educational purposes only. I therefore ask you to answer the questions in this questionnaire with openness.

Questionnaire no.: .....

Tick (✓) where appropriate. Multiple answers are accepted where applicable.

### **PART I: ABOUT YOURSELF**

**SERIAL NO.....**

1. Gender of respondent

a) Male ( )

b) Female ( )

2. Age

3. Income KSHs <10,000  10,0001-20,000  20,001-30,000  30,001-40,000  
40,000>

4. What is your highest level of completed education?

University

Secondary

Primary

None

5. Where do you live?

### **PART II: ABOUT YOUR DIABETES**

6. Which form of diabetes do you have?

Type I.....

Type II.....

Other.....

Uncertain.....

7. In which year were you diagnosed with diabetes (please state years in digits).....

8. Has your diabetes led to any health-related problem/complications associated diseases (several answers possible)
- Impaired vision.....
  - Cardiac infarction.....
  - Reduced renal function (proteinuria).....
  - Angina (chest pain associated with physical exertion).....
  - Diabetic foot .....
  - Stroke .....
  - Amputation .....
  - Renal transplantation .....
  - Neuropathy (damage to the nerves) .....
  - Uncertain .....
  - None .....
  - Other, (please state) .....
  - Any comorbid disease/condition (e.g hypertension).....

### **PART III: DRUGS/MEDICATION**

9. Drugs used from the treatment sheets (please check)

#### **Tablets**

(Actos, Glucobay, Amaryl, Glipizid, Apamid, Metformin, Avandia, Minidiab, Avandamet, Novonorm, Glibenclamid, Starlix, Glucophage)  
Other specify.....

#### **Insulin**

Lantus .....

Insulin (long acting).....

Levemir .....

Insulin (short acting) .....

10. Do you use any hypertensive drugs?

Yes

No

Uncertain

11. Do you use any other medications on a regular basis?

Yes

No

Uncertain

12. Have you experienced hypoglycaemia in the course of treatment since you were diagnosed?

Yes

No

If yes, please state the number of times according to the description of severity

13. Have you ever been hospitalised?

Yes

No

**PART VI: YOU AND YOUR FAMILY**

14. Does your diabetes make you dependent on your next of kin/family/close friends with regard to particular activities? (if yes, please check the relevant boxes in the table below, several answers possible)

Administer injections .....

Clean the house .....

Tablet dosing .....

Spend time outdoors .....

Cook .....

Others (specify) .....

15. Income

16. Do you have your own glucometer YES NO

17. How has diabetes affected your family?

18. How do people in your community relate to you?

19. How else have you been affected because of living with iabetes?

20. Weight Kgs

Height cm

BMI .....

Blood sugar reading.....

Blood pressure.....

**Register to capture**

- a) Name
- b) Mobile number
- c) TCA
- d) NO. of Consultations
- e) Death and cause

## Appendix 3: Estimated Costs per Drugs

**Table showing the cost of drugs**

<b>s/n</b>	<b>Name of the drug</b>	<b>Strength</b>
1	Insulin Mixtard 30/70	@ KSHs 600
2	Glucophage	500mg @KSHs 10 850mg @ KSHs 20 1g @ KSHs 30
3	Nogluc	5mg @KSHs 4
4	Glucomet	500mg @ KSHs 5
7	Amlodopine	2.5mg @ KSHs 5mg @ KSHs 15 10mg @ KSHs 30
8	Nifelat	30mg @ KSHs 5 60mg @ KSHs 10
9	Enapril	2.5/5mg @ KSHs 5
10	HCTZ	25/50mg @ KSHs 2
11	Losartan HT/plain	25mg @ KSHs 15 50mg @ KSHs 30
12	Atenol	50mg @ KSHs 5 100mg @ KSHs 10
13	Lasix	40mg @ KSHs 2
14	Arteravastatin	20mg @ KSHs 25 40mg @ KSHs 50
15	Cardiocare	@ KSHs 15
16	Cabaline	25mg @ KSHs 25 50mg @ KSHs 50

Appendix 4: EQ-5D-5L Questionnaire



**Health Questionnaire**

**English version for Kenya**

Under each heading, please tick the ONE box that best describes your health TODAY.

**MOBILITY**

- I have no problems in walking
- I have slight problems in walking
- I have moderate problems in walking
- I have severe problems in walking
- I am unable to walk

**SELF-CARE**

- I have no problems washing myself or dressing myself (putting on my own clothes)
- I have slight problems washing myself or dressing myself
- I have moderate problems washing myself or dressing myself
- I have severe problems washing myself or dressing myself
- I am unable to wash myself or dress myself

**USUAL ACTIVITIES** (e.g. work, study, housework, family or leisure activities)

- I have no problems doing my usual activities
- I have slight problems doing my usual activities
- I have moderate problems doing my usual activities
- I have severe problems doing my usual activities
- I am unable to do my usual activities

**PAIN / DISCOMFORT**

- I have no pain or discomfort
- I have slight pain or discomfort
- I have moderate pain or discomfort
- I have severe pain or discomfort
- I have extreme pain or discomfort

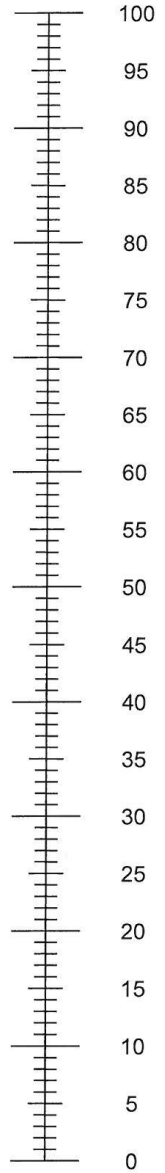
**WORRY (ANXIETY) / DEPRESSION**

- I am not worried or depressed
- I am slightly worried or depressed
- I am moderately worried or depressed
- I am severely worried or depressed
- I am extremely worried or depressed

- We would like to know how good or bad your health is TODAY.
- This scale is numbered from 0 to 100.
- 100 means the best health you can imagine.  
0 means the worst health you can imagine.
- Mark an X on the scale to indicate how your health is TODAY.
- Now, please write the number you marked on the scale in the box below.

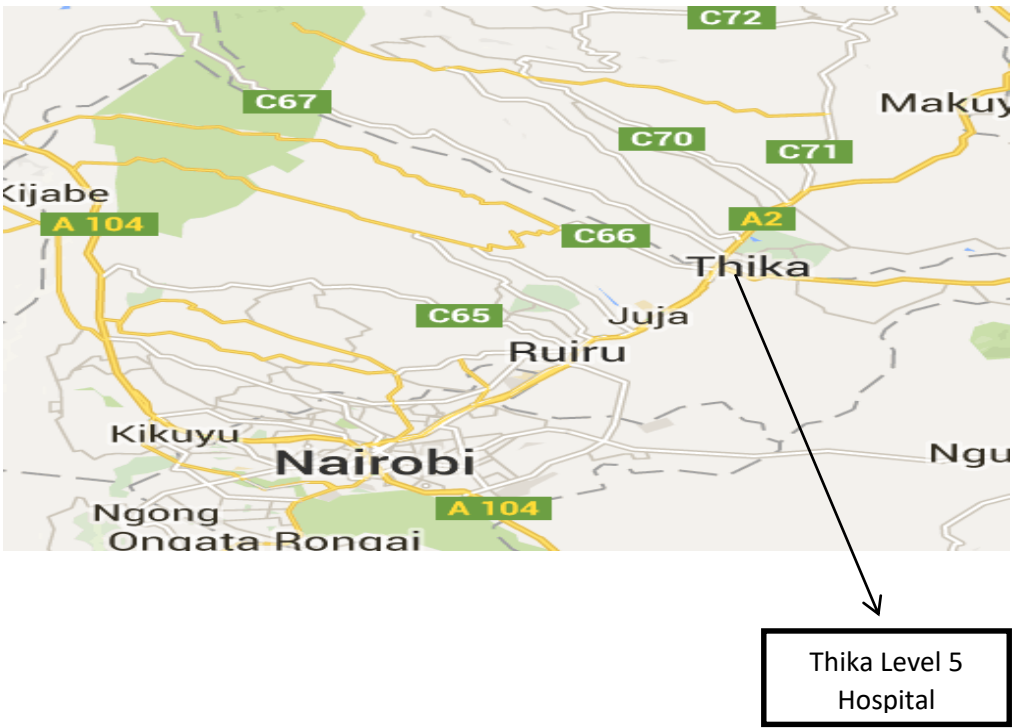
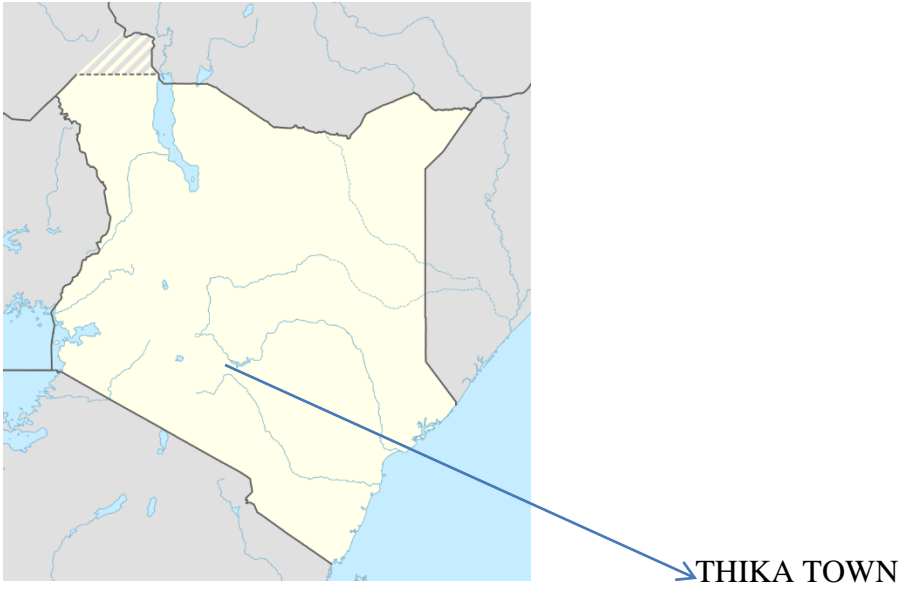
YOUR HEALTH TODAY =

The best health  
you can imagine



The worst health  
you can imagine

**Appendix: 5 Map of Study Area**



Appendix 6: Ethics Review



KENYATTA UNIVERSITY  
ETHICS REVIEW COMMITTEE

Email: [chairman.kuerc@ku.ac.ke](mailto:chairman.kuerc@ku.ac.ke)  
[secretary.kuerc@ku.ac.ke](mailto:secretary.kuerc@ku.ac.ke)  
[erkku2008@gmail.com](mailto:erkku2008@gmail.com)  
Website: [www.ku.ac.ke](http://www.ku.ac.ke)

P. O. Box 43844 - 00100 Nairobi  
Tel: 8710901/12  
Fax: 8711242/8711575

Our Ref: KU/R/COMM/51/702

Date: 23<sup>rd</sup> May, 2016

Rosebella J. Kipkalom  
Kenyatta University,  
P.O Box 43844,  
Nairobi

Dear Rosebella J. Kipkalom,

APPLICATION NUMBER PKU/496/I592- "ASSESSMENT OF BURDEN OF DIABETES MELLITUS IN THIKA LEVEL FIVE HOSPITAL, KIAMBU COUNTY, KENYA."

1. IDENTIFICATION OF PROTOCOL

The application before the committee is with a research topic, "Assessment of burden of diabetes Mellitus in Thika Level Five Hospital, Kiambu County, Kenya." received on 19<sup>th</sup> April, 2016 and discussed on 17<sup>th</sup> May, 2016.

2. APPLICANT

Rosebella J. Kipkalom, Department of Environmental and Population Health

3. SITE

Kiambu County, Kenya

4. DECISION

The committee has considered the research protocol in accordance with the Kenyatta University Research Policy (section 7.2.1.3) and the Kenyatta University Ethics Review Committee Guidelines AND APPROVED that the research may proceed for a period of ONE year from 23<sup>rd</sup> May, 2016.

5. ADVICE/CONDITIONS

- i. Progress reports are submitted to the KU-ERC every six months and a full report is submitted at the end of the study.
- ii. Serious and unexpected adverse events related to the conduct of the study are reported to this board immediately they occur.
- iii. Notify the Kenyatta University Ethics Committee of any amendments to the protocol.
- iv. Submit an electronic copy of the protocol to KUERC.

When replying, kindly quote the application number above.

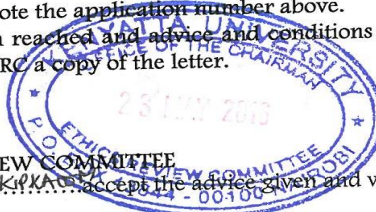
If you accept the decision reached and advice and conditions given please sign in the space provided below and return to KU-ERC a copy of the letter.

DR. TITUS KAHIGA  
CHAIRMAN ETHICS REVIEW COMMITTEE

I, Rosebella J. Kipkalom, accept the advice given and will fulfill the conditions therein.

Signature: [Signature] Dated this day of 16/05/2016 2016.

cc. Vice-Chancellor  
DVC-Research Innovation and Outreach







**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

9<sup>th</sup> Floor, Utalii House  
Uhuru Highway  
P.O. Box 30623-00100  
NAIROBI-KENYA

Ref. No.

Date:

NACOSTI/P/16/55178/13181

22<sup>nd</sup> August, 2016

Rosebella J. Kipkalom  
Kenyatta University  
P.O. Box 43844-00100  
NAIROBI.

**RE: RESEARCH AUTHORIZATION**

Following your application for authority to carry out research on "*Assessment of burden of diabetes mellitus in Thika Level Five Hospital, Kiambu County, Kenya,*" I am pleased to inform you that you have been authorized to undertake research in **Kiambu County** for the period ending **22<sup>nd</sup> August, 2017.**

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

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

  
BONIFACE WANYAMA  
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner  
Kiambu County.

The County Director of Education  
Kiambu County.

The County Director of Health Services  
Kiambu County.

## Appendix 8: Research Authorization, County Commissioner, Kiambu

**OFFICE OF THE PRESIDENT**  
 MINISTRY OF INTERIOR AND CO-ORDINATION OF NATIONAL GOVERNMENT  
**COUNTY COMMISSIONER, KIAMBU**

Telephone: 066-2022709  
 Fax: 066-2022644  
 E-mail: [countycommkiambu@yahoo.com](mailto:countycommkiambu@yahoo.com)  
 When replying please quote



County Commissioner  
 Kiambu County  
 P.O. Box 32-00900  
**KIAMBU**

Ref.No: **ED.12/1/VOL.IV/132**

**30<sup>th</sup> September, 2016**

Rosebella J. Kipkalom  
 Kenya University  
 P.O. Box 43844 - 00100  
**NAIROBI**

**RE: RESEARCH AUTHORIZATION**

Reference is made to National Commission for Science, Technology and Innovation letter Ref No. **NACOSTI/P/16/55178/13181**.

You have been authorized to conduct research on "*Assessment of burden of diabetes mellitus in Thika Level Five Hospital in Thika Sub-County in Kiambu County*". The data collection will be carried out in *Kiambu County for a period ending 22<sup>nd</sup> August, 2017*.

You are requested to share your findings with the County Education Office upon completion of your research.

  
**MUGO GICHIRI**  
 FOR COUNTY COMMISSIONER  
**KIAMBU COUNTY**

Cc County Director of Education  
**KIAMBU COUNTY**

National Commission for Science, Technology and Innovation  
 P.O. Box 30623-00100  
**NAIROBI**

Deputy County Commissioner (For information and record purposes)  
**THIKA SUB-COUNTY**

## Appendix 9: Research Authorization, Ministry of Education, Kiambu County



**MINISTRY OF EDUCATION**  
**State Department of Education**

Telephone: Kiambu (office) 020-2044686  
 FAX NO. 020-2090948  
 Email: [directoreducationkiambu@yahoo.com](mailto:directoreducationkiambu@yahoo.com)

COUNTY DIRECTOR OF EDUCATION  
 KIAMBU COUNTY  
 P. O. Box 2300  
 KIAMBU

*When replying please quote*

REF: KBU/CDE/HR/4/VOL.II/ (171)

30<sup>th</sup> September, 2016.

**Rosebella J. Kipkalom**  
 Kenyatta University  
 P.O BOX 43844-0010  
**NAIROBI**

**RE: RESEARCH AUTHORIZATION**

Reference is made to the National Commission for Science Technology and Innovation letter Ref. No NACOSTI/P/16/55178/13181 dated 22<sup>nd</sup> August 2016.

The above named has been authorized to carry out research on "*Assessment of burden of diabetes mellitus in Thika Level Five Hospital*" for a period ending 22<sup>nd</sup> August , 2017.

Please accord her the necessary assistance.

COUNTY DIRECTOR OF EDUCATION  
 KIAMBU COUNTY  
 P O BOX 2300-00900 KBU.  
 TEL: 020-2044686  
 FAX: 020-2090948

**JAMES GATHOGO**  
 For: COUNTY DIRECTOR OF EDUCATION  
**KIAMBU COUNTY**

## Appendix 10: Clearance to conduct Research, Dept. of Health Service

### COUNTY GOVERNMENT OF KIAMBU DEPARTMENT OF HEALTH SERVICES

All correspondence should be addressed to HEAD  
HRDU – HEALTH DEPARTMENT  
Email address: [mndiritu@gmail.com](mailto:mndiritu@gmail.com)  
[mkwasa@live.com](mailto:mkwasa@live.com)  
Tel. Nos: 0721641516  
0721974633



HEALTH RESEARCH AND DEVELOPMENT  
UNIT  
P. O. BOX 2344 – 00900  
KIAMBU

Ref No: KBU/HRDU/GEN/VOL 1/34

Date: 26<sup>th</sup> October 2016

#### TO WHOM IT MAY CONCERN

#### RE: CLEARANCE TO CONDUCT RESEARCH IN KIAMBU COUNTY

Kindly note that we have received a request by Ms. Rosebella J Kipkalom of Kenyatta University to carry out research in Kiambu County, the research topic being on "**Assessment of burden of diabetes mellitus in Thika level five hospital, Kiambu county Kenya**"

We have duly inspected her documents and found that she has been cleared by the NACOSTI to carry out the research for a period ending 22<sup>nd</sup> August 2017. She thus does not need any further clearance with another regulatory body in order to conduct research within the county of Kiambu.

However, it is incumbent upon the institution where she is carrying out research to ensure that she receives adequate supervision during the process of conducting the research. This note also accords her the duty to provide a feedback on her research to the county at the conclusion of her research.

**DR. KWASA MAGOMA**  
**FOR: HEAD, HEALTH RESEARCH DEVELOPMENT UNIT**  
**KIAMBU COUNTY**

## Appendix 11: Approval to carry out Research

**COUNTY GOVERNMENT OF KIAMBU  
DEPARTMENT OF HEALTH**

Tel.Thika 067 21621/2 fax 21778  
All correspondence should be addressed to  
MED.SUPT.  
When replying please quote



THIKA LEVEL 5 HOSPITAL  
P.O. BOX 227  
THIKA

Ref: NO. MOM/TKA VOL III (343)

Date: 14<sup>th</sup> November, 2016

**APPROVAL TO CARRY OF RESEARCH**

Principle investigator: **Rosebella J. Kipkalom**

**RESEARCH TOPIC: ASSESSMENT OF BURDEN OF DIABETES MELLITUS IN THIKA LEVEL FIVE HOSPITAL, KIAMBU COUNTY, KENYA**


Following deliberations by Thika Level 5 hospital research committee, your proposal to carry out the above research at this facility has been approved. However, you will need to provide us with licence from NACOSTI before you can commence the data collection.

Take note that you are required to submit a copy of your research findings upon completion of the study to the hospital. It is also expected that the Ethical consideration and the research subjects confidentiality will be maintained as you have outlined in your proposal.

Any patient confidential information that you may access during your research should not be used without consent.

This letter is valid up to 14<sup>th</sup> November, 2017.

For any queries feel free to contact the committee chair through the Medical Superintendent's office. Thank you and all the best

  
DR. J. WANGECHI  
CHAIR TREC  
**THIKA LEVEL 5 HOSPITAL**

