

# The Impact of a Medication Therapy Management Service on the Outcomes of Hypertension Treatment Follow-Up Care in an Ethiopian Tertiary Hospital: A Pre-Post Interventional Study

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## ABSTRACT

**BACKGROUND:** According to a report from the WHO, an estimated 1.13 billion people worldwide have hypertension. Medication therapy management (MTM) service is a clinical service based on the theoretical and methodological framework of pharmaceutical care practice, which aims to ensure the best therapeutic outcomes for the patient by identifying, preventing, and resolving drug therapy problems (DTPs).

**PURPOSE:** The goal of this study was to determine the impact of MTM on hypertension management in Ethiopia.

**METHODS:** A pre-post interventional study design was used. Descriptive statistics, linear regression, and logistic regressions were employed to present and analyze data.

**RESULTS:** The final analysis included 279 patients out of 304, with a 7.8% attrition rate. The prevalence of drug therapy problems (DTPs) reduced from 63.4% at baseline to 31.5% during the post-intervention phase. Polypharmacy (AOR = 2.46; 95% CI: 1.27–4.77) and complications (AOR = 0.52; 95% CI: 0.27–0.99) were substantially associated with DTPs at the start of the study. The MTM resulted in a significant reduction in mean systolic blood pressure (SBP) (AOR = 5.31, 95% CI (3.50–7.11),  $P < .001$ ), as well as a significant increase ( $P < .001$ ) in the number of study patients who reached a target BP. At the end of the MTM intervention, non-adherence was linked with DTP (AOR = 2.40; 95% CI: 1.33–4.334) and living outside Addis Ababa (AOR = 1.73; 95% CI: 1.38–1.88). On average, treatment satisfaction was 86.55% (+SD) 10.34.

**CONCLUSION:** To resolve DTPs and improve clinical outcomes, the MTM service was critical. The majority of patients were found to be compliant with a high treatment satisfaction score.

**KEYWORDS:** Drug Therapy Problems (DTPs), hypertension, medication adherence, Medication Therapy Management (MTM), outcome research, treatment satisfaction

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## Introduction

Hypertension is the condition of persistent, non-physiologic elevation of systemic blood pressure (BP). It is typically defined as a resting Systolic BP (SBP) of 140 mm Hg or higher or Diastolic BP (DBP) of 90 mm Hg or higher following repeated examination or receiving therapy for the indication of BP-lowering.<sup>1</sup> It is a chronic condition that usually is treated with different anti-hypertensive drugs and lifestyle changes. Patients with hypertension often receive multiple medications<sup>2,3</sup> and have different co-morbid chronic diseases that can lead to the occurrence of Drug Therapy Problems (DTPs).<sup>4</sup>

DTPs are undesirable events experienced by the patient involving drug therapy that impede progress toward achieving the desired goals of therapy.<sup>5</sup> It includes unnecessary drug therapy, the need for additional drug therapy, ineffective drug therapy, adverse drug reaction, appropriate dosing, and

non-adherence.<sup>5,6</sup> In studies related to the determination of DTPs, the prevalence of DTPs has been reported to be high in patients with hypertension.<sup>7–10</sup> DTPs among hypertensive patients could be the major contributors to poor health outcomes,<sup>4,7</sup> lower health-related quality of life,<sup>8</sup> increase health care costs, and eroded public confidence in health care systems.<sup>11</sup>

Hypertension is an important worldwide public health problem and the most preventable risk factor for cerebrovascular, cardiovascular, and kidney disease.<sup>12</sup> Genetic, environmental as well as important gene-environment interactions and behavioral factors influence the development of hypertension.<sup>13</sup> According to a report from the World Health Organization (WHO), an estimated 1.13 billion people worldwide have hypertension.<sup>14</sup> Different surveys of the prevalence of hypertension also indicate a growing global burden of the disease as



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it increases sharply with the growing pandemic of obesity, advancing age, and urbanization.<sup>15</sup>

The trend of hypertension in Africa shows that it has risen from 55 million in 1990 to 130 million in 2010 and by 2030 expected to be 220 million.<sup>16</sup> A community-based survey from 9 regions of Ethiopia showed the overall prevalence of raised BP among the Ethiopian population aged 15 to 69 years to be 15.8%. The prevalence is higher in the urban population (19.7%) than rural (14.8%).<sup>17</sup> In Ethiopia, hypertension affects 19.6% of the population, and it is associated with high rates of morbidity and mortality. Ethiopia's hypertension treatment appears to be lacking as only 4.5% of its hypertensive patients have their blood pressure under control.<sup>18,19</sup> Some of the challenges and obstacles to managing hypertension in Ethiopia include inadequate resources for health care, inadequate quality of service, poor drug adherence, and a lack of information.<sup>19,20</sup> Therefore, practical and efficient measures are needed to enhance Ethiopia's hypertension outcomes. One such intervention is medication therapy management (MTM), MTM service is a clinical service based on the theoretical and methodological framework of pharmaceutical care practice, which aims to ensure the best therapeutic outcomes for the patient by identifying, preventing, and resolving DTPs.<sup>21-23</sup>

MTM is typically provided by pharmacists through Performing patient assessment and a comprehensive medication review (CMR); formulating a medication treatment plan, monitoring efficacy and safety of medication therapy; enhancing medication adherence through patient empowerment and education; and documenting and communicating MTM services to prescribers to maintain comprehensive patient care.<sup>24,25</sup> MTM can help patients get the most benefit from their medications, prevent costly medication problems, and achieve optimal goals of medication therapy.<sup>21-23</sup> MTM has also been shown to improve blood pressure management and reduce cardiovascular events in a number of settings. However, there is a lack of information regarding MTM's impact on hypertension treatment follow-up, an important indicator of care quality and continuity.

This is the first study that we are aware of that evaluates the impact of an MTM service on the follow-up of hypertension medication in Ethiopia, a nation with limited resources and limited access to high-quality healthcare.<sup>26</sup> The study identifies several gaps, including limited research in low-resource settings, a lack of understanding of patient-centered outcomes, a lack of research on long-term impact, comparative effectiveness, and implementation strategies. The study aims to bridge these gaps by examining the sustainability and durability of the observed effects over an extended period, comparing the effectiveness of medication therapy management services with alternative interventions, and understanding factors influencing successful implementation. Addressing these gaps can contribute to the advancement of hypertension management knowledge and optimize care delivery in similar healthcare settings.

## Materials and Methods

### *Study setting*

The research has been carried out in Ethiopia at a centrally located referral hospital renal ambulatory clinic. The hospital is the country's largest referral teaching hospital. The hospital's outpatient clinics serve 500 000 patients annually and include 51 disciplines, sub-specializations, and super-specialties. The renal out-patient clinic functions 3 times per week serving 60 to 80 patients per session. Hypertensive patients account for the majority.

### *Study type and period*

A one-group pre-post interventional study was conducted in 2 phases from July 2019 to April 2020. The first phase lasted 6 months of the intervention period and the second phase was a posted intervention study, which lasted for 4 months.

### *Study population*

The study population involves all hypertensive patients visiting the renal ambulatory clinic of the hospital during the study period and who fulfilled the inclusion criteria. Patients who were  $\geq 18$  years of age and those patients who were on antihypertensive drug treatment for at least 1 year were included. Those patients with any evidence of hypertensive urgency or emergency, serious renal, cardiac, or hepatic disease, pregnancy, dementia, or cognitive impairment, and those who refused to give informed consent were excluded.

### *Sampling method and sample size determination*

The sample size was calculated using a single proportion formula with the assumption of a 5% margin of error, 95% confidence interval, and 55.6% prevalence of DTPs in patients with hypertension from the prior study.<sup>11</sup> The sample size was determined using an estimated population size of 1010 adult hypertensive patients based on the previous hypertensive patients' attendance records at the renal ambulatory Clinic of the hospital. Using a single proportion formula, the sample size was determined to be 304 patients. A systematic random sampling method was used to recruit samples for the study on each day of the data collection process.

### *Intervention development and implementation*

The MTM service was launched by creating a patient database: relevant previous medical and medication histories by data collectors. After the patient visited the physician, he/she met with the MTM pharmacist face-to-face for the Medication Therapy Review (MTR).

The clinical pharmacists identified medication-related needs of patients including indication, effectiveness, safety, and

adherence. This was followed by an evaluation of the appropriateness of pharmacotherapy using various references and current practice guidelines. Micromedex drug interaction checker was used to identify the potential drug–drug interactions. With the aid of Micromedex medication interaction checkers, Pharmacists may identify and manage any drug interactions in their patients. They provide information on the severity, mechanism, start, clinical effects, and therapy of drug interactions in addition to references to support the advice. Micromedex drug interaction checkers are not a substitute for clinical expertise, but rather a support tool to enhance patient safety and quality of care.

Adverse drug reactions were also identified from the patient medical record and through interviews. Eventually, drug-related problems (DTPs) were listed and prioritized leading to the development of a pharmaceutical care plan. If any of the patients experienced DTP pharmacist identified its cause and classified it into different categories according to and prioritized DTPs for intervention. The MTM Pharmacist then created a pharmaceutical care plan to resolve the problem. The care plan might have necessitated the participation of patients, physicians, or both. If a pharmaceutical care plan involved patient participation to resolve DTP the pharmacist created a medication action plan (MAP) and directly communicated with the patient to resolve the identified problem. When the identified DTPs need the participation of prescribing physicians pharmaceutical care plan that involves physicians was prepared and communicated with them.

After communicating with physicians and patients to resolve DTPs and all necessary modifications were made to optimize drug therapy, a reconciled medication list was written and provided to the patient as a personal medication record (PMR). The status of the identified DTP was then recorded. An evidence-based brochure that was prepared in the Amharic language to increase patients' knowledge of drug use and disease management was provided after counseling on all important issues related to therapy.

After each visit, patients were interviewed for progress, any new DTP, and counseled on their disease state and medication use. Unresolved issues from the prior sessions were also discussed. The pharmacist assessed the treatment care plan to monitor the patient's adherence to the medication action plan and to establish new therapy goals when required. Finally, after 6 months of follow-up, outcomes of the pharmaceutical care (PC) provided for each patient were assessed. The assessment included DTP identification, medication adherence, and patient treatment satisfaction.

### *Data collection and management*

*Data collection instruments and procedures.* Socio-demographic data, health information, and lifestyle factors, clinical characteristics, medication history were collected using questionnaires and data abstraction format (Supplemental Annex I).

Blood pressure was measured using a sphygmomanometer at baseline and during each visit to monitor the efficacy of the medication and the goal of therapy achieved.

The Micromedex drug interaction tool lists the drug–drug interactions that occurred during patient assessment. The tool assigns a severity rating to each interaction, from contraindicated to minor. When analyzing the results, we considered the patient's health, the availability of substitute medications, and the clinical importance of the interactions. We have also discussed the tool's results and the pharmacists' expertise with the physician to help patients and make the best clinical decision.

DTPs were identified and classified according to the Cipolletti et al DTP classification tool which specifies 4 categories of DTP and 7 types of DTP and a specific cause for each DTP.<sup>6</sup> The level of adherence was assessed using the Morisky Green Levin Medication Adherence Scale (MGL) at the end of the intervention. Thus, patients were considered adherent if the score was  $\leq 2$  and non-adherent if the score was  $> 2$  (Supplemental Annex II). A self-administered Treatment Satisfaction with Medicines Questionnaire (SATMED-Q) 17 was also used to measure patients' treatment satisfaction after MTM service (Supplemental Annex III).

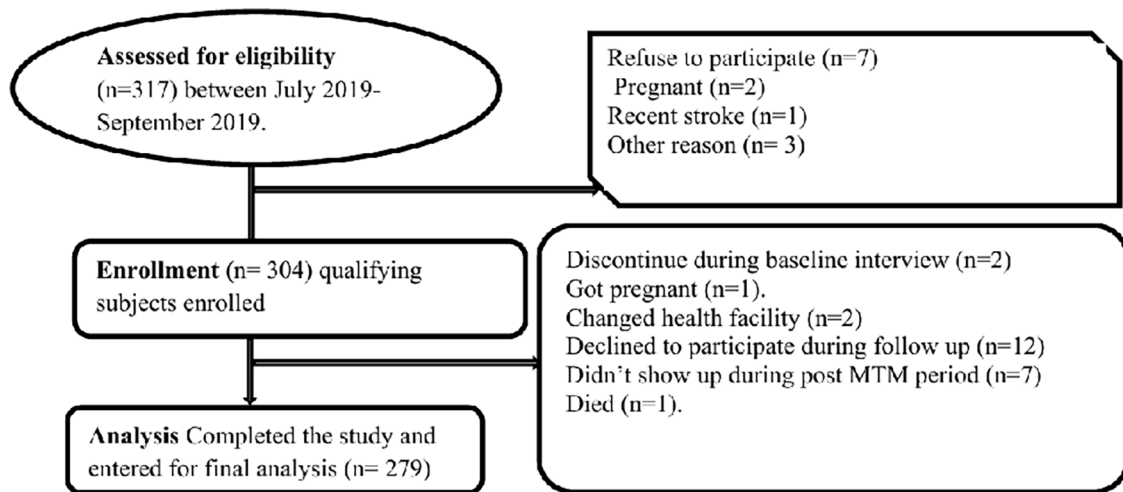
*Data collector's recruitment and training.* Three nurses and one clinical pharmacist were recruited as data collectors. The training was given to the data collectors; to familiarize them with the study protocol, how to request informed consent from eligible participants, and to conduct a patient interview.

*Data quality management.* A pre-test was carried out on 5% of the sample at the outpatient department of Tirunesh Beijing General Hospital before commencing the patient recruitment process and data collection to check the completeness of the instruments. Based on the results obtained from the pre-test, an amendment was made to the assessment tools and ways of assessment. Appropriate training was also given to the data collectors. The principal investigator (PI) was closely supervising the data collection daily.

### *Data analysis*

Data were coded and entered into SPSS version-25 statistical software for management and analysis. Descriptive analysis was computed as frequency and percent for categorical variables and mean and standard deviation (SD) for continuous variables. Both binary and multiple logistic regression analyses were performed. Independent variables having a  $P$ -value  $< .20$  in the bivariate logistic regression analysis were entered into a multivariable logistic regression analysis to control the confounding effect.

A paired sample  $t$ -test was used to ascertain the significance of differences between the mean value of baseline and post-MTM SBP and DBP. The statistical significance of treatment satisfaction was determined using an independent  $t$ -test for mean values of 2 continuous variables and one-way analysis of variance



**Figure 1.** Flow diagram of patients with hypertension participating in MTM service study at ambulatory clinic of TASH, July 2019 to April 2020.

(ANOVA) with post hoc analysis for mean values of more than 2 continuous variables. A 95% CI and *P*-value of <.05 were considered statistically significant for all data analyses.

#### *The flow of study participants*

A total of 304 patients meeting the previously described inclusion criteria were referred and recruited to the HTN MTM service using systematic random sampling after patients gave informed consent from July 2019 to April 2020. Out of this, 279 (92.7%) study participants completed the study and entered into the final analysis. Thus, the attrition rate was found to be 7.8% (Figure 1).

## Results

### *Sociodemographic characteristics*

Males and females were equally represented (50.5% females). The mean (SD) age of the study participants was  $56.26 \pm 11.75$  years and 23.7% of them were  $\geq 65$  elders. Most of the study participants were married (82.8%) and the majority of them were living within the study city (89.6%). Of the study's participants, almost a quarter (26.2%) had completed secondary school, and 24.4% were employed. Half (53.8%) of the study participants were found to get their medication through third-party coverage (Table 1).

### *Clinical characteristics and medication profile*

Most of the study participants had a hypertension treatment duration of >10 years. Around 66.6% and 45.9% had experienced at least one co-morbid condition and complication, respectively; with diabetic Mellitus (DM) (31.2%) and nephropathy (35.4%) being the most common co-morbid condition and hypertension-related complication respectively. The mean (SD) number of medications was  $3.70 (\pm 2.00)$ . The majority of them were prescribed dual therapy (39.1%). Calcium channel blockers (CCBs) were the most frequently

**Table 1.** Socio-demographic characteristics of ambulatory hypertensive patients on follow-up clinic (n=279).

VARIABLES	CATEGORIES	STUDY PARTICIPANTS	
		FREQUENCY	PERCENT
Age (y)	18-24	1	0.4
	25-39	25	9.0
	40-64	187	67.0
	$\geq 65$	66	23.7
Gender	Male	138	49.5
	Female	141	50.5
Marital status	Married	231	82.8
	Single	17	6.1
	Divorced	20	7.2
	Widowed	11	3.9
Education	No formal education	33	11.8
	Primary school	60	21.5
	Secondary school	73	26.2
	Diploma and above	113	40.5
Occupation	Employed	68	24.4
	Unemployed	62	22.2
	Private	102	36.6
	Retired	42	15.1
	Student	5	1.8
Residence	Study city	250	89.6
	Out of the study city	29	10.4
Health cost coverage	Third-party coverage	150	53.8
	Buying	129	46.2
Current smoker	Yes	7	2.5
	No	272	97.5

(Continued)



**Table 1.** (Continued)

VARIABLES	CATEGORIES	STUDY PARTICIPANTS	
		FREQUENCY	PERCENT
Khat* chewing	Yes	11	3.9
	No	268	96.1
Physical activity	Yes	155	55.6
	No	124	44.4
Alcohol drinking	Yes	43	15.4
	No	236	84.6

Abbreviation: SD, standard deviation.

All participants who took part were literate. Thirty-three individuals did not hold a formal education, nonetheless. Secondary school refers to high school education, while tertiary-level education refers to college or university education. \*The khat plant is found throughout East Africa and the Arabian Peninsula.<sup>27</sup> Khat contains stimulant chemicals that can cause increased talkativeness, alertness, excitement, and mild euphoria.<sup>28</sup> Khat chewing is part of some social and cultural traditions in the regions where the plant grows, but it is also associated with some health and legal risks. Chahat is used for social and cultural purposes despite its risks to health and legality.<sup>29</sup>

prescribed class of drugs (69.9%) followed by angiotensin-converting enzymes (ACEIs) (54.1%) and diuretics (48.7%). Only 52.7% had controlled BP. The majority (73.1%) of the study participants had 1 to 2 MTM pharmacist visits and about 26.9% had 3 or more visits (Table 2).

*Drug therapy problems*

*Prevalence and pattern.* At baseline, a total of 260 DTPs were identified. Additionally, 27 DTPs were identified during follow-up. The prevalence of DTP at baseline was 63.4%. At the end of the study, at least one, DTP was identified among 88 patients; which makes a prevalence of 31.54% (Figure 2).

There was a significant reduction in the proportion of patients with at least one DTP from 63.4% in the pre-intervention phase to 31.5% during the post-intervention phase ( $P < .05$ ). The most encountered DTPs in the pre-intervention phase were non-adherence ( $n = 53$ , 20.38%) followed by ADR ( $n = 48$ , 18.46%) and the need for additional drug therapy ( $n = 47$ , 18%). On the other hand, the most encountered DTP in the post-intervention was ineffective drug therapy ( $n = 32$ , 26.66%) followed by the need for additional drug therapy ( $n = 31$ , 25.83%) and non-adherence ( $n = 19$ , 15.83%). Using the McNemars test, there was a statistically significant decline in the proportion of patients with overall DTP ( $P < .01$ ) and each type of DTP from baseline to end of the study ( $P < .01$ ) except for ineffective drug therapy (Table 3).

From a total of 287 identified DTPs, MTM service resolved 203 (70.73%) of them. Pharmaceutical care interventions were made for 161(56%) involving physicians. From these, 104 (64.5%) DTPs were accepted, 42 (26%) were partially accepted and 15 (9.3%) were rejected. The pharmaceutical care plan involving patient participation was 126 (43%). Ninety-nine

**Table 2.** Clinical characteristics of ambulatory hypertensive patients on follow-up clinic ( $n = 279$ ).

VARIABLES	CATEGORIES	STUDY PARTICIPANT	
		FREQUENCY	PERCENT
BMI	Mean $\pm$ SD	25.45 $\pm$ 3.45	
	<18.5	4	1.4
	18.5-24.9	131	47.0
	25-30	114	40.9
	>30	30	10.8
Blood pressure	Controlled	147	52.7
	Uncontrolled	132	47.3
Duration of HTN treatment	<5	77	27.6
	5-10	89	31.9
	$\geq 10$	113	40.5
Hospitalization within 1 y (n, %, yes)	Yes	49	17.6
Number of medications	Mean $\pm$ SD	3.70 $\pm$ 2.00	
	1	35	12.5
	2-4	157	56.2
	5 and above	87	31.1
Antihypertensive drug use	Monotherapy	96	34.4
	Dual therapy	109	39.1
	Triple therapy	54	19.4
	Quadruple therapy	17	6.1
	Five agents	3	1.1
Class of anti-hypertensive drug	CCB	195	69.9
	ACEIs	151	54.1
	ARB	7	2.5
	Diuretics	136	48.7
	Beta-blockers	64	22.9
Complication present	Yes	128	45.9
	No	151	54.1
Specific complications	Nephropathy	99	35.4
	HHD	39	14.0
	Stroke	24	8.6
	Retinopathy	5	1.8
Number of MTM visits	1	38	13.6
	2	166	59.5
	$\geq 3$	75	26.9
Co-morbidity	No	48	17.2
	1-2	186	66.6
	$\geq 3$	45	16.1

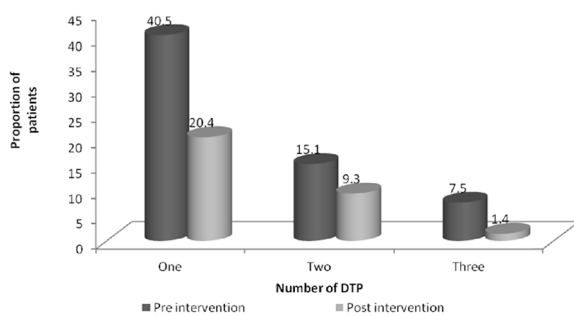
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**Table 2.** (Continued)

VARIABLES	CATEGORIES	STUDY PARTICIPANT	
		FREQUENCY	PERCENT
Specific co-morbidity	DM	87	31.2
	Dyslipidemia	50	17.9
	PN	36	12.9
	Goat	18	6.5
	IHD	16	5.7
	HIV/AIDS	15	5.4
	Asthma	13	4.7
	Osteoarthritis	12	4.3
	Others*	52	18.7

Abbreviations: BMI, Body Mass Index; CKD, chronic kidney disease; DM, diabetic mellitus; HTN, hypertension; HHD, hypertensive heart disease; IHD, ischemic heart disease; MTM, Medication Therapy Management; PN, peripheral neuropathy; SD, standard deviation.

\*Heart failure, atrial fibrillation, peptic ulcer disease, valvular heart disease, Thyroid disorders, Psychiatric and Neurological disorders, infection, obesity, cancer.



**Figure 2.** Pattern of DTPs among ambulatory hypertensive patients on follow-up clinic at TASH, Addis Ababa, Ethiopia, July 1, 2019 to April 30 2020 (n=279).

(78.50%) of these were solved with the patient. The majority of them were about unnecessary OTC medication use, adherence enhancement, and ADR management.

**Predictors of drug therapy problems.** Different socio-demographic and clinical characteristics were considered for binary logistic regression analysis. The variables included in the bivariate analysis were age, sex, residency, education status, marital status, alcohol use, physical activity, chat chewing, co-morbidity, aspirin use, statin use, non-steroidal anti-inflammatory drug use, BP control, number of medications, duration of treatment, complication, health care cost coverage, and salt consumption. Depending on the result of binary logistic regression variables like age, sex, marital status, salt restriction, duration of treatment, presence of co-morbidity, presence of complication, number of medications, and BP control status were considered for multivariate analysis to determine predictors of DTP at baseline. After the provision of MTM service, the level of adherence and the number of MTM visits were also considered for binary and multivariate logistic analysis.

**Table 3.** Type and proportion of DTPs among ambulatory hypertensive patients in follow-up clinic (n=279).

TYPE OF DTP	PRE MTM N (%)	POST MTM N (%)	P-VALUE
Unnecessary drug therapy	23 (8.85)	8 (6.66)	.003
Needs additional drug therapy	47 (18)	31 (25.83)	.02
In effective drug therapy	39 (15)	32 (26.66)	.115
Dose too low	26 (10)	5 (4.16)	.000
Adverse drug reaction	48 (18.46)	18 (15)	.000
Dose too high	24 (9.23)	7 (5.83)	.000
Non-compliance	53 (20.38)	19 (15.83)	.000

McNamara chi-square test, DTP, drug therapy problems; MTM, Medication Therapy Management.

The result of the multivariate logistic analysis showed that several medications, the presence of complications, and salt restriction status were significantly associated with the occurrence of DTP at baseline. Accordingly, participants who took more than 5 medications were 2.5 times (AOR=2.46 95% CI: 1.27-4.77) more likely to develop DTPs as compared to those taking less than 5 medications. Patients without hypertension-related complications were twice as likely to develop DTP than those who developed hypertension-related complications (AOR=0.52 95% CI: 0.27-0.99). The status of salt restriction was also found to be associated with the occurrence of DTPs. The data showed a decreased risk of developing DTPs by half for samples who reported having restricted salt intake (AOR=0.56 95% CI: 0.33-0.97) as compared to those who consumed without restriction.

At the end of the study, the presence of hypertension-related complications and the level of medication adherence were found to be significantly associated with experiencing DTPs. The risk of occurrence of DTP was lower approximately by 50% (AOR=0.43 95% CI: 0.23-0.80) in patients with complications as compared to those without it. Moreover, the risk of DTPs was 70% times (AOR=0.30, 95% CI: 0.14-0.69) lower in those patients with high adherence status as compared to participants with low adherence (Table 4).

A total of 103 (37%) potential DDIs have been observed out of which 5% were associated with serious drug interactions (Table 5).

#### Changes in clinical outcomes

The mean SBP at baseline was 136.67 mmHg and this was decreased to 131.36 mmHg at the end of the study. Using paired *t*-test analysis the change in SBP was found to be significant ( $P < .001$ ). The difference in DBP was not found to be statistically significant ( $P = .053$ ) from the baseline (Table 6).

**Table 4.** Multivariate analysis of factors associated with drug therapy problems among ambulatory hypertensive patients on follow-up (n=279).

VARIABLES	CATEGORIES	BASELINE ODDS RATIOS (95% CI)		END OF MTM ODDS RATIOS (95% CI)	
		COR	AOR	COR	AOR
Age	18-24	1		—	—
	24-39	1.766 (0.10-28.89)	0.52 (0.02-10.72)		
	40-64	2.94 (1.19-7.24)	1.63 (0.54-4.94)		
	≥65	0.82 (0.48-1.32)	0.64 (0.36-1.15)		
Marital status	Ever married	1		1	1
	Never married	0.29 (0.1-0.8)	0.35 (0.1-1.18)	0.72 (0.22-2.29)	0.83 (0.20-3.44)
Salt restriction	No	1		1	1
	Yes	0.59 (0.367-0.96)	<b>0.56 (0.33-0.97)</b>	0.65 (0.38-1.11)	0.59 (0.33-1.06)
Duration of treatment	1-5	1			1
	5-10	1.74 (0.95-3.18)	1.12 (0.56-2.25)	1.47 (0.75-2.85)	1.02 (0.47-2.20)
	>10	1.50 (0.83-2.70)	1.16 (0.61-2.19)	0.92 (0.51-1.68)	0.68(0.35-1.32)
Comorbidity	Yes	1			
	No	0.43 (0.23-0.79)	0.66 (0.33-1.31)	0.65 (0.32-1.31)	0.99 (0.44-2.24)
Complication	No	1			1
	Yes	0.43 (0.24-0.78)	<b>0.52 (0.27-0.99)</b>	0.43 (0.24-0.74)	<b>0.43 (0.23-0.80)</b>
Number of drugs	1-4	1		1	
	≥5	2.99 (1.67-5.35)	<b>2.46 (1.27-4.77)</b>	2.17 (1.27-3.72)	1.79 (0.95-3.35)
BP (Pre and Post)	Controlled	1			1
	Uncontrolled	1.30 (0.79-2.512)	1.18 (0.69-2.00)	1.12 (0.63-1.98)	1.13 (0.60-2.13)
Number of MTM visits	1	—	—	1	1
	2			1.26 (0.56-2.84)	1.15 (0.47-2.80)
	≥3			1.84 (1.02-3.31)	1.76 (0.94-3.32)
Level of adherence	Low	—	—	1	1
	High			0.50 (0.26-0.96)	<b>0.30 (0.14-0.69)</b>

Abbreviations:AOR, adjusted odds ratio; CI, confidence interval;COR, crude odds ratio; DTP, drug therapy problem; MTM, Medication Therapy Management.

The Proportion of patients with controlled BP was 52.70% at the beginning of the study and this was increased to 72.40% at the end of the study ( $P < .01$ ). Likewise, we have also found a decreased proportion of patients with stage 1 and stage 2 hypertension from baseline to the end of the study. The proportion of stage-1 hypertension decreased from 36.52% to 20.95% while stage-2 hypertension decreased from 10.78% to 6.65% as depicted in Figure 3.

#### Medication adherence status

According to the MGL medication adherence scale, after the implementation of the MTM service, 194 (69.5%) of patients

were found to be adherent to their antihypertensive medications. Different socio-demographic and clinical characteristics were included in the univariate analysis and variables with  $P$ -value  $< .2$  were further entered into multivariate analysis to identify the predictors of medication non-adherence.

Thus, the source of medication and residency was significantly associated with medication non-adherence. Patients who got their medication through third-party coverage were 90% times (AOR = 0.10; 95% CI: 0.01-0.77) less adherent than those buying their medications on a cash basis. Similarly, study participants who lived in the study city were 1.73 times more adherent (AOR = 1.73; 95% CI: 1.38-1.88) than those living outside the study city (Table 7).

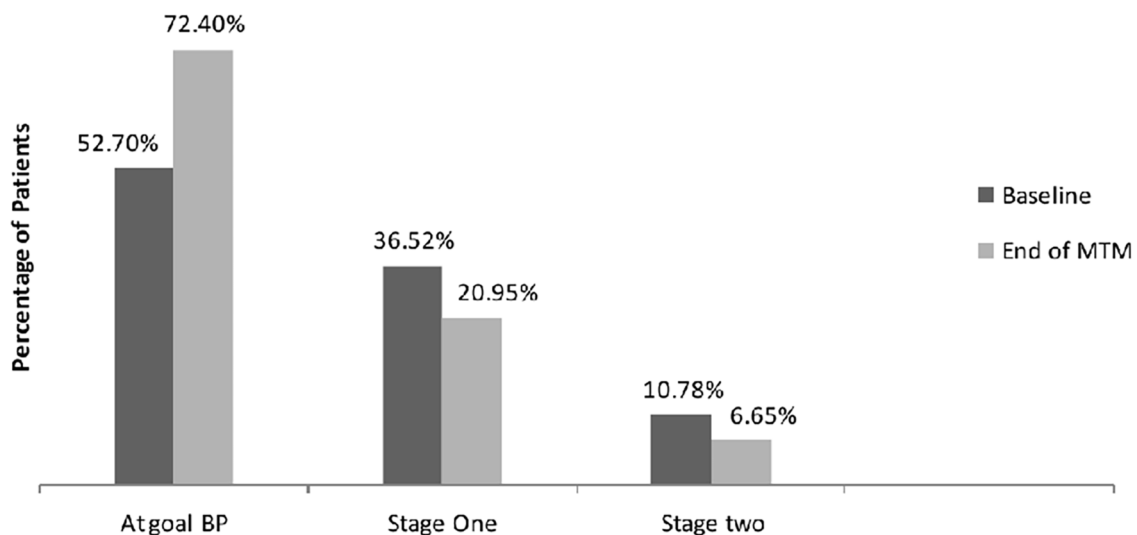
**Table 5.** The list of serious drug interactions observed in the study.

SR. NO.	INTERACTIONS	CONSEQUENCE IF USED ACCIDENTALLY
1	Aspirin + Enalapril	Coadministration may result in a significant decrease in renal function. NSAIDs may diminish the antihypertensive effect of ACE inhibitors. The mechanism of these interactions is likely related to the ability of NSAIDs to reduce the synthesis of vasodilating renal prostaglandins.
2	Diclofenac + Enalapril	Coadministration may result in a significant decrease in renal function. NSAIDs may diminish the antihypertensive effect of ACE inhibitors. The mechanism of these interactions is likely related to the ability of NSAIDs to reduce the synthesis of vasodilating renal prostaglandins.
3	Ibuprofen + Enalapril	Avoid or Use Alternate Drugs. Coadministration may result in a significant decrease in renal function. NSAIDs may diminish the antihypertensive effect of ACE inhibitors. The mechanism of these interactions is likely related to the ability of NSAIDs to reduce the synthesis of vasodilating renal prostaglandins.
4	Enalapril + Allopurinol	Risk of anaphylaxis, Stevens-Johnson syndrome. ibuprofen + aspirin ibuprofen decreases the effects of aspirin by Other (see comment). Avoid or Use Alternate Drugs. Comment: Ibuprofen decreases the antiplatelet effects of low-dose aspirin by blocking the active site of platelet cyclooxygenase. Administer ibuprofen 8 h before aspirin or at least 2 to 4 h after aspirin. The effect of other NSAIDs on aspirin is not established.
5	Nifedipine + Simvastatin	Nifedipine will increase the level or effect of simvastatin by affecting hepatic/intestinal enzyme CYP3A4 metabolism. Avoid or Use Alternate Drugs. nifedipine + amlodipine nifedipine will increase the level or effect of amlodipine by affecting hepatic/intestinal enzyme CYP3A4 metabolism. Avoid or Use Alternate Drugs.

**Table 6.** The mean systolic blood pressure and diastolic blood pressure of ambulatory hypertensive patients in follow-up clinic (n=279).

VARIABLE	AT BASELINE (N=279)	POST MTM (N=279)	MODEL-BASED DIFFERENCE 95% CI	P-VALUE
SBP mean (SD)	136.67(14.84) mmHg	131.36 (14.69) mmHg	-5.31 (3.50-7.11)	.000
DBP mean (SD)	80.48 (9.20) mmHg	79.37 (8.67) mmHg	-1.11 (-0.01 to 2.25)	.053

Abbreviations: BP, blood pressure; CI, confidence interval; DBP, diastolic blood pressure; MTM, Medication Therapy Management; SBP, systolic blood pressure.

**Figure 3.** Blood pressure control status of ambulatory hypertensive patients on follow-up clinic at TASH, Addis Ababa, Ethiopia, July 2019 to April 2020 (n=279).

Abbreviations: BP, blood pressure; MTM, Medication Therapy Management.

### Patient treatment satisfaction

The treatment satisfaction rate for all domains is described in Figure 4. According to the SATMED-Q<sub>score</sub> tool of treatment satisfaction, the overall mean score (SD) of treatment satisfaction was  $86.55 \pm 10.34$ .

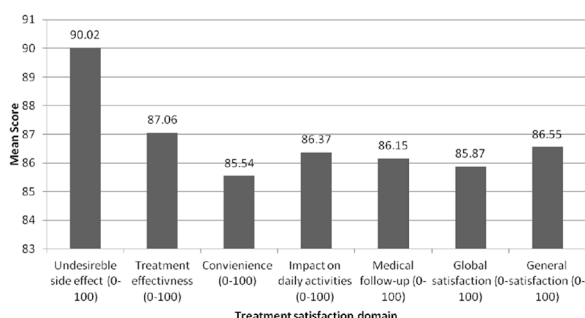
*Predictors of patients' treatment satisfaction.* There was no statistically significant difference in general treatment satisfaction among patients' age groups, sex, marital status, education level, employment status, Source of medication, residence, co-morbid condition, and duration of treatment. The presence of



**Table 7.** Multivariate analysis of factors associated with medication adherence among ambulatory hypertensive patients in follow-up clinic (n=279).

VARIABLES	CATEGORIES	LEVEL OF ADHERENCE		ODDS RATIOS (95% CI)	
		ADHERENT (COUNT)	NON-ADHERENT (COUNT)	COR	AOR
Level of education	No formal education	27	6	1	
	Primary	38	22	0.51 (0.19-1.36)*	0.56 (0.19-1.61)
	Secondary	50	23	1.34 (0.69-2.60)	1.48 (0.69-3.15)
	College and above	79	34	1.06 (0.56-2.02)	1.02 (0.50-2.05)
Source of medication	Buying	89	40		
	Free	88	37	0.44 (0.13-1.48)	0.38 (0.10-1.39)
	Company	11	2	0.42 (0.12-1.38)	0.28 (0.07-1.07)
	Third-party coverage	6	6	0.18 (0.02-1.19)**	<b>0.10 (0.01-0.77)**</b>
Residency	Out of the study city	68	17	1	
	From the study city	180	14	<b>1.69 (1.34-1.86)**</b>	<b>1.73 (1.38-1.88)**</b>
Comorbidity	No	37	13	1	
	1-2	129	55	0.57 (0.24-1.38)*	0.76 (0.26-2.23)
	≥3	28	17	0.70 (0.35-1.38)	0.85 (0.39-1.85)
Number of medication	1	29	5	1	
	2-4	106	49	0.32 (0.11-0.92)**	0.37 (0.11-1.24)
	≥5	59	31	0.88 (0.50-1.52)	1.06 (0.55-2.03)
Number of MTM visits	1	28	12	1	
	2	116	49	0.89 (0.38-2.05)	1.06 (0.42-2.69)
	≥3	50	24	0.88 (0.48-1.58)*	1.18 (0.62-2.25)

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; COR, crude odds ratio; DTP, drug therapy problem; MTM, Medication Therapy Management. Variables in bivariate analysis with  $P \leq .20$  and  $\leq .05$  indicated by \* and \*\* respectively.



**Figure 4.** Treatment satisfaction level following MTM intervention among ambulatory hypertensive patients on follow-up at TASH, Addis Ababa, Ethiopia, January 1 to April 30 (n=279).

Poly-pharmacy, ADR, and complications was found to be significantly associated with treatment satisfaction (Table 8).

There was a significant difference in general treatment satisfaction among patients with DTP experiencing status. Accordingly, patients experiencing DTPs had a lower mean

score as compared to those without it ( $F=4.88$ ;  $P=.002$ ) for general treatment satisfaction. Significant differences among patients with different adherence statuses were found as patients with low adherence were less likely to be satisfied with their treatment ( $F=0.84$ ;  $P<.001$ ). The median general satisfaction scores for those patients' adherent and not adherent to antihypertensive medications were around 90 and 80, respectively (Figure 5).

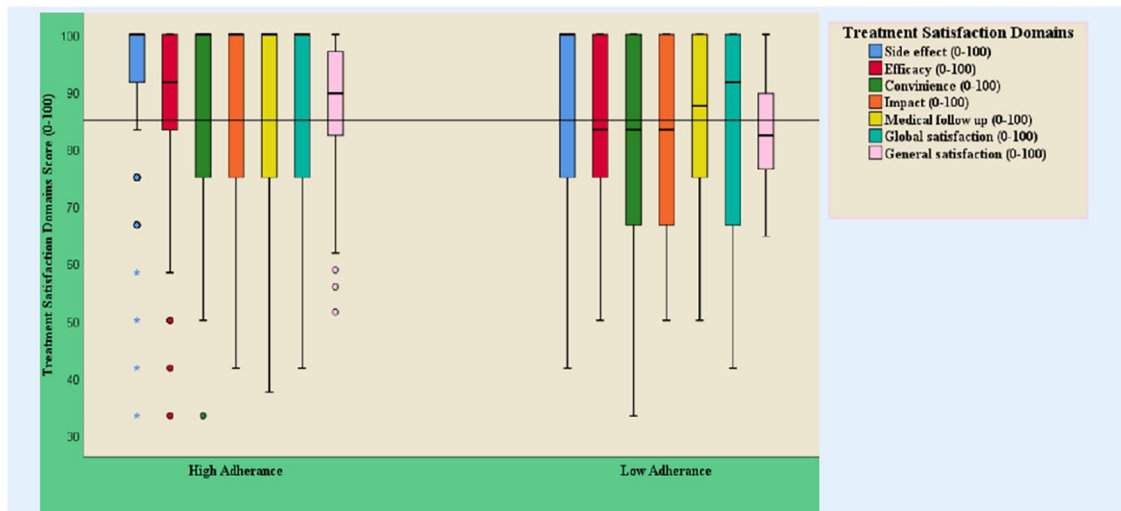
## Discussion

The study aimed to assess the impact of Medication Therapy Management (MTM) services on blood pressure control, medication adherence, Drug Therapy Problems (DTPs), and treatment satisfaction among hypertensive patients in Ethiopia, recognizing their high risk of developing DTPs due to multiple co-morbidities and poly-pharmacy.<sup>3,30</sup> The identification and resolution of DTPs are critical healthcare contributions, as they compromise therapy goals and contribute to greater clinical, humanistic, and economic burdens.<sup>8</sup>

**Table 8.** Relationship between treatment satisfaction and different characteristics of ambulatory hypertensive patients in follow-up clinic (n=279).

VARIABLES	CATEGORIES	N	MEAN SCORE $\pm$ SD	F	P
Age	Less than 65	213	86.10 $\pm$ 10.13	0.12	.44
	$\geq$ 65	66	87.06 $\pm$ 10.60		
Sex	Male	138	86.80 $\pm$ 9.98	0.93	.69
	Female	141	86.31 $\pm$ 10.71		
Marital status	Ever married	262	86.57 $\pm$ 10.17	4.82	.89
	Never married	17	86.24 $\pm$ 13.12		
Education level	No and primary	91	86.69 $\pm$ 10.35	0.21	.87
	Secondary or above	188	86.48 $\pm$ 10.36		
Employment status	Employed	172	86.64 $\pm$ 9.97	0.15	.84
	Unemployed	107	86.40 $\pm$ 10.96		
Source of medication	Free	150	86.00 $\pm$ 10.45	0.01	.34
	Buying	129	87.19 $\pm$ 10.22		
Residence	From the study city	248	86.60 $\pm$ 10.46	0.53	.81
	Out of the study city	31	86.14 $\pm$ 9.51		
Duration of treatment	1-5	77	88.23 $\pm$ 9.33	2.69	.069
	5-10	89	87.22 $\pm$ 10.42		
	$\geq$ 10	113	84.88 $\pm$ 10.77		
Comorbidity	Yes	226	86.13 $\pm$ 10.65	6.32	.16
	No	53	88.34 $\pm$ 8.77		
Complication	Yes	128	84.49 $\pm$ 10.36	0.21	.035
	No	151	87.38 $\pm$ 10.24		
Number of drugs	1	34	91.43 $\pm$ 9.37	8.06	.000
	2-4	155	87.18 $\pm$ 9.42		
	$\geq$ 5	90	83.62 $\pm$ 11.38		
DTP (Post)	Yes	88	83.68 $\pm$ 11.41	4.88	.002
	No	191	87.87 $\pm$ 9.55		
Number of MTM visits	1	40	85.09 $\pm$ 11.01	1.07	.344
	2	165	86.95 $\pm$ 9.86		
	$\geq$ 3	74	87.60 $\pm$ 10.97		
Adherence	Low	85	82.83 $\pm$ 9.10	0.84	.000
	High	194	88.18 $\pm$ 10.45		
ADR (Post MTM)	Yes	18	77.93 $\pm$ 10.22	0.18	.000
	No	261	87.11 $\pm$ 10.12		
BP control (Post MTM)	Controlled	202	87.81 $\pm$ 9.69	3.83	.001
	Uncontrolled	77	83.24 $\pm$ 11.28		

Abbreviations: MTM, Medication Therapy Management; SD, standard deviation.



**Figure 5.** Box plot of association of all domains of treatment satisfaction with adherence status of ambulatory hypertensive patients on follow-up at TASH, Addis Ababa, Ethiopia, January April 2020 (n=279).

The implementation of MTM services in the study resulted in the resolution of 70.73% of identified DTPs and a decrease in DTP prevalence from 63.4% at baseline to 31.54% at the end of the program.<sup>3</sup> Comparable rates were observed in Nigeria (69.23%), while higher rates were reported in England (86.7%) and the USA (78%), suggesting variations possibly influenced by factors such as healthcare infrastructure and study methodology.<sup>31,32</sup> Factors contributing to higher DTP prevalence in low- and middle-income countries (LMICs) compared to high-income countries (HICs) include low health literacy, poor adherence, and limited access to healthcare and medications.<sup>3</sup>

Physician acceptance of pharmacist recommendations in the study was 64.5%, consistent with rates reported elsewhere but lower than certain studies, potentially attributed to methodological differences and varying DTP classification systems.<sup>33-36</sup> Reasons for rejection included concerns about drug availability, affordability, clinical experience, and distinguishing potential from actual DTPs.<sup>37,38</sup>

In conclusion, the study highlights the efficacy of MTM services in addressing DTPs among hypertensive patients in Ethiopia and underscores the importance of pharmacist involvement in community healthcare to enhance medication availability and optimize therapy outcomes.<sup>3,37,38</sup>

The study revealed that non-adherence to medications, Adverse Drug Reactions (ADRs), and the need for additional drug therapy were the most common types of Drug Therapy Problems (DTPs) at baseline, consistent with previous research.<sup>33,39</sup> This pattern suggests patients' lack of access to medications, poor knowledge about drugs, and the long-term complications of hypertension as contributing factors to DTP occurrence.<sup>40</sup>

Pharmacist interventions primarily addressed doses too low, doses too high, and unnecessary DTPs, aligning with other studies reporting a lower substitution rate for ineffective drugs

after pharmacist intervention.<sup>34,40</sup> Specifically, the study highlighted concerns regarding the use of atenolol, a frequently prescribed beta-blocker for hypertension, due to its limited evidence for efficacy and safety compared to other antihypertensive medications.<sup>41-43</sup>

Several medications, complications related to hypertension, and salt consumption status were significantly associated with DTP occurrence at baseline, supporting earlier findings.<sup>7,10,44</sup> Notably, the presence of hypertension-related complications emerged as a protective factor against DTPs, likely due to increased caution in medication management and enhanced clinician attention to patients with complications.<sup>44,45</sup> These findings underscore the importance of educational interventions targeting disease management, complications, and medication adherence in hypertensive patients.<sup>46</sup>

The study also noted a frequent occurrence of ADRs, potentially influenced by the high rate of significant cardiovascular drugs, highlighting the importance of identifying and managing Drug-Drug Interactions (DDIs) in hypertension management to prevent adverse outcomes and reduce healthcare costs.<sup>47</sup>

The findings suggest several actionable measures to address hypertension management challenges. Clinical pharmacists could play a pivotal role in optimizing drug therapy by enhancing rational drug use and preventing ineffective drug therapy.<sup>48</sup> Furthermore, patient education and counseling to improve medication adherence and raise awareness about treatment goals and Adverse Drug Reactions (ADRs) are crucial.<sup>49</sup>

Significant improvements were observed in mean systolic blood pressure (SBP) levels from baseline to the end of the study, with an increase in the proportion of patients achieving controlled blood pressure (BP).<sup>18</sup> Although these results were favorable compared to prior studies in Ethiopia and the USA, variations in intervention intensity, follow-up duration, and participant characteristics may account for discrepancies.<sup>50</sup> The

study applied relaxed BP goals in accordance with national and international guidelines.<sup>51,52</sup>

Drug-Drug Interactions (DDIs) emerged as a major concern, with a considerable proportion of serious DDIs necessitating changes in prescribed drugs.<sup>53</sup> While a significant reduction in SBP was noted, the impact on diastolic blood pressure (DBP) was not significant, possibly influenced by baseline characteristics and intervention components.<sup>54-56</sup> The sensitivity of SBP to interventions could be attributed to the higher prevalence of co-morbidities like Chronic Kidney Disease (CKD) and Diabetes Mellitus (DM), emphasizing the importance of tailored interventions for specific patient groups.<sup>57</sup>

Medication adherence rates varied, with factors such as third-party medication coverage and urban residency influencing adherence levels.<sup>58</sup> However, the association between medication accessibility and adherence warrants further investigation, as it appears to be a multifaceted issue influenced by various factors.<sup>59-61</sup>

The study demonstrated high treatment satisfaction scores post-intervention, potentially attributable to increased health literacy, adherence rates, and reduced DTPs and ADRs.<sup>62,63</sup> Importantly, treatment satisfaction was positively associated with medication adherence, highlighting the need to address patient concerns and safety issues during consultations to enhance adherence and overall treatment satisfaction.<sup>62,64-66</sup>

### Limitation of the Study

The study has limitations due to its small sample size, short follow-up, limited generalizability, lack of randomization, and self-reporting adherence measurement, which could lead to regression to the mean and recall bias.

### Conclusions

The provision of MTM service demonstrated the decreased prevalence of DTPs after 6 months of follow-up. Additionally, modest improvement in clinical outcomes such as average SBP and DBP with an increased proportion of patients who are at goal BP from baseline to the end of the study was found. Furthermore, a higher medication adherence rate and patient treatment satisfaction were reported by study participants after introducing the MTM service. Conjointly, this result will be valuable in the management of hypertension and could serve as a framework for further research on a similar topic.

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### Author Contributions

BB: Data Curation, Formal analysis, Investigation, Writing—Original Draft, Writing—Funding acquisition; MA:

Conceptualization, Methodology, Software, Review & Editing, Project administration, Supervision AB: Conceptualization, Methodology, Software, Review & Editing, Project administration, Supervision DM: Review & Editing, Supervision; EE: Conceptualization, Methodology, Supervision, Writing—Review & Editing, Funding acquisition.

### Ethical Considerations

The Ethical Review Board of Addis Ababa University's School of Pharmacy granted ethical clearance and approval for the study protocols (ERB/SOP/114/07/2019). Furthermore, we received approval to carry out the study at the clinic from the directors of the Renal Clinic and the Department of Internal Medicine. The Declaration of Helsinki's guiding principles were followed in the conduct of the study.

### Patient Consent

Prior to the commencement of data collection, all participants were informed about the study's objectives, and their written consent was acquired. They were also made fully aware of their unrestricted right to withdraw from the study at any time. Strict protocols were put in place to protect confidentiality and privacy, such as purposefully avoiding identifiers and limiting access to data. Before participating in the trial, all patients—regardless of their educational background—provided written informed consent. During the recruitment procedure, individuals without formal education participated in literacy evaluations by reading consent forms translated into Amharic and writing their names in Geez or Ethiopic letters. This method ensured that participants without formal education understood the study material and gave independent written informed consent without the need for a legally authorized representative (LAR).

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### Supplemental Material

Supplemental material for this article is available online.

### REFERENCES

1. Hoye NA. *The Physiological Changes That Occur Post Endovascular Renal Denervation in Dialysis Patients*. University of Otago; 2017.
2. Munger MA. Polypharmacy and combination therapy in the management of hypertension in elderly patients with co-morbid diabetes mellitus. *Drugs Aging*. 2010;27:871-883.
3. Al-azzam S, Alzoubi K, AbuRuz S, Alefan Q. Drug-related problems in a sample of outpatients with chronic diseases: a cross-sectional study from Jordan. *Ther Clin Risk Manag*. 2016;12:233-239.
4. Redzuan A, Ramli A, Pheng M, Ramili A. Drug-related problems in hypertensive patients with multiple comorbidities. *J Pharm Res*. 2017;1:1-8.
5. Law AM, Kelton WD, Strand LM, Morley PC. *Pharmaceutical Care Practice: The Clinicians Guide*. McGraw-Hill; 2004.
6. Cipolle RJ, Strand LM, Morley PC, Strand LM. *Pharmaceutical Care Practice: The Patient-Centered Approach to Medication Management*. McGraw Hill Professional; 2012.

7. Hussein M, Lenjisa J, Woldu M, et al. Assessment of drug related problems among hypertensive patients on follow up in Adama Hospital Medical College, East Ethiopia. *Clin Pharmacol Biopharm.* 2014;3:1-6.
8. Abu Farha R, Basheti I, Abu Al Ruz H, Alsaleh A, AbuRuz S. Assessment of drug-related problems and their impact on blood pressure control in patients with hypertension. *Eur J Hosp Pharm.* 2016;23:126-130.
9. Yimama M, Jarso H, Desse TAA, Dese TA. Determinants of drug-related problems among ambulatory type 2 diabetes patients with hypertension comorbidity in southwest Ethiopia: a prospective cross sectional study. *BMC Res Notes.* 2018;11:679.
10. Kefale B, Tegegne GT, Kefale Y, et al. Magnitude and determinants of drug therapy problems among type 2 diabetes mellitus patients with hypertension in Ethiopia. *Sage Open Med.* 2020;8:1-8.
11. Weldegebreel 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;19:2571-2579.
12. Chobanian AV, Bakris GL, Black HR, et al. Seventh report of the Joint National Committee on Prevention, detection, evaluation, and treatment of high blood pressure. *Hypertension.* 2003;42:1206-1252.
13. George LB, Matthew SM, eds. *Hypertension: A Companion to Braunwald's Heart Disease.* 3rd ed. Elsevier; 2018.
14. WHO. *Hypertension.* WHO; 2019.
15. Mills KT, Bundy JD, Kelly TN, et al. Global disparities of hypertension prevalence and control: a systematic analysis of population-based studies from 90 countries. *Circulation.* 2016;134:441-450.
16. Wong ND, Moran A, Narula J, Moran A. Hypertension control in Africa: a call to action. *Glob Heart.* 2018;13:1-2.
17. Gebreyes YF, Goshu DY, Geletew TK, et al. Prevalence of high bloodpressure, hyperglycemia, dyslipidemia, metabolic syndrome and their determinants in Ethiopia: evidences from the National NCDs STEPS Survey, 2015. *PLoS One.* 2018;13:1-18.
18. Yazie D, Shibeshi W, Alebachew M, Beyene Berha A. Assessment of blood pressure control among hypertensive patients in Zewditu Memorial Hospital, Addis Ababa, Ethiopia: a cross-sectional study. *J Bioanal Biomed.* 2018;10:80-87.
19. Abaynew Y, Hussien M. A qualitative study on barriers to treatment and control of hypertension among patients at Dessie Referral Hospital, Northeast Ethiopia, Ethiopia: healthcare workers' perspective. *Integr Blood Press Control.* 2021;14:173-178.
20. Hussien M, Muhye A, Abebe F, Ambaw F. The role of health care quality in hypertension self-management: a qualitative study of the experience of patients in a public hospital, North-West Ethiopia. *Integr Blood Press Control.* 2021;14:55-68.
21. Bluml BM. Definition of medication therapy management: development of professionwide consensus. *J Am Pharm Assoc.* 2005;45:566-572.
22. Burns A. Medication therapy management in pharmacy practice: core elements of an MTM service model (version 2.0). *J Am Pharm Assoc.* 2008;48:341-353.
23. McGivney MS, Meyer SM, Duncan-Hewitt W, et al. Medication therapy management: its relationship to patient counseling, disease management, and pharmaceutical care. *J Am Pharm Assoc.* 2007;47:620-628.
24. Cardoso L, Hohmeier KC, Fisher C, Wasson M. Patient satisfaction with a comprehensive medication review provided by a community pharmacist. *J Pharm Technol.* 2018;34:48-53.
25. Renfro CP, Turner K, Desai R, et al. Implementation process for comprehensive medication review in the community pharmacy setting. *J Am Pharm Assoc.* 2019;59:836-841.e2.
26. Woldemichael A, Takian A, Akbari Sari A, Olyacemanesh A. Availability and inequality in accessibility of health centre-based primary healthcare in Ethiopia. *PLoS One.* 2019;14: e0213896.
27. Damania A. Khat (*Catha edulis*): an ancient stimulant from East Africa and the Arabian Peninsula. *Asian Hist.* 2014;18:205-219.
28. Cox G, Rampes H. Adverse effects of khat: a review. *Adv Psychiatr Treat.* 2003;9:456-463.
29. Mansingh A, Narang GC. *Firaq Gorakhpuri: The Poet of Pain & Ecstasy.* Roli Books Private Limited; 2015.
30. Adusumilli P, Adepu R. Drug related problems: an over view of various classification systems. *Asian J Pharm Clin Res.* 2014;7:7-10.
31. Sobieraj D, Nigro S, Olayiwola N, Nigro S. Targeted hypertension medication therapy management in federally qualified health center. *Pharm J N Engl.* 2011;8:16-23.
32. Isetts BJ, Schondelmeyer SW, Artz MB, et al. Clinical and economic outcomes of medication therapy management services: the Minnesota experience. *J Am Pharm Assoc.* 2008;48:203-214.
33. Neves CDM, Nascimento MMD, Silva DÁM, Ramalho-de-Oliveira D. Clinical results of comprehensive medication management services in primary care in Belo Horizonte. *Pharmacy.* 2019;7:58.
34. Shareef J, Fernandes J, Samaga L, Fernandes J. Clinical pharmacist interventions in drug therapy in patients with diabetes mellitus and hypertension in a university teaching hospital. *Int J Pharm.* 2015;6:4424.
35. Hirsch JD, Steers N, Adler DS, et al. Primary care-based, pharmacist-physician collaborative medication-therapy management of hypertension: a randomized, pragmatic trial. *Clin Ther.* 2014;36:1244-1254.
36. Morgado M, Rolo S, Castelo-Branco M, Branco M. Pharmacist intervention program to enhance hypertension control: a randomised controlled trial. *Int J Clin Pharm.* 2011;33:132-140.
37. Mossialos E, Courtin E, Naci H, et al. From "retailers" to health care providers: transforming the role of community pharmacists in chronic disease management. *Health Policy.* 2015;119:628-639.
38. van Grootheest AC, de Jong-van den Berg LT. The role of hospital and community pharmacists in pharmacovigilance. *Res Soc Adm Pharm.* 2005;1:126-133.
39. Steele KM, Ruisinger JF, Bates J, et al. Home-based comprehensive medication reviews: pharmacist's impact on drug therapy problems in Geriatric Patients. *Consult Pharm.* 2016;31:598-605.
40. Bowry AD, Shrank WH, Lee JL, Stedman M, Choudhry NK. A systematic review of adherence to cardiovascular medications in resource-limited settings. *J Gen Intern Med.* 2011;26:1479-1491.
41. Dahlöf B, Devereux RB, Kjeldsen SE, et al. Cardiovascular morbidity and mortality in the losartan intervention for endpoint reduction in hypertension study (LIFE): a randomised trial against atenolol. *Lancet.* 2002;359:995-1003.
42. Mangano DT, Layug EL, Wallace A, Tateo I. Effect of atenolol on mortality and cardiovascular morbidity after noncardiac surgery. Multicenter Study of Perioperative Ischemia Research Group. *New Engl J Med.* 1996;335:1713-1720.
43. Marott SC, Nielsen SF, Benn M, Nordestgaard BG. Antihypertensive treatment and risk of atrial fibrillation: a nationwide study. *Eur Heart J.* 2014;35:1205-1214.
44. Ghembaza MA, Senoussaoui Y, Tani MK, Meguenni K. Impact of patient knowledge of hypertension complications on adherence to antihypertensive therapy. *Curr Hypertens Rev.* 2014;10:41-48.
45. Nguyen TPL, Schuiling-Veninga CCM, Nguyen TBY, et al. Adherence to hypertension medication: Quantitative and qualitative investigations in a rural northern Vietnamese community. *PLoS One.* 2017;12:1-13.
46. Tilea I, Petra D, Voidazan S, Ardeleanu E, Varga A. Treatment adherence among adult hypertensive patients: a cross-sectional retrospective study in primary care in Romania. *Patient Prefer Adherence.* 2018;12:625-635.
47. Chelkeba L, Alemseged F, Bedada W, Bedada W. Assessment of potential drug-drug interactions among outpatients receiving cardiovascular medications at Jimma University specialized hospital, South West Ethiopia. *Int J Basic Clin Pharmacol.* 2013;2:144-152.
48. Melo DOD, Castro LLC. Pharmacist's contribution to the promotion of access and rational use of essential medicines in SUS. *Cien Saude Colet.* 2017;22:235-244.
49. Baroletti S, Dell'Orfano H. Medication adherence in cardiovascular disease. *Circulation.* 2010;121:1455-1458.
50. Angell SY, Garg RK, Gwynn RC, et al. Prevalence, awareness, treatment, and predictors of control of hypertension in New York City. *Circ Cardiovasc Qual Outcomes.* 2008;1:46-53.
51. Michael G, Dagnaw W, Yadeta D, et al. Ethiopian national guideline on major NCDs 2016. *Fed Democr Repub Ethiop Minist Heal.* 2016:121-165.
52. James PA, Oparil S, Carter BL, et al. 2014 evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8). *JAMA.* 2014;311:507-520.
53. Zaman Huri H, Fun Wee H. Drug related problems in type 2 diabetes patients with hypertension: a cross-sectional retrospective study. *BMC Endocr Disord.* 2013;13:1.
54. Wang J, Wu J, Yang J, et al. Effects of pharmaceutical care interventions on blood pressure and medication adherence of patients with primary hypertension in China. *Clin Res Regul Aff.* 2011;28:1-6.
55. Rita A, John A, Akpevwe A, John A. Impact of pharmaceutical care interventions on the quality of life of group of hypertensive patients. *UK J Pharm Biosci.* 2016;4:19-28.
56. Santschi V, Lord A, Berbiche D, et al. Impact of collaborative and multidisciplinary care on management of hypertension in chronic kidney disease outpatients. *J Pharm Health Serv Res.* 2011;2:79-87.
57. Farnett L, Mulrow CD, Linn WD, Lucey CR, Tuley MR. The J-curve phenomenon and the treatment of hypertension. Is there a point beyond which pressure reduction is dangerous? *JAMA.* 1991;265:489-495.
58. Sookaneknun P, Richards RM, Sanguanserm Sri J, Teerasut C. Pharmacist involvement in primary care improves hypertensive patient clinical outcomes. *Ann Pharmacother.* 2004;38:2023-2028.
59. Sinnott S-J, Buckley C, O'Riordan D, Bradley C, Whelton H H. The effect of copayments for prescriptions on adherence to prescription medicines in publicly insured populations; a systematic review and meta-analysis. *PLoS One.* 2013;8:1-11.



60. McDonald HP, Garg AX, Haynes RB. Interventions to enhance patient adherence to medication prescriptions: scientific review. *JAMA*. 2002;288:2868-2879.
61. World Health Organization. *Adherence to Long-Term Therapies: Evidence for Action*. World Health Organization; 2003.
62. Zyoud SH, Al-Jabi SW, Sweileh WM, Morisky DE. Relationship of treatment satisfaction to medication adherence: findings from a cross-sectional survey among hypertensive patients in Palestine. *Health QualLife Outcomes*. 2013;11:191.
63. Berhe DF, Taxis K, Haaijer-Ruskamp FM, et al. Impact of adverse drug events and treatment satisfaction on patient adherence with antihypertensive medication - a study in ambulatory patients. *Br J Clin Pharmacol*. 2017;83:2107-2117.
64. Saarti S, Hajj A, Karam L, et al. Association between adherence, treatment satisfaction and illness perception in hypertensive patients. *JHumHypertens*. 2016;30:341-345.
65. Ajayi DT, Adedokun BO, Owwoeye DO, Akpa OM. Treatment satisfaction and medication adherence among hypertensive patients seeking care in selected hospitals in Ibadan, Nigeria. *Arch Basic Appl Med*. 2018;6:67-72.
66. Morisky DE, Ang A, Krousel-Wood M, Ward HJ. Predictive validity of a medication adherence measure in an outpatient setting. *J Clin Hypertens*. 2008;10:348-354.