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Medication Non-adherence and Associated Factors among Patients with Hypertension attending Internal Medicine Department at University Teaching Hospital of Butare, Rwanda: A Cross-sectional Study.

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ABSTRACT

Purpose: Non-adherence to antihypertensive medication compromises blood pressure control and increases the risk of cardiovascular complications. This study determined the prevalence of antihypertensive medication non-adherence and the factors associated with adherence among adults with hypertension attending the University Teaching Hospital of Butare (CHUB), Rwanda.

Methods: A hospital-based cross-sectional study was conducted among 255 adults with hypertension attending the Internal Medicine Department of CHUB between September and November 2025. Participants were recruited consecutively and interviewed using a structured questionnaire. Non-adherence was defined as any self-reported missed dose, or taking antihypertensive medication less often than prescribed, in the preceding 30 days. Data were analyzed in SPSS version 25 using descriptive statistics and multivariable logistic regression, with $p < 0.05$ considered statistically significant.

Results: Of the 255 participants, 134 were non-adherent, a prevalence of 52.5% (95% CI: 46.2%–58.8%). Most participants were aged 61 years or older (62.0%) and female (58.0%), 38.0% had no formal education, and 48.0% reported a monthly household income below 10,000 RWF. Of the 286 responses given on reasons for missing doses, the most frequent were forgetfulness (21.0%), believing that medication was unnecessary (15.7%) and medication cost (8.0%). Non-adherence was higher among participants who reported difficulty obtaining medication than among those who did not (70.4% vs 45.7%). In multivariable analysis, receiving hypertension education (AOR = 2.58, 95% CI: 1.33–5.01), perceiving hypertension to be effectively managed (AOR = 2.40, 95% CI: 1.30–4.41) and higher income (AOR = 1.59, 95% CI: 1.01–2.50) were associated with higher odds of adherence, whereas difficulty obtaining medication was associated with lower odds of adherence (AOR = 0.41, 95% CI: 0.17–0.98).

Unique Contribution to Theory, Practice and Policy: More than half of adults with hypertension attending this tertiary hospital were non-adherent to antihypertensive medication. Strengthening patient education and ensuring consistent and affordable access to antihypertensive medicines may improve adherence in this setting. Ethical approval was granted by the Institutional Review Board of CHUB (REC/CHUB/066/2025), and all participants gave informed consent.

Key Words: *Hypertension, Antihypertensive medications, Medication non-adherence*

1. Background

Hypertension is a major global public health challenge and a leading preventable risk factor for cardiovascular disease, with an estimated 1.4 billion adults worldwide affected [1]. Non-adherence to antihypertensive treatment is a major barrier to blood pressure control and contributes to the progression of the disease to complications [2]. A systematic review and meta-analysis found that nearly half of patients with hypertension are non-adherent to their medication, with higher rates among African and Asian patients [3]. In Serbia, non-adherence was associated with an increasing number of medications, urban residence, mild memory impairment and polypharmacy [4]. In Sudan, non-adherence was associated with sex, duration of hypertension, the interval between follow-up visits, the number of drugs, younger age, use of more than one pharmacy and level of education [5]. In Cameroon, forgetfulness, taking several doses a day, financial difficulties and side effects were the main contributors to non-adherence [6], and in central Ethiopia only about a third of patients had high adherence [7]. In Kenya, more than half of patients missed medication because of lack of time, lack of funds, the belief that they had been cured, forgetfulness and stock-outs at the pharmacy [8]. In Rwanda, national surveys indicate a high and growing prevalence of hypertension, which significantly strains healthcare infrastructure and contributes heavily to cardiovascular morbidity and mortality. According to the latest national Non-Communicable Diseases (NCD) STEPS survey, hypertension affects 16.2% of adults overall in Rwanda, with prevalence reaching 43.2% among older adults aged 60–69 years [9]. And a study done in Rwanda also in rural district hospitals linked adherence to literacy, absence of side effects and the facility attended [10]. A study in a district hospital in Northern Province reported that just over a third of patients were non-adherent [11]. Evidence on adherence and its associated factors in tertiary referral settings in Southern Rwanda remains limited. This study therefore aimed to determine the prevalence of antihypertensive medication non-adherence and to identify the factors associated with adherence among adults with hypertension attending the Internal Medicine Department at CHUB.

2.Methods

2.1 Study Design and Setting

This hospital-based cross-sectional study was conducted between September and November 2025 in the general Internal Medicine Outpatient Department at the University Teaching Hospital of Butare (CHUB), a major tertiary referral center serving a catchment area of over 3.5 million residents in Southern Rwanda. The hospital manages approximately 700 adult hypertensive patients over a typical three months in average, with patients returning for routine follow-up consultations every 1 to 3 months depending on blood pressure stability. During these visits, physicians prescribe 30 to 90 days supplies of antihypertensive medications, which patients refill through the hospital or private pharmacies, primarily utilizing public health insurance schemes to cover costs.

2.2 Participants and Sampling

The study population comprised adult patients (aged ≥ 18 years) attending routine outpatient reviews at the Internal Medicine Department. Hypertension was defined based on standard clinical diagnosis documented in medical records, characterized by persistent resting blood pressure $\geq$ 140 mmHg systolic and/or ≥ 90 mmHg diastolic (according to WHO guidelines), and confirmed ongoing prescription of pharmacological antihypertensive treatment for at least six months prior to enrollment. Based on an average 3 months hospital source population ($N = 700$), The sample size was calculated using the single-proportion formula for cross-sectional studies with a finite population correction. Assuming an expected non-adherence prevalence (p) of 50% to yield the maximum required sample size, a 95% confidence level ($Z = 1.96$), and a 5% margin of error ($d = 0.05$), the initial sample size was 384. Based on historical hospital records, an average of 700 adult patients with hypertension attend the Internal Medicine Department at CHUB over a typical 3-month period ($N = 700$). Applying the finite population correction formula ($n_{corrected} = \frac{n_0}{1+\frac{n_0-1}{N}}$) yielded a required sample size of 248. Accounting for a potential ~3% non-response or incomplete data rate, the target sample size was set at 255. Participants were recruited consecutively as they presented to the outpatient clinic during the study period; all 255 invited individuals consented and fully completed the study questionnaire, yielding a final analyzed sample size of exactly 255.

Using nonprobability consecutive sampling between September and November 2025, every eligible patient attending scheduled reviews was approached sequentially; of 280 patients screened, 12 were excluded (11 severely ill, 1 cognitively impaired) and 13 declined, resulting in 255 analyzed participants (95.1% response rate). Participant national IDs and Open Clinic record numbers were cross-checked against a central screening registry to prevent duplicate enrollments. Recruiting exclusively from active hospital attendees introduces potential selection bias, as disengaged patients missing scheduled reviews were not captured and may systematically exhibit lower medication adherence.

2.3 Data Collection Tool and Procedure

Data were collected using a pre-tested, structured interviewer-administered questionnaire adapted from previous validated studies [12, 13, 14]. The tool was originally prepared in English, translated into Kinyarwanda by a bilingual clinical researcher, and independently back-translated into English by a certified translator to ensure semantic equivalence. Face and content validity were evaluated by a panel of experts, including two nurse specialists and a senior cardiologist at CHUB. A pilot study was conducted among 26 hypertensive patients (10% of the sample size) at a neighboring health center to assess clarity and feasibility; these pilot data were excluded from the final analysis. The structured questionnaire demonstrated acceptable internal consistency reliability (Cronbach's $\alpha = 0.78$).

Independent Variables and Operational Definitions

The questionnaire collected comprehensive data on demographic, clinical, and health-system-related predictors: Socio-demographic metrics: Age (≤ 60 vs. > 60 years), gender (male vs. female), educational background (no formal education vs. primary or higher), occupation (unemployed, informal/farming, formal employment), and estimated monthly household income ($< 10{,}000$ RWF vs. $\geq 10{,}000$ RWF). Clinical & health-system predictors: Duration of hypertension diagnosis (< 5 years vs. ≥ 5 years), presence of comorbid conditions (yes vs. no), geographic distance to health facility (< 5 km vs. ≥ 5 km), exposure to hypertension health education (yes vs. no), perceived difficulty obtaining medication due to stockouts or logistics (yes vs. no), financial constraints in acquiring medication (yes vs. no), and receiving help or reminders to take medication (yes vs. no). Perceptual metrics: Perceived effectiveness of hypertension management (perceived as effectively managed vs. not effectively managed) and perceived importance of adherence to long-term health (perceived as important vs. not important).

Dependent Variable and Recall Period Alignment

The primary dependent variable, *antihypertensive medication non-adherence*, was operationally defined as a binary outcome ($0 =$ Adherent, $1 =$ non-adherent) based on a standardized 30-day recall period. Participants were classified as non-adherent if they reported missing any prescribed doses or taking medication less frequently than prescribed in the preceding 30 days. Single-item 30-day self-report metrics are widely validated in low-resource clinical settings with diverse literacy levels (where 38% of our sample had no formal education), offering minimal cognitive recall burden while maintaining strong clinical correlation with pharmacy refill adherence metrics. All self-estimated dose-missing frequencies, self-reported reasons, and figure metrics throughout the study were standardized strictly to this 30-day recall window.

2.4 Statistical Analysis

Data cleaned and validated in Microsoft Excel were exported into IBM SPSS Statistics Version 25 for analysis. Categorical variables were summarized using frequencies (n) and percentages (%). Continuous variables were categorized based on clinical relevance or median cut-offs. Bivariate logistic regression analysis was initially conducted to evaluate the unadjusted association between each candidate predictor and medication adherence, generating Crude Odds Ratios (COR) with 95% Confidence Intervals (CI). Variables displaying a bivariate association with $p < 0.20$, alongside clinically non-negotiable confounders (such as age and gender), were entered into the multivariable logistic regression model using a backward stepwise (Wald) elimination procedure.

To ensure correct outcome modeling, the dependent variable in Table 3 was binary-coded as 1 = Medication Adherent and 0 = non-adherent. Categorical predictors were dummy-coded with designated reference groups as follows: Age: ≤ 60 years (reference) vs. > 60 years, Education: Formal education (reference) vs. No formal education, Monthly Income: $< 10{,}000$ RWF

(reference) vs. $\geq 10{,}000$ RWF, Difficulty obtaining medication: No (reference) vs. Yes, Hypertension education exposure: No (reference) vs. Yes, Perceived effective management: No/Not effectively managed (reference) vs. Yes/Effectively managed. Multi-collinearity among independent variables was assessed using the Variance Inflation Factor (VIF) and tolerance statistics; all VIF values were < 2.0 (mean VIF = 1.34), confirming no significant multicollinearity. The overall goodness-of-fit for the final multivariable model was evaluated using the Hosmer-Lemeshow test ($\chi^2 = 6.42, p = 0.600$), indicating an acceptable model fit. Adjusted Odds Ratios (AOR) and 95% CIs were calculated, with statistical significance defined at $p < 0.05$.

2.5 Ethical Considerations

Institutional review, protocol validation, and ethical clearance were officially granted by the Institutional Review Board (Ethics Committee) of the University Teaching Hospital of Butare (Approval No: REC/CHUB/066/2025). Administrative permission was obtained from hospital management prior to clinical field entry. All participating individuals provided free, written, or thumb-printed informed consent following a comprehensive native-language explanation regarding study aims, data usage, and the right to withdraw without clinical penalty. To preserve anonymity, all identifiers were stripped from public datasets using coded keys.

3. Results

3.1 Socio-demographic characteristics of participants

A total of 255 hypertensive patients were included in the final cross-sectional analysis. The study population was predominantly elderly, with 62% (n = 159) of participants aged 61 years or above. More than half of the cohort was female (n = 148, 58%). High socioeconomic vulnerability was evident across the sample: 38% (n = 97) had no formal education, and 37% (n = 94) had attained only a primary school level of education. Regarding occupational profiles, 43% (n = 109) were self-employed within the informal sector, while 36% (n = 92) were unemployed. Financial strain was widespread, with the respondents (n = 122, 48%) reporting an estimated monthly household income below 10,000 RWF.

Table 1: Demographic Profile of Participants (N = 255)

Variable	Category	Frequency (percent)
Age group (years)	18–40	17 (7.0)
	41–50	24 (9.0)
	51–60	55 (22.0)
	61+	159 (62.0)
Gender	Female	148 (58.0)
	Male	107 (42.0)
Education level	No formal education	97 (38.0)
	Primary education	94 (37.0)
	Secondary education	45 (18.0)
	Higher education	19 (7.0)
Occupation	Self-employed	109 (43.0)
	Unemployed	92 (36.0)
	Employed (public/private)	34 (13.0)
	Retired	20 (8.0)
Income level	Less than 10,000	122 (48.0)
	10,000–50,000	60 (24.0)
	Above 50,000	73 (29.0)

Note: values in parentheses are percentages.

3.2 Patient behavioral metrics and self-reported reasons for non-adherence

Patient-centered behavioral metrics indicated that the participants (n = 121, 48%) reported missing zero doses of their prescribed antihypertensive medications in the preceding months, whereas 29% (n = 75) reported missing more than five doses and 14% (n = 35) missed between three and five doses where (N = 255).

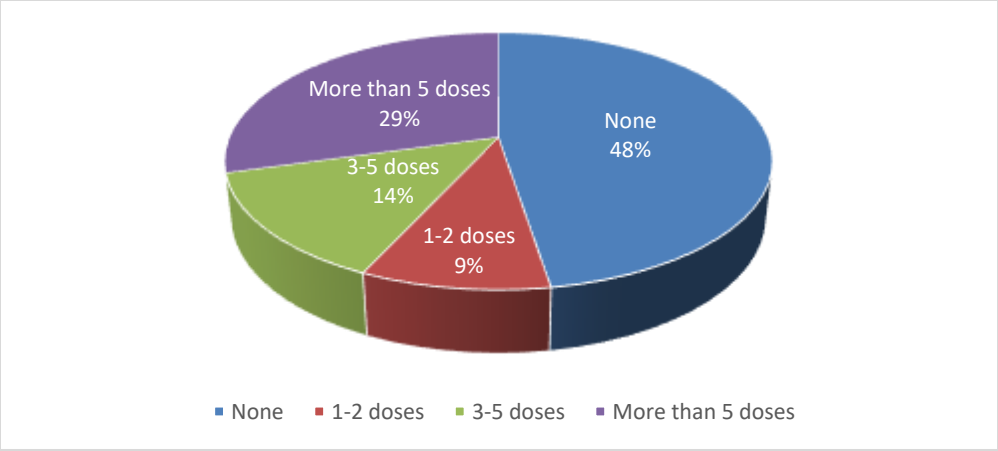

Figure 1: The doses have missed in the past six months

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Among the 134 non-adherent participants (52.5% of the total sample size of $N = 255$), a total of 165 reason responses were reported, as participants were permitted to select more than one justification for missing doses (31 participants cited multiple reasons). When evaluated as a proportion of all non-adherent individuals ($n = 134$), the most frequent behavioral barrier reported was forgetfulness ($n = 60$,44.8%), followed by the belief that medication was not clinically necessary ($n = 45$,33.6%). Financial constraints related to medication costs were cited by 17.2% ($n = 23$), feeling better/asymptomatic by 12.7% ($n = 17$), structural lack of drug access (pharmacy stock-outs) by 4.5% ($n = 6$), experiencing adverse side effects by 4.5% ($n = 6$), complex dosing regimens by 2.2% ($n = 3$), and other reasons by 3.7% ($n = 5$).

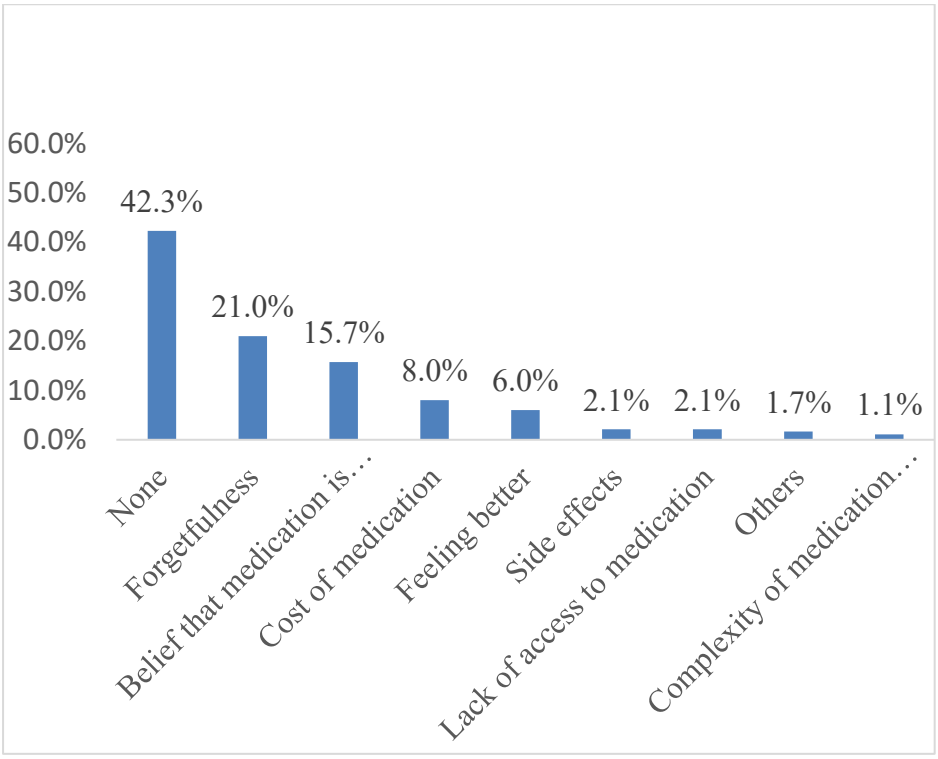

Figure 2: The reasons for missing medication

The cross-tabulation of difficulty obtaining medication by adherence status is presented in Table 2. Overall, 27.8% ($n = 71/255$) of participants reported experiencing difficulty obtaining their antihypertensive medications. Among patients who experienced difficulty obtaining medication, the majority were non-adherent (70.4%, $n = 50/71$), compared to 29.6% ($n = 21/71$) who maintained adherence. Conversely, among patients without difficulty obtaining medication ($n = 184$), 54.3% ($n = 100/184$) were adherent while 45.7% ($n = 84/184$) were non-adherent. Difficulty obtaining medication was strongly associated with poorer medication adherence. Patients facing structural supply barriers experienced a substantially higher rate of non-adherence

compared to those with unhindered access (70.4% vs. 45.7%), highlighting medication access as a critical determinant of treatment compliance in this population

Table 2. Difficulty Obtaining Medication * Medication Adherence (Binary) Crosstabulation.

Difficulty obtaining medication	Non-adherent, n (%)	Adherent, n (%)	Total, n (%)
No	84 (45.7)	100 (54.3)	184 (72.2)
Yes	50 (70.4)	21 (29.6)	71 (27.8)
Total	134 (52.5)	121 (47.5)	255 (100.0)

Note: Percentages in the adherence columns for "No" and "Yes" are row percentages; percentages in the Total column represent the proportion of the overall sample.

In multivariable logistic regression analysis (Table 3), receiving formal education on hypertension (AOR = 2.58, 95% CI: 1.33–5.01, $p = 0.005$), perceiving hypertension to be effectively managed (AOR = 2.40, 95% CI: 1.30–4.41, $p = 0.005$), and higher income level (AOR = 1.59, 95% CI: 1.01–2.50, $p = 0.046$) were independently associated with significantly higher odds of medication adherence. Conversely, experiencing difficulty obtaining medication was significantly associated with lower odds of adherence (AOR = 0.41, 95% CI: 0.17–0.98, $p = 0.045$). Other factors—including age, gender, education level, presence of comorbidities, distance to health facility, and general financial constraints—did not display statistically significant independent associations with adherence. These findings indicate that medication adherence among hypertensive patients in this setting is associated with key healthcare delivery and socio-economic factors.

Table 3. Factors Associated with Antihypertensive Medication Adherence: Multivariable Logistic Regression Analysis

Predictor	AOR	95% CI	p-value
Female vs Male	0.73	0.41–1.30	0.238
Age (years)	0.98	0.95–1.01	0.23
Education level	0.65	0.41–1.03	0.067
Income level	1.59	1.01–2.50	0.045*
Duration of hypertension	0.78	0.54–1.12	0.138
Other chronic condition	0.6	0.32–1.10	0.13
Difficulty obtaining medication	0.41	0.17–0.98	0.046*
Financial constraints	1.48	0.61–3.60	0.339
Long distance to facility	0.73	0.38–1.42	0.336
Help remembering medication	0.91	0.47–1.74	0.737
Hypertension effectively managed	2.4	1.30–4.41	0.005*
Medication perceived important	1.05	0.24–4.53	0.935
Received hypertension education	2.58	1.33–5.01	0.005*

*Note: AOR = Adjusted Odds Ratio; CI = Confidence Interval; outcome = medication adherence (1 = adherent). $p < 0.05$.

Access barriers specifically difficulty obtaining medication severely compromise treatment compliance, whereas formal patient education, higher income, and strong patient perception of treatment effectiveness serve as pivotal independent drivers of optimal medication adherence. Regarding patient-identified priority areas for health system improvement, a total of 351 responses were recorded, as participants were permitted to select multiple interventions from N=255. Enhanced patient education on hypertension (n = 131, 37.3%) and better access to medications (n = 130, 37.0%) emerged as the two primary institutional priorities reported by the cohort, indicating that patients view educational reinforcement and supply-chain reliability as equally vital components of adherence optimization.

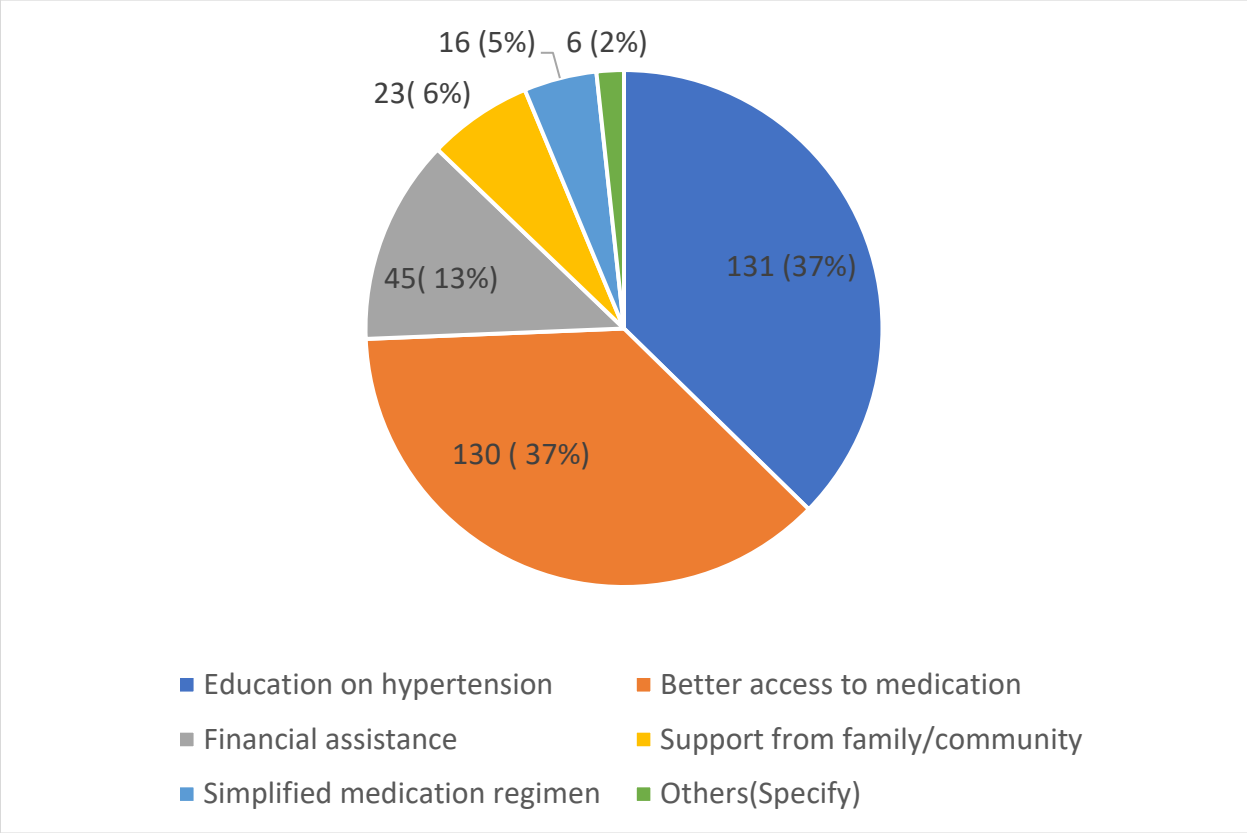

Figure 3: Patient reported suggestions for improving medication adherence

4. Discussion

This study found that more than half of adults with hypertension attending the Internal Medicine Department at CHUB were not taking their antihypertensive medication as prescribed. This burden lies within the range reported for African and Asian populations [3] and in Sudan [5], but is higher than the level reported from a district hospital in Northern Rwanda [11]. Two explanations are likely. First, CHUB is a tertiary referral hospital whose patients are predominantly older, may have more advanced disease and often travel long distances for care. Second, our definition classified

any missed dose in the preceding 30 days as non-adherence, a stricter threshold than the scale-based definitions used in several earlier studies, which would be expected to produce a higher estimate. Whatever its exact magnitude, the finding shows that a substantial proportion of patients who remain engaged in specialist care do not receive the full benefit of their prescribed treatment, and that adherence should be assessed routinely at clinic visits rather than assumed.

Difficulty obtaining medication emerged as an important barrier to adherence. This is consistent with reports from Kenya, where stock-outs and lack of funds led patients to miss doses [8], and from Cameroon, where financial difficulty was among the main reasons for non-adherence [6]. In our setting, patients refill prescriptions either at the hospital or at private pharmacies; when the hospital pharmacy is out of stock, a patient may have to pay out of pocket at a private outlet, wait for stock to be restored, or make an additional journey, and any of these can interrupt treatment. Notably, patients less often named access as their own reason for missing doses than forgetfulness or the belief that medication was unnecessary. Patients may therefore attribute missed doses to personal behaviour even when structural conditions contribute, and relying only on patient-reported reasons may underestimate the role of the health system. Because pharmacy stock-outs, out-of-pocket prices and the place where medicines were purchased were not measured, these mechanisms should be regarded as explanations to be tested rather than established conclusions.

Higher household income was associated with better adherence, whereas self-reported financial constraints were not. A plausible explanation is that income reflects a broader capacity to absorb the indirect costs of care, such as transport, time away from work, co-payments and purchases from private pharmacies when public stock is unavailable, rather than only the ability to pay for a prescription. Even where health insurance covers most of the cost of medicines, these indirect costs can be considerable for households that depend on informal work, as many participants in this study did. Similar income-related barriers have been described in Kenya and Cameroon [6,8]. This suggests that financial protection for patients with hypertension may need to extend beyond the price of the drug itself.

Patients who had received hypertension education from health workers were more likely to adhere to treatment. Hypertension is often asymptomatic, and patients who do not understand that treatment must continue when they feel well may regard medication as unnecessary or stop it once symptoms resolve, reasons that were commonly given by participants in this study. Counselling during routine visits can correct such beliefs and explain the long-term consequences of uncontrolled blood pressure. Comparable links between patient knowledge and adherence have been reported in Northern Rwanda and Ethiopia [15,16], and patients' perception of hypertension was associated with adherence in western Iran [17]. Beliefs about treatment, including reliance on traditional medicine, have likewise been associated with poor adherence across twelve sub-Saharan African countries [18], underscoring the role of counselling in addressing such beliefs. However, education in this study was measured as self-reported exposure to counselling by health

staff, not as participation in a standardized programme or as a validated measure of health literacy. Formal schooling, which was not independently associated with adherence, cannot be taken as a proxy for health literacy. The content, frequency and quality of the counselling that patients received are therefore unknown and should be specified in future evaluations.

Patients who perceived their hypertension to be effectively managed were also more likely to adhere. Patients who see evidence that treatment is working, such as controlled readings at clinic visits or the absence of symptoms, may be more motivated to continue it. Conversely, doubts about the benefits of medication and about the diagnosis itself have been identified as barriers to adherence in South Africa [19]. Because adherence is itself an important determinant of blood pressure control [20], patients who adhere are more likely to observe the benefit of treatment. Because of the cross-sectional design, the direction of this relationship cannot be established: perceiving treatment as effective may encourage adherence, but patients who already take medication regularly are also more likely to achieve good control and therefore to perceive their condition as well managed. In either case, sharing blood pressure readings with patients at each visit and explaining what they mean may help sustain adherence.

Age, sex, formal education, duration of hypertension, comorbidity and distance to the facility were not independently associated with adherence. This differs from studies in Sudan and Serbia, in which demographic characteristics, the number of medicines and polypharmacy were linked to non-adherence [4,5]. In our sample, the predominance of older participants and the low level of formal schooling may have limited the variation needed to detect such differences, and the study may have been underpowered for some comparisons. In European and North American literature, multiple chronic conditions are often associated with poorer adherence because of higher pill burden [2]; in our setting, any such effect may have been offset by the more frequent clinical contact that patients with several conditions receive [21,22]. Taken together, these findings suggest that in this population adherence depends less on fixed patient characteristics than on modifiable factors, namely access to medicines, income-related barriers and patients' understanding of their treatment, all of which can be addressed by health services.

5. Limitations

This study has several limitations. First, the cross-sectional design precludes establishing temporal precedence or causality; observed associations between non-adherence and factors such as drug availability, hypertension education, and income are strictly observational correlations. Second, sampling active outpatients at a single tertiary hospital introduces selection bias. By excluding individuals who missed appointments, disengaged from care, or faced prohibitive financial or geographic barriers to tertiary care, the true prevalence of non-adherence in the region may be underestimated. Additionally, tertiary care cohorts often exhibit higher clinical complexity, which can uniquely influence medication-taking behavior. Third, evaluating adherence via self-report over 30-day and six-month recall periods introduces recall and social desirability biases, which

typically lead to overestimating actual compliance. Objective metrics such as longitudinal pharmacy refill records, electronic pill containers, or biochemical assays were not utilized. Fourth, residual confounding remains possible as important structural and individual variables were unmeasured, including formal health literacy, exact out-of-pocket medication costs, central pharmacy stock-out frequencies, caregiver support, and mental health status. Finally, external validity is circumscribed; data collection occurred exclusively within an internal medicine outpatient clinic at a single tertiary center in Southern Rwanda, limiting generalizability to primary health facilities, rural health posts, or community-based populations.

6. Recommendations

Based on the study findings, the University Teaching Hospital of Butare (CHUB) and relevant health authorities should prioritize targeted clinical and structural interventions focused directly on education exposure, perceived disease management, and medication accessibility: Strengthen Patient Education: Integrate structured hypertension education and adherence counseling into routine outpatient clinical care to improve patient disease awareness and treatment perception, emphasizing continuous therapy even when asymptomatic. Enhance Medication Access and Affordability: Improve the consistent availability and affordability of essential antihypertensive medicines by strengthening facility supply chains, stock monitoring, refill systems, and linkages to financial support mechanisms for lower-income patients.

7. Conclusion

Over half (52.5%) of hypertensive patients receiving care at the tertiary referral hospital were non-adherent to their prescribed pharmacological therapy. In multivariable analysis, reporting difficulty obtaining medication was independently associated with lower odds of adherence. Conversely, receiving formal hypertension education, perceiving hypertension as effectively managed, and having a higher income level were independently associated with higher odds of adherence. These findings highlight potential areas for targeted clinical and health system interventions. In clinical settings, incorporating standardized patient education during outpatient consultations may help improve disease awareness and self-management. Additionally, health policy initiatives focused on improving the availability and affordability of antihypertensive medications could address key access barriers and support improved adherence among patients in this setting.

8. Ethics Approval and Consent to Participate:

This study was reviewed and formally approved by the Institutional Review Board (Ethics Committee) of the University Teaching Hospital of Butare (Approval No: REC/CHUB/066/2025). Participants were informed about the purpose of the study, the procedures involved, potential risks and benefits, and their right to withdraw from the study at any time without any consequences. Free and informed written consent was explicitly obtained from all respondents before enrollment. All operations adhered completely to the ethical tenets of the Declaration of Helsinki.

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10. Authors' Contributions:

DN (Dorothée NIYONSABA) served as the principal investigator and designed the primary study protocol. DN and TN conducted field data collection, performed statistical processing and compiled the first draft of the manuscript. SH, TN, JNM, and TT reviewed the logistic regression configurations and critically updated the discussion text. TTN contributed to the methodology, data curation and revised Manuscript and JDT was contributed to data analysis and manuscript revision. All authors reviewed and authorized the final manuscript file.

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