

A Cross-Sectional Study on Drug Therapy Problems and Contributing Factors Among Type II Diabetes Mellitus Patients at Zewditu Memorial Hospital, Addis Ababa 2024

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ABSTRACT

Background: Type II diabetes mellitus is a chronic metabolic disorder characterized by insulin resistance and insufficient insulin production. It is a globally prevalent condition that, if not properly managed, can result in serious health complications. Effective drug therapy is essential in the management of diabetes, as it helps regulate blood glucose levels and significantly lowers the risk of diabetes-related complications.

Objective: To assess drug therapy problems and their contributing factors among ambulatory patients with Type II Diabetes Mellitus attending Zewditu Memorial Hospital, Addis Ababa.

Methods: A cross-sectional study was conducted among ambulatory patients with Type II diabetes at Zewditu Memorial Hospital. Data were collected using a structured questionnaire, which included demographic details, medical history, medication profiles, and patient-reported drug therapy problems. Medical records were also reviewed to obtain objective data on drug therapy issues. The data collected were analyzed using SPSS to identify patterns and associations related to drug therapy problems.

Result: 248 patients participated in the study, with more than half being females (172, 69.4%). The average age of the participants was 59.17 ± 14.68 years, with 88 patients (35.5%) aged 60 years or older. Most patients were married (185, 74.6%). A significant portion, 220 patients (88.7%), lived in Addis Ababa. One-third of the participants (82, 33.0%) had at least a college-level education, and 172 (69.3%) were employed. Only nine patients (3.6%) were active smokers, and 45 (18.1%) were regular alcohol consumers.

Conclusion: This study underscores the high occurrence of drug therapy problems (DTPs) and emphasizes the need to address co-existing health conditions in the management of diabetes mellitus (DM) to minimize DTPs. To enhance treatment outcomes, healthcare professionals should prioritize thorough assessments and personalized care plans for patients with multiple health issues. Future research should aim to address the current study's limitations and explore effective approaches to reduce DTPs in patients with co-morbidities, thereby improving overall patient care and quality of life.

KEYWORDS: drug therapy problems, type II diabetes mellitus, ambulatory patients, contributing factors, prevalence.

INTRODUCTION

Background

Type II diabetes mellitus is a chronic metabolic disorder characterized by insulin resistance and impaired insulin secretion. It affects a significant portion of the global population and is associated with complications if not properly managed. One of the key components in the management of type II diabetes is drug therapy, which aims to control blood glucose levels and prevent or minimize the occurrence of complications [1]

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However, the effectiveness of drug therapy in type II diabetes heavily relies on several factors, including appropriate medication selection, adherence to treatment regimens, and avoidance of drug therapy problems (DTPs). DTPs refer to situations where patients' medication-related needs are not met or where drug therapy poses potential risks or complications. Identifying and addressing DTPs is crucial to optimizing treatment outcomes and improving patient quality of life [2].

In Ethiopia, Zewditu Memorial Hospital is a referral hospital that provides ambulatory care services to many patients with type II diabetes mellitus. However, limited research has been conducted to assess the prevalence of DTPs and identify the contributing factors, specifically among ambulatory patients attending Zewditu Memorial Hospital [3].

Understanding the patterns of DTPs and their contributing factors in this setting is essential for healthcare providers to implement targeted interventions, improve patient-centered care, and enhance treatment outcomes. By conducting a comprehensive assessment of DTPs and their associated factors, healthcare professionals can gain insights into the challenges faced by ambulatory patients with type II diabetes and develop strategies to mitigate these issues effectively [4,5].

Hence, this study aims to assess the prevalence of DTPs and identify the contributing factors among ambulatory patients with type II diabetes mellitus attending Zewditu Memorial Hospital.

Statement of the Problem

Type II diabetes mellitus is a prevalent chronic condition requiring ongoing management, including drug therapy, to achieve optimal glycemic control and prevent complications [6-7]. However, little is known about the occurrence and contributing factors of drug therapy problems (DTPs) among ambulatory patients with type II diabetes attending Zewditu Memorial Hospital in Ethiopia. Understanding the prevalence of DTPs and the factors contributing to their occurrence is essential for improving patient care and treatment outcomes [8].

Since DTPs increase in diabetic patients as their clinical condition worsens, with more associated risk factors and more treatments to stabilize their clinical condition, health professionals should be aware of such problems and ensure the adoption and implementation of a preventive strategy [9]. One of the preventive strategies is early identification of those DTPs. However, there is still limited baseline data about these problems in this Hospital [10]. DTPs are of significant concern in the healthcare delivery system because of increased cost, morbidity and mortality. It was also associated with lower quality of life [11]. One study conducted in India indicates that the cost of drug-related morbidity and mortality exceeded \$177.4 billion in 2000 total costs, followed by long-term-care admissions, which accounted for 18% (\$32.8 billion) [12].

Another study tried to show that DTPs are the dominant reasons for admission. A retrospective cross-sectional study in Singapore showed that 71.9% of DTPs resulted in admission, while from a prospective multi-center multi-center study, among 13,000 unplanned admissions, 714 (5.6%) were medication-related [13]. One study in New York showed that DTPs were associated with mortality, morbidity, and lower quality of life [14].

Unlike in high-income countries, there is a shortage of literature that reveals the prevalence of DTPs in diabetic patients in low- and middle-income countries such as those in Sub-Saharan Africa. Furthermore, little is known about the exact prevalence and specific predictors of DTPs in patients with diabetes residing in Ethiopia [15]. Because of differences in genetic makeup, sociodemographic characteristics, and healthcare practices, study results on this area on the other side of the world may not show the actual state of DTPs among diabetic patients in Ethiopia [16]. So additional studies are therefore essential to investigate the prevalence of DTPs in patients with diabetic patients residing in this region. This study would establish the extent and types of DTPs among patients with diabetes and identify various related risk factors contributing to DTPs among those population groups.

Significance of the study

The assessment of drug therapy problems (DTPs) and their contributing factors among ambulatory patients with type II diabetes mellitus attending Zewditu Memorial Hospital holds significant importance for several stakeholders [17]. The findings of this study will provide valuable insights that can contribute to improvements in patient care, treatment outcomes, and healthcare practices in this context. By identifying and understanding the prevalence of DTPs among ambulatory patients with type II diabetes, healthcare providers can improve the quality of patient care. The study findings can help healthcare professionals tailor their interventions and develop patient-centered strategies to address specific medication-related challenges, improving treatment outcomes and patient satisfaction [18]. The findings of this study can inform healthcare policymakers and administrators about the particular challenges faced by ambulatory patients with type II diabetes attending Zewditu Memorial Hospital. This knowledge can guide the development of policies, protocols, and guidelines that address the identified DTPs and their contributing factors. Policy interventions can focus on resource allocation, healthcare infrastructure improvements, and training programs to enhance the overall management of type II diabetes in this setting [19-20].

LITERATURE REVIEW

Diabetes Prevalence Global, in Africa and Ethiopia

Diabetes mellitus is a significant global health concern with increasing prevalence worldwide. According to the International

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Diabetes Federation (IDF) Diabetes Atlas, an estimated 463 million adults (20-79 years) had diabetes in 2019, representing 9.3% of the global adult population. The IDF also reported that Africa had approximately 20 million adults living with diabetes in the same year, and this number is projected to rise to 47 million by 2045. In Ethiopia, the prevalence of diabetes has been increasing steadily. The IDF estimated that 1.8 million adults (20-79 years) had diabetes in Ethiopia in 2019, with a prevalence rate of 5.2% [21].

Impact, Complications, and Burden of Type II Diabetes

Type II diabetes mellitus has a significant impact on individuals and healthcare systems. Poorly managed diabetes can lead to various complications, such as cardiovascular disease, neuropathy, nephropathy, retinopathy, and lower limb amputations. These complications contribute to increased morbidity, mortality, and reduced quality of life for individuals with diabetes. Furthermore, diabetes imposes a substantial economic burden on healthcare systems due to increased healthcare utilization, hospitalizations, and medication costs [22].

Drug Therapy Problems in Diabetic Patients and its Burden

Drug therapy problems (DTPs) refer to situations where the medication-related needs of patients are not met, potentially leading to suboptimal treatment outcomes and patient harm. Among patients with diabetes, DTPs are common and can significantly impact their disease management. Examples of DTPs in diabetic patients include medication non-adherence, inappropriate medication selection, dosage errors, drug interactions, and adverse drug reactions. These problems can compromise glycemic control, increase the risk of complications, and contribute to poor overall health outcomes [23].

Contributing Factors of Drug Therapy Problems in Diabetic Patients:

Several factors contribute to the occurrence of DTPs in diabetic patients:

- a. Medication-related factors: These include complex medication regimens, limited availability of specific medications, lack of patient education about medication use, and inadequate therapy monitoring.
- b. Patient-related factors: Medication non-adherence, lack of self-care skills, poor health literacy, cultural beliefs, and financial constraints can contribute to DTPs in diabetic patients.
- c. Healthcare system factors: Inadequate healthcare resources, lack of coordination among healthcare providers, inadequate training of healthcare professionals, and limited access to specialized diabetes care can contribute to DTPs.
- d. Healthcare provider-related factors: Inappropriate prescribing practices, lack of medication review, insufficient communication with patients, and inadequate counseling and follow-up contribute to DTPs in diabetic patients.

Understanding these contributing factors is crucial for identifying and addressing DTPs effectively, ultimately improving patient outcomes and optimizing drug therapy in diabetic patients [24].

OBJECTIVE OF THE STUDY

General objective

- ✓ The purpose of this study is to assess drug therapy problems and their contributing factors among ambulatory patients with Type II Diabetes Mellitus attending Zewditu Memorial Hospital, Addis Ababa.

The specific objectives

- ✓ To identify the types and prevalence of drug therapy problems among ambulatory Type II Diabetes Mellitus patients.
- ✓ To determine the factors contributing to drug therapy problems in these patients.
- ✓ To evaluate the appropriateness of prescribed anti-diabetic medications based on standard treatment guidelines.
- ✓ To assess patient adherence to anti-diabetic medications and their impact on drug therapy problems.
- ✓ To explore the role of healthcare providers in minimizing drug therapy problems in diabetes management.

METHODOLOGY

The study area and period

Zewditu Hospital is a public hospital in Addis Ababa, Ethiopia. It was built, owned, and operated by the Seventh-day Adventist church but nationalized during the Derg regime in 1976. The Hospital is named after Empress Zewditu, the cousin and predecessor on the throne of Emperor Haile Selassie. Today, Zewditu Hospital is operated by the Minister of Health. It is located at Taitu St, Kirkos sub-city, Addis Abeba 9°1'6"N 38°45'22"E. The study was conducted from May to June 2024.

Study design

A hospital-based cross-sectional study was conducted among ambulatory patients with diabetes who visited Zewditu Memorial Hospital, Addis Ababa, Ethiopia.

Source population

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The study population consisted of ambulatory adult patients diagnosed with diabetes undergoing treatment and follow-ups at Zewditu Memorial Hospital.

Study population

The study population consisted of ambulatory adult patients diagnosed with diabetes and undergoing treatment who had follow-ups at Zewditu Memorial Hospital during the study period and fulfilled eligibility criteria.

Eligibility Criteria

Inclusion criteria

Ambulatory adult patients with diabetes, those who received treatment at Zewditu Memorial Hospital during the study period, and those who gave voluntary informed consent.

Exclusion criteria

Patients with Type I diabetes and patients with cognitive impairment were excluded from the study participants.

Sample size determination

The number of patients to be involved in the study was determined by using the single population proportion formula:

$$n = \frac{Z_{\alpha/2}^2 P (1-P)}{d^2}$$

Where

n Minimal sample size required.

P = Estimated prevalence of DTPs in diabetic patients (50%)

$Z_{\alpha/2}^2$ = Standard normal deviate at 95% confidence interval corresponding to 1.96

d = Absolute error between the estimated and actual population prevalence of DTPs in diabetic patients of 5%.

The calculated sample size using this formula is 384. The expected number of source population in the study period (N), based on the average number of patients coming to the diabetic sites during the study period, gave us 540.

Corrected sample size = $n \times N / n + N - 225$. 10% contingency was considered; thus, the final sample size used in this study was **248**.

Sampling technique

A convenience sampling technique was used to recruit available respondents during the data collection period.

Study variables

Dependent variables

Prevalence of drug therapy problems

Independent variables

- Patient age
- Sex
- Economic status
- Social drug use
- Level of education
- Presence of co-morbidities
- Number of co-morbidities
- Presence of complication
- Type and number of drugs

DATA COLLECTION

The data collection process consisted of two main phases. The first phase involved patient interviews: after obtaining informed consent, the investigator conducted interviews using a structured questionnaire. The initial section of the questionnaire gathered baseline sociodemographic information, such as age, sex, marital status, education level, occupation, income level, and smoking and alcohol use status. It also collected past medical history, medication history, and any drug therapy problems (DTPs) reported by the patient and other patient-related risk factors associated with DTPs.

The second phase involved reviewing medication charts, which was done using the second section of the questionnaire. In this phase, medical history, physical examination notes, laboratory test results, working diagnosis, and treatment plans were reviewed. Information about the presence and number of co-morbidities, complications, and the types and number of medications prescribed was also examined.

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DATA ANALYSIS

The data will be analyzed using SPSS version 25. Descriptive statistics were used to describe demographic information and variables in the questionnaire to assess DTPs and contributing factors. The results were presented as tables, texts, and figures.

ETHICAL CONSIDERATION

Before starting the data collection, we secured an official approval letter from the Department of Internal Medicine at Zewditu Memorial Hospital. Once approval was granted, we proceeded with the data collection process. Before conducting interviews, each patient was thoroughly informed about the study's objectives, and verbal informed consent was obtained from all participants. We ensured that all data collected was kept strictly confidential, with patient identities always protected. Additionally, efforts were made to safeguard the privacy of each participant throughout the study, maintaining ethical standards in the process.

RESULTS

Sociodemographic characteristics

A total of 248 study patients were involved in the study. More than half (172, 69.4%) of the patients were females. The mean (\pm SD) age of the study patients was 59.17 ± 14.68 years, and 88 (35.5%) were ≥ 60 years old. The majority of patients were married (185) 74.6%). Most patients, 220(88.7%) resided in Addis Ababa. One-third, 82(33.0%), of the patients had at least a college and above level of education. One hundred seventy-two (69.3%) were employed. Only 9 (3.6%) and 45(18.1%) patients were active smokers and regular alcohol users, respectively. Even though 213 (85.8%) patients responded that they do physical activity, only 80 (32.3%) adhered to regular physical activity (Table 1).

Table 1 Sociodemographic characteristics of participants attending the DM clinic of Zewditu Memorial Hospital, 2024

Characteristics	Frequency (n 248)	Percent
Age		
18 – 40	70	28.2
41 – 60	90	36.3
>60	88	35.5
Sex		
Male	76	30.6
Female	172	69.4
Marital status		
Single	52	20.9
Married	185	74.5
Divorced	6	2.4
Widowed	5	2.0
Residence		
Addis Ababa	220	88.7
Out of Addis Ababa	28	11.3
Educational status		
No formal education	15	6.0
Primary (1 - 8)	50	20.1
Secondary (9 - 12)	101	40.7
College and above	82	33.0
Employment status		
Employed	172	69.4
Unemployed	76	30.6
Smoking status		
Smoker	9	3.6
Denied smoking	239	96.4
Alcohol use		
User	45	18
Denied using	203	82
Physical status		
Yes	80	32.2
No	168	67.7

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Clinical characteristics

The mean duration of the diabetes disease since the first diagnosis was 4.12 ± 1.035 years. Study patients' most recent calculated mean (\pm SD) BMI was 23.38 ± 3.7 kg/m². Only 14 (5.6%) patients were obese (≥ 30 kg/m²). Fifty-five (22.2%) patients had at least one hospitalization history related to diabetes within the last year. More than half of the study patients, 138 (55.8%), had co-morbid conditions with a mean \pm SD of 1.66 ± 0.597 co-morbidities. The most common co-morbid condition was hypertension, 110 (44.4%), followed by dyslipidemia, 31(12.5%) and ischemic heart disease, 23(9.3%). Fifty-eight (23.4%) patients also developed complications.

The pattern of prescribed medications

In patients with type 2 diabetes, four hundred thirty-seven medications had been prescribed with the mean \pm SD of 2.11 ± 1.4 per patient. Patients on oral glucose-lowering drugs (OGLD) alone were 115 (46.4%), while those with metformin plus glibenclamide therapy were 75 (30.2%). Twenty-five (9.7%) patients were on insulin alone. Other medications were also prescribed for the co-morbidities and complications, of which angiotensin-converting enzyme inhibitors (ACEIs) were frequently prescribed, 81 (32.7%).

Drug therapy problems encountered and their causes.

A total number of 151 DTPs were identified with a mean \pm SD of 0.61 ± 0.11 per patient. One hundred nine (43.9%) patients had at least one DTP. The most commonly encountered DTPs were non-compliance, 89 (35.9%) commonly due to unavailability of drugs. The second most common DTP was a need for additional drug therapy, 31(12.5%), primarily due to untreated conditions. Another commonly identified DTP was dosage too low 18(7.3%) because of sub-therapeutic dose.

Factors associated with drug therapy problems

Univariate analysis and multivariable logistic regression were done to determine factors associated with the occurrence of DTPs, respectively. After univariate analysis, variables with a P-value greater than 0.25 were excluded from the multivariable analysis. The only variables found to have a P-value of less than 0.25 were the type of DM duration, polypharmacy and presence of co-morbidities. The multivariable analysis included these variables: co-morbidities, polypharmacy, and pre-treatment weight, which were significantly associated factors (Table 2). After controlling for the duration of DM and polypharmacy, participants with co-morbidities have 4.8 times higher odds of DTP compared to those with no co-morbidity.

Table 2 Factors associated with the occurrence of DTP among DM patients that have attended Zewuditu Memorial Hospital, 2024

Variables	Category	Presence of DTP		COR (95% CI)	AOR (95% CI)	P-value
		No	Yes			
DM duration	1-5	130	35	1	1	0.303
	6-10	52	27	1.54(0.55-4.36)	0.67(0.2,2.21)	
Co-morbidities	Present	81	14	1	1	0.01
	Absent	36	31	4.98(2.37,10.48)	4.85(2.22,10.63)	
Polypharmacy	<3 drugs	45	8	1	1	0.024
	≥ 3	54	32	3.33(1.4,7.9)	2.89(1.15,7.28)	

DISCUSSION

This study aimed to assess the magnitude of DTPs in diabetic ambulatory patients and the associated factors. Cipolle's DTP classification system was used (25). Drug therapy problems (DTPs) were identified based on IDF. In addition, the American Diabetes Association/European Association for the Study of Diabetes (ADA/EASD) guideline recommendations were used to identify DTPs [26]. According to the findings of this study, 43.9% of the patients had at least one DTP per patient. The main types of DTPs identified were non-compliance, commonly due to the unavailability of drugs, followed by needing additional drug therapy, primarily due to untreated conditions. Eighteen patients (7.3%) had DTPs of sub-therapeutic doses. The present study's findings showed a slightly higher prevalence of DTP than those of Sri Lanka studies [27] and findings in TASH, Ethiopia [28]. The slight variation could be attributed to differences in study design (prospective), DTPs classification system (PCNE) employed, and study setup.

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In contrast, the findings of this study were considerably lower than those reported by two studies in Malaysia, in which more than 90% of patients had at least one DTP [29]. This discrepancy may be explained by differences in the type of diabetes study patients (our study patients were both type 2 diabetes only and type 2 diabetes with hypertension or dyslipidemia, while those of the Malaysian studies were only type 2 diabetes with hypertension or dyslipidemia). Thus, study patients with type 2 diabetes, hypertension and/or dyslipidemia could more likely experience DTPs.

The prevalence of DTPs in our study was also lower than that in a multi-center study conducted in Jordan [30], which revealed 81.2%. This variation could be due to the difference in hospital settings, where the study was conducted in five different teaching hospitals and the difference in sample size (1494). Similarly, this finding was much lower than that of a study in Nigeria [31]. This difference might be due to a difference in the study setting (inpatient versus outpatient). Moreover, the number of DTPs per patient (1.34 ± 0.47) was lower in the present study compared to that of other previous studies reported from Malaysia (29) and Nigeria [31]. These discrepancies may be explained by differences in clinic setup and practitioners working in the field. In reality, healthcare systems vary with countries and healthcare facilities. Variations in inclusion criteria, population diversity, treatment guidelines, study period, study design, and setting could also explain the differences in the prevalence of DTPs observed across studies. And classification, as well as an assessment method of DTPs. For instance, in our study, when a patient has more than one similar DTP, they were considered as one DTP, while in other studies, they might have counted as more than one. This might explain why the overall magnitude of DTPs observed in the present study was lower than that observed in the previous studies.

Non-compliance (26.3%) was the most common type of DTP found in our study, which was in agreement with the findings of other studies in Ethiopia (32), India (33), and Nigeria (31). At the same time, it was higher than other studies conducted in Uganda (34) and Ethiopia. (28). the difference in the non-compliance rate might be explained by the difference in types of diabetes and co-morbid conditions and tools used (MMAS-4 versus eight items). Need additional drug therapy and dosage too low were also the common DTPs identified in the present study respectively.

The variables in the multivariable analysis reveal the significant associations between certain factors and the outcome. In Table 2, co-morbidities and polypharmacy were significantly associated factors. After controlling for the duration of diabetes mellitus (DM) and polypharmacy, participants with co-morbidities had 4.8 times higher odds of experiencing drug therapy problems (DTP) compared to those without any co-morbidity.

The presence of co-morbidities emerged as a significant factor associated with DTP. This finding suggests that individuals with co-morbidities, in addition to having DM, are more likely to experience challenges related to drug therapy. This could be due to the complexity of managing multiple conditions simultaneously, which may require various medications and pose potential interactions or conflicting treatment approaches. Therefore, healthcare professionals should pay close attention to patients with co-morbidities to identify and address potential DTPs, ensuring appropriate and safe drug therapy management.

Additionally, polypharmacy was found to be another significant factor associated with DTP. Polypharmacy refers to the concurrent use of multiple medications, and its association with DTP implies an increased risk of medication-related issues. The use of various medications can lead to drug interactions, adverse drug reactions, or challenges in medication adherence. Healthcare providers should be cautious when prescribing multiple medications to patients, particularly those with DM, and closely monitor for potential DTPs.

Furthermore, controlling for the duration of DM and polypharmacy highlights the independent impact of co-morbidities on DTP. Even after accounting for the duration of DM and polypharmacy, the presence of co-morbidities remained significantly associated with higher odds of experiencing DTP. This emphasizes the unique contribution of co-morbidities in influencing drug therapy outcomes and the need for tailored approaches to address the specific challenges faced by patients with co-morbidities.

LIMITATIONS OF THE STUDY

There are several limitations to consider regarding the above research. First, the study's cross-sectional design limits the ability to establish causality between the variables. Longitudinal or experimental designs would provide more substantial evidence of the relationship between co-morbidities, polypharmacy, and drug therapy problems (DTPs). Second, the reliance on self-reporting or medical records for co-morbidity and polypharmacy data may introduce recall bias or incomplete information, potentially affecting the accuracy of the results.

CONCLUSION AND RECOMMENDATION

Conclusion

The prevalence of drug therapy problems (DTPs) in patients with type 2 diabetes was notably high. The most frequently observed DTPs included non-compliance, the need for additional drug therapy, and inadequate dosages. The primary causes of these issues were drug unavailability, the presence of untreated conditions, and the use of sub-therapeutic doses. The study's findings emphasize the importance of co-morbidities and polypharmacy as key factors contributing to DTPs in individuals with diabetes mellitus (DM).

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The presence of co-morbid conditions was shown to significantly increase the likelihood of experiencing DTPs, highlighting the need for careful management and monitoring of patients with multiple health conditions.

Recommendations

- The findings underscore the importance of considering co-morbidities and polypharmacy in managing DM and preventing DTPs.
- Healthcare professionals should prioritize comprehensive assessments, including medication reviews and monitoring, to ensure optimal treatment outcomes for patients with DM and co-morbid conditions.
- Future research could explore interventions or strategies to mitigate DTPs among individuals with co-morbidities, aiming to improve the quality of care and patient outcomes in this vulnerable population.

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Acronyms/Abbreviations

ADA/USD	American Diabetes Association/European Association for the Study of Diabetes
ADRs	Adverse Drug Reactions
CI	Confidence Interval
CVD	Cardiovascular Disease
DM	Diabetes Mellitus
DMH	Dagimawi Menelik Hospital
DTPs	Drug Therapy Problems
EHRIG	Ethiopian Hospital Reform Implementation Guidelines
FIP-	International Pharmaceutical Federation
HFSUH	Hiwot Fana Specialized University Hospital
IDF	International Diabetes Federation
PCNE	Pharmaceutical Care Network of Europe
PFSA	Pharmaceutical Fund and Supply Agency
RVU	Rif Valley University
SMBG	Self-monitoring of Blood Glucose
SPSS	Statistical Package for Social Sciences
T2DM	Type 2 Diabetes Mellitus
WHO	World Health Organization

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