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Drug therapy problems related to cardiovascular agents and associated factors among heart failure patients: a prospective observational study of a tertiary inpatient setting in Uganda

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ABSTRACT

Background: Heart failure (HF) is a clinical syndrome that is treated with multiple medications, putting patients at risk of drug therapy problems (DTPs). DTPs are a great concern in health care due to their significant impact on morbidity, mortality, and higher costs associated with health care. **Aims:** This study aimed to assess the prevalence and factors associated with DTPs related to cardiovascular agents among HF patients hospitalized at the Mbarara Regional Referral Hospital. **Methods:** A prospective observational study was conducted among hospitalized HF patients from November 2021 to January 2022. A total of 118 patients diagnosed with HF were recruited. Patient file reviews and interviewer-administered questionnaires were used for data collection. Univariate and multivariate logistic regressions were employed to determine factors associated with the DTPs. **Result:** A total of 118 HF patients with a median age of 43 years were included in this study. Among them, 57 participants experienced a total of 81 DTPs with a prevalence of 48.3%. "Dosage too high" was the most common DTP (23, 28.3%) followed by "needs additional drug therapy" (22, 27.2%). Hospitalized HF patients aged 60 years and above (adjusted odds ratio [AOR]: 4.1; 95% confidence interval [CI]: [1.5 – 10.3]; $P = 0.012$) and taking more than five medications during their hospital stay (AOR: 2.92; 95% CI: [1.5 – 7.6]; $P = 0.029$) were significantly associated with experiencing at least one DTP. **Conclusion:** Almost half of the hospitalized HF patients experienced at least one DTP during their hospital stay. "Dosage too high" and "needs additional drug therapy" were the most common DTPs. Hospitalized HF patients with poly-pharmacy (taking more than five cardiovascular agents) and aged above 60 were more likely to have DTPs. It is noted that patient groups who are at risk require follow-ups to improve the treatment outcome, and incorporation of clinical pharmacy service could be part of the solution. **Relevance for Patients:** This study identifies the factors associated with the development of DTP to facilitate the development and implementation of prevention strategies for the commonly identified DTPs.

1. Introduction

Heart failure (HF) is a clinical syndrome characterized by functional or structural impairments of the heart leading to the inability of the organ to fill with or pump a sufficient amount of blood to meet the metabolic needs of the body [1,2]. HF can be managed by lifestyle modification and lifelong therapy with multiple medications [3]. There has been a consistent increase in the number of medications used in HF patients, but this has been

associated with detrimental health outcomes, such as frequent hospitalization and drug-related problems [4,5].

Over 40% of newly diagnosed cardiovascular disease (CVD) patients are HF patients [6]. The incidence and prevalence of CVD in Africa are increasing, and CVD is predicted to overtake communicable disease as the most common cause of death in a few decades, especially in sub-Saharan Africa (SSA) [7]. The impact of CVDs, including HF, is more prominent in the working class from low- and middle-income countries, like Uganda [8,9]. However, there is a lack of population-based incidence and prevalence of HF studies in SSA, including Uganda. It was reported that HF is responsible for 9.4 – 42.5% of all medical admissions and 25.6 – 30.0% of admissions into the cardiac units [10].

A drug therapy problem (DTP) can be defined as any undesirable drug treatment-related event experienced by a patient, which potentially interferes with the desired goals of therapy and requires professional intervention to resolve [11]. DTPs can be classified using validated tools, like Cipolle's [11], Pharmaceutical Care Network Europe [12], and APS-Doc [13]. Common DTPs can be classified accordingly as: "dosage too low," "adverse drug reaction," "needs additional drug therapy," "ineffective drug," "unnecessary drug therapy," "dosage too high," and "non-adherence" [11]. DTPs are common in HF patients as HF treatment involves multiple medications (poly-pharmacy), coupled with its risk factors, i.e., comorbidities, advanced age, and poor continuity of care [3,14–19].

The prevalence of DTPs among HF patients is reportedly 29.8 – 88.66% [20,21]. HF patients are vulnerable to DTPs, which raises their risk of mortality and morbidity [22]. DTPs are related to clinical outcomes, health-care costs, and quality of life of CVD patients [23]. Reducing health-care costs, mortality, and hospitalization and improving quality of life can be achieved through optimized drug therapy to prevent DTPs [24].

The increase in HF prevalence in SSA [25] and cardiovascular drug-related DTPs warrant further investigation into the prevalence of DTPs and their associated factors in HF patients for a better treatment outcome. Given the lack of data regarding cardiovascular drug-related DTPs in HF patients and undefined factors associated with DTPs, the present study aimed to determine the prevalence and factors associated with cardiovascular drug-related DTPs among HF patients hospitalized at the Mbarara Regional Referral Hospital (MRRH), Mbarara, Uganda.

2. Methods

2.1. Study design

This study was a prospective observational study conducted among hospitalized HF patients at the MRRH medical and pediatric wards from November 2021 to January 2022. MRRH is a 600-bed tertiary hospital and is the largest referral center in southwestern Uganda, 280 km from the capital Kampala. The hospital serves a population of over four million people in its catchment area comprising 13 districts of southwestern Uganda. The medical inpatient ward comprises 50 beds with an estimated monthly admission of 300 patients.

The study population included all inpatient HF patients who were hospitalized at MRRH during the study period. The inclusion and exclusion criteria were:

(i) Inclusion criteria: All newly diagnosed or known HF patients who were hospitalized for any reason at MRRH (internal medicine for adult and general pediatric wards) during the study period and were willing to participate in the study.

(ii) Exclusion criteria: Patients who were critically ill and/or in intensive care units.

2.2. Sample size determination

The sample size (n) was calculated using a single proportion formula;

$$n = Z^2 \, p \, (1–p)/w^2 \tag{I}$$

Where n is the required sample size, p is the prevalence of the DTP, w is the tolerated margin of error (5%), and Z is the level of confidence (i.e., 1.96 at 95% confidence interval [CI]). The prevalence of DTP among HF patients from a previous study in Ethiopia was 91.3% [26]. Since the study settings were similar, we used 91.3% as p of DTP among hospitalized HF patients, with a 0.05 significance level at a 95% CI (i.e., p: 91.3%; w: 0.05; Z: 1.96 [95% CI]).

Using the above formula, the number of patients to be included in the study was 122. The *post hoc* power was 69 – 96% for variables included in the logistic regression analysis, with a generally acceptable level of type II errors.

A consecutive sampling technique was used during the study period, and data collection was continued for 3 months (November 2021 – January 2022) until the required sample size was achieved.

2.3. Data quality control

Pre-testing of the data collection tool was conducted using 10 patients who met the inclusion criteria. This was performed to identify any challenges or issues with the tool, allowing for necessary modifications and refinements to be made thereafter. The principal investigator (E.A.S.) selected and recruited research assistants, and training on data collection protocols and ethical considerations was given before the study's commencement. The data collection tool was translated to Runyankole (the local language in western Uganda) by a professional and then the results were back-translated to English to check for consistency.

2.4. Data collection

All patients who presented to the medical and pediatric inpatient units with a diagnosis of HF were subjected to preliminary screening and assessed for eligibility as potential study participants. The research assistants and the principal investigator enrolled patients as study participants upon voluntarily consenting to participate by writing. Assent forms were prepared for the pediatric patients and their parents, and

the data were collected after voluntary consent. The study aim was explained on enrollment.

Questionnaire-based interviews were conducted among eligible participants to obtain participants' baseline socio-demographics, past medical history, medication use, social drug use, and any known drug allergies. A data collection form was used to obtain data from patients' medical files. Patients' vital signs were taken daily and recorded. Laboratory and diagnostic investigations and current medication use were recorded daily.

Each drug therapy given during the hospital stay was evaluated for appropriateness, effectiveness, and safety based on Ugandan Clinical Guidelines (UCG, 2016), Up-To-Date (2019) version 3.12.0.44, and HF treatment guidelines. The main outcome measure refers to DTP, which was determined if any undesirable event was experienced by a patient that involves drug treatment, potentially interfering with achieving the desired goals of therapy [11]. In addition, poly-pharmacy was determined when a patient consumes five or more medications daily.

DTPs that were identified were categorized according to the Cipolle *et al.* classification system [11]. When a patient had more than one DTP during follow-up, each DTP was classified and counted separately. Lexicomp software was used to detect potential drug–drug interaction (DDI), and it was recorded as clinically significant when the interaction was rated as C, D, and X as per the Lexicomp drug interaction checker. The primary investigator (E.A.S.) classified the common drugs used according to the World Health Organization (WHO)-Anatomical Therapeutic Chemical (ATC) classification method [27]. The above-mentioned tools are standard to assess DTP and valid to use in our study based on previous studies in a similar setting. The Cipolle *et al.* DTP classification system [11] is summarized as follows:

(i) "Unnecessary drug therapy" defines a situation where drug therapy is unnecessary as the patient does not have a clinical indication for drug therapy; the use of multiple drug products for a condition that requires only a single drug; when nondrug therapy is more appropriate; addiction or recreational drug use; or treating avoidable adverse reactions [11].

(ii) "Needs additional drug therapy" defines a situation where a patient requires additional medication either for an untreated condition or to prevent a new medical condition [11].

(iii) "Ineffective drug" defines a situation where a different drug is needed after the patient is prescribed a drug that is not the most effective for the medical condition; the medical condition is refractory to the drug product; the dosage form of the drug product is inappropriate; the drug product is contraindicated in this patient; or the drug is not indicated for the condition [11].

(iv) "Dosage too low" defines a situation where the dosage is too low to produce the desired response in the patient; the dosage interval is too infrequent to produce the desired response; incorrect administration; a drug interaction that reduces the bioavailability of the active drug, resulting in lack of effectiveness in this patient; or the duration of the drug therapy is too short to produce the desired response [11].

(v) "Dosage too high" can be related to toxicity; the dosing frequency being too short for the patient; the duration of drug therapy being too long for a patient; or a drug interaction that increases the bioavailability of the active drug, resulting in toxicity in a patient [11].

2.5. Data analysis

All the statistical data analysis was performed using the Statistical Package for the Social Sciences (SPSS), version 21 (SPSS Inc., United States of America [USA]). The descriptive analysis of sociodemographic, clinical, and drug-related variables was presented as the median with the interquartile range (IQR) or percentage (%).

The prevalence of cardiovascular agent-related DTPs among hospitalized HF patients was calculated as follows:

$$\text{Prevalence }(\%) = \frac{\text{Number of cardiovascular agent} - \text{Related DTP patients}}{\text{Total number of patients}} \times 100\% \quad \text{(II)}$$

Univariate and multivariate logistic regressions were employed to determine the independent factors associated with DTPs. Variables were included in the model based on their significant association with DTP in previous studies. Multicollinearity between the independent variables was checked, indicating that there was no significant correlation between two the variables. Variables with $P < 0.25$ from the univariate analysis were included in the multivariate logistic regression. In the multivariate model, $p < 0.05$ was considered statistically significant.

3. Results

3.1. Recruitment and sociodemographic characteristics of participants

During the study period, 123 patients were screened for eligibility. Among these, five patients were excluded: three were unwilling to consent and two were discharged before an interview could be conducted; 118 HF patients were included in the final analysis. The median (IQR) age of the patients was 43 (20.75 – 69.25); 44 (37.3%) patients were elderly patients; 72 (61%) patients were females (Table 1).

3.2. Clinical characteristics and medication use of patients

A total of 56 (47.5%) patients were newly diagnosed with HF; 32 (27.1%) patients stayed in the hospital for more than 11 days; 93 (78.8%) of the patients had at least one comorbid condition; 75 (63.5%) of the patients were on poly-pharmacy; and 79 (66.9%) patients incurred a significant DDI among their medications (Table 2).

According to the ATC classification, anti-infective agents were used by 53 (44.9%) of the patients, followed by the use of alimentary tract and metabolism agents by 48 (40.6%) patients (Figure 1). Hypertension was the most common comorbid condition (37 [31.4%]), followed by kidney disease (23 [19.5%]) (Figure 2). All patients were using at least one cardiovascular agent.

Table 1. Socio-demographic characteristics of hospitalized heart failure patients at the MRRH

Variable	*n* (%)
Age (years)	
≤18	26 (22)
19 – 59	48 (40.7)
≥60	44 (37.3)
Sex	
Male	46 (39)
Female	72 (61)
Educational status	
No formal education	53 (44.9)
Primary	53 (44.9)
Secondary and above	12 (10.2)
Occupation	
Unemployed	42 (35.6)
Self-employed/private business	71 (60.2)
Formally employed	5 (4.2)
History of alcohol use	33 (28.0)

Abbreviation: OTC: Over-the-counter.

Table 2. Clinical characteristics and medication use of hospitalized HF patients at the MRRH

Variable	*n* (%)
Status of HF	
New	56 (47.5)
Known	59 (52.5)
Previous hospital admission	78 (66.1)
Length of hospital stay (days)	
≤5	27 (22.9)
6 – 10	59 (50)
≥11	32 (27.1)
Total comorbidities	93 (78.8)
Number of comorbidities	
1	56 (60.2)
≥2	37 (39.8)
Major comorbid conditions	
Hypertension	37 (31.4)
Kidney disease	23 (19.5)
Anemia	18 (15.3)
Counseling on medication use	107 (90.7)
OTC medication use within the past 4 weeks	42 (35.6)
Herbal use within the past 4 weeks	52 (44.1)
Poly-pharmacy	75 (63.5)
Significant drug-drug interaction	79 (66.9)
Treatment affordability	18 (15.3)

Abbreviations: HF: Heart failure; MRRH: Mbarara Regional Referral Hospital; OTC: Over-the-counter.

3.3. Prevalence of DTPs related to cardiovascular drugs

Out of the 118 patients, 57 had at least one DTP during their hospital stay, corresponding to a prevalence of 48.3% (95% CI: 39 – 56.8%) (Figure 3). A total of 81 DTPs related to cardiovascular agents were identified among the 57 patients:
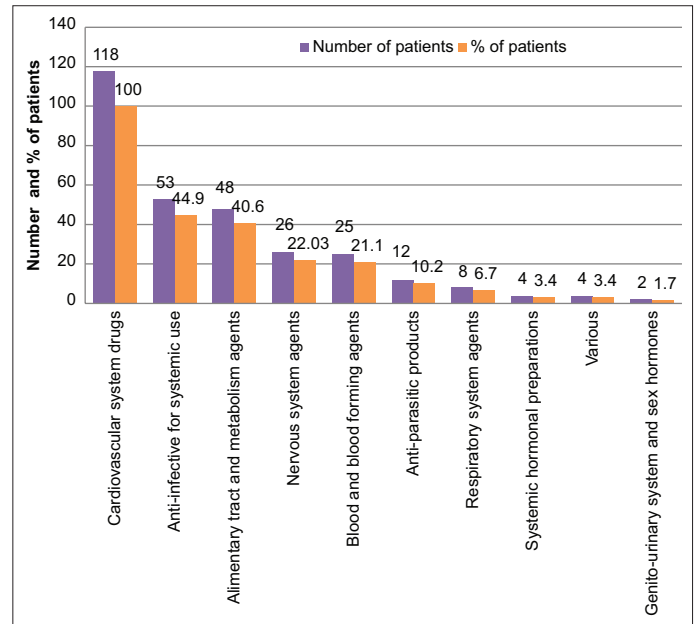

Figure 1. Common medications used among hospitalized heart failure patients at the Mbarara Regional Referral Hospital.

38 (66.7%) had one, 15 (26.3%) had two, 3 (5.2%) had three, and 1 (1.8%) had four DTPs.

3.4. Types and causes of DTPs related to cardiovascular agents

"Dosage too high" (23 [28.3%]) was the most common type of DTP related to cardiovascular agents, followed by "needs additional drug therapy" (22 [27.2%]) (Figure 4). For the "dosage too high" classification, the medication dose being too high was the most common cause, identified for 19 (23.5%) patients. For the "needs additional drug therapy" classification, an untreated condition was the most common, identified for 15 (18.5%) patients (Table 3).

3.5. Factors associated with the occurrence of DTPs

A total of 14 independent factors were analyzed using univariate logistic regression. Among these variables, age ≥60 years (crude odds ratio [COR]: 4.8; 95% CI: [2.1 – 10.6]; $P = 0.003$), gender, occupation, previous hospital admission, length of hospital stay >11 days (COR: 4.1; 95% CI: [1.4 – 10.7]; $P = 0.012$), comorbidity, herbal use within the previous 4 weeks, and poly-pharmacy were qualified for multivariate logistic regression analysis at $P = 0.25$ (Table 4).

According to the multivariate logistic regression, elderly patients >60 years old were four times more likely to experience DTPs related to cardiovascular agents compared to the pediatrics group (adjusted odds ratio [AOR]: 4.1; 95% CI: [1.5 – 10.3]; $P = 0.012$). Patients who were taking more than five medications during their hospital stay were three times more likely to experience DTPs related to cardiovascular agents than those who were taking less than five medications (AOR: 2.92; 95% CI: [1.5 – 7.6]; $P = 0.029$) (Table 4).
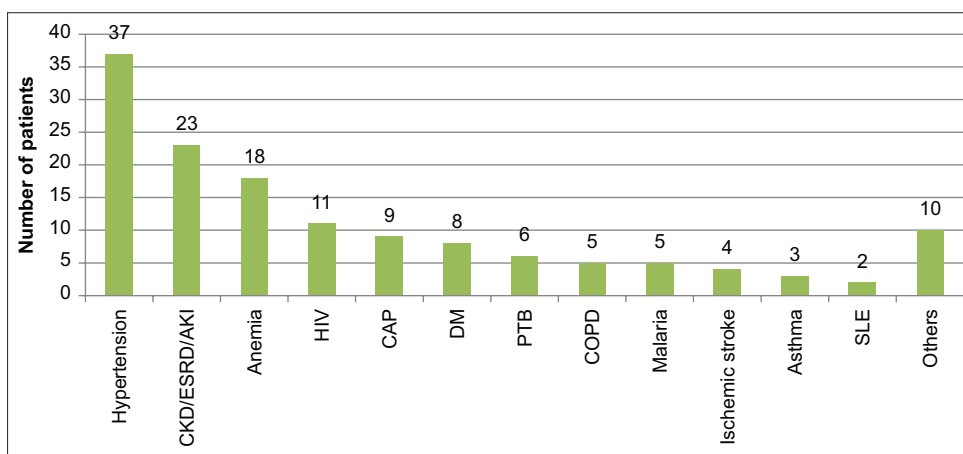
Figure 2. Common comorbid conditions among hospitalized heart failure patients at the Mbarara Regional Referral Hospital. The "others" category includes alcoholic liver disease, hypothyroidism, thyrotoxicosis, deep vein thrombosis, pharyngitis, interstitial lung disease, cholecystitis, peptic ulcer disease, cellulitis, and vitamin D deficiency.
Abbreviations: AKI: Acute kidney injury; CAP: Community-acquired pneumonia; CKD: Chronic kidney disease; COPD: Chronic obstructive pulmonary disease; DM: Diabetes mellitus; ESRD: End-stage renal disease; HIV: Human immunodeficiency virus; PTB: Pulmonary tuberculosis; SLE: Systemic lupus erythematosus.
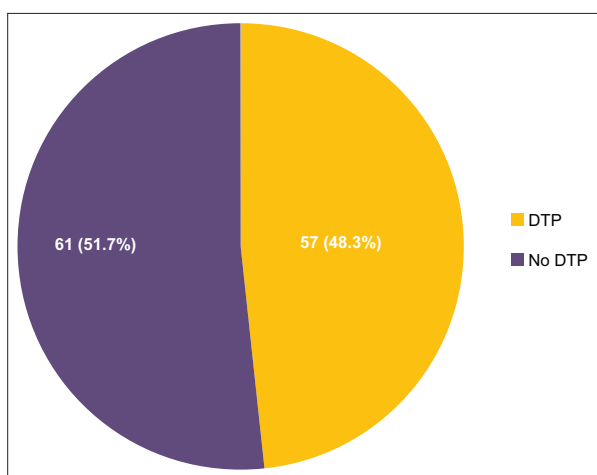

Figure 3. Prevalence of drug therapy problems related to cardiovascular agents among hospitalized heart failure patients at the Mbarara Regional Referral Hospital from November 2021 to January 2022.

Figure 4. Types of drug therapy problems related to cardiovascular agents among heart failure patients hospitalized at the Mbarara Regional Referral Hospital from November 2021 to January 2022.

4. Discussion

The primary aim of our study was to assess the prevalence of DTPs related to cardiovascular agents among HF patients. Our findings revealed that 48.3% of the HF patients had at least one DTP related to cardiovascular agents during their hospital stay, indicating a significant prevalence of DTP among this patient population, which is comparable to the reported DTP prevalence of 39.3% in a previous study in India [22]. However, the prevalence of DTPs related to cardiovascular agents is lower than the reported prevalence in previous prospective observational studies conducted among hospitalized HF patients in Ethiopia, i.e., 91.3% [26] and 83.5% [28] in Jimma, 90.6% [29] in Bahir Dar, and 68.8% [30] at the Tikur Anbessa Specialized Hospital (TASH). The low prevalence of DTP in our study may be attributed to our DTP assessment method which
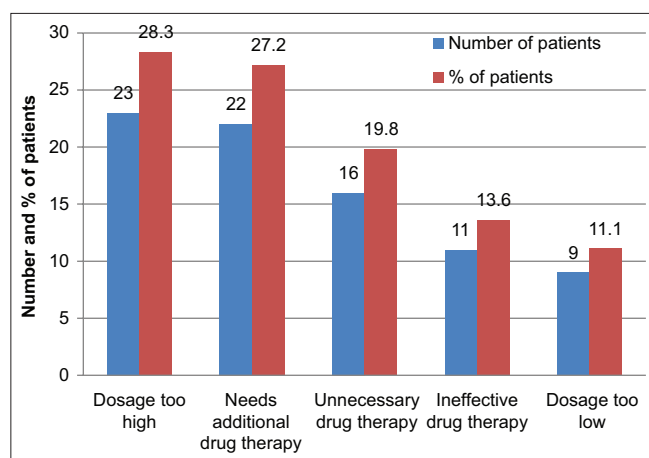
only assessed the DTP related to cardiovascular agents used by the hospitalized HF patients, while the other studies [26,28-30] assessed the DTP related to all drugs used by the HF patients. A study conducted in Spain reported a high prevalence of DTP, but the prevalence of DTPs related specifically to HF medications was only 22% [31]. The discrepancy in prevalence with our findings could also be due to the different study populations, sample sizes, inclusion criteria, and study designs; the studies conducted in Ethiopia had a larger sample size and used a cross-sectional study design; the study at TASH [30] was conducted among HF patients who were in ambulatory care. Moreover, during this study, data collection period and clinical pharmacy residents were actively assessing and preventing DTPs among noncommunicable diseased patients in the medical ward of our study site. Our study highlights the need to prioritize the burden of DTPs and design an effective intervention to mitigate

Table 3. Types of DTPs and their causes among hospitalized HF patients at the MRRH from November 2021 to January 2022

Type of DTP	Cause of DTP	n (%)
Needs additional drug therapy	Untreated condition	15 (18.5)
	Preventive drug needed	2 (2.5)
	Synergistic therapy	5 (6.2)
Unnecessary drug therapy	No valid medical indication	5 (6.2)
	Duplicate therapy	9 (11.1)
	To treat avoidable ADR	2 (2.5)
Dosage too low	Ineffective dose	3 (3.7)
	Dosing too infrequent	5 (6.2)
	Short duration of therapy	1 (1.2)
Ineffective drug therapy	More effective drug available	11 (13.6)
Dosage too high	Dose too high	19 (23.5)
	Drug interaction	3 (3.7)
	No dose adjustment for renal impairment	1 (1.2)

Abbreviations: HF: Heart failure; MRRH: Mbarara Regional Referral Hospital; DTPs: Drug therapy problems; ADR: Adverse drug reaction.

the associated problems. In addition, this study also warrants further research among CVD patients on the study site.

Multiple studies conducted among patients on cardiovascular agents revealed DTPs related to cardiovascular agents. A study conducted among Taiwanese HF patients [32] and in Barcelona [31] identified that the principal drugs associated with DTPs were cardiovascular agents, such as angiotensin-converting enzyme/angiotensin II receptor blockers (ACEI/ARBs), diuretics, spironolactone, and β-blockers.

The most common type of DTP related to cardiovascular agents identified in this study was "dosage too high" (28.3%). The common cause for "dosage too high" was the prescribed medication dose being too high for the hospitalized patients. This might be attributed to a lack of compliance with the standard and updated guidelines while selecting and dosing medications for HF patients. Moreover, it could be due to failure to assess the patient's organ functions (e.g., renal and hepatic functions), the patient's age and weight, and possible DDIs. On the contrary, studies [15,28,33] had reported that "dosage too low" (22 – 27.8%) was one of the common DTPs observed among patients who were using cardiovascular agents, whereas our finding reported that only 11.1% of DTPs related to cardiovascular agents were "dosage too low." Therefore, efforts should focus on minimizing drug dosing problems in HF patients by adhering to standard treatment guidelines and increasing the involvement of clinical pharmacists in deciding the dosing of drugs, i.e., considering the age and clinical condition of the patient.

The second most common DTP related to cardiovascular agents in this study was "needs additional drug therapy" (27.2%). This proportion is consistent with many studies involving CVD patients, i.e., 27.4 – 45.5% [15,26,28,33–36]. In the current study, the common cause for "needs additional drug therapy" was the presence of an untreated condition, leading patients to low quality of life, increased hospitalization, increased overall health-care cost, and death if undetected and resolved early [28]. This emphasizes the importance of ensuring

the appropriate use of medication by adhering to national and evidence-based guidelines to optimize patient outcomes. Adverse drug reactions, another DTP, were reported in 59.3% of the same population [37].

The identification of associated factors for DTPs related to cardiovascular agents helps to identify the most susceptible patients who require close monitoring of drug therapy [15]. Multivariate logistic regression revealed that elderly patients >60 years old were four times more likely to be associated with DTPs related to cardiovascular agents compared to the pediatrics group (AOR: 4.1; 95% CI: [1.5 – 10.3]; $P = 0.012$). This finding is in agreement with several studies that revealed that elderly patients were more susceptible to DTPs compared to younger adults [28,33,38]. This may be explained by the fact that there is a difference in pharmacokinetics and pharmacodynamics among elderly and pediatric populations [16]. Many medications act differently in older and younger people due to the physiological and pathological changes that accompany aging. According to the American Geriatrics Society (AGS), many medications have different efficacy and safety profiles in younger and older age groups [33]. In addition, studies have demonstrated that elderly patients have comorbidities and usually take complex medication regimens, increasing the risk of DTPs. From the current findings, special attention is warranted for these patient groups by optimizing dosage regimens and following up during medication therapy. This study has revealed that almost 40% of pediatric HF patients had at least one DTP during their hospitalization. Similarly, a multi-center study conducted in four French-speaking countries among pediatric patients in a cardiac and intensive care unit revealed that a significant number of DTPs were recorded during their follow-up [39]. Therefore, there is a need for further studies to be conducted among the pediatric population to mitigate the problem.

In addition, the present study reported that patients who were taking more than 5 medications during their hospital stay were three times more likely to experience DTPs related to cardiovascular agents than those who were taking <5 medications during their hospital stay (AOR: 2.92; 95% CI: [1.5 – 7.6]; $P = 0.029$). This finding is consistent with previously reported studies involving hospitalized HF patients [15,22,28,33,35,40]. Poly-pharmacy has been a significant challenge among CVD patients, but it can be controlled by simplifying the medication regimen by eliminating pharmacologic duplication and regularly reviewing the treatment regimen [40]. Studies have indicated that having clinical pharmacists in the multidisciplinary team in treating CVDs, including HF, would reduce DTPs, improve medication adherence, and increase the treatment satisfaction of HF patients [15,40-42]. For this reason, the clinical pharmacists' intervention could help in addressing this problem and improve the treatment outcome of HF patients.

Our study had several limitations. The study was conducted in a hospital serving referred patients who have severe illnesses and more comorbidity. Hence, the findings may not be representative of the general population. In addition, the DTPs assessed were limited in number and only limited to those associated with cardiovascular agents.

Table 4. Factors associated with DTPs among hospitalized HF patients at the MRRH

Variable	No DTP, n (%)	DTP, n (%)	COR (95%CI)	P_{COR}	AOR (95% CI)	P_{AOR}
Age* (years)						
≤18	16 (61.5)	10 (38.5)	1	-	1	-
19 – 59	34 (70.8)	14 (29.2)	0.66 (0.24 – 1.81)	0.416	0.39 (0.12 – 1.2)	0.099
≥60	11 (25)	33 (75)	4.8 (2.1 – 10.6)	0.003#	4.1 (1.5 – 10.3)	0.012#
Gender*						
Male	28 (60.8)	18 (39.2)	1	-	1	-
Female	33 (45.8)	39 (54.2)	0.54 (0.26 – 1.16)	0.113	2.09 (0.86 – 5.06)	0.102
Education						
No formal education	23 (43.4)	30 (56.6)	1.3 (0.37 – 4.57)	0.678	N/A	N/A
Primary	32 (60.3)	21 (39.7)	0.65 (0.18 – 2.31)	0.512	N/A	N/A
Secondary and above	6 (50)	6 (50)	1	-	1	-
Occupation*						
Unemployed	21 (50)	21 (50)	4.0 (0.41 – 12.8)	0.232	2.73 (0.17 – 20.81)	0.477
Self-employed	36 (50.7)	35 (49.3)	3.88 (0.41 – 13.1)	0.235	1.23 (0.10 – 15.47)	0.869
Formally employed	4 (80)	1 (20)	1	-	1	-
Disease status						
New	28 (50)	28 (50)	1	-	1	-
Known	33 (53.2)	29 (46.8)	0.88 (0.43 – 1.8)	0.726	N/A	N/A
Previous hospital admission*						
Yes	44 (56.4)	34 (43.6)	1.75 (0.81 – 3.77)	0.154	0.44 (0.17 – 1.15)	0.093
No	17 (42.5)	23 (57.5)	1	-	1	-
Length of hospital stay* (days)						
≤5	20 (74.1)	7 (25.9)	1	-	1	-
6 – 10	28 (47.4)	31 (52.6)	3.2 (1.2 – 8.6)	0.024#	1.82 (0.54 – 6.09)	0.332
≥11	13 (40.6)	19 (59.4)	4.1 (1.4 – 10.7)	0.012#	2.21 (0.59 –8.34)	0.238
Counseling						
Yes	55 (51.4)	52 (48.6)	1	-	1	-
No	6 (54.5)	5 (45.5)	1.13 (0.33 – 3.9)	0.843	N/A	N/A
Comorbidity*						
Yes	45 (48.3)	48 (51.7)	1.89 (0.76 – 4.72)	0.16	2.52 (0.86 – 5.06)	0.094
No	16 (64)	9 (36)	1	-	1	-
OTC medication use within the past 4 weeks						
Yes	21 (50)	21 (50)	1.11 (0.52 – 2.36)	0.784	N/A	N/A
No	40 (52.6)	36 (47.4)	1	-	1	-
Herbal use within the past 4 weeks*						
Yes	22 (42.3)	30 (57.7)	1.97 (0.94 – 3.11)	0.071	1.52 (0.64 – 3.64)	0.344
No	39 (59.1)	27 (40.9)	1	-	1	-
Alcohol use history						
Yes	18 (54.5)	15 (45.5)	0.85 (0.38 – 1.9)	0.70	N/A	N/A
No	43 (50.6)	42 (49.4)	1	-	1	-
Poly-pharmacy*						
Yes	35 (46.6)	40 (53.4)	1.75 (0.82 – 3.51)	0.151	2.92 (1.5 – 7.6)	0.029#
No	26 (60.5)	17 (39.5)	1	-	1	-
Drug–drug interaction						
Yes	39 (49.4)	40 (50.6)	1.32 (0.62 – 2.8)	0.472	N/A	N/A
No	22 (56.4)	17 (43.6)	1	-	-	-

Note: *Denotes variables with p_{COR}<0.25, selected for further AOR analysis; # $p_{COR/AOR}$ <0.05; N/A denotes AOR (and p_{AOR}) not determined for the respective variable. Abbreviations: COR: Crude odds ratio; AOR: Adjusted odds ratio; CI: Confidence interval: OTC: Over-the-counter; HF: Heart failure; MRRH: Mbarara Regional Referral Hospital; DTPs: Drug therapy problems.

5. Conclusion

The current findings revealed that almost half of the hospitalized HF patients were experiencing DTPs related to cardiovascular agents. Inappropriate dosing was the most common DTP in this study, followed by failure to initiate recommended medications. Many different independent variables have been identified as determinants for the prevalence of DTP in our study. Among those, elderly patients (i.e., 60 years and older) and patients on five or more concurrent medications were at a significantly higher risk of experiencing DTP related to cardiovascular agents during hospitalization. Based on our findings, the inclusion of a pharmacist in multidisciplinary HF teams should be considered among chronic patients, and patients at a high risk of contracting cardiovascular agent-related DTPs should be given additional follow-ups upon hospital admission.

Conflict of Interest

All authors declare that they have no conflict of interest.

Ethical Approval and Consent to Participate

This study was conducted in accordance with the Declaration of Helsinki. Approval to conduct the study was obtained from the Mbarara University Institutional Research Ethics Committee (Reference no.: MUST-2021-185). We obtained site clearance to conduct the study from the MRRH director. Written informed consent was obtained from the patients before participating in the study. The purpose, objectives, benefits, risks, and impact of the study on the total time spent in the hospital were clearly explained to the participants. Participants' confidentiality was maintained during and after data collection.

Consent for Publication

Written informed consent was obtained from all the study participants for publishing the data.

Availability of Data

Data are available from the corresponding author upon reasonable request.

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