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Research

Evaluation of Clinical Pharmacy Services on Antihypertensive Drug Prescribing Patterns and Compelling Indications in a Teaching Hospital

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Abstract

Hypertension is a prevalent cardiovascular disorder and a significant risk factor for various life-threatening conditions, including congestive heart failure, ischemic heart disease, chronic kidney disease, and stroke. The present study was undertaken to assess the impact of clinical pharmacy interventions on prescribing patterns of antihypertensive medications and their compelling indications in a tertiary care teaching hospital.

This prospective observational study involved the review and analysis of inpatient records of individuals diagnosed with hypertension. Patient demographic characteristics, such as age and sex, were systematically documented. Among the 450 hypertensive patients included in the study, a total of 387 potential drug–drug interactions were identified.

The findings underscore the critical role of clinical pharmacy services in optimizing antihypertensive drug therapy. Additionally, the results highlight the necessity of improving patient education related to medication adherence and lifestyle modifications to enhance blood pressure control in hospital-based care settings.

Keywords: Clinical pharmacy, Prescription pattern, Antihypertensive drugs, Tertiary care teaching hospital

INTRODUCTION

Hypertension is defined as a persistent elevation of arterial blood pressure that adversely affects adequate tissue and organ perfusion. Clinically, it is diagnosed when systolic blood pressure is ≥140 mmHg and/or diastolic blood pressure is ≥90 mmHg. Hypertension is among the most common cardiovascular disorders and represents a significant risk factor for severe complications such as congestive heart failure, ischemic heart disease, chronic kidney disease, and stroke [1].

The primary objective of the present study is to evaluate the prescribing patterns of antihypertensive medications in a tertiary care hospital.

The specific objectives of the study are as follows:

1. To assess the rational use of antihypertensive drugs among patients diagnosed with hypertension.
2. To implement and evaluate clinical pharmacy interventions, including the identification and

management of drug–drug interactions, adverse drug reactions, and medication errors.
3. To conduct medication history interviews and provide patient counseling to improve therapeutic outcomes.
4. To evaluate the effectiveness of commonly prescribed antihypertensive agents.
5. To compare the therapeutic efficacy of monotherapy versus combination therapy regimens.

MATERIAL AND METHODOLOGY

Study Site

The present study was conducted in the Department of General Medicine at a tertiary care hospital.

Study Design

This was a prospective observational study.

Study Period

The study was carried out over a period of two years, from June 2023 to April 2025.

Study Criteria

Inclusion Criteria

1. Inpatients of either gender aged ≥ 18 years who were diagnosed with primary or secondary hypertension.
2. Patients who were receiving antihypertensive medications.

Exclusion Criteria

1. Patients attending the outpatient department (OPD).
2. Pregnant women.
3. Children below 18 years of age.

Source of Data

Data for this study were obtained through:

1. Direct patient interviews (for demographic details, past medical and medication history).
2. Review of patient case notes, treatment charts, laboratory reports, and discharge summaries.

Study Method

This prospective, longitudinal study was conducted to assess the prescribing patterns of antihypertensive drugs among inpatients diagnosed with hypertension in the general medicine department.

1. Data were collected by reviewing and recording patient case sheets.
2. Signs and symptoms (both common and uncommon) observed in patients were documented.
3. Past medical and family history, as well as social habits (such as smoking and alcohol consumption), were noted in a patient profile form.
4. Therapeutic data including drug name, dose, frequency, and duration of therapy were collected from patient treatment charts.
5. Drug–drug interactions were assessed using the Micromedex 2.0 database and recorded in a drug interaction form.
6. Any clinical interventions made during the study were documented using intervention reporting forms.
7. Follow-up was carried out for all patients until hospital discharge.

The collected data were analyzed as per the JNC 7 and IGH-II guidelines. Inpatient data were entered, stored, and managed in Microsoft Office Access for retrieval and analysis.

Statistical Analysis

Data analysis was performed using GraphPad Prism Version 5.

1. Continuous data were expressed as mean ± SEM (Standard Error of Mean).
2. Categorical data were presented as percentages.
3. Unpaired Student's t-test was used to compare differences between means of two groups.
4. A p-value < 0.05 was considered statistically significant.

RESULTS

Age and Gender Distribution of Hypertensive Patients

A total of 450 hypertensive inpatients were included in the study. Of these, 265 (58.88%) were male and 185 (41.11%) were female.

The majority of patients belonged to the ≥70 years age group (123, 27.33%), followed by:

1. 60–69 years: 119 (26.44%)
2. 50–59 years: 102 (22.66%)
3. 40–49 years: 80 (17.77%)

4. 30–39 years: 24 (5.33%)
5. 20–29 years: 2 (0.44%)

(Figures 1 & 2 illustrate the age and gender distribution.)

Co-morbidities in Hypertensive Patients

Among the study population, the distribution of co-morbidities was as follows:

1. One co-morbidity: 213 patients (53.77%)
2. Two co-morbidities: 155 patients (34.44%)
3. Three co-morbidities: 60 patients (13.33%)
4. More than four co-morbidities: 29 patients (6.44%)
5.
6. Mortality: 3 patients (0.66%)

The average number of co-morbidities per patient was also calculated (Fig. 3).

Classes of Antihypertensive Drugs Prescribed

Eight different classes of antihypertensive drugs were prescribed:

Drug Class	Number of Prescriptions	Percentage
Diuretics	187	29.21%
β-blockers	129	20.15%
Calcium channel blockers (CCBs)	128	20.00%
Angiotensin receptor blockers (ARBs)	97	15.15%
ACE inhibitors	67	10.46%
α-blockers	12	1.87%
Centrally acting drugs	13	2.88%
α+β blockers	10	1.56%

(Fig. 4)

Pattern of Antihypertensive Drug Regimens

Among 450 patients, the distribution of drug regimens was:

1. Monotherapy: 193 patients (42.88%)
2. Two-drug combination: 173 patients (38.44%)
3. Three-drug combination: 68 patients (15.11%)
4. Four or more drugs: 16 patients (3.55%)

Monotherapy: The most commonly prescribed drugs were:

1. Amlodipine: 80 (17.77%)
2. Furosemide: 47 (10.44%)
3. Ramipril: 12 (2.66%)
4. Metoprolol: 10 (2.22%)
5. Nebivolol: 7 (1.55%)
6. Telmisartan, Propranolol, Atenolol: 5 each (1.11%)
7. Hydrochlorothiazide: 4 (0.88%)
8. Olmesartan, Enalapril: 2 each (0.44%)
9. Clinidipine, Carvedilol: 1 each (0.22%)

(Fig. 6)

Two-drug combinations: Most frequent combinations were:

1. Amlodipine + Atenolol: 65 (14.44%)
2. Amlodipine + Hydrochlorothiazide: 40 (8.88%)
3. Torsemide + Spironolactone: 10 (2.22%)
4. Furosemide + Spironolactone: 7 (1.55%)
5. Amlodipine + Furosemide, Furosemide + Losartan: 5 each (1.11%)
6. Losartan + Hydrochlorothiazide, Losartan + Ramipril: 4 each (0.88%)
7. Amlodipine + Losartan: 3 (0.66%)
8. Rare combinations (Ramipril + Torsemide, Furosemide + Telmisartan, Amlodipine + Metoprolol, Telmisartan + Amlodipine): 2 each (0.44%)

(Fig. 7)

Three-drug combinations:

1. Most common: Amlodipine + Atenolol + Furosemide: 20 (4.44%)
2. Less common: Amlodipine + Metoprolol + Hydrochlorothiazide: 2 (0.44%)

Four or more drug combinations:

1. Furosemide + Amlodipine + Losartan + Hydrochlorothiazide: 6 (1.33%)
2. Bisoprolol + Amlodipine + Torsemide + Spironolactone: 4 (0.88%)
3. Furosemide + Clonidine + Amlodipine + Atenolol: 3 (0.66%)
4. Amlodipine + Atenolol + Furosemide + Losartan + Hydrochlorothiazide: 2 (0.44%)
5. Amlodipine + Atenolol + Furosemide + Prazosin: 1 (0.22%)

(Fig. 8)

Assessment of Drug-Drug Interactions in Antihypertensive Prescriptions

During the study, a total of 395 drug–drug interactions (DDIs) were identified. Their severity was categorized as follows:

1. Major interactions: 137 (30.44%)
2. Moderate interactions: 255 (56.66%)
3. Minor interactions: 7 (1.55%)

Among the major DDIs, the most frequent were:

1. Aspirin + Clopidogrel: 85
2. Insulin + Moxifloxacin: 13
3. Amlodipine + Clopidogrel: 9

Among the moderate DDIs, the most common were:

1. Aspirin + Ramipril: 12
2. Diclofenac + Losartan: 6

(Figures 9 & 10)

Assessment of Rationality of Antihypertensive Prescriptions

The rationality of prescriptions was evaluated according to JNC 7 guidelines. Out of 450 patients, 427 (94.88%) were prescribed antihypertensive drugs rationally, while 23 (5.11%) received irrational prescriptions (Fig. 11).

Efficacy of Antihypertensive Agents

Different classes of antihypertensive drugs were evaluated for their effect on systolic (SBP) and diastolic blood pressure (DBP):

Monotherapy:

- Amlodipine significantly reduced DBP ($p = 0.216$).
- Furosemide significantly reduced SBP ($p = 0.0034$).
- Overall, SBP showed a significant reduction on discharge compared to admission ($p = 0.0034$).

Combination therapy:

- Amlodipine + Metoprolol: significant reduction in SBP ($p = 0.034$) and DBP ($p = 0.144$) at discharge.
- Amlodipine + Ramipril: reduction in SBP was observed ($p = 0.6253$), though not statistically significant.

(Results detailed in Tables 1, 2 & 3)

Comparison of Efficacy Between Monotherapy and Combination Therapy

The study compared the efficacy of selected antihypertensive drugs in mono versus combination regimens:

- Amlodipine + Atenolol: mean SBP reduction was significantly greater than Amlodipine monotherapy ($p = 0.018$).
- Furosemide + Losartan: mean SBP and DBP reduction were greater than Furosemide alone, with significant increase in DBP ($p = 0.451$).
- Other combinations did not show statistically significant differences.

Clinical Pharmacy Services in Hypertensive Patients

Clinical pharmacy services provided during hospitalization included:

- Patient counseling: 300 patients (66.66%)
- Drug–drug interaction interventions (major + moderate): 387 cases (27.77%)
- Adverse drug reactions (ADRs): 2 patients (0.44%)
- Medication errors: 24 cases (5.33%)

(Fig. 12). These interventions demonstrate the role of clinical pharmacy in optimizing antihypertensive therapy

and minimizing adverse outcomes

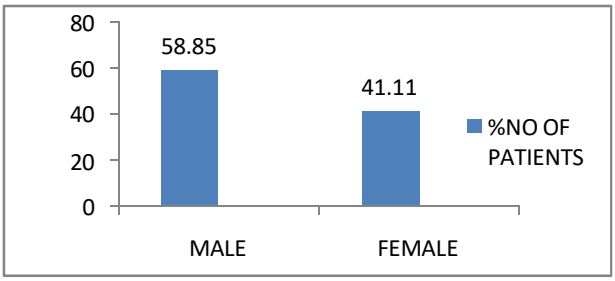

Figure 1: According to Gender Wise Distribution:

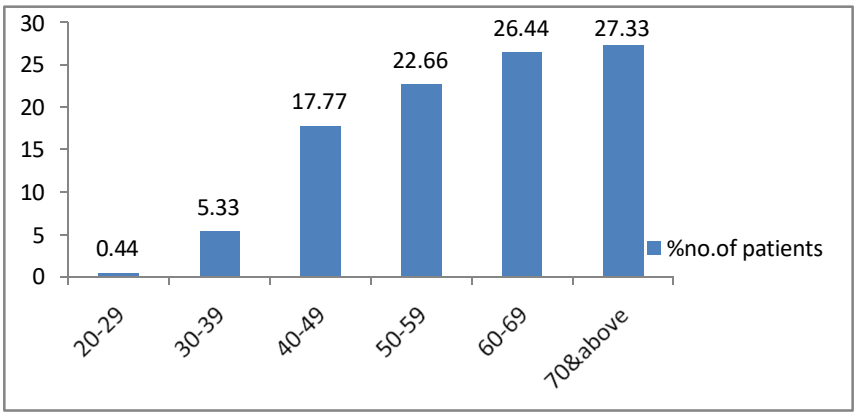

Figure 2: Age Wise Distribution

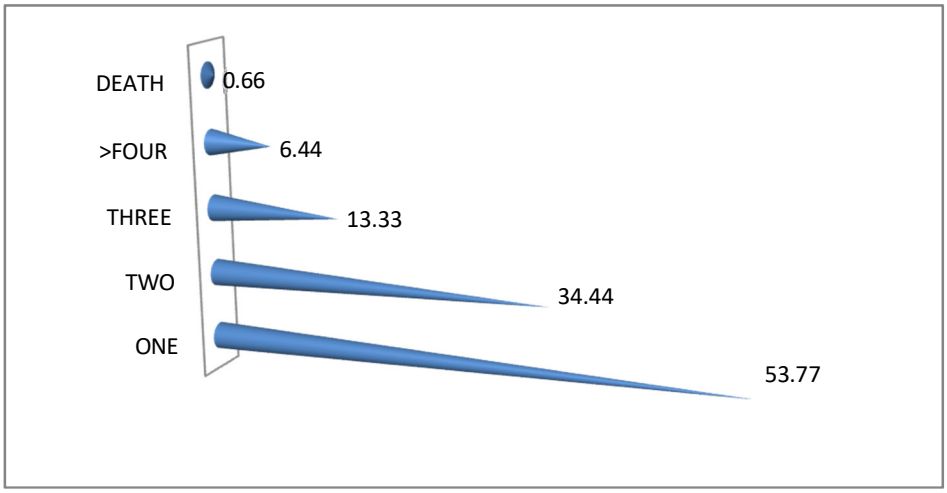

Figure 3: Percentage of Co-morbidities in Antihypertensive in-patients at tertiary care hospital

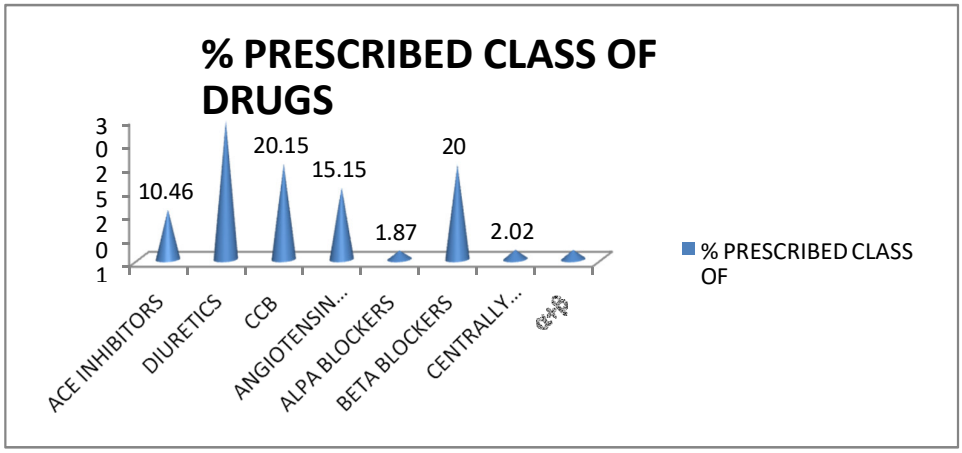

Figure 4: Percentage Classof Antihypertensive Drugs Prescribed for Hypertension Patients

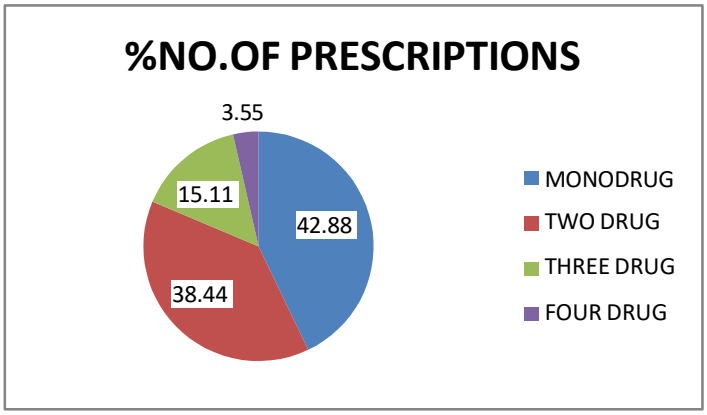

Figure 5: Percentage Pattern of drug regimen prescribed for hypertensive patients

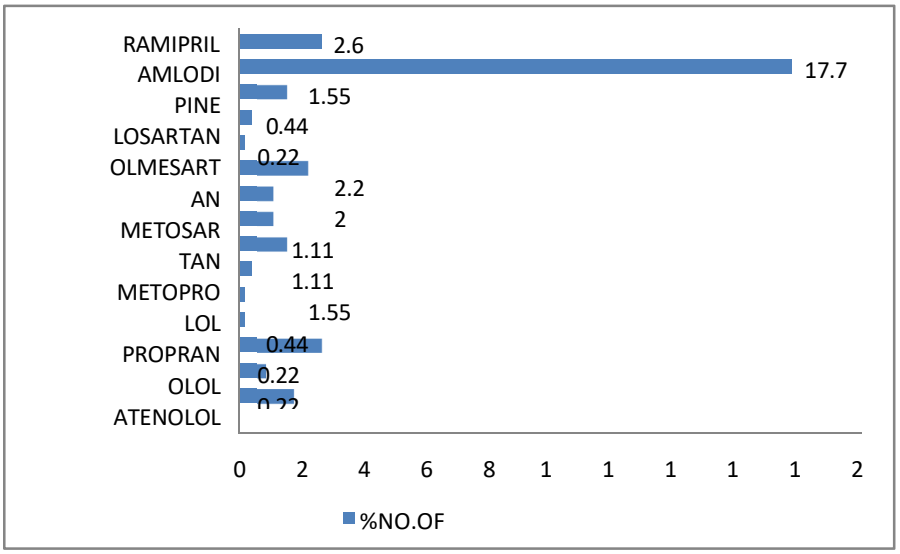

Figure 6: percentage of mono drug regimen prescribed for hypertensive patients

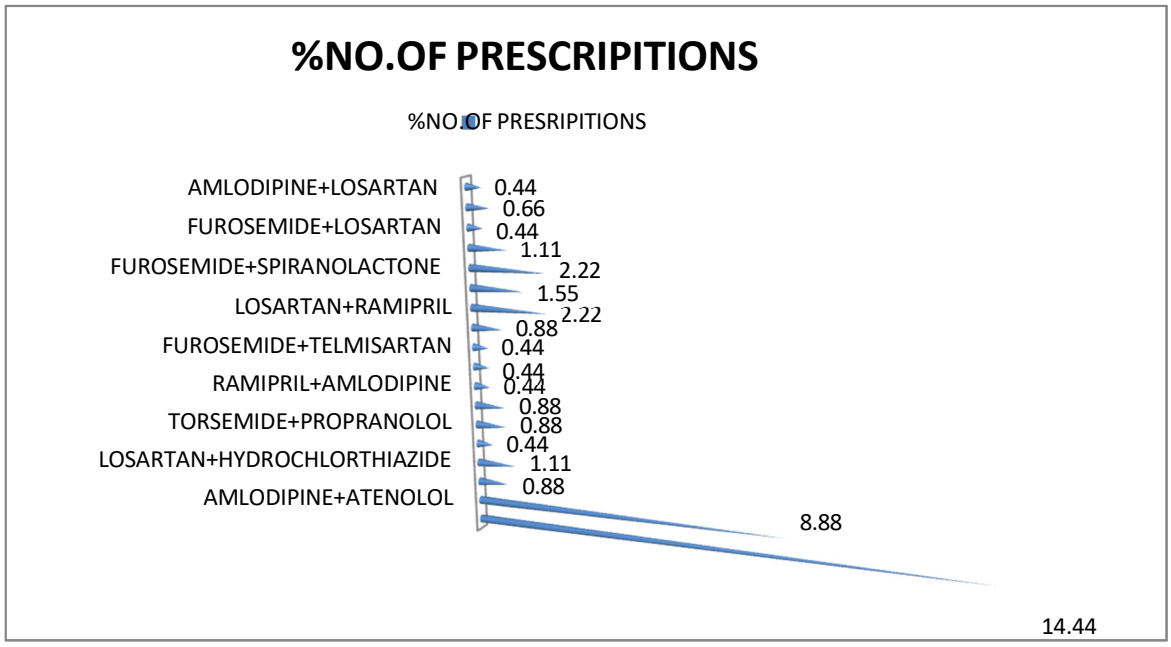

Figure 7: Two Drug Regimen Prescribed for Hypertensive Patients

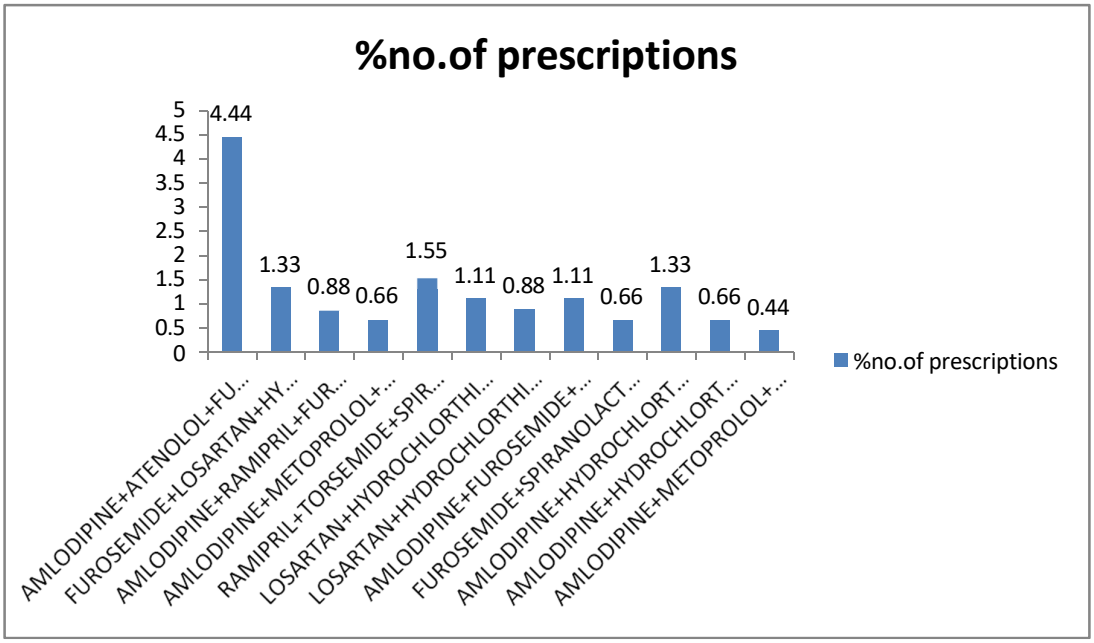

Figure 8: Three Drug Regimen Prescribed for Hypertensive Patients

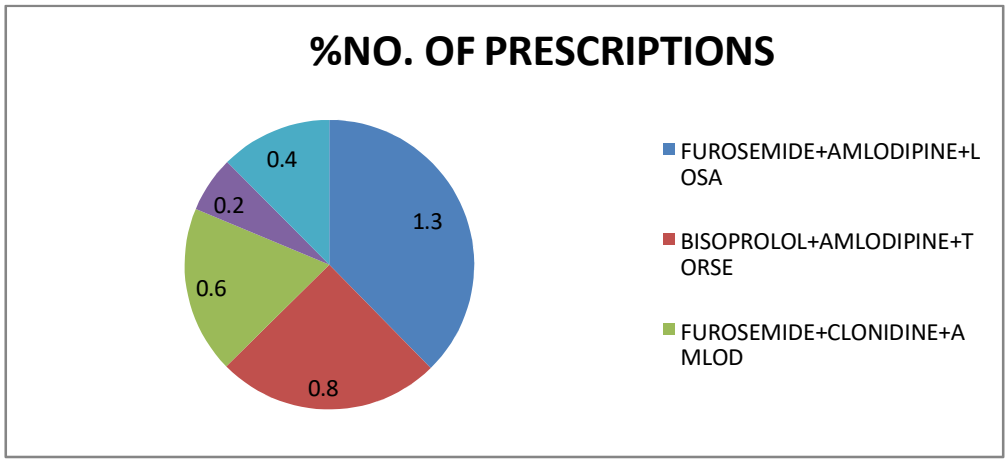

Figure 9:four Drug Regimen Prescribed for Hypertensive Patients

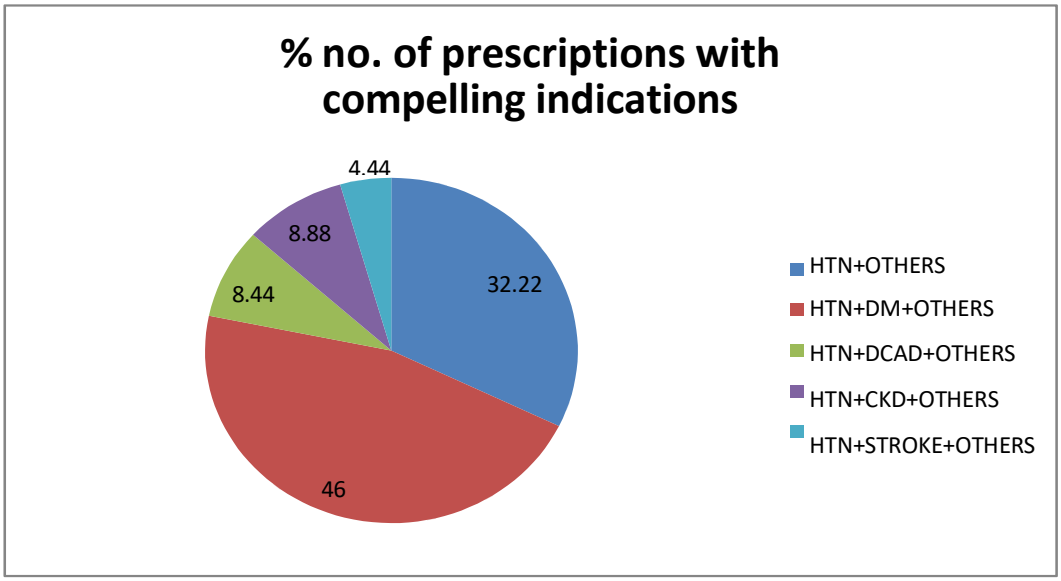

Figure 10: Number of prescriptions with compelling indications

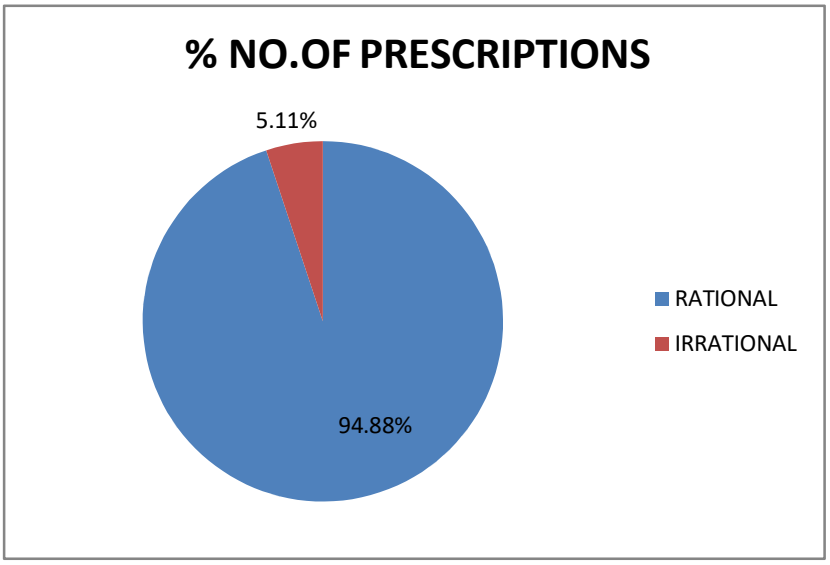

Figure 11: Rationality of antihypertensive drug prescribed for patients

Table 1: Efficacy of Monotherapy Antihypertensive Drugs in Patients in A Tertiary Care Hospital:

BLOOD PRESSURE MEAN±SEM	ON ADMISSION	ON DISCHARGE	P-VALUE	T-VALUE
ATENOLOL				
SBP	152±6.268	130±2.981	0.116	**2.561**
DBP	86.75±5.126	80.26±2.45	0.0138	**2.135**
METOPROLOL				
SBP	150±6.268	124±3.910	0.0034	2.520
DBP	83.45±5.425	80.12±1.231	0.44	2.152
LOSARTAN				
SBP	148±6.761	130.5±2.589	0.0286	2.506
DBP	82.75±5.126	76.25±1.830	0.2522	1.194
ENALAPRIL				
SBP	137.1 ± 13.22	128.4 ± 1.601	0.5253	0.6543
DBP	85.36±12.22	82.29±2.012	0.8561	0.4561
OLMESARTAN				
SBP	148.8±6.417	130.1±2.948	0.1156	2.756
DBP	84.29 ± 6.117	84.29 ± 6.117	0.9678	0.04120
NEBIVOLOL				
SBP	137.6±6.561	125.3±3.847	0.0236	2.404
DBP	80.71±3.225	77.57±2.517	0.4493	0.7682

Table 2: Efficacy of Monotherapy Antihypertensive Drugs in Patients in A Tertiary Care Hospital:

BLOOD PRESSURE MEAN±SEM	On Admission	On Discharge	p-VALUE	t-VALUE
AMLODIPINE				
SBP	155±6.268	132±2.881	0.216	2.861
DBP	85.75±5.126	80.26±2.45	0.238	2.235
FUROSEMIDE				
SBP	152±6.268	124±3.910	0.0034	2.520
DBP	86.45±5.425	80.12±1.231	0.44	2.152
TORSEMIDE				
SBP	146±5.761	132.5±2.589	0.286	2.606

DBP	85.75±5.126	78.25±1.830	0.1522	1.294
RAMIPRIL				
SBP	138.1 ± 13.22	125.4 ± 1.601	0.6253	0.7543
DBP	83.36±12.22	80.29±2.012	0.6561	0.3561
LOSARTAN				
SBP	145.8±5.417	132.1±2.948	0.2156	2.756
DBP	82.29 ± 5.117	85.29 ± 6.117	0.8678	0.0312
CLINIDIPINE				
SBP	135.6±6.561	128.3±3.847	0.1236	2.504
DBP	82.71±3.225	78.57±2.517	0.6493	0.8682

Table 3: Efficacy Of two drug therapy Antihypertensive Drugs In Patients In A Tertiary Care Hospital:

BLOOD PRESSURE MEAN±SEM	**ON ADMISSION**	**ON DISCHARGE**	**P-VALUE**	**T-VALUE**
ATENOLOL±AMLODIPINE				
SBP	178±8.268	132±2.981	0.4516	2.891
DBP	92.75±8.126	80.26±2.45	0.4138	2.035
METOPROLOL±AMLODIPINE				
SBP	175±6.268	125±3.910	0.034	2.620
DBP	88.45±5.425	82.12±1.231	0.144	2.352
LOSARTAN±HYDROCHLORTHIAZIDE				
SBP	176.2±6.761	130.5±2.589	0.0286	2.506
DBP	89.75±5.126	76.25±1.830	0.2522	1.194
RAMIPRIL±AMLODIPINE				
SBP	167.1 ±	128.4 ± 1.601	0.6253	0.6843
	13.22			

DBP	85.36±12.22	82.29±2.012	0.8561	0.4561
FUROSEMIDE±RAMIPRIL				
SBP	168.8±6.417	130.1±2.948	0.1156	2.756
DBP	89.29 ± 6.117	84.29 ± 6.117	0.8678	0.04120
AMLODIPINE±FUROSEMIDE				
SBP	177.6±6.561	125.3±3.847	0.1236	2.5104
DBP	87.71±3.225	78.57±2.517	0.5493	0.1682

Table 4: Comparison of efficacy between mono and combination therapy of amlodipine:

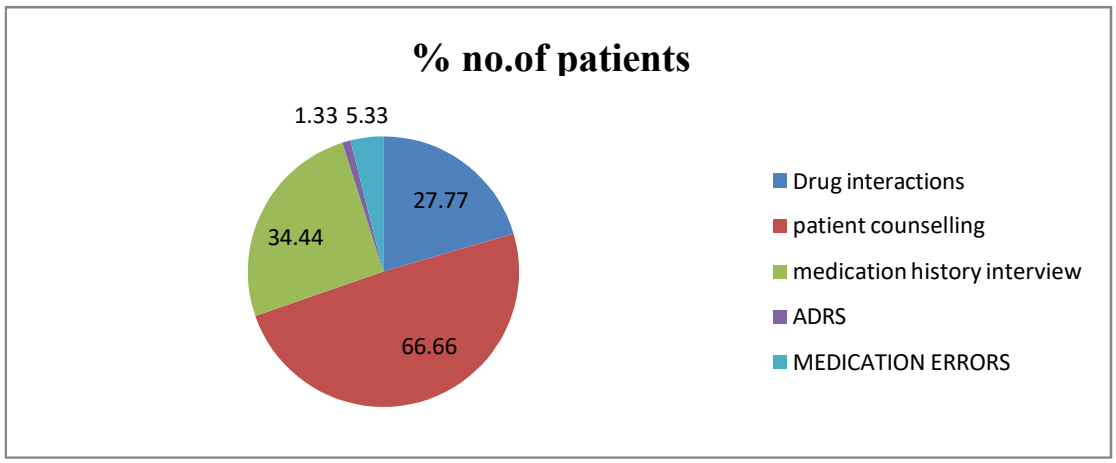

Figure. 12.Clinical Pharmacy Services Provided in Antihypertensive Patients.

DISCUSSION

Prescription-based studies are considered one of the most effective methods to assess and evaluate the prescribing attitudes of physicians and the dispensing practices of pharmacists. With India's increasing economic growth, the country faces a rising burden not only of coronary artery disease but also of obesity, diabetes mellitus, and hypertension. The prevalence of hypertension is increasing dramatically in India. Age represents an accumulation of environmental influences and physiological stress, making it an important risk factor. Studies report that the prevalence of hypertension in urban India is highest among males aged 50–59 years and females aged 60–64 years, whereas in rural areas, both sexes show increased prevalence in the 60–64-year age group. This aligns with our findings, where the majority of patients were in the 50–70 years age group, confirming age as a significant risk factor for hypertension.

Pharmacist interventions have been shown to significantly improve disease-related knowledge, blood pressure control, and medication adherence in hypertensive patients, although further research is required to assess long-term effects on quality of life.

In our study, the most prescribed class of antihypertensive drugs were diuretics, followed by calcium channel blockers and β-blockers. Similar results have been reported in studies from Nigeria and other regions, and are consistent with JNC VII guidelines, which recommend diuretics as first-line therapy for hypertension.

We observed that 57.11% of prescriptions contained combination therapy, which is lower than some

recommended levels suggesting that at least 70% of patients may require combination therapy to achieve optimal blood pressure control. Monotherapy was prescribed in 42.88% of cases. The relatively lower use of combination therapy may be due to the higher risk of drug–drug interactions (27.77% in our study) and pharmacoeconomic considerations. Comparisons with other studies show variation: 73% combination therapy in Nigeria, 60% combination therapy in India, and 51% monotherapy in Hong Kong.

The rationality of prescriptions, assessed using JNC VII and Indian guidelines, was high in our hospital: 427 patients (94.88%) received rational prescriptions, while 23 patients (5.11%) received irrational prescriptions. This indicates that physicians at our institution generally adhere well to established guidelines for hypertension management.

Regarding efficacy, combination therapy showed significant reductions in mean SBP and DBP, confirming the global consensus that combination therapy often provides better blood pressure control. However, some combinations failed to produce statistically significant reductions, highlighting the need for individualized therapy.

The high prevalence of drug–drug interactions (DDIs) in our study (387 DDIs in 450 patients) aligns with other studies showing that multiple prescriptions increase the likelihood of potential DDIs. Evidence suggests that clinical pharmacists can help minimize DDIs by advising physicians and monitoring prescriptions, as demonstrated in studies from Thailand and other regions.

Overall, our study demonstrates that the choice of antihypertensive drugs in our hospital largely complies with JNC VII and IGH guidelines, with diuretics, calcium channel blockers, and β-blockers preferred as first, second, and third-line therapies. Nevertheless, there is a need to improve patient education, adherence to therapy, and lifestyle modification counseling to enhance blood pressure control.

This study also highlights the impact of clinical pharmacy services, including patient counseling, monitoring for drug interactions, and promoting adherence to therapy. The efficacy of antihypertensive drugs, both in mono and combination therapy, was confirmed by statistically significant reductions in blood pressure (values expressed as mean ± SEM, *$p<0.05$, **$p<0.01$, ***$p<0.001$; unpaired Student's t-test).

CONCLUSION

The present study concludes that:

1. Future strategies should focus on minimizing drug-related problems associated with antihypertensive therapy, potentially through the recruitment of clinical pharmacists.
2. Similar studies may be extended to other hospital departments to assess prescribing patterns and rational drug use.
3. Training programs for hospital pharmacists should be implemented to monitor prescribing patterns and ensure rational therapy.
4. Educational initiatives for medical staff should emphasize the rational use of combination antihypertensive drugs.
5. Medication adherence monitoring should be applied for all patients admitted to tertiary care hospitals.

Overall, this study supports the rational prescribing of antihypertensive drugs, highlights the importance of combination therapy where appropriate, and emphasizes the critical role of clinical pharmacy services in improving patient outcomes**.**

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