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APPROPRIATENESS OF TYPE 2 DIABETES MELLITUS DRUG THERAPY: A CASE OF TIKUR ANBESSA SPECIALIZED HOSPITAL DIABETES CLINIC

ALEMSEGED AYELE ASFAW

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Appropriateness of Type 2 diabetes mellitus drug therapy: A case of Tikur Anbessa Specialized Hospital Diabetes Clinic

ALEMSEGED AYELE ASFAW

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This is to certify that the thesis prepared by Alemseged Ayele Asfaw, entitled: Appropriateness of Type 2 diabetes mellitus drug therapy: A case of Tikur Anbessa Specialized Hospital Diabetes Clinic and submitted in partial fulfillment of the requirements for the Degree of Master of Pharmacy in Pharmacy Practice complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Abstract

Appropriateness of Type 2 diabetes mellitus drug therapy: A case of Tikur Anbessa Specialized Hospital Diabetes Clinic

ALEMSEGED AYELE ASFAW

ADDIS ABABA UNIVERSITY, 2014

Background: Diabetes mellitus (DM) is a metabolic problem involving chronically high blood glucose levels or hyperglycemia, which is thought to arise from insulin deficiency. This insulin deficiency can be decrease in amount or a complete absence in body. In the long run high blood glucose level could lead to various complications. Beside altered glucose metabolism carbohydrate, protein, and lipids metabolisms are also affected in diabetes mellitus.

Objective: To assess appropriateness of Type 2 diabetes mellitus drug therapy (T2DM) and investigate association between fasting blood glucose (FBG) and the patients' clinical and demographic characteristics at the diabetes clinic of Tikur Anbessa specialized hospital (TASH).

Methods: The study was a cross sectional hospital based survey and used both quantitative and qualitative methods. T2DM patients who came for their follow up treatment at the diabetes clinic of TASH over a one month period (April 2013) were used as research participants. Plus key informant interview with the help of semi-structured open ended questioner was used focusing on the experience and practice physicians within the diabetes clinic regarding medication choice and guidelines they use.

Results: A total of 103 patients enrolled in the survey and the proportion of females (59.2%) was higher than males (40.8%). The mean age was 52.2 years and most of them live in Addis Ababa. When it comes to clinical characteristics mean FBG was 155.99 ± 44.32 mg/dl, the difference in FBG between male and female was insignificant (P=0.325). Body mass index (BMI) had a mean value of 26.4± 3.05 kg/m^2 and 51.45% of the patients were overweight. Medication wise NPH (56.3%), metformin plus glibenclamide (19.4%) and metformin (10.7%) were the most prescribed

drug therapies. And 3.88% of patients were only on glibenclamide. The association of gender, age, BMI and medication used with the FBG levels of patients was not significant with a p value of 0.6, 0.803, 0.97 and 0.081 respectively. The key informants point out that patient load, physician rotation, lack of guide-line and devices as a reason for inadequacy of treatment.

Conclusions: The treatment of T2DM is appropriate with existing problems. Metformin was the first choice oral medication, while most patients were on NPH. And no single factor was associated with influencing the FBG of patients.

Key Words: Type 2 diabetes mellitus, Drug therapy

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Table of Contents

List of Figures

List of Tables

List of Acronyms

ADA	American Diabetic Association
CADRE	The council for the advancement of diabetes research and education
CDA	Canadian Diabetic Association
CI	Confidence Interval
DACA	Drug Administration and Control Authority
DM	Diabetes Mellitus
EDA	Ethiopian Diabetes Association
FBG	Fasting Blood Glucose
GDM	Gestational Diabetes Mellitus
IDF	International Diabetes Federation
NCD	Non Communicable Disease
OGTT	Oral Glucose Tolerance Test
T1DM	Type 1 Diabetes Mellitus
T2DM	Type 2 Diabetes Mellitus
TASH	Tikur Anbessa Specialized Hospital
WHO	World Health Organization

1. INTRODUCTION

1.1. DEFINITION AND CLASSIFICATION

Diabetes mellitus (DM) is a metabolic problem involving chronically high blood glucose levels or hyperglycemia, which is thought to arise from defects in both insulin secretion and use. This insulin deficiency can be decrease in amount or a complete absence in body. In the long run high blood glucose level could lead to various complications (Smushkin and Vella, 2010; Valitutto, 2008). Beside altered glucose metabolism carbohydrate, protein, and lipids metabolisms are also affected in diabetes mellitus (Conget, 2002).

According to the American Diabetes Association (ADA) symptoms like excessive urination (polyuria), increased fluid consumption (polydipsia), weight loss, and sometimes it can also be accompanied by with polyphagia, and blurred vision are typical of DM (ADA, 2009). These symptoms are not always present in type 2 diabetes patients (T2DM) and as a result hyperglycemia sufficient to cause pathological and functional changes may be present for a long time before the diagnosis is made (WHO, 1999). Insidious pathological changes in DM include particularly damage, dysfunction and failure of various organs especially, the kidneys, eyes, nerves, heart and blood vessels (CDA, 2008). Furthermore, impairment of growth in children and susceptibility to certain infections may also accompany chronic hyperglycemia (ADA, 2009).

The effect of the disease on the patient is in direct relation with the extent of hyperglycemia. DM patients have a more than twofold increased risk of the above listed complications (Burger *et al*, 2012). Due to these reasons DM exerts a considerable burden on individual patients and society at large. The deleterious effect ranges from cost of treatment to loss of life (Solli *et al*, 2010).

Through time better understanding of the causes of DM led to classification by etiological type (WHO, 1999). And based on this DM includes four clinical classes (Table 1) Type 1 diabetes (T1DM), T2DM, Gestational diabetes mellitus (GDM) and other specific types of diabetes due to other causes including drug or chemical-induced (ADA, 2011).

1.1.1. TYPE 1 DIABETES MELLITUS

T1DM, accounts for only 5–10% of total diabetes, previously, was known by the terms insulin dependent diabetes or juvenile- onset diabetes (ADA, 2009). As it is shown in Table 1, these patients have absolute insulin deficiency and are dependent on insulin replacement for life. And diabetes ketoacidosis is often the presenting symptom in patients with T1DM (CADRE, 2004).

The cause for the absolute insulin deficiency is mostly due to an autoimmune process and those for which the etiology of beta cell destruction is unknown (CDA, 2008). And T1DM does not include those forms of beta–cell destruction or failure to which specific causes can be assigned e.g. cystic fibrosis (WHO, 1999).

1.1.2. TYPE 2 DIABETES MELLITUS

T2DM, formerly noninsulin-dependent or adult (older than 40 years of age) diabetes mellitus (Conget, 2002), accounts for 90-95% of patients with diabetes and is a progressive disease encompassing defects in both insulin secretion and use (Valitutto, 2008). Individuals with this type of diabetes secrete insulin to some degree therefore may not require insulin therapy initially, which is not the case in T1DM. The β-cell function deteriorates over the course of the disease,

and therefore therapies designed to control glucose may vary from initial treatment with life style change only to monotherapy or combination therapy, and later insulin therapy (CADRE, 2004).

This type of DM remained as the leading cause of various problems including heart problems, retinal damage, renal failure, amputations and hospitalizations. In addition, it is also linked with increased risk of cancer, psychiatric illness, cognitive decline, chronic liver disease, accelerated arthritis, and other disabling or deadly conditions (Kang, 2012).

1.2. EPIDEMIOLOGY

In the 21st century non-communicable diseases (NCDs) account for one of the major health and socioeconomic threats (Rudasingwa *et al*, 2012). In parallel, DM is now one of the most common NCDs globally. It is becoming one of the leading causes of death in the developed world and its prevalence is substantially increasing in the developing countries (Sicree, 2009).

DM is becoming a pandemic worldwide (Akhter *et al*, 2011). In terms of numbers DM is estimated to affect as many as 408 million people in 2013, and is expected to reach up to 776 million people by the year 2035 (IDF, 2013). Based on type, T2DMs share will be significantly higher than other types. This prediction is mostly due to obesity and lack of exercise that are thought to arise from rapid economic development, improved living standard and an aging population (Kang, 2012).

The problems associated with T2DM are becoming increasingly evident in Africa in the chronic diseases category. In a 2013, about 19.8 million individuals were thought to have diabetes in Africa, which is expected to rise to 41.5 million by 2035 and most of the number will accumulate

around urban areas (IDF, 2013). Sub-Saharan Africa is also being affected, experiencing an increasing prevalence of DM (Hall *et al*, 2011). In the previous year's one major hiatus in Africa was the lack of data, from standardized World Health Organization (WHO) criteria, on the impact of the disease in the continent (Motala et al, 2003).

In line with this, presence of poor awareness about the disease and limited screening thwart the calculation of the actual prevalence of the disease in Africa (Mbanya *et al*, 2010). According to the latest data estimate of diabetes prevalence in Ethiopia is 4.36% and the number of DM related deaths was 34,262. In addition Ethiopia is ranked third from Africa, with 1.8 million people with diabetes (20-79 years) (IDF, 2013).

1.3. RISK FACTOR AND PATHOPHYSIOLOGY OF TYPE 2 DIABETES MELLITUS

Evidences indicate that the primary causes of T2DM are lifestyle factors and genetics. These lifestyle factors are modifiable meaning they can be changed in order to decrease the chance of developing T2DM. These factors include physical inactivity, sedentary lifestyle, cigarette smoking and high alcohol consumption (Olokoba *et al*, 2012).

Among the fore mentioned factors physical inactivity represent the most important modifiable risk factor for DM (Ahmad *et al*, 2011). In addition, the risk factors can be gender, age, education level, hypertension, triglyceride and cholesterol level (Ahmad and Pervaiz, 2006). An association between hepatitis C infection and T2DM was also noted (Naing *et al*, 2012).

The development of T2DM encompasses different pathological defects which end up in the failure of the β-cells to secret insulin. These are peripheral insulin resistance, impaired regulation of hepatic glucose production, and declining β-cell function (Mahler and Adler, 1999).

Under normal physiologic conditions, the human body maintains a tight control over glucose concentrations showing minimal deviation between fasting and postprandial periods. This tight glucose regulation is possible by the right levels of insulin and tissue sensitivity for insulin. This balance is responsible for maintaining the right level of glucose in the blood. Once this balance between secretion and sensitivity is lost glucose intolerance and diabetes will occur (Tfayli and Arslanian, 2009).

Insulin resistance in T2DM is commonly linked to obesity. Obesity will increase the circulating free fatty acids in the body. These free fatty acids inhibit glucose uptake, glycogen synthesis and glycolysis. It is described earlier that resistance is compensated by increased secretion of insulin in order to maintain the glucose level in the blood. But β-cell mass is reduced in obese patients by a marked increase in β-cell apoptosis, which leads to lack of sufficient insulin (Segura-Egea *et al*, 2012).

Over time all T2DM patients, not only the obese ones loss most of the functional pancreatic β-cell mass. The decrease in β-cell mass leads to impaired insulin secretion that in turn lead to lowered glucose responsiveness. And this problem is evident by the decrease in postprandial phase secretion (Kaku, 2010). On the other hand, the genetic basis of this disease has been demonstrated only in small groups of patients (Stenson, 2001).

In general, it is not clear as to what the primary cause of T2DM is. Whether it is impaired secretion or insulin resistance is not known, but there is a general consensus that defective insulin release is a requirement for the disease to develop (Stenson, 2001).

1.4. DIAGNOSIS

The diagnosis of DM was solely based on plasma glucose criteria, either the fasting plasma glucose (FPG) or the 2-h glucose tolerance test (OGTT). In 2009, hemoglobin A1C test to diagnose diabetes was recommended (Table 1) by an International Expert Committee that included representatives of the American Diabetes Association (ADA), the International Diabetes Federation (IDF), and the European Association for the Study of Diabetes (EASD), also added the random plasma glucose (ADA, 2011). Besides using appropriate diagnostic technique the test results should be repeated on subsequent days with another test to make sure of diagnosis (Kang, 2012). This is except in unequivocal presentations including acute complications.

Table 1: Diagnosis criteria for DM

Diagnostic Method	Criteria. . . .
FPG	≥ 126 mg/dl (7.0 mmol/L) on more than one occasion
Random plasma glucose	≥ 200 mg/dl (11.1 mmol/L) Plus symptoms (such as polyuria, polydipsia, unexplained weight loss)
A 75 g OGTT with a 2 h value of plasma glucose	≥ 200 mg/dl (11.1 mmol/L)
Hemoglobin A1C	≥ 6.5%.

1.5. MANAGEMENT

The widely known study, The United Kingdom Prospective Diabetes Study (UKPDS) underlines the importance of glucose control in prevention of complications in people with type 2 diabetes. Therefore one of the primary goal in managing DM is to have good glycemic control in order to decrease mortality and morbidity of DM patients, specially incase of microvascular complications (Kang, 2012).

The issue then arises as to the desirable level of plasma glucose control to be achieved. According to the IDF guideline for T2DM, 2012, the target level of fasting/pre-meal capillary plasma glucose is 115 mg/dl and for the post meal capillary plasma glucose it needs to be 160 mg/dl (Table 3).

Table 2: Glucose control levels IDF, 2012

	Normal	Target
HbA1c	< 6.0% / 42 mmol/mol	< 7.0% / 53 mmol/mol
Fasting/pre-meal capillary plasma glucose	5.5 mmol/l (100 mg/dl)	6.5 mmol/l (115 mg/dl)
Post meal capillary plasma glucose	7.8 mmol/l (140 mg/dl)	9.0 mmol/l (160 mg/dl)

To achieve the above tabulated targets different options are available. Treatment modalities range from lifestyle modification to the last resort of insulin (Olokoba *et al*, 2012). But increased understanding of the pathophysiology of DM has contributed to the advance of new pharmacological approaches continually (Tsang, 2012). And several newer therapeutic options

have become available within the past decade. Physicians are therefore faced with the challenge of designing appropriate treatment strategy (Valitutto, 2008).

Evidence supports the effectiveness of nutrition therapy and physical activity in the prevention and management of T2DM (IDF, 2012). Based on the evidences the guideline from the IDF (Figure 1) puts nutrition and physical activity first in the management of T2DM. Despite applying these measures, if the required level of blood sugar is not achieved, metformin is considered as a first line treatment. Sulfonylurea or α-Glucosidase inhibitor can be used as an alternative.

Sulfonylurea, metformin or α-Glucosidase inhibitor or dipeptidyl peptidase-4 (DPP-4) inhibitors or thiazolidinediones can all be considered as a second line drugs based on the situation and patient condition. As a third line, basal insulin or pre-mix insulin is used. As an alternative, α-Glucosidase inhibitor or DPP-4 inhibitor or thiazolidinedione or glucagon-like peptide-1 (GLP-1) agonist can all be considered.

Insulin therapy becomes necessary once two or three oral diabetes drugs have failed. For patients whose disease duration is 7 to 10 years, use of insulin therapy should be considered. And meal-time insulin intensification needs to be considered when the target FBG levels and glycated hemoglobin levels could not be met (LaSalle and Berria, 2013).

Beside the internationally recognized guidelines countries adopt guidelines to their existing conditions. Accordingly the standard treatment guidelines for regional hospitals in Ethiopia have

been prepared by the responsible body. The guideline puts glibenclamide, a sulfonylurea, as a first line treatment for T2DM with the addition of metformin as a second line agent or as an alternative. In addition, there could be cases where both drugs can be given together to achieve optimal glycemic control.

In events where oral agents fail to achieve the required level of glycemic control, different formulations of insulin can be used including rapid acting (e.g. insulin lispro), intermediate acting (e.g. isophane insulin) and long acting insulin preparations (e.g. crystalline insulin) (DACA, 2010). One point that needs to be stressed is, this guideline doesn't include specialized hospitals in the country. In these specialized hospitals the physicians have the freedom to follow different guidelines.

In light of the increasing number of medications for the treatment of T2DM, new remedies are still in great demand. This is due to limited efficacy and undesirable side effects of current drugs. To overcome these limitations other sources of potential medications are being perused. In this regard nature is an extraordinary source of antidiabetes medicines. To date, more than 1200 flowering plants have been claimed to have antidiabetes properties. Among them, one-third have been scientifically studied and documented in around 460 publications (Chang et al, 2013).

Finally, T2DM is perceived to be less severe by both patients and physicians. This is despite a lot of literature available. But the numbers indicate that a majority of microvascular complications occur in these patients (Sheehan, 2003).

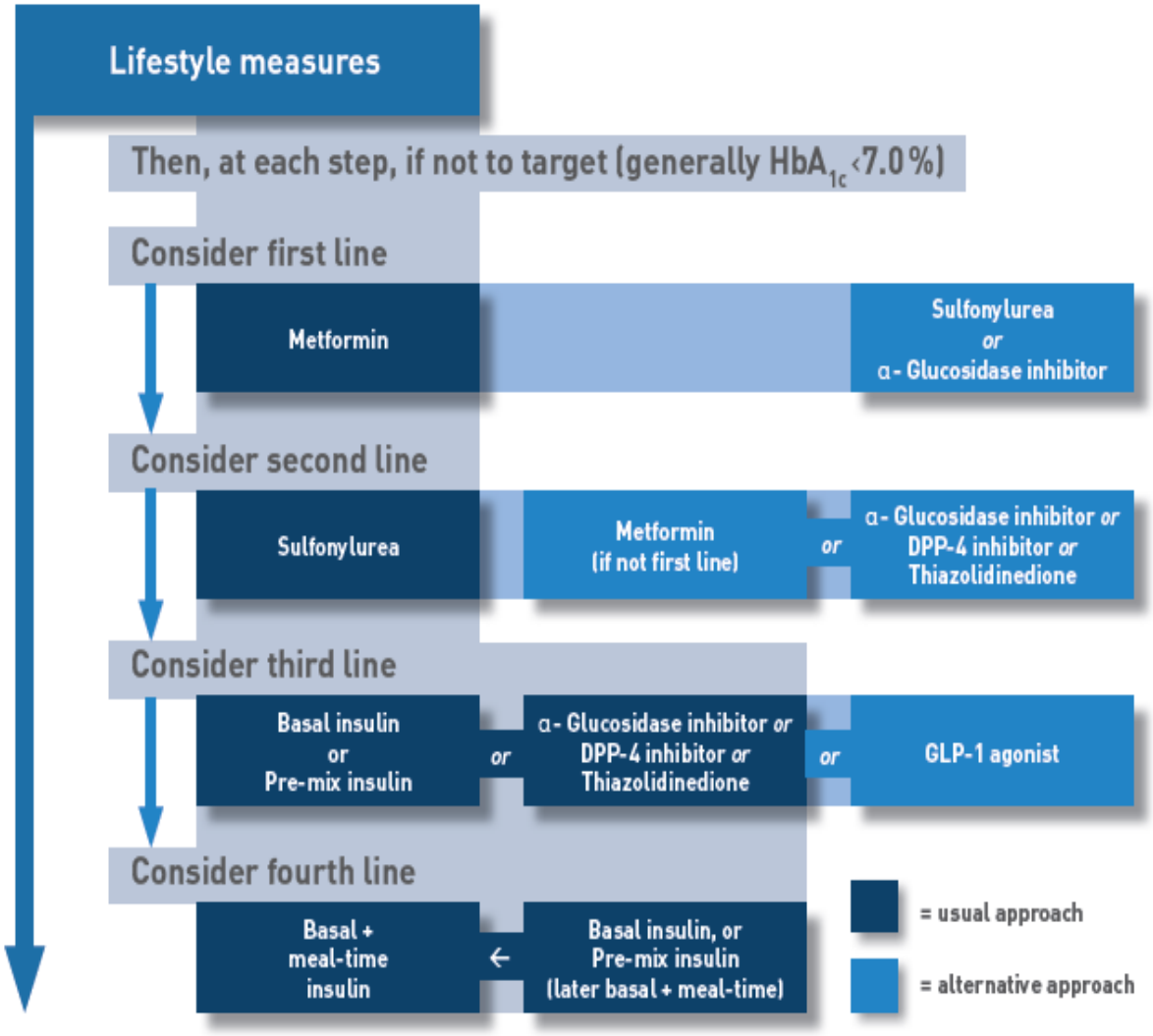


Figure 1 Treatment algorithm for patients with type 2 diabetes, (IDF, 2012)

1.6. RATIONALE FOR THE STUDY

As stated above increased understanding of the pathophysiology behind T2DM has led to the development of many new agents (Brown and Brillon, 1999). The rise in number of treatment options make choosing the right treatment plan for the right patient quite challenging. The available guidelines show a slight discrepancy. And the complications of diabetes are common and the economic burden is very high (Ramachandran *et al*, 2012, Solli et al, 2010).

In the treatment of T2DM drugs take the central role besides other treatment strategies. And choosing one drug over another must definitely be based on a certain guideline approved by the responsible body. In the study by Holmer *et al.* (2013) it was reported, the overall quality of clinical practice guidelines for glycemic control in T2DM is moderate, but there is substantial inconsistency among quality domains within and across guide-lines. In addition to this, (Barquera *et al.*, 2013; Deerochanawong and Ferrario, 2013) concluded that the increasing diabetes mortality and lack of control among diagnosed patients make quality of treatment a major concern. Currently the diabetes clinic at Tikur Anbessa Specialized Hospital (TASH) has no designated guideline. The physicians use their personal experience or other guidelines.

DM treatment is more of awareness as it is the medications. Knowing the source of the problem and where it is most common among the population is vital. In this context patient characterization is useful in identifying risk factors. That is useful for early diagnosis thus stopping the disease from its source (Majgi *et al*, 2012).

Different studies have been done patient characterization one way or another to enable them to identify the risk factors of diabetes and the impact of these factors on treatment outcome. For example, a cross-sectional descriptive study on profile of patients with diabetes was done on patients in Eritrea by Seyum *et al*, 2010. Studies by (Abubakari *et al*, 2008; Barquera *et al.* 2013; Jayawardena *et al.* 2012; Ramachandran *et al.* 2008; Wahab *et al.* 2011; Wild *et al*, 2004) finds a relation between obesity, area of residency and gender with T2DM. And they recommend identifying risk factors and focus groups for urgent preventive and curative strategies.

Different studies on T2DM have been done in Ethiopia but a study focusing on the type of medications used lacking. This study will provide a picture to what is currently happening in the clinic with regard to the medication choice, guidelines preferred and where it stands in comparison with the IDF guideline. In addition it will also provide the current patient profile of T2DM at the diabetes clinic of TASH.

2. OBJECTIVE

2.1. GENERAL OBJECTIVE

- To assess appropriateness of T2DM drug therapy and investigate association between FBG and the patients' clinical and demographic characteristics at the diabetes clinic of Tikur Anbessa specialized hospital.

2.2. SPECIFIC OBJECTIVES

- To characterize T2DM patients demographically and in terms of clinical status.
- To identify the frequently used medications for T2DM patients in order to check its appropriateness.
- To identify the association between fasting blood glucose level and age groups, gender, body mass indexes and medications used.

3. METHODS

3.1. STUDY SETTING

The study was conducted in the diabetes center of TASH, located in Addis Ababa, Ethiopia. It is a teaching hospital under the administration of Addis Ababa University. The hospital has 627 beds and gives diagnostic and treatment service for about 370,000-400,000 patients per year. The diabetes service in TASH includes two diabetes clinics/week, one diabetes and pregnancy clinic/week, one foot clinic/week, diabetes retinopathy screening, laser treatment, twice/week-diabetes education and monthly diabetes education by the EDA. Approximately 500 patients receive diabetes and endocrinology services per month.

3.2. STUDY DESIGN

The study was a cross sectional study and used both quantitative and qualitative methods. On one hand, T2DM patients who came for their follow treatment at the diabetes clinic of TASH over a one month period (April 2013) were used as research participants. Plus key informant interview with the help of semi-structured open ended questioner was used focusing on the experience and practice of practitioners (i.e. physicians) within the diabetes clinic regarding medication choice and guidelines they use.

3.3. SOURCE AND STUDY POPULATION

All T2DM patients attending the diabetes clinic of TASH were used as a source population for the selection of patients to be involved in the study. Out of the source population, those patients who got treatment in April 2013 were enrolled in the study.

3.4. SAMPLING

The sample size for the study was determined using single proportion population sample size determination. Since the latest data estimate of diabetes prevalence in Ethiopia is 4.36% (IDF, 2013), 0.044 is used as the P value in the calculation and 5% is used as the error margin.

$$N = \frac{(1.96)^2 \times (0.044(1-0.044))}{(0.05)^2} = 64$$

Based on the calculation the minimum sample size required for the study was 64. In order to increase the statistical power of the study or inference power, the study was conducted prospectively for a period of one month. A period of one month was used to control the effects of variability in medication and professional rotation.

103 patients who obtained follow up treatment in the diabetes clinic of TASH were included in the study. This number represented all T2DM patients who were screened in the study period. Data from these sample was used to identify the medications and for patient characterization. For the interview, two key informants were chosen for the interview, fellows in the diabetes and endocrinology.

3.5. INCLUSION AND EXCLUSION CRITERIA

All T2DM patients at the diabetes clinic and with the necessary information were included. On the other hand T1DM patients and T2DM patients whose patient card did not have all the study variables required were excluded from the study.

3.6. STUDY VARIABLES

3.6.1. Dependent Variable

For this study the dependent variable was the fasting blood glucose level of the study participants.

3.6.2. Independent Variables

The independent variables include:

- Age
- Sex
- Body mass index (BMI)
- Medication(s) used

3.7. DATA COLLECTION AND MANAGEMENT

3.7.1 DATA COLLECTOR

Collection of patients' data such as demographic characteristics, medical characteristics, and the type of medication used as well as interview of professionals regarding T2DM management were carried out by the principal investigator.

3.7.2. DATA COLLECTION INSTRUMENT

Patients' data were collected by reviewing medical charts (data abstraction tool can be found in Annex 1). Data extracted from the medical charts include demographic characteristics (age, gender and area of residency), medical characteristics (body mass index, fasting blood glucose levels), and the type of medication used. The patient data collected were after physician consultation with the patient.

Key informant interview using semi-structured open ended questioner (Annex 2) was used to assess the experience and practice of the practitioners working within the diabetes unit regarding T2DM management. The interview assessed back ground information including education level, work experience and current responsibilities. On the other hand question regarding patient assessment, medication choice and specific guidelines they follow if there is any. And finally the questions were focused on barriers to optimal treatment of T2DM from the physicians' perspective.

3.7.3. DATA ENTRY AND ANALYSIS

Data was entered and analyzed using SPSS version 17.0.0. Categorical variables were presented in numbers and percentages. Continuous variables including demographics, clinical and medication used were presented as complete data sets (average, standard deviation, minimum and maximum value, and 95% CI).

Data for numerical variables are expressed as mean ± standard deviation and mean difference was determined using independent sample t-test. Association between FBG and sex, age, BMI and medications used was determined using bivariate analysis with Pearson correlation coefficient. Significance was set at $p<0.05$.

Since obesity is considered as one of the major predisposing factor to Type 2 Diabetes, patients were categorized as underweight (<18.5 kg/m^2), normal body weight (18.5kg/m^2-24.9kg/m^2), overweight (25kg/m^2-29.9kg/m^2) and obese (>30kg/m^2) based on their BMI.

3.8. ETHICAL CONSIDERATION

Ethical clearance was obtained from the Ethics Review Committee of the School of Pharmacy; Collage of Health Sciences, Addis Ababa University and from Institutional Review Board (IRB) of TASH. During data collection only patient card number was used rather than patient names to ensure patient information confidentiality.

4. RESULTS

4.1. DEMOGRAPHIC CHARACTERISTICS

Out of the total 103 patients enrolled in the survey, the proportion of female patients was higher than male patients. The mean age of the patients was 52.2 (SD=10.9). The minimum age was 25 and the maximum was 82. Table 4 shows the socio-demographic profile of the study participants.

Table 3: Socio-demographic profile of diabetes patients treated at the diabetes clinic of Tikur Anbessa Specialized Hospital, 2013

Demographic characteristics		N (%)
Sex	Male	42 (40.8)
	Female	61 (59.2)
Age (Years)	25-39	11 (10.68)
	40-54	53 (51.45)
	55-69	29 (28.15)
	70-82	10 (9.7)
Area of residency	Out of Addis Ababa	4(3.88)
	Addis Ababa	99(96.12)

During the chart review, it was found that the mean age of patients receiving NPH, the most commonly used drug, was 50 ± 9.8 years.

4.2. CLINICAL CHARACTERISTICS

4.2.1 FASTING BLOOD GLUCOSE LEVEL

The mean FBG was found to be 153.99 ± 44.32 mg/dl. The minimum value was 58 mg/dl and the maximum value was 287 mg/dl. Taking 126 mg/dl as a reference point, greater proportion of the patients (75, 72.8%) were found to be above the reference point. A one sample t-test taking 126 mg/dl as a test value revealed a mean difference of 27.990 mg/dl. Meaning on average the fasting blood glucose levels of the study participants is higher by the above given value from the reference value.

The fasting blood glucose level was also grouped according to sex of the patient and mean female FBG was found to be 158.75± 45.753, whereas the mean FBG of male patients was 133.33±47.9. To spot if there is any significant difference between the two groups independent sample t-test was performed and a value of 0.325, (>0.05), making it insignificant.

4.2.2 BODY MASS INDEX LEVEL

BMI of the study participants was also calculated using their weight and height. Based on the calculation, the mean BMI was found to be 26.4 ± 3.05 kg/m^2. This put patients of the study under the category of overweight. The minimum value was 19.5 kg/m^2 and the maximum was 35.2 kg/m^2. Putting the results categorically, 36 (34.95%) of the patients had normal body mass index, 53 (51.45%) were found to be overweight and 14 (13.59%) of them were obese. None of the study participants were found to be underweight.

4.3. MEDICATIONS USED

Four types of antidiabetes agents were used in the clinic during the study period and they were used either as single therapy or combinations. Majority of the patients were on Neutral Protamine Hagedorn (NPH) and this was followed by metformin and glybenclamide combination therapy. Those patients who took single oral medication were mostly on metformin.

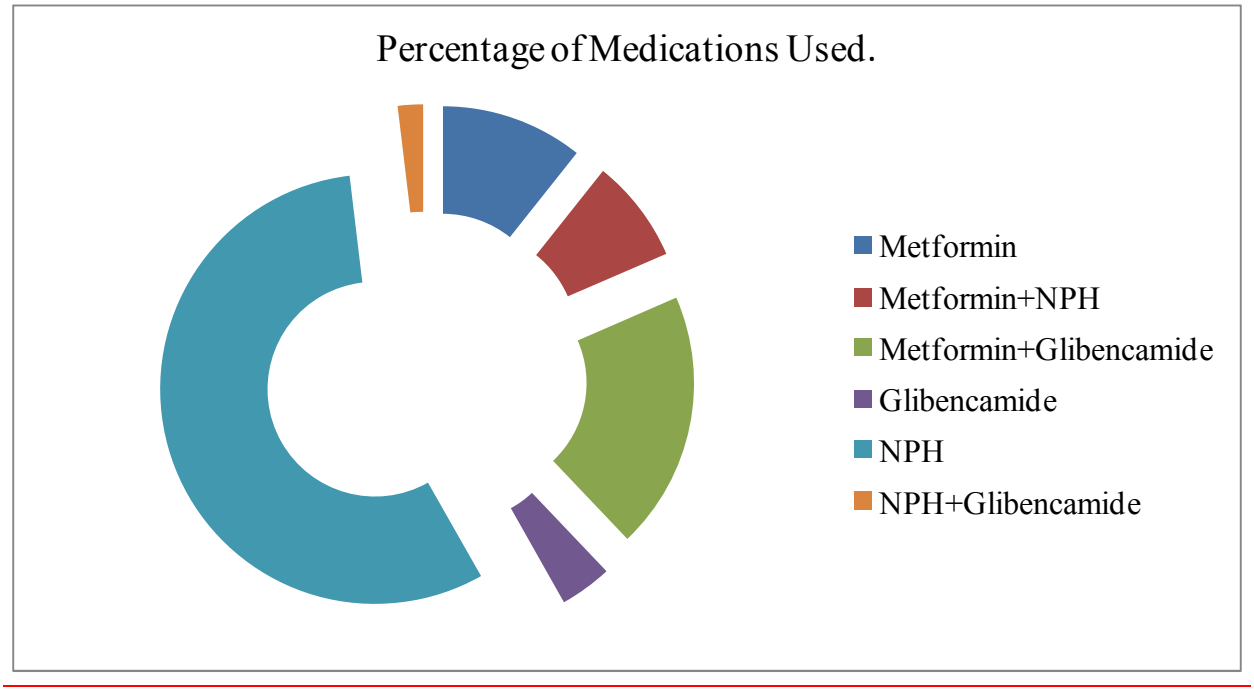


Figure 2: Percentage of Medications prescribed to patients during the study period

Among the NPH group, each patient was categorized into different sub-groups based on the oral medications they took before being switched to NPH and the result showed that 14 (24.13%) were on metformin and 44 (75.86%) were on metformin plus glibenclamide.

4.4 FACTORS AFFECTING FASTING BLOOD GLUCOSE LEVELS

The effect of gender on FBG was checked using crosstab with Pearson chi-square as a statistical tool and results in a p value of 0.600 in a 95% confidence interval. On the other hand, the relation between age and FBG of the patients was checked using a bivariate analysis with the Pearson correlation coefficient. Based on the calculation no significant association is obtained with a p value of 0.803.

Table 4: Gender and fasting blood glucose cross tabulation using 126 mg/dl as a reference point

	FBG of patients with 126 mg/dl as a reference		Total	p.
	Patients with FBG <126	Patients with FBG >126		
Gender				
Female	16	45	61	0.600
Male	13	29	42	
Total	29	74	103	

The same was done for association between FBG and body mass index. The two variables have a linear relation but there was no significant association between them (p value of 0.97). And finally cross tabulation between medications used and FBG level using Pearson chi-square as a significance test was used to look for association between the two variables. The result again shows no significant difference (p value of 0.081). The overall result is tabulated below.

Table 5: Medications used and fasting blood glucose levels with 126 mg/dl reference cross tabulation

	FBG of patients with 126 mg/dl as a reference		Total	p.
	Patients with FBG <126	Patients with FBG >126		
Medication				
Metformin	2	9	11	0.081
Metformin+NPH	0	8	8	
Metformin+Glibencamid	6	14	20	
Glibenclamide	2	2	4	
NPH	17	41	58	
NPH+Glibencamid	2	0	2	
Total	29	74	103	

4.5 KEY INFORMANT INTERVIEW

The interview included two fellows at the diabetes clinic of TASH, who are regularly available at the clinic in treating T2DM. Besides treating patients, the interviewees, pointed out that they are involved in teaching residents and undergraduate students for the past two years. In doing so they stated that the trainings they or the school gives is comprehensive towards T2DM treatment and it is not directed to a specific guideline.

For the question of what aspects of the patient do you assess during each visit, the answer was glycemic test, blood pressure, lipid control, current complaint, diet and exercise checks, any new symptoms, and medications being taken. When found appropriate, retinal and foot exams would be conducted and in female patients pregnancy plans would also be discussed. After assessing patients, their management strategy was found to be different. Whilst one preferred the ADA and CDA guide-lines, the other used the IDF guideline.

Based on the above mentioned guidelines, the medication choice was mainly metformin and combination of oral medications or in certain conditions insulin was prescribed by the physicians. After wards a question on the influence of age, gender and body weight on their medication choice was raised. One fellow answered no effect, while the other said a patient centered or individualized approach is followed. For example, some medications are avoided in female patients who are planning to get pregnant or who are currently pregnant.

They added, as far as our knowledge goes, the most commonly prescribed medications for T2DM patients are metformin and glibenclamide. The reason for this was the followed guidelines, availability and price of medications. When it comes to uncontrolled blood glucose levels, one fellow says, obesity was a factor due to insulin resistance. Gender and age were not given any relevance by both fellows. But before any change or addition was made, the physicians try to achieve the desired out come on the current medication the patient is on.

The interviewees pointed out that inadequacy of treatment for T2DM patients arise from suboptimal monitoring, patient load, and rotating physicians. Among the challenges faced by practitioners for managing T2DM patients include, among others, lack of guide-lines adopted for the setting, scarcity of blood glucose monitoring devices and medication availability.

With regard to patient related problems, lack of adherence to medications and dietary advices was cited as a major problem. In addition, absence of self-monitoring device, reliance on free medications and resistance to insulin initiation were another factors mentioned for insufficient treatment outcomes.

5. DISCUSSION

This study was primarily designed to give a picture with regard to T2DM drug therapy. Together with this the demographic characteristics and clinical characteristics of patients at the TASH diabetes clinic was also investigated. In addition, factors that could influence the fasting blood glucose levels of the patients were also studied.

With regard to patient demographic characteristics, it is important to know the source of the problem either with age, with sex or area of residency because knowing these issues have a place in choosing the appropriate treatment modality. Lack of public understanding about the disease has dangerous consequences leading to increase in prevalence, associated death and cost. This includes whether it is sudden onset or insidious, the seriousness of the disease and its relation with lifestyle.

According to the study, the first main point was the age of the patients, and the mean age of the study participants was found to be 52. In a study done in Ghana, the mean age of the patients was found to be 54.7 (Danquah *et al*, 2012), which is in line with the present study. In addition, a study conducted in Eritrea found that more than half of the patients participated in the study were more than 50 years of age with a mean age of 57.4 (Seyum *et al*, 2010).

Different age groups were formed to see if there was difference in each group and based on this the age group ranging from 40-54 accounted for the greater proportion of patients. This group enclosed the mean age of the study participants which is expected and gives an idea of the most affected section of the population. Similar result was obtained in the study in Eritrea, (Seyum *et*

al, 2010), with most of the patients being in the age group of late forties and in their fifties. In general there is an increased incidence of T2DM with increased age.

With regard to gender, different studies showed different results. In our study, 59.2% of the study participants were female. A study done in Rwanda also reported a higher incidence in females (Rudasingwa et al, 2012). A study done in India found a significantly higher incidence of T2DM in females than males (Ahmad et al, 2011). In another study, a slightly higher number was obtained in the male group as compared to the females (Majgi *et al*, 2012).

The possible reasons for this can be that females usually remain in the house limiting their physical activity, which make them prone to obesity. Obesity is one of the risk factor for developing T2DM, and in this study of all the participants who are either overweight or obese, 68.7% of them were females. Only taking the obese patients, 84.6% were females.

Urbanization and city life has been associated with a rise in T2DM (Sicree et al, 2009). Different studies show relation of type 2 diabetes with urbanization for example, it ranged from 1% in rural Uganda to 12% in urban Kenya (Hall *et al*, 2011) and from 2.6% in rural Sudan to 20.0% in urban Egypt (Bos and Agyemang, 2013). Diabetes prevalence is higher in urban, migrant and African-origin populations living abroad (Motala *et al*, 2003).

The study found that most of the patients are form Addis Ababa, which is an urban area. One common reason is the fact that the hospital is located in the city. Other reason can be the sedentary life style in the city as compared to the rural areas. And this can be associated to the

risk of obesity. This was also found in a study by Hall *et al* (2011) which suggested that the comparatively higher prevalence of T2DM recorded in urban areas was associated with a higher prevalence of obesity among the urban samples and a lower proportion reporting regular physical activity.

Investigators working in urban and peri-urban areas of South Africa have reported prevalence as high as 3-10 %,(Mbanya *et al*, 2010). This study was done in the city and most of the patients were from the city and taken together the findings lend evidence to the notion that associates T2DM with urbanization.

With regard to clinical characteristics, FBG and BMI were taken and it was found to be 153.99 mg/dl and 26.368, respectively. The fasting blood glucose level was above what is recommended by the IDF and the BMI was within the category of overweight. In similar studies, a mean FPG of 149.88 mg/dl was found in Ghana (Danquah *et al*, 2012) and 24.2 +/- 4.7 of BMI were obtained in a study by Ramachandran *et al.* (2008).

The diabetes clinic at TASH does not have its own standard treatment guideline. The physicians use their previous experience and other guidelines. The study collected the data and compared it with the international diabetes federation guideline. According to the guideline the first line treatment is metformin with sulfonylurea as an alternative. In this study, similar finding was shown, with metformin placed as the first choice medication, with sulfonylurea being the second choice.

Most of the T2DM patients were on NPH. This drug is placed as a last resort, when single and combination oral anti-diabetes drugs cannot achieve the desired therapeutic goal, according to the IDF guidelines. This shows that most patients either started using medication a long time ago or they were not responding to other medications as desired. This argument is supported by the finding that the mean age of patients on NPH which was 50 years. The mean age of the total study participants was 52 years.

The charts of the patients who were on NPH were reevaluated to check previous medications used in order to identify the most commonly used oral agents before they were placed on NPH. It was found that metformin and metformin plus glibenclamide were used as first and second most commonly prescribed agents, respectively, which is in line with the IDF guideline.

Oral hypoglycemic drugs are the first intervention for T2DM patients. IDF treatment guideline is somewhat followed on patients receiving treatment in TASH. This is said because there is a disparity in medication choice there are some patients who are on sulfonylurea only and on metformin only. This variation could arise from individual physician choice, availability issue, cost wise preference, personal experience, lack of a standardized treatment guideline or patient related factors e.g. drug side effects or co-morbid conditions.

An attempt was made to see if there was any significant effect on FBG by different factors including age, sex, BMI and medications used. But, the analysis fails to indicate any one significant factor for the high levels of FBG among the patients. Possible reason can be poor regimen adherence, especially for diet and exercise. Peyrot *et al*, 2005 put forward a reason for

poor outcome including patients psychological problems that affected diabetes self-care, and lack of resources to manage these problems. And according to Stratton *et al*, 2000 these uncontrolled blood sugar levels of the study participants can also lead to the various diabetes associated complications.

In collaboration with the response obtained from our key informants, other studies also put forward the reasons for poor outcome and improvement strategies. Alhyas *et al*, (2013) and Duran *et al*, (2008) stresses the role of primary care should be reinforced and strengthened regarding the management of T2DM. And the role of feedback should be magnified from the patient side, because it provides an important tool for improvement (Guldberg *et al*, 2009).

Although the study was relevant and provided crucial information it has its own limitations. These include the small sample size, the short study period, using only a one point FBG for recording patient outcome. In addition, the results would have been strengthening if it had included instrument to assess the patient side of the problem.

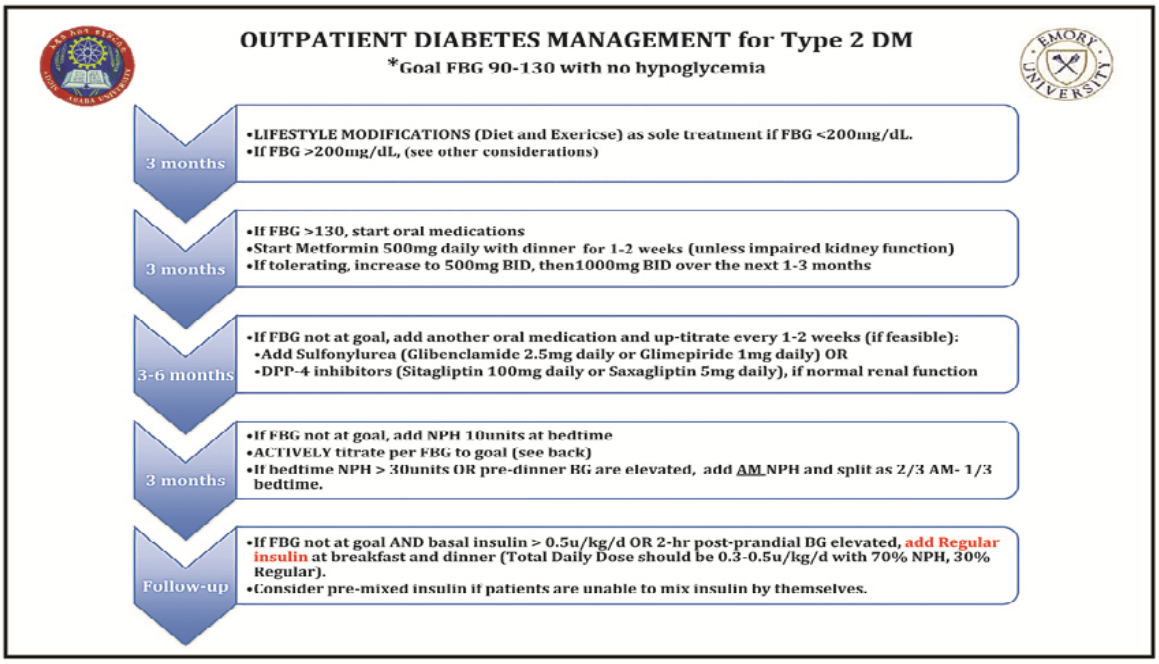
6. CONCLUSION

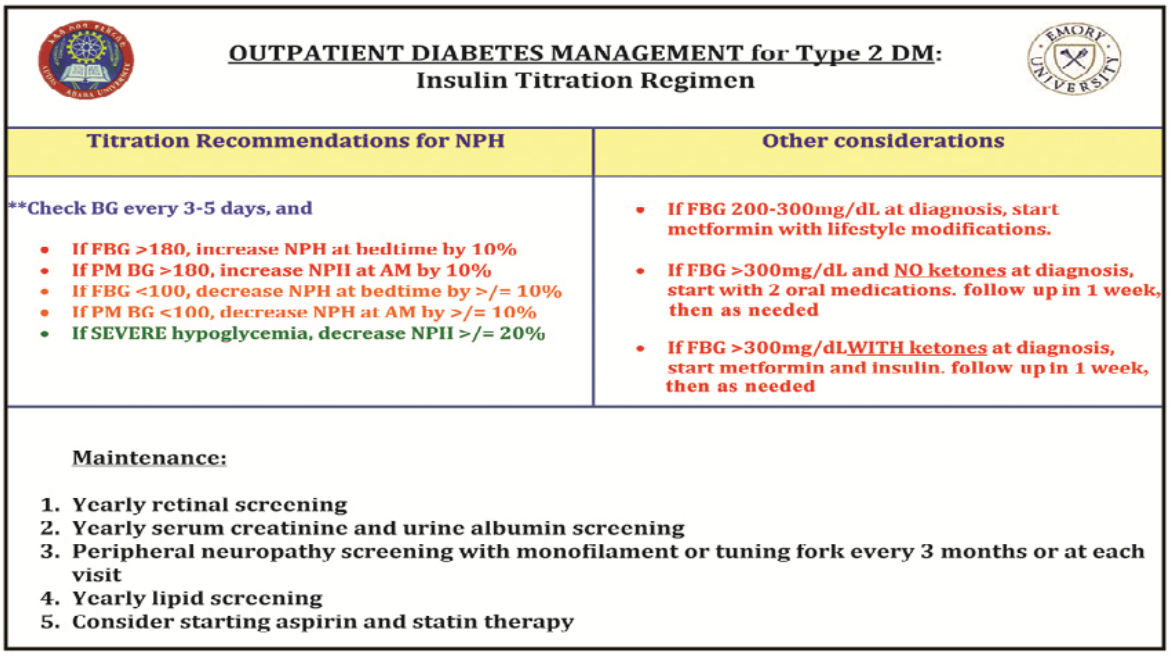
In general, the study tried to address issues related to drug therapy of T2DM, patient demographics, and clinical characteristics. And in conclusion the first choice of drug therapy is metformin, while most of the patients were on NPH. Most patients fell under overweight category with a higher blood glucose level than the one put by the IDF. Demographically most of the patients were females and the mean age was found to be above 50 years of age. The drug therapy at the TASH diabetes clinic follows the recommendation made by IDF. One thing to note is the FBG of the patients is higher than the recommended level.

7. RECOMMENDATION

As a recommendation work needs to be done on patient education, with regard to life style modification and patient perception of the disease. With regard to having a standard treatment guideline, it is highly suggested for future treatment as it avoids confusion and makes treatment at the diabetes center uniform. In addition, pharmacists can act as educators and patient advocates and establish patient-specific goals to increase medication effectiveness, adherence to a medication regimen, and minimize the likelihood of adverse events (Grossman, 2011). And I strongly recommend a hiring of a pharmacist whose work focusing on the diabetes clinic

After the completion of the study the diabetes clinic in TASH have developed specific guideline for treating diabetes patients in both inpatient and outpatient setting. The guideline is provided below.





INPATIENT DIABETES MANAGEMENT

*GOAL BG while hospitalized= 140-180 with NO hypoglycemia
**BG should be checked Q6h
***ACTIVELY titrate insulin to goal

TYPE 1 DIABETES	**IF NPO or poor PO intake:** • Give 60% of home NPH dose • Hold scheduled Regular insulin dose • Start Sliding Scale Insulin (SSI) with Regular insulin (see back) **IF TAKING GOOD PO:** • Continue NPH at home dose and titrate according to suggested regimen (see back) • Continue Regular insulin at home dose **NEVER STOP INSULIN!** **ACTIVELY MONITOR BG AND TITRATE DAILY, AS NEEDED!**
TYPE 2 DIABETES ON ORALS ONLY (at home)	**IF UNSTABLE OR CRITICALLY ILL:** • Stop all oral diabetes medications (ie metformin, sulfonylureas) • Start SSI with Regular insulin • Evaluate insulin needs over 48-72hrs and consider switching to NPH (0.1-0.2u/kg/day split 2/3 qam and 1/3 qpm) as needed • Consider continuing insulin on discharge based on pre-admission and in-hospital control • Can resume oral diabetes medications on discharge if good pre-admission control **IF STABLE:** • Continue home dose of oral medications • Supplement with Regular insulin SSI
TYPE 2 DIABETES ON INSULIN (at home)	**IF UNSTABLE OR CRITICALLY ILL:** • Stop any oral diabetes medications (ie metformin, sulfonylureas), if on orals at home • Continue home dose of NPH at 50% and discontinue any previously scheduled Regular insulin • Start SSI/correctional with Regular insulin until eating and stable. THEN switch to scheduled Regular insulin, as needed • Up-titrate NPH as needed. • Consider continuing insulin on discharge based on pre-admission and in-hospital control. **IF STABLE:** • Continue home dose of oral diabetes medications and insulin if medically stable and eating well. **TITRATE DAILY, AS NEEDED!**
NEW-ONSET HYPERGLYCEMIA (NOT Newly diagnosed Type 1 DM)	• Initiate SSI with Regular insulin Q6h (see back) • Monitor insulin requirements over 48-72hrs with SSI • Transition to scheduled NPH insulin as needed: ○ 0.1-0.2u/kg/d of NPH

INPATIENT DIABETES MANAGEMENT:
Insulin titration regimens

Sliding Scale Insulin (Regular Insulin)	Insulin Titration Regimen (NPH)
• If BG 180-199, GIVE 2 UNITS • If BG 200-249, Give 3 UNITS • If BG 250-299, Give 4 UNITS • If BG 300-349, Give 5 UNITS **CALL Resident or Endocrinology Fellow if BG >350	• If FBG >180, increase NPH at bedtime by 10% • If PM BG >180, increase NPH at AM by 10% • If FBG <100, decrease NPH at bedtime by >/= 10% • If PM BG <100, decrease NPH at AM by >/= 10% • If SEVERE hypoglycemia, decrease NPH >/= 20%

Other considerations:

1. Monitor kidney function throughout hospitalization. Impaired renal disease will decrease insulin clearance.
2. Consult Endocrinology service for any pre-op consultations.

REFERENCES

Abubakari1 A. R., Lauder W, Agyemang C, Jones M, Kirk A and Hopal R. S (2008). Prevalence and time trends in obesity among adult West African populations: a meta-analysis. *Obes rev* (2008) 9, 297–311

ADA, American Diabetes Association (2009). Diagnosis and classification of diabetes mellitus. *Diabetes Care* **32**(1)

ADA, American Diabetes Association (2011), Standards of Medical Care in Diabetes. *Diabetes care* **34**(1)

Akhter A, Fatema K, Afroz1A, Bhowmik B, Ali L and Hussain A (2011). Prevalence of Diabetes Mellitus and its Associated Risk Indicators in a Rural Bangladeshi Population. *Open Diabetes J* **4**: 6-13

Ahmad J, Masoodi M A, Ashraf M, Rashid R, Ahmad R, Ahmad A and Dawood S (2011). Prevalence of Diabetes Mellitus and Its Associated Risk Factors in Age Group of 20 Years and Above in Kashmir, India *Al Ame en J Med S c i* **4** :3 8 -4 4

Ahmad Z and Pervaiz M K (2006). Risk Factors and Diabetes Mellitus (Statistical Study of Adults in Lahore, Pakistan). *Journal of Statistics* **13**(1): 46-66

Alhyas L, Nielsen J.D.J., Dawoud D, Majeed A (2013). Factors affecting the motivation of healthcare professionals providing care to Emiratis with type 2 diabetes. *J R Soc Med Sh Rep* **4**:14

Barquera S, Campos-Nonato I, Aguilar-Salinas C, Lopez-Ridaura R, Arredondo A and Rivera-Dommarco J (2013). Diabetes in Mexico: cost and management of diabetes and its complications and challenges for health policy. *Globalization and Health* 2013, 9:3

Bos M and Agyemang C (2013). Prevalence and complications of diabetes mellitus in Northern Africa, a systematic review. *BMC Public Health* **13**:387

Brown DL, Brillon D (1999). New directions in type 2 diabetes Mellitus: an update of current Oral antidiabetes therapy. *J Natl Med Assoc*. **91**:389-395.

Burger KNJ, Beulens JWJ, van der Schouw YT, Sluijs I, Spijkerman AMW, et al. (2012). Dietary Fiber, Carbohydrate Quality and Quantity, and Mortality Risk of Individuals with Diabetes Mellitus. *PLoS ONE* **7**(8): e43127.

CADRE, The council for the advancement of diabetes research and education (2004). *The Handbook of Diabetes Management*. **02**:007-028

CDA, Canadian Diabetes Association (2008). Definition, Classification and Diagnosis of Diabetes and Other Dysglycemic Categories. Canadian Diabetes Association Clinical Practice

Guidelines Expert Committee. Available at https://www.**diabetes**.ca/files/cpg2008/cpg-2008.pdf Viewed July 12*, 2013*

Chang C L. T., Lin Y, Bartolome A P., Chen Y, Chiu S and Yang W (2013). Herbal Therapies for Type 2 Diabetes Mellitus: Chemistry, Biology, and Potential Application of Selected Plants and Compounds. *Evid-Based Compl Alt* Volume 2013, Article ID 378657, 33 pages

Conget I (2002). Diagnosis, Classification and Pathogenesis of Diabetes Mellitus. *Rev Esp Cardiol* **55**(5):528-35

Deerochanawong C and Ferrario A (2013). Diabetes management in Thailand: a literature review of the burden, costs, and outcomes. *Globalization and Health* 2013, 9:11

DACA, drug administration and control authority of Ethiopia (2010). Standard treatment guidelines for zonal hospital, first edition January, 2010.

Danquah I, Bedu-Addo G, Terpe K, Micah F, Amoako Y A , Awuku Y A, Dietz E, Giet M, Spranger J and Mockenhaupt F P (2012). Diabetes mellitus type 2 in urban Ghana: characteristics and associated factors. *BMC Public Health* **12**:210

Duran A, Runkle I, Matía P, MiguelM P, Garrido S, Cervera E, Fernandez M D, Torres P, Lillo T, Martin P, Cabrerizo L, Torre N G, Calle J R, Ibarra J, Charro A L and Calle-Pascual A L

(2008). Family physician and endocrinologist coordination as the basis for diabetes care in clinical practice. *BMC Endocrine Disorders* **8**:9

Grossman S (2011). Management of type 2 diabetes mellitus in the elderly: role of the pharmacist in a multidisciplinary health care team. *J Multidiscip Healthc* 2011:4 149–154

Guldberg T L, Lauritzen T, Kristensen J K and Vedsted P (2009). The effect of feedback to general practitioners on quality of care for people with type 2 diabetes. A systematic review of the literature. *BMC Fam Pract* **10**:30

Hall V, Thomsen R W, Henriksen O and Lohse N (2011). Diabetes in Sub Saharan Africa 1999-2011: Epidemiology and public health implications. A systematic review. *BMC Public Health* **11**:564

Holmer HK, Ogden LA, Burda BU, Norris SL (2013) Quality of Clinical Practice Guidelines for Glycemic Control in Type 2 Diabetes Mellitus. *PLoS ONE* 8(4): e58625.

IDF, Internation Diabetes Federation (2012). Global guideline for type2 diabetes. Available at www.idf.org/sites/default/files/IDF%20T2DM%20Guideline.pdf, viewed July 12, 2013.

IDF, International Diabetes Federation (2013). International Diabetes Federation: IDF Diabetes Atlas. 5th edition. Brussels, Belgium.

Jayawardena R, Ranasinghe P, Byrne NM, Soares MJ, Katulanda P and Hills AP (2012). Prevalence and trends of the diabetes epidemic in South Asia: a systematic review and meta-analysis. *BMC Public Health* 2012, 12:380

Kaku K (2010). Pathophysiology of Type 2 Diabetes and Its Treatment Policy. *JMAJ* **53**(1): 41–46

Kang H (2012). Current therapeutic agents and anesthetic considerations for diabetes mellitus *Korean J Anesthesiol* 63(3): 195-202.

LaSalle J R., Berria R (2013). Insulin Therapy in Type 2 Diabetes Mellitus: A Practical Approach for Primary Care Physicians and Other Health Care Professionals. *J Am Osteopath Assoc.* **113**(2):152-162

Mahler RJ and Adler M L (1999). Type 2 diabetes mellitus: update on diagnosis, Pathophysiology, and treatment. *J Clin Endocrinol Metab* **84**(4): 1165-1171

Majgi SM, Soudarssanane BM, Roy G, Das AK (2012). Risk Factors of Diabetes Mellitus in Rural Puducherry. *Online J Health Allied Scs.* **11**(1):4

Mbanya J.C. N, Motala A.A., Sobngwi E, Assah F.K., Enoru S.T. (2010). Diabetes in sub-Saharan Africa. *Lancet* **375**: 2254–66

Motala A A., Omar M A.K. and Pirie F J. (2003). Epidemiology of Type 1 and Type 2 Diabetes in Africa. *European Journal of Cardiovascular Risk* **10**(2): 77-83

Naing C, Mak J W, Ahmed S I, Maung M (2012). Relationship between hepatitis C virus infection and type 2 diabetes mellitus: Meta-analysis *World J Gastroenterol* **18**(14): 1642-1651

OÈ STENSON C-G (2001). The pathophysiology of type 2 diabetes mellitus: an overview. *Acta Physiol Scand* **171**: 241-247

Olokoba AB., Obateru OA., Olokoba LB (2012). Type 2 Diabetes Mellitus: A Review of Current Trends. *Oman Med J* **27**(4): 269-273

Peyrot M., Rubin R. R., Lauritzen T., Snoek F. J, Matthews D. R. and Skovlund S. E. (2005). Psychosocial problems and barriers to improved diabetes management: results of the Cross-National Diabetes Attitudes, Wishes and Needs (DAWN) Study. *Diabet. Med*. **22**:1379–1385

Ramachandran A, Simon Mary, Annasami Y, Narayanasamy M, Chamukuttan S (2008). High prevalence of diabetes and cardiovascular risk factors associated with urbanization in India. *Diabetes Care* **31**:893–898

Rudasingwa G J, Amendezo E, and Twagirumukiza M (2012). Clinical patterns and complications of African diabetes patients: preliminary data from Kigali University Teaching Hospital, Rwanda. *African Journal of Diabetes Medicine* **20**(2):39-42

Segura-Egea JJ, Castellanos-Cosano L, Machuca G, López-López J, Martín- González J, Velasco-Ortega E, Sánchez-Domínguez B 1, López-Frías FJ (2012). Diabetes mellitus, periapical infl ammation and endodontic treatment outcome. *Med Oral Patol Oral Cir Bucal* **17**(2):e356-61.

Seyum B, Mebrahtu G, Usman A, Mufunda J, Tewolde B, Haile S, Kosia A, Negassi E (2010). Profile of patients with diabetes in Eritrea: results of first phase registry analyses. *Acta Diabetol* **47**:23–27

Sheehan MT (2003). Current Therapeutic Options in Type 2 Diabetes Mellitus: A Practical Approach. *Clin Med Res* 1(3): 189-200.

Sicree R, Shaw J, Baker P Z (2009). The Global Burden Diabetes and Impaired Glucose Tolerance. IDI Heart and Diabetes Institute IDF Diabetes Atlas fourth edition. Available at https://www.idf.org/sites/default/files/The_Global_Burden.pdf*, Viewed July 12, 2013.*

Smushkin G, Vella A (2010). What is type 2 diabetes? *Medicine (Baltimore). Author manuscript; available in PMC* 38(11): 597–601.

Solli O, Jenssen T, Kristiansen IS (2010). Diabetes: cost of illness in Norway. *BMC Endocr Disord* **10**:15

Stenson c . - g . Oè (2001). The pathophysiology of type 2 diabetes mellitus: an overview. *Acta Physiol Scand* 2001, 171, 241±247

Stratton I M, Adler A I, Andrew H, Neil W, Matthews D R, Manley S E, Cull CA, Hadden D, Turner RC, Holman RR (2000). Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study *BMJ* **321**:405–12

Tfayli H and Arslanian S (2009). Pathophysiology of type 2 *diabetes mellitus* in youth: the evolving chameleon. *Arq Bras Endocrinol Metabol* **53**(2): 165–174.

Tsang MW (2012). The Management of Type 2 Diabetes Patients with Hypoglycaemic Agents. *ISRN Endocrinol* volume 2012: 9 pages.

Valitutto M (2008). Common crossroads in diabetes management. *Osteopath Med Prim Care* 2008, 2:4

Wahab KW, Sani MU, Yusuf BO, Gbadamosi M, Gbadamosi A, Yandutse MI (2011). Prevalence and determinants of obesity - a cross-sectional study of an adult Northern Nigerian population. *Int Arch Med* 2011, 4:10

WHO, World Health Organization (1999). Definition, Diagnosis and Classification of Diabetes Mellitus and its Complications. Report of a WHO Consultation. Available at whqlibdoc.who.int/hq/1999/who_ncd_ncs_99.2.pdf, Viewed July 12, 2013.

Wild S, Roglic G, Green A, Sicree R, King H (2004). Global Prevalence of Diabetes, Estimates for the year 2000 and projections for 2030. *Diabetes Care* 27:1047–1053

Annex 1

DATA ABSTRACTION FORMAT

NO.	CARD NO.	AGE	SEX	RESIDENCY	FBG (MG/DL)	WEIGHT (KG)	HEIGHT (M)	BMI (KG/M^2)	MEDICATION USED

Annex 2

Key Informant Interview on Type 2 diabetes drug therapy

First of all, thank you for agreeing to participate on this interview. My name is Alemseged Ayele. I will be talking with you today regarding Type 2 diabetes drug therapy. The main purpose of this interview will be to learn more about the professionals' existing experience and practice in the diabetes clinic of Tikur Anbessa Specialized Hospital. The confidentiality regarding the following interview will be strictly maintained. At any time during our interview, please feel free to let me know if you have any questions or we can stop the interview at any time for any reason. The interview will take about 30minutes.

1. Background Information

I will like to ask you some questions about yourself and your current job.

Age _____

Sex _____

Can you tell me your current educational level? _____

What is your current position at the diabetes clinic? What are your major responsibilities at the current position?

_____

_____

Year of experience working at the unit _____

I will like to get some information about professionals working within the unit

How many physicians are currently working within the clinic? _____

How many interns, residents, fellows, attending physicians are there in the unit?

_____

In your opinion does the medical school training include a comprehensive training on type 2diabetes treatment or are there subsequent trainings? If yes, are there any specific guidelines?

_____

2. Conceptual Questions

What aspects of the patient do you assess during each visit? Does it include laboratorial, physical and psychological and if yes how?

Do you think the presence uncontrolled blood glucose levels based on the gender, age difference and body weight? If yes, which category of patients tends to do so?

How do you manage Type 2 diabetes patients? Do you follow a specific guideline? If yes, please specify?

Regarding the pharmacological treatment of type 2 diabetes, what do you prescribe as a first line drug? And what is the rationale behind your choice?

Does your choice of medication depend up on age, gender and body weight?

If yes please explain your reason.

As far as you know what is the most commonly prescribed medication for type 2 diabetes patients and the reason behind this?

With respect to blood glucose levels, what do you think the cutoff points for changing or adding another medication?

---

3. **Barriers form Physician Perspective**

What do you think the possible challenges faced for the management of type 2 diabetes within the unit? What are potential solutions for such challenges?

_____
_____

What are the possible reasons for inadequacy of treatment?

_____
_____

What are the possible patients' related barriers for type 2 diabetes treatment within your unit?

_____
_____

Any other points you wish to communicate regarding type 2 diabetes and its management?

_____
_____

Thank you very much for you time and willingness to answer these question.