QUALITY OF GLYCEMIC CONTROL AMONG INSULIN TREATED AMBULATORY PATIENTS WITH DIABETES MELLITUS AT KENYATTA NATIONAL HOSPITAL

SALIM RASHID MASOUD, MD

A DISSERTATION SUBMITTED AS PARTIAL FULFILLMENT OF AWARD OF MASTERS OF MEDICINE IN CLINICAL MEDICINE AND THERAPEUTICS AT THE UNIVERSITY OF NAIROBI

FACULTY OF MEDICINE, UNIVERSITY OF NAIROBI

2011

DECLARATION BY THE PRINCIPAL INVESTIGATOR:

I declare that this is my original work and has not been presented for purposes of award of a degree at any other university. I also declare that this study was only done after the approval of the proposal by the Department of Clinical Medicine and Therapeutics and authorization by the Kenyatta National Hospital Scientific Research and Ethical Review Committee (Reference;

Signature: _____ 14/11/11

DR. SALIM RASHID MASOUD

Department of Clinical Medicine and Therapeutics. School of Medicine

University of Nairobi

DECLARATION BY THE SUPERVISORS:

This dissertation was submitted for examination with our approval as supervisors.

PROFESSOR FREDRICK C. F. OTIENO

Senior Lecturer, Department of Clinical Medicine and Therapeutics, University of Nairobi.

Signature: _____ Date: 14/11/2021

PROFESSOR MARK DAVID JOSHI

Associate Professor, Department of Clinical Medicine and Therapeutics, University of Nairobi

Signature: _____ Date: 15/11/21

DR. KIRTIDA S. ACHARYA

Lecturer, Department of Clinical Medicine and Therapeutics, University of Nairobi.

Signature: _____ Date: 14/11/21

ACKNOWLEDGEMENT

First and foremost, I thank the Almighty God for his countless blessings as He says 'if you should count God's favors, you could not enumerate them' (Q14:34).

Secondly, I thank my supervisors for their priceless contribution, insight and guidance into this work as well as having faith in and to stand for and by this work.

I am grateful to my wife. She was a pillar of support and encouragement as well as a source of repose and mercy in difficult times.

My gratitude goes to Steve Mburu of IsisAfrica, Angela Kimani and Angeline Macharia of Laborex Kenya for their trust and support; Dr. Ritesh and his colleagues of Star-biotech for their support; Mr. Miruka and Mr. Osoro for assisting in collecting data; Members of staff at the diabetic clinic for their understanding and support and the stastician, Mr. Kenneth Mutai, for assisting in making sense out of the data.

Last but not least, my deepest gratitude goes to the patients who participated in this study. Without them, there would have been no study.

Thank you all.

TABLE OF CONTENTS PAGE

I. LIST OF ABBREVIATIONS

A1C	Glycated hemoglobin/ Hemoglobin A1C/ HbA1C / glycohemoglobin
ACCORD	Action to Control Cardiovascular Risk in Diabetes trial
ADA	American Diabetes Association
ADVANCE	Action in Diabetes and Vascular Disease: Preterax and Diamicron Modified Release Controlled Evaluation
CI	Confidence Interval
DAWN	Diabete: Attitudes Wishes and Needs Study
DCCT	Diabetes Control and Complications Trial
DM	Diabetes Mellitus
EDIC	Epidemiology of Diabetes Interventions and Complications Study
IDF	International Diabetes Federation
IQR	Inter-Quartile Range
KNH	Kenyatta National Hospital
LDL	Low- Density Lipoprotein
MMAS-4	4- point Morisky Medication Adherence Scale
NCD	Non-Communicable Disease
NHANES	National Heath and Nutrition Examination survey
OAA	Oral Anti-Diabetic Agent
OR	Odds ratio
PI	Principal Investigator
RAPIA	Rapid Assessment Protocol for Insulin Access
SD	Standard Deviation
SMBG	Self- Monitoring of Blood Glucose
SPSS	Statistical Packages for Social Scientists
T1DM	Type 1 diabetes mellitus
T2DM	Type 2 Diabetes Mellitus
UKPDS	United Kingdom Prospective Diabetes Study
VADT	Veterans Affairs diabetes trial
WHO	World Health Organization

2. LIST OF FIGURES, TABLES AND APPENDICES

2.1. LIST OF FIGURES

2.2. LIST OF TABLES

2.3. LIST OF APPENDICES

3. ABSTRACT

Background: Diabetes mellitus is one of the most prevalent NCDs associated with increasing morbidity, mortality and socio-economic burden. Lowering blood sugar levels as close to normal as possible is associated with improved morbidity and mortality in patients with diabetes. Insulin is an effective medication that can reduce any elevated level of A1C to recommended targets. All patients with T1DM and eventually majority with T2DM require insulin to achieve near normal glycemic levels. Despite improved therapy and knowledge, glucose control is still unsatisfactory in many patients. Data on the quality of control in Kenya, especially on insulin treated patients, is scarce and limited.

Objective: Determine the quality of glycemic control and patient, disease and treatment factors associated with quality of glycemic control among insulin treated ambulatory diabetic patients at the diabetic outpatient clinic at KNH.

Design: Cross-sectional descriptive study

Setting: Diabetic Outpatient clinic at KNH.

Subjects: Ambulatory patients with diabetes on insulin therapy for at least 3 months

Main Outcome measure: A1C.

Materials and Methods: A designated questionnaire and analysis of blood samples for AIC were used to collect data from consecutively sampled patients. The data was analyzed using SPSS version 17.0.

Results: From 1,018 ambulatory patients attending the diabetic clinic at KNH, 212 patients on insulin therapy for at least 3 months were recruited. 66.5% were females. The mean (SD) age was 53.4(17.4) years. Mean (SD) age at disease onset was 39.6 (16.1) years. Median duration of disease and duration of insulin use were 11.1 and 6.0 years, respectively. Sixty four percent were adherent to insulin injections and only 5.2% monitored sugars at least once per day. 201 samples were analyzed for A1C. The mean (SD) A1C was 9.4(2.2) % with a range of between 5.2 and 15.0%. Eighty six percent had A1C above or equal to 7% and were considered poorly controlled. Seventy percent had A1C above or equal to 8% whereas 42% had A1C equal or above 10%. Glycemic control was significantly associated with age at disease onset (p. 0.017) and duration of insulin use (p. 0.041).

Conclusion: Overwhelming majority of ambulatory patients with diabetes mellitus on insulin attending the diabetic clinic at KNH were poorly controlled. Early age at disease onset and longer duration of insulin use were associated with poor control.

4. LITERATURE REVIEW

4.1. BURDEN OF DISEASE

Diabetes mellitus is undoubtedly one of the most challenging health problems in the 21st century despite numerous advances achieved in its control and evaluation. It is one of the most prevalent non-communicable diseases globally, presenting a significant public health burden based on its increasing incidence, morbidity, mortality, and socio- economic costs (1). It is estimated that approximately 285 million people worldwide, or 6.6% of the world population, in the age group 20-79, had diabetes in 2010, some 70% of whom live in low- and middle-income countries where health resources are needed to combat both contagious and chronic diseases. This number is expected to increase by more than 50% in the next 20 years if preventive programs are not put in place. By 2030, some 438 million people, or 7.8% of the global adult population, are projected to have diabetes. Once thought of as a disease of the elderly, people in younger productive age groups now form the bulk of those with diabetes. Some 46% of adults, some 132 million in 2010, with diabetes mellitus were in the 40–59 age group (2). In Africa, over 12 million were estimated to have diabetes in 2010. This number is expected to double to 24 million by 2030. In Kenya, the prevalence amongst the adult population was estimated at 4.2% in 2009 with a range of between 3 and 7% and showing urban-rural variation (3).

T1DM usually accounts for only a minority of the total burden of diabetes in a population. T2DM constitutes about 85 to 95% of all diabetes in high-income countries and may account for an even higher percentage in low- and middle-income countries. T2DM diabetes is now a common and serious global health problem, which, for most countries, has evolved in association with rapid cultural and social changes, ageing populations, increasing urbanization, dietary changes, reduced physical activity and other unhealthy lifestyle and behavioral patterns (4).

4.2. NEED OF GOOD QUALITY OF GLYCEMIC CONTROL

Glycemic control is fundamental to the management of diabetes. Studies show that diabetes at any age, if not properly managed, will lead to serious outcomes, and, in some cases, death. Diabetes is associated with serious long-term complications including microvascular and macrovascular complications, the consequences of which can include blindness, kidney damage, coronary artery and peripheral vascular disease, stroke, diabetic neuropathy and amputations, which account for increasing disability, reduced life expectancy and enormous health costs for virtually every society (1). Diabetes is also associated with depression, an important condition that is common in people with diabetes. Diabetes is one of the major causes of premature illness and death in most countries.

Cardiovascular disease, resulting from damage to large blood vessels, causes the death of 50% or more of people with diabetes. Close to four million deaths in the 20-79 age group may have been attributable to diabetes in 2010, accounting for 6.8% of global all-cause mortality in this age group. Complications attributed to diabetes are similarly prevalent in diabetic populations in Kenya. Diabetes underlies a big proportion of indications for hospital admissions in Kenya (5). 8% are admitted with diabetes ketoacidosis, a third of whom die within 48 hours of admission (6). Over three quarters of dialysis cases are due to diabetes and hypertension (5). 28% of patients with diabetes have polyneuropathy, between a quarter and up to 40% have microalbuminuria (7 - 10) and about 5% have foot ulcers (11). 30% of newly diagnosed T2DM at KNH were found to have retinopathy (12).

Unlike some other diseases, treatment exists for diabetes, and if managed correctly, is very effective in reducing complications. There is excellent evidence that the development of complications can be significantly reduced and their progress and impact limited once they have developed. Evidence from key controlled studies conducted in the past decade like the DCCT (13), UKPDS (14), EDIC (15), KUMAMOTO (16), VADT (17,18), ADVANCE (19) and ACCORD trials (20,21) has established the importance of tight and sustained glycemic control among T1DM and T2DM patients. These studies have emphasized the central role of consistently managing A1C levels in patients with diabetes, as a result, some professional organizations proposed clinical guidelines in the range of 6.5 - 7.0% to motivate health professionals and patients to constantly manage blood glucose levels (22, 23). The ultimate goal of diabetes therapy is to prevent diabetes complications in order to improve quality of life and life expectancy.

Diabetes imposes a large economic burden on the individual, national healthcare system and economy. The emerging epidemic of non-communicable diseases is threatening to overwhelm healthcare systems worldwide unless action is taken now. Diabetes, cardiovascular disease, cancer and chronic respiratory diseases cause 60% of all deaths worldwide, with four in every five of these deaths occurring in low- and middle-income countries. Non-communicable diseases are an under-appreciated cause of poverty and now present a serious barrier to economic development including Vision-2030. They are estimated to reduce gross domestic product by up to 5% in many low- and middle-income countries, dealing a double blow to fragile struggling economies. Non-communicable diseases threaten all sectors of society and have been recognized as a serious and increasing global risk by the World Economic Forum (24)

4.3. ADEQUACY OF GLYCEMIC CONTROL

Despite the numerous advances achieved in diabetes control and evaluation, the management of such a complex disease remains challenging and in spite of the benefits of tight glucose control, outcomes among patients with diabetes remain less than optimal. Recent epidemiological data from various regions of the world show most patients with diabetes are not controlled to recommended A1C targets (25 - 32). In the US, data from the National Heath and Nutrition Examination surveys from 1999 to 2002 (NHANES-I), including both T1DM and T2DM patients of whom approximately one-fourth were using insulin, showed that, overall, 63% of patients were not controlled to recommended levels. Only 24% of patients on insulin- only therapy and 14% on combination therapy reached the A1C goal of less than 7.0%. Despite, subsequent surveys (NHANES-II and III) showing significant improvements ($p < 0.05$), majority of patients were still not controlled to targets. The analysis of NHANES datahad certainstrengths. The NHANES sample is nationallyrepresentative and has a sufficientsample size to detect differences betweentime periods. Uniform methods wereused for the diabetes section of NHANES,and A1C values were assessed by a singlelaboratory with close attention to qualityof control and measurement. The results were significant even after controlling fordemographic variables in the multivariateanalysis. The analysis, however, had at least one potentiallimitation. Diabetes status was self reported and, in the absence of a clinicalpatient history, some individuals in thesample might not have had diabetes (25). A Swedish study on T1DM found 83% of patients in 1997 and 79% in 2004 having A1C levels of less than 7% (26). Similarly, reports from the United Kingdom (n = 10.663) (27), Canada (n = 5.569) (28), and the Netherlands (29) also revealed unfavorable rates of poor glycemic control in T2DM diabetes: 76%, 73% and 42% respectively.

In a large (n = 6.671), multi-centered, cross-sectional survey in Brazil, the prevalence of diabetic patients with inadequate glycemic control (A1C ≥ 7.0%) among patients with T1DM and T2DM was 76%. Poor glycemic control was more common in patients with T1DM (90%) and those with insulin-treated T2DM (90%) than in those with non-insulin treated T2DM (64%).The distinctive strengths of this study were the large multicentre sample, the collection of data by trained and certified interviewers, the measurement of HbA_{1c} by a reliable method in a central laboratory, and the high response rate (84%). Despite that, one limitation was that the study was centre based, and might be representative of patients with diabetes attending health care facilities and not the whole population of Brazilian patients with diabetes(30). In a single-centered study at a tertiary referral and a teaching hospital in Ethiopia, 99% of patients with T1DM had A1C equal or above 8.7%. This study, however,

was a single-centered in a rural setting and might not be representative of the general Ethiopian diabetic population (31). In Kenya, the rates of poor control show wide variations ranging between 13% of patients with T2DM in Western Kenya and 61% of those with T1DM and T2DM at the KNH (9, 32). The study by Wafula et al in Western Kenya that suggested good control in majority of the respondents may have been biased towards the motivated patients due to the design of the study that required more than one contact with the patients. The study also excluded patients with T1DM and included patients with T2DM on all modalities of treatment. Patients on insulin treatment in Kenya, as well as other areas, have been shown to have worse control than patients on other modalities of treatment (9, 25, 30-32).

4.4. BARRIERS TO EFFECTIVE INSULIN THERAPY

The reasons for poor control are many and complex and have been described by Wallace and Mathews for T2DM as "conspiracy of the disease, suboptimal therapy and attitude" (33). They relate to the disease process itself, the inadequacy of therapeutic regimens and attitudes of both doctors and patients. Achieving a desirable glycemic control requires well-motivated and informed patients with a good healthcare and social economical support. Barriers to effective insulin therapy have been well-documented (34). Much of what is known about the barriers relates to either hypoglycemia (35) or demographic and psychosocial factors such as age, motivation and compliance, diabetes education and coping skills (36, 37). Age, duration of diagnosis, mode of treatment, and level of education influence a patient's participation in control of his or her diabetes (38). Health beliefs, lifestyle, control issues, social norms, health goals, and emotional health may also play roles. (39). Physician characteristics, including knowledge, attitude and ability to interact with patient are important (40). Other factors that influence control include consistency and discipline in the timing and content of meals and exercise and site of injections; frequency of blood glucose monitoring and subsequent treatment adjustments, nutrition, weight gain and frequency of follow-up.

Several studies (35-46) have identified patient attitudes that contribute to resistance to or acceptance of insulin therapy. Results from the DAWN study indicate that although there are significant variations across countries, resistance to taking insulin among patients and resistance to prescribing insulin among health care providers is substantial (34). Clinicians may be concerned about the costs, effects of polypharmacy or side effects like weight gain, hypoglycemia and postulated atherogenic effects of insulin. They may also not feel adequately prepared to effectively manage insulin therapy or they may lack the time and resources to provide the needed follow-up. In the DAWN study, belief

in the efficacy of the insulin therapy and cost were considered factors that hinders effective insulin therapy in the study among the providers (34). This resistance is based on a variety of factors, primarily beliefs and perceptions regarding diabetes and its treatment, the nature and consequences of insulin therapy, needle phobia, costs and how others would regard insulin therapy (41-46). Earlier studies (37, 47) indicate that a positive provider attitude has a positive impact on patient attitudes toward insulin.

Patients may have false beliefs about the complexity of the insulin therapy. Most patients express >1 concern about insulin use (48), and their reluctance generally represents a complex set of beliefs and their lack of skill to administer insulin, as well as a lack of information(47) what can be termed as" psychological insulin resistance"(49). True needle phobia is rare. (50, 51)Other reasons include treatment guidelines that have advocated late insulin initiation only if all other treatment strategies have failed.

More-specific barriers identified by patients include (49-52): The perceived loss of control over their lives and the loss of flexibility, fear that they cannot manage the demands of insulin therapy, a sense of personal failure in not managing their diabetes effectively, the disruption in lifestyle or in relationships with family and friends, fear that the need for insulin is a sign of more severe disease or impending death, anxiety about daily injections and that insulin will not be effective, fear of being perceived as a drug addict, apprehension about potential side effects (e.g., hypoglycemia, weight gain), and the belief that insulin causes long-term complications.

Accessibility and affordability of insulin and related materials is another challenge in effective insulin therapy especially in the developing countries. The International Insulin Foundation established a tool, RAPIA (53), for analyzing constraints to insulin access and diabetes care by patients especially in developing countries. RAPIA was implemented in Mozambique and Zambia in 2003 and barriers identified from the studies included: intermittent supply of insulin, syringes, urine and blood reagents especially in the rural areas; cost especially in the private sector when public sector runs out of stock; inexperience in the management of diabetes by most health care workers and traditional beliefs and medicine (54).

Besides challenges in diagnosis, care and knowledge about the disease among the providers and the general public and lack of priority among policy makers, other challenges in sub-Saharan Africa

include: unsettled political situation, illiteracy, poverty, cultural and economic problems such as low penetration of refrigerators and depending on one large meal in a day by many families, lack of interest by providers due to the challenging nature of the disease and poor financial rewards and overburdening of health facilities.

4.5. INSULIN

Insulin is a peptide hormone that is synthesized, packaged, and secreted in pancreatic beta cells. Most insulin molecules are degraded by liver cells. Insulin half-life is approximately 4 to 6 minutes. Insulin directly or indirectly affects the function of virtually every tissue in the body. Exogenous insulin must be administered to patients who experience insulin deprivation. Insulin is used in the treatment of patients with diabetes of all types. All patients with T1DM need insulin treatment permanently; many patients with T2DM will require insulin for effective regulation of their blood sugar level as their beta cell function declines over time. T2DM is characterized by defects in both insulin secretion and insulin resistance. The defect in insulin secretion seems to be progressive; newly diagnosed patients in the UKPDS Group had 50% of normal insulin secretion, and they had <25% of normal insulin secretion 5 years after diagnosis (14). Consequently, good glycemic control in T2DM often requires insulin supplementation therapy. Insulin is the most effective of the diabetes drugs in lowering glycemia. It can, when used in adequate doses, decrease any level of elevated A1C to, or close to, therapeutic targets. Unlike other medications, there is no maximum dose of insulin beyond which a therapeutic effect will not occur.

The initial sources of insulin for clinical use in humans were cow, horse, pig or fish pancreases. Biosynthetic "human" insulin is now manufactured using genetic engineering techniques using recombinant DNA technology. Clinical insulins are specially prepared mixtures of insulin plus other substances including preservatives. These delay absorption of the insulin, adjust the pH of the solution to reduce reactions at the injection site, and so on. Slight variations of the human insulin molecule are called insulin analogues. The commonly used types of insulin are: Rapid-acting types, such as aspart or *lispro*; Short-acting, such as *regular* insulin; Intermediate-acting, such as neutral protamine Hagedorn (NPH); Long-acting, such as *ultralente*, *Insulin glargine* and *Insulin detemir*; A mixture of NPH and regular insulin that starts working in 30 minutes and is active 16 to 24 hours and a mixture of Semilente and Ultralente, known as *Lente*, that is typically active for an entire 24-hour period.

Although the manufacturers recommend storing insulin in a refrigerator (1 to 8 degrees Celsius), injecting cold insulin can sometimes make the injection more painful. Insulin kept at room temperature (15 to 30 degrees) will last approximately one month. There are several problems with insulin as a clinical treatment for diabetes. These are problems associated with:

- The mode of administration.
    - Insulin is usually taken as subcutaneous injections by syringes with needles, an insulin pump, or by repeated-use insulin pens with needles. The oral, sublingual, inhalational, transdermal'y and other modes of delivery are being investigated.
- Selecting the 'right' dose and timing.
    - It is difficult to simulate physiologic endogenous insulin secretion.
- Selecting an appropriate insulin preparation.
- Adjusting dosage and timing to fit food intake timing, amounts, and types.
- Adjusting dosage and timing to fit exercise undertaken.
- Adjusting dosage, type, and timing to fit other conditions, for instance the increased stress of illness.
- Variability in absorption into the bloodstream via subcutaneous delivery
    - The degree of absorption of any dose, both among patients and in the same patient, can vary from day to day by as much as 25 to 50 %. Major variables that affect the degree of subcutaneous insulin absorption include the insulin preparation, the size of the subcutaneous depot, injection technique, the site of injection, and subcutaneous blood flow.
- The danger of overdosing.

The term "intensive insulin therapy" has been used to describe complex regimens that nearly approximate normal insulin physiology and describes treatment with 3 or more injections per day or with continuous subcutaneous insulin infusion with an insulin pump. The term "conventional insulin therapy" has been used to describe simpler insulin regimens comprising fixed dosages and fixed times. Patients with T2DM and with persistent hyperglycemia despite oral hypoglycemic therapy may add insulin to oral medication or may stop the oral drug(s) and begin insulin (Insulin monotherapy). Many studies have shown that glycemia improves with insulin combination therapy. In some studies, target A1C goals are achieved in 60 to 70 % of subjects. Insulin monotherapy is cheaper than combined therapy in patients with persistent hyperglycemia despite oral hypoglycemic

therapy, but results in more weight gain and more episodes of hypoglycemia, few of which are severe.

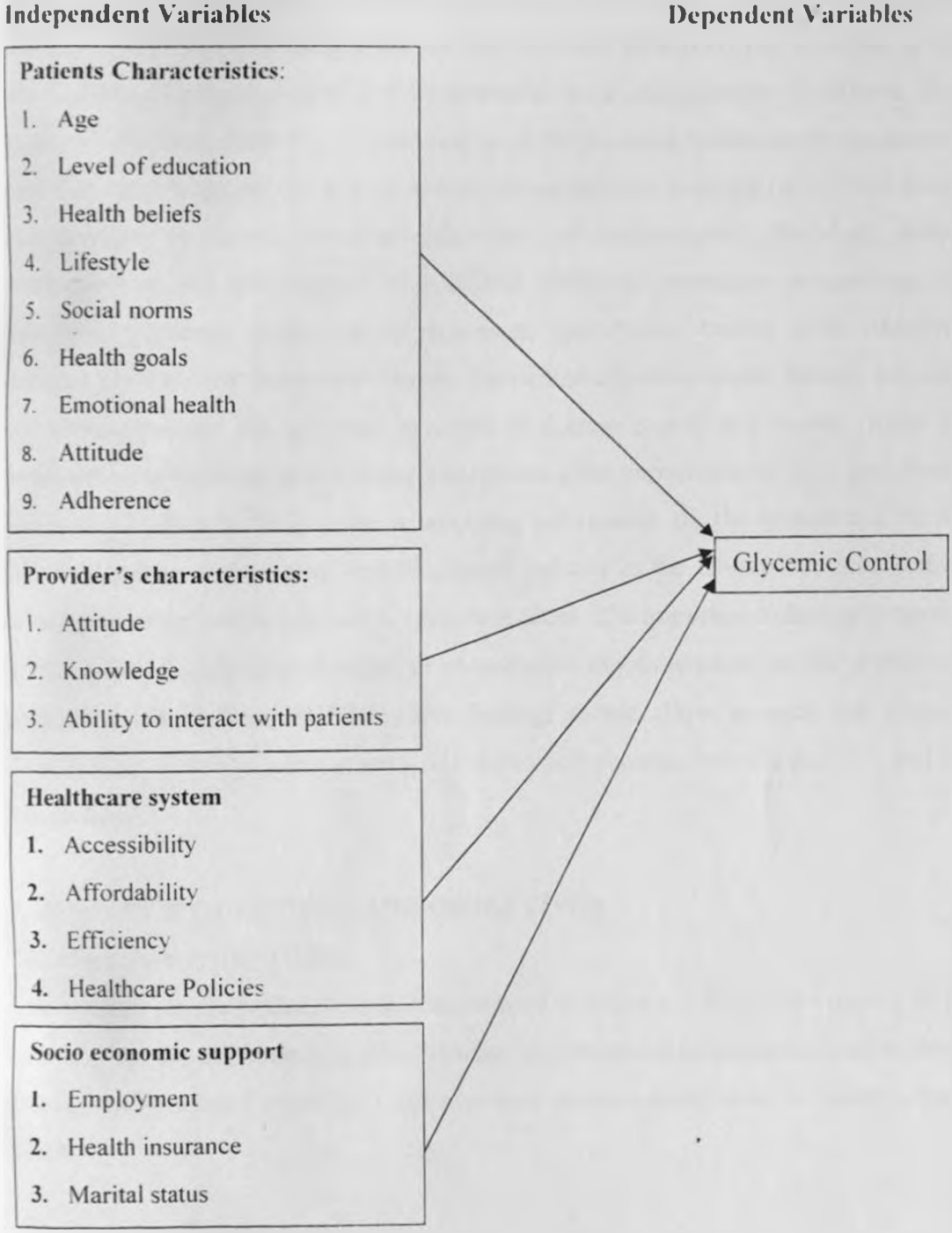
The progressive nature of the disease requires frequent and proper monitoring and appropriate treatment adjustments for continued satisfactory control. Patients and providers should be aware of this fact and that patients are likely to need dose adjustments at regular intervals and that such augmentation does not represent failure on anybody's part but the natural progression of the disease. Unfortunately, many patients with T2DM who could benefit from insulin therapy do not receive it or do not receive it in a timely manner.

4.6. A1C

Diabetes care is comprehensive and lack of standardization in the definition of indicators and the systems to provide such indicators in representative groups of people with diabetes has been one of the limitations in attempting to compare studies done on diabetes quality of care across countries. In order to respond to this handicap. The Organization for Economic Co-operation and Development's Health Care Quality Indicators Project (55, 56) selected nine indicators, in 3 groups, for assessing diabetes care: *Process of care* (Annual A1C testing, Annual LDL cholesterol testing, Annual screening for nephropathy, Annual eye examination), *proximal outcomes* (A1C control, LDL cholesterol control) and *Distal outcomes* (Lower-extremity amputation rates, Kidney disease in persons with diabetes, Cardiovascular mortality in people with diabetes).

Measurement of A1C, however, is the most widely used clinical test and an effective measure of glucose control in diabetics. It also correlates well with complications of diabetes and therefore a useful quality measure for assessing the quality of diabetic care (57) Glucose becomes irreversibly attached to hemoglobin at a rate dependent upon the prevailing blood glucose. The average amount of A1C changes in a dynamic way and indicates the mean blood glucose concentration over the life span of the red cell (120 days). A relatively strong correlation between A1C and average glucose levels was noted in the DCCT and other trials and A1C values could be translated into a comparable average glucose level (13). The DCCT found an inverse relationship between the A1C value and the incidence of developing microvascular and macrovascular complications. A1C is useful in assessing the effectiveness of therapy and guiding therapeutic decisions. The international standardization of the A1C assay has decreased potential technical errors in interpreting A1C results.

5. CONCEPTUAL FRAMEWORK(Figure 1):



6. JUSTIFICATION OF THE STUDY

Diabetes is a major public health concern associated with increased morbidity, mortality and economic costs. In developing countries, like the sub-Saharan Africa, incidence of diabetes is on the rise. Quality of glycemic control is fundamental in the management of diabetes. Knowledge on the quality of glycemic control is of great relevance for planning healthcare programs targeting improved care. The knowledge on the disease and its management is evolving rapidly and consequently targets and strategies in various treatment guidelines are metamorphic. Regularly updated data on the disease and on the effectiveness of available therapeutic strategies in achieving treatment targets, such good glycemic control, is of paramount importance. Insulin is an effective medication in reducing glycemia to therapeutic targets. Barriers to effective insulin therapy are many and complex and although some are universal in terms of disease course and burden, some have geo- social peculiarities of different populations, underscoring the importance of local data. Such data is limited and scarce in Kenya. In addition to evolving information on the disease and its management, the social economic environment and healthcare policies in the country are also evolving; findings in older studies may not be relevant to present realities. It is important to have a comparative assessment of the available data and attempts to characterize the dimensions of the problem of poor control among the insulin users at KNH. The findings should allow an audit and improved delivery of diabetic care to insulin users at the KNH which will enhance both the patient's and the practitioner's satisfaction.

7. RESEARCH QUESTIONS AND OBJECTIVES

7.1. STUDY QUESTIONS

The research questions that were addressed were as follows: 'What is the quality of glycemic control and what are the socio-demographic, disease and treatment factors associated with glycemic control among insulin-treated ambulatory patients with diabetes mellitus at the diabetic outpatient clinic at KNH?'

7.2. STUDY OBJECTIVES

7.2.1. BROAD OBJECTIVE

To determine the quality of glycemic control and patient, disease and treatment factors associated with quality of glycemic control among insulin-treated ambulatory diabetic patients at the diabetic outpatient clinic at KNH.

7.2.2. SPECIFIC OBJECTIVES

1. To determine the quality of glycemic control among ambulatory diabetic patients at diabetic outpatient clinic at KNH by determining A1C levels.
2. To determine the socio-demographic factors (i.e. age, sex and level of education) associated with quality of glycemic control.
3. To determine disease and treatment factors (i.e. type of disease, age at disease onset, duration of disease, duration of insulin use, concurrent use of oral anti-diabetic agents, frequency of blood glucose monitoring and adherence to insulin) associated with quality of glycemic control.

7.2.3. SECONDARY OBJECTIVES

1. To determine patients' perceived accessibility and affordability to care.
2. To assess the level of satisfaction of patients with current insulin treatment and determine association with quality of glycemic control.

8. METHODOLOGY

8.1. STUDY DESIGN

This was a descriptive cross sectional study

8.2. VARIABLES

8.2.1. INDEPENDENT VARIABLES

The variables included:

- Socio- demographic factors (age, sex, level of education).
- Disease and treatment related factors (type of disease, age at disease onset, duration of disease, duration of insulin use, concurrent use of oral anti-diabetic agents, frequency of blood glucose monitoring and adherence to insulin).
- Patients' attitude and practice (perceived affordability and accessibility to care and drugs and satisfaction with current insulin treatment)

8.2.2. DEPENDENT / OUTCOME VARIABLE

The outcome variable was quality of glycemic control.

8.3. STUDY PERIOD AND SITE

Data was collected from the 14th February, 2011 to 22nd, March, 2011 at the diabetic outpatient clinic at KNH. KNH is a national referral and teaching hospital, located within Nairobi city. The hospital runs a specialized diabetic clinic every weekday run by a team of specialist endocrinologists, physicians, resident doctors, nutritionists, diabetic educators and nurses. The clinic on Mondays through Thursdays is designated as 'mini clinic' and the one on Fridays as 'major clinic' based on the number of patients and cadre of clinicians at the clinic in those particular days which are more at the 'major' than the 'mini' clinic. The hospital caters mostly for residents of the Nairobi metropolis and nearby districts.

8.4. STUDY POPULATION AND CASE SELECTION

The study population was constituted of insulin-treated ambulatory patients documented to have diabetes, either T1DM or T2DM, attending the diabetic outpatient clinic at the KNH from which cases, defined as an ambulatory individual documented to have diabetes, either T1DM or T2DM, and on insulin for management of diabetes for a period of not less than 3 months, were selected.

8.4.1. INCLUSION AND EXCLUSION CRITERIA

8.4.1.1. INCLUSION CRITERIA

1. Those patients who provided consent or assent to participate in the study.
2. Those patients aged 12 years and above

8.4.1.2. EXCLUSION CRITERIA

1. Those patients who reported or documented to be pregnant.
2. Those patients who reported or documented to have a hemoglobinopathy.
3. Those patients who reported or documented to have hemochromatosis, acute or chronic pancreatitis, cystic fibrosis or pancreatic cancer.
4. Those patients who reported or documented to have pheochromocytoma, acromegaly or Cushing syndrome.
5. Those patients who reported or documented to have prolonged usage (more than 3 months) of phenytoin, glucocorticoids or estrogens.

8.5. SAMPLE SIZE DETERMINATION

The sample size was determined using the following formula (58):

$$n = z^2 p (1-p)/ d^2$$

Where n = desired minimum sample size; z = standard normal deviation value; p = known prevalence rate for the factor of interest under study (In this case proportion of patients with T1DM or T2DM on insulin with good glycemic control in Brazil = 10% (23))and d = the level of desired precision.

When this formula is applied at z = 1.96, p = 0.1 and d = 0.05

$$n = (1.96)\ (1.96)\ (0.1)\ (0.9)/\ 0.05^2 = 138 \text{ patients.}$$

Therefore, a minimum of 138 patients was desired. 212 patients were, however, recruited improving the level of precision to 0.04.

8.6. SAMPLING, SCREENING AND RECRUITMENT

Patients who attended the diabetic clinic during the study period were sampled consecutively. Patients were assigned serial numbers on arrival at the mini and the major clinic and were screened for case definition using a screening question. Identified cases were further screened for other eligibility criteria. Those who were eligible were recruited into the study.

On a regular clinic day, patients register on arrival and their medical records arranged. They then gather at the waiting area where one at time proceed for triaging and have their blood pressure, height and weight measured. They then have their blood sugar measured. Thereafter, they meet with the clinician. The study, its contents and the investigators were introduced to the patients as they move from registration, triage, laboratory, meeting the clinician to exit. This was done with minimal interference, if any, with the clinic's ordinary flow of events partly because of in-between the many stages patients have to pass: there was considerable amount of waiting time which also, sometimes, facilitated administration of the questionnaire and collection of blood samples.

8.7. DATA COLLECTION

Data was collected through a designated questionnaire (see APPENDIX 5) and analysis of blood samples for A1C which were the main instruments employed. The questionnaire was structured and administered to all study subjects. The questionnaire focused on the potential exposures of interest which included age, sex, education, and duration of disease, adherence, monitoring, perceived accessibility and affordability to care and insulin and satisfaction with current diabetes treatment. The

language of the questionnaire was both English and Kiswahili. In case it was necessary to use another language to conduct the interview, a suitable translator was sought. The questionnaire was self administered. Patients who had difficulty reading or comprehending the questions were assisted to fill the questionnaire by the investigators.

An approximately 2 mls of blood sample was then drawn from each patient from a peripheral vein under aseptic conditions, collected in EDTA bottle, stored under temperatures of between four andeight degreesCelsius dispatched to the laboratory within the shortest time possible and analyzed the same day. Analysis of the samples for A1C was done in a central laboratory (Star Biotech laboratory) by use of COBAS INTEGRA 400/800 analyzers and was based on turbidimetric inhibition immunoassay (TIMA) for hemolysed whole blood. Three quality control checks were done for this assay during the study period and were found to be within accepted limits. The laboratory also undergoes external and internal quality control checks regularly.

8.8. MEASUREMENT AND SCALING

All variables except A1C and sex were self- reported and verified by scrutiny of available medical records. The medical records scrutinized included doctors' and nurses' notes, prescriptions, appointment cards, booking records and patients' personal medical diaries. Any discrepancy between reported and recorded or observed data was discussed with the patient, if not resolved the reported data was recorded as the study data.

Age: It was determined to nearest number of years as the period from the reported or documented date of birth.

Level of education: This was determined as the reported completed numbers of years in formal education.

Sex: It was determined by the observed phenotypical sex,' which is, observed secondary sexual characteristics of male or female sex

Duration of disease: This was determined as the period in nearest months from the reported or documented date of disease onset. The date of disease onset was the date when the patient learnt about the diagnosis for the first time or documentation of the date when the diagnosis was made for the first time.

Frequency of monitoring: This was measured by an ordinal scale (several times a day, daily, several times a week, weekly and occasionally).

Adherence: This was determined by the 4- point Morisky Medication Adherence Scale (MMAS - 4) (58) (APPENDIX 4)

Perceived level of accessibility and affordability to care and insulin and **level of satisfaction with current treatment**: These were determined by a 5- item Likert response scale using global questions such as 'how easy (or difficulty) is it to access diabetic care at KNH?' (Very easy/ somewhat easy/neither easy nor difficult/ somewhat difficult/ very difficult). 'How affordable is diabetic care at KNH?' (Very affordable/ affordable/ not affordable/ not affordable at all) and ''If you were to spend the rest of your life with your diabetes treatment the way it is today, how would you feel about this? "Very satisfied, somewhat satisfied, neither dissatisfied nor satisfied, somewhat dissatisfied, or very dissatisfied'')

Quality of glycemic control: This was determined by levels of A1C.

8.9. DATA PROCESSING AND ANALYSIS

8.9.1. DATA PROCESSING

Data collected was preserved in a secure environment to avoid loss and breach of confidentiality. All research materials including hard copy questionnaires and other scripts were securely kept in lockable cabinets. Electronic files containing data were password encrypted. All collected data were cleaned, validated, coded, processed and stored at the end of each day by the PI. Processing and storage were done both electronically by entering data into Microsoft Excel spreadsheet and manually into pre-prepared tables.

8.9.2. DATA ANALYSIS

The Statistical Packages for Social Scientists (SPSS) version 17.0 was used for analysis. Processed data was entered for analysis at the end of the study. Continuous variables such as age, number of years in education, age at disease onset, duration of insulin use, duration of disease and A1C levels were summarized into means, medians and standard deviation while categorical data such as sex, age group, adherence, type of disease, frequency of monitoring, use of oral anti-diabetic agents, accessibility, affordability, satisfaction and status of glycemic control were presented as proportions. Age and A1C levels were entered as continuous data then categorized into age groups and status of glycemic control respectively. A1C was dichotomized into poor and good control. Levels below 7% were categorized as good glycemic control whereas levels above or equal to 7% were categorized as poor glycemic control.

Summation of items in the Likert scales for frequency of monitoring, affordability, accessibility and satisfaction was done. Five items were summed to three items for monitoring, accessibility and satisfaction while four items were summed to two items for affordability. Similarly, the three levels of adherence on the MMAS-4 were summed to two categories namely adherence and non- adherence. Total Morisky's score of zero was categorized as adherence and above zero as non-adherence.

Continuous variables were compared between the two categories of glycemic control (good and poor) using Student's t test. The test of associations between glycemic controls with categorical variables was performed using Chi square/ Fisher's exact tests. All statistical tests were performed at 5% level of significance (95% confidence interval).

9. ETHICAL CONSIDERATIONS.

This study was only done after the approval of the proposal by the Department of Clinical Medicine and Therapeutics and authorization by the KNH Scientific Research and Ethical Review Committee. Oral and written consents were also obtained from all patients participating in the study. The data collected was not used for purposes other than those specified in the proposal. Results from the A1C assessment were communicated to all participants and filed in the patients' records for interpretation and incorporation into the patients care by the primary care provider. Appropriate advice was given when sought. No incentive of any kind such as fare, drugs and food were given to participants. Participants' personal details such as contact details and names were separated from the questionnaires, which only bore serial numbers to maintain confidentially. All documents were put under lock and only available to the primary investigator and when necessary to a stastician. The financial responsibility for the study was born primarily by the primary investigator with assistance from IsisAfrica, Laborex Kenya and Sanofi- Aventis Pharmaceutical companies. None of the sponsors were in anyway involved in the data collection, analysis and writing of the report.

9.1 INFORMED CONSENT

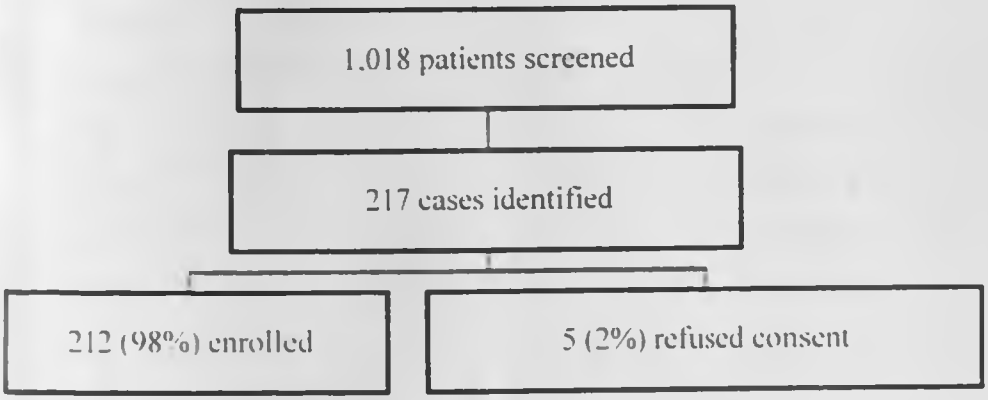
The objective of the study was explained to the participants. The risks, benefits and the confidentiality issues were conveyed. Written informed consents for participation in the study were obtained. Respondents were assured that all the questionnaire identity was anonymous. No information that would make it possible to identify the respondents was included in the questionnaire. Participation in the study was voluntary and participants were encouraged to complete the study.

however, they were free to withdraw at will. Participants who consented signed a form for confirmation. For those who withdrew, their data was not used in the final analysis (APPENDIX 1).

10. RESULTS

In February and March 2011, 1,018 ambulatory diabetic patients attending the KNH diabetic outpatient clinic were consecutively screened. 217 were on insulin for a minimum of 3 months, all of whom satisfied the predefined inclusion criteria and were recruited into the study. 5 refused to give informed consent and were excluded and therefore a final sample of 212 was enrolled into the study which constituted 98% response rate (Figure 2).

Figure 2: Flow-chart on screening and enrollment of patients into the study



The study population was relatively young with a mean age of 53.4 years and the age ranging from 13 to 99 years. More than half of the patients (n =117) were in the 20 – 59 age group. Most were female, well educated, had T1DM, adherent to insulin, had adequate experience with diabetes and insulin but were not monitoring their blood sugars as frequently as recommended. Females comprised 66.5% of the population with a 1:2 male to female ratio. About half had completed at least 8 years of formal school education with the mean number of years spent schooling of 8.3 years and a median of 9.0 years (Table 1). One hundred and twenty three patients (58%) had T1DM and 89 (42%) had T2DM; the mean age at disease onset was 39.6 years with a range of 6 to 82 years. The median duration of disease was 11.1 years. Median duration of insulin use was 6 years ranging between 3 months and 42 years. Slightly over a half of the patients (n =111) were on combined insulin and oral anti-diabetic agents. Eleven patients only (5.2%) monitored their blood sugar levels at least once a day; majority (71.2%) monitored their blood sugar less than once per week. One hundred and thirty

six patients (64%) were adherent to insulin injections. Most found diabetes care at KNH affordable and easily accessible and were satisfied with ongoing treatment (Table 2).

Table 1: Summary of the demographic characteristics of patients included in the study

Variable (n =212)	n (%)/ Mean/Median
Sex	
Male	071 (33.5)
Female	141 (66.5)
Age (years)	
Mean (SD)	53.4 (17.4)
Median (IQR)	55.2 (41.4 - 65.6)
Range	13 – 99
Age Groups	
<20	05 (02.4)
20-39	42 (19.8)
40-59	75 (35.4)
60-79	75 (35.4)
>79	15 (07.1)
Number of years spent in school	
Mean (SD)	8.3 (4.7)
Median (IQR)	9.0 (5.0-12.0)
Range	0 19
Years Of Formal Education	
<5	48 (22.6)
5- 8	57 (26.9)
9-12	72 (34.0)
>12	35 (16.5)

Table 2: Summary of the disease and treatment characteristicsand attitude of the patients

Variable (n = 212)	n (%)/ Mean/Median
Type of Diabetes	
T1DM	123 (58)
T2DM	89 (42)
Age at Disease Onset (Years)	
Mean (SD)	39.6 (16.1)
Range	6 – 82
Duration Of Disease, Median (IQR)	11.1 (6.1 – 19.1)
Duration Of Using Insulin (Years)	
Median (IQR)	6.0 (3.0-10.0)
Range	0.25 42
Treatment Modality	
Insulin only	102 (48)
Insulin + Oral anti diabetic agent(s)	111 (52)
Monitoring	
Several times in a day	5 (2.4)
Once daily	6 (2.8)
Several times in a week	16 (7.5)
Once weekly	34 (16.0)
Occasionally	151 (71.2)
Adherence	
Adherent (Total Morisky score = 0)	136 (64)
Non-adherent (Total Morisky score > 0)	76 (36)
Type of clinic attended	
Major clinic	107 (50.5)
Minor clinic	105 (49.5)
Accessibility of care at KNH	
Easy	172 (81)
Neither easy nor difficult	24 (11)
Difficult	16 (8)
Affordability of care at KNH	
Affordable	183 (86)
Not affordable	29 (14)
Satisfaction with care	
Satisfied	125 (59)
Neither satisfied nor dissatisfied	45 (22)
Dissatisfied	41 (19)

Blood samples from all patients were taken and all but 11 samples, which were inadequate, were analyzed for A1C to assess the level of glycemic control. The total number of samples analyzed was, therefore, 201. The level of A1C which was the measure of glycemic control ranged between 5.2 and 15.0 % with a mean of 9.4% (SD, 2.2) and a median of 9.4% (IQR, 7.6 – 11.0). One hundred and seventy three patients (86%) had A1C values of 7.0% or more and were considered poorly controlled (95% CI, 81% – 91%) (Table 3).

Table 3: A1C levels, distribution and glycemic control of the study subjects

Variable (n = 201)	Mean/ Median
A1C levels	
Mean (SD)	9.4% (2.2)
Range	5.2 – 15.0%
A1C Distribution	
< 6.0 %	10 (5.0)
6.0 – 6.9 %	18 (9.0)
7.0 – 7.9 %	36 (17.9)
8.0 – 8.9 %	22 (10.9)
9.0 – 9.9 %	37 (18.4)
>9.9%	78 (38.8)
Glycemic control	
Poor (A1C ≥7%)	173 (86.1)
Good (A1C <7%)	28 (13.9)

There were no statistically significant differences in age, sex and education between those with good control and those with poor control. There was, however, a trend towards poor control in the females. Females were 1.6 times more likely to be poorly controlled than males (p, 0.200, OR, 1.6: 95% CI, 0.8 – 3.8). Patients with poor control were younger and more educated with a mean age of 52.9 years and a mean number of years spent schooling of 8.6 years compared to 57.2 years and 7.0 years for the patients with good control, respectively (Table 4).

When data was stratified by disease and treatment characteristics, significant differences in age at disease onset (p, 0.017) and duration of insulin use (p, 0.041) were evident between patients with good control and those with poor control: patients with good control had an older age at disease onset with a mean of 46.2 (SD, 16.3) years and a shorter duration of insulin use of a median of 5.0 years (IQR, 1.8 – 7.5) compared to those with poor control who had a mean age at disease onset of 38.4

(SD. 15.8) years and median duration of insulin use of 6.0 (IQR. 3.0 – 10.0). Differences in other disease and treatment characteristics. that is. type of diabetes. duration of disease. use of oral anti-diabetic agent(s). frequency of blood glucose monitoring and adherence to insulin. did not demonstrate statistical significance (Table 4).There was a trend. however. towards good control in patients on combined insulin and oral anti-diabetic agent(s) therapy when compared to those on insulin-only therapy (OR. 1.7; CI. 0.7 -3.9; p. 0.206) . Eighteen patients (16.8%) on combined therapy had good control compared to 10 patients (10.6%) on insulin-only therapy. Patients with poor control had a longer duration of disease with a mean of 11.4 years compared to those with good control who had a mean of 8.7 years (p. 0.060). All the 9 patients who monitored their sugars at least once a day had poor control. Majority of those considered adherent to insulin were poorly controlled (Table 4).

Bivariate analysis of patients' attitude and control did not show any statistically significant difference in perceived accessibility and affordability to care as well as satisfaction with ongoing treatment between good control and poor control. Control which was predominantly poor was comparable between those who found care to be easily accessible and affordable as well as those who were satisfied with ongoing treatment and those who did not. Eighty six percent of those who found care to be easily accessible and 100%. who did not. had poor control as well as 86% of those who found care affordable and 89% of those who did not. Similarly 86% of patients satisfied with ongoing treatment and 92% of those not satisfied were poorly controlled (Table 4). As a result of multivariate analysis of variables significantly associated with glycemic control. none of the variables was demonstrated to be independently predictive of glycemic control among the study population (Table 5).

One of the confounding factors that may have influenced the results of the study is the organization of the diabetic clinic. Mondays through Thursdays are designated 'mini-clinic' which is run mostly by clinical officers trained in diabetes management. Fridays are designated 'major clinic' and is run by consultant physicians and specialist endocrinologists as well as registrars. The quality of care provided by each of these care providers and its effect on glycemic control has not been determined in the present study but it is inherently not the same due to varied knowledge. attitude and practice as a consequence of varied nature of training and experiences. Patients are randomly subjected to differing quality of care every visit. In addition to this randomization. though not systematically. we aimed to recruit a balanced number of patients from the mini and the major clinic to minimize any unapparent confounding effect arising from any disparity of quality of care.

Table 4: Demographic, disease and treatment characteristics and attitude of the study subjects according to glycemiccontrol

Variable (n = 201)	Good Control (A1C <7%)	Poor Control (A1C =>7%)	OR (95% CI)	P value
Sex				
Male	12 (42.9)	53 (30.6)	1.7 (0.8-3.9)	0.200
Female	16 (57.1)	120 (69.4)		
Age, mean (SD)	57.2 (18.3)	52.9 (17.0)	-	0.221
Number of years schooling, mean (SD)	7.0 (5.2)	8.6 (4.7)	-	0.081
Age at disease onset	46.2 (16.3)	38.4 (15.8)	-	0.017
Duration of diabetes	8.7 (4.5-13.6)	11.4(6.2-20.2)	-	0.060
Type of disease				
T1DM	13 (11.2)	103 (88.8)	0.6 (0.3-1.3)	0.193
T2DM	15 (17.6)	70 (82.4)		
Duration of insulin use, median (IQR)	5.0 (1.8-7.5)	6.0 (3.0-10.0)	-	0.041
Treatment				
Insulin + oral anti-diabetic agent(s)	18 (16.8)	89 (83.2)	1.7 (0.7-3.9)	0.206
Insulin only	10 (10.6)	84 (89.4)		
Monitoring				
At least once a day	0 (0.0)	9 (5.2)	-	-
At least once a wk, less than once daily	7 (25.0)	40 (23.1)	1.0 (0.4-2.6)	0.945
Less than once a week	21 (75.0)	124 (71.7)	1.0	
Adherence				
Good	18 (64.3)	111 (64.2)	1.0 (0.4-2.3)	0.990
Poor	10 (35.7)	62 (35.8)	1.0	
Type of Clinic				
Major Clinic	83 (83.0%)	17 (17.0%)	0.6 (0.3-1.3)	0.211
Mini Clinic	90 (89.1%)	11 (10.9%)		
Accessibility				
Easy	23 (100.0%)	138 (89.0%)	-	0.134
Difficult	0 (0.0%)	17 (11.0%)		
Affordability				
Affordable	25 (89.3%)	149 (86.1%)	1.3 (0.4-4.8)	1.000
Not affordable	3 (10.7%)	24 (13.9%)		
Satisfaction				
Satisfied	17 (73.9%)	105 (76.1%)	0.9 (0.3-2.4)	0.822
Dissatisfied	6 (26.1%)	33 (23.9%)		

Table 5: **Independent Predictors of Glycemic Control**

Variable	OR (95% CI)	P value
Duration of insulin use	1.1 (1.0-1.2)	0.196
Age of onset	1.0 (1.0-1.0)	0.071

One hundred and five patients (49.5%) were recruited at the mini-clinic and 107 (50.5%) at the major clinic. Analysis of glycemic control between those recruited at the mini clinic and those at the major clinic found no statistical significant difference between them (p. 0.211: OR. 0.6: CI. 0.3 – 1.3) (Table4).

11. DISCUSSION

The quality of glycemic control has been documented to be a predictor of microvascular development in diabetes and to be associated with macrovascular disease particularly in T2DM at early disease stage. Studies have established the importance of achieving and sustaining a near normal quality of glycemic control to prevent and delay complications associated with diabetes (14-21). Consequently, near- normal glycemic levels have been recommended in treatment targets in treatment guidelines (22. 23). Insulin, in adequate doses, can decrease any level of elevated A1C to, or close to, therapeutic targets. Information about quality of control among patients on insulin in Kenya is scarce and limited. The present study set out to examine the quality of glycemic control among insulin-treated diabetic patients in a tertiary institution and explore patients and disease factors related to quality of glycemic control. In a probability sample of ambulatory patients with diabetes on insulin therapy on follow-up at a referral and a teaching center in Nairobi, the study has shown that majority of patients on insulin were not controlled to recommended levels consistent with findings from various regions of the world that show majority of patients with diabetes on insulin were not controlled to recommended A1C targets (25 - 32).

Our rates of poor glycemic control were more than estimates in the United States (76 86%) among insulin-treated T1DM and T2DM) (25). Sweden (83% among T1DM) (26) and Denmark (51%) (29). The rates were, however, less than those in Brazil (90% among insulin-treated T1DM and T2DM) (30) and Ethiopia (99% of T1DM) (31). The rates of poor control in Kenya vary between 13% of patients with T2DM in Western Kenya (9) and 61% of those with T1DM and T2DM at KNH (32). In both studies patients on insulin had poorer control compared to those on other treatment modalities.

The reasons why patients in western Kenya have a high rate of good control is unclear. Estimates of prevalence of poor glycemic control, however, vary widely across studies, although these variations may be true, they may also be due to differences in populations surveyed, methods of data collection, measurements of A1C, and definitions of A1C cut point for adequate glycemic control. Lack of standardization in the definition of indicators and the systems to provide such indicators in representative groups of people with diabetes has been one of the limitations in attempting to compare quality of control across studies. Diabetes care is a challenge to both developed and developing countries alike. The challenges in diabetes care in both developing and developed countries may be similar in terms of disease course and burden but the capabilities to cope in resource allocation, expertise and health care facilities are very different and are certainly superior in the developed countries reflecting on higher rates of good control in these countries compared to those in developing countries. One of the biggest challenges in diabetes care in developing countries is ensuring uninterrupted supply of affordable insulin and related materials (54).

Our study population was relatively young, well educated and mostly female. Recent data has shown an increasing young diabetic population. According to the IDF, majority of the adults with diabetes in the world are in the age bracket 40 – 59 years old (2). The mean age of the present study population was comparable to the mean age found by CF Otieno et al in 1998 of ambulatory patients with diabetes at the same site (32). The median number of years spent schooling was almost double the national median (6.0 years for men and 5.2 years for women), slightly higher than the median for the urban areas (8.8 years for men and 7.6 years for women) and almost the same as for the Nairobi province (9.6 years) probably reflective of the fact that majority of the patients reside within the Nairobi metropolis and neighboring areas(60). Female preponderance is in contrast to the sex distribution in 2010 IDF estimates of persons with diabetes (2) as well as in the general population, where in both, sexes are evenly distributed (60). Factors associated with health- seeking were, however, not subject to this study. Despite majority being adherent to insulin injections, a very small minority monitored their sugars as recommended. Factors associated with adherence and monitoring were, however, not interrogated. Nevertheless, while insulin is available at a subsidized cost at the hospital making it accessible and affordable to the majority of patients, monitoring equipments and materials are not.

In our data, there was no significant difference in glycemic control by gender, age and level of education but there was a trend towards poor control in the female, the younger and the more

educated patients. Results from a survey in Mexico have suggested that women have several social disadvantages, deterioration of healthy life, poor self-care, and lack of solidarity that increases their vulnerability to reach glycemic control successfully (61). However, several studies have failed to show significant gender differences related control (25-32). The UKPDS, EDIC and DCCT trials have suggested worsening of control with duration of disease, hence: age (13 – 15). Other studies have, however, suggested that the older the age the better the control consistent with our data(62). This may reflect that patients with better control live longer or milder diabetes correlates with more advanced age. Not addressed by our study is the concept of severity of diabetes.It is possible that the poor control is related to the severity of illness. For example, a mild older diabetic may be able to control diabetes with minimal effort, while a younger individual with a more severe illness may have greater difficulty with control. Education levels were higher than the national average and were even higher amongst those with poor control. These parameters, however, did not correlate with diabetic control. Literacy has been indicated as a barrier to care in other studies (63 - 65). It is possible that broader problems in the youngerand the more educated individuals such as lack of motivation, coping skills, understanding and diabetes self management education are summation variables of more narrow factors, such as age and education.that contribute to poor control. Diabetes self management education that is culturally and age appropriate and tailored to individual needs and preferences, and that addresses psychosocial issues and incorporated behavioral strategies, irrespective of level of formal education, has been found to be associated with improved diabetes knowledge and improved self-care behavior, improved clinical outcomes such as lower A1C, lower self-reported weight, improved quality of life, healthycoping and lower costs (66).

In the present study, there were significant associations between age at disease onset and duration of insulin use with control: younger age at disease onset and longer duration of insulin use were associated with poor control as well as a trend towards poor control in those with longer duration of disease and those on insulin-only therapy. Patients whose onset of the disease was later in life presumably had better pancreatic insulin reserve compared to those whose onset of the disease was earlier. Diabetes exhibits a progression of a progressively worsening nature hence worseningof the disease with increasing duration.Patients on insulin treatment longer possibly had either a more difficult to control diabetes or a more advanced disease. The type and the number of oral anti-diabetic agents used together with insulin were not investigated in this study.It is, however, presumed that metformin,followed by sulphonylureas, is the most commonlyprescribed agent at the KNH. Metformin has been demonstrated to decrease hepatic glucose production and improve peripheral

insulin sensitivity. Sulfonylureas. which stimulate pancreatic insulin production. may also have extra-pancreatic effects. one of which is to increase tissue sensitivity to insulin (67). The reason why. majority of those considered adherent to insulin as well as all the patients who monitored their sugars at least once a day were poorly controlled. is probably due to combination of several factors which include the fact that most patients at KNH on insulin are put on fixed doses and fixed intervals. lack of emergency channels of communication to care providers to consult on abnormal results and lack of capacity of patients to enable them regulate their treatment. Most of the monitoring is done for record purposes for consultations in future interactions with care providers.

The distinctive strengths of this study are the high precision level. the collection of data by trained interviewers who were familiar with the organization of the diabetic clinic. the measurement of A1C by a single laboratory with close attention to quality of control and measurement. and the high response rate (98%). Some of the limitations of the study included selection bias. recall bias. social desirability bias. choice of MMAS-4 to measure adherence and the cross sectional study design. Selection of patients may have favored patients who had more frequent visits to the clinic. probably due to difficult to control disease or proximity to the hospital. than those who were infrequent. The number of patients. both with frequent and those with infrequent visits. in any particular day of the year is. however. a result of chance and the effect of this potential bias was therefore considered minimal. Apart from A1C values and sex. data collected was principally self-reported and some respondents may have provided information that was socially desirable and some may have had difficulty recalling old information. In order to minimize these biases. patients were encouraged to provide answers that represent the most correct of their true feelings however undesirable and to provide the answers discreetly without conferring with one another. The confidential nature of the provided answers was also re-emphasized.

The use of MMAS-4 to measure level of adherence may notbe ideal for insulin. Despite MMAS-4 having been cited almost 1000 times since its publication in 1986. one of the items on the scale is based on omission of taking medications when patients feel worse when taking the medications (58). Such omissions. in the use of insulin. might be seen as non-adherence but might as well be as a result of fear of real or imagined hypoglycemia. Omissions of insulin in the event of hypoglycemia should not be considered non-adherence because it may be life-saving. Majority was not monitoring sugars as recommended and was probably relying on past experiences to suspect hypoglycemia. MMAS-4 may need to be adapted to separate omissions due to non-adherence from those due to fear of

hypoglycemia. Data reference to adherence is. therefore. an underestimate: adherence was higher than reported. The study is single-centered in a national public referral hospital situated in an urban setting and may not be representative of the whole population of Kenyan patients with diabetes.

12. CONCLUSION

This study established that majority of ambulatory patients with diabetes mellitus on insulin therapy attending the diabetic outpatient clinic at KNH were poorly controlled and did not achieve the recommended A1C targets.It also established that majority of patients were not monitoring their sugars as required. It was. however. not able to establish obvious determinants of poor control. The study however suffered several limitations; it was not adequately powered to establish associations between poor control and the selected demographic. disease and treatment variables. itscross-sectional design limited its ability to establish cause and effect between control and the and its tool for adherence was less than ideal. Nevertheless. the study was able to establish a trend towards poor control in the young. the female and more years in schooling.

13. RECOMMENDATIONS

Following the results of the study we recommend:

- A larger sample size in future studies investigatingfactors associated with glycemic control among diabetic patients on insulin.
- Facilitation of blood glucose monitoring among patients at KNH.
- A choice of medication adherence tools for insulin treatment that will recognize justifiable omissions of insuli n doses in future studies.

14. REFERENCES

Narayan KM. Gregg EW. Fagot-Campagna A. Engelgau MM. Vinicor F. Diabetes - a common. growing. serious. costly. and potentially preventable public health problem. Diabetes Res Clin Pract. 2000 Oct: 50 Suppl 2:S77-84

International Diabetes Federation. IDF Diabetes Atlas. 4th edition. International Diabetes Federation. 2009

Christensen DL. Friis H. Mwaniki DL. Kilonzo B. Tetens I. Omondi B et al. Prevalence of glucose intolerance and associated risk factors in rural and urban populations of different ethnic groups in Kenya. DiabetesResClinPract. 2009 Jun: 84(3):303-10

World Health Organization. Prevention of diabetes mellitus.Report of a WHO study group. Geneva. World Health Organization. 1994. Technical Report Series 844

Kenyatta National Hospital's medical records. Kenyatta National Hospital. 2010

Mbugua PK. Otieno CF. Kayima JK. Amayo AA. McLigeyo SO. Diabetic ketoacidosis: clinical presentation and precipitating factors at Kenyatta National Hospital. Nairobi. East Afr Med J. 2005 Dec: 82(12 Suppl):S191-6

Mwendwa FM. Otieno CF. Kayima JK. Amayo EO. Otieno PO. Risk factor profile and the occurrence of microvascular complications in short term type 2 diabetes mellitus at Kenyatta National Hospital. Nairobi. East Afr Med J . 2005 Dec: 82(12 Suppl):S163-72

Wanjohi FW. Otieno CF. Ogola EN. Amayo EO. Nephropathy in patients with recently diagnosed type 2 diabetes mellitus in black Africans. East Afr Med J. 2002 Aug: 79(8):399-404

Nalwa WZ. Glycemic control. cardiovascular risk profile and therapeutic interventions in T2DM patients at the New Nyanza Provincial General Hospital. Kisumu (MMed Thesis). University of Nairobi: 2009

Twahir AH. Microalbuminuria as seen at KNH (MMed Thesis). University of Nairobi: 1994

Nyamu PN. Otieno CF. Amayo EO. McLigeyo SO. Risk factors and prevalence of diabetic foot ulcers at Kenyatta National Hospital. Nairobi. East Afr Med J. 2003 Jan: 80(1):36-43

Nkumbe HE. Kollmann KHM. Gaeckle HC. Assessment of diabetic retinopathy in newly diagnosed black Kenyan type 2 diabetics. East Afr Med J. 2010: 87(3): 109 - 114

The Diabetes Control and Complications Trial (DCCT) Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. N Engl J Med. 1993 Sep 30; 329(14):977-86

14 UK Prospective Diabetes Study (UKPDS) Group. Intensive blood glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). Lancet. 1998 Sep 12; 352(9131):837-53

15 Epidemiology of Diabetes Interventions and Complications (EDIC). Design, implementation, and preliminary results of a long-term follow-up of the Diabetes Control and Complications Trial cohort. Diabetes Care. 1999 Jan; 22 (1):99-111

16 Ohkubo U, Kishikawa H, Araki E, Miyata T, Isami S, Motoyoshi S et al. Intensive insulin therapy prevents the progression of diabetic microvascular complications in Japanese patients with non-insulin-dependent diabetes mellitus: A randomized prospective 6-year study. Diabetes Res Clin Pract. 1995 May; 28(2):103-17

17 Duckworth W, Abraira C, Moritz T, Reda D, Emanuele N, Reaven PD et al. Glucose control and vascular complications in veterans with type 2 diabetes. N Engl J Med. 2009 Jan 8; 360(2):129-39

18 Moritz T, Duckworth W, Abraira C. Veterans Affairs diabetes trial corrections. N Engl J Med. 2009 Sep 3; 361(10):1024-5

19 ADVANCE Collaborative Group. Intensive blood glucose control and vascular outcomes in patients with type 2 diabetes. N Engl J Med. 2008 Jun 12; 358(24):2560-72

20 ACCORD trial group. Effect of intensive treatment of hyperglycemia on microvascular outcomes in type 2 diabetes: an analysis of the ACCORD randomized trial. Lancet. 2010 Aug 7; 376(9739):419-30

21 ACCORD Study Group. ACCORD Eye Study Group. Effects of medical therapies on retinopathy progression in type 2 diabetes. N Engl J Med. 2010 Jul 15; 363(3):233-44

22 American Association of Clinical Endocrinologists (2002) American College of Endocrinology consensus statement on guidelines for glycemic control. Endocr Pract 8:5–11. Endocr Pract. 2002; 8:5–11

23 American Diabetes Association. Standards of Medical Care in Diabetes—2011.Diabetes Care. 2011 Jan; 34 Suppl 1: S11-61.

24 World Economic Forum. Global Risks 2011 Sixth Edition: An initiative of the Risk Response Network. Geneva. World Economic Forum. 2011

25 Hoerger TJ, Segel JE, Gregg EW, Saaddine JB. Is Glycemic control improving in the US adults? Diabetes Care. 2008 Jan; 31(1):81-6

26 Eeg-Olofsson K, Cederholm J, Nilsson PM, Gudbjörnsdottir S, Eliasson B. Glycemic and Risk Factor Control in Type 1 Diabetes: Results from 13,612 patients in a national diabetes register. Diabetes Care. 2007 Mar; 30(3):496-502

27 Fox KM. Gerber Pharmd RA. Bolinder B. Chen J. Kumar S. Prevalence of inadequate glycemic control among patients with T2DM diabetes in the United Kingdom general practice research database: a series of retrospective analyses of data from 1998 through 2002. Clin Ther. 2006 Mar; 28(3):388-95

28 Shah BR. Hux JE. Laupacis A. Mdem BZ. Austin PC. Walraven C. Diabetic patients with prior specialist care have better glycaemic control than those with prior primary care. J Eval Clin Pract. 2005 Dec; 11(6):568-75

29 Goudswaard AN. Stolk RP. ZuithoffP .Rutten GE. Patient characteristics do not predict poor glycaemic control in type 2 diabetes patients treated in primary care. Eur J Epidemiol. 2004; 19(6):541-5

30 Mendes AB. Fittipaldi JA. Neves RC. Chacra AR. Prevalence and correlates of inadequate glycemic control: results from a nationwide survey in 6.671 adults with diabetes in Brazil. Acta Diabetol. 2010 Jun; 47(2):137-45

31 Gebre-Yohannes A. Rahlenbeck SI. Glycaemic control and its determinants in diabetic patients in Ethiopia. Diabetes Res Clin Pract. 1997 Mar; 35(2-3):129-34

32 Otieno CF. Kariuki M. Ng'ang'a L. Quality of glycaemic control in ambulatory diabetics at the outpatient clinic of Kenyatta National Hospital. Nairobi. East Afr Med J. 2003 Aug; 80(8):406-10

33 Wallace TM. Mathews DR. Poor glycemic control in type 2 diabetes: a conspiracy of disease. suboptimal therapy and attitude. QJM. 2000 Jun; 93(6):369-74

34 Dalewitz J. Khan N. Hershey CO. Barriers to control of blood glucose in diabetes mellitus. Am J Med Am J Med Qual. 2000 Jan-Feb; 15(1):16-25

35 Korytkowski M. When oral agents fail: practical barriers to starting insulin. Int J Obes Relat Metab Disord. 2002 Sep; 26 Suppl 3:S18-24

36 Koerbel G. Korytkowski M: Insulin-therapy resistance: another form of insulin resistance in type 2 diabetes. Practical Diabetology. 2003; 22:36–40

37 Peyrot M. Psychological insulin resistance: overcoming barriers to insulin therapy. Practical Diabetology. 2004; 23:6 12

38 Hiss RG. Barriers to Care in Non-Insulin-dependent Diabetes Mellitus: The Michigan Experience. Ann Intern Med. 1996 Jan 1; 124(1 Pt 2):146-8

39 Leslie CA. Satin-Rapaport W. Psychological insulin resistance: a challenge for diabetes patients and health care professionals. Jour New Develop Clin Med. 1995; 13:21 27

40 Rubin RR. Peyrot M. Psychological issues and treatments in people with diabetes. J Clin Psychol. 2001 Apr; 57(4):457-78

41 Dailey GE. Early insulin: An important therapeutic strategy. Diabetes Care. 2005 Jan: 28(1):220-1

42 Davidson MB. Early insulin therapy for type 2 diabetic patients: More cost than benefit. Diabetes Care. 2005 Jan; 28(1):222-4

43 Davis S. Alonso MD. Hypoglycemia as a barrier to glycemic control. J Diabetes Complications. 2004 Jan-Feb: 18(1):60-8

44 Bott U. Jörgens V. Grüsser M. Bender R. Mühlhauser I. Berger M. Predictors of Glycaemic Control in Type 1 Diabetic Patients after Participation in an Intensified Treatment and Teaching Programme. Diabet Med. 1994 May; 11(4):362-71

45 Golin CE. DiMatteo MR. Gelberg L. The role of patient participation in the doctor visit: implications for adherence to diabetes care. Diabetes Care. 1996 Oct: 19(10):1153-64

46 John LD. Why should patients do what we ask them to do? Pat Education Counsel. 26 (1995): 113 – 118

47 Funnell MM. Kruger DF. Spencer M. Self-management support for insulin therapy in type 2 diabetes. Diabetes Educ. 2004 Mar-Apr: 30(2):274-80

48 Polonsky WH. Jackson RA. What's so tough about taking insulin? Addressing the problem of psychological insulin resistance in type 2 diabetes.Clinical Diabetes. 2004: 22:147 150

49 Polonsky WH. Fisher L. Guzman S. Villa-Caballero L. Edelman SV. Psychological insulin resistance in patients with type 2 diabetes: The scope of the problem. Diabetes Care. 2005 Oct: 28(10):2543-5

50 Hunt LM. Valenzuela MA. Pugh JA. NIDDM patients' fears and hopes about insulin therapy. The basis of patient reluctance. Diabetes Care. 1997 Mar: 20(3):292-8

51 Mollema ED. Snoek FJ. Pouwer F. Heine RJ. van der Ploeg HM. Diabetes fear of injecting and self-testing questionnaire: A psychometric evaluation. Diabetes Care. 2000 Jun: 23(6):765-9

52 Hayes RP. Bowman L. Monahan PO. Marrero DG. McHorney CA. Understanding diabetes medications from the perspective of patients with type 2 diabetes: Prerequisite to medication concordance. Diabetes Educ. 2006 May-Jun: 32(3):404-14

53 Berran D. Yudkin JS. de Courten M. Assessing health systems for type 1 diabetes in sub-Saharan Africa: developing a 'Rapid Assessment Protocol for Insulin Access'. BMC Health Serv Res. 2006 Feb 24: 6:17

54 Berran D. Yudkin JS. deCorten M. Access to care for patients with insulin-requiring diabetes in developing countries: case studies of Mozambique and Zambia. Diabetes Care. 2005 Sep; 28(9):2136-40

55 Fleming BB. Greenfield S. Engelgau MM. Pogach LM. Clauser SB. Parrott MA. The Diabetes Quality Improvement Project: moving science into health policy to gain an edge on the diabetes epidemic. Diabetes Care. 2001 Oct: 24(10):1815-20

56 Nicolucci A. Greenfield S. Mattke S. Selecting indicators for the quality of diabetes care at the health systems level in OECD countries. Int J Qual Health Care. 2006 Sep: 18 Suppl 1:26-30

57 Goldstein DE. Little RR. England JD. Wiedmeyer HM. Rohlfing CL. Wilke AL. Is Glycohemoglobin Testing Useful in Diabetes Mellitus? Lessons from the Diabetes Control and Complications Trial. Clin Chem. 1994 Aug: 40(8):1637-40

58 Daniel WW. Biostatistics: a foundation for analysis in the health sciences. 8th edition. New York. NY: John Wiley and Sons. Inc: 2004

59 Morisky DE. Green LW. Levine DM. Concurrent and Predictive Validity of a Self-reported Measure of Medication Adherence. Med Care. 1986 Jan: 24(1):67-74

60 Kenya National Bureau of Statistics. Kenya Demographic and Health Survey 2008-09. Calverton. Maryland. Kenya National Bureau of Statistics and ICF Macro. June 2010

61 Salcedo-Rocha AL. Garcia de Alba-Garcia JE. Frayre-Torres MJ. Lopez-Coutino B. Gender and metabolic control of type 2 diabetes among primary care patients. Rev Med Inst Mex Seguro Soc. 2008 Jan-Feb: 46(1):73-81

62 Dalewitz J. Khan N. Hershey CO. Barriers to control of blood glucose in diabetes mellitus. Am J Med Qual.2000 Jan-Feb:15(1):16-25.

63 Williams MV. Baker DW. Honig EG. Lee TM. Nowlan A. Inadequate literacy is a barrier to asthma knowledge and self-care. Chest. 1998 Oct:114(4):1008-15

64 Baker DW. Parker RM. Williams MV. Clark WS.Health literacy and the risk of hospital admission. J Gen Intern Med. 1998:13:791-798.

65 RoterDL. RuddRE. Comings J.Roter DL. Rudd RE. Comings J. Patient literacy: a barrier to quality of care. J Gen Intern Med. 1998:13:850-851.

66 Norris SL. Engelgau MM. Narayan KM. Effectiveness of self-management training in type 2 diabetes: a systematic review of randomized controlled trials. Diabetes Care 2001: 24: 561–587

67 Bressler R. Johnson DG. Pharmacological regulation of blood glucose levels in non-insulin-dependent diabetes mellitus. Arch Intern Med. 1997:157(8):836

5 Fleming BB. Greenfield S. Engelgau MM. Pogach LM. Clauser SB. Parrott MA. The Diabetes Quality Improvement Project: moving science into health policy to gain an edge on the diabetes epidemic. Diabetes Care. 2001 Oct; 24(10):1815-20

6 Nicolucci A. Greenfield S. Mattke S. Selecting indicators for the quality of diabetes care at the health systems level in OECD countries. Int J Qual Health Care. 2006 Sep; 18 Suppl 1:26-30

7 Goldstein DE. Little RR. England JD. Wiedmeyer HM. Rohlfing CL. Wilke AL. Is Glycohemoglobin Testing Useful in Diabetes Mellitus? Lessons from the Diabetes Control and Complications Trial. Clin Chem. 1994 Aug; 40(8):1637-40

8 Daniel WW. Biostatistics: a foundation for analysis in the health sciences. 8th edition. New York. NY: John Wiley and Sons. Inc; 2004

9 Morisky DE. Green LW. Levine DM. Concurrent and Predictive Validity of a Self-reported Measure of Medication Adherence. Med Care. 1986 Jan; 24(1):67-74

0 Kenya National Bureau of Statistics. Kenya Demographic and Health Survey 2008-09. Calverton. Maryland. Kenya National Bureau of Statistics and ICF Macro. June 2010

1 Salcedo-Rocha AL. Garcia de Alba-Garcia JE. Frayre-Torres MJ. Lopez-Coutino B. Gender and metabolic control of type 2 diabetes among primary care patients. Rev Med Inst Mex Seguro Soc. 2008 Jan-Feb; 46(1):73-81

2 Dalewitz J. Khan N. Hershey CO. Barriers to control of blood glucose in diabetes mellitus. Am J Med Qual.2000 Jan-Feb;15(1):16-25.

3 Williams MV. Baker DW. Honig EG. Lee TM. Nowlan A. Inadequate literacy is a barrier to asthma knowledge and self-care. Chest. 1998 Oct;114(4):1008-15

4 Baker DW. Parker RM. Williams MV. Clark WS.Health literacy and the risk of hospital admission. J Gen Intern Med. 1998:13:791-798.

5 RoterDL. RuddRE. Comings J.Roter DL. Rudd RE. Comings J. Patient literacy: a barrier to quality of care. J Gen Intern Med. 1998:13:850-851.

6 Norris SL. Engelgau MM. Narayan KM. Effectiveness of self-management training in type 2 diabetes: a systematic review of randomized controlled trials. Diabetes Care 2001: 24: 561–587

7 Bressler R. Johnson DG. Pharmacological regulation of blood glucose levels in non-insulin-dependent diabetes mellitus. Arch Intern Med. 1997:157(8):836

15. APPENDICES

APPENDIX 1: CONSENT EXPLANATION

My name is Dr. Salim Rashid. I am a postgraduate student in the Department of Clinical Medicine and Therapeutics, University of Nairobi. I am conducting a study on quality of glycemic control among diabetic patients on insulin therapy at KNH. The study is aimed at identifying problems associated with poor control among insulin users. It involves answering questions from a questionnaire and a blood test for hemoglobin A1C. The results will help stakeholders in the diabetes care better understand the problems underlying poor control and consequently be able to address them accordingly.

You are free to accept or decline to participate in the study. If you choose not to participate in the study, your care will not be compromised in any way. If you accept, a set of questions will be put forward to you followed by drawing of small amount of blood (i.e. 2 mls) from your forearm under hygienic precautions. There is a minimal risk of bleeding associated with this procedure especially in persons with a known blood clotting problem. This blood will be used to measure the level of hemoglobin A1C in your blood which is a measure of the state of your blood sugar over the past 3 months.

The results of the blood test will be recorded in your file and appropriate advice will be offered in consultation with your primary care provider. Answers provided in the questionnaire will not be disclosed to anybody, will remain confidential and will be used solely for the purpose of the study. Your personal details such as names and contact details will be separated from the questionnaire.

In case you have questions related to this study, you can contact the following:

1. Dr. Salim Rashid. Tel. 0733 422 272. Department of Clinical Medicine and Therapeutics. University of Nairobi
2. Prof. C.F. Otieno. Department of Clinical Medicine and Therapeutics. University of Nairobi.
3. Chairman. Ethics and Research Committee. Kenyatta National Hospital

KIAMBATISHO 1: MAELEZO

Jina langu ni Dkt. Salim Rashid. Mimi ni mwanafunzi wa masomo ya kiwango cha juu katika kitengo cha 'clinical medicine and therapeutics', katika chuo kikuu cha Nairobi. Ninaendeleza utafiti wa kuchunguza kiwango cha sukari mwilini kwa watumiaji wa insulin kati ya wanaougua ugonjwa wa kisukari. Lengo la utafitihuunikubainishamatatizoyanayohusiananakuwepokwaviwangodunivyasukarimwilinikwawatumiaji wa insulin. Utafiti huu unahusisha kujibu maswali kadhaa pamoja na upimaji wa damu kuthibitisha kiwango cha sukari kutumia kipimo cha hemoglobin A1C. Matokeo ya utafiti huu yatawawezesha washikadau katika huduma za ugonjwa wa kisukari kufahamu vyema matatizo yanayowakumba watumiaji wa insulin nakuweza kuyatatua ipasavyo.

Uko na uhuru wa kukubali au kukataa kushiriki katika utafiti huu. Kukataakwakokushirikihakutaathirikwanjiayeyotehudumaunayopatakilasiku. Ukikubali kushiriki utauulizwa maswali kadhaa na kiwango kidogo cha damu. takriban mililita 2. kutolewa kutoka mkononi mwako kwa njia ya usafi unaostahili. Hakuna kipimo chengine chochote kitakachofanywa kwa damu hiyo.

Utapatanasahainayostahilikulingananamatokeoyakipimohichonabaadayausharianonamhudumuwakowakilasiku. Majibu utakayotoa kwa maswali utakayoulizwa yatabaki kuwa siri. hayatatobolewa kwa mtu yeyote na yatatumika kwa lengo la utafiti huu peke yake. Majibuyenyesifayaubinafsikamamajinanaanwaniyataekwakandonamajibumengineo.

Kwa maelezo zaidi unaweza kuwasiliana na mmoja wa wanaofuata:

1. Dkt. Salim Rashid. Tel. 0733 422 272. Department of Clinical Medicine and Therapeutics. University of Nairobi

2. Prof. C.F. Otieno. Department of Clinical Medicine and Therapeutics. University of Nairobi.

3. Mwenyekiti. Ethics and Research Committee. Kenyatta National Hospital

APPENDIX 2: CONSENT FORM (FOR THOSE AGED 18 YEARS OR OLDER)

I. _____ consent to participate in the study on quality of glycemic control among ambulatory insulin-treated diabetics. I do this with the full understanding of the purposes of the study and the procedures involved which include a blood test for AIC. I also understand that I can withdraw from the study any time without my care being compromised. All of these have been explained to me by _____

Signature/ Thumbprint of patient _____

Signature of witness _____ Date _____

KIAMBATISHO 2: FOMU YA RIDHAA. (Kwa walio na miaka kumi na nane au said)

Mimi _____ naridhia (nakubali) kushiriki katika utafiti wa 'viwango vya sukari mwilini kwa watumiaji wa insulin kati ya wanaotembea na kuugua ugonjwa wa kisukari katika hospitali kuu ya Kenyatta'.

Nakubalikushirikinikifahamumalengonataratibuzautafitihuuikiwemokipimo cha damu cha AIC. Ninafahamuyakwambanawezakujiondoakutokautafitihuuwakatiwowotebilakuathirihudumaninazopata.Ha yayotenimefahamishwanakjelezewana _____

Sahihi au kidole cha mshiriki _____

Sahihi ya shahidi _____ Tarehe _____

APPENDIX 3: ASSENT FORM (FOR THOSE YOUNGER THAN 18 YEARS)

I _____ guardian/ parent to _____ assent to participate in the study on the quality of glycemic control among ambulatory insulin-treated diabetics. I do this with the full understanding of the purposes of the study and the procedures involved which include a blood test for AIC. I also understand that I can withdraw from the study any time without my care being compromised. All of these have been explained to me by _____

Signature/ Thumbprint of guardian/ parent _____

Signature of witness _____ Date _____

KIAMBATISHO 3: FOMU YA RIDHAA YA MLEZI. (Kwa walio na miaka chini ya kumi na nane)

Mimi _____ mlezi wa _____ naridhia (nakubali) kushiriki katika utafiti wa 'viwango vya sukari mwilini kwa watumiaji wa insulin kati ya wanaotembea na kuugua ugonjwa wa kisukari katika hospitali kuu ya Kenyatta'.

Nakubalikushirikinikifahamumalengonataratibuzautafitihuuikiwemokipimo cha damu cha A1C. Ninafahamuyakwambanawezakujiondoakutokautafitihuuwakatiwowotebilakuathirihudumaninazopat a.Hayayotenimefahamishwanakuelezewana _____

Sahihi au kidole cha m'ezi _____

Sahihi ya shahidi _____ Tarehe _____

APPENDIX 4: 4- POINT MORISKY MEDICATION ADHERENCE SCALE

1. Do you ever forget to take your medicine? YES/ NO
2. Do you ever have problems remembering to take your medication? YES/ NO
3. When you feel better do you sometimes stop taking your medicine? YES/ NO
4. Sometimes if you feel worse when you take the medicine, do you stop taking it? YES/ NO

Interpretation:

Score 1 point for every YES answer

0 point = high adherence

1 – 2 points = intermediate adherence

3 – 4 points — low adherence

APPENDIX 5: THE QUESTIONNAIRE

1. Hospital Number (*Nambari ya hospitali*) _____
2. Interviewer's identity (*Kitambulisho cha muhojaji*) _____
3. Interview language (*Lugha ya mahojiano*) _____
4. Date and time of interview (*Tarehe na wakati wa mahojiano)* _____
5. Telephone number where possible (*Nambari ya simu ikiwezekana*) _____

ELIGIBILITY (SCREENING QUESTIONS)

6. Do you suffer from any of the following diseases in addition to diabetes? (*Je, unauguaugonjwamwenginembalinaugonjwawakisukarikatiyamagonjwayafuatayo?* Sickle cell disease/ thelassemia/ hemochromatosis/ pancreatitis/ cystic fibrosis/ pancreatic cancer/ pheochromocytoma/ acromegaly/ Cushing's syndrome.
   a. Yes (1)
   b. No (2)
7. Have you been using the following drugs consistently in the last 3 months? (Je. *umekuwa ukitumia dawa zifuatazo mfululizo kwa miezi mitatu iliyopita?*) Phenytoin/ Steroids/ Estrogens (such as oral contraceptives)
   a. Yes (1)
   b. No (2)
8. What is your date of birth? (*Ulizaliwa tarehe gani)*_____
9. How old are you? (*Uko na miaka mingapi)* _____
10. How long have you been using insulin? (*Umekuwa ukitumia insulin kwa mda gani sasa?) (Miezi)* _____*Months/ (Miaka)*_____*years*
11. (Ladies only) Are you pregnant? (*Je. uko na mimba?)*
    a. Yes (1)
    b. No (2)
12. Has the consent been read and obtained?
    a. Yes (1)
    b. No (2)

(Stop the interview if the answer to question F1 or F2 or F6 is YES or to F4 is less than 12 years, or to F5 is less than 3 months or to F7 is NO

DEMOGRAPHIC CHARACTERISTICS

13. Sex (*Jinsia)*

a. *Male* *(1)*

b. *Female* *(2)*

14. How many years have you completed in formal education (starting from class one)? *(Umekamilisha miaka mingapi katika elimu rasmi tangu darasa la kwanza?* _____

DISEASE AND TREATMENT CHARACTERISTICS

15. Since what age have you been having diabetes? (*Umekuwa na ugonjwa wa kisukari tokea umri gani?)* _____

16. Are you currently receiving any of the following treatments or advice for diabetes in addition to insulin prescribed by a health care worker? *(Je, kwa wakati huu mbali na insulin unapata matibabu au nasaha yeyote kati ya yanayofuata kutoka kwa muuguzi kwa ajili ya ugonjwa wa kisukari?)*

	1. Yes	2. No
a. Oral anti-diabetic drugs (Tembe za kisukari)		
b. Special prescribed diet (Lishe bora)		
c. Advice or treatment to loose weight (Nasaha au matibabu ya kupunguza uzito wa mwili)		

17. How often do you monitor your blood sugar? *(Unapima kiwango cha sukari mwilini mara ngapi?)*

a. *Several times in a day (mara kadhaa kwa siku) (1)*

b. *Once daily (mara moja kwa siku) (2)*

c. *Several times in a week (mara kadhaa kwa wiki) . (3)*

d. *Once weekly (mara moja kwa wiki) (4)*

e. *Occasionally (mara kwa mara/ nadra) Specify _ (5)*

ATTITUDE AND PRACTICE

18 In your opinion, how easy is it to access diabetic care at KNH?

19 *(Kulingana na maoni yako, huduma za ugonjwa wa kisukari katika hospitali kuu ya Kenyatta zinapatikana kiurahisi namna gani?)*

a. *Very easy (rahisi sana) (1)*

b. *Somewhat easy (rahisi kiasi)* *(2)*

c. *Neither easy nor difficult (sio rahisi wala ngumu)* *(3)*

d. *Somewhat difficult (Ngumu kiasi)* *(4)*

e. *Very difficult (Ngumu sana)* *(5)*

20. In your opinion, how affordable is diabetic care at KNH? *(Kulingana na maoni yako, huduma za ugonjwa wa kisukari katika hospitali kuu ya Kenyatta zinapatikana kinafuu namna gani?)*

a. *Very affordable (nafuu sana)* *(1)*

b. *Affordable (nafuu)* *(2)*

c. *Not affordable (sio nafuu)* *(3)*

d. *Not affordable at all (sio nafuu kabisa)* *(4)*

21. If you were to spend the rest of your life with the current treatment for your diabetes, how would you feel about it? *(Kama nimwenyekuendeleanamatibabuyaugonjwawakisukarimaishayakoyotekamailivosasa, utafurahi/ utaridhia namna gani?)*

a. *Very satisfied (Nitafurahishwa sana)* *(1)*

b. *Somewhat satisfied (nitafurahishwa kiasi)* *(2)*

c. *Neither satisfied nor dissatisfied (katiya kufurahishwa na kutofurahishwa)(3)*

d. *Somewhat dissatisfied (sitafurahishwa kiasi)* *(4)*

e. *Very dissatisfied (sitafurajishwa kabisa)* *(5)*

22. Do you ever forget to take your medicine (insulin)? *(Je, unasahau kujidunga insulin wakati mwengine?)*

a. *Yes (Ndio)* *(1)*

b. *No (La)* *(2)*

23. Do you ever have problems remembering to take your medication (insulin)? *(Je, unapata shida kukumbuka kujidunga insulin wakati mwengine?)*

a. *Yes (Ndio)* *(1)*

b. *No (La)* *(2)*

24. When you feel better do you sometimes stop injecting yourself with insulin? *(Je, ukisikia umepata nafuu unaacha kujidunga insulin wakati mwengine?)*

a. *Yes (Ndio)* *(1)*

b. *No (La)* *(2)*

25. Sometimes if you feel worse when you inject yourself with insulin, do you stop injecting? *(Je, wakati mwengine ukisikia vibe ukijidunga insulin unaacha kujidunga?)*

a. *Yes (Ndio)* *(1)*

b. No (La) (2)

AIC _____

APPENDIX 6: STUDY BUDGET

Item	Amount
Stationary	20.000.00
Assistants	20.000.00
Laboratory investigations	201.000.00
Data analysis	25.000.00
Ethical approval fee	1.000.00
Total	267.000.00

APPENDIX 7: STUDY TIME- LINE

Activity	Date
Protocol presentation	October 19, 2010
KNH ERC submission	January 3, 2011
KNH ERC approval	February 3, 2011
Data collection commencement	February 14, 2011
Data collection completion	March 22, 2011
Analysis and report writing	April - September, 2011
Results presentation	October 21, 2011
Final submission	November, 2011

UNIVERSITY OF NAIROBI

College of Health Sciences

DEPARTMENT OF CLINICAL MEDICINE AND THERAPEUTICS
Kenyatta National Hospital
P.o.Box 19676
NAIROBI,KENYA

Telegrams 22095 "Medken" Nairobi
DIRECT LINES 2725452 K.N.H.726300

November 8, 2010

The Secretary,
Ethics and Research Committee,
K.N.H

Dear Sir,

RE: M.MED THESIS STUDENT PROPOSAL

TITLE: QUALITY OF GLYCEMIC CONTROL AMONG INSULIN TREATED AMBULATORY PATIENTS WITH DIABETES MELLITUS AT KNH

STUDENT: DR. SALIM RASHID MASOUD

The above-mentioned proposal has been approved by the department of Medicine on, November 8, 2010.

It is hereby forwarded to you for further review and approval.

Thank you.

Yours sincerely,

DR. A.J.O. WERE.
Research Coordinator
Thematic Department of Medicine

C.C
Student
All Supervisors: Prof. Amayo, Prof. I. Wamola
Unit Head Thematic Department

KENYATTA NATIONAL HOSPITAL
Hospital Rd. along, Ngong Rd.
P.O. Box 20723, Nairobi.
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP", Nairobi.
Email: KNHplan@Ken.Healthnet.org

Ref: KNH-ERC/ A/13

February 3, 2011

Dr. Salim Rashid Masoud
Dept. of Clinical Medicine & Therapeutics
School of Medicine
University of Nairobi

Dear Dr. Masoud

RESEARCH PROPOSAL: "QUALITY OF GLYCEMIC CONTROL AMONG INSULIN TREATED AMBULATORY PATIENTS WITH DIABETES MELLITUS AT KENYATTA NATIONAL HOSPITAL' (P388/11/2010)

This is to inform you that the KNH/UON-Ethics & Research Committee has reviewed and **approved** your above revised research proposal for the period 3rd February 2011 – 2nd February 2012.

You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given. Clearance for export of biological specimens must also be obtained from KNH/UON-Ethics & Research Committee for each batch.

On behalf of the Committee, I wish you a fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of the data base that will be consulted in future when processing related research study so as to minimize chances of study duplication.

Yours sincerely,

PROF A N GUANTAI
SECRETARY, KNH/UON-ERC

c.c. The Deputy Director CS, KNH
The HOD, Records, KNH
The Dean, School of Medicine, UON
The Chairman, Dept. of Clinical Medicine & Therapeutics, UON
Supervisors: Prof. F.C. F. Otieno, Dept. of Clinical Med. & Therapeutics, UON
Prof. M. D. Joshi, Dept. of Clinical Med. & Therapeutics, UON
Dr. Kirtida S. Acharya, Dept. of Clinical Med. & Therapeutics, UON