IKR Publishers

IKR Journal of Clinical Medicine and Medical Research (IKRJCMMR)
Journal homepage: https://ikrpublishers.com/ikrjcmmr/
Volume-2, Issue-3 (May-June) 2026
OPEN ACCESS
ISSN: 3107-6521 (Online)

Polypharmacy and Drug–Drug Interactions in Hospitalized Hypertensive Patients in Mozambique: A Cross-Sectional Study

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DOI:*10.5281/zenodo.21384036*

ARTICLE INFO

Article history:
Received : 15-06-2026
Accepted : 23-06-2026
Available online : 15-07-2026

Citation: Mussa, M. M., Ribeiro, R. V., Daudo, H. A., Saavedra, P. A. E., & Ferrão, M. (2026). Polypharmacy and Drug–Drug Interactions in Hospitalized Hypertensive Patients in Mozambique: A Cross-Sectional Study. *IKR Journal of Clinical Medicine and Medical Research (IKRJCMMR), 2*(3), 8-17.

ABSTRACT **Original Research Article**

Introduction: Hypertension affects approximately 25.3% of Mozambican adults, representing a primary driver of cardiovascular morbidity. Despite its high prevalence, granular clinical data detailing the safety and complexity of inpatient pharmacotherapy in sub-Saharan acute care settings remain critically scarce.

Objective: To characterize the inpatient pharmacotherapeutic profile, quantify the prevalence and severity of potential drug–drug interactions (DDIs), and describe the distribution of drug-related problems (DRPs) among hypertensive patients admitted to a quaternary referral hospital in Mozambique.

Methods: An observational, cross-sectional, exploratory study was conducted in the Internal Medicine wards of Nampula Central Hospital (NCH) over a two-month period (December 2025–January 2026). Seventy-one patients hospitalized for 3 consecutive days were enrolled using convenience sampling. Clinical data were obtained via structured patient interviews and electronic/physical medical records. Potential DDIs were screened using the Medscape Drug Interaction Checker and stratified by clinical severity. Statistical analysis relied on non-parametric tests, with precision reported via 95% confidence intervals (CIs).

Results: The cohort was predominantly female (56.3%) and elderly (60–69 years: 25.4%). A heavy burden of cardiorenal multimorbidity was present, led by heart failure (36.6%) and chronic kidney disease (32.4%). Inpatient medication burden was severe: patients received a median of 7 drugs (IQR: 6–8.5; range: 3–12), with systemic hospital polypharmacy (5 drugs) reaching 91.5% (95% CI: 82.8–96.1). Concurrently, potential DDIs and overall DRPs were near-universal, affecting 84.5% (95% CI: 74.3–91.1) and 90.1% (95% CI: 81.0–95.1) of the cohort, respectively. Out of 245 potential DDIs identified, 64.1% were of major clinical severity, dominated by the furosemide–lisinopril pair (16.3%). Because DRPs affected nearly all participants, statistical determinants could not be contrastingly isolated. Nevertheless, inpatient protocols achieved a significant reduction in mean blood pressure (systolic: -38.9 mmHg; diastolic: -18.1 mmHg; both $p < 0.001$), establishing a 59.2% control rate (<140/90 mmHg) at interview.

Conclusion: Although acute inpatient management successfully controls peripheral blood pressure, these complex cardiorenal patients carry an extreme medication burden characterized by near-universal DRPs and high-severity potential DDIs. These findings underscore that in-hospital hypertension care in resource-limited wards is fundamentally a medication safety challenge, reinforcing the urgent need to integrate clinical pharmacists into multidisciplinary ward teams to conduct systematic, proactive pharmacological surveillance.

Keywords: Hypertension, Pharmacotherapy, Polypharmacy, Drug–Drug Interactions, Drug-Related Problems.

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Introduction

Arterial hypertension (HTN) is a chronic condition characterized by a persistent elevation of systolic blood pressure (SBP) to ≥140 mmHg and/or diastolic blood pressure (DBP) to ≥ 90 mmHg [1]. Recognized as the leading modifiable risk factor for cardiovascular diseases (CVDs), HTN constitutes an apex threat to global longevity [2].

Current epidemiological data estimate that 1.28 billion adults are affected worldwide, contributing to approximately 10 million deaths annually and accounting for 218 million disability-adjusted life years (DALYs) [3]. While high-income regions show stabilized prevalence rates, low- and middle-income countries (LMICs) face an escalating epidemiological shift, currently bearing nearly 70% of the global burden [4].

The clinical severity of HTN is magnified by its prolonged asymptomatic course, which delays timely diagnosis and triggers structural target-organ damage, driving the development of myocardial infarction, stroke, heart failure, and chronic kidney disease [5].

Within the African continent, the epidemiological impact is disproportionately severe, affecting an estimated 30.8% of the adult population [6], with sub-Saharan Africa (SSA) presenting regional prevalence rates as high as 48% among women and 34% among men [7]. Mozambique mirrors this critical public health scenario. Data from the National Survey on the Prevalence and Risk Factors for Chronic Diseases (*Inquérito Nacional de Prevalência e Fatores de Risco para Doenças Crónicas* - InCRÓNICA 2024) indicated a baseline prevalence of 25.3% among individuals aged 18 to 69 years [8]. When incorporating patients under active antihypertensive therapy, this rate shifts to 31.6%, implying that approximately one in every three adults in the country is hypertensive [8]. This scenario is profoundly compounded by a high clustering of metabolic and behavioral risk factors, including physical inactivity (56.5%), obesity (14.1%), and excessive dietary sodium intake (21.2%) [8].

Optimizing pharmacotherapeutic management is foundational to mitigating cardiovascular morbidity and mortality; however, clinical outcomes are frequently jeopardized by the structural complexity of these patients [9]. Hypertension rarely occurs in isolation; it is heavily anchored in multimorbidity, requiring complex therapeutic regimens to manage coexisting conditions such as diabetes mellitus, chronic kidney disease, and dyslipidemia [9].

This therapeutic accumulation often results in polypharmacy, commonly defined as the concurrent daily use of five or more medications [10]. In vulnerable populations, polypharmacy operates as an independent driver of negative clinical outcomes, significantly escalating the incidence of severe drug–drug interactions (DDIs) and cumulative adverse drug reactions (ADRs), which undermine treatment adherence and predispose patients to iatrogenic events such as acute kidney injury and falls [10].

Despite the therapeutic risk associated with high medication burdens, substantial knowledge gaps persist regarding the safety profiles of hospitalized hypertensive patients in sub-Saharan Africa. Most available African evidence is derived from cross-sectional, community-based surveys, which lack the granular clinical data required to evaluate prescribing patterns, inpatient safety, and the true prevalence of Drug-Related Problems (DRPs) in acute care [10, 11]. Furthermore, systemic barriers within the Mozambican National Health Service, such as stock-outs of essential drugs and critical shortages of basic diagnostic equipment, including shared ward sphygmomanometers, hinder continuous hemodynamic monitoring and precise dose titration [11]. Consequently, generating localized, hospital-centered evidence is an urgent step toward designing safer protocols and clinical decision-support systems.

Evaluating the quality of inpatient pharmacotherapy is vital to intercept potentially harmful drug combinations and mitigate the cumulative risks of polypharmacy. Identifying the explicit clinical and therapeutic determinants associated with DRPs is essential to optimize cardiovascular outcomes, guarantee patient safety, and establish structured clinical pharmacy interventions. Strengthening fragile healthcare delivery systems depends on transitioning from fragmented prescribing habits to integrated, multidisciplinary strategies that prioritize pharmacological surveillance and strict cardiorenal management [9].

To address these gaps, the primary objective of this study was to evaluate the inpatient pharmacotherapeutic profile, quantify the prevalence and severity of potential drug–drug interactions, and identify the determinants of drug-related problems among hypertensive patients admitted to the Internal Medicine wards of the Nampula Central Hospital, Mozambique [1].

Methods

Study Setting and Design

An observational, quantitative, cross-sectional and field-based exploratory study was conducted in the Internal Medicine I and II wards of Nampula Central Hospital, Mozambique. NCH is the main quaternary-level referral facility in northern Mozambique, with a 564-bed capacity. Data were collected within the hospital over an approximately two-month period, from December 2025 to January 2026.

Sampling and Eligibility

A non-probabilistic convenience sampling method was used, chosen because of high patient turnover and frequent clinical instability in acute-care wards. As an exploratory study, no a priori sample-size calculation was performed. Eligible patients had a confirmed diagnosis of arterial hypertension, were aged ≥18 years and had an active hospitalization of at least three consecutive days; all provided written informed consent. Patients admitted for reasons entirely unrelated to hypertension, those enrolled in concurrent experimental protocols, and those with severe cognitive or communicative impairment precluding an interview without a legal representative were excluded.

Data Collection

Data were collected from medical records, active prescription sheets and structured bedside interviews with the patients. Blood pressure (BP) was recorded at admission (from the clinical records) and at the study interview.

Operational Definitions: DRPs and DDIs

A drug-related problem (DRP) was defined as the presence of at least one of six problems identified from each patient's records and active prescriptions: therapeutic duplication; a potential drug-drug interaction; a need for renal or hepatic dose adjustment; a drug without a clear indication; an ineffective drug; or an unnecessary drug. A potential DDI is therefore one constituent category of the DRP, not a separate outcome: the patient-level DDI variable indicates whether a patient had at least one such interaction, whereas the 245 interaction pairs (identified with Medscape and stratified by severity) describe this category in pharmacological detail. DDIs were thus a subset of DRPs and were not double-counted.

Screening of Drug-Drug Interactions

Potential DDIs within the active inpatient prescriptions were identified with the Medscape Drug Interaction Checker and stratified by severity as contraindicated/serious, major, moderate or minor.

Data Processing and Statistical Analysis

Data were analyzed in Python (v3.13). As an exploratory study without a power calculation, the analyses were hypothesis-generating, and the precision of each estimate is reported as a 95% CI (Wilson intervals for proportions) rather than as confirmatory. Categorical variables are summarized as counts and percentages, and continuous variables as mean ± standard deviation (SD) and median (interquartile range, IQR). The number of medications per patient was taken directly from the documented active prescription list. Normality was assessed with the Kolmogorov-Smirnov test; because most variables were non-normal, non-parametric methods were used throughout.

The primary outcome was the presence of any DRP. Because a DRP was present in almost all patients (only 7 of 71 were DRP-negative), the cohort offered too little contrast to identify determinants of DRPs; a determinant analysis was therefore not undertaken and the problem burden is reported descriptively. As a pre-specified secondary analysis, admission versus interview BP was compared with the Wilcoxon signed-rank test (two-tailed, $\alpha = 0.05$).

Ethical Considerations

The study protocol was approved by the Institutional Bioethics Committee for Health of Lúrio University (Comité Institucional de Bioética para Saúde da Universidade Lúrio, CIBSUL), Mozambique (approval reference no. 110/Out/CIBSUL/25, dated 30 October 2025), with institutional authorization from the Faculty of Health Sciences of Lúrio University and the Scientific Commission of Nampula Central Hospital. All participants provided written informed consent, and the principles of the Declaration of Helsinki (2013 revision) for research involving human participants were observed.

Results

Socio-Demographic Profile and Lifestyle Factors

The study cohort (n = 71) was predominantly female (56.3%; n = 40) and elderly, with the 60–69-year age group being the most frequent (25.4%; n = 18), followed by those aged 50–59 years (22.5%; n = 16). Regarding formal education, the sample was polarized: 25.4% (n = 18$) of the individuals had no formal schooling, while 22.5% (n = 16) had completed secondary education.

In tandem with these demographic characteristics, cardiovascular risk behaviors were remarkably pervasive among the monitored patients. Notably, nearly three-quarters of the participants (71.8%; n = 51) exhibited a deeply sedentary lifestyle characterized by severe physical inactivity, whereas regular physical activity was documented in only 23.9% (n = 17) of the cohort (Table 1).

Table 1. Socio-demographic, clinical and pharmacotherapeutic profile of the cohort (n = 71).

Domain	Characteristic	n	%	95% CI
Sex	Female	40	56.3	44.8-67.3
	Male	31	43.7	32.7-55.2
Age (years)	18-29	9	12.7	6.8-22.4
	30-39	11	15.5	8.9-25.7
	40-49	11	15.5	8.9-25.7
	50-59	16	22.5	14.4-33.5
	60-69	18	25.4	16.7-36.6
	≥70	6	8.5	3.9-17.2
Education	No schooling	18	25.4	16.7-36.6
	Secondary complete	16	22.5	14.4-33.5
Lifestyle	Physical inactivity	51	71.8	60.5-81.0
Blood pressure	Controlled (<140/90) at interview	42	59.2	47.5-69.8
Medication	Polypharmacy (≥5 drugs)	65	91.5	82.8-96.1
Outcomes	Any potential DDI	60	84.5	74.3-91.1
	Any DRP	64	90.1	81.0-95.1

Cardiorenal Multimorbidity and Clinical Complexity

Beyond the immediate challenge of acute blood pressure management, the baseline clinical landscape was heavily defined by a troubling clustering of metabolic syndromes and target-organ damage. Chronic non-communicable comorbidities were highly prevalent, led by concurrent heart failure in over a third of the hospitalized individuals (36.6%; n = 26), which was closely trailed by a substantial burden of chronic kidney disease (32.4%; n = 23).

This heavy, overlapping multi-disease profile underscores that the typical hypertensive inpatient in this acute care setting is structurally complex. Navigating synchronous cardiovascular and renal impairments creates an intricate clinical synergy that considerably narrows the safety margins of their prescribed inpatient pharmacotherapy (Figure 1).

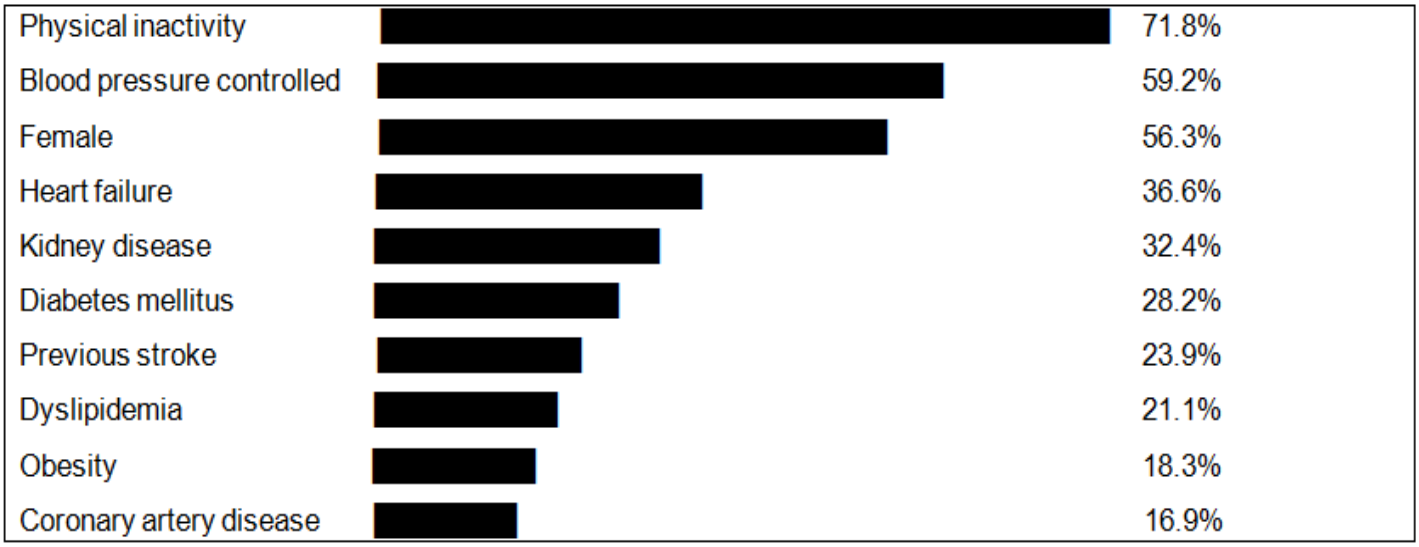

Figure 1. Clinical profile of hospitalized hypertensive patients

Prescribing Patterns and Hospital Polypharmacy

The inpatient therapeutic landscape was prominently dominated by cardiovascular and supportive medications, revealing a highly concentrated prescribing pattern. Angiotensin-converting enzyme inhibitors and diuretic regimens constituted the cornerstones of therapy, led by lisinopril, furosemide, and hydrochlorothiazide. Concurrently, agents such as ranitidine, spironolactone, ceftriaxone, and amlodipine were frequently introduced into the acute care management plans (Figure 2).

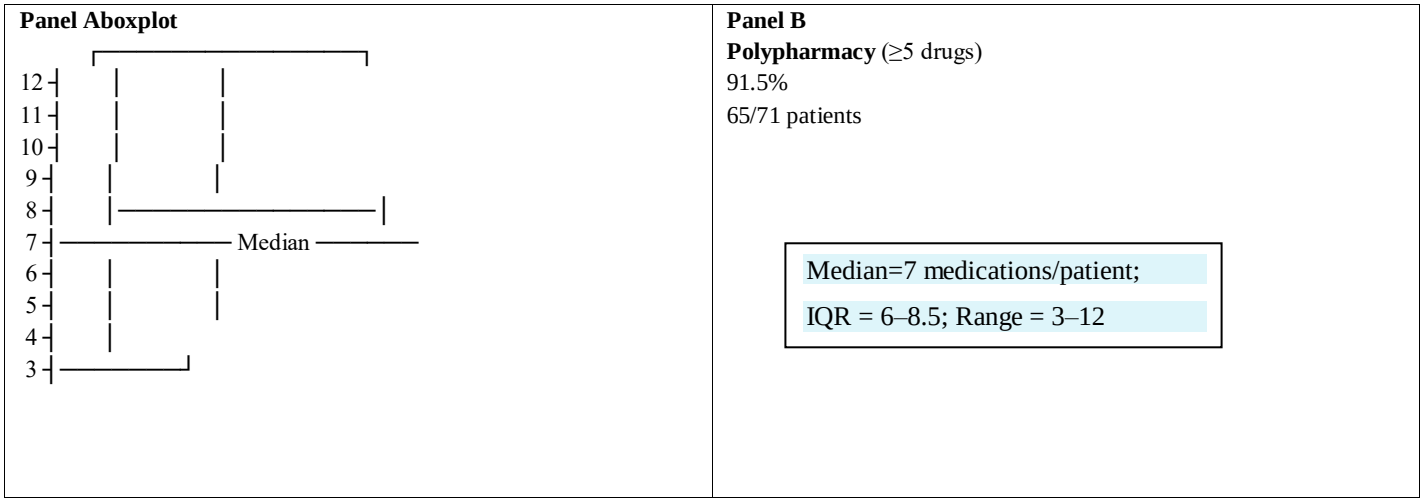

Figure 2. Medication burden among hospitalized hypertensive patients (n = 71).

When evaluating the overall pharmaceutical density, the active clinical regimens demonstrated a well-distributed medication volume across the cohort. While most of the hospitalized individuals were successfully stabilized with more streamlined pharmacological regimens containing fewer than five concurrent drugs, nearly a quarter of the patients required intensive multitherapy. This subset of the population faced a heightened therapeutic burden, navigating complex regimens that spanned up to ten active medications simultaneously, which highlights the critical need for vigilant, individualized pharmacotherapeutic monitoring during acute hospitalizations.

Lisinopril was the most frequently prescribed drug, followed by the loop and thiazide diuretics furosemide and hydrochlorothiazide, spironolactone, ranitidine, amlodipine and ceftriaxone (Figure 3). Counting all active inpatient prescriptions, patients received a median of 7 medications each (IQR 6-8.5; mean 7.2 ± 2.2; range 3-12) (Figure 2). Polypharmacy (≥5 concurrent medications) was present in 91.5% of patients (65/71; 95% CI 82.8-96.1), indicating an extreme therapeutic burden in this acute-care cohort.

Potential Drug-Drug Interactions and Drug-Related Problems

Across the reviewed prescriptions, 245 potential DDIs were identified. By severity, 64.1% (n = 157) were major, 19.6% (n = 48) moderate, 10.6% (n = 26) minor and 5.7% (n = 14) of contraindicated/serious risk (Figure 4). The most frequent interacting pairs were furosemide-lisinopril (40 of 245; 16.3%), ceftriaxone-furosemide (22; 9.0%), lisinopril-spironolactone (17; 6.9%) and hydrochlorothiazide-lisinopril (12; 4.9%) (Figure 3).

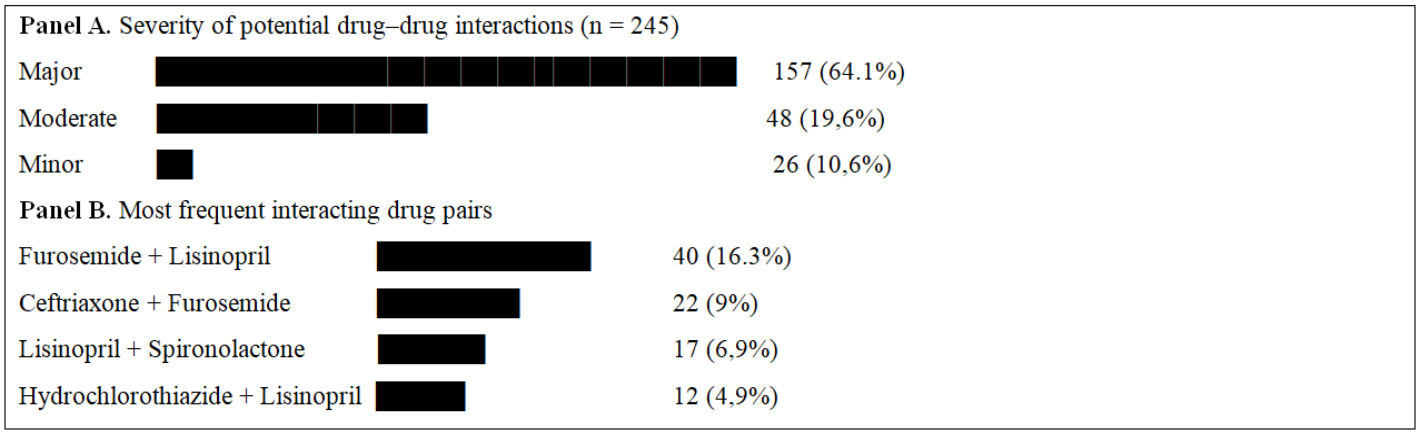

Figure 3. Profile of potential drug–drug interactions among hospitalized hypertensive patients (n = 71).

Overall Burden and Categories of Drug-Related Problems (DRPs)

The evaluation of clinical pharmacy indicators revealed a critical, near-universal vulnerability to medication safety risks across the acute care cohort. Nine out of ten hospitalized hypertensive individuals presented with at least one drug-related problem (DRP), driven predominantly by a pervasive overlap of potential drug-drug interactions (DDIs). Every patient identified with an interacting medication pair fell within the broader DRP spectrum, confirming that potential DDIs represent the primary, foundational component of the overall therapeutic risk in this setting (Figure 4).

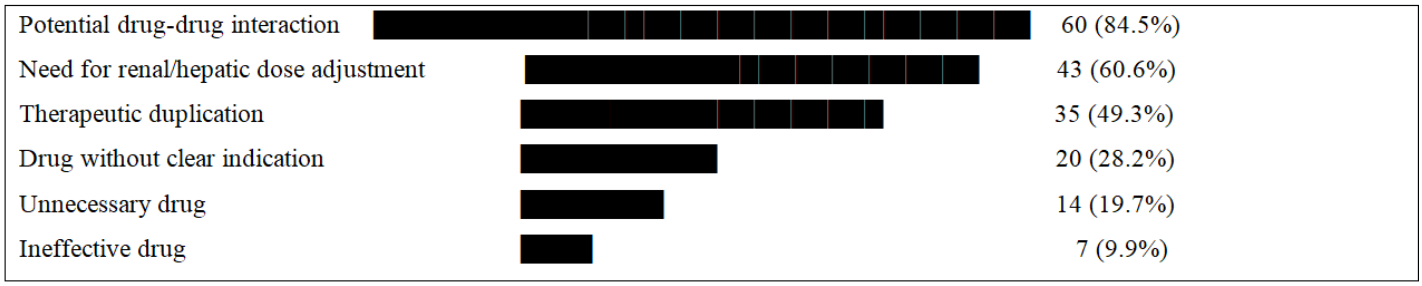

Figure 4. Prevalence of drug-related problem categories among hospitalized hypertensive patients (n = 71).

When dissecting the specific typologies of these clinical safety liabilities, the hierarchy of problems highlights a profound need for active pharmacotherapeutic surveillance. Beyond the dominance of potential DDIs, a substantial majority of the patients required immediate renal or hepatic dosage adjustments, and nearly half of the cohort was exposed to therapeutic duplications. Less frequent but clinically significant issues also emerged, including medications lacking a clear medical indication, unnecessary drugs, and therapeutic choices deemed ineffective for the active clinical scenario. Because this overwhelming problem burden left only seven individuals completely free of DRPs, the sample lacked the epidemiological contrast required to statistically isolate independent predictors or clinical determinants; the data therefore robustly establish the extreme magnitude of this system-level challenge through a descriptive lens.

Hemodynamic Evolution and In-Hospital Clinical Outcomes

The evaluation of in-hospital longitudinal parameters demonstrated a highly significant, positive response to acute therapeutic interventions. Patients entered the medical wards with severely elevated blood pressure profiles, which underwent a substantial, statistically robust decline by the time of the follow-up assessment. This marked reduction was consistently observed across both systolic and diastolic parameters, indicating efficient short-term stabilization of acute hypertensive states within the clinical setting (Table 2 and Table 3).

Table 2. In-hospital blood-pressure change from admission to interview

Parameter	n	Admission (mean)	Interview (mean)	Mean change	p
Systolic BP (mmHg)	71	171.7	132.8	−38.9	<0.001
Diastolic BP (mmHg)	69	103.4	85.3	−18.1	<0.001

(Wilcoxon signed-rank test).

The paired diastolic analysis is restricted to the 69 patients with both admission and interview readings (interview mean 85.3 mmHg); the Table 1 descriptive diastolic-interview mean (85.0 mmHg) is over all 71 patients. Systolic readings were complete for all 71.

Table 3. Hemodynamic parameters and medication profile of hospitalized hypertensive patients.

Variable	n	Mean ± SD	Median (IQR)
*SBP at admission (mmHg)	71	171.7 ± 24.4	169 (152.5-186.5)
**DBP at admission (mmHg)	69	103.4 ± 21.7	101 (90-111)
SBP at interview (mmHg)	71	132.8 ± 19.9	130 (121.5-145)
DBP at interview (mmHg)	71	85.0 ± 15.0	83 (78-92.5)
Heart rate (bpm)	70	90.7 ± 17.3	88.5 (79-99)
Number of medications/patient	71	**7.2 ± 2.2**	**7 (6-8.5); range 3-12**

*Systolic blood pressure (SBP); **Diastolic blood pressure (DBP)

Concurrently, the cohort maintained a relatively elevated average heart rate, suggesting sustained autonomic or compensatory activity during their recovery phase. Overall, while individual trajectories varied, the collective therapeutic response reflects an effective downward trend in hemodynamic strain from clinical admission to bed-side interview, establishing successful acute blood pressure reduction as a key feature of the inpatient stay (Figure 5).

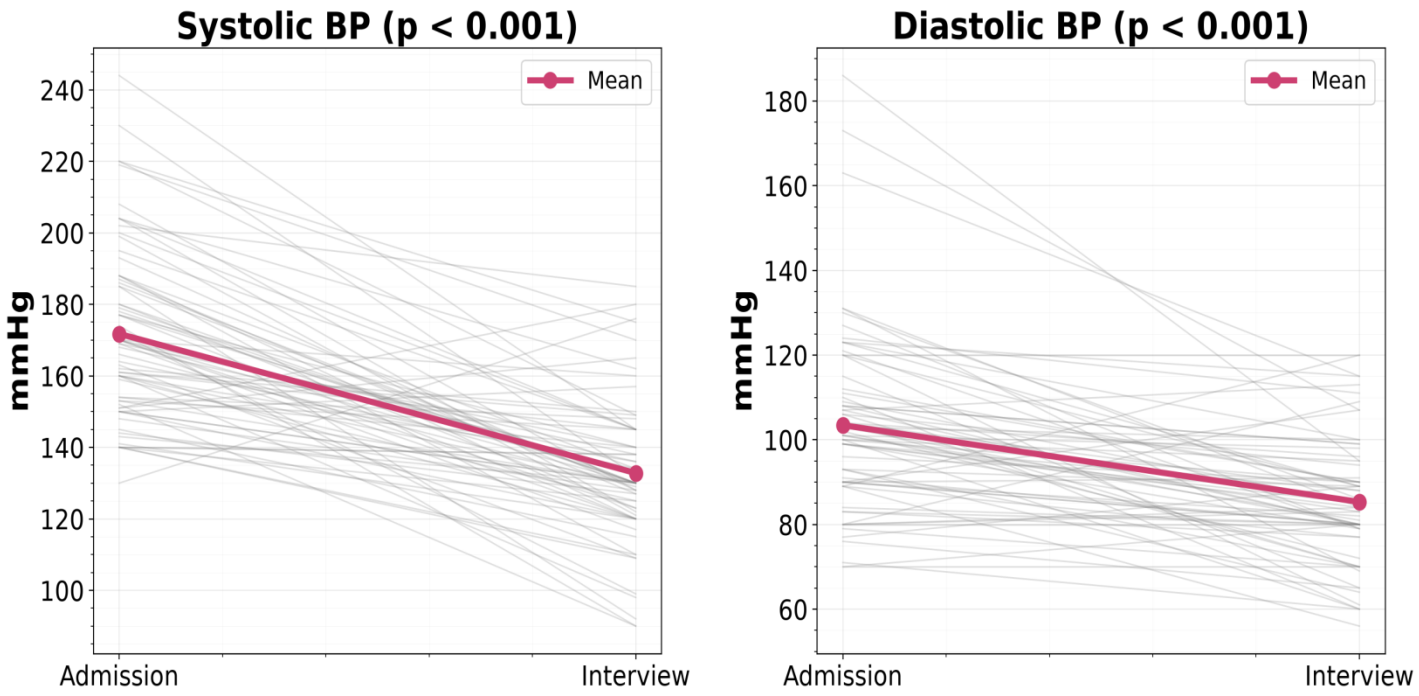

Figure 5. In-hospital blood-pressure reduction from admission to interview (Wilcoxon signed-rank; both $p < 0.001$). Grey lines: individual patients; coloured line: mean.

In summary, the clinical journey of hospitalized hypertensive patients in this acute care setting is characterized by a striking paradox. While in-hospital therapeutic management successfully achieves a statistically significant, acute reduction in both systolic and diastolic blood pressure, this positive hemodynamic surrogate outcome masks an underlying system-level vulnerability. The combination of severe cardiorenal multimorbidity and an extreme medication burden drives a near-universal prevalence of complex drug-related problems and high-severity potential drug-drug interactions. Consequently, these findings robustly demonstrate that achieving peripheral blood pressure stabilization represents only a fraction of the clinical challenge; the true priority for enhancing patient safety in resource-limited wards lies in mitigating the pervasive and unmonitored pharmacotherapeutic risks that threaten these structurally complex individuals throughout their hospital stay.

Discussion

Clinical-Demographic Profile and Cardiorenal Multimorbidity Burden

The blood pressure control rate of 59.1% (<140/90 mmHg) documented at the Hospital Central de Nampula is markedly higher than control thresholds traditionally reported across low- and middle-income countries (LMICs), where clinical success rates frequently remain well below 50% [13]. This finding indicates that acute, inpatient antihypertensive protocols were acutely effective for a significant portion of the cohort, despite the extensive baseline clinical complexity of the population [1]. However, in the context of advanced cardiovascular care, achieving conventional surrogate blood pressure targets does not automatically translate into optimal cardiorenal protection [14]. Given the high baseline prevalence of advanced target-organ damage in this sample, therapeutic targets should be aggressively individualized to mitigate residual neurohormonal and structural cardiovascular risks [14].

The high prevalence of heart failure (36.6%) and chronic kidney disease (32.4%) observed in this study directly confirms the tight pathophysiological axes linking uncontrolled hypertension to severe target-organ destruction [1]. This clinical frailty is further aggravated by a complex web of multimorbidity, including Type 2 diabetes mellitus (16.9%), stroke (21.1%), anemia (12.7%), pulmonary tuberculosis (12.7%), and HIV/AIDS (11.3%) [1]. This heterogeneous phenotypic distribution is highly consistent with contemporary sub-Saharan African epidemiological data, where the rapid emergence of non-communicable diseases (NCDs) intersects with an ongoing, heavy historical burden of endemic infectious diseases in acute care wards [15, 16]. This syndemic framework drastically escalates competitive metabolic demands, complicates therapeutic protocols, and fundamentally undermines basic medication safety margins [15].

Furthermore, the significant association identified between non-pharmacological risk variables, specifically the high dietary intake of salt ($p = 0.0353$), oils ($p = 0.0176$), and sugar-sweetened beverages ($p = 0.0028$) and the development of Drug-Related Problems (DRPs) underscores that lifestyle

determinants deeply influence inpatient clinical outcomes [1, 23]. Compounded by high rates of physical inactivity (71.8%) and limited formal education (25.4%), these parameters reflect substantial structural barriers to long-term post-discharge adherence, continuous home blood pressure tracking, and effective secondary cardiovascular prevention [1, 23].

Prescribing Patterns and Hospital Polypharmacy Prevalence

The clear predominance of lisinopril (n = 61), furosemide (n = 45), hydrochlorothiazide (n = 33), and spironolactone (n = 30) within the analyzed prescriptions directly reflects a clinical attempt to manage the high volume of heart failure and renal impairment characterizing this cohort [1]. While these therapeutic choices are fundamentally aligned with international guideline-directed medical therapies (GDMT), their concurrent administration inevitably shifts the patient profile into a state of severe pharmacotherapeutic complexity [10].

Although systemic hospital polypharmacy (≥ 5 medications) was quantified in 22.5% of the overall sample, the maximum range of up to 10 concurrent active medications per patient exposes an extreme therapeutic burden for these individuals [1]. This high drug accumulation serves as an independent, statistically validated vector for iatrogenic complications, a vulnerability strongly corroborated by our inferential data showing that polypharmacy was significantly associated with the definitive manifestation of DRPs ($p = 0.0411$) [1, 17, 18]. Managing multi-drug cardiorenal regimens within resource-constrained clinical settings requires an immediate transition from fragmented, reactive prescribing to structured, proactive therapeutic reconciliation protocols [17].

Safety Profile: Severity of Drug–Drug Interactions and Clinical Outcomes

The screening of inpatient prescriptions exposed a severe safety liability, uncovering a total of 245 potential drug–drug interactions (DDIs), with a critical 64.1% classified as major clinical severity and 5.7% classified as immediate severe risks [1]. In a highly vulnerable cohort, these automated electronic flags represent profound real-world physiological risks that demand strict, mechanisms-based pharmacological analysis [12].

The most frequent interacting drug pair identified was furosemide combined with lisinopril, occurring in 16.3% of the studied sample [1]. From a clinical pharmacy perspective, the co-administration of an angiotensin-converting enzyme (ACE) inhibitor and a loop diuretic requires strict hemodynamic monitoring [1, 19]. Loop diuretics induce potent intravascular volume depletion and activate the renin-angiotensin-aldosterone system (RAAS), making the patient's systemic vascular resistance highly dependent on angiotensin II. Concurrently introducing lisinopril abruptly blunts this compensatory neurohormonal mechanism, which can precipitate severe orthostatic hypotension, profound systemic hypoperfusion, and acute pre-renal kidney injury (AKI) [19]. This risk is highly critical given that nearly one-third of this specific population (32.4%) already presents with pre-existing kidney disease, leaving them with severely compromised functional renal reserves [1].

Equally concerning is the major interaction identified between lisinopril and spironolactone (6.9% of the sample) [1]. While this combination is a cornerstone of neurohormonal blockade in heart failure with reduced ejection fraction (HFrEF) to prevent myocardial remodeling, its safety profile is highly dependent on underlying renal filtration capacity [21]. Both agents act synergistically to decrease aldosterone activity, directly impairing potassium excretion at the level of the distal convoluted tubule and collecting duct [21]. In the presence of the high baseline prevalence of chronic kidney disease (32.4%) and Type 2 diabetes mellitus (16.9%) documented in this cohort, this combination exponentially increases the hazard of severe, life-threatening hyperkalemia [1]. Without routine, daily laboratory access to track serum electrolytes, silent potassium elevations can rapidly progress to malignant ventricular arrhythmias, advanced electromechanical dissociation, and sudden cardiac arrest [21].

Additionally, the frequent prescription of ceftriaxone concurrently with furosemide (9.0%) represents a significant hospital-acquired risk factor [1]. In critically ill patients exposed to multi-drug therapies, loop diuretics can exacerbate cephalosporin-induced nephrotoxicity through transient states of localized renal hypoperfusion and concentrated tubular cellular exposure, requiring close monitoring of output metrics [20].

In this context, the strong and significant negative correlation observed between the total number of prescribed medications and serum creatinine levels ($r_s = -0.7035$, $p = 0.0034$) represents a major clinical paradox that diverges from established literature, where polypharmacy typically correlates with worsened renal parameters [1, 22]. This atypical statistical signal must be interpreted with extreme caution [1]. It is highly likely that this correlation does not reflect a biological protective mechanism, but rather a profound missing-data bias and survival selection bias within the hospital [1]. Due to the severe infrastructural stock-outs and resource limitations cited at Nampula Central Hospital, serum creatinine assessments were not performed uniformly for all patients, restricting the statistical model to a small, non-random subpopulation of highly unstable or younger individuals, which artificially skewed the correlation [11, 22].

Ultimately, while acute inpatient management succeeded in decreasing peripheral blood pressure levels from baseline admission peaks, the heavy accumulation of major drug–drug interactions, cardiorenal comorbidities, and polypharmacy proves that these patients remain highly vulnerable to severe iatrogenic injury [1]. Mitigating these hidden risks requires

the urgent integration of clinical pharmacists into the multidisciplinary ward teams to implement systematic medication reviews, manage alert fatigue, perform active pharmacovigilance, and optimize drug safety in resource-limited sub-Saharan hospital settings [22].

Study Limitations: This study presents several limitations that must be considered when interpreting the results. First, the cross-sectional design precludes the establishment of causal relationships between polypharmacy and the occurrence of drug-related problems. Second, the small sample size (n = 71) obtained through convenience sampling at a single healthcare center limits the generalizability of the findings to the broader Mozambican population. Additionally, the unavailability of complete laboratory data (such as serum creatinine and potassium levels for the entire sample) restricted the evaluation of the actual clinical impact of the drug-drug interactions identified by automated tools. Finally, the reliance on a single database (*Medscape*) for interaction screening may have overestimated or underestimated risks compared to other clinical decision support platforms.

Conclusion

The present study characterized the inpatient pharmacotherapeutic profile of hypertensive patients at Nampula Central Hospital, revealing a complex and high-risk clinical scenario. Although the immediate blood pressure control rate was favorable, true therapeutic success in this population extends far beyond acute hemodynamic stabilization. The critical burden of cardiorrenal multimorbidity, driven primarily by the clustering of heart failure and chronic kidney disease, intersecting with endemic infectious conditions, significantly escalates the clinical vulnerability of these individuals.

The high prevalence of potential drug–drug interactions, with an overwhelming majority classified as being of major clinical severity, combined with the statistically validated association between hospital polypharmacy and the manifestation of drug-related problems, underscores a critical institutional safety liability. These findings demonstrate that managing inpatient hypertension in this resource-limited setting requires a profound paradigm shift, transitioning from a fragmented, symptom-focused prescribing model to an integrated, multidisciplinary framework. Implementing systematic pharmaceutical screening protocols and embedding clinical pharmacists into internal medicine wards stand out as vital strategies to optimize multi-drug regimens, execute timely dose titrations, and intercept high-risk drug combinations, ultimately guaranteeing clinical safety and effectiveness for highly vulnerable inpatients.

Declaration of Interest

The authors declare no conflicts of interest related to this article.

Funding

This study received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Author Contributions

Márcia Mariano Mussa: Conceptualization, Funding acquisition, Investigation, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review and editing.

Hamza Age Daudo: Data curation, Formal analysis, Methodology, Resources.

Ribeiro Vasco Ribeiro: Investigation, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review and editing.

Pamela Alejandra E. Saavedra: Writing – review and editing.

Melanie Ferrão: Conceptualization, Investigation, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review and editing.

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