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RESEARCH ARTICLE
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ASSESSMENT OF DRUG UTILIZATION PATTERNS IN CARDIOVASCULAR DISEASE PATIENTS WITH CO-MORBIDITIES AT J.L.N. MEDICAL COLLEGE AND ASSOCIATED HOSPITALS, AJMER: A PROSPECTIVE STUDY

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Abstract

Background: Cardiovascular diseases (CVDs) continue to be a primary cause of morbidity and mortality around the world followed by co-morbidities like hypertension, diabetes, and dyslipidemias. Rational utilization of drugs is a key factor in optimizing treatment outcomes and minimizing adverse effects.

Objective: The aim of this prospective study was to evaluate the patterns of drug utilization in patients with CVD and co-morbidities at J.L.N. Medical College and Associated Hospitals, Ajmer.

Methods: A total of 400 patients diagnosed with cardiovascular diseases and co-morbidities were included in the study. Data on demographics, disease patterns, prescribed medications, polypharmacy, and adherence to WHO core drug prescribing indicators were collected and analyzed. The study also assessed the occurrence of adverse drug reactions (ADRs) and potential drug-drug interactions (DDIs).

Results: The study found that the most frequently prescribed cardiovascular drugs were antiplatelet agents, statins, nitrates, and anticoagulants, with significant use of oral medications such as Aspirin (89.25%), Clopidogrel (70.25%), and Atorvastatin (88.25%). The pattern also revealed a high reliance on injectables, particularly Heparin (75.25%). Non-cardiovascular drugs, such as Pantoprazole (58%), Bisacodyl (55.25%), and Alprazolam (64.25%), were commonly prescribed to manage gastrointestinal, metabolic, and psychiatric co-morbidities. Polypharmacy was prevalent, with an average of 11.35 drugs prescribed per patient, which raised concerns about the potential for DDIs and ADRs. Adherence to essential drug lists (100%) and generic drug prescribing (99.9%) were notable, but overuse of antibiotics (43.5%) and injectables (86.5%) exceeded optimal prescribing recommendations.

Conclusion: The study highlights the complex pharmacotherapy required for managing cardiovascular diseases with co-morbidities. While there is strong adherence to essential drug lists and the use of generics, the over-prescription of antibiotics and injectables necessitates further

attention. Optimizing drug therapy, reducing polypharmacy, and ensuring rational antibiotic use are essential for improving patient safety and outcomes. This study emphasizes the need for continuous monitoring and improvement in prescribing practices, especially in multi-morbid populations.

Keywords: Cardiovascular disease, drug utilization study, co-morbidities, prescription patterns, polypharmacy, WHO core drug prescribing indicator

1. Introduction

Cardiovascular diseases (CVDs) are the leading cause of mortality globally, necessitating effective management strategies. 27% of deaths in India are caused by cardiovascular diseases. **(World Health Organization, 2021).** Drug utilization studies (DUS) serve as essential tools to evaluate current prescribing trends, ensuring the appropriateness and safety of medications used in patients with CVDs, particularly those with co-morbidities such as hypertension and diabetes mellitus **(Kumar et al., 2018).** Understanding these patterns is crucial for optimizing therapeutic outcomes, minimizing drug-drug interactions (DDIs), and enhancing the overall quality of care for patients suffering from cardiovascular conditions **(Biradar et al., 2022)**. Cardiovascular diseases (CVDs) are a leading cause of morbidity and mortality worldwide, significantly impacting public health **(Yusuf et al., 2008).** The presence of comorbidities, such as hypertension and diabetes mellitus, complicates the management of CVDs and necessitates a comprehensive approach to pharmacotherapy **(Iqbal et al., 2015).** Assessing drug utilization patterns in patients with CVDs and co-morbid conditions is essential to promote rational prescribing, minimize adverse drug interactions, and enhance patient outcomes through evidence-based therapies **(Patil et al., 2015).** Cardiovascular diseases (CVDs) are a major global health challenge, representing the leading cause of death worldwide. The prevalence of CVDs is rising steadily, particularly in low- and middle-income countries, where the impact on public health is disproportionately high. In India, CVDs are responsible for a significant proportion of morbidity and mortality, with coronary artery disease (CAD) and stroke being the most common manifestations of cardiovascular disorders **(Rangapriya et al., 2021)**. These diseases pose substantial healthcare burdens and are associated with increased healthcare costs and long-term disability **(Olusanya et al., 2021).** Patients with CVD often present with multiple comorbid conditions such as hypertension, diabetes, and hyperlipidemia, which complicate treatment strategies. The management of such patients typically involves polypharmacy, where multiple drugs are prescribed to address the various aspects of the disease and its comorbidities **(Sathish Kumar, 2019).** While polypharmacy is essential for controlling the symptoms and preventing disease progression, it also increases the risk of drug-drug interactions (DDIs) and adverse drug reactions (ADRs), which can lead to treatment failure or harmful effects on patient health **(Biradar et al., 2022).** Drug utilization studies (DUS) are crucial tools for assessing prescribing practices, identifying inappropriate medication use, and ensuring the rational use of drugs. DUS plays a vital role in improving drug therapy outcomes by providing insights into prescribing patterns, medication adherence, and the effectiveness of treatment regimens. Such studies help healthcare providers make informed decisions to optimize treatment while minimizing risks associated with polypharmacy **(Vincent et al., 2017).**

The present study is to evaluate the drug utilization patterns in patients with cardiovascular diseases and comorbidities, focusing on the most commonly prescribed medications and their interactions. By identifying potential risks and areas for improvement, this study aims to contribute to the development of safer, more effective prescribing practices in cardiovascular care **(Rishitha et al., 2021)**

1.1 Rationale for Drug Utilization Studies in Cardiovascular Diseases

Drug utilization studies (DUS) are essential for ensuring the rational use of medications, particularly in the complex management of cardiovascular diseases (CVDs). These studies assess the prescribing patterns of cardiovascular medications, identify deviations from established guidelines, and highlight areas for improvement in treatment strategies. In cardiovascular disease management, where patients often have multiple comorbidities such as hypertension, diabetes, and hyperlipidemia, polypharmacy

is common **(Fardan et al., 2019).** This increases the risk of drug-drug interactions (DDIs) and adverse drug reactions (ADRs), which can complicate treatment and affect patient outcomes **(Mukesh et al., 2016).** By evaluating prescribing practices, DUS help to optimize therapy, reduce unnecessary drug use, and minimize the potential for harmful interactions **(Raval, 2020).** Moreover, these studies facilitate the adoption of evidence-based practices by healthcare professionals, ensuring that drugs are prescribed in the most effective and cost-efficient manner. They also provide valuable feedback for clinicians, helping them align their prescriptions with the best available clinical evidence, thus improving patient safety and reducing healthcare costs **(Shastry et al., 2014).** In settings like India, where CVD-related mortality is high, DUS are crucial for understanding local prescribing patterns and addressing challenges such as limited access to essential medications and the widespread use of non-generic drugs **(Kumar et al., 2016)**. Therefore, conducting drug utilization studies in CVD patients not only enhances therapeutic outcomes but also promotes more rational, patient-centered care in the management of cardiovascular diseases.

1.2 Common Comorbidities in Cardiovascular Disease Patients

The common comorbidities observed in patients with cardiovascular diseases include hypertension (45%), diabetes mellitus (33%), chronic obstructive pulmonary disease (COPD) (7%), coronary artery disease (CAD) (5%), hyperlipidemia (5%), and acute renal failure (ARF) (5%) **(Divya Jyothi et al., 2019).** Cardiovascular diseases (CVDs) are often accompanied by various comorbidities that significantly complicate their management. Among the most common comorbid conditions in CVD patients are hypertension, diabetes mellitus, and hyperlipidemia. Hypertension, being a major risk factor for coronary artery disease (CAD) and stroke, is prevalent in a large proportion of CVD patients **(Rangapriya et al., 2021)**. Similarly, diabetes mellitus, particularly type 2 diabetes, is frequently observed in patients with cardiovascular conditions. Diabetes not only increases the risk of developing CVD but also presents challenges in treatment due to the need for medications that manage both the glycemic levels and cardiovascular risks **(Olusanya et al., 2021)**.

Dyslipidemia, often seen in CVD patients, is another critical factor in the development of atherosclerosis and CAD, further complicating treatment **(Sathish Kumar, 2019)**. In addition to these, comorbidities such as chronic obstructive pulmonary disease (COPD), obesity, and renal dysfunction are frequently encountered in CVD patients. These conditions not only exacerbate the primary cardiovascular disease but also necessitate complex medication regimens, increasing the risk of polypharmacy and drug-drug interactions **(Rishitha et al., 2021).** Furthermore, atrial fibrillation, which is commonly seen in CVD patients, requires careful management with anticoagulants and ratecontrolling medications, adding another layer of complexity to treatment plans **(Vincent et al., 2017)**. The presence of multiple comorbidities increases the likelihood of drug-drug interactions (DDIs) and adverse drug reactions (ADRs), highlighting the importance of carefully monitoring drug therapy to avoid complications **(Biradar et al., 2022).** Common comorbidities in cardiovascular disease (CVD) patients are frequently observed and significantly contribute to the complexity of managing these conditions. **Hypertension** is one of the most prevalent comorbidities, being present in a substantial number of CVD patients. In fact, a study by **Raval (2020)** found that hypertension was present in 70.88% of the cardiovascular patients studied. **Diabetes mellitus (DM)**, particularly type 2 diabetes, is another common comorbidity, affecting approximately 21.6% of patients with cardiovascular conditions **(Mukesh et al., 2016).** Alongside these, **dyslipidemia**—characterized by elevated cholesterol levels—also frequently coexists with cardiovascular diseases, playing a crucial role in the pathophysiology of coronary artery disease. Other notable comorbid conditions include **chronic kidney disease (CKD)**, which complicates drug treatment, and **chronic obstructive pulmonary disease (COPD)**, further aggravating cardiovascular symptoms and complicating treatment strategies (Fardan et al., 2019). These comorbidities not only make managing cardiovascular diseases more challenging but also increase the likelihood of polypharmacy, raising the risk of drug-drug interactions and adverse drug reactions. As such, a comprehensive approach to managing CVD and its comorbidities is essential for improving patient outcomes and reducing complications.

1.3 Risk Factors & Comorbidities

Cardiovascular disorders (CVDs) are governed by an extensive range of risk factors and comorbidities, and hence their management and treatment become a complicated affair. Various research works emphasize the escalating burden of CVD, especially in economically less developed countries, where incidence rates of such comorbidities as hypertension, diabetes, and dyslipidemia accentuate the problem. It is therefore essential that the risk factors for these CVDs be studied thoroughly. Hypertension is among the most common risk factors for CVD. In a study by **Tassew et al. (2021),** 28.9% of the participants had hypertension, with a strong correlation between increased blood pressure and incidence of coronary artery disease (CAD). In the same way, **Sarebanhassanabadi et al. (2024)** reported that hypertension, in addition to dyslipidemia, was an important determinant of CAD development in their Iranian population. The exaggerated prevalence of hypertension, particularly among aged groups, frequently results in intensive drug treatment to manage blood pressure and avert additional cardiovascular complications.

Another significant risk factor is diabetes mellitus, which often occurs with hypertension. Research such as that conducted by **Naliganti et al. (2019)** and **Sarebanhassanabadi et al. (2024)** has highlighted the high prevalence of diabetes in CVD patients, underscoring its contribution to speeding up the advancement of heart disease. Diabetes facilitates ischemic heart disease (IHD) due to increased risk by inducing atherosclerosis and other pathophysiologic processes in blood vessels. A majority of CVD patients are prescribed medications for both diabetes and hypertension, leading to polypharmacy, which is complicated by regimens and potentiates drug-drug interactions (DDIs). Dyslipidemia, especially raised cholesterol, is another important risk factor for CVD. Several studies have identified a significant association between high LDL levels and an increased rate of heart disease. In the research conducted by **Rangapriya et al. (2021)**, 80% of CVD patients presented with dyslipidemia, and lipid level management with statins was a prevalent therapeutic strategy. Furthermore, metabolic syndrome, which encompasses a cluster of hypertension, diabetes, and dyslipidemia, is highly associated with an increased risk of CVD and is often found in cardiovascular patients. Other comorbidities that are common to CVD are chronic kidney disease (CKD), obesity, and chronic obstructive pulmonary disease (COPD). Not only do these comorbidities complicate the management of CVD but also result in poorer outcomes. For instance, CKD is strongly associated with hypertension and diabetes, and research indicates that renal impairment worsens the course of cardiovascular diseases. In the same manner, obesity is recognized as an important risk factor for the emergence and development of CVD, especially through insulin resistance and augmented inflammation. Polypharmacy, a frequent aftermath of the management of these myriad comorbidities, challenges both patients and healthcare professionals. The requirement of drugs for addressing different conditions exposes the patient to the risk of DDIs that can lead to ADRs or reduced therapeutic effects. It was observed through a study conducted by **Rashid et al. (2021)** that polypharmacy was a major indicator of enhancing the risk of DDIs, thus making the case of CVD in hospitalized patients more challenging to manage. Identification and treatment of such risk factors and comorbid conditions are vital in order to optimize outcomes among patients with CVD. Rational use of medications, utilization of important medications, and vigilant screening for DDIs will help alleviate the adverse effect of such comorbid conditions and enhance the treatment of the patient. Furthermore, the high prevalence of these conditions highlights the significance of preventive interventions, including lifestyle changes and early detection, in lowering the overall burden of CVD.

1.4 Objective

The goal of this study is to evaluate drug utilization patterns in cardiovascular disease patients, with a focus on the most commonly prescribed medications, the presence of comorbidities, the impact of polypharmacy, and potential drug-drug interactions, in order to promote rational and effective treatment strategies in a clinical setting.

2. Materials And Methods

The study was conducted in the cardiology department of J.L.N. Medical College and Associated Group of Hospitals, a tertiary care teaching hospital located in Ajmer, Rajasthan. It was a prospective observational study, carried out over a period of 12 months, from August 2023 to July 2024. The sample size was determined to be 400 participants, calculated using prevalence data from previous studies. The sample size calculation was based on a confidence level of 95%, a margin of error of ±4.9%, and an expected frequency of 50%. The formula for calculating the sample size included a Z-score of 1.96 for a 95% confidence level, with the expected frequency (p) being 0.5. After substituting the values and performing the necessary calculations, the required sample size was determined to be 400 participants. Ethical clearance for the study was obtained from the ethical committee of J.L.N. Medical College, Ajmer. The inclusion criteria for the study included patients of all ages, both male and female, admitted to the cardiology department with a diagnosis as per the ICD-10 classification, and those who were willing to provide informed consent. Exclusion criteria were patients or their relatives who were unwilling to provide informed consent and those with incomplete data. Data collection involved various instruments, including a standard socio-demographic data collection form, an informed consent form, WHO core drug indicator guidelines, information about indications for drug use, co-morbidities, duration of hospital stay, medication details, treatment duration, laboratory parameters, and adverse drug reactions (ADRs). All relevant information regarding the diagnosis, medical history, treatment for ADRs, investigations, and outcomes was systematically recorded.

The collected data were entered into a Microsoft Excel sheet and analyzed statistically. Descriptive statistics were employed to analyze the data, with the mean and standard deviation being used for quantitative data, and rate and percentage being used for qualitative data. A p-value of less than 0.05 was considered statistically significant.

3. RESULTS AND OBSERVATIONS

The research examined medication use and adverse drug reactions (ADRs) in patients with cardiovascular diseases (CVD) and co-morbid illnesses. The cardiology department at J.L.N. Medical College and Associated Group of Hospitals, Ajmer, collects data on prescription practices, drug frequency and type, and ADR prevalence. Statistical analysis supports this section's conclusions on medication consumption patterns, co-morbid conditions, and ADRs' effects on patient outcomes.

Age & Gender Distribution

The research examined medication use and adverse drug reactions (ADRs) in patients with cardiovascular diseases (CVD) and co-morbid illnesses. The cardiology department at J.L.N. Medical College and Associated Group of Hospitals, Ajmer, collects data on prescription practices, drug frequency and type, and ADR prevalence. Statistics confirm the study's conclusions on medication consumption patterns, co-morbid conditions, and ADRs' effects on patient outcomes.

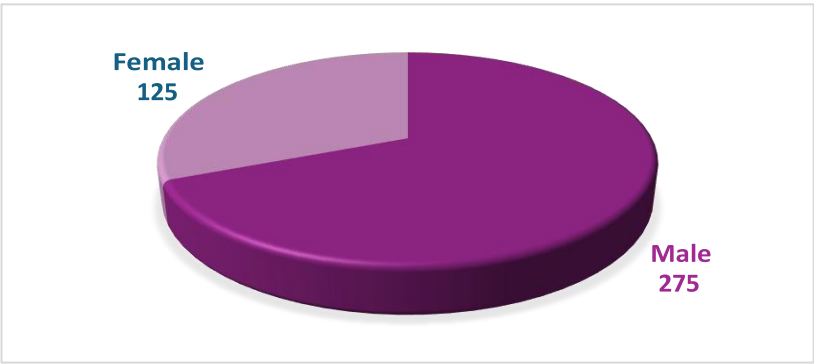


Figure 1a Age & Gender

Figure 1a showing gender distribution in 400 Patients included in the study -275 (68.75%) were male and 125 (31.25%) were female which indicate that CVD's are more common in male.

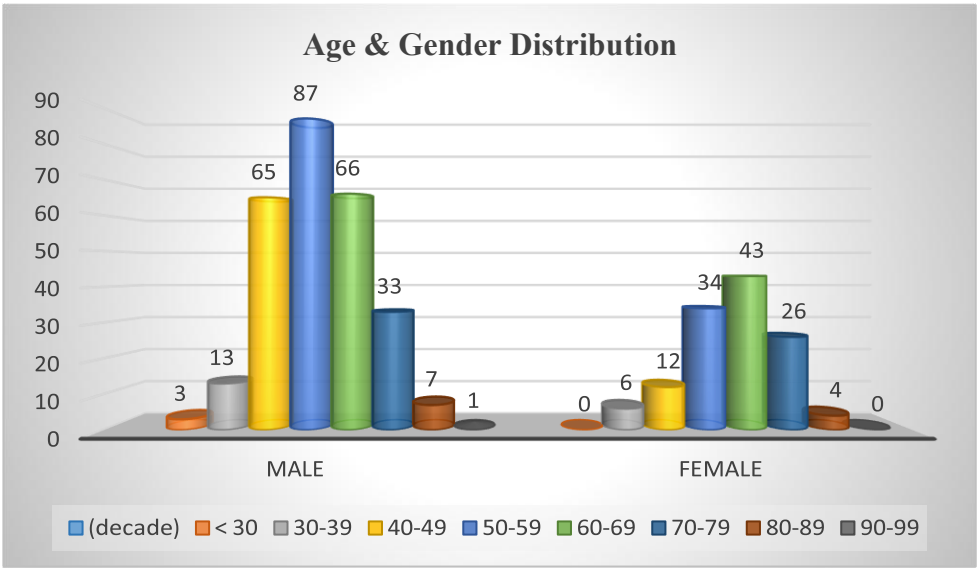


Figure 1b Age & Gender Distribution

Figure 1b showing age distribution of CVDs - The most common decade for males with CVD's was 50 to 59 years (23%) with most cases occurring from 40 to 69 years (62.75% of total and 79.2% of males while for females most common decade was 60 to 69 years (54.5%) with most patients occurring from 50 to 79 years (25.25% of total and 82.4% of Females. So, CVDs are not only more common in males but also occur a decade earlier. However, when all 400 cases were considered the most common decade was 50 to 59 years (30.25%) with 60 to 69 years (27.25%) coming a very close second.

Types of CVDs

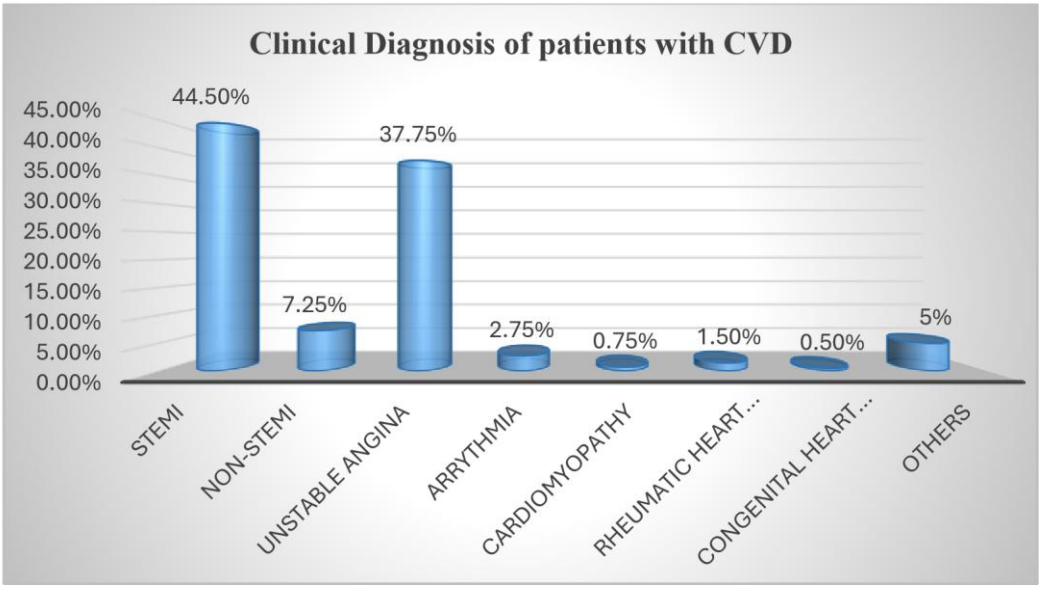


Figure 1. prevalence of different CVDs in our study

Of the 400 patients included in our study 358 (89.5%) were diagnosed with Acute Coronary Syndrome. Others included Arrythmia in 11 (2.75%), RHD in (1.5%), LVF IN 5 (1.25%), PVD & Dyspnea on exertion in 3 (0.75%) each, Congenital heart disease, Cardiogenic shock and Left Bundle Branch Block in 2 (0.5%) each.

Drug Utilization Pattern of Cardiovascular Drugs

The study on the "Assessment of Drug Utilization Patterns in Cardiovascular Disease Patients with CoMorbidities at J.L.N. Medical College and Associated Hospitals, Ajmer: A Prospective Study" provides insights into the patterns of drug use among 400 cardiovascular patients with co-morbidities. The data shows the varying frequency of drug use, with certain medications being used far more frequently than others.

Table 1 Drug Utilization Pattern of Cardiovascular Drugs

Sr NO	Drug Name	No Of Patient (N=400)	Percentage
1	Inj. Reteplase	30	7.5
2	Inj Alteplase	40	10
3	Inj. Tenecteplase	47	11.75
4	Inj Streptokinase	3	0.75
5	Inj Heparin	301	75.25
6	Tab Nicoumalone	2	0.5
7	Tab Warfarin	1	0.25
8	Tab Apixaban	1	0.25
9	Tab Aspirin	357	89.25
10	Tab Clopidogrel	281	70.25
11	Tab Ticagrelor	89	22.25
12	Tab Ecosprin	1	0.25
13	Inj GTN	67	16.75
14	ISDN (sublingual)	342	85.5
15	Tab ISMN	88	22
16	Tab GTN	13	3.25
17	Tab Trimetazidine	42	10.5
18	Tab Ranolazine	36	9
19	Tab Ivabradine	11	2.75
20	Tab Atorvastatin	353	88.25
21	Tab Rosuvastatin	7	1.75
22	Tab Metoprolol	245	61.25
23	Tab Atenolol	3	0.75
24	Tab Carvedilol	7	1.75
25	Tab. Amlodipine	33	7.75
26	Inj Amlodipine	4	1.00
27	Tab Clindipine	3	0.75
28	Tab Diltiazem	2	0.5
29	Inj Diltiazem IV	1	0.25
30	Tab Nicorandil	56	14
31	Inj. Xylocaine	1	0.25
32	Inj Xylocard	1	0.25
33	Inj Amiodarone	3	0.75
34	Tab Amiodarone	5	1.25
35	Tab Losartan	24	6
36	Tab Telmisartan	5	1.25
37	Tab Ramipril	58	14.5
38	Tab Furosemide	19	4.75

39	Tab Spironolactone	30	7.5
40	Tab Torsemide	11	2.75
41	Inj Furosemide	30	7.5
42	Inj Nor- Adrenaline	8	2
43	Tab Digoxin	8	2
44	Tab Prazosin	1	0.25
45	Tab Clonidine	1	0.25
46	Tab Tranexamic Acid	1	0.25
	Mean= SD=	58.08695652 103.5380394	

In terms of injectable drugs, Inj. Heparin (75.25%) is the most commonly prescribed, followed by Inj. Alteplase (10%) and Inj. Tenecteplase (11.75%). On the other hand, drugs like Inj. Streptokinase (0.75%) and Inj. Diltiazem IV (0.25%) were prescribed to fewer patients. Oral medications also exhibit a similar trend, with Tab Aspirin (89.25%), Tab Clopidogrel (70.25%), and Tab Atorvastatin (88.25%) being the most frequently prescribed, suggesting a strong emphasis on antiplatelet and lipid-lowering therapy in this population. Statins and antiplatelet medications, such as aspirin and clopidogrel, are widely used due to their role in preventing further cardiovascular events and managing risk factors like hypertension and hyperlipidemia.

Additionally, medications like Tab Metoprolol (61.25%), which is a beta-blocker, and Tab ISDN (85.5%), a nitrate, are also commonly utilized to manage heart failure and ischemic heart disease. Other drugs like antihypertensives (e.g., Tab Ramipril, Tab Losartan, and Tab Telmisartan) are prescribed to manage co-morbidities such as hypertension, which is prevalent in cardiovascular disease patients.

The findings highlight the emphasis on primary interventions such as antiplatelet and statin therapy, along with a high prescription rate of anticoagulants like Heparin. However, there is also an evident use of secondary medications aimed at symptom management, heart failure prevention, and controlling comorbid conditions such as hypertension and diabetes. The mean and standard deviation values of the study (mean=58.09, SD=103.54) suggest variability in the drug utilization pattern, with a few drugs being significantly more common than others.

Drug Utilization Pattern of Non-Cardiovascular Drugs

The "Drug Utilization Pattern of Non-Cardiovascular Drugs" in this study on patients with cardiovascular diseases and co-morbidities reveals important trends in the use of medications for various non-cardiovascular conditions. The data indicates that a significant portion of patients received treatments for gastrointestinal, infectious, metabolic, and respiratory issues, alongside their cardiovascular management.

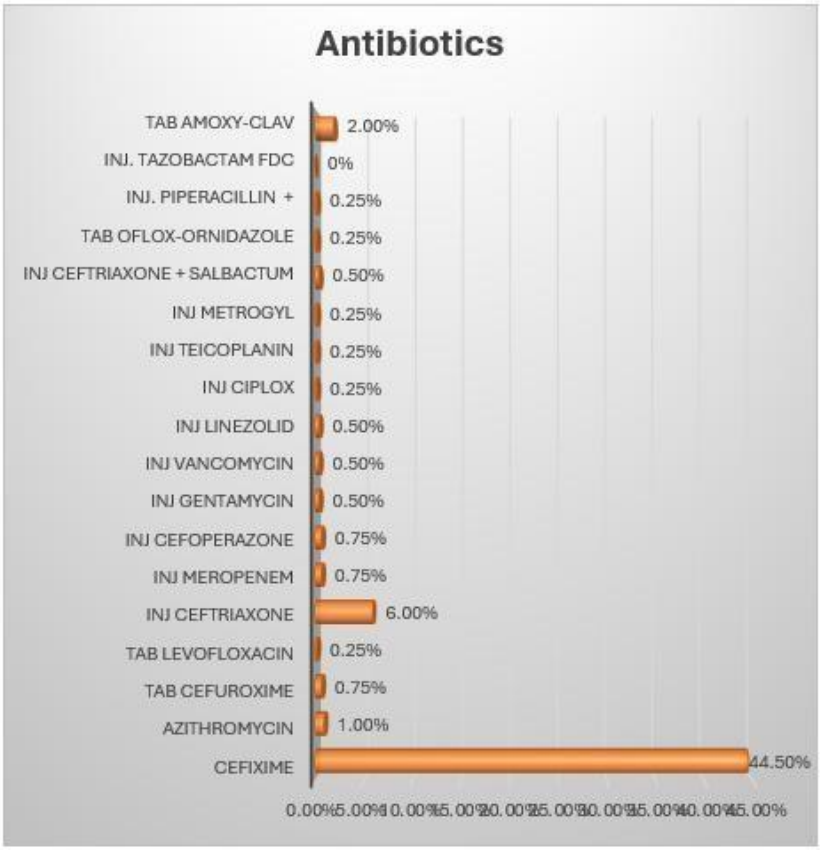
Table 2 Drug Utilization Pattern of Non-Cardiovascular Drugs

Sr. no	Name of Non-CVS Drug	No of Patients (N=400)	Percent (%)
1.	Tab Pantoprazole	232	58
2.	Tab Rabeprazole	8	2
3.	Tab Ondansetron	16	4
4.	Tab Bisacodyl	221	55.25
5.	Tab Lactulose	75	18.75
6.	Inj Pantoprazole	26	6.5
7.	Inj Ondansetron	20	5
8.	Tab Cefixime	178	44.5
9.	Tab Azithromycin	4	1

10.	Tab Cefuroxime	3	0.75
11.	Inj Meropenem	3	0.75
12.	Inj Ceftriaxone	24	6
13.	Inj Cefoperazone	3	0.75
14.	Inj Gentamycin	2	0.5
15.	Inj Vancomycin	2	0.5
16.	Inj Linezolid	2	0.5
17.	Inj Teicoplanin	1	0.25
18.	Tab Levofloxacin	1	0.25
19.	Inj Ciplox	1	0.25
20.	Inj Metrogyl	1	0.25
21.	Inj. Insulin(R)	45	11.25
22.	Inj Insulin (G)	30	7.5
23.	Tab Metformin	10	2.5
24.	Tab Teneligliptin	4	1
25.	Tab Dapagliflozin	27	6.75
26.	Tab Sitagliptin	1	0.25
27.	Tab Voglibose	4	1
28.	Tab N- Acetyl Cystine	19	4.75
29.	Tab Salbutamol	2	0.5
30.	Inj. Etophyllin	2	0.5
31.	Inj Deriphyllin	1	0.25
32.	Tab Budenoside Inhalation	5	1.25
33.	Tab Ipravent Inhalation	6	1.5
34.	Tab Alprazolam	257	64.25
35.	Tab Levocetrizine	1	0.25
36.	Tab Paracetamol	130	32.5
37.	Tab Diclofenac gel (Topical)	3	0.75
38.	Tab Dicyclomine	11	2.75
39.	Tab Etoricoxib	12	3
40.	Tab Tramadol	9	2.25
41.	Inj Tramadol	2	0.5
42.	Tab Levocetirizine	17	4.25
43.	Inj Avil (pheniramine maleate)	3	0.75
44.	Syp Dextromethorphan	12	3
45.	Alfa Keto analog (Nutrition supplement)	5	1.25
46.	Tab/capsule Gabapentene	1	0.25
47.	Inj Ferrous Succinate	1	0.25
48.	Inj Calcium	1	0.25
49.	Beta Histin (Vertin-16)	2	0.5
50.	Tab Tamsulosin	1	0.25
51.	Tab Serratiopeptidase	1	0.25
52.	Tab Lactobacillus	4	1

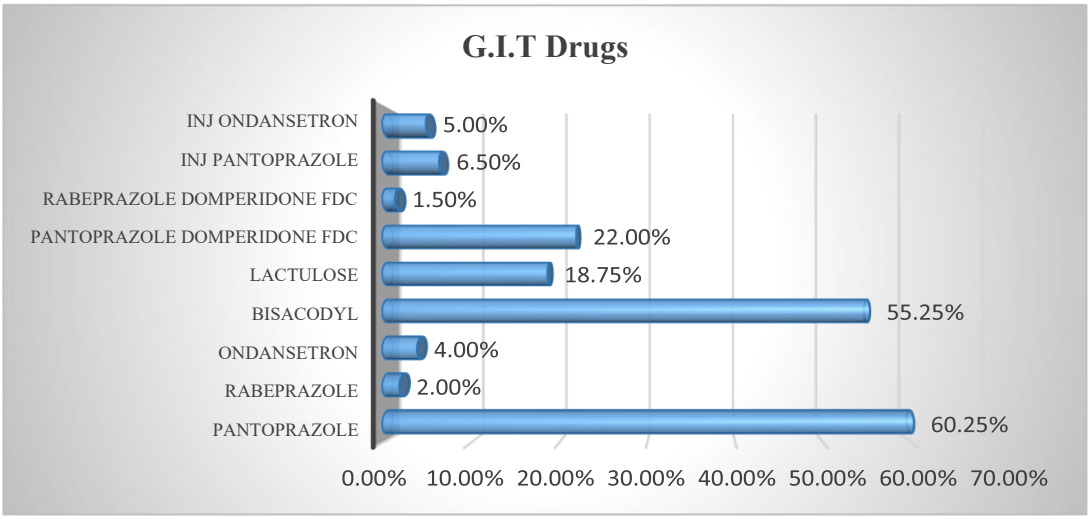
53.	Cap Racecadotril	1	0.25
54.	Tab Chymotrypsin	2	0.5
55.	Tab Fabuxstat	2	0.5
56.	Tab Ointment Mupirocin	1	0.25
57.	Inj Normal Saline (0.9%)	12	3
58.	Inj Calcium Gluconate	1	0.25
59.	Inj Sodium Bicarbonate	2	0.5
60.	Inj Hydrocortisone	1	0.25
61.	Inj Dexamethasone	1	0.25
62.	Inj Glucagon	1	0.25
63.	Inj Mannitol	3	0.75
64.	Inj Fluconazole IV	1	0.25
	Mean= SD=	23.125 55.77321	

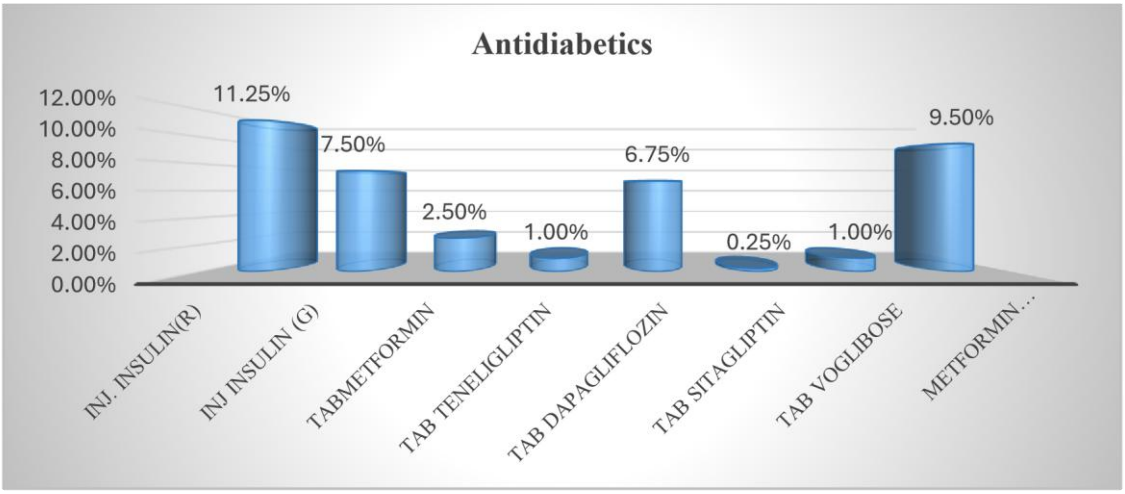
Most commonly used Non-Cardiovascular Drugs used were Alprazolam (64.25 %), Pantoprazole (58%), Bisacodyl (55.25%), Cefixime (44.5%), Paracetamol (32.5%), Lactulose (18.75%), Inj Insulin(R) (11.25 %), Inj Pantoprazole (6.5%), Ondansetron - oral (4%), Inj Ondansetron (5%), Insulin (G) (7.5%).

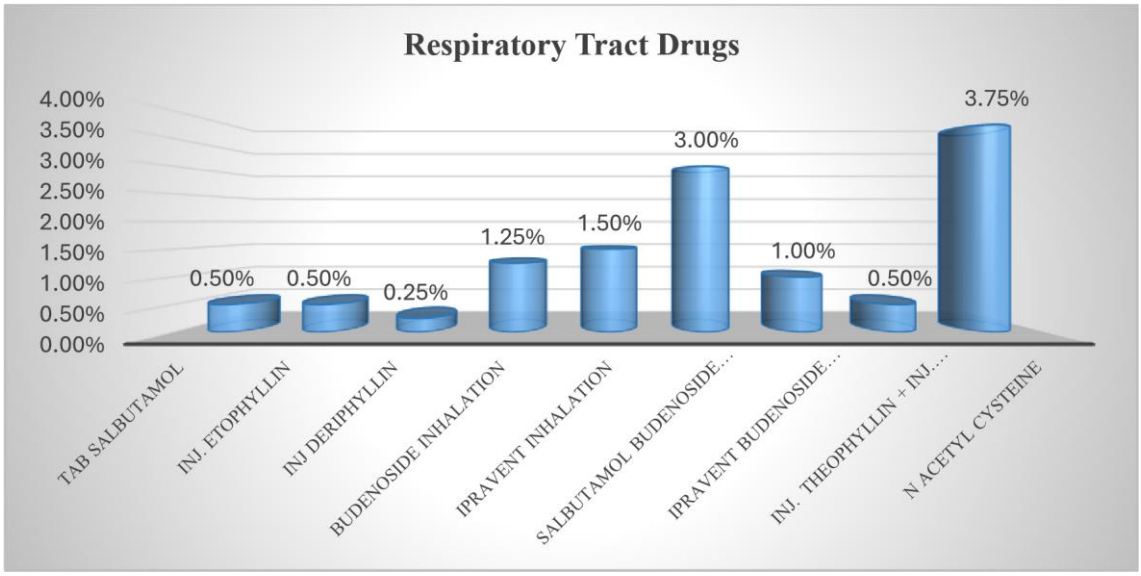


The drug utilization pattern for non-cardiovascular drugs shows distinct preferences across various therapeutic groups. Gastrointestinal tract (GIT) drugs are the most commonly used, with antacids like (PPI) Pantoprazole being administered to 60.25% of patients, and laxatives such as Bisacodyl used by 55.25%. Antibiotics are also significant, with Cefixime being the most prevalent at 44.5%. Antidiabetic drugs, particularly insulin and metformin, are used by a notable portion of patients. Respiratory drugs are less frequently utilized, with bronchodilators and mucolytics showing lower usage rates. Central nervous system (CNS) drugs, specifically anxiolytics like Alprazolam, are highly

utilized at 64.25%, while NSAIDs, including Paracetamol and Diclofenac, have varied usage. Antihistamines and nutritional supplements have minimal presence, reflecting their more specific applications. Miscellaneous drugs also contribute to the overall pattern, though with less frequency. The mean utilization rate of 20.24 and a standard deviation of 49.67 suggest considerable variability in drug use across different categories.







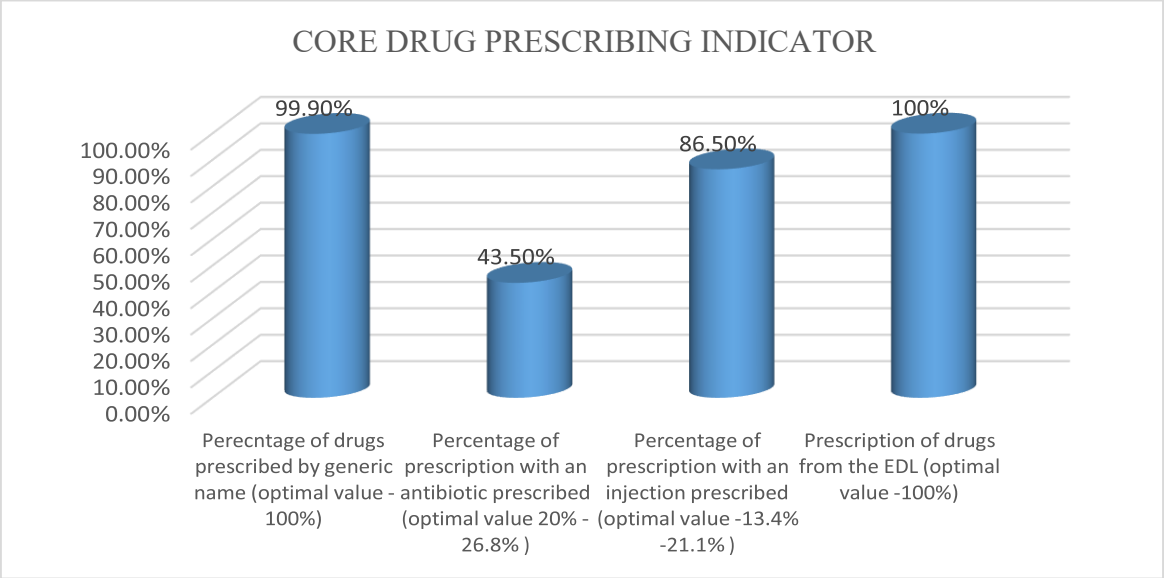
The most commonly used non-cardiovascular drugs were Tab Pantoprazole (58%) and Tab Bisacodyl (55.25%), highlighting a significant prevalence of gastrointestinal issues like acid reflux and constipation among the patients. The use of Tab Lactulose (18.75%) further suggests that gastrointestinal management was a crucial aspect of patient care, especially considering the impact of medications on the digestive system. Injectable Inj Pantoprazole (6.5%) and Inj Ondansetron (5%) were also used to address more severe or acute gastrointestinal conditions, such as severe acid reflux or nausea. In terms of infections, Tab Cefixime (44.5%) was the most frequently prescribed antibiotic, followed by a variety of injectable antibiotics like Inj Ceftriaxone (6%) and Inj Meropenem (0.75%). This indicates that a substantial number of patients were treated for bacterial infections, possibly secondary to their underlying cardiovascular conditions or due to co-morbidities such as diabetes. However, more potent antibiotics like Inj Gentamycin and Inj Vancomycin were prescribed less frequently, reflecting their use in more severe or resistant infections. For metabolic disorders, the use of Inj Insulin (R) (11.25%) and Tab Metformin (2.5%) indicates a significant number of patients had diabetes or were being managed for hyperglycemia. Additionally, drugs like Tab Dapagliflozin (6.75%) and Tab Sitagliptin (0.25%) were prescribed to manage blood sugar levels, with a focus on newer oral antidiabetic therapies for better glycemic control. The prescription of Tab Alprazolam (64.25%) and Tab Paracetamol (32.5%) suggests that many patients were managing symptoms of anxiety and pain, which are common in patients with cardiovascular diseases, particularly those with chronic conditions. There was also a moderate prescription of respiratory medications like Tab Salbutamol (0.5%) and Inj Etophyllin (0.5%), indicating the treatment of respiratory conditions such as asthma or chronic obstructive pulmonary disease (COPD). In terms of injectable drugs, Inj Insulin (G) (7.5%) and a variety of injectable antibiotics and corticosteroids were used, indicating the need for more intensive or urgent therapeutic interventions. The lower usage of more specific drugs like Inj Teicoplanin and Inj Metrogyl suggests that these medications were reserved for particular clinical indications. The mean and standard deviation (mean=23.13, SD=55.77) reflect considerable variability in the non-cardiovascular drug usage, with some drugs being prescribed much more frequently than others. This variability may be due to the wide range of co-morbid conditions present in the patients and the differing severity of those conditions. The drug utilization pattern in this study reveals a diverse approach to managing non-cardiovascular conditions, with a heavy emphasis on gastrointestinal, infection, metabolic, and pain management. The findings underscore the complexity of treatment regimens in cardiovascular patients, highlighting the need for comprehensive care that addresses both cardiovascular and co-morbid health issues.

WHO CORE DRUG PRESCRIBING INDICATOR

The WHO Core Drug Prescribing Indicators in this study provide valuable insights into the prescribing practices for cardiovascular disease patients with co-morbidities at J.L.N. Medical College and Associated Hospitals. The analysis reveals several key points regarding the prescribing patterns and adherence to recommended guidelines.

Table 3 WHO CORE DRUG PRESCRIBING INDICATOR

Prescribing Indicators	No of Patients (Total-400)	%
Average no. of drugs prescribed per prescription (optimal value -<3)	4540/400	11.35
Percentage of drugs prescribed by generic name (optimal value-100%)	4537	99.9%
Percentage of prescription with an antibiotic prescribed (optimal value 20% -26.8%)	172	43.5%
Percentage of prescription with an injection prescribed (optimal value -13.4% -21.1%)	346	86.5%
Prescription of drugs from the EDL (optimal value -100%)	400	100%
Mean=	2398.75	
SD=	2471.791	



The average number of drugs prescribed per prescription was found to be 11.35, which is significantly higher than the optimal value of less than 3. This suggests a trend of polypharmacy, where patients are prescribed multiple medications, possibly due to the complex nature of cardiovascular diseases and their co-morbidities. Polypharmacy, while necessary in certain cases, increases the risk of drug interactions, side effects, and patient non-compliance, which could be a concern in this patient population. The percentage of drugs prescribed by generic name was 99.9%, which is exceptionally close to the optimal value of 100%. This reflects a strong adherence to the practice of prescribing generic drugs, which is cost-effective and ensures access to essential medications. The high percentage of generic prescriptions indicates an efficient and patient-friendly approach, likely aimed at minimizing the financial burden on patients while ensuring effective treatment.

However, the percentage of prescriptions with an antibiotic prescribed was found to be 43.5%, significantly higher than the optimal value range of 20% - 26.8%. This suggests a higher than recommended use of antibiotics, which may indicate overuse or misuse, potentially contributing to the growing concern of antibiotic resistance. This is an area that may require further attention to ensure antibiotics are used only when absolutely necessary. The percentage of prescriptions with an injection prescribed was found to be 86.5%, which is much higher than the optimal range of 13.4% - 21.1%. This indicates a heavy reliance on injectable medications in the treatment of patients, which could be due to the severity of conditions or the need for more rapid therapeutic effects in cardiovascular patients. While injectables are often necessary in acute care settings, their frequent use could imply challenges in managing patients' conditions with oral medications alone or a preference for injectable formulations by healthcare providers.

The prescription of drugs from the Essential Drug List (EDL) was 100%, which is an excellent indicator of the hospital's commitment to using essential, safe, and effective medications in line with national and international guidelines. This is a positive aspect of the prescribing practice, ensuring that the drugs used are appropriate and widely recognized as essential for patient care.

While the study shows a high adherence to the use of generic drugs and the Essential Drug List, it also highlights areas of concern, such as the over-prescription of antibiotics and the excessive use of injectables. These findings suggest a need for review and optimization of prescribing practices to ensure patient safety, cost-effectiveness, and the rational use of medications in line with global best practices. The mean and standard deviation (mean=2398.75, SD=2471.79) further indicate the variability in drug prescribing, which warrants attention to achieve a more balanced and standardized approach.

Beers Criteria of Polypharmacy

The Beers Criteria, developed by the American Geriatrics Society, is a guideline widely used to identify potentially inappropriate medications (PIMs) in older adults, particularly in the context of polypharmacy. It serves as a valuable tool for clinicians to enhance medication safety by minimizing adverse drug events (ADEs) in geriatric populations, who are more vulnerable to the harmful effects of multiple drug use. The criteria list specific medications or classes of medications that should generally be avoided in older adults due to their higher risk of causing side effects, lack of efficacy, or potential for drug-drug and drug-disease interactions. It also includes medications that should be avoided in certain diseases or syndromes, those to be used with caution, drug-drug interaction considerations, and dosage adjustments based on kidney function. The Beers Criteria emphasizes the importance of regular medication reviews, especially for elderly patients with multiple comorbidities, to assess the appropriateness, effectiveness, and necessity of each drug. It promotes a shift from simply counting the number of drugs (as in numerical polypharmacy) to evaluating the clinical appropriateness of each medication, supporting the concept of "appropriate polypharmacy" while discouraging potentially harmful or unnecessary drug use.

4. Discussion

This study aimed to assess the drug utilization patterns among cardiovascular disease (CVD) patients with co-morbidities at J.L.N. Medical College and Associated Hospitals, Ajmer, and provided valuable insights into prescribing practices. The findings indicate a significant trend towards polypharmacy, with an average of 11.35 drugs prescribed per patient, far exceeding the optimal value of <3 drugs per prescription. This high rate of polypharmacy can be attributed to the complex nature of cardiovascular diseases and the prevalence of multiple co-morbid conditions such as diabetes, hypertension, and hyperlipidemia among the study population. While polypharmacy is often essential for managing multiple health issues, it increases the risk of drug-drug interactions (DDIs), adverse drug reactions (ADRs), and non-compliance, which could negatively impact patient outcomes. The study also observed a notable adherence to the use of generic medications (99.9%), which reflects a patientfriendly and cost-effective approach to treatment.

However, some concerning trends were noted in relation to the over-prescription of antibiotics (43.5%) and injectables (86.5%), both of which exceed the optimal recommendations. The overuse of antibiotics could lead to antimicrobial resistance, a global concern, and suggests a need for better stewardship in prescribing antibiotics, ensuring they are used only when absolutely necessary. Similarly, the excessive use of injectable drugs may indicate a preference for more immediate therapeutic effects or a tendency towards aggressive treatment strategies in managing cardiovascular diseases, especially in acute settings. However, such practices may also be indicative of an underutilization of oral medications or a need for more efficient outpatient management.

Despite these deviations from optimal practices, the study demonstrated that prescriptions were largely aligned with essential drug lists (EDLs), with 100% of drugs being prescribed from the EDL. This adherence suggests that healthcare providers are utilizing safe and effective medications in accordance with national and international standards, which is a positive aspect of the prescribing pattern observed in this study. Furthermore, the high percentage of drugs prescribed by generic name highlights an emphasis on affordability and accessibility, important factors for improving patient adherence and reducing healthcare costs.

In terms of non-cardiovascular drugs, the study found significant use of medications for managing comorbid conditions, including gastrointestinal medications like Pantoprazole and Bisacodyl, antibiotics like Cefixime, and diabetes medications such as Insulin and Metformin. This further underscore the multi-faceted approach required to manage CVD patients with co-morbidities. The study also highlighted a substantial use of anxiolytics (Alprazolam), indicating the high prevalence of anxiety symptoms in this patient group, potentially exacerbated by their cardiovascular health status. While these non-cardiovascular drugs are critical in addressing the full spectrum of patient needs, they contribute to the overall burden of polypharmacy and the risk of DDIs. The findings of this study

suggest a need for greater optimization in prescribing practices. The emphasis on rational prescribing, adherence to treatment guidelines, and monitoring for potential adverse drug interactions is essential to ensure that the complex pharmacotherapy of cardiovascular patients remains effective and safe.

5. Conclusion

This study provides a comprehensive overview of the drug utilization patterns in cardiovascular disease (CVD) patients with co-morbidities at J.L.N. Medical College and Associated Hospitals, Ajmer. The findings underscore the complexity of managing CVD in patients who also suffer from multiple comorbid conditions such as hypertension, diabetes, and hyperlipidemia. Polypharmacy, which was observed in a significant portion of the patient population with an average of 11.35 drugs per prescription, is a common practice in such settings. While polypharmacy is often essential for addressing the multifaceted nature of cardiovascular diseases and their associated co-morbidities, it carries inherent risks, including drug-drug interactions (DDIs) and adverse drug reactions (ADRs). These risks can complicate treatment regimens and may lead to suboptimal therapeutic outcomes, highlighting the need for continuous vigilance and individualized treatment planning.

One of the key findings of the study is the substantial adherence to prescribing generic medications, with 99.9% of the drugs being prescribed by their generic names. This practice is beneficial in terms of reducing the financial burden on patients and ensuring access to essential medications. Furthermore, the use of drugs from the Essential Drug List (EDL) in 100% of prescriptions reflects a commitment to using safe, effective, and recommended drugs. However, despite these positive aspects, the study revealed some concerning trends, particularly the over-prescription of antibiotics (43.5%) and injectable drugs (86.5%). These figures exceed recommended norms and raise significant concerns about antimicrobial resistance, patient burden, and overall healthcare costs.

To ensure safer prescribing in elderly patients—who are especially vulnerable to the risks of polypharmacy—the integration of guidelines like the Beers Criteria is imperative. Developed by the American Geriatrics Society, the Beers Criteria offers a framework to identify potentially inappropriate medications (PIMs) in older adults. It encourages prescribers to carefully evaluate the benefit-risk profile of each medication, consider drug-drug and drug-disease interactions, and adjust prescriptions based on kidney function and overall health status. By applying these criteria, healthcare providers can better distinguish between appropriate and inappropriate polypharmacy, ultimately minimizing adverse outcomes in geriatric populations who often present with multiple co-morbidities.

The findings of this study emphasize the urgent need for optimization in prescribing practices. While the adherence to essential drugs and the use of generics are commendable, the overuse of antibiotics and injectables, and the high average number of medications per prescription, indicate areas for improvement. Rational drug prescribing, guided by standard treatment protocols, Beers Criteria, and evidence-based practices, is essential to reducing the risks associated with polypharmacy. Healthcare professionals must be encouraged to adopt a more cautious, individualized approach—prescribing only when clinically indicated and avoiding medications that may do more harm than good. Continuous education, regular prescription audits, and enhanced patient monitoring will play a vital role in optimizing therapeutic outcomes and ensuring the delivery of safe, effective, and patient-centered care for CVD patients with co-morbidities.

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