College of Health Sciences

School of Pharmacy

Clinical Characteristics, Management Practices and Outcomes among Hospitalized Patients with Diabetes at Three Tertiary care Hospitals , Addis Ababa, Ethiopia

A study Submitted to the Department of Pharmacology and Clinical Pharmacy, School of Pharmacy, College of Health Sciences, Addis Ababa University in Partial Fulfillment for the Requirements of Master of Science Degree in Pharmacy Practice.

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This is to certify that the thesis prepared by Yonas Demissie, entitled: "**Clinical Characteristics, Management Practices and Outcomes among Hospitalized Patients with Diabetes at Three Tertiary care Hospitals, Addis Ababa, Ethiopia: Prospective observational study**" and submitted in partial fulfillment of the requirements for the Degree of Master of Pharmacy in Pharmacy Practice, complies with the regulations of Addis Ababa University and meets the accepted standards regarding originality and quality.

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Abbreviations and Acronym

ACEI-Angiotensin Converting Enzyme Inhibitor

ADA-American Diabetic Association

ADF-Acute Decompensated Heart Failure

AHR-Adjusted Hazard Ratio

AKI-Acute Kidney Injury

AOR-Adjusted Odds Ratio

ARB-Angiotensin Receptor Blocker

BB-Beta Blocker

BMI-Body Mass Index

BP-Blood Pressure

BSC-Bachelor of Science

CCB-Calcium Channel Blocker

CGM-Continuous Glucose Monitoring

CI-Confidence Interval

CKD-Chronic Kidney Disease

CLD-Chronic Liver Disease

COPD-Chronic Obstructive Pulmonury Disease

COVID-19-Corona Virus Disease-19

dBP-Diastolic Blood Pressure

DFU-Diabetic Foot Ulcer

DKA-Diabetic keto acidosis

DM-Diabetes mellitus

DNP-Diabetic Nephropathy

DPP4I-Diapepidyl Peptidase 4 Inhibitors

DVT-Deep Vien Trombosis

FMOH-Federal Ministry Of Health

HAART-Highly Active Antiretroviral Therapy

HAP-Hospital Acquired Pnuemonia

HDL-High Density Lipoprotein

HgA1c- Hemoglobin A1c.

HHS-Hyperosmolar Hperglycemic state

HIV- Human Immunodeficiency Virus

HMIS-Health Management Information System

ICU-Intensive care unit

IDF-International Diabetic Federation

IHD-Ischemic Heart Disease

INT$-International dollars

IQR-Inter Quartile Range

LDL-Low Density Lipoprotein

MI-Myocardial Infarctions

MST-Midian Survival Time

NICU-None Intensive Care Unit

NPH-Neutral Protamine Hagedorn

NPO-Nothing Per Oral

OAD-Oral Antidiabetic Drugs

PAD-Peripheral Arterial Disease

PNP-Peripheral Neuropathy

POC-BGM-Point Of Care Blood Glucose Monitoring

PPSV23-Pnuemoccocal Polysacharide Vaccine23

RBS-Random Blood Sugar

S.CAP-Sever Community Acquired Pneumonia

sBP-Systolic Blood Pressure

SGLT2I-sodium glucose cotransporter 2 inhibitors

SMBG-Self Monitoring Blood glucose

SOB-Shortness Of Breath

SPMMC- Saint Paul's Millennium Medical College

SSI-Sliding Scale Insulins

SU-SulphonylUrea

T2DM-Type 2 Diabetes Mellitus

TASH-Tikur Abesa specialized Hospital

TC-Total Cholesterol

TG-Tireglyceride

UK-United kingdom

USA-United states of America

USD-United State Dollar

UTI-Urinary Tract Infection

WHO-World Health Organization

ZMH-Zewditu Memorial Hospital

Abstract

Back ground: Diabetes is a rapidly growing global health concern, with approximately 537 million adults affected in 2021, projected to increase to 784 million by 2045. This condition not only leads to high morbidity but significantly raises the risk of severe complications, such as cardiovascular disease, infections, cancer, and lower-extremity amputations, all of which increase the likelihood of hospitalization. Despite the known burden, limited data exist on the clinical characteristics, management practices, and outcomes of hospitalized diabetes patients.

Objective: To assess the clinical characteristics, management practices, and outcomes of individuals with diabetes mellitus (DM) admitted to the internal medicine wards of Tikur Anbessa Specialized Hospital (TASH), Zewditu Memorial Hospital (ZMH) and St. Paul's Hospital Millennium Medical College (SPHMMC) from 15-Jully-2023 to 29-February-2024.

Method A hospital-based multicenter prospective observational study was conducted. A consecutive sampling technique was used to include all eligible patients with DM who met the inclusion criteria during the study period. Kaplan-Meier survival analysis and Cox proportional regression were used to analyz the data. A $p < 0.05$ was considred to declare statistical significance.

Result: A total of 398 patients with DM were included in the final analysis. Among these, more than half (n=219, 55%) were male ,nearly half (n=210, 52.8%) used health insurance and two-third (n=247,62.1%) maintained an active lifestyle.The most common admission diagnosis included severe community-acquired pneumonia (S.CAP) at 12.6%, acute kidney injury on chronic kidney disease (AKI on CKD) at 8.5%, and acute decompensated heart failure (ADHF) at 8.5%. Most DM patients (n=355, 89.2%) had at least one comorbidity, with hypertension being the most common (n=244, 61.3%). Additionally, 249 patients (62.6%) experienced at least one chronic complication related to diabetes, such as diabetic neuropathy (DNP), peripheral neuropathy (PNP), and chronic kidney disease (CKD).Nearly half (n=187, 47.1%) achieved acceptable blood glucose control ,defined as hemoglobin A1c (HbA1c) ≤7%) ,prior to hospitalization and 59.5% not achieved target blood glucose level (random blood sugar, RBS) during hospital stay. During their hospital stay, 189 patients (47.5%) developed complications, with AKI being the most common at 13.1%. The overall hospital expenditure was $166,074.14, averaging $417.27 per individual. While 340 participants (85.4%) were discharged with improvement, 30 (7.5%) died, primarily type 2 DM patients (n=26, 7.9%). The analysis revealed that 50% of patients with more than three comorbidities did not experience the event during the follow-up period, compared to those with three or fewer comorbidities

(logrank p = 0.002). Patients admitted with acute hemorrhagic stroke had a midian survival times (MST) of 23 days , which is shorter than the 55 days for those without this diagnosis (logrankp = 0.002).
Cox proportional hazards regression analysis revealed that Known diabetes patients had a 4.59((AHR = 4.59, 95% CI: 0.41–50.84; p = 0.214) fold increased risk of death compared to newly diagnosed individuals, while those with more than three comorbidities exhibited a 5.5(AHR = 5.50, 95% CI: 1.96–15.40; p = 0.001)fold increased risk. Statistically significant risks were observed in patients admitted with sepsis (AHR =7.98, 95%CI: 2.44-26.14;p = 0.001) or acute hemorrhagic stroke (AHR =4.54,95%CI: 1.07-19.24; p = 0.040). Additionally, developing urinary tract infections (UTI) during hospitalization was associated with a 6.87-fold increased risk of death (AHR=6.87,95%CI: 1.63-29.02;p = 0.009). Notably, patients failing to achieve target blood glucose levels had a 3.63-fold higher mortality risk (AHR=3.63,95%CI: 1.12-11.76;p = 0.032).

Conclussion:This study highlighted the critical role of admission diagnosis, glycemic control, and in-hospital complications in influencing mortality outcomes for patients with diabetes in Ethiopia.Effective glycemic monitoring and management during hospitalization are essential to mitigate risks and improve survival rates. A targeted approach addressing these factors is crucial for enhancing patient outcomes.

Key words: Clinical Characteristics, Management practice, Outcome , Diabetes Patients, Ethiopia

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1. Introduction

1.1 Background

Diabetes mellitus (DM), also known as "diabetes," is a common chronic endocrine condition and one of the three illnesses with the fastest growing worldwide, along with cancer and cardiovascular disease.[1] According to the International Diabetes Federation's(IDF) 10th edition, approximately 537 million individuals aged 20 to 79 had diabetes in 2021, projected to rise to 784 million by 2045. The Middle East and North Africa are expected to see the highest prevalence, with cases increasing from 72.7 million to 135.7 million. In Africa, the number of people with diabetes is anticipated to grow from 23.6 million to 54.9 million. Country-specific data shows that Pakistan had the highest proportion of diabetes, with 30.8% affected in 2021, rising to 33.6% by 2045. In Egypt, the prevalence was 20.9% in 2021, projected to reach 23.4% by 2045.[2] A 2019 systematic review reported the prevalence of diabetes in Ethiopia ranging from 2% to 6.5%.[3]

The increased prevalence of DM can be attributed to a variety of factors, many of which reflect both advances in healthcare,population increase and changes in lifestyle. People with diabetes are generally living longer than before, thanks to a better understanding of the disease and improvements in treatment. Despite the ongoing burden of illness and death due to traditional complications of DM, such as acute metabolic disturbances and microvascular and macrovascular diseases, the incidence rate is declining. This is largely due to the comprehensive understanding of the relationship between diabetes and its negative health impacts, which has led to the development and implementation of primary and secondary preventive guidelines. Furthermore, advancements in diabetes management, including the innovation of novel antidiabetic medications, and improvements in key population risk factors such as hypertension, smoking, and the consumption of saturated and trans fats have also contributed to this decline[4-7] .For instance, heart failure, which is commonly seen in patients with type 2 diabetes, has historically been linked to a tenfold increase in diabetes-related mortality. However, the introduction of Sodium-Glucose Cotransporter-2 Inhibitors (SGLT2I) has significantly reduced this risk.[8]

Nevertheless, the extended life expectancy of diabetes patients comes with new challenges, as they increasingly experience complications beyond the conventional issues associated with the disease. These complications include a higher risk of certain cancers, dementia, functional and emotional impairments, liver disease, and an increased susceptibility to infections. [9] The situation is particularly serious in low

and middle income countries, where the prevention of conventional DM complications is often poorly implemented, and the adoption of a Westernized lifestyle characterized by poor dietary habits, reduced physical activity, and increased stress exacerbates the problem. [4]

Moreover, managing DM patients who are admitted to the hospital with new medical illnesses in addition to their conventional complications presents significant complexity to healthcare professionals due to several factors.[10] The meal schedules of hospitalized diabetic patients can vary due to different factors, including 'nothing by mouth' (NPO) orders for surgical procedures, reduced appetite from acute illness, and increased insulin resistance caused by the release of counter-regulatory hormones in response to acute illness, inflammation, and decreased activity levels. Additional factors include the administration of medications that can raise blood glucose (e.g., corticosteroids), intravenous fluids containing dextrose, delays in administering diabetes medications by nursing staff, parenteral and enteral nutrition orders, and the failure to adopt and implement an appropriate blood glucose monitoring protocol or select an optimal diabetes medication regimen.[10-14]

Hospital-acquired hyperglycemia or hypoglycemia can occur in diabetic patients due to the aforementioned factors, and both can negatively impact patients prognosis. For example, hyperglycemia can lead to delayed wound healing, slower recovery from infections, increased risk of thrombosis, in-hospital complications, longer length of stay, and even death[15] .On the other side, hypoglycemia may be a sign of illness severity and clinical condition decline of the patient on the top of prolong hospital stay, increased mortality risk, increased cost of hospitalization. For example, the 2021 report from the IDF 10th edition highlighted that 6.7 million people aged 20-79 globally died from diabetes-related conditions. Notably, working individuals between the ages of 20 and 60 were disproportionately affected, with 306,000 deaths. Moreover, the direct medical costs associated with diabetes saw a significant increase, rising from 232 billion USD in 2017 to 966 billion USD in 2021[2].Improving in hospital blood glucose control had showed to decrease the above adverse health outcomes[16].Despite this ,the clinical characteristics ,management practice and outcomes were not well studied .So this study amid to assess the clinical characteristics,management practices and outcomes.

1.2. Statement of the problems

People with diabetes face an increased risk of hospitalization and subsequent adverse effects. In 2021, an estimated 6.7 million adults aged 20 to 79 worldwide died as a result of diabetes or its complications[2].In

Germany within the same year, reports indicated that 864,691 (32.6%) diabetes-related hospitalizations were due to peripheral arterial disease(PAD) out of a total of 2,654,871 admissions. Of these patients, 295,788 (34.3%) underwent amputations, compared to 335,437 (18.8%) patients without diabetes. Additionally, 29.76% of 261,260 diabetes patients developed other complications, such as AKI and myocardial infarctions (MI),compared to 22.43% of 400,209 patients without diabetes[17].Additionally, diabetes patients with MI had a higher hospitalization rate, totaling 1,007,326 (30.5%), as reported by Schmitt et al. in 2020. These patients experienced a greater incidence of adverse hospital events compared to those without diabetes, with higher rates of mortality, subsequent MI, and AKI: 13.2% vs. 12.1% ($P < 0.00$), 0.8% vs. 0.6% ($P < 0.001$), and 8.6% vs. 5.2% ($P < 0.001$), respectively[18]. This trend is observed in other countries as well; for example, in Taiwan, 27,473 diabetes patients were admitted due to diabetes-related problems, resulting in additional complications such as amputations and cardiovascular events[19]. In Spain, 619,188 diabetes patients were hospitalized in various wards in 2015, with a mortality rate of 10% among those in medical wards[20]. Higher mortality rates have also been reported in developing countries, such as Nigeria, where the mortality rate among hospitalized diabetes patients reached 32.5%[21], and Egypt, where 26.9% of diabetes patients died in 2021[22].Diabetes patients face not only the challenges of managing their condition but also an increased risk of hospitalization-related health issues.From 1998 to 2011 in the United kingdom(UK), individuals with type 1 and type 2 diabetes had an elevated risk of developing dementia[23].Similarly in Brazil, 313,273 adult hospitalizations for diabetes in 2014 accounted for 4.6% of all adult hospitalizations, costing approximately 264.9 million international dollars (Int$), which is 19% more than for hospitalizations without diabetes[24]. In the USA, hospitalization costs for diabetes patients totaled over $848 million in 2008, with those developing hypoglycemia incurring greater cumulative costs and longer hospital stays[25]. A 2009 other study in this country found that 8,234 hospitalized patients developed laboratory evidence of hypoglycemia after 24 hours, while 3,923 patients (from 8,971 encounters) showed signs of hypoglycemia within the first 24 hours. This group incurred higher cumulative costs, with a mean of $85,905 and a median of $33,446, compared to those without low blood glucose symptoms, who had a mean cost of $54,038 and a median of $17,609 ($P < 0.001$). Additionally, patients who experienced hypoglycemia had prolonged hospital stays and a higher mortality rate than those who did not develop this condition[26]. Despite the prevalence of these issues, many diabetes patients are admitted for reasons unrelated to their diabetes, resulting in insufficient attention to diabetes management. This neglect can lead to elevated and low blood glucose levels, contributing to adverse outcomes[27]. For instance, a study in the USA found that of 3,613 admitted diabetes patients, 84% were prescribed sliding scale

insulin(SSI), while only a small percentage received a standing insulin regimen or oral antidiabetic drug(OAD). Elevated blood glucose levels were detected in 82.5% of these patients, but treatment adjustments were made only in 22% of hospital stays. Many patients prescribed SSI did not have their regimens modified throughout their hospital stays, despite evidence of poor outcomes associated with this approach[28]. Moreover, there is ongoing debate regarding the use of OAD in hospital settings, with some guidelines supporting their use and others opposing it. Although basal-bolus insulin is currently recommended for glycemic control in most diabetes patients admitted to non-critical care medical wards, some physicians hesitate to prescribe it due to concerns about hypoglycemia. This underscores the need for improved diabetes management practices in non-critical medical wards to reduce complications and enhance patient outcomes.

1.3. Significance of the study

This study holds significant value in addressing the complex and evolving clinical landscape of DM among hospitalized patients. By comprehensively evaluating the clinical characteristics, current management practices, direct medical costs, in-hospital blood glucose control, and the impact of prolonged hospital stays on complications and mortality, the study generates critical baseline data essential for informing clinical and policy decisions. The findings are instrumental in guiding the prioritization of early interventions for hospitalized DM patients, thereby contributing to the reduction of preventable complications, excessive mortality, and the overall economic burden on patients and the healthcare system. The assessment of current inpatient practices also emphasizes the urgent need for adopting individualized, evidence-based treatment protocols tailored to the unique needs of DM patients. Furthermore, the study underscores the limitations of the widely used point-of-care blood glucose monitoring methods and advocates for the transition to continuous glucose monitoring (CGM) systems. The adoption of CGM has the potential to significantly enhance glycemic control, improve clinical outcomes, and support a more efficient and cost-effective model of inpatient diabetes care. Importantly, this study raises awareness about the multifaceted challenges of inpatient DM management and the necessity for timely and appropriate interventions to manage hyperglycemia and its related complications. Given the absence of prior comprehensive studies focusing on hospitalized DM patients in Ethiopia, this study serves as a foundational reference for researchers, clinicians, and policymakers. It offers evidence-based insights that can drive improvements in clinical practice, inform policy formulation, and support the development of more sustainable diabetes care strategies in similar healthcare settings.

2. Literature review

To find local and international studies that are pertinent for this study, a systematic search strategy using Google Scholar, PubMed, Scopus and direct Google search were used using key words, and mesh terms.

2.1 Clinical characteristic of hospital admitted diabetic patients

Literature increasingly highlights the hospitalization of DM patients due to various clinical conditions. A 2003 study in the USA found that most type 2 DM patients suffered from multiple concurrent medical conditions, with cardiovascular, respiratory, and infectious diseases being the most prevalent. Exacerbations of these conditions were common causes of hospitalization[29] . Additionally, patients with undiagnosed or poorly controlled diabetes had higher hospitalization rates, as shown in a 2016 study by Schneider et al. Poor blood glucose control, especially in patients with HbA1c values of 7% or higher, significantly increased the likelihood of hospitalization[30].

In Spain, infections were the leading cause of hospitalization for patients with unrecognized diabetes, many of whom also had coexisting conditions like cardiovascular diseases, chronic heart failure, PAD, and stroke[20]. Orozco-Beltrán et al. (2021) noted that low blood glucose levels and heart failure were key causes of hospitalization, while cancer became the primary comorbidity associated with hospital admissions, although other cardiovascular and cerebrovascular conditions remained prevalent due to advanced treatments[31].

Furthermore, a 2020 study in South Korea found that DM patients with more diabetes-related complications had higher hospitalization and mortality rates, with a hazard ratio of 1.13%[32]. Similarly, a study in China found that inadequate blood glucose control and infections were major contributors to hospitalizations, accounting for 42.1% of cases. These findings emphasize the complex relationship between diabetes, its complications, and hospitalization rates[33].

In addition to the direct effects of diabetes, other patient characteristics also contribute to the increased risk of hospitalization. Overweight and obese individuals, for example, have higher rates of admission. Findings from a 2004 study in the USA revealed that 334 DM patients were hospitalized due to decompensation of chronic heart failure, and many of these patients were overweight or obese[34].Another study carried out in USA using admission information from 2004-2012 forty percent and almost half of hospitalized DM patients had at least one small blood vessel and large blood vessel related DM complication

respectively. Moreover melancholy, anemia, as well as chronically elevated blood pressure were the most prevalent comorbiditie[35]. Further supporting this, a study conducted in the USA using admission data from 2004 to 2012 found that 40% of hospitalized DM patients had at least one small blood vessel-related complication, while nearly half experienced complications related to large blood vessels. Additionally, comorbidities such as melancholy, anemia, and chronically elevated blood pressure were prevalent among these hospitalized patients[36]. Studies in countries like Romania, Brazil, and England reinforce the idea that cardiovascular complications are a dominant cause of hospitalization for DM patients, often overshadowing metabolic issues. In Romania, more than 40% of hospitalized DM patients were admitted due to cardiovascular events, with only 2.6% admitted for acute metabolic derangements[37]. Similarly, in Brazil, while cardiovascular diseases were the leading cause of hospitalization, respiratory disorders and malignancies also played a significant role in overall admissions[24]. In England, non-diabetic causes such as atherosclerotic heart disease, anemia, and unknown diseases contributed heavily to DM-related hospitalizations, alongside conditions such as kidney failure, increased blood pressure, and eye problems[38]. In other parts of the world, including Italy, Vietnam, Egypt, and Libya, the prevalence of cardiovascular diseases, kidney disease, and hypertension as comorbid conditions in DM patients continues to be high. In Vietnam, for instance, over 95% of DM-related admissions were for type 2 diabetes, with a significant proportion of patients suffering from hypertension and multiple associated morbidities[1].

Similarly, in Egypt, the majority of hospitalized diabetes patients 90.4% were diagnosed with type 2 diabetes. Most of these admissions were related to chronic complications of diabetes, such as DNP, DFU,MI, and cerebrovascular accidents, though sepsis, which is not directly related to diabetes, was also common[22]. A study from Libya reported a similar proportion of type 2 diabetes admissions, with infectious diseases being the leading cause of hospitalization, followed by circulatory and lower extremity disorders, while alimentary canal disorders were among the least common causes[39]. In Nigeria, a similar trend was observed, with type 2 diabetes patients being the most commonly hospitalized group. Acute metabolic derangements were the leading cause of admission, followed by sepsis, diabetic foot problems, cerebrovascular accidents, and chronic diabetes-related complications[40].

In Ethiopia, a study in the Harari region reported that acute hypertension was the leading cause of hospitalization, followed by acute metabolic derangements, indicating that hypertension was the most common comorbidity. Interestingly, small blood vessel-related damage was the least common cause of admission in this region[41]. Another retrospective study conducted in Addis Ababa found that diabetic foot problems accounted for the majority of hospitalizations, with increased blood pressure being the most common

comorbidity, followed by infectious diabetic foot problems and other microvascular complications. Tuberculosis infections were also frequently observed in these patients[42]. The existing literature on diabetes-related hospitalizations globally highlights several clinical characteristics, but there are significant gaps in understanding the full clinical characteristics of diabetic patients in Ethiopia. Studies conducted so far in Ethiopia have been retrospective; therefore, this prospective study aims to assess the evolving clinical characteristics of diabetes patients admitted to medical wards.

2.2. Management practice of hospital admited diabetic patients and outcomes

Diabetes management in hospitalized patients involves a variety of treatment regimens, each with its unique characteristics and effectiveness. The clinical strategies for controlling blood glucose in diabetic patients include basal-bolus insulin regimens, supplemental insulin (SSI), and the use of (OADs) alongside insulin therapy.

A 2015 study conducted in the USA highlighted the management of diabetic patients with SSI alone or in combination with OADs or basal insulins. The findings showed that neither approach effectively controlled blood glucose. The use of SSI as a sole agent resulted in blood glucose levels that exceeded the recommended range, while combining SSI with OADs did not provide additional benefits. Furthermore, episodes of hypoglycemia were common, indicating poor blood glucose control in some patients[43]. A similar study in hyperglycemic patients with known diabetes found that over 80% of patients did not achieve the recommended blood glucose levels (5-7.22 mmol/L). Moreover, repeated SSI injections were linked to episodes of hypoglycemia in some patients[23]. In a comparison study involving 130 type 2 diabetic patients hospitalized in medical wards, basal-bolus insulin regimens, comprising glargine and glulisine, were shown to provide superior blood glucose control compared to SSI. The basal-bolus group demonstrated better glycemic control ($p<0.001$), while nine patients receiving SSI failed to achieve target blood glucose levels, even with the highest dose of SSI[44]. In 2013, another comparative study involving 353 type 2 diabetic patients in non-ICU surgery and medicine wards found that the basal-bolus and basal-plus correction insulin regimens outperformed SSI in terms of efficacy (42%, 37%, and 32% respectively). However, fewer episodes of hypoglycemia were observed in the SSI group, compared to basal-bolus and basal-plus correction insulin regimens, which had similar outcomes[45]. Blood glucose fluctuation, known to contribute to poor hospital outcomes, was observed more frequently in patients treated with basal-bolus insulin regimens in surgical wards than in medical wards. Notably, this fluctuation did not result in hypoglycemias[46]. A study in Vietnam, evaluating the efficacy of basal-bolus insulin regimens, showed that

64.1% of hospitalized type 2 diabetic patients achieved good glycemic control[27]. In Mexico, a comparison between basal-plus and premixed insulin regimens for hospital glycemic control demonstrated similar outcomes, with both regimens resulting in equivalent average blood glucose control[43].

In Vietnam, premixed insulin, particularly a 70% Neutral Protamine Hagedorn (NPH) 30% regular insulin formulation, was the most commonly used approach (77.5%) during hospitalization, although other regimens, including basal-bolus and OADs, were also employed[1].This trend of using premixed insulin during hospitalization was similar to practices observed in Italy, where insulin was the primary treatment, often combined with OADs such as metformin, sulfonylureas, and DPP-4I. Despite these treatment approaches, blood glucose control was suboptimal in many patients[47].

In Egypt, a study conducted in 2021 reported that basal-bolus insulin regimens were the most common treatment for patients admitted to medical and intensive care units, with 67.3% of patients receiving basal-bolus insulin and 30.1% receiving insulin infusions. This study's focus on critically ill patients may explain the higher use of insulin infusions[22]. In Ethiopia, a 2016 study from Jimma University revealed that 98.9% of hospitalized diabetes patients were receiving insulin treatment, though the specific insulin regimen was not reported. Additionally, only one patient was using an OAD, which was metformin[33]. These findings emphasize the importance of assessing the current management practices for diabetes in Ethiopia, particularly given the gaps in knowledge regarding the use of OADs and insulin regimens. This assessment will provide insights for improving diabetic care and highlight areas for future research

2.2.1. Guidelines recommendation of glycemic control for admitted DM patients

Different international guidelines recommend insulin as the cornerstone of management for hospitalized diabetes patients[48-50] since insulin in the hospital context gives advantages such as easy dose adjustment, a faster onset of action, and fewer contraindications and adverse effects than OAD, even though hypoglycemic events are the most common and feared side effects of it[51].

Although insulin is the drug of choice according to these guidelines, different types of insulin regimens are advocated based on various clinical and non-clinical considerations in hospital settings. For example, basal-bolus treatment consists of intermediate or long-acting insulin given once or twice per day and short or rapid-acting insulin administered two to three times, occasionally four times per day, with as needed supplemental short or rapid-acting insulin indicated for type 2 diabetes patients who were using this regimen in an outpatient setting, poor glycemic control with OAD before admission, patients who presented with severe blood glucose (>300 mg), patients with good oral intake or receiving parenteral or enteral nutrition, as well as patients with a diagnosis of type 1 DM are candidate for this regimen[15, 52]. The

American Association of clinical endocrinology guideline 2022 also recommends the use of a basal-bolus regimen in hospitalized type 2DM patients who can take a sufficient amount of food. According to this guideline, the use of a basal-bolus regimen is optional for patients who can't take the optimal amount of food. On the other hand, SSI use for the control of hyperglycemia is discouraged except in individuals that have blood glucose levels within the recommended range most of the time. Likewise, the use of OAD requires individualized treatment criteria based on blood glucose levels during hospitalizations[49]. According to the American Diabetes Association (ADA) Guidelines 2021 recommendation, a basal-bolus insulin regimen is also the choice of treatment approach for non-critically ill Type 2DM patients who eat a sufficient amount of diet. Like the American diabetic Association clinical endocrinology recommendation, Type 2DM patients admitted to non-intensive care unit (NICU) wards with low food intake should be treated with basal insulin or basal plus bolus correctional insulin. But premixed insulin and SSI regimens are not recommended on a regular basis. It also recommends a basal-bolus insulin regimen for type 1DM patients who have good nutritional intake[53].

3. Objective

3.1. General objective

To assess the clinical characteristics, management practice , outcomes and associated factors among DM patient admitted to internal medicine ward of TASH, ZMH and SMMPC.

3.2 Specific objectives

1. To assess the clinical characteristics of DM patients admitted to medical ward of the three selected Hospitals
2. To assess the management practice in medical ward of the three selected hospitals
3. To assess the outcomes following diabetes patients' admission to medical ward of the three selected Hospitals.
4. To identify factors independently associated with mortality among DM patients admitted to internal medicine of the three selected hospital

4. Method

4.1. Study areas

The study was conducted in the adult internal medical wards of TASH, SPHMMC, and ZMH.TASH, founded in 1972 is located in the Lideta Sub City of Addis Ababa, Ethiopia. It is the largest teaching hospital affiliated with Addis Ababa University's College of Health Sciences and serves as a training hub for undergraduate and graduate students in medicine, pharmacy, and health sciences. The TASH serves 500,000 patients annually through 20 outpatient specialty clinics, emergency departments, and inpatient units. In the past three months(October ,2023,November ,2023 and December 2023) 300 diabetic patients were admitted for various medical conditions (source: health management information system (HMIS). The hospital's medical staff includes endocrinologists, internists, cardiologists, nephrologists,nurses, and pharmacists, among others.

SPHMMC was established in 1969 through a collaboration between Emperor Haile Selassie and the German Evangelical Church. Initially named St. Paul General Specialized Hospital until 2008, it currently operates with 392 beds and serves approximately 200,000 patients annually. The internal medical ward admitted about 312 diabetic patients for various medical conditions in the past three months (October ,2023,November ,2023 and December 2023) (source: HMIS). The hospital boasts more than 1,300 clinical and non-clinical staff working across 13 departments, including the National Kidney Transplant Center

and a newly inaugurated hemodialysis unit. The healthcare team comprises endocrinologists, internists, cardiologists, nephrologists, midwives, nurses, and pharmacists.

ZMH is located in Ward 8, Kirkos Sub City, Addis Ababa, Ethiopia. Originally built and managed by the Seventh-day Adventist Church, ZMH was nationalized in 1976 during the military government era. The hospital is named after Empress Zewditu's cousin and predecessor, Emperor Haile Selassie. Today, it operates under the Federal Ministry of Health (FMOH) through the Addis Ababa Health Bureau, serving as a referral center for trauma and critical emergency cases. With 56 adult medical beds, ZMH treated approximately 220 diabetic patients admitted for various medical reasons in the past three months (October ,2023,November ,2023 and December 2023 (source: HMIS). The hospital's healthcare team includes endocrinologists, internists, cardiologists, nephrologists, nurses, and pharmacists.

4.2. Study design and period

A hospital-based, multicenter, prospective observational study design was utilized across TASH, SPHMMC, and ZMH from July 15, 2023, to February 29, 2024.

4.3. Population

4.3.1 Source population

All diabetic patients admitted to the adult medical wards of TASH, SPHMMC, and ZMH, regardless of the reason for admission, constituted the source population**.**

4.3.2. Study population

The study population included all diabetic patients admitted during the study period who met the inclusion criteria**.**

4.4 Eligibility criteria

4.4.1. Inclusion criteria

- Adult patients (age ≥18 years) with a diagnosis of new-onset diabetes or known diabetes, admitted to the internal medical ward for any medical condition.

4.4.2. Exclusion criteria

- Patients who refused to provide consent, as evidenced by not signing the consent form.
- Patients treated in the ICU.
- Pregnant women with diabetes
- Patients presenting active psychiatric symptoms.

4.5.Study variables

4.5.1.Dependent variable

- Mortality: The primary outcome, defined as all-cause death occurring during the hospital stay.
- Direct Medical Cost of Hospitalization: Total expenses incurred by the patient during the hospitalization period, including costs related to diagnostics, treatments, medications, and other hospital services

4.5.2.Independent variables

Patient-Related Factors

- Demographics: Age, sex, and educational status.
- Socioeconomic Indicators: Household income and insurance status.
- Lifestyle Factors: Physical activity level, smoking status, alcohol consumption, and body mass index (BMI).
- **Health-Related Practices:**
    - Self-monitoring of blood glucose.
    - Vaccination status (e.g., influenza, pneumococcal).
    - Presence of a medication adherence supporter (e.g., caregiver or family member).
    - Dietary restrictions and specific types of restricted diets followed.

Drug-Related Factors

- Current Medications:
    - Medications used for the treatment of existing comorbidities (e.g., antihypertensives, lipid-lowering agents).
    - Antidiabetic medications used to control blood glucose levels (e.g., insulin, oral hypoglycemic agents).

Disease-Related Factors

- Duration and Type of DM: Time since diagnosis and classification (e.g., type 1 or type 2).
- Comorbidities and Complications:
    - Number and type of existing comorbidities (e.g., cardiovascular disease, renal impairment).
    - Presence of diabetes-related complications (e.g., retinopathy, neuropathy).
    - In-hospital complications that arise during the stay (e.g., infections, acute kidney injury).
- Laboratory Tests:
    - HbA1c.
    - Lipid profile parameters: High-density lipoprotein (HDL), low-density lipoprotein (LDL), triglycerides (TG), and total cholesterol(TC).
    - Blood pressure (BP) readings during admission.
    - RBS measured prior to the outcome.

4.6. Sample size determination and sampling technique

4.6.1. Sample size determination

The sample size for this study was calculated by using single proportion population formula considering as d= marginal error of 5% (d=0.05), Z α/2= the degree of accuracy required (95% level of significance = 1.96 .The p- value was determined from the previous study done at Jima university which assessed the treatment outcome[54].

$N=\frac{\left(\frac{za}{2}\right)^2 * p}{d^2}(1-P)=(\frac{(1.96)^2 *}{(0.05)^2}0.5(1-0.5)=384$

Taking 5% for contingency of sampling error due to missed data during recording from all hospitals will be =403

The sample size (n) was proportionally allocated to each selected hospital depending on the number of patients being hospitalized for any medical conditions having diabetics for the last 3 months (N = 832) total admission from the three hospitals, which was counted and summed from the respective hospitals HMIS. TASH (N = 300/3 months), ZMH (N = 220/3 months), and SPMMC(N = 312/3 months, n = 403).Then DM patients who fulfil the eligeblity criteria were selected with consequative sampling techniques.

Sample sizes were allocated for each selected Hospitals, proportionally as follow: TASH=300/832*403=145, SPMMC=312/832*403=151, ZMH=220/832*403=107

4.6.2. Sampling technique

Patients who fulfilled the inclusion criteria were consecutively included in the study from each purposefully selected hospital. Those purposefully selected hospitals were TASH, SPMMC, and ZMH.

4.7. Data collection instrument and procedures

After preparing the data collection tool, which included semi-structured questionnaires and a data abstraction format based on a review of various literatures, it was revised and validated by endocrinologists and other experts. Sociodemographic data were then collected through face-to-face interviews with either the patient or their attendant if the patient was not competent to provide informed oral or written consent. Then baseline data on medications used before admission, existing comorbidities, relevant laboratory values, duration of DM, types of DM, and other relevant data indicated by the data abstraction tool were collected from patients medical records. Finally, the patient was followed from day one of admission by trained data collectors while observing the medication regimen being taken for glycemic control; his or her blood glucose level and complications developed until the outcome of the patient was known.Patients who were followed for only 24 hours withdrawn from analysis. The total direct costs of medications and supplies, including gloves and syringes, were calculated by multiplying the unit price from the respective hospital(dispensing) pharmacies by the quantities purchased. For participants who obtained items from pharmacies outside the hospitals, receipts were collected to ensure accurate capture of these costs. For those who underwent imaging procedures, the costs for each procedure were summed based on the stated prices in the respective hospitals. If procedures were not performed within the hospitals, receipts were collected and summed accordingly. Additionally, the total cost of bed occupancy was calculated by multiplying the length of hospital stay by the daily cost for one bed, as specified by the respective hospitals. The costs were recorded in birr and were subsequently converted to United states dollars (USD) dividing by fifty-five birr, assuming that the average exchange rate at the time of data collection was fifty-five birr per dollar.

4.8. Data quality assurance

Data collectors were given a one day training that focuses on the study's objectives and how to complete the data collection form and pretest was conducted among 5% of the samples size (20 DM patients) at

Yekatit 12 Hospital before actual data collection started. Furthermore to guarantee the accuracy of the data collected, daily supervision was practiced for data completeness and reliability.The data were collected by three bachelor of science (BSC) nurses.

4.9.Data analysis

Data were entered into epidemiological information (EPI INFO) version 7 and exported to the statistical package for social science software (SPSS) version 27 for data analysis. Categorical variables were presented as frequencies and percentages. Continuous data were tested for normal distribution using the Shapiro and Kolmogorov-Simonov tests. Non-normally distributed data were recoded into categorical variables, referring to different literature for cut points, and presented with non-parametric tests like median and interquartile range. Moreover, dummy variables were created for variables that have many categories for convenience of analysis such as admission diagnosis. Time to death cure were evaluated using Kaplan-Meier method. The association between independent and dependent variables was tested by Cox proportional regression. The assumption of the Cox proportional hazards model was tested using the log-minus-log method. Independent variables for the multivariable Cox regression were selected based on bivariate Cox regression analysis, including those with a p-value of less than 0.25, while a p-value of less than 0.05 in the final adjusted multivariable Cox regression was considered statistically significant.Lastly, the results were presented in graphs, tables, and figures and interpreted according to the outcome.

4.10. Ethical consideration

Letters of ethical clearance were obtained from the Ethical Review Committee of the School of Pharmacy, the College of Health Sciences, Addis Ababa University (PCP/241/15/23), the Addis Ababa Health Bureau (A/A/H/579/227), and the SPMMC (Pm23/214) ethical review board. The patient's data were accessed after the approval of ethical clearances by the respective hospitals. Then, after a clear description of the study objectives, participants were requested to sign informed consent before the data collection process started. Moreover, to maintain patients' confidentiality, the patient's name and other identifiers were not entered into the data gathering check list during the data collection process.

4.11. Operational Definitions

Adult: participants whose age is 18years and above

Physically active: If the patient walked ≥150 minutes/week, engaged in regular supervised physical exercise training 3 times/week and above or did unsupervised regular exercise at home 3 times/week

Physically inactive: If the patient walked <150 minutes/week, or not engaged in regular supervised physical exercise training 3 times/week and above or did unsupervised regular exercise at home 3 times/week

Previous smoker: Those who smoke cigarettes but have quit smoking in the past 2 months and above

Current smoker: Those who smoked cigarettes within 30 days before data collection started

Glycemic target: 140–180 mg/dl based on the American association of clinical endocrinology recommendations.Patients who achieved this target were considered as having good glycemic control and all other glycemic readings are poor glycemic control

Knewly diagnosed DM:Those who diagnosed during admission or three months preceding data collection

Hospital aquired complications:Any medical condition that was not present during admission diagnosis.

Main diagnosis : The diagnosis listed first in the patient's medical problem list

Short duration of DM:Those having DM for less than 5 years since diagnosis.

Long duration of DM:Those having DM for 5 years and above since diagnosis.

Body mass index were categorized based on World health organizations (WHO) classification as follow

Underweight:Less 18.5kg/m2

Normal weight:18.5-<25kg/m2

Overwieght :25-<30kg/m2

Obesity :≥30kg/m2

4.12. Dissemination of the result

The study's ultimate findings will be presented to Addis Ababa University's School of Pharmacy and College of Health Science by the principal investigator, and a manuscript will be prepared by the principal investigator and submitted for publication to the scientific community.

1. Result

1.1 Sociodemographic characteristics of DM patients admitted the three hospitals

Of the 403 DM patients consecutively admitted to three selected hospitals over a seven-month period, 398 were included in the final analysis, giving a response rate of 98.76%. Five patients were excluded due to staying less than 24 hours. The folloup included 219 males (55%) with a median age of 60, primarily between 35-64 years. Most participants were urban residents (n = 295, 74.1%), and 144 (36.2%) had a primary school education level. Almost half of the particpants monthly household income predominantly fell within the 65-165. Over half of the participants (n = 210, 52.8%) had health insurance, though 168 (42.8%) reported partial benefits, requiring out-of-pocket payments for labs, medications, or imaging not covered by their insurance as shown in **Table 1**.

Table 1 :Socio-demographic characteristic among admitted DM patients at TASH,ZMH and SPMMC from15-Jully-2023 to 29-February-2024 (N=398)

Variables	Categories	N (%)
Gender	Male	219(55.00)
	Female	179(45.00)
Age groups (years)	18-34	31(7.80)
	35-64	232(58.30)
	≥65	135(33.90)
Place of residence	Urban	295(74.10)
	Rural	103(25.90)
Educational level	No formal education	64(16.10)
	Primary school	144(36.20)
	Secondary school	60(15.10)
	College and above	130(32.70)
Occupation	Government employed	75(18.80)
	Private employed	79(19.80)
	Merchant	86(21.60)
	Student	14(3.50)
	Farmer	25(6.30)
	House wife	76(19.10)
	Retired	43(10.8)
Medication access type	Out-of-pocket	185(46.50)
	Free (no direct cost to the individual)	3(0.80)
	Full health insurance coverage	42(10.60)
	Partial health insurance coverage (subsidized or reimbursed plus out-of.pocket)	168(42.20)
Household incomes	<65$	151(37.90)
	65-165	198(49.70)
	>165$	49(12.30)

1.2 .Clinical characteristic of DM patients admitted to TASH, ZMH and St.Paulos Hospital

1.2.1. Life style factors

As shown in Table 2, the majority of participants (n = 345, 86.7%) were non-smokers, while 28 individuals (7%) were current smoker, and 25 (6.3%) were former smoker. Alcohol use was also low, with 351 participants (88.2%) reporting they did not drink. Interestingly, a larger proportion of participants reported being former drinkers compared to former smokers. Regarding dietary habits, 107 participants (26.9%) were advised by healthcare providers to limit intake of carbohydrates, fatty foods, salt, and alcohol. Additionally, 42 respondents (10.5%) reported recreational use of substances such as khat and hashish .Physical activity was common, with 247 participants (62.1%) leading active lifestyles, defined as walking for at least 30 minutes three or more times per week or engaging in other forms of physical activity with similar frequency.

Table 2: Lifestyle factors among admitted DM patients admitted at TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398)

Variables	Categories	N(%)
Level of physical activity	Physically inactive	151(37.90)
	Physically active	247(62.10)
Types of restricted diet	No restricted diet	5(1.30)
	Carbohydrate and alcohol	31(7.80)
	Carbohydrate ,fatty meal and alcohol	16(4.00)
	Carbohydrate ,fatty meal ,alcohol and salt	107(26.90)
	Carbohydrate, alcohol and salt	77(19.30)
	Carbohydrate and salt	93(23.40)
	Carbohydrate only	69(17.30)
Types recreational drug used	Not recreational drug user at all	356(89.40)
	Chat chewing	38(9.50)
	Hashish/cannabis	4(1.00)
Cigarette smoking status	Never smoked	345(86.70)
	Current smoker	28(7.00)
	Previous smoker	25(6.30)
Alcohol drinking status	Never drink	351(88.20)
	current drinker	15(3.80)
	previous drinker	32(8.00)

1.2.2 Adulthood immunizations and other health related factors

A total of 239 participants (60.1%) had not received any adulthood immunizations. Among those vaccinated, Coronavirus Disease 2019 (COVID-19) was the most common vaccination reported. Notably, although hepatitis B vaccination is recommended for diabetic patients, only 11 participants (2.8%) reported being vaccinated for it. Most participants (n = 359, 90.2%) had assistance with medication management at home. While more than half of the diabetic participants practiced SMBG, a significant number (n = 173, 43.5%) did not monitor their blood glucose levels at home. Additionally, 206 participants (51.8%) had no family history of diabetes. Despite the relatively high number reporting an active lifestyle, only 206 participants (51.8%) maintained a healthy weight, while among those outside the normal weight range, the majority were overweight (n=121, 30.4%) (Refer Table 3)

Table 3: Adulthood immunization history and other health related factors among admitted DM patients at TASH,ZMH and SPMMC from15-Jully-2023 to 29-February-2024 (N=398)

Conditions	Category	N (%)
Types of vaccination	Not immunized	239(60.10)
	Immunized for COVID-19	145(36.40)
	Immunized for hepatitis B	11(2.80)
	COVID-19 and hepatitis B	3(0.80)
Medication use assistant	No	39(9.80)
	Yes	359(90.20)
Availability of SMBG practice	No	173(43.50)
	Yes	225(56.50)
Family history of DM	No	206(51.80)
	Yes	192(48.20)
BMI categorized	Under weight	13(3.30)
	Healthy weight range	205(51.50)
	Overweight	121(30.40)
	Obesity	59(14.80)

BMI:body mass index in kilogram/meter2,SMBG:Self monitoring blood glucose,DM:Diabetes mellitus ,COVID-19:Coronavirus disease-2019

1.2.3 Clinical presentations of DM patients at admission

Regarding clinical presentation upon admission, the most commonly reported symptoms among patients were shortness of breath (SOB) (49%), fever (36.4%), foot swelling (28.4%), and loss of appetite (26.1%). Fewer patients presented with classic symptoms such as polyuria, polydipsia, and polyphagia. For a comprehensive overview of all clinical presentations observe Figure 1 bellow

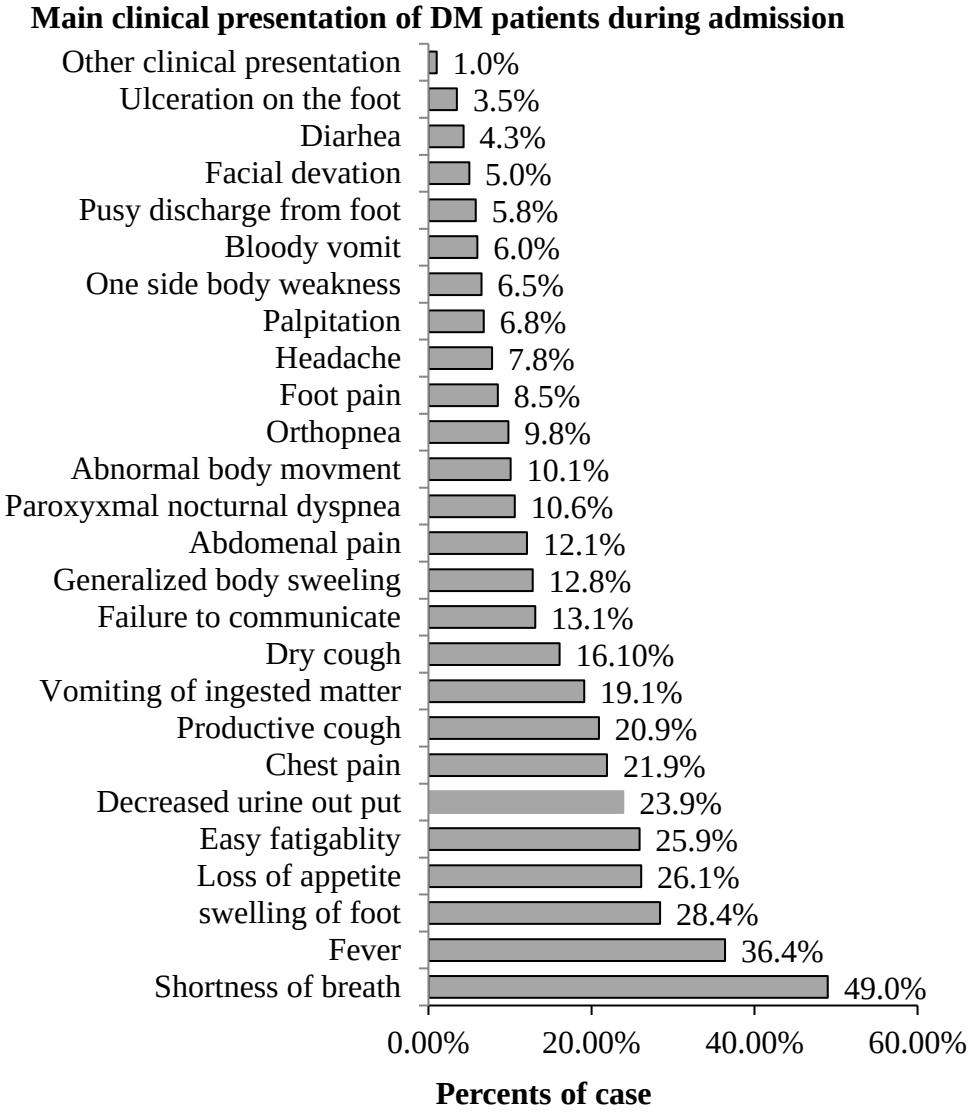

Figure 1: ***Clinical presentation of admitted DM patients*** at **TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398)**

Otherclinical presentation :Polyuria,polydipsia and polyphagia

1.2.4 Main admission diagnosis of DM patients

Of the participants, 330 (82.9%) had Type 2 DM, and the majority of admitted DM patients had a known history of diabetes (n = 372, 93.7%). The three primary reasons for admission among DM patients were severe community-acquired pneumonia (S.CAP) (n = 50, 12.5%) ,AKI on CKD (n = 34, 8.5%), and ADHF (n = 34, 8.5%). Additionally, sepsis with various foci and strokes, particularly ischemic stroke, were also relatively common causes of admission in these patients. While acute metabolic complications such as DKA and hyperosmolar hyperglycemic State (HHS) were not observed, hypoglycemia accounted for the hospitalization of 15 DM patients (3.8%). Other, less common reasons for admission included acute pulmonary embolism, brain abscess, and neutropenic fever (See **Table 4** for more details)

Table 4: Main diagnosis ,Types of DM and diabetes status among admitted DM patients** at **TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398)

Clinical conditions	N (%)
Type of DM	
Type 1 DM	68(17.10)
Type 2 DM	330(82.90)
Diabetes status	
Newly diagnosed DM	26(6.50)
Known DM	372(93.50)
Main diagnosis of admission	
Diabetic foot ulcer	15(3.80)
Peripheral arterial disease with gangrene	11(2.80)
Acute decompensated heart failure	34(8.50)
Decompensated chronic liver disease	21(5.30)
Severe community acquired pneumonia	50(12.60)
Acute kidney injury	19(4.80)
Acute kidney injury on chronic kidney disease	34(8.50)
Acute ischemic stroke	17(4.30)
Acute haemorrogic stroke	15(3.80)
Severe anemia	12(3.00)
Sepsis	32(8.00)
Acute exacerbation of asthma	12(3.00)
Pyogenic meningitis	13(3.30)
Acute exacerbation of chronic obstructive air way disease	10(2.50)
Complicated tuberculosis	13(3.30)
Upper gastrointestalil bleeding	14(3.50)
Acute ischemic heart disease	18(4.50)
Cellulitis	10(2.50)
Hypoglycemia	15(3.80)
Corpulmonale	12(3.00)
Other[e]	21(5.30)

[e]*Acute pulmonary embolism, Necrotizing funiculitis, Emphysema ,Neutropenic fever, Brain abscess, Non cardiogenic pulmonary edema, Necrotizing otitis externa, severe malaria, Acute lymphocytic leukemia and Cardiogenic pulmonary edema*

1.2.5 Existing comorbidities and chronic complication of admitted DM patients

Majority (n=355,89.2%%) of DM patients engaged in this study had at least one or more existing comorbidity. Of these comorbidities hypertension took the highest proportion (N=244, 61.3%) followed by chronic heart failure (N=150, 37.7%). Moreover respiratory disease such as Chronic Obstructive Pulmonary Disease (COPD), asthma (N=50, 12.6%, N=41, 10.3%) respectively also common. On the other hand mental health problems such as depression and a few bipolar disorders cases also observed. Even though most existing comorbidities were noninfectious disease, HIV (N=44,11.1%), chronic otitis media and chronic hepatitis B and C infection, also affected DM patients in this study. The other less commonly responsible existing comorbidities includes Cushing syndrome, prostatic hyperplasia, arthritis (osteoarthritis, rheumatoid arthritis and gouty arthritis), chronic peptic ulcer disease etc. as shown in Table 5 below also affected DM patients. However small proportions of individuals were not affected by any existing comorbidities (N=43, 10.8%).Apart from the above comorbid condition DM patients in this study also witnessed as suffered from chronic complication of diabetes. Of these chronic complications DNP, PNP, and CKD (N=114, 28.6%, N=110, 27.6%, N=78, 19.6%) respectively were the three most commonly observed cases of complications. Compared to DFU (N=23, 5.8%), PAD (N=29, 7.3%) was slightly more common foot problem seen in these patients and unlike existing comorbidities higher proportion of individuals (N=149, 37.4%) had no chronic complications. As shown*Table 5* and *Figure 3* these complications were more prevalent as the duration of DM ranged into greater than five years. This figure also showed that majority of individuals (n=241, 60.6%) had long duration of DM. In general most participants (N = 360, 90.45%) had three or fewer existing comorbidities, while only 9.55% had more than three comorbidities (***For further information see*** *Table 5*)

***Table 5: Existing comorbidities and chronic complications among admitted DM patients** at TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398)*

Category	Condition	N (%)
Types of Existing Comorbidities©	Hypertension	244 (61.30%)
	Heart failure	150 (37.70%)
	Chronic obstructive airway disease	50 (12.60%)
	Hypertensive heart disease	48 (12.10%)
	Chronic valvular heart disease	44 (11.10%)
	Human Immunodeficiency Virus	44 (11.10%)
	No existing comorbidities	43 (10.80%)
	Other$^{\beta}$	42 (10.60%)
	Asthma	41 (10.30%)
	Chronic liver disease	27 (6.80%)
	Cancer	23 (5.80%)
	Chronic anemia	13 (3.30%)
	Depression	13 (3.30%)
	Epilepsy	12 (3.00%)
	Parkinson	11 (2.80%)
Number of Existing Comorbidities	≤3	360 (90.45%)
	>3	38 (9.55%)
Chronic Complications of DM⁎	Diabetic nephropathy	114 (28.60%)
	Peripheral neuropathy	110 (27.60%)
	Chronic kidney disease	78 (19.60%)
	Diabetic retinopathy	66 (16.60%)
	Ischaemic heart disease	61 (15.30%)
	Ischemic stroke	41 (10.30%)
	Peripheral arterial disease	29 (7.30%)
	Chronic diabetic foot ulcer	23 (5.80%)
	Haemorogic stroke	10 (2.50%)
	No chronic complication of DM	149 (37.40%)

©counted at value 1

⁎Counted at value 1

$^{\beta}$Prostatic hyperplasia, dyslipidemia, chronic bronchitis, gouty arthritis, rheumatoid arthritis, peptic ulcer disease, chronic hepatitis C virus infection, chronic hepatitis B virus infection, bipolar disoder,osteoarthritis,autoimmue pancreatitis, metabolic syndrome,hyperparathyroidism,chronic otitis media, pulmonary hypertensions, mixed nutritional deficiency, chronic deep veinthrombosis and Cushing syndrome

Figure 2 illustrates the prevalence of chronic complications in patients with diabetes for less than five years, showing that 18.5% (n = 29) had microvascular complications, while the majority, 63.1% (n = 99), had no complications. In contrast, Figure 3 depicts the prevalence of chronic complications in patients with diabetes for more than five years, with 36% (n = 88) experiencing microvascular complications and 37% (n = 88) having both microvascular and macrovascular complications.see figure 2 and 3 below for more detail.

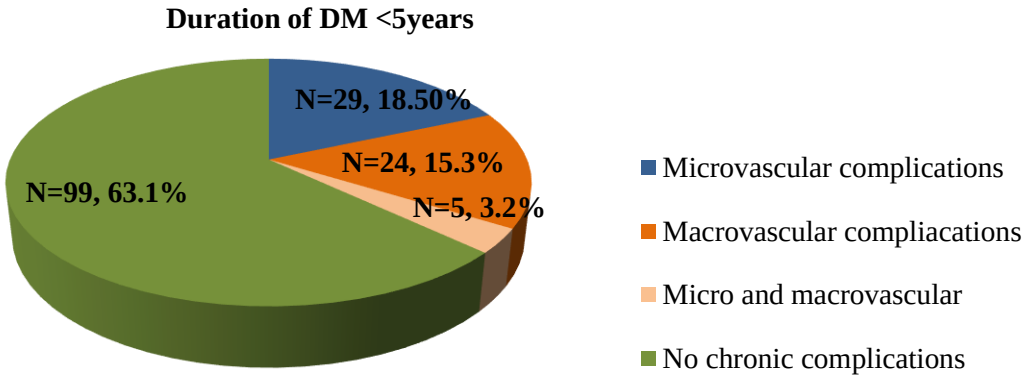

Figure 2: The prevalence of chronic complications of DM when the disease has been present for five years or less** at **TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398)

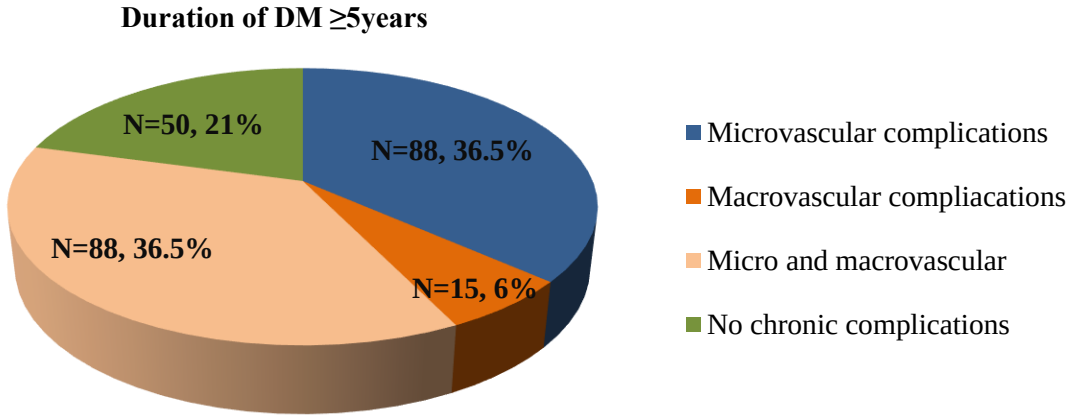

Figure 3: The prevalence of chronic complications of DM when the duration of DM ranged beyond five years** at **TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398)

1. 2.6. Medications Used Before Admission for Existing Comorbidities or Diabetes Management

Patients were prescribed various medications to manage pre-existing comorbidities or prevent both primary and secondary diabetes-related complications. The most commonly used medications were statins (48%, n = 191), calcium channel blockers (CCB) (47%, n = 186), diuretics (43.5%, n = 173), aspirin (%, n = 159), and angiotensin-converting enzyme inhibitors (ACEI) (39.9%, n = 159). Regarding antidiabetic treatments prior to hospitalization, the majority of patients were using metformin alone (32.7%, n = 130), followed by metformin plus sulfonylurea (SU) (14.6%, n = 58), basal insulin alone (14.6%, n = 58), and basal insulin plus SGLT2 inhibitors (11.3%, n = 45).As shown in ***Table 6***

Table 6: Medications Used Before Admission** at **TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398)

Medication for comorbidities[0]	**N (%)**	**Medication for glycemic control**	**N (%)**
Statins	191 (48.0%)	Metformin Monotherapy	130 (32.7%)
Calcium Channel Blocker (CCB)	187 (47.0%)	Metformin + Sulfonylurea (SU)	58 (14.6%)
Diuretics	173 (43.5%)	Basal Insulin Only	58 (14.6%)
Aspirin (75/81/100 mg)	165 (41.5%)	Basal Insulin + Metformin + SGLT2I	8 (2.0%)
Angiotensin-Converting Enzyme Inhibitor (ACEI)	159 (39.9%)	Basal Insulin + Metformin	24 (6.0%)
Beta-blockers (BB)	134 (33.7%)	Mixtard Insulin	15 (3.8%)
Warfarin	27 (6.8%)	Metformin + SGLT2I	14 (3.5%)
Angiotensin Receptor Blocker (ARB)	31 (7.8%)	Sulfonylurea (SU) Monotherapy	8 (2.0%)
Highly Active Antiretroviral Therapy (HAART)	43 (10.8%)	Metformin + DPP4I	7 (1.8%)
Amitriptyline	53 (13.3%)	Metformin + SU + SGLT2I	2 (0.5%)
Gabapentin	28 (7.0%)	Basal-bolus Insulin	47 (11.8%)
Digoxin	17 (4.3%)	Not on Antidiabetic Medications	21 (5.3%)
Levodopa/Carbidopa	12 (3.0%)	Other [e]	6 (1.5%)
Beclomethasone Puff	29 (2.1%)		
Budesonide/Salmeterol Puff	25 (6.3%)		
Other[β]	34 (8.5%)		
No Medication Used	47 (11.8%)		

SU:Sulphonylurea;SGLT2I:sodium glucose cotransporter 2 inhibitor ;DpP4I:dipeptiday peptidase 4 inhibitors,[0]**counted at value 1**

[β] Phenytoin, Allopurinol, Sodium valproate, Amiodarone, Alfuzosin, Tamsulosin, Epoitin Alpha, Fluoxetine, Omeprazole, Tenofovir, and Pregabalin Ferrous sulphate[e] Basal + SGLT2I.

1.2. 7 Baseline laboratory profiles

Table 7 shows baseline laboratory and vital sign values for the study population. Nearly half (48.2%) had HbA1c >7%, indicating poor glycemic control, while 47.0% achieved good control (≤7%). Regarding blood pressure, 65.1% had systolic pressure <140 mmHg, but 34.9% had elevated levels. For diastolic pressure, 92.7% were within the target range. Lipid profiles showed that 78.6% had desirable total cholesterol levels, 60.1% achieved LDL-C targets, but 71.6% had low HDL-C, and 15.6% had elevated triglycerides, suggesting a higher cardiovascular risk. These findings highlight the need for improved glycemic and lipid management in this population (see ***Table 7***)

Table 7: Baseline laboratory and vital signs *at* ***TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398)***

Laboratory tests/Vital Sign Values	N (%)
HbA1c	
≤7%	187 (47.00)
>7%	192 (48.20)
Missing	19 (4.80)
Systolic BP (sBP) during admission	
<140 mmHg	259 (65.10)
≥140 mmHg	139 (34.90)
Diastolic BP (dBP) during admission	
<90 mmHg	369 (92.70)
≥90 mmHg	29 (7.30)
Total Cholesterol (TC)	
<200 mg/dL	313 (78.60)
≥200 mg/dL	60 (15.10)
Missing	25 (6.30)
Low-Density Lipoprotein (LDL-C)	
<100 mg/dL	239 (60.10)
≥100 mg/dL	133 (33.40)
Missing	26 (6.50)
High-Density Lipoprotein (HDL-C)	
<45 mg/dL	285 (71.60)
≥45 mg/dL	88 (22.10)
Missing	25 (6.30)
Triglycerides (TG)	
<150mg/dL	237 (59.50%)
≥150mg/dL	136 (34.20%)
Missing	25 (6.30)

2.Management of admitted diabetes patients

While basal-bolus insulin and basal insulin alone were the second and third most common antidiabetic regimens (n = 97,24.4% ,n=76, 19.1%), respectively, the majority of hospitalized DM patients first addressed with basal +correctional insulin (n = 181, 45.5%). In this study, basal plus SGLT2I was the least common antidiabetic treatment(see table for further information ***Table 8***). DM patients discharged with metformin (30.7%), followed by basal insulin only and basal-boulus insulin (14.8% and 14.3%), respectively.Forty-seven DM patients (11.8%) had no discharge medications.Sulphonylurea, basal insulin + metformin + SGLT2I, and metformin + DPP4I were the least commonly prescribed discharge medications.For more detail, see ***Figure 4***

Table 8: Distribution of Antidiabetic Regimens for Glycemic Control during hospitalization *at* ***TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398)***

Type of Regimen	N (%)
Basal Insulin Regimens	
Basal with correctional insulin	181 (45.5)
Basal-bolus	97 (24.4)
Basal insulin only	76 (19.1)
Alternative Regimens	
Sliding scale only	28 (7.0)
Basal with SGLT2I	10 (2.5)
Other*	6 (1.5)

Note:SGLT2I= Sodium glucose cotransporter-2 inhibitor, DPP4I=dipeptidyl peptidase 4 inhibitors

* Dapagliflozin only, Metformin + SGLT2I, Metformin only, and Basal + bolus insulin + SGLT2I.

SGLT2I, DPP4I,

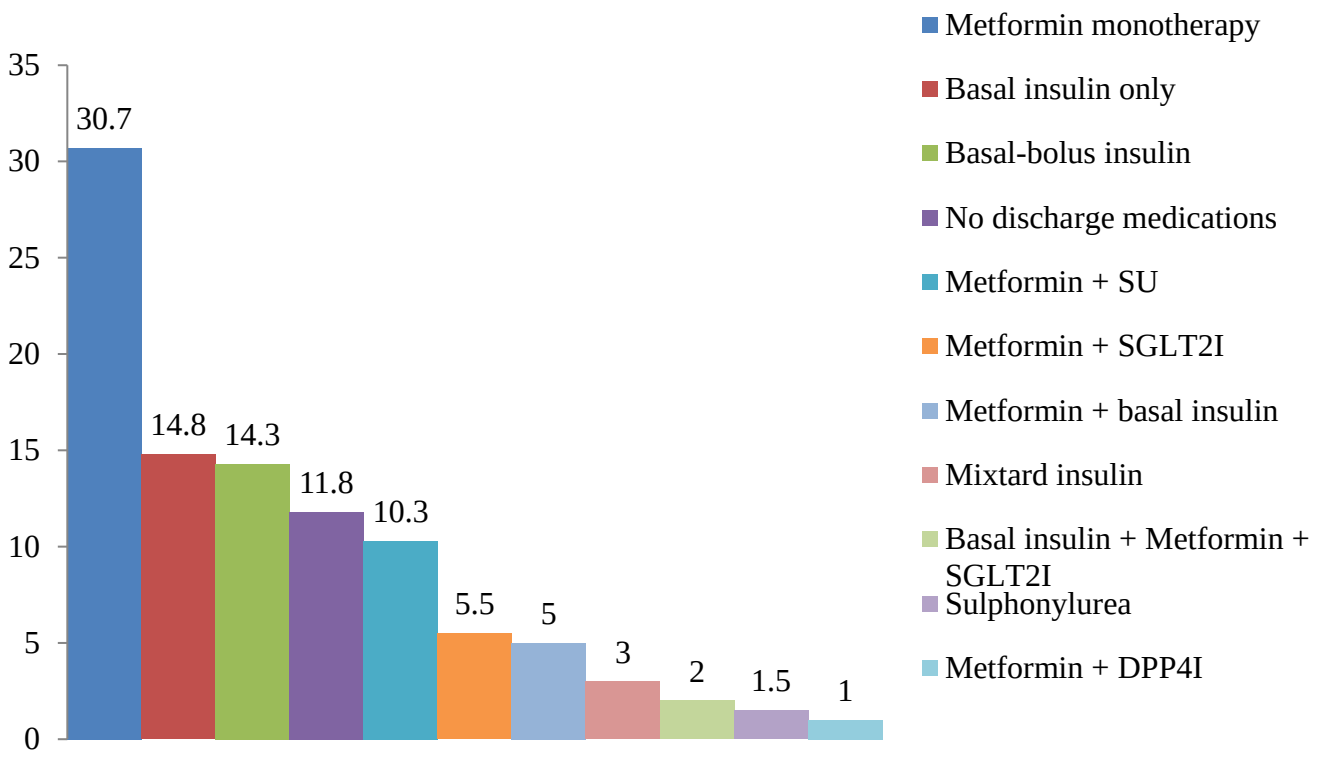

Figure 4: Discharge antidiabetic medications** at **TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398)

SGLT2I;Sodium glucose cotransporter 2 inhibitor, DPP4I;Dipeptidaylpeptidase 4 inhibitor

2.1. Complication developed during hospital stay

Among the complications observed during hospitalization, AKI was the most common, affecting 13.1% of patients (N = 52). Electrolyte imbalances, including hypokalemia, hyperkalemia, hyponatremia, and hypernatremia, were also frequently noted, along with episodes of hypoglycemia, defined as any blood glucose measurement below 70 mg/dL. Less frequent complications included thrombophlebitis and DKA (***Table 9***). As illustrated (***Figure 5***) , there was a general increase in complications with increases in hospital stays, although this trend was not sharply linear.

Table 9: Distribution of complications developed during hospital stay** at **TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398)

Types of Complications[0]	**N (%)**
No complication during hospitalization	209 (52.50%)
Acute kidney injury (AKI)	52 (13.10%)
Hypoglycemia	37 (9.30%)
Electrolyte disturbance	38 (9.50%)
Hospital acquired pneumonia (HAP)	27 (6.80%)
Sepsis	24 (6.00%)
Urinary tract infection (UTI)	23 (5.80%)
Others[n]	23 (5.80%)
Amputation	12 (3.00%)
Acute deep vein thrombosis (DVT)	11 (2.80%)
Bed sore	9 (2.30%)
Thrombophlebitis	2 (0.50%)
Diabetic keto-acidosis (DKA)	2 (0.50%)

[n]Aspirational pneumonia, acute pulmonary embolism, atrial flutter, atrial fibrillation and pulmonary vasculitis

[0]Counted at value 1

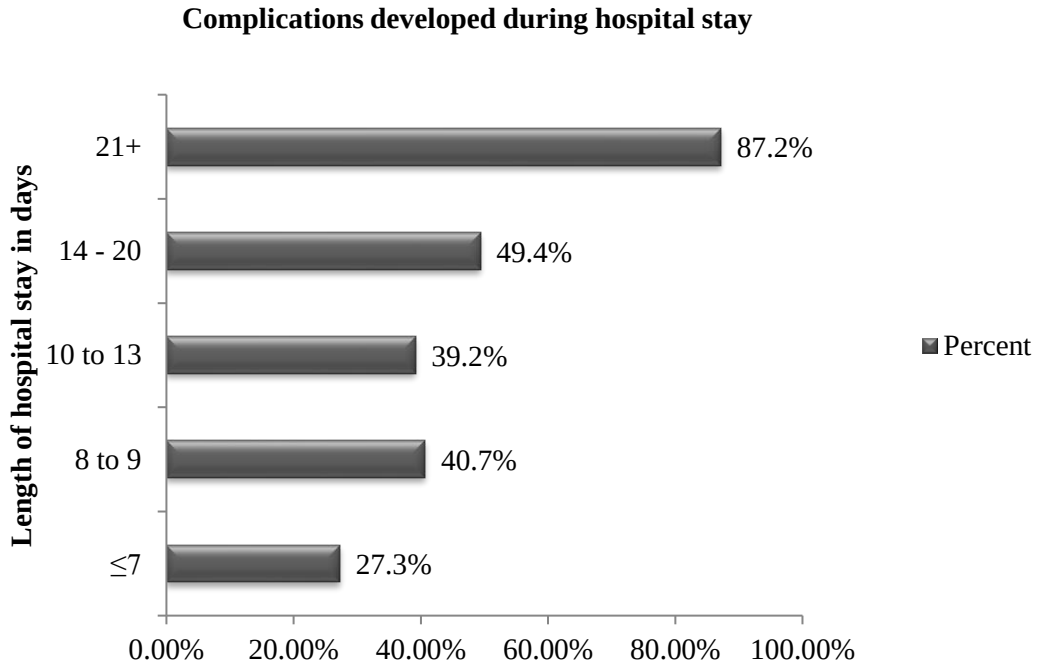

Figure 5: The trend of complication incidence among DM patients during hospital stay** at **TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398)

2.2. Direct medical cost of Hospitalization

During hospital stays, the total expenditure for DM patients amounted to $166,074.14 . The largest components of this cost were for medication and medical supplies ($65,804.70), followed by laboratory and imaging procedures ($53,649.76 and $26,174.33 , respectively). The median costs and IQR for these categories were as follows: $133.02 (IQR 113.02) ,$128.39 (IQR $68.97) , $47.27 (IQR 80.69). On average, each patient incurred a total cost of $417.27 from admission to discharge Table 10 **.**

Table 10: Direct medical cost of DM patients admitted** at **TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398)

Direct Medical Cost Types	N	Median	IQR	Total Cost ($)
Total cost for medication and medical supplies	398	$133.02	$113.20	$65,804.70
Total cost for laboratory procedures	398	$128.39	$68.97	$53,649.76
Total cost for imaging procedure	398	$47.27	$80.69	$26,174.33
Total cost for bed occupancy	398	$38.18	$37.47	$18,416.46
Cost of medical record	398	$1.82	$1.00	$602.94
Other direct medical costs[a]	398	$0.00	$0.00	$1,425.95
Grand Total				$166,074.14

[a]Includes cost for wound care ; IQR, Interqurtile range; USD, United State's dollar

2.3. Outcomes of admitted DM patients

Among DM patients admitted to the three hospitals and included in this study, 340 (85.4%) were discharged with significant improvement. However, 30 individuals (7.5%) died, representing the overall mortality rate. Notably, the majority of these deaths occurred in patients with type 2 DM, accounting for 26 (7.9%) of the total deaths*Table 11*.

Table 11: Outcome of admitted DM patients by types** at **TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398)

Outcomes	Overall (N = 398)	T2DM (N = 330)	T1DM (N = 68)
Discharged to home after improvement	340 (85.4%)	279 (84.5%)	61 (89.7%)
Died in hospital	30 (7.5%)	26 (7.9%)	4 (5.1%)
Transferred to other units	20 (5%)	17 (5.2%)	3 (3.4%)
Discharged against medical advice	8 (2%)	8 (2.4%)	0 (0%)

T2DM, type 2 diabetes mellitus; T1DM, type 1 diabetes mellitus

3. Mortality Analysis and Survival Outcomes

A Kaplan-Meier survival analysis was conducted to estimate time-to-death based on variables significantly associated with mortality. The analysis showed that 50% of patients with more than three comorbidities did not experience the event from the time of inclusion to the end of the follow-up, compared to those with three or fewer comorbidities. This difference was statistically significant (log-rank test, P = 0.002).Patients admitted with acute hemorrhagic stroke had a MST of 23 days (95% CI [21.37–24.63]), significantly shorter than patients without this diagnosis, who had a MST of 55 days (log-rank test, P = 0.002). A notable difference in median survival was also observed between patients who developed UTI during their hospital stay and those who did not. Patients with a UTI had a MST of 25 days versus 55 days for those without a UTI, which was statistically significant (log-rank test, P = 0.015). For detailed statistics, see Table 12. Survival curves are shown in *Figure 6*,*Figure 7*,*Figure 8*,and *Figure 9*

Table 12: Mortality Events Stratified by Significant Variables of DM patients admitted** at **TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398)

Variables	Category	Cases	Events	Censored	Median survival time in days (95% CI)
Existing comorbidity	≤3	360	21	339	55(28.90-81.11)
	>3	38	9	29	NR
Urinary tract infection(UTI) during hospital stay	No	375	26	349	55(30.75-79.25)
	Yes	23	4	19	25(10.85-39.16)
Acute Haemorragic stroke at admission	No	383	26	357	55(8.84-101.16)
	Yes	15	4	11	23(21.37-24.63)
Sepsis at admission	No	366	24	342	90(28.94-151.06)
	Yes	32	6	26	35(8.21-61.79)
Last RBS before outcome	Achieved target RBS	161	4	157	90
	Notachieved target RBS	237	26	211	45(29.74-60.26)

NR:Not reached median survival time ,RBS:Random blood sugar,DM:Diabetes mellitus,AKI:Acute kidney injury,CKD:Chronic kidney disease

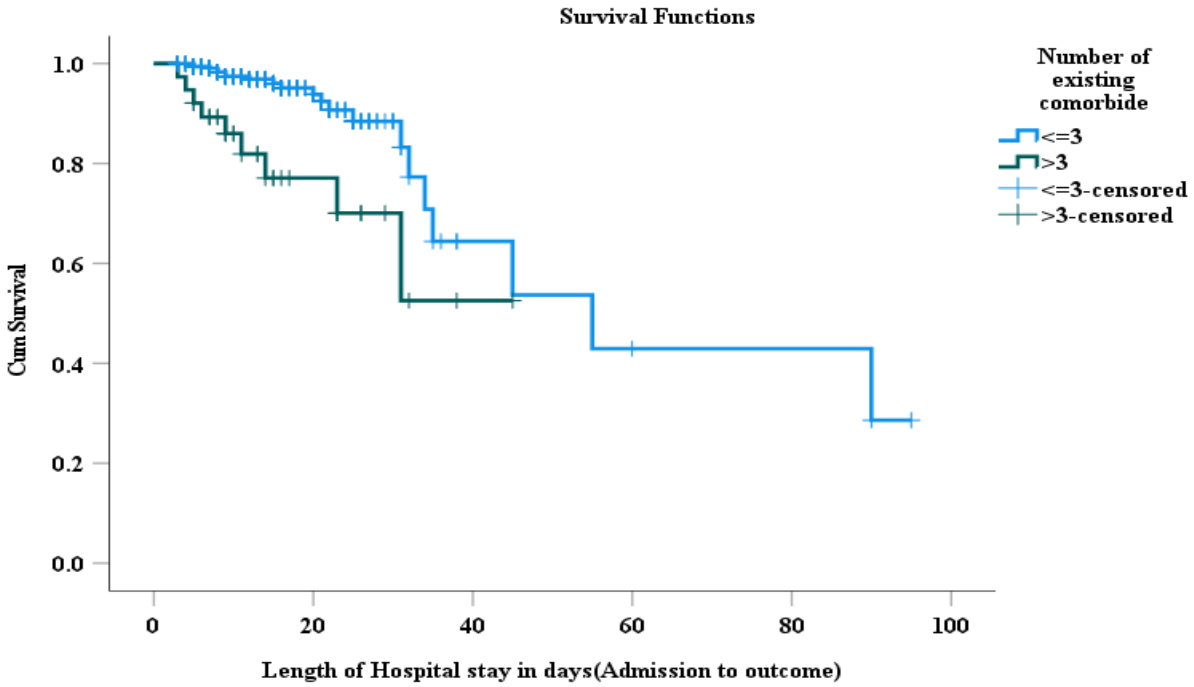

Figure 6: Survival cures stratified by number of comorbidities of DM patients admitted** at **TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398)

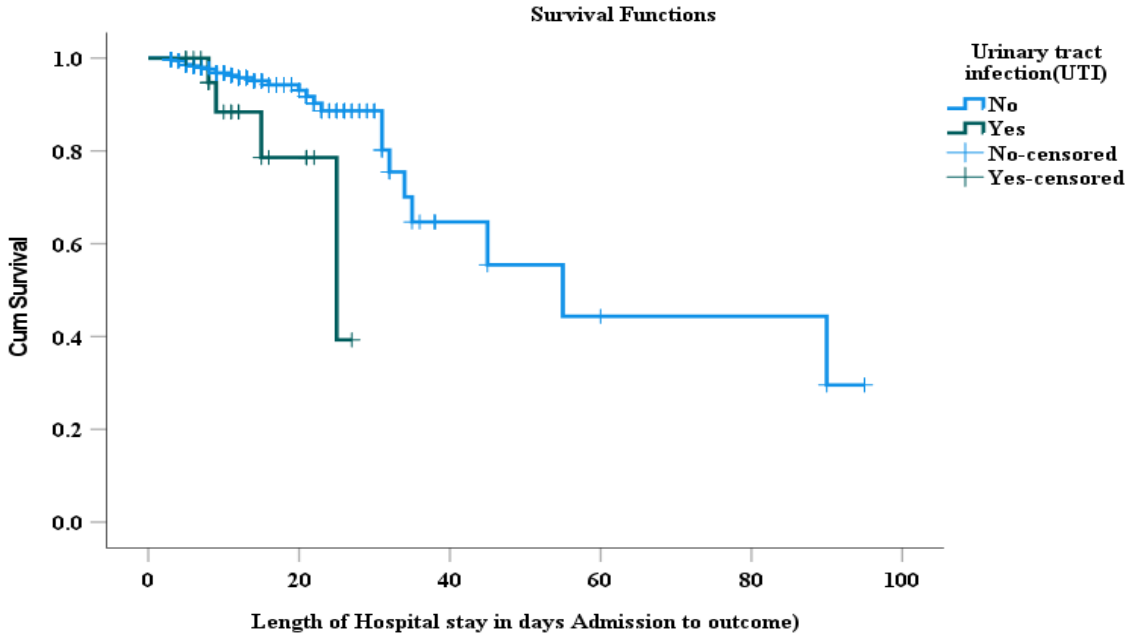

Figure 7: Survival cures stratified by hospital acquired UTI of DM patients admitted** at **TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398)

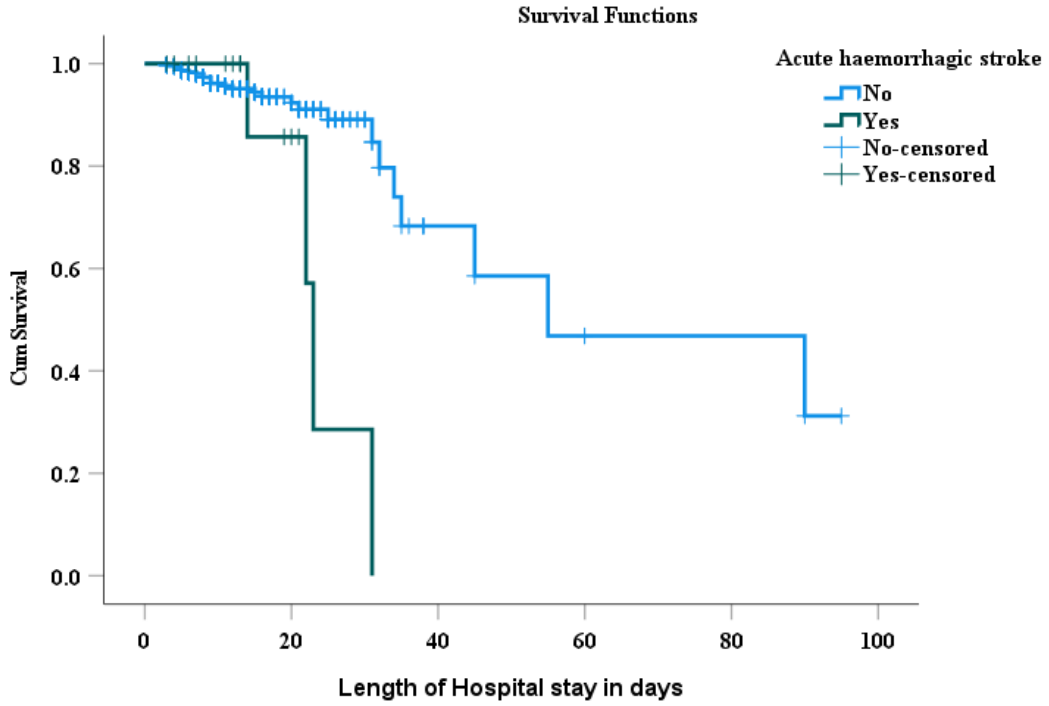

Figure 8:Surival curves stratified by acute haemorragic stroke of DM patients admitted** at **TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398)

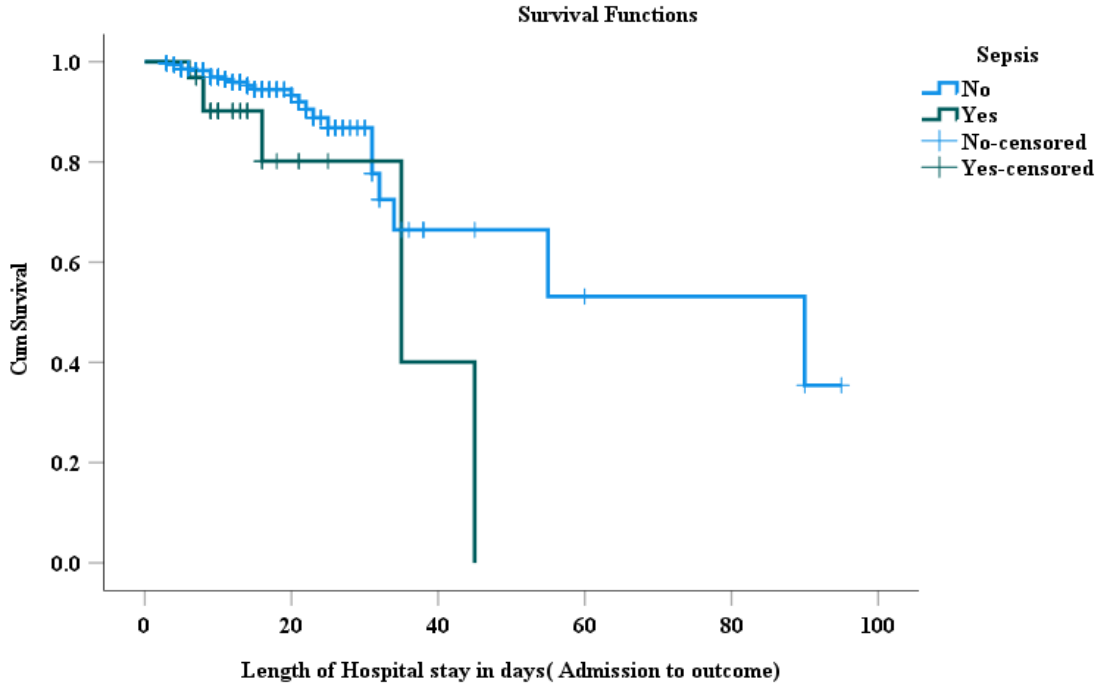

Figure 9:Survival curves stratified by sepsis of DM patients when admitted** at **TASH,ZMH and SPMMC from 15-Jully-2023 to 29-February-2024 (N=398

3.1:Risk factors associated with mortality outcome

Using Cox's proportional hazards model to assess the impact of various variables on mortality among DM patients, we initially found that several factors were associated with mortality in the bivariate Cox regression analysis. These included occupation, existing comorbidities such as chronic liver disease, chronic anemia, depression, and old ischemic stroke, as well as the number of existing comorbidities. Main admission diagnoses like ADHF ,AKI on CKD, acute hemorrhagic stroke, and community acquired sepsis were also significant. In-hospital complications such as hypoglycemia and UTIs, as well as digoxin use before and during the hospital stay, duration of diabetes, the last RBS value before the outcome, and diabetes status were additionally associated with mortality with the cut points (P=0.25). However, after adjusting for confounding factors in the multivariate Cox proportional hazards regression analysis, only the following factors remained independently and significantly associated with mortality ($p < 0.05$): having three or more comorbidities, admission with AKI on CKD, acute hemorrhagic stroke, community-acquired sepsis, and uncontrolled blood glucose levels during the hospital stay.

The impact of various risk factors on mortality among DM patients was evaluated using Cox's proportional hazards model, controlling for potential confounders. The results showed that DM patients employed in agriculture and the private sector faced significantly higher risks of death compared to government employees, with AHRs of 7.29 and 6.53, respectively. In contrast, those with chronic liver disease had a 2.78-fold higher risk of mortality compared to those without this comorbidity, although this finding was not statistically significant ($p = 0.223$). Known diabetes had a 4.59-fold higher risk of death compared to newly diagnosed patients, but this difference was not statistically significant ($p = 0.214$). The study also found that patients with more than three existing comorbidities had a significantly higher mortality risk, with an AHR of 5.50 ($p = 0.001$). Additionally, DM patients admitted with sepsis or acute hemorrhagic stroke had significantly higher mortality risks, with AHRs of 7.98 and 4.54, respectively. Those who developed UTIs during hospitalization faced a 6.87-fold increased risk of death, a finding that was statistically significant ($p = 0.009$). Although hypoglycemia during hospitalization was associated with a 2.65-fold increased risk of mortality, this association did not reach statistical significance ($p = 0.065$). Lastly, patients who failed to achieve target blood glucose levels had a significantly higher mortality risk, with an AHR of 3.63 ($p = 0.032$). These findings highlight the significant role of occupational status, comorbidities, acute conditions, and blood glucose control in influencing mortality outcomes in DM patients.For further information, please refer to **Table 13** below.

Table 13: Hazard ratios for risk factors associated with mortality among admitted DM patients at TASH,ZMH,and SPMMC from July 15-2023 to 29-February -2024(N=398)

Variables	Category	Crude Hazard ratio (95% CI)	P value	Adjusted Hazard ratio (95% CI)	P value
Occupation	Government employed	1	-	1	-
	Private employed	2.70(0.57-12.74)	0.209	6.92(0.98-48.69)	0.052
	Merchant	0.76(0.11-5.38)	0.779	0.63(0.07-5.81)	0.682
	Student	1.79(0.24-13.60)	0.572	6.53(0.51-83.32)	0.149
	Farmer	1.74(0.16-19.28)	0.652	7.29(0.44-119.96)	0.164
	House wife	2.85(0.59-13.51)	0.187	2.66(0.39-18.21)	0.318
	Retired	3.28(0.66-16.44)	0.148	3.42(0.43-27.30)	0.247
Chronic liver disease (CLD)	No	1	-	1	-
	Yes	2.35(0.69-7.96)	0.17	2.78(0.54-14.40)	0.223
Chronic anemia	No	1	-	1	-
	Yes	3.38(1.00-11.39)	0.049	1.52(0.29-7.83)	0.618
Depression	No	1	-	1	-
	Yes	2.22(0.66-7.54)	0.2	0.79(0.14-4.46)	0.793
Acute decompensated heart failure(ADHF)	No	1	-	1	-
	Yes	1.78(0.68-4.70)	0.243	1.51(0.25-5.21)	0.856
Diabetic status of the patient	Newly diagnosed	1	-	1	-
	Known diabetics	6.56(0.82-52.46)	0.076	4.59(0.41-50.84)	0.214
Ischemic stroke	No	1	-	1	-
	Yes	2.39(1.00-5.71)	0.049	0.98(0.30-3.21)	0.977
Number of existing comorbidities	≤3	1	-	1	-
	>3	3.37(1.52-7.51)	0.003	5.50(1.96-15.40)	**0.001**
Digoxin	No	1	-	1	-
	Yes	2.17(0.67-6.26)	0.208	2.32(0.48-11.30)	0.296
Hypoglycemia developed during in hospitals stay	No	1	-	1	-
	Yes	2.47(1.05,5.82)	0.038	2.65(0.94-7.48)	0.065

Urinary tract infection(UTI)	No	1		1	
	Yes	3.48(1.18-10.30)	0.024	6.87(1.63-29.02)	**0.009**
AKI on CKD	No	1	-	1	-
	Yes	1.89(0.71-5.01)	0.201	2.47(0.60-9.67)	0.214
Acute hemorrhagic stroke	No	1	-	1	-
	Yes	4.57(1.56-13.41)	0.006	4.54(1.07-19.24)	**0.04**
Sepsis at admission	No	1	-	1	-
	Yes	2.76(1.11-6.85)	0.029	7.98(2.44-26.14)	**0.001**
Duration of DM	≤5years	1	-	1	-
	>5years	2.73(1.08-6.89)	0.035	1.69(0.53-5.36)	0.373
Last measurement of RBS before out-come	Achieved target RBS	1	-	1	-
	Not achieved target RBS	4.55(1.57,13.14)	0.005	3.63(1.12-11.76)	**0.032**

4.Discussion

This multicenter prospective study of DM patients in non-ICU internal medicine wards assessed clinical characteristics, management practice, and outcomes. Many patients were overweight, with low vaccination rates and suboptimal SMBG, highlighting gaps in preventive care. Most (95%) had ≤3 comorbidities, commonly hypertension and heart failure, and 62.6% had chronic complications like PNP or CKD. Treatment included basal insulin with correctional doses (45.5%) or basal-bolus therapy (24.4%), yet 59.5% failed to achieve target blood glucose levels. Nearly half (47.5%) developed in-hospital complications, primarily AKI, hypoglycemia, and electrolyte disturbances. The mortality rate was 7.5%, higher in Type 2 DM patients. Shorter MST were to patients admitted with hemorrhagic stroke, and those who developed UTIs. Cox regression identified >3 comorbidities, AKI on CKD, hemorrhagic stroke, sepsis, and uncontrolled blood glucose as independent predictors of mortality ($p < 0.05$).

Physical activity improves diabetes management by lowering HbA1c, enhancing insulin sensitivity, reducing post-meal glucose, decreasing cardiovascular risks, and boosting fitness and immune function, aiding infection and vaccine response[53, 55]. The ADA recommends 150 minutes of walking per week for diabetes patients[53], despite this only 62.1% met this target, aligning with Gonder (60.6%)[56] but, lower than 82.30% in China[57]. Differences may reflect China's use of metabolic equivalents and inclusion of shorter activities.Diabetes patients face higher risks of infections like influenza, hepatitis B, COVID-19, and pneumococcal pneumonia, leading to increased complications and mortality. The ADA recommends vaccinations, including influenza, Pneumococcal Polysaccharide Vaccine 23 (PPSV23) for adults 19–64 (with a second dose at ≥65), and hepatitis B[53]. However, only 39.9% reported any vaccination, with no reports for pneumococcal or influenza vaccines, and just 2.8% received hepatitis B, far below Brazil's 13.7%[58]. This disparity may reflect gaps in healthcare access, awareness, infrastructure, and policies.

Similarly SMBG allows patients to monitor their blood glucose levels daily, providing real-time information about hypoglycemia and hyperglycemia. This enables patients to adjust carbohydrate intake, insulin administration, and activity levels accordingly, thereby reducing the risk of both short-term and long-term complications associated with DM[59].Our study however found that 56.5% of participants engaged in SMBG at home, higher than 38.3% reported in 2019 at referral hospitals in Addis Ababa[60].This relatively increased rate of home SMBG in our study may be due to increased awareness of glycemic monitoring over time among DM patients. However, it is lower compared to the study done in China 67.8%[61] and 97.72% in the USA[62]. Low SMBG rates may be due to limited education, financial constraints,

overwhelm with disease management, reliance on healthcare providers, undervaluing daily self-monitoring and psychological barriers, such as fear of needles or anxiety about results[63, 64]. Addressing these issues could enhance self-management and ultimately improve patient outcomes.

In our study, 89.7% of participants had at least one medical condition ,a higher prevalence than India's 78% [65] but lower compared to reports from USA where 91.3% had the conditions[66]. Systematic reviews indicate that diabetes patients often develop multimorbidity due to chronic inflammation, insulin resistance, obesity, vascular damage, and aging, which worsen health outcomes [9, 53] .

Cardiovascular conditions were prominent comorbidities, including hypertension (61.3%) and heart failure (37.2%), alongside HIV (11.1%), COPD (12.6%), asthma (10.3%), and depression (3.3%). Hypertension prevalence was higher than in India at 44.6%[65] but similar to Nigeria at 59.1%[67], South Korea at 66.94%[32], Jimma Ethiopia58.62%[68]. On the other hand the prevalence of heart failure (HF) in our study was lower compared to the findings from Spain where 55.6% of participants had HF[69], suggesting common challenges in managing cardiovascular health alongside diabetes. The lower COPD prevalence in our study compared to 22.5% in Spain[69] and 27% in Georgia [70] may be due to differences in environmental factors like air quality, pollution, and industrial emissions, as well as regional variations in smoking, occupational hazards, and indoor air quality.

In our finding, 62.6% of diabetes patients experienced chronic complications, higher than reported in Egypt (50.8%) [22]and Uganda (56.7%)[71], but lower than South Korea (67.24%)[32]. Differences may be due to variations in healthcare access, education, duration of DM and resources. Limited resources in Ethiopia may contribute to the higher prevalence despite the lower report rate than South Korea. The prevalence of DNP (28.4%) aligns with Pakistan[72], but PNP was lower than in Pakistan (36.6%)[72] and Iran (52%)[73], possibly due to diagnostic criteria, or healthcare access ,lifestyle factors, disease duration, and genetic predispositions could influence the observed differences in PNP prevalence, emphasizing the importance of tailored healthcare strategies that consider these variables. Our study indicates that microvascular complications are significantly more pronounced in individuals with diabetes for ≥5 years compared to those with diabetes for <5 years, whereas macrovascular complications show a less dramatic increase. This difference can be attributed to the distinct pathophysiological mechanisms underlying each type of complication. Microvascular complications begin soon after the onset of diabetes, primarily due to chronic hyperglycemia, which leads to endothelial dysfunction, increased oxidative stress, and inflammation[74-76]. In contrast, macrovascular complications, including ischemic heart disease (IHD), PAD, and stroke, are

influenced more by long-term risk factors such as atherosclerosis, hyperte nsion, and dyslipidemia. In addition to these, factors such as chronic inflammation, insulin resistance, and lifestyle behaviors (like smoking and physical inactivity) also contribute to their development. Thus macrovascular conditions generally take years to manifest, as they result from the cumulative effects of these risk factors over time[76, 77].Therefore proactive measures during the initial stages of DM are essential to mitigate both immediate microvascular complications and future macrovascular issues.

The basal-bolus insulin regimen is preferred for hospitalized diabetic patients with good oral intake. It involves multiple daily injections, with basal insulin for background coverage and bolus insulin for mealtime control, mimicking natural insulin secretion. This regimen improves glycemic control, reduces fasting and postprandial hyperglycemia**,** and lowers the risk of hypoglycemia when adjusted properly. It offers flexibility in meal timing and enhancing outcomes and reducing complications[53, 78]. Despite the advantages and guidelines recommendations, our study found the basal-bolus insulin regimen used in only 24.4% of hospitalized diabetic patients, significantly lower than studies in the USA 41.4%[79], and Australia 56.36%[80] , and Egypt 67.3% [22] .However, it is higher than than 16.6% reported in South African hospital[81]. These differences might be due to variations in hospital protocols, healthcare infrastructure, provider awareness and training, challenges in implementing personalized insulin regimens, patient specific factors and ,fear of hypoglycemia.

A basal-correctional insulin regimen is used when oral intake is poor, combining basal and correctional insulin to manage hyperglycemia. It is suitable for NPO patients or those on enteral or parenteral nutrition,in the absence of regular meal. While less flexible than the basal-bolus regimen, it can lead to less optimal glycemic control, higher postprandial glucose, and an increased risk of hypoglycemia or hyperglycemia due to less precise dosing[13, 53, 78]. Our findings showed that 45.5% of patients were prescribed the basal plus correctional insulin regimen, which is higher than the 36.6% reported in South Africa[81] but comparable to the 48.1% documented in Atlanta, Georgia[46]. The discrepancy may be differences in clinical guidelines, healthcare system resources, and patient factors such as age, comorbidities, baseline blood glucose control and varying severities of conditions treated across locations could influence insulin regimen choices. Although we couldn't directly associate these treatment regimens to blood glucose control, mortality, or in-hospital complications due to varying insulin regimen used, the suboptimal glycemic control with only 40.5% of participants achieving target RBS may be related to these regimens.

While patients with diabetes received various antidiabetic medications alongside the specified insulin regimens, 40.5% achieved target blood glucose levels. This outcome is higher than a study done in Jimma,Ethiopia, which reported only 18.2% of patients reached their target levels[54]. Several factors may have contributed to this low level of glycemic control. A significant reason could be that diabetes management may receive less attention, as many patients were admitted for non-diabetes-related diagnoses, which can lead to inadequate monitoring and adjustments in treatment plans[27]. Moreover poor patients adherence to insulin regimens, psychological stress, more coexisting health conditions, relying on point-of-care blood glucose monitoring (POC-BGM) rather than using continuous glucose monitoring (CGM) and limited access to education and support services, complicate effective glycemic control during hospitalization[82]. Together, these factors illustrate the multifaceted challenges that patients with diabetes face in achieving optimal blood glucose control during hospitalization.

Furthermore, 47.5% of patients experienced various in hospital complications,such as AKI at 13.1**%**, hypoglycemia at 9.3**%**, and electrolyte disturbances at 9.5**%**.The rate of AKI was significantly higher than the 2.5**%** reported in Germany[17] and hypoglycemia was also elevated compared to a study in Spain, which reported a rate of 2.2**%**[69]. These findings highlight the challenges diabetic patients face during hospitalization, likely due to poor diabetes management.However, due to the wide variety of medications patients were taking, we could not link these complications to specific treatments, complicating the analysis of potential causes. This indicates the critical need for targeted monitoring and individualized management strategies.

The median hospital stay was eleven days, longer than the eight days reported in Jimma, Ethiopia[68], but shorter than the eighteen days reported in Harari[41], Ethiopia. It is also significantly longer than the four days reported in India[65].These suggests some similarities in trend of hospital stay within Ethiopia, while highlighting notable differences compared to Indian. This discrepancy may reflect differences in patient care practices or the severity of cases treated in the two settings.With this median length of stay, the mortality rate was 7.5%, concerning for type 2 DM patients, where the mortality rate was 7.9% compared to 5.4% for type 1 DM patients. This overall mortality rate is lower than the 10% reported in Spain[20] ,23.7% in Nigeria[83] and 13.34% in Jimma[68], Ethiopia ,which had more admissions due to acute complications of diabetes, factors that may increase mortality risk.

The analysis showed that 50% of patients with more than three comorbidities did not experience the event from the time of inclusion to the end of the follow-up, compared to those with three or fewer

comorbidities. But a study done in Jima,Ethiopia also revealed that the risk of mortality increased with the number of comorbidities[68]. Additionally, it is inconsistent with a systematic review that indicated patients with DM often face compounded health issues due to comorbidities and complications. These factors increase the risk of acute events and polypharmacy, raising the potential for adverse drug interactions and side effects, which can significantly reduce survival time[84]. The discrepancy may be attributed to a combination of high censoring, timing of the events, and a small number of events in this study

Moreover, Cox proportional hazards regression was employed to estimate the hazard of death among hospitalized DM patients. The analysis revealed that, after controlling for covariates, the risk of death was significantly higher for DM patients working in agriculture and the private sector compared to those employed in government positions, with AHRs of 7.29 and 6.53, respectively. Additionally, another study in Ethiopia reported an increased hazard of mortality among rural residents, with AHR of 3.46 for rural residents[68].This increased risk may be attributed to factors such as greater exposure to physical stressors, limited access to healthcare, and potential socioeconomic challenges faced by agricultural and private sector workers, which can adversely impact their overall health management and increase mortality risk.
DM patients with chronic liver disease face a higher mortality risk, with an AHR of 2.78 times greater chance of dying compared to those without this comorbidity. This risk is higher than an AHR of 1.98 reported in the USA[85],but consistent with another study in this country that reported an AHR of 2.41 for mortality[86] . Increased mortality in these patients is due to impaired liver function disrupting glucose metabolism and detoxification, chronic inflammation, and comorbidities like obesity and hypertension .Limited healthcare access further complicates management, heightening infection risk leading to worse outcomes[87].
In general DM patients with more than three existing comorbidities had a 5.5 times increased risk of death rate compared to those with ≤3 comorbidities, and there was a statistically significant difference between the two groups (logrankp=0.001, 95%CI:1.96-15.40) after adjusted for covariates. However, study done in Jima ,Ethiopia reported that DM patients with three comorbidities had an AHR of 2.21 for mortality[68], which is lower than our finding. This discrepancy may stem from differences in data categorization, which can affect reported associations and underscores the need for standardized definitions in future research to allow better comparison of outcomes across studies.
Our study revealed that certain main admission diagnoses significantly impact mortality outcomes , beyoned existing comorbidities. Notably, DM patients admitted with sepsis from various foci demonstrated

a strikingly high risk of mortality, reflected by an AHR of 7.98. This suggests a severe vulnerability in this population, especially when contrasted with the much lower AHR of 1.21 reported in the Israeli study[88]. The si gnificant difference in mortality risk may stem from factors such as patient demographics, clinical management practices, sepsis severity at admission, underlying health conditions, and access to timely interventions, highlighting the need for targeted strategies to improve outcomes in DM patients with sepsis.

Additionally, those presenting with acute hemorrhagic stroke had a mortality risk of of 4.54, compared to those without such medical conditions. This represents a higher risk than reported in Germany, which found an AHR of 2.65[89] and an AOR of 1.46 reported in Australia[90]. The increased mortality risk in our study may be due to factors like patient demographics, a high prevalence of underlying conditions such as HTN (a stroke risk factor), and regional variations in healthcare practices.

Furthermore, patients who experienced inhospital complications, such as UTIs and hypoglycemia, faced increased mortality risks even after adjustment for various confounders, as indicated in**Table 13**. In our finding, patients who developed UTIs were significantly associated with increased mortality, with a p-value of 0.009. The link between UTIs and diabetes is well-established, with hyperglycemia leading to glucosuria, promoting bacterial growth, and autonomic neuropathy causing urinary retention, all increasing UTI risk[91, 92].These complications often correlate with poor glycemic control, creating a vicious cycle that may culminate in higher mortality rates.

Moreover, DM patients who developed hypoglycemia during their hospital stay showed an increased risk of mortality, evidenced by an AHR of 2.65. Previous studies by **Brodovicz**, **Davies, and Engel** reported relatively similar findings, with an AOR of 1.66 [93] and Hinojosa et al. noted an OR of 1.24[94]. Systematic reviews have pointed out that hypoglycemia can lead to mortality due to low blood glucose-induced arrhythmias resulting in cardiac death[95].

Furthermore, patients who did not achieve target blood glucose levels had a 3.63 times higher risk of mortality compared to those who did, with a significant difference observed between the two groups (Logrank P = 0.032). This risk of mortality was higher than reported in Jima, where an AHR of 2.42 was found[68]. These findings emphasize the critical importance of effective glycemic control and the management of complications to reduce mortality risks in hospitalized diabetes patients.

5.Strength and Limitation of study the study

5.1 Strength of the study

This multicenter prospective study provides valuable insights by capturing both objective and subjective data on clinical characteristics, management, and direct medical costs. It enables comprehensive monitoring of factors like glycemic control, in-hospital complications, and associated costs, offering critical information for future management. The prospective design allows for tracking changes over time, deepening our understanding of clinical dynamics and supporting the development of targeted interventions to improve patient outcomes.

5.2.Limitation of the study

This study has several limitations that should be considered when interpreting its findings. First, the research was confined to three hospitals in Addis Ababa, which limits its generalizability to the broader diabetic patient population across Ethiopia. The results may not reflect the experiences of patients in rural or under-resourced regions. Additionally, as a prospective observational study, it can only identify associations between variables such as mortality and hospitalization costs but cannot establish causality. The exclusion of specific patient groups, including those in intensive care units, pregnant women, individuals with active psychiatric symptoms, and those with hospital stays of less than 24 hours, further limits the scope and comprehensiveness of the findings, as these populations might have distinct patterns of mortality and hospitalization costs.

Another limitation stems from the reliance on self-reported data for lifestyle factors such as physical activity, smoking and alcohol consumption, which are prone to recall bias or inaccuracies in reporting. Incomplete or missing data, particularly for costs associated with external pharmacies or imaging procedures, could also affect the reliability of the cost analysis despite efforts to account for sampling errors. Moreover, the study's focus on data collection during hospitalization means that long-term effects, such as post-discharge mortality or the progression of chronic conditions, are not captured.

The use of semi-structured interviews and medical records, although validated by endocrinologists, may introduce observer bias or fail to fully document the patients' conditions and treatments. Despite controlling for factors such as demographics, comorbidities, and lifestyle, unmeasured confounders—such as environmental influences or variations in hospital care practices could influence the outcomes. The cost

calculations are based on hospital-specific pricing data and the exchange rates at the time of data collection, which could be impacted by changes in exchange rates or healthcare costs over time. Finally, the findings may be influenced by cultural and socioeconomic factors unique to Addis Ababa, which may not reflect the experiences of diabetic patients in other parts of Ethiopia, particularly those in regions with different cultural or socioeconomic contexts.

6. Conclusion

Our study underscores the critical impact of comorbidities, complications, and treatment-related factors on in-hospital mortality among patients with diabetes. Independent predictors of mortality identified with statistical significance ($p < 0.05$) included the presence of more than three comorbidities, admission wit-AKI on CKD, hemorrhagic stroke, sepsis, and uncontrolled blood glucose levels during hospitalization. In-hospital complications such as hypoglycemia and urinary tract infections were also independently associated with increased mortality. Furthermore, low adulthood vaccination rates and inadequate self-monitoring practices highlighted significant gaps in care. A longer hospital stay was associated with a higher risk of acquiring in-hospital complications. Additionally, the assessment of direct medical costs revealed a high expenditure burden, even without factoring in the devaluation of the Ethiopian birr. These findings emphasize the urgent need for comprehensive and proactive management strategies to improve clinical outcomes and reduce the healthcare burden among hospitalized diabetes patients. To achieve better outcomes, tailored treatments, proactive clinical management, and enhanced patient education are essential.

6.1. Recommendations

For Policymakers (MOH):

To shape a healthier future, policymakers must urgently elevate diabetes as a national public health priority starting with targeted education campaigns in rural and underserved communities where awareness and access remain limited. Accelerating the integration of advanced technologies, such as CGM in hospital settings, is essential for real-time, patient-centered disease management. Nationwide implementation of updated, evidence-based treatment guidelines and algorithms will ensure consistent, high-quality care across both inpatient and outpatient services, aligned with evolving clinical characteristics and individual patient needs. Increased and sustained healthcare financing is critical to support these reforms and guarantee uninterrupted access to essential diagnostics, medications, and monitoring tools. With bold, future-

ready leadership, policymakers can transform diabetes care reducing complications, empowering patients, and building a resilient, equitable health system

For healthcare providers and hospitals:

Hospital leadership and clinical teams must drive a transformative approach to diabetes management by prioritizing high risk patients particularly those with hemorrhagic stroke, sepsis, AKI on CKD, or multiple comorbidities through focused, multidisciplinary care aimed at reducing complications and improving survival. A shift from traditional point of care testing to CGM is essential for achieving tighter glycemic control, quicker interventions, and consistent care supported by standarized protocols. Early, individualized insulin regimens should be implemented to prevent deterioration and accelerate recovery. Streamlined workflows, proactive care coordination, and early warning systems can further reduce hospital stays and prevent avoidable complications. Simultaneously, hospitals must ensure uninterrupted access to essential medications, diagnostics, and supplies to ease patient financial burdens and enhance treatment efficiency. These measures are not optional they are vital to delivering smarter, faster, more equitable, and financially sustainable inpatient diabetes care..

For the Public:

- Improve awareness and participation in diabetes management practices, including vaccination and regular health monitoring, to reduce complications.

For Future Researchers:

- Explore the effectiveness of tailored treatment regimens and integrated management strategies in reducing diabetes-related mortality in similar settings.
- Investigate barriers to achieving optimal vaccination rates and self-monitoring among diabetes patients for targeted interventions.

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8. Annex

Date of admission ……and Date of discharge/death/referral/discharge against/transferred…….

8.1. Data Collection tool

Part I: Demographic data

1. Age (yrs.) --------

2. Gender: 1. Male 2. Female

3. Place of residence: 1) Urban 2) Rural

4. Educational level: 1) No formal education 2) Primary school 3) Secondary school 4) College and above

5. Household income :(ETB/month) --------birr

6. Occupation: 1) Government employed 2) Private employed 3) Merchant) 4) Student 5) Farmer 6) House wife 7) Retired 8.labor

7. Marital status: 1.Single 2.Married 3.Divorced 4.Widowed

8. How do get your medication? 1. Paid 2. Free 3.Fully Health Insurance 4.partial health insurance coverage

Part II. Health Information and Lifestyle Factors

9. History of cigarette smoking	1.Never smoked 1.previous smoker 2.current smoker
10.History of alcohol consumption	1.Never drank 2.Previous drinker 3.Current drinker
11. Restricted diets by health care providers	1.No restricted diet 2.charbohydrate and alcohol 3.carbohydrate ,fatty meal and alcohol 4.carbohydrate ,fatty meal, salt and alcohol 5.Carbohydrate,salt and alcohol 6.carbohydrate ,protein ,salt and alcohol 7.carbohydrate and salt only 8.Carbohydrate only 9. If other specify…….
12.Level of physical activity	1.physiclally inactive 2.Physically active
13.History of recreational drug use	1.Not recreational drug user 2.Chat chewing 3.Hashish/cannabis 4.Opoid drugs 5. If other specify……
14. Immunization history	1.Not immunized 1.Covid-19 vaccination 2. Hepatitis B 3. If other specify…

15.Body mass index (BMI)	Normal	Height(M)	Weight(Kg) ,BMI= Kg/m^2
	Over weight		
	Under weight		
	Obese		
	Morbid obese		
16. Do you have person assist you in medication use	Yes (1)	No (0)	
17. Is there self-monitoring blood glucose monitoring practice at home?	Yes(1)	No(0)	
18.Do you have Family History of DM	Yes(1)	No(0)	

19) **Types of DM**: 1) Type I 2) Type II 3) Not classified

20) Encircle the main diagnosis of admission:

1. Diabetic foot ulcer
2. Peripheral artery diseases with gangrene (PAD)
3. Acute decompensated heart failure (ADHF)
4. Decompensated CLD
5. Uncontrolled hypertension
6. Severe community acquired Pneumonia (SCAP)
7) acute kidney injury (AKI).
8. AKI on Chronic kidney disease (CKD)
9.Acute ischemic stroke
10. Acute haemorogic stroke
11. Severe anemia
12.sepsis
13. Acute exacerbation of asthma
14.Acute deep vein thrombosis (DVT)
15. Pyelonephritis
16.pyogenic meningitis
17. Acute exacerbation of COPD
18.complicated Tuberculosis (TB)
19. Upper GI bleeding
20.acute ischemic heart disease (IHD)
21. Cellulitis
22.Acute pulmonary embolism
23. Recurrent hypoglycemia
25.Epileptic seizure
24. Corpulmonale
26. If other specify

21. List the main clinical presentation during admission:

22. Encircle all existing comorbidities

1. Hypertension
2. Heart failure
3.Cancer
4.chronic valvular heart disease
5.HIV
6.chronic anemia
7.chronic liver disease
8.Parkinson
9. Asthma
10.Known hypertensive heart disease (HHD)
11. Depression
13.Epilepsy
12.COPD
14 .If other existing comorbidities specify……..

15.No existing comorbidities

23. **Number of existing comorbidities…….**

24. **What is the diabetes status of the patient**? 1. Newly diagnosed 2.known diabetes

25) Duration of diabetes after confirmed diagnosis for known diabetes……years

26) Encircles all chronic complication of DM that exists

1. Diabetic retinopathy 4.CKD 7) known IHD

2. Diabetic nephropathy 5.Old stroke 8.PAD

3. Diabetic foot Ulcer 6.peripheral neuropathy (PNP) 10.No chronic complications

9.If other chronic complications specify……..

27. **Number of diabetic specific chronic complications** …….

Part3) Complications developed during hospital stay

28. Encircle types of all complications that develops while in hospital

1) Bed sore 4.DVT 7.Urinary tract infection (UTI) 12.HHS

2. Hypoglycemia 5.AKI 8.DKA 13.If other specify……

3. Sepsis 6.HAP) 9.Electrolyte disturbance 14.No complications

Part 4.Management for glycemic control before admission to medical ward

29) Encircle the antidiabetic regimen he/she was taking

1) Metformin monotherapy 3) Basal insulin only

2) Metformin plus SU 4) Basal Insulin + metformin+ SGLT2I

5) Basal Insulin + metformin 6).Mixtard insulin

7) Metformin +SGLT2I 8) SU monotherapy

9) Metformin+DPP4I 10.Metformin + SU +SGLT2I

11. Basal-bolus insulin 13.specify if other

12.Not on antidiabetic agents

30).If the patient has existing comorbidities, encircle all the medications he/she was taking

1. CCB 6.clopidogril 75mg 11.Warfarin 16.Diuretics

2. ACEI 7.HAART 12.Statin 17.Digoxin …

3. ARB 8.Asprin 81mg/100mg 14.BB 18.Amitryptyline

4.Beclomethasone puff 9.Budisonide/salmeterol 15.Gabapentin

5.Budisonide/salmeterol 10.levodopa/carbidopa … 19.If other specify it……

20.Not on antidiabetic agents

31) Initial antidiabetic regimen used for glycemic control after hospitalization

1. Basal with correctional insulin 3.Basal insulin only
2. Basal-bolus insulin 4.Sliding scale insulin only
5. Basal insulin +SGLT2I 6.If other specify……
7.Not on antidiabetic agent

Part5. Outcome

32. Encircle the outcomes of the patient

1. Discharged home after getting improvement
2. Died in the hospital
3. Transferred to other units
4. Discharged against medical care

Part6: Discharge medication of DM

33. Encircle the discharge DM medications

1. Metformin only 5. SU only
2. Metformin +SU 6. Metformin + DPP4I
3. Basal insulin +metformin 7. Basal insulin only
4. Metformin +SGLT2I 8. Mixtard insulin
9. Basal-bolus insulin 10.If other specify……
11.No antidiabetic medication

43. **Length of hospital stay** ……in days before death/discharge to home/transferred/referred/discharged against medical care

Part7.Baseline laboratory values

34. HbA1c value which is done during admission or within the past 3 months ……%

35) Random blood glucose within 24hours before discharge or death or transfer ----------mg/dl

36) Systolic blood pressure during admission……mmHg

37) Diastolic blood pressure during admission ……..mmHg

38) Systolic blood pressure during discharge/transfer to other units/death/refer…….mmHg

39) Diastolic blood pressure during discharge/transfer to other units/death/refer…….mmHg

40) Total cholesterol……..mg/dl

41) LDL cholesterol …….mg/dl.

42) HDL cholesterol ……..mg/dl

43) Triglyceride level……mg/dl

Part8. Direct medical cost of Hospitalization

44. Total cost for medication and medical supplies: ……birr

45. Total cost for imaging procedures……birr

46. Total cost for bed occupancy……birr

47. Total cost for laboratory procedures……birr

48. Total cost for medical record…….....birr

49. If there is other direct cost specify……. ……..birr

8.2. Annex II: Informed consent form

Hello, I am Yonas Demissie, MSC graduating student in pharmacy practice at department of pharmacology and clinical pharmacy, School of Pharmacy, College of health sciences, Addis Ababa University. I am conducting a study on the title of clinical characteristics, management and outcome of admitted diabetic patients at internal medical ward of Zewditu Hospital, Tikur Anbessa specialized Hospital and St.pual millennium medical college. So, I would like to ask you to take a few minutes and provide me information which will only be used in this study. Some information which is necessary for the study will also be taken from your medical records. The information collected will be kept confidential, which is ensured by your name and other personal identifiers will not be recorded on data collection form. So it has no any harm on you. The information will be taken only when you give permission and participation is totally dependent on your volunteerism. You have full right not to let access to your information on your medical records and not to give verbal information to be used for this study. But the information that would be taken will be quite useful for the study. You will not face any problem if you do not allow the information to be taken from your records and you. You will not also be denied of getting any medical services from the hospital. If you have any questionsabout this study you may ask me or the principal investigator Yonas Demissie: Tel: 0906121809

E-mail.dagmawiyonas782@gmail.com

Are you willing to let your information to be used for this study? 1. Yes 2. No

Signature of the interviewer which shows that the respondent has consented (verbally) to take partin the study