**CHAPTER ONE**

**INTRODUCTION**

* 1. **. BACKGROUND OF THE STUDY**

Type 2 diabetes mellitus (DM) is a chronic disease that usually co-exists with other medical conditions. Uncontrolled DM leads to various short-term as well as long term, micro vascular and macro vascular complications. Hence, the patient may be taking multiple medications to treat several coexisting conditions. This creates a complex situation where the patient has to be on multiple drug therapy with complicated dosing schedules that is likely to result in low adherence to the medication plan (White, 2010). Adherence to the medication schedule is of utmost importance in successful management of chronic diseases. Adherence can been defined as the extent to which individuals follow the instructions they are given for prescribed treatments (Clark 2004).

As much as 30–60% of patients with chronic illnesses have been reported to be non-adherent to drug therapy in various settings (Rifkin *et al*., 2010), only half of people with chronic diseases are medication adherent (WHO, 2010).

Non-adherence to medication is common in patients with type 2 DM making glycemic control difficult to achieve. Inadequate glycemic control over a prolonged period increases the chances of disease related complications resulting in physical, mental and financial suffering to the patients. Highly variable rates of adherence to medication in patients of diabetes have been reported in different studies. Patient-reported adherence rates for medication of 83% and 78% in type 1 and type 2 diabetic patients respectively were reported in the Cross-National Diabetes Attitudes, Wishes, and Needs (DAWN) Study (Peyrot *et al*., 2005). In two studies in adult patients of type 2 diabetes mellitus 47% and 45.1% of patients were adherent with their study drug over the 1-year follow-up period ( Curkendall *et al*., 2013) (Ahmad *et al*., 2013).

The cause of poor adherence is complex, multifaceted, and varies with each situation and patient. Hence, it is necessary to understand non-adherence to medication in a particular disease and study the factors affecting it. Various causes have been reported such as complex medication schedule, high cost of treatment, fear of adverse effects, lack of belief in the treatment, psychological problems etc. Variables such as age, medication knowledge and comorbidities were also shown to be associated with no adherence.

With this background, this study was planned to help adherence to medication and to study factors associated with non-adherence in patients of type 2 DM.

* 1. **INTRODUCTION**
     1. **WHAT IS DIABETES?**

Diabetes is a defect in the body’s ability to convert glucose (sugar) to energy. Glucose is the main source of fuel for our body. When food is digested it is changed into fats, protein, or carbohydrates. Foods that affect blood sugars are called carbohydrates. Carbohydrates, when digested, change to glucose. Examples of some carbohydrates are: bread, rice, pasta, potatoes, corn, fruit, and milk products. Individuals with diabetes should eat carbohydrates but must do so in moderation. Glucose is then transferred to the blood and is used by the cells for energy. In order for glucose to be transferred from the blood into the cells, the hormone - insulin is needed. Insulin is produced by the beta cells in the pancreas (the organ that produces insulin). In individuals with diabetes, this process is impaired. Diabetes develops when the pancreas fails to produce sufficient quantities of insulin – Type 1 diabetes or the insulin produced is defective and cannot move glucose into the cells – Type 2 diabetes. Either insulin is not produced in sufficient quantities or the insulin produced is defective and cannot move the glucose into the cells.

* + 1. **WHAT ARE THE SYMPTOMS OF DIABETES?**

Some symptoms of diabetes include:

1. Blurred vision
2. Unusual thirst
3. Frequent urination
4. Slow-healing cuts
5. Unexplained tiredness
6. Rapid weight loss (Type 1 diabetes)
7. Erectile dysfunction
8. Numbness or tingling in hands or feet

Symptoms may occur rapidly with Type 1 diabetes; however, with Type 2 diabetes the onset is more insidious and may not be noticed.

* + 1. **WHAT ARE COMORBIDITIES?**

Comorbidity is the presence of one or more additional diseases or disorders co-occurring with (that is, concomitant or concurrent with) a primary disease or disorder.

* + 1. **WHAT ARE THE COMORBIDITIES ASSOCIATED WITH DIABETES MELLITUS?**

As may be expected with a chronic disease that primarily affects middle-aged and older individuals, type 2 diabetes is usually complicated by other medical conditions. In the 1999-2004 cohort of the National Health and Nutrition Examination Survey (NHANES), only 14% of patients with type 2 diabetes had no other comorbidities (Suh *et al.,* 2010). Here, we briefly outline major comorbidities of patients diagnosed with diabetes.

1. Obesity
2. Dyslipidemia
3. Hypertension
4. Chronic Kidney Disease
   * 1. **HOW CAN A PATIENT COPE WITH DIABETES?**

Treatment typically includes diet control, exercise, home blood glucose testing, and in some cases, oral medication and/or insulin. Approximately 40 percent of people with type 2 diabetes require insulin injections.

* + 1. **EFFECTS OF NON ADHERENCE TO DIABETES MEDICATION**

Non-adherence to treatment is a formidable problem, leading as it often does to

1. a reduction in or lack of treatment benefits,
2. extra visits to the doctor,
3. unnecessary hospitalization,
4. decreased satisfaction with medical care,
5. and sometimes further medication prescription.
   * 1. **ICT ADVANCEMENTS THAT SUPPORT DRUG ADHERENCE IN DIABETES MELLITUS PATIENTS**

Incorporating ICT into health care offers the potential to address these concerns and to save the patient extra costs associated with treatment, complications and so on.

Many projects have applied the features of mobile technology in designing interventions for medication adherence. Such projects include: the Mobile MedAlert, a mobile medical alert system that sends SMS to patients, prompting them to take their drugs (Okuboyejo *et al.*, 2012); WelTel Kenyan project, a randomized trial of mobile (cell) phone text messaging to improve patients’ adherence to antiretroviral therapy (Lester *et al*., 2010); Disease Management Assistance System (DMAS), a programmable electronic device that provides verb-al reminder messages at dosing times (Wu *et al*., 2006); Computerized Automated Reminder Diabetes System (CARDS), an e-mail and SMS cell phone text messaging reminders to support Diabetes management (Hanauer *et al*., 2009). In Norway, SMS messages are sent to educate parents with Type 1 diabetic children. These messages included definitions, facts and tips for managing diabetes (Wangberg *et al.*, 2006). In India, South Africa and Uganda, SMS message campaigns have been used to create awareness of HIV/AIDS. They have also been notified of the centers where they can receive counselling, testing and treatment (Vital Wave Consulting, 2009). Information about communicable diseases and reproductive health are also disseminated via SMS. Project Masilukeke in South Africa takes advantage of the 120 spare characters on free “please call me” SMS messages to provide HIV/AIDS education and awareness (Vital Wave Consulting, 2009). In Norway, SMS messages are sent to educate parents with Type 1 diabetic children. These messages included definitions, facts and tips for managing diabetes (Wangberg *et al.*, 2006). Text to Change (South Africa) project employs an SMS-based quiz to test users’ knowledge of HIV/AIDS and encourage testing and counselling (Vital Wave Consulting, 2009). Other projects include: TRICKs (Text Reminders for Immunization Compliance in Kids) which sends out text messages of immunization reminders prior to immunization dates (Ahlers-Schmidt *et al*., 2012); Text messaging to motivate walking in older African-Americans (Kim *et al.,* 2013); Text4baby, the first free national health text messaging service in the United States that aims to provide timely information to pregnant women and new mothers to help them improve their health and the health of their babies (Whittaker *et al.*, 2012); a mobile phone text message program to measure oral antibiotic use and provide feedback on adherence to patients discharged from the emergency department (Suffoletto *et al*., 2012) and the use of text messaging to increase the receipt of influenza vaccine among low-income urban children (Stockwell *et* *al*., 2012).

* 1. **STATEMENT OF THE PROBLEM**

The prevalence of diabetes mellitus (DM) is rising worldwide and is more in the developing countries which unfortunately are already suffering from communicable diseases (Ogbera and Kuku, 2012). It is estimated that over 70% of people with diabetes will reside in developing countries by the year 2030 (Inzucchi, 2012) (Shaw *et al.,*2010). Up about 85% to 95% of all diabetes in high-income countries is type II diabetes and may account for an even higher percentage in low- and middle-income countries (Nigatu, 2012). Type II DM became a very common and serious global health problem, which, for most countries, is associated with rapid cultural and social changes, ageing populations, increasing urbanization, dietary changes, reduced physical activity, and other unhealthy behaviors. The prevalence of diabetes is expected to almost double in 2030 (International diabetes Federation, 2011). Despite the presence of effective medical treatments for diabetes, a very large number of diabetic patients die every year in Africa.

Non-adherence to medical treatment remains a challenge for the medical professionals. Their efforts to improve patient adherence often appear to be ineffective. Anti-diabetic medications are integral for glycemic control in diabetes, therefore non-adherence to drugs can alter blood glucose level resulting in complications (Arifulla *et al.,* 2014). Consistent adherence among patients with chronic conditions is disappointingly low, dropping most dramatically after the first six months of therapy (Varney *et al.,* 2008). Poor adherence has been shown to decrease the effects of prescribed medications or other treatments and to increase the likelihood of poor outcomes (McDonald *et al.,* 2011).

* 1. **AIM AND OBJECTIVES OF THE STUDY**

This project is aimed at developing a mobile application software that will assist in reminding diabetic patients to take their medications daily.

Objectives are:

1. To design an e-medication reminder system.
   1. **SIGNIFICANCE OF THE STUDY**

This software makes use of the existing Google Calendar App present on all Android devices to remind patients to use their medication which in turn eliminates the need to download any special application. This software will help to automatically update a patient’s medication on all his/her devices. This software will help many diabetic patients all over the world adhere to their drug regimen more strictly, it will also help our healthcare system reduce the amount of complications that emanate from non-adherence to drug regimen by patients suffering from diabetes mellitus.

Further research can also emanate from this study.

**ADVANTAGES OF SYSTEM**

1. The system provides security and integrity to information. It allows patients retain all their medication information even if they lose any of their android devices. All information is automatically backed up on the internet.
2. With this application, the patient can get a reminder on all android devices at the same time without the need to update it on each and every device.
   1. **SCOPE OF THE STUDY**

The proposed reminder system should remind patients suffering from diabetes mellitus and its comorbidities to effectively adhere to their drug regimen.