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Unmet needs and polypharmacy as key drivers of drug therapy problems among cardiac patients at a tertiary hospital: a cross-sectional study

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Informed consent: written consent to participate were obtained from all study participants.

Patient consent for publication: written informed consent was obtained from a legally authorized representative(s) for anonymized patient information to be published in this article. The manuscript does not contain any individual person's data in any form.

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Abstract

Drug therapy problems (DTPs), unintended events in pharmacotherapy that impede therapeutic goals and risk patient harm, are critical barriers to effective cardiovascular disease (CVD) management. Ambulatory cardiac patients are highly vulnerable to DTPs primarily due to complex comorbidities, but the prevalence and specific drivers of these problems within chronic care settings in Ethiopia are poorly characterized. Therefore, this study aimed to determine the prevalence and predictors of DTPs among adult ambulatory CVD patients at Wolaita Sodo University Comprehensive Specialized Hospital from May 9 to July 8, 2022. We conducted an institution-based cross-sectional study among ambulatory cardiac patients receiving chronic care. Data were collected through structured patient interviews and comprehensive medical record reviews. DTPs were systematically identified and classified using Cipolle's validated methodology, adapted for the local patient population. Binary logistic regression was used to assess the associations between predictor variables and DTPs, followed by multiple logistic regression to control for potential confounders. Statistical significance was determined at p 0.05, with 95% confidence intervals used to estimate precision of effect measures.

Among 195 ambulatory CVD patients, hypertension (59.5%, n=116) and heart failure (47.2%, n=92) were the most prevalent conditions. The study identified DTPs in 69.7% of patients (n=136), totaling 168 DTPs (mean: 1.3, standard deviation: 0.461) per affected patient. Unmet therapeutic needs (41.0%) and medication non-adherence (24.4%) emerged as the most common DTP categories. ASCVD risk assessment classified 40% of evaluated patients as high-risk (10-year risk 20%). Significant predictors of DTPs included polypharmacy [adjusted odds ratio (AOR): 3.48, 95% confidence interval: 1.47-8.24] and age (25-64 years: AOR=16.38), while prior hospitalization (AOR: 0.31) demonstrated protective effects. This study identifies unmet therapeutic needs and medication non-adherence as the predominant DTPs and polypharmacy as the most significant predictor among ambulatory CVD patients at Wolaita Sodo University Comprehensive Specialized Hospital, calling for systematic medication reviews, pharmacist-led interventions for high-risk groups, and enhanced adherence support programs to optimize treatment outcomes.

Key words: drug therapy problems, cardiovascular diseases, polypharmacy, Wolaita Sodo, unmet therapeutic needs, Ethiopia.

Introduction

The global rise in cardiovascular diseases (CVD) reflects an epidemiological shift impacting all races, ethnicities, and cultures. Cardiovascular diseases include a variety of heart and blood vessel disorders [1], categorized into rhythm disorders, heart disorders, and both coronary and peripheral vascular diseases [2]. While most patients can be managed in outpatient settings, these conditions still account for 7-10% of adult medical admissions in African hospitals, with heart failure comprising approximately 3-7% of these cases [3].

Pharmacotherapy plays a vital role in reducing morbidity and mortality associated with cardiovascular diseases. However, drug therapy problems (DTPs) can undermine the benefits of pharmacotherapy, negatively affecting patients' quality of life, prolonging hospital stays, and increasing healthcare costs [4]. DTPs are defined as any unintended effects experienced by patients during treatment that can hinder desired health outcomes and potentially cause harm if unresolved [2].

DTPs are linked to adverse patient outcomes and elevated healthcare costs. They are classified into seven categories: Unmet therapeutic need or need for additional drug therapy, unnecessary drug therapy, ineffective drugs, incorrect dosages, adverse drug reactions, and noncompliance. Identifying and resolving DTPs involves modifying medications or dosages, educating patients on proper medication use, and creating individualized care plans [2]. When DTPs are recognized, they can be addressed through medication adjustments, dosage changes, or patient education to enhance therapeutic effectiveness. Consequently, a tailored care plan is developed for each patient, focusing on specific therapeutic goals for every medical condition [5,6].

As CVD remain the leading cause of death globally, significant investments in prevention and treatment are warranted. The high prevalence of comorbidities in patients with CVD complicates management, as these conditions can directly or indirectly affect cardiovascular health. This complexity can lead to DTPs, highlighting the need for comprehensive medication management services to optimize patient outcomes [6,7].

DTPs significantly impact patient outcomes, contributing to increased morbidity and mortality, extended hospital stays, and higher healthcare costs. The intricate nature of medication use in both institutional and ambulatory settings elevates the risk of DTPs, particularly among patients on multiple medications. Addressing DTPs is essential for reducing healthcare costs and improving patient outcomes [8]. In 2000, drug-related morbidity and mortality accounted for

$177.4 billion in total costs, with long-term care admissions representing 18% ($32.8 billion) [9,10].

Studies are scarce on DTPs among adult ambulatory cardiovascular disease patients in Ethiopia, especially within chronic care units. This study aims to identify and address DTPs and their underlying causes in ambulatory cardiovascular disease patients at Wolaita Sodo University Comprehensive Specialized Hospital in Southern Ethiopia. The findings will inform strategies to optimize drug use, ultimately reducing morbidity and mortality associated with DTPs.

Materials and Methods

Study design and setting

A hospital-based cross-sectional study was conducted at the ambulatory care clinic of Wolaita Sodo University Comprehensive Specialized Hospital (WSUCSH) in Wolaita, South Ethiopia. WSUCSH is the largest public hospital in southern Ethiopia, serving an estimated catchment population of 3.5–5 million. The chronic care unit offers medical services for registered, newly diagnosed, and referred cardiovascular disease (CVD) patients, with scheduled follow-up appointments from Monday to Friday. Approximately 412 CVD patients had follow-up appointments during the study period.

Sample size and data collection

Patients aged 18 years with complete medical records and regular follow-up between May 9 and July 8, 2022, were included. Patients were recruited during medication refilling appointments and excluded if newly diagnosed with CVD (<6 months), seriously ill, unwilling to consent, or lacking complete medical records. A sample size of 195 was calculated, accounting for a 10% non-response rate. Data were collected through interviews using a structured questionnaire and the retrieval of medical charts by two clinical pharmacists and two nurses who received one day of training. A convenience consecutive sampling technique was employed during the two-month study period. All adult ambulatory CVD patients presenting for their scheduled chronic follow-up and medication refilling appointments from Monday through Friday were evaluated sequentially. Patients who met the inclusion criteria were consecutively invited to participate until the target sample size was reached. Data were collected via face-to-face patient interviews using a structured questionnaire, alongside a comprehensive review of medical charts, by two trained clinical pharmacists and two trained nurses.

Drug therapy problems identification

DTPs were assessed using a modified version of Cipolle's DTP categories and the Naranjo algorithm for adverse drug reactions (ADRs). DTPs were identified through reviews of medical records, laboratory investigations, patient interviews, and physical observations, categorized into seven groups: unnecessary drug therapy, need for additional drug therapy, ineffective drug therapy, dosage too high, adverse drug reaction, dosage too low, and non-adherence (2). Initial screening and comprehensive chart reviews were conducted independently by two trained clinical pharmacists to identify issues across the seven validated Cipolle categories. To ensure clinical accuracy, any suspected DTP was presented to a multidisciplinary expert clinical panel consisting of the investigative team, senior clinical pharmacists, and attending physicians/cardiologists at the ambulatory care clinic. The final decision to confirm a DTP and recommend an intervention was based entirely on expert panel consensus.

Data analysis

Data were analyzed using IBM SPSS version 20.0. Descriptive statistics were computed, and univariable logistic regression was performed to determine associations with DTPs. Independent variables with a p-value <0.25 were included in a multivariable binary logistic regression model to identify DTP predictors, with p <0.05 considered statistically significant.

Results

Socio-demographic characteristics

In this study, 195 patients with cardiovascular diseases (CVD) were analyzed, with a mean age of 54 ± 27.724 years, ranging from 20 to 110 years. The largest age group was those aged 65 years and older (40.5%). More than half of the participants were female (54.4%), and a significant portion were married (79.5%) and illiterate (42.1%). Regarding substance use, the majority of patients reported consuming coffee (81.5%).

Most participants identified as followers of a particular religion, lived in rural areas, and did not have a regular monthly income, accounting for 69.8%, 69.2%, and 35.4% of the study group, respectively. Additionally, the highest proportion of patients were farmers (42.6%), with approximately 160 (82.1%) of them falling into this category (Table 1).

Clinical characteristics

Disease-related variables of study patients

The mean duration of cardiovascular disease since diagnosis was 2.26 ± 0.752 years. Among the study participants, 61 (31.3%) had a history of hospitalization while undergoing treatment, with the majority 39 (20%) experiencing only one hospitalization. The most common comorbidities identified were infectious diseases 35(32.8%), followed by dyspepsia secondary to peptic ulcer disease 15(14%). The least frequent comorbidities included chronic liver disease and nephrotic syndrome 3(2.8%) (Figure 1). A total of 107 comorbidities were identified among 79 subjects: 60 (76%) had a single comorbidity, 16 (20.2%) had two, and 3 (3.8%) had more than two comorbidities (Figure 2). The most prevalent cardiovascular conditions during the data collection period were hypertension 116(59.5%) and congestive heart failure 92 (47.2%). Average blood pressure measurements, based on at least two consecutive readings, indicated that 84 (43.2%) had poor blood pressure control. Details of the disease-related conditions among the study subjects are presented in Table 2.

Medication-related variables of study patients

Among the study participants, 91 (46.7%) were prescribed more than five medications per day. The average number of medications taken per patient was 2.65 ± 0.5. Most patients reported no history of drug allergies; only three patients (1.5%) experienced allergies, with doxycycline responsible for 0.5% and ceftriaxone for 1% of cases (Table 3).

A total of 640 medications were utilized. The most commonly prescribed drug classes included diuretics (21.4%), calcium channel blockers (15.9%), spironolactone (15.6%), antibiotics (9.8%), ACE inhibitors (6.8%), beta blockers (5.3%), antiplatelet agents (5.3%), statins (4.7%), cardiac glycosides (3.2%), and anticoagulants (2.8%) (Figure 3).

Epidemiology of drug therapy problems

A total of 136 patients experienced one or more drug therapy problems (DTPs), resulting in a prevalence of 69.8%. In this study, 168 DTPs were identified, with an average of 1.3 ± 0.461 DTPs per patient. The maximum number of DTPs recorded for a single patient was three. The majority of patients (108 or 79.5%) had only one DTP (Table 4). Most indications required additional drug therapy, accounting for 69 cases (41% of all DTPs). Among the most commonly needed drug categories for preventing cardiac remodeling and disease progression were ACE

inhibitors and beta-blockers. Of the seven categories of DTPs identified, unmet therapeutic need or need additional drug therapy was the most prevalent, comprising 69 (41% of total DTPs) (Table 4).

The most common reason for drug therapy problems (DTPs) was a medical condition requiring treatment, reported by 38 patients (22.6%). According to the Validated Morisky Medication Adherence Scale (MMAS), 41 patients (24.4%) were non-adherent to their medication, making non-compliance the second most frequent type of DTP. Among non-adherent patients, 14 (8.4%) cited forgetting to take their medication as the primary reason, while issues of drug unavailability and affordability were reported by 11 patients (6.6%). Unnecessary drug therapy was identified as the third most frequent DTP category, affecting 20 patients (11.9%).

The most commonly involved drug class in drug therapy problems (DTPs) was beta-blockers, followed by diuretics, ACE inhibitors (ACEIs), mineralocorticoid receptor antagonists (MRAs), calcium channel blockers (CCBs), antiplatelet agents, statins, anticoagulants, and cardiac glycosides. The primary indication for the need for additional drug therapy was preventing cardiac remodeling and disease progression, particularly in cases with complicating factors, such as hypertension combined with heart failure.

Predictors of drug therapy problem occurrence in study patients

Multivariable logistic regression analysis was conducted to identify independent predictors of drug therapy problems (DTPs) among study participants. The analysis revealed that polypharmacy, history of hospitalization, and age were independent predictors of DTPs. Specifically, the likelihood of experiencing DTPs increased with age. Patients aged 25-64 years were 16.382 times more likely to have DTPs [AOR=16.382, 95% CI: (5.554-48.321)], while those over 65 years were 5.837 times more likely compared to individuals under 25 years [AOR=5.837, 95% CI: (2.096-16.254)] (p-value = 0.000). Notably, multivariable logistic regression confirmed that age operated as an independent risk factor for experiencing DTPs completely separate from the total number of pills or medications prescribed, even after adjusting for polypharmacy status within the model. Additionally, patients taking more than five medications per day were approximately 3.484 times more likely to experience DTPs [AOR=3.484, 95% CI: (1.472-8.244)] compared to those taking five or fewer medications (p-value = 0.005). Conversely, patients with a history of hospitalization were less likely to have DTPs [AOR=0.309, 95% CI: (0.098-0.973)] compared to those without such a history (Table 5).

Discussion

This study aimed to evaluate the occurrence of drug therapy problems (DTPs) and predictors among patients with cardiovascular disease (CVD) attending the ambulatory clinic of WSUCSH. A significant proportion of participants presented with hypertension and congestive heart failure (CHF), with rates exceeding those reported in other studies, where the prevalence of CHF and hypertension was less than 30% [11,12]. However, these findings are consistent with a study conducted in Saudi Arabia [6] .

Additionally, our study identified infectious diseases (32.8%) and dyspepsia secondary to peptic ulcer disease (14%) as the most prevalent comorbidities among CVD patients. These conditions increase the risk of DTPs due to the necessity for multiple medications to manage health issues alongside CVD. This may explain the high number of participants receiving five or more drugs, aligning with findings from a study in northwest Ethiopia, where patients also reported multiple comorbidities and high medication usage [12,13].

In terms of DTPs, 136 patients (69.8%) experienced a total of 168 DTPs, similar to results from a study conducted at Gebretsadik Shawo General Hospital in Bonga, Ethiopia [14]. Conversely, a study at FHRH reported 105 DTPs , while another at JUSH recorded 149 DTPs [15]. Furthermore, the current DTP prevalence is higher than a study conducted in Ayder Hospital, Ethiopia [16] . The variation in DTP prevalence may be attributed to the higher number of patients with comorbidities in our study, as well as differences in clinical knowledge among investigators and the methodologies employed. The average number of DTPs per patient was 1.23 ± 0.6, which contrasts with figures from FHRH (18) and JUSH [15], where averages were 1.38 ± 0.8 (24) and 3.014 (23), respectively. This indicates that the number of patients experiencing DTPs in our study is relatively higher than in the other two studies. This prevalence is notably higher than rates reported at Ayder Hospital [17] and Felege Hiwot Referral Hospital (FHRH) [13], yet closely mirrors the burden documented at Jimma University Specialized Hospital (JUSH) [16]. This elevated rate is directly attributable to the high density of complex, multi-system comorbidities unique to our catchment population, paired with varying levels of diagnostic clinical pharmacy oversight across different tertiary settings.

The most common type of DTP identified was related to indication, specifically an unmet need or need for additional drug therapy. This finding is consistent with studies in Los Angeles [11], as well as in Ethiopia, where indications for additional therapy were also prevalent (FHRH: 90.69% [12]; JUSH [15]: 83%. In China, efficacy and safety-related DTPs were more common [17].

Differences in DTP types may stem from variations in health professionals' knowledge regarding appropriate drug indications and the selection of drugs based on observed cases, influenced by patient comorbidities. Out of the DTPs, only 15 (8.9%) were related to effectiveness, which is lower than rates reported in FHRH (31%) and Mekonnen AB [12,13]. The comparatively low rate of effectiveness-related DTPs (8.9% vs. 31% and 22%) likely stems from methodological differences, including a broader patient cohort, insufficient laboratory monitoring, and a constrained classification for such problems.

Safety-related DTPs occurred in 13.7% of patients, a notably lower figure compared to JUSH (45.83%) and Mekonnen AB (31.39%) [4,15]. The limited types of safety issues covered in this study, such as high dosages and contraindications, may account for this discrepancy. In contrast, studies in Bonga and European studies highlighted higher rates of contraindications and inappropriate frequencies [14]. In Belo Horizonte, adverse drug events were the primary safety issue, whereas European studies reported high rates of excessive dosages (27.5% and 13.75%).

Around 41 patients (24.4%) exhibited non-compliance, primarily due to forgetting to take medication. This aligns with findings from Nigeria (27%) [3], and JUSH (29%) [15], although studies in the USA (8%) [11], Brazil (11%) [18], and Venezuela (13%) reported lower non-compliance rates. The discrepancies may be attributed to differences in healthcare services and the educational levels of patients, as many participants in this study had no formal education or education below secondary school. At Wolaita Sodo University Comprehensive Specialized Hospital, patient counseling is primarily verbal, brief, and conducted opportunistically by nurses during clinic check-ins and by pharmacists at dispensing windows. Due to high daily patient volumes, a lack of dedicated counseling rooms, and the complete absence of standardized, written educational materials printed in local languages (such as Wolayttatto), deep behavioral reinforcement is challenging. Structurally, it is vital to note that our reported non-adherence rate reflects structural and socioeconomic barriers (forgetfulness, cost, supply failures) rather than patient-initiated discontinuation due to intolerance. Clinical side effects, such as statin-induced myalgia, were intercepted early by the on-duty clinical pharmacy team and prioritized as active Adverse Drug Reactions (ADRs). By separating clinical safety events from behavioral non-adherence, the study highlights that chronic cardiac care gaps in this high-volume setting are predominantly driven by resource and follow-up limitations rather than active patient rejection of therapy due to drug toxicity.

The most common drugs associated with DTPs in this study were beta-blockers, diuretics, and ACE inhibitors. These findings are consistent with studies conducted at Jimma University Specialized Hospital and interventional studies among heart failure patients in Barcelona and Taiwan [15,19,20].

Multiple regression analysis revealed that age, polypharmacy, and history of hospitalization, were independent predictors of DTPs. This finding goes in line with the study done in Jordan [21]. The use of multiple medications was significantly associated with DTPs in both binary and multivariate logistic regressions. Patients taking more than five drugs were 3.484 times more likely to experience DTPs than those using five or fewer, corroborating findings from a study in Jordan and Saudi Arabia that linked medication usage to treatment-related problems and another from northwest Ethiopia that highlighted the relationship between medication count and DTP risk [13,21,22]. This clear compounding risk highlights a structural limitation in local cardiovascular management: the lack of widely available commercial "polypills" (fixed-dose single-pill combinations containing common multi-drug regimens like an ACE inhibitor, statin, and aspirin together). In public healthcare settings across Southern Ethiopia, patients must obtain and take individual monotherapy pills for each indication. This inevitably increases the daily pill burden, drives the high rate of polypharmacy (46.7%) found in our clinic, and subsequently triggers avoidable drug-therapy conflicts.

Moreover, the likelihood of experiencing DTPs increased with age. Patients aged 25-64 years were approximately sixteen times more likely to develop DTPs compared to those under 24, and this likelihood increased to five times for patients over 65. This relationship is well-documented; as advanced age often leads to multiple conditions requiring complex medication regimens. While this finding aligns with studies in Jordan and Taiwan, a study from Hiwot Fana Specialized University Hospital in Ethiopia did not find a significant association between age and DTPs [23]. This discrepancy may be due to differences in study populations, particularly the higher proportion of elderly participants in our study.

Lastly, a history of hospitalization was significantly associated with lower rates of DTPs. Patients with a history of hospitalization while on treatment were less likely to experience DTPs compared to those without such a history. Although limited studies have explored this association, it may be attributed to enhanced patient assessment and education during hospitalization, which can lead to improved medication adherence and awareness, ultimately reducing DTP prevalence.

Limitations of the study

This study has some limitations. Its cross-sectional design assessed only current DTPs without follow-up or interventions. Non-adherence may be overestimated due to self-reporting bias in the Morisky scale. Missing data (e.g., HbA1c, BMI, RFT, LFT, lipid profiles) limited analysis. Additionally, being a single-center study, broader multi-center research is needed for generalizability.

Conclusions

In conclusion, this study highlights significant medication management challenges among ambulatory CVD patients, with a majority experiencing drug therapy problems. The most prevalent issues were unmet therapeutic needs and medication non-adherence, with polypharmacy as a significant predictor particularly affecting younger patients and those on multiple medications. While some clinical factors appeared protective, the high prevalence of therapy gaps and cardiovascular risk underscores the urgent need for enhanced medication review processes and coordinated care strategies to optimize treatment outcomes in this vulnerable population.

References

1. Thorvaldsen P, Davidsen M, Brønnum-Hansen H, Schroll M. S Stable stroke occurrence despite incidence reduction in an aging population: stroke trends in the danish monitoring trends and determinants in cardiovascular disease (MONICA) population. Stroke 1999;30:2529-34.
2. Cipolle RJ, Strand LM, Morley PC. Pharmaceutical care practice the patient centered approach to medication management. 3rd Edition. New York, NY, USA: McGraw-Hill, Health Professions Division; 2012.
3. Adibe MO, Igboeli NU, Ukwe CV. Evaluation of drug therapy problems among renal patients receiving care in some tertiary hospitals in Nigeria. Trop J Pharm Res 2017;16:697-704.
4. Hepler CD, Strand LM. Opportunities and responsibilities in pharmaceutical care. Am J Hosp Pharm 1990;47:533-43.
5. Reinhold JA, Earl G. Clinical therapeutics primer: link to the evidence for the ambulatory care pharmacist. Burlington, MA, USA: Jones & Bartlett Publishers; 2014.

6. Al-Arifi M, Abu-Hashem H, Al-Meziny M, et al. Emergency department visits and admissions due to drug related problems at Riyadh military hospital (RMH), Saudi Arabia. Saudi Pharm J 2014;22:17-25.
7. Goff DC Jr, Lloyd-Jones DM, Bennett G, et al. 2013 ACC/AHA guideline on the assessment of cardiovascular risk: a report of the American College of Cardiology/American Heart Association task force on practice guidelines. Circulation 2014;129:S49-73.
8. Gastelurrutia P, Benrimoj SI, Espejo J, et al. Negative clinical outcomes associated with drug-related problems in heart failure (HF) outpatients: impact of a pharmacist in a multidisciplinary HF clinic. J Card Fail 2011;17:217-23.
9. Niquille A, Bugnon O. Relationship between drug-related problems and health outcomes: a cross-sectional study among cardiovascular patients. Pharm World Sci 2010;32:512-9.
10. Ernst FR, Grizzle AJ. Drug-related morbidity and mortality: updating the cost-of-illness model. J Am Pharm Assoc 2001;41:192-9.
11. Elaine L LR. Drug related problems in cardiovascular patients receiving pharmaceutical care in Los Angeles teaching hospital. Int J Pharm Pract 2009;13:165-77.
12. Temsgen G, Kefale B, Degu A. Drug therapy problem among patients with cardiovascular diseases in felege hiwot referral hospital, north east, Bahir dar Ethiopia. Indo Amer J Pharm Res 2014;4:2828-38.
13. Srikanth A. Assessment of drug related problems and its associated factors among medical ward patients in University of Gondar Teaching Hospital, Northwest Ethiopia: a prospective cross-sectional study. J Basic Clin Pharm 2017;8:205-10.
14. Gizaw K, Dubale M. Drug related problems and contributing factors among adult ambulatory patients with cardiovascular diseases at Gebretsadik Shawo General Hospital, Bonga, South west Ethiopia. J Nat Sci Res 2017;7:9-16.
15. Tigabu BM, Daba D, Habte B. Drug-related problems among medical ward patients in Jimma university specialized hospital, Southwest Ethiopia. J Res Pharm Pract 2014;3:1-5.
16. Weldegebreal AS, Tezeta F, Mehari AT, et al. Assessment of drug therapy problem and associated factors among adult hypertensive patients at Ayder comprehensive specialized hospital, Northern Ethiopia. Afr Health Sci 2019;19:2571-9.
17. Bedouch P, Allenet B, Grass A, et al. Drug-related problems in medical wards with a computerized physician order entry system. J Clin Pharm Ther 2009;34:187-95.

18. Nascimento YDA, Carvalho WDS, Acurcio FDA. Drug-related problems observed in a pharmaceutical care service, Belo Horizonte, Brazil. Braz J Pharm Sci 2009;45:321-30.
19. Morcillo C, Valderas JM, Aguado O, et al. Evaluation of a home-based intervention in heart failure patients. Results of a randomized study. Rev Esp Cardiol 2005;58:618-25.
20. Chang HY, Lee CM, Hung CL, et al. Taiwan Society of Cardiology heart failure registry 2020: rationale and design. Acta Cardiol Sin 2024;40:235-41.
21. Al Fahmawi H, Albsoul-Younes A, Saleh M, et al. Drug therapy problems identified by clinical pharmacists at a general surgery ward of an academic referral hospital in Jordan. Ther Clin Risk Manag 2024;20:619-31.
22. Basheti IA, Qunaibi EA, Bulatova NR, et al. Treatment related problems for outpatients with chronic diseases in Jordan: the value of home medication reviews. Int J Clin Pharm 2013;35:92-100.
23. Gelchu T, Abdela J. Drug therapy problems among patients with cardiovascular disease admitted to the medical ward and had a follow-up at the ambulatory clinic of Hiwot Fana Specialized University Hospital: the case of a tertiary hospital in eastern Ethiopia. SAGE Open Med 2019;7:2050312119860401.

Table 1. Sociodemographic characteristics of adult ambulatory patients with CVDs attending the chronic care unit at WSUCSH, from May 9 to July 8, 2022 (n=195).

Variables	Category	Frequency (%)	Mean ± SD
Sex	Male	89 (45.6)	
	Female		
	- Pregnant	1 (0.5)	
	- Non-pregnant	105 (53.9)	
	- Breastfeeding	0 (0)	
Age of Participants	18 – 24	65 (33.3)	54 ± 27.724
	25-64	51 (26.2)	
	65	79 (40.5)	
Religion	Protestant	136 (69.8)	
	Orthodox	57 (29.2)	
	Muslim	2 (1)	
	Others	0 (0)	
Marital Status	Single	30 (15.4)	
	Married	155 (79.5)	
	Widowed	10 (5.1)	
	Divorced	0 (0)	
Educational Status	No formal education	82 (42.1)	
	Primary education	54 (27.7)	
	Secondary education	27 (13.8)	
	College diploma	20 (10.3)	
	Degree & above	12 (6.2)	
Ethnicity	Wolayta	160 (82.1)	
	Tigre	13 (6.7)	
	Gamo	7 (3.6)	
	Gurage	10 (5.1)	
	Others	5 (2.6)	
Occupation	Employed	20 (10.3)	
	Unemployed	54 (27.7)	
	Student	15 (7.7)	
	Merchant	17 (8.7)	
	Farmer	83 (42.6)	
	Retired	6 (3)	
Family Size	5	168 (86.2)	
	>5	27 (13.8)	
Place of Residence	Urban	60 (30.8)	
	Rural	135 (69.2)	
Monthly Income	No income	69 (35.4)	
	<1500	35 (17.9)	
	1500-2500	33 (16.9)	
	2500-3500	21 (10.8)	
	>3500	37 (19)	
Family History of CVDs	Yes	6 (3.1)	
	No	189 (96.9)	
Aerobic Exercise	Yes	10 (5.1)	
	No	185 (94.9)	
Salt Restriction	Yes	174 (89.2)	
	No	21 (10.8)	
Traditional Medicine Use	Yes	28 (14.4)	
	No	167 (85.6)	
Cigarette Smoking	Yes	1 (0.5)	
	No	194 (99.5)	
Khat Chewing	Yes	2 (1)	
	No	193 (99)	
Coffee Use	Yes	159 (81.5)	
	No	36 (18.5)	
Alcohol Use	Yes	3 (1.5)	
	No	192 (98.5)	

Table 2. Disease-related variables among adult ambulatory patients with CVDs attending the chronic care unit at WSUCSH, from May 9 to July 8, 2022 (n=195).

Disease Related Variables	Category	Number (%)	Mean ± SD
Duration of CVDs	<1 years	36 (18.5)	2.26 ± 0.752
	1 year	72 (36.9)	
	>1 years	87 (44.6)	
Duration of Therapy	<1 year	35 (17.9)	
	1 year	71 (36.5)	
	>1 year	89 (45.6)	
Previous Hospitalization	Yes	61 (31.3)	1.69 ± 0.465
	No	134 (68.7)	
No. of Hospitalizations	One time	39 (20)	1.44 ± 0.696
	Greater than one	22 (11.3)	
Reasons for Hospitalization	Drug discontinuation	7 (3.6)	
	Comorbidity	18 (9.2)	
	Disease exacerbation	21 (10.8)	
	Drug discontinuation & disease exacerbation	15 (7.7)	
Presence of Comorbidity	Yes	79 (40.5)	
	No	116 (59.5)	
Types of CVDs	HTN	116 (59.5)	
	CHF	92 (47.2)	
	ACS	4 (2)	
	IHD	10 (5.2)	
	Stroke	14 (7.2)	
	VTE	4 (2)	
	AF	23 (11.8)	
Etiology of CVDs	CRVHD	33 (16.9)	
	HHD	35 (17.9)	
	IHD	13 (6.7)	
	DCMP	15 (7.7)	
	Others	14 (7.2)	
Average BP Measures	90/60 – 130/80 mmHg	105 (53.8)	
	Above 130/80	84 (43.2)	
Average Glycemic Value	Less than 70 (hypoglycemia)	6 (3.1)	
	70 – 130 (good)	50 (25.6)	
	Above 130 (poor)	5 (2.5)	
Lipid Profile	Normal	15 (7.6)	
	Dyslipidemia	20 (10.2)	
	Not available	160 (82.2)	
RFT	Normal	121 (62)	
	Impaired	38 (19.5)	
	Not available	36 (18.5)	
LVEF	Not available	43 (22)	
	EF (<35)	96 (49.2)	
	EF (40—55)	45 (23)	
	EF (55—70)	32 (16.5)	

Table 3. Medication-Related Variables Among Adult Ambulatory Patients with CVDs attending the chronic care unit at WSUCSH, from May 9 to July 8, 2022 (n=195).

Medication Related Variables	Category	Frequency (%)	Mean ± SD
Source of Medication	Payment	67 (34.4)	
	Free	94 (48.2)	
	Both	34 (17.4)	
Polypharmacy	No	104 (53.3)	2.65 ± 0.5
	Yes	91 (46.7)	
Drug Allergy	Yes	3 (1.5)	
	No	192 (98.5)	
Drug Responsible for Allergy	Doxycycline	1 (0.5)	
	Ceftriaxone	2 (1)	
MMAS-8	8 (good)	154 (79)	
	6 – 8 (medium)	16 (8.2)	
	<6 (poor)	25 (12.8)	
Narenjos ADR Scale	9 (definite)	1 (0.5)	
	5-8 (probable)	5 (2.6)	
	0 (doubtful)	189 (96.9)	

Table 4. Total number and type of Drug Therapy Problems among adult ambulatory patients with CVDs attending the chronic care unit at WSUCSH, from May 9 to July 8, 2022 (n=136).

No	No of Patients	No of DTPs	Total No of DTPs	Patients with DTP (%)	Categories of DTPs	No of DTPs (%)
1	108	Only one DTP per patient	108	79.5	Unnecessary drug therapy	20 (11.9)
2	24	Two DTPs per patient	48	17.6	Need additional drug therapy	69 (41)
3	4	Three DTPs per patient	12	2.9	Ineffective drug therapy	15 (8.9)
					Dose too low	0 (0)
					Adverse drug effects	19 (11.4)
					Dose too high	4 (2.4)
					Non-adherence	41 (24.4)
Total	**136**		**168**	**100**		

Table 5. Results of multiple logistic regressions for predictors of DTPs among adult ambulatory patients with CVDs attending the chronic care unit at WSUCSH, from May 9 to July 8, 2022 (n=195).

Predictors	Category	DTP Yes (%)	DTP No (%)	COR	AOR (95% CI)	P-value
Age Category	18-24	3 (17.5)	4 (15.8)	(1)	(1)	(1)
	25-64	3 (15.8)	20 (10.2)	2.2	16.4 (5.6 - 48.3)	0.01*
	65	7 (36.5)	8 (4.2)	2.5	5.8 (2.1 - 16.3)	0.001*
History of Hospitalization	Yes	5 (26.6)	2 (4.2)	0.3	0.3 (0.1 – 1.0)	0.045*
	No	84 (43)	51 (26.2)	(1)	(1)	(1)
Salt Restriction	Yes	117 (60)	57 (29.2)	4.6	3.4 (0.6 - 19.3)	0.17
	No	19 (9.8)	2 (1)	(1)	(1)	(1)
Aerobic Exercise	Yes	5 (2.5)	5 (2.5)	(1)	(1)	(1)
	No	13 (67.3)	54 (27.7)	2.4	1.5 (0.3 - 7.7)	0.64
Polypharmacy	Yes	7 (38.5)	1 (8.2)	3.3	3.5 (1.5 - 8.2)	0.01*
	No	6 (31.3)	43 (22)	(1)	(1)	(1)
Comorbidity	Yes	6 (35.4)	1 (5.1)	0.2	0.2 (0.1 - 0.4)	0.01*
	No	6 (34.4)	49 (25.1)	(1)	(1)	

Note: *-significant results, 1-reference category, *p-value 0.05, CI=confidence interval, COR=crude odds ratio, AOR=adjusted odds ratio

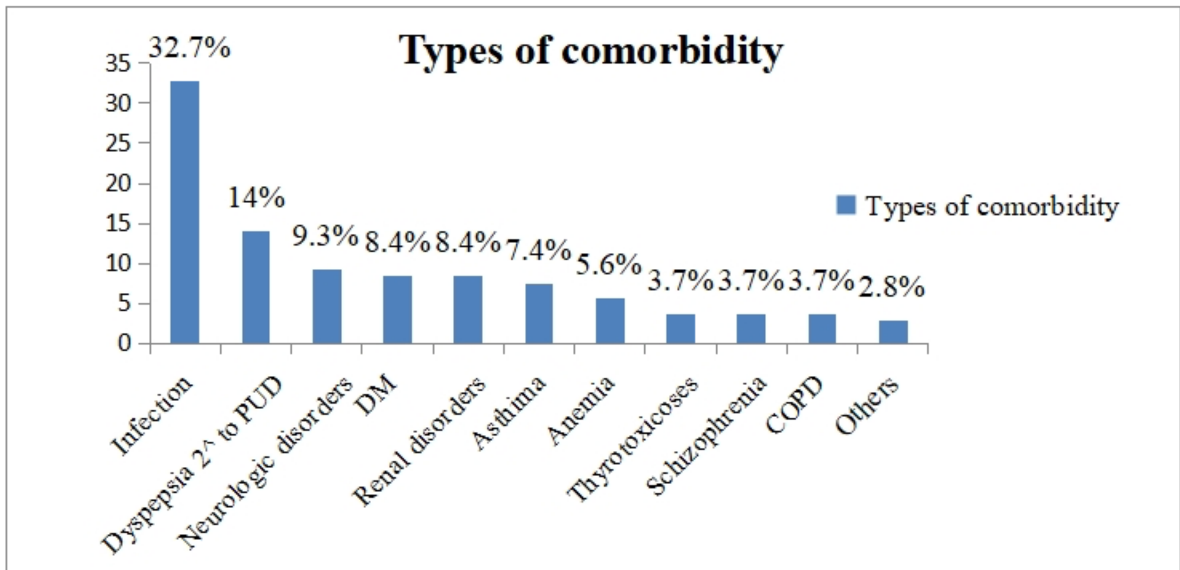

Figure 1. Type of comorbidity among adult ambulatory patients with CVDs attending the chronic care unit at WSUCSH, from May 9 to July 8, 2022 (n=107). Note: others: - Chronic liver disease and Nephrotic nephritic syndromes.

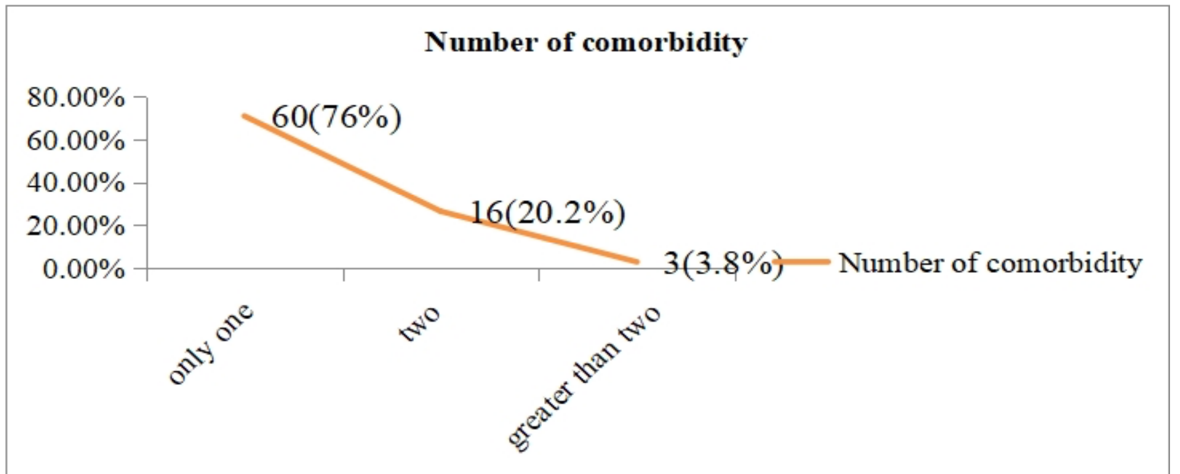

Figure 2. Number of comorbidities among adult ambulatory patients with CVDs attending the chronic care unit at WSUCSH, from May 9 to July 8, 2022 (n=79).

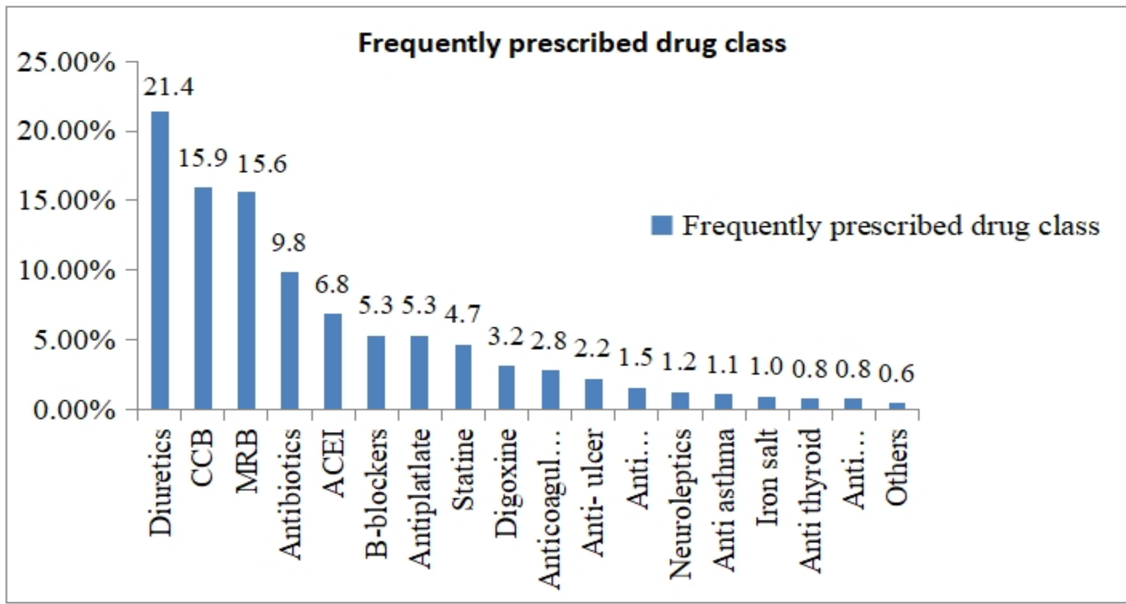

Figure 3. Frequently prescribed drug classes among adult ambulatory patients with CVDs attending the chronic care unit at WSUCSH, from May 9 to July 8, 2022 (n=640). Note: Others: (anti-TB, HAART & NSAIDs), ACIEs: Angiotensin converting enzyme inhibitors, ARBs: angiotensin receptor blockers, CCBs: calcium channel blockers, diuretics: (loop & thiazide diuretics).