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Adherence to Treatment and Associated Factors Among Patients with Type 2 Diabetes Mellitus Attending Non-Communicable Disease Services in Rwanda: A Cross-Sectional Study

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HIGHLIGHTS

Even though most of the patients were females, l was aware of insulin and its purpose, their overall knowledge of insulin therapy was inadequate. Additionally, attitudes toward self-administration of insulin were generally unfavorable, which may negatively impact adherence to treatment

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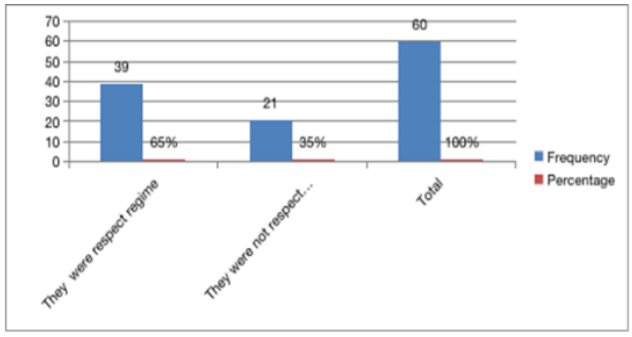
GRAPHICAL ABSTRACT



ABSTRACT

For effective management of type II diabetes mellitus (T2DM), the Adherence to therapy is crucial particularly in preventing complications and achieving optimal health outcomes. This cross-sectional study assessed treatment adherence and its associated factors among T2DM patients attending the non-communicable disease (NCD)

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service at Kibogora Level Teaching Hospital in Rwanda. structured interviews were used to collect data Among 60 participants; adherence levels were generally low. Younger age, lower education levels, and irregular clinic attendance were significantly associated with poor adherence, while participation in diabetes education sessions positively influenced adherence ($p < 0.05$). The findings underscore the need to strengthen patient education and follow-up within NCD services to enhance treatment adherence and reduce complications associated with T2DM in Rwanda.

Background

Millions of worldwide people have been diagnosed with diabetes mellitus, which is a serious non-communicable illness. currently a roughly 425 million persons between the ages of 20 and 79 have it, and by 2045, with prediction of the increase. Diabetes was a direct cause of 1.5 million fatalities in 2012. Furthermore, even while blood glucose levels were below the diagnostic criteria for diabetes, they were high, increasing the risk of death, especially from cardiovascular disease, which resulted in an additional 2.2 million fatalities. Nearly half of these fatalities happened prematurely before the age of 70, and the majority took place in higher middle-income nations (Roglic, 2016; World Health organization, 2016). Diabetes Mellitus, continues to be a serious public health with anticipated number of diabetics in Africa and still on the rise worldwide, despite the fact its preventability and, in many cases, reversible when identified and treated early. This trend is mainly caused by raised obesity rates, which are impacted by a number of socioeconomic, environmental, and behavioral variables(Ong et al., 2023).Therefore, Comprehensive, multi-sectoral approaches are desperately needed to fight this illness.as in prediction by 2030 a rise of the number of diabetics to 578 million and 700 million by 2045 if no prompt and sufficient treatments implemented(Saeedi et al., 2019; Sun et al., 2022). Diabetes is a long-term condition brought on by inefficient insulin use by the body either insufficient or nonexistent insulin production by the pancreas or Overweight, poor food, inactivity, and genetic susceptibility are risk factors for uncontrolled diabetes as it can lead to hyperglycemia, or elevated blood sugar, which over time can seriously harm many bodily systems, including the blood vessels and neurons(Basri et al., 2018; Patterson et al., 2019; Sweeting et al., 2024). Functional health literacy related to diabetes treatment and self-care is low, and some persons have shown poor self-care practices and insufficient functional health literacy in different context of life(Mukanoheli et al., 2020). Greater understanding about diabetes mellitus does not avoid the decline of People’s adherence to treatment because Diabetes management is very complicated and sometimes requires taking many drugs for a long time, perhaps even for the rest of one's life, as well as making significant lifestyle adjustments, even if more understanding can make patients feel more empowered. Even for individuals who are well-informed, dissatisfaction and treatment weariness can come from this intricacy, and makes difficult to adhere to therapy consistently. Furthermore, recognizing the condition and its treatment may not be sufficient to overcome deeply ingrained attitudes, cultural beliefs, or misconceptions (Borgnakke, 2019; Nyirongo et al., 2021). The adherence to therapy is influenced by

Patients' comprehension of their regimen, side effects, drug prices, and treatment complexity(Dumke et al., 2024; Kazi et al., 2021). Despite the proven benefits of behavior changes and lifestyle modifications**,** adherence to medication, diet, and exercise remains low, influenced by factors such as side effects, alcohol use, healthcare access, education, and the presence of other chronic illnesses(Atsedemariam Andualem et al., 2020; Sidahmed et al., 2023).Which may be enhance by improving healthcare access, providing targets, and low-side-effect medications (Lara-Castor et al., 2025; Pourhabibi et al., 2022; Ufitamahoro et al., 2022). Although Rwanda has expanded community-based health insurance**,**80% project the adherence on diabetes treatment is still low influenced by financial limitations, low health literacy, poor patient-provider communication**,** and sociocultural norms (Al-Haj Mohd et al., 2016; Alqarni et al., 2019; Nkambule et al., 2023; Nyandekwe et al., 2020; Sidahmed et al., 2023; Sun et al., 2022).These challenges highlight the need for context-specific strategies that improve education, access, and adherence support. This study examines treatment adherence among T2DM patients at Kibogora Level Two Teaching Hospital**,** focusing on clinical, demographic, and health system-related factors affecting adherence.

Methodology

This study used a cross-sectional design and was conducted at Kibogora Level 2 Teaching Hospital in Rwanda from August to December 2021. It focused on patients diagnosed with Type 2 Diabetes Mellitus (T2DM) who received care at the hospital's Non-Communicable Disease (NCD) Treatment Services. A total of 60 patients with confirmed T2DM were purposively selected. Patients with incomplete records or who did not meet the criteria were excluded. After receiving ethical approval from the Kibogora Polytechnic Ethical Committee and permission from the hospital, data were collected from patient by a structed questionnaire reviewed and validated in board of experts. The data were analyzed using SPSS Version 20, employing descriptive statistics such as frequencies and percentages to summarize treatment adherence. The study also examined clinical, health system, and demographic factors influencing adherence using appropriate statistical methods. All patient information was kept confidential and anonymized, and data were used solely for academic and research purposes without including any personal identifiers.

Results

This part includes the presentation of finding from the field, finding is presented in tables, diagrams and charts, it covers also the analysis and interpretation of findings conducted from the questionnaires.

Demographic Characteristics

Variable	Frequences	Percentage
Age		
20-39	20	33%
40- 54	10	17%
above 55	30	50%
Gender		
Male	20	33%
Female	40	67%
Habitation		
Rural	41	68%
Urban	19	32%
Occupation		

Farmer	14	23%
Businessman/Woman	25	42%
Government Agent	21	35%
Period diagnosed of diabetes.		
Last 1 week -1 years	26	43%
1 years – 3years	34	57%

Table 1: Demographic Characteristics

A total of 60 patients with Type 2 Diabetes Mellitus participated in the study. The age distribution showed that half of the participants (50%) were aged above 55 years, while 33% were between 20–39 years, and 17% fell in the 40–54 age group. In terms of gender, the majority were female, accounting for 67%, while males represented 33% of the sample. Regarding place of residence, 68% of participants lived in rural areas, whereas 32% resided in urban settings. Occupationally, 42% of respondents were engaged in business, 35% were government employees, and 23% were farmers. When asked about the duration since being diagnosed with diabetes, 57% had been diagnosed for a period between one and three years, while 43% had been diagnosed within the past week to one year.

Knowledge of patient about diabetes mellitus

Knowledge of patient about diabetes mellitus	**Frequence**	**Percentages**
Signs and symptoms of diabetes mellitus		
Polydipsia	17	28%
Oliguria	6	10%
Polyphagia	22	37%
Dizziness	15	25%
Convulsions	0	0
Knows insulin medications		
They know insulin	51	85%
They didn’t know insulin	9	15%

Table2: **Knowledge of patient about diabetes mellitus**

The study also assessed patients' knowledge regarding the signs, symptoms, and treatment of diabetes mellitus. Among the 60 participants, awareness of specific signs and symptoms varied. Approximately 37% identified polyphagia (excessive hunger) as a symptom, while 28% recognized polydipsia (excessive thirst). Dizziness was reported as a known symptom by 25% of respondents, and oliguria (reduced urination) by 10%. Notably, none of the participants (0%) identified convulsions as a symptom of diabetes. Regarding knowledge of insulin medication, a large majority 85% (n = 51)—reported being aware of insulin as a treatment for diabetes, while 15% (n = 9) stated they were not familiar with insulin, The figure above displays the distribution of participants based on the timing of their insulin administration. Among the participants, 25 (42%) were taking their insulin medication regularly, while 35 (58%) were taking it irregularly.

Adherence of treatment for Diabetes

Factor	**Category/Response**	**Frequency**	**Percentage**
Insulin Availability at Home	Had insulin	49	82%
	Didn’t have insulin	11	18%
Route of Administration	Subcutaneous	47	78%
	Intramuscular	13	22%
Site of Self-Administration	Subcutaneous	27	45%
	Intramuscular	22	37%

	None	11	18%
Glucometer Use	Uses glucometer	47	78%
	Doesn't use glucometer	13	22%
Feeding Before Insulin	Eats before insulin	54	90%
	Doesn't eat before insulin	6	10%
Knowledge of Normal Blood Glucose	Knows	49	82%
	Doesn't know	5	8%
	No idea	6	10%
Knowledge of Insulin Regimen Preparation	Knows how to prepare regimen	47	78%
	Doesn't know	13	22%
Follow-up Regularity	Regular follow-ups	40	67%
	Irregular/none	20	33%

Table 3: **Adherence of treatment for Diabetes**

A significant proportion of participants (82%) reported having insulin available at home, indicating adequate access to the medication necessary for self-care. Regarding the route of insulin administration, 78% used the recommended subcutaneous route, while 22% administered it intramuscularly, which may reflect either improper technique or a misunderstanding of administration guidelines. When examining the site of self-administration, 45% reported using appropriate subcutaneous sites, 37% used intramuscular sites, and 18% did not administer insulin at all an adherence gap that may be due to knowledge deficits, psychological resistance, or logistical barriers. The use of glucometers was reported by 78% of participants, suggesting a high level of engagement in self-monitoring, a critical component of effective diabetes management. Still, the 22% who do not use glucometers may be at risk of poor glycemic control due to lack of regular feedback on their blood glucose levels. In terms of dietary behavior, 90% of participants consumed food before insulin administration, a practice that helps prevent hypoglycemia. However, 10% did not, which could put them at risk for dangerous drops in blood sugar. Regarding knowledge of blood glucose levels, 82% were aware of normal glucose values, while 8% lacked this knowledge and 10% had no idea, highlighting the importance of educational reinforcement for a minority of participants. Similarly, 78% of participants knew how to prepare their insulin regimen, but 22% did not an indication that nearly one in four individuals may be mishandling or underusing their prescribed regimen. Beyond self-care behaviors, social and contextual factors also play a significant role in adherence. Family or social support was reported by 73% of participants, while 27% had no such support, suggesting that nearly one-third may face challenges in managing their condition alone. Education level was split, with 63% having a secondary education or higher and 37% below that level, indicating that a substantial portion of the population may have limited health literacy, potentially impacting their understanding of diabetes management instructions. The duration since diagnosis was evenly distributed, with 50% having been diagnosed for more than five years and 50% for five years or less. This balance indicates a mix of experience levels, where long-term patients may have developed habits (positive or

negative) and newly diagnosed individuals may still be adjusting. Follow-up regularity is another critical factor: 67% reported regular follow-ups with healthcare providers, while 33% had irregular or no follow-ups, increasing the risk of unmonitored complications and lapses in adherence. Finally, psychological barriers such as fear of needles or medication-related anxiety were reported by 30% of participants. These barriers can significantly affect adherence behavior and highlight the need for emotional and psychological support as part of diabetes care.

Factors Associated with Adherence to T2DM Treatment (N = 60)

Factor	Barrier (Category)	Yes (n)	Yes (%)	No (n)	No (%)
Medication Adherence	Missed doses due to being away from home	23	38 %	37	62 %
	Ran out of insulin/medication	24	40 %	36	60 %
	Lack of syringes or injection tools	15	25 %	45	75 %
	Pain or fear of self-injection	18	30 %	42	70 %
	Forgetting to take medication	24	40 %	36	60 %
Glucose Monitoring	Forgot to test blood glucose	27	45 %	33	55 %
	Difficulty calculating/interpreting glucose levels	24	40 %	36	60 %
Healthcare Access	Far from place of medication access	21	35 %	39	65 %
	Late diagnosis or complications	18	30 %	42	70 %
Economic Barriers	Could not afford medication/testing supplies	24	40 %	36	60 %
Health Literacy	Difficulty understanding medication instructions	24	40 %	36	60 %
Psychosocial Factors	Depression, stigma, or emotional stress	15	25 %	45	75 %
Forgetfulness / Disorganization	Missed medication/testing due to stress or forgetfulness	27	45 %	33	55 %

Table 4: **Factors Associated with Adherence to T2DM Treatment**

The findings from the sample of 60 participants reveal multiple barriers that significantly hinder adherence to type 2 diabetes management. Medication adherence is notably compromised, with 38% of participants reporting missed doses due to being away from home and 40% indicating they had run out of insulin or medication. Additionally, 25% lacked essential tools such as syringes,

and 30% experienced pain or fear related to self-injection, while 40% admitted to forgetting to take their medication. Glucose monitoring also presents major challenges, as 45% of participants reported forgetting to test their blood glucose, and 40% had difficulty calculating or interpreting their glucose levels highlighting issues related to forgetfulness and limited health literacy. Regarding healthcare access, 35% of respondents stated they lived far from places where they could access medication, and 30% experienced late diagnosis or treatment complications. Economic barriers were prevalent as well, with 40% unable to afford medications or testing supplies. Similarly, 40% had difficulty understanding how to follow prescribed treatment regimens, indicating gaps in patient education. Psychosocial and behavioral factors further complicated adherence, with 25% of participants citing emotional distress, stigma, or fear as challenges, and 45% reporting that daily stress or disorganization led to missed medications or testing. These results emphasize the complex interplay of personal, economic, educational, and systemic factors that must be addressed to improve adherence in diabetes care.

Influence Medication Adherence in Type 2 Diabetes Mellitus

Variable	**Category**	**Missed Doses: Yes (n)**	**Missed Doses: No (n)**	**Total (n)**	**% Yes in Category**	**p-value**
Age Group	20–39	8	12	20	40%	0.30
	40–54	2	8	10	20%	
	55+	13	17	30	43.30%	
Gender	Male	10	10	20	50%	0.20
	Female	13	27	40	32.50%	
Habitation	Rural	18	23	41	43.90%	0.04
	Urban	5	14	19	26.30%	
Knowledge of Insulin	Knows Insulin	15	36	51	29.40%	0.03
	Doesn’t Know	8	1	9	88.90%	

Table 5: **Influence Medication Adherence in Type 2 Diabetes Mellitus**

The analysis of 60 patients with type 2 diabetes mellitus revealed several important factors influencing adherence to medication, particularly the occurrence of missed doses. Demographic factors such as age group and gender did not show statistically significant associations with missed medication doses, indicating that missed doses

occur relatively uniformly across these categories in this sample. However, habitation was significantly associated with adherence: patients living in rural areas were more likely to miss medication doses (43.9%) compared to those residing in urban settings (26.3%, p = 0.04). This suggests potential barriers related to healthcare access or resource availability in rural environments. A key knowledge factor awareness of insulin medication was strongly linked to adherence. Patients unaware of insulin had a much higher rate of missed doses (88.9%) compared to those knowledgeable about insulin (29.4%, p = 0.03). This highlights the critical role of patient education in managing diabetes effectively.Practical challenges also emerged as significant barriers. Running out of insulin was reported by many who missed doses (62.5%), significantly more than those who did not run out (22.2%, p = 0.01). Similarly, patients who reported forgetting to take their medication had a very high missed dose rate (75%), compared to just 12.2% among those who did not forget (p < 0.001). These findings underscore the impact of logistical and cognitive factors on medication adherence.

The use of glucometers was another significant factor. Patients not using glucometers missed doses more frequently (84.6%) than those who regularly monitored their blood glucose (25.5%, p = 0.002). This association suggests that self-monitoring may reinforce medication-taking behavior. Regularity of follow-up visits was also important. Those with irregular or no follow-ups missed doses more often (65%) than patients who attended regular check-ups (25%, p = 0.01), emphasizing the value of continuous healthcare engagement.

Discussion

The findings from this study highlight critical factors influencing adherence to Type 2 Diabetes Mellitus treatment among the participants. The majority of participants were older adults, predominantly female, reflecting well-established epidemiological trends that show a higher prevalence of T2DM in older populations and a slightly increased occurrence among women (Kyrou et al., 2020; Nascimento et al., 2025). This demographic context is important because adherence behaviors and challenges can vary significantly with age and gender. Education emerged as a significant factor affecting adherence. Participants with secondary or higher education were more likely to adhere to their treatment regimens compared to those with lower educational attainment. This finding aligns with previous studies demonstrating that education enhances patients' understanding of diabetes management, enabling better self-care practices and medication adherence(Dorcélus et al., 2021; Panahi et al., 2022) Conversely, participants with lower education levels may face difficulties in comprehending treatment instructions and recognizing the importance of strict adherence, which may contribute to poorer outcomes. Insulin administration practices revealed gaps that could negatively impact treatment effectiveness. While subcutaneous injection is the recommended route for insulin delivery and was used by most participants however same participants reported intramuscular administration which can alter insulin absorption and efficacy, indicating a need for more

focused education on proper injection techniques(Kumar et al., 2018; Ong et al., 2023; Rauniyar et al., 2018).Furthermore, less than half of participants were fully proficient in self-administering insulin subcutaneously, and nearly one-fifth lacked these skills altogether, reinforcing the need for enhanced hands-on training and support from healthcare providers(Feleke et al., 2025). Knowledge and self-monitoring were key to adherence of participants understood diabetes medications and knew normal blood glucose levels, lacked this knowledge and could benefit from targeted education. Additionally unregularly used glucometers, leads on missing chances for timely glucose management(Mohamed et al., 2023).Feeding before insulin use is adhered to the Most participants, as a key practice to prevent hypoglycemia, however those who don't need counseling. Regular clinic attendance and participation in diabetes education were strongly linked to better adherence, showing that continuous healthcare support and patient education are essential for effective self-management (Powers et al., 2020). Psychological barriers, including fear and anxiety related to injections, were found to adversely affect adherence correlating with poorer adherence outcomes. Addressing these psychological aspects through counseling, peer support, or behavioral therapy could improve adherence and overall diabetes control. Social support was another important determinant; participants with strong family or caregiver support showed better adherence rates. This finding is consistent with literature showing that emotional and practical support systems facilitate chronic disease management(Mostafavi et al., 2021). Diabetes Self-Management Education (DSME) significantly enhances lifestyle changes and self-care in Type 2 Diabetes patients, resulting in improved health outcomes (Ernawati et al., 2021).

Conclusion:

This study highlights that treatment adherence among patients with Type 2 Diabetes Mellitus (T2DM) at Kibogora Level Two Teaching Hospital is shaped by a range of factors, including age, education level, clinic attendance, diabetes knowledge, and psychosocial support. Older adults, individuals with higher education, those who attended regular follow-up visits, and participants engaged in diabetes education programs demonstrated better adherence to treatment. In contrast, psychological distress and limited social support were associated with lower adherence rates. Although most patients had a general understanding of insulin use and blood glucose monitoring, significant gaps were identified in proper insulin administration techniques and attitudes toward self-injection. Inconsistent use of self-monitoring tools further contributed to suboptimal adherence, signaling the need for targeted interventions. To enhance diabetes management and outcomes in this rural Rwandan setting, it is vital to implement patient-centered educational initiatives, strengthen psychosocial and peer support structures, and integrate self-care skill development into non-communicable disease services.

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