



**A STUDY ON PRESCRIBING PATTERN OF DRUGS IN PATIENTSWITH  
CARDIOVASCULAR DISEASES**

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**ABSTRACT**

**Background:** Cardiovascular diseases are a major health problem and have become the world's most common cause of morbidity and mortality. Prescription Pattern Monitoring Studies are the Drug Utilization Studies that help to evaluate the problems in prescribing patterns. Thus, the study aimed to assess the prescribing pattern of drugs in patients with cardiovascular diseases. **Materials and Methods:** A Prospective observational study was conducted from July 2018 to March 2019 in the In-Patient Department of Cardiology in a tertiary care hospital, Hyderabad. The demographic and treatment data of 196 patients were collected in a specially designed data collection form. WHO prescribing indicators and other parameters were analyzed using descriptive statistics to measure the performance of health care providers related to the appropriate use of drugs. **Results:** In this study, among 196 patients, 65.82% and 34.18% were males and females respectively. A maximum number of patients was in the age group of 51-60 years (33.67%). Most commonly prescribed cardiovascular single drugs, 25.93% were anti-hypertensives followed by 22.70% of antiplatelets. The most commonly prescribed cardiovascular FDCs were a combination of two Antihypertensive drugs (50.94%) followed by a combination of Antihyperlipidemic and Antiplatelet drugs (21.70%). The average number of drugs per prescription was 9.96. Antibiotics were prescribed to 34.18% patients and injections were prescribed to 75% of patients. Cardiovascular drugs prescribed from the 2017 WHO model list of essential medicines was 35.81%. Among drug-drug interactions, moderate interactions were most commonly found followed by major interactions. **Conclusion:** Present study results conclude that pharmacists and prescribers should collaborate to improve prescribing patterns and help promote rational drug use.

**KEYWORDS:** Rational use, prescription pattern, WHO prescribing indicators, cardiovascular drugs, polypharmacy, drug-drug interactions.

**INTRODUCTION**

Drugs, being an intrinsic and incomprehensible unit of present-day health care services play an important role in not only saving lives and promoting advanced well-being, but in counteracting pandemics and diseases as well and its accessibility is the major right of each individual.<sup>[1]</sup> Despite the fact that they are not the sole therapeutic intervention that contributes desirable to health levels, to provide their desired effect they ought to be utilized safely, efficiently, and rationally.<sup>[2]</sup>

In 1985, the World Health Organization defined the rational use of medicines as requiring that "patients receive medications appropriate to their clinical needs, in doses that meet their requirements, for an adequate period of time and at lowest cost to them and their

community."<sup>[3]</sup> This definition can be reduced to five rights – the right drug with the right dose by the right route at the right time for the right patient.<sup>[4]</sup> It represents a systematic approach that involves making of (differential) diagnosis, estimating prognosis, establishing therapeutic goals, adopting the most appropriate treatment and monitoring the effects of that treatment.<sup>[5]</sup>

Good prescribing is a complex balance between various contradicting factors. Its aim is to achieve clinical benefit at minimum risk at cost-effective price while respecting the patient's choice.<sup>[6]</sup>

Unfortunately, in reality, the pattern of prescribing does not generally fit within these standards and in clinical

practice, the event of irrationality is not uncommon.<sup>[7][8]</sup>

According to WHO estimate, overall over half of all medications are prescribed, administered, or sold improperly, while half of the patients neglect to take them effectively. Also, around 33% of the total population needs access to essential medicines<sup>[9]</sup>, Also the errors in the prescription are prevalent even in the tertiary care hospitals and are expected to be due to ignorance and insufficient knowledge about the disease and the pharmacology of prescribed drugs leading to irrational use of drugs.<sup>[10]</sup>

Cardiovascular diseases (CVDs) are a group of disorders of the heart and blood vessels, which include coronary heart disease, cerebrovascular disease, peripheral arterial disease, Rheumatic Heart Disease (RHD), congenital heart disease, Deep Vein Thrombosis (DVT), and pulmonary embolism.<sup>[6]</sup> It is a major health problem and has become the headmost cause of morbidity and mortality globally.<sup>[11]</sup> Nearly 80% of cardiovascular deaths occur in low and middle-income countries worldwide, which include most of the countries of Asia. World Health Organization (WHO 2009) reported that by 2015 about 20 million people might die due to CVDs.<sup>[12]</sup>

Optimal pharmacotherapy for cardiovascular disease is required. For efficient management and better patient outcomes, treatment requires being safe, efficacious and appropriate.<sup>[13]</sup> Due to an increase in irrationality and improper utilization of drugs, prescribing behavior in cardiovascular conditions needs to be identified.<sup>[14]</sup>

Drug utilization review (DUR) also referred to as Drug Utilization Evaluation (DUE)/ Medication Use Evaluation (MUE) is defined as an authorized, structured, ongoing review of prescribing, dispensing, and use of medication.<sup>[15]</sup> It is a continuous, systematic, criteria-based drug assessment ensuring the appropriate utilization of medications.<sup>[16]</sup>

Drug utilization studies helps to assess problems in prescribing patterns. It provides feedback to the prescriber and helps to identify, correct or modify the treatment strategies and provide appropriate treatment to the patient.<sup>[13]</sup>

Pharmacists, because of their expertise in the area of medication therapy management play a significant role in DUR process. They can collaborate with the physicians and other healthcare professionals and optimize the drug therapy for patients.<sup>[15]</sup>

To our knowledge, there are limited numbers of studies from India [in Hyderabad] to provide an idea about recent prescription patterns. Therefore, this study was carried out to assess the prescribing pattern of drugs in patients with cardiovascular diseases.

## MATERIALS AND METHODS

A prospective, observational and non-interventional study was carried out in the In-patient department of Cardiology in a tertiary care hospital, Hyderabad.

### Study duration

The study was conducted for 6 months from October 2018 to March 2019

### Sample size

One hundred and ninety-six adult patients with cardiovascular diseases.

### Inclusion criteria

- Patients 18 years and above.
- Patients of either gender.
- Patients with cardiovascular disease with or without co-morbid conditions.

### Exclusion criteria

- Patients below 18 years.
- Patients in other departments of the hospital.
- Pregnant and lactating women.

### Data collection form

All the data obtained from the patient's medical record was documented in the data collection form. Data Collection Form was specially designed for purpose of this present study. It comprised of patient demographics like age and gender, medical history, lab investigations, final diagnosis, and treatment details such as the name of the drug, dosage form, frequency, route of administration, duration of treatment and drug interactions.

**Validation of data collection forms:** Pilot study was conducted including 20 patients with cardiovascular disease as per the inclusion criteria eligibility of the present study. It was easy and took 15 min to complete a form.

### Data analysis

WHO prescribing indicators and other parameters were analyzed to measure the performance of health care providers related to the appropriate use of drugs.<sup>[17]</sup>

### WHO prescribing drug indicators

1. Average number of drugs per encounter.
2. Percentage of drugs prescribed by generic name.
3. Percentage of encounters with an injection prescribed.
4. Percentage of encounters with an antibiotic prescribed.
5. Percentage of drugs prescribed from an Essential Drug List /Formulary.

### Other parameters assessed were as follows

1. Distribution of CVDs in the study population.

2. Gender wise distribution of CVDs.
3. Age-wise distribution of CVDs.
4. Common co-morbid conditions observed in patients with CVDs.
5. Common cardiovascular Fixed Dose Combinations (FDC) prescribed.
6. Common cardiovascular individual drugs prescribed.
7. Drug-drug interactions.

screened for potent drug-drug-drug interactions by using Medscape multidrug interaction checker tool to identify and analyze the pattern of drug-drug drug interactions.<sup>[18]</sup>

**Statistical analysis**

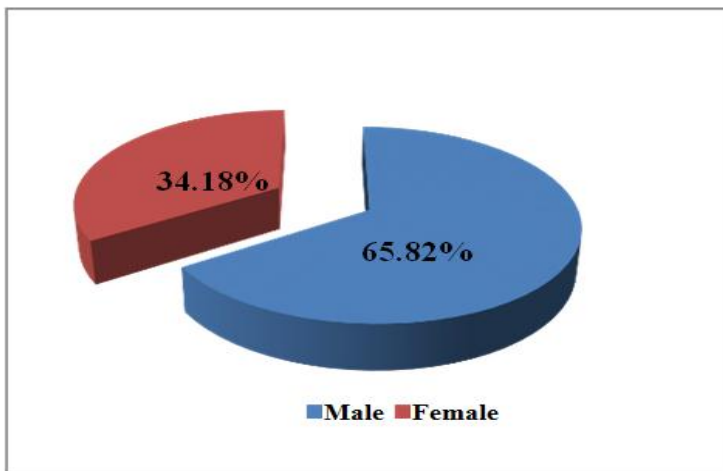
All the data was entered into a computer program (MS Excel) and suitable codes were given to some parameters for calculations. Descriptive statistics were used to analyze data and were expressed as counts and percentages.

**Tools used for identifying drug-drug interactions**

All the prescriptions of the study population were

**RESULTS**

**Gender wise distribution**

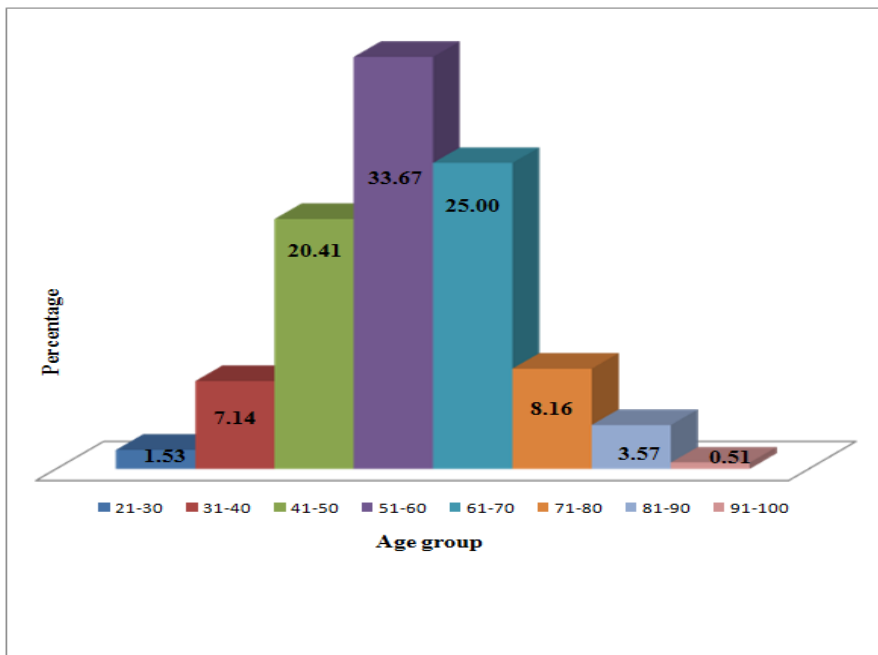


**Fig. No. 1: Gender wise distribution.**

Out of 196 patients, male patients were 129 (65.82%) and female patients were 67 (34.18%). In this present

study, male patients were more when compared to females as shown in Fig.1.

**Age-wise Distribution**



**Fig. No. 2: Age wise distribution.**

In this present study maximum number of patients were in the age group of 51-60 years (33.67%), followed by

the patient age group of 61-70 years (25%). Data related to the group is mentioned in Fig.2.

### Distribution of cardiovascular diseases

**Table No.1: Distribution of cardiovascular diseases (N=196)**

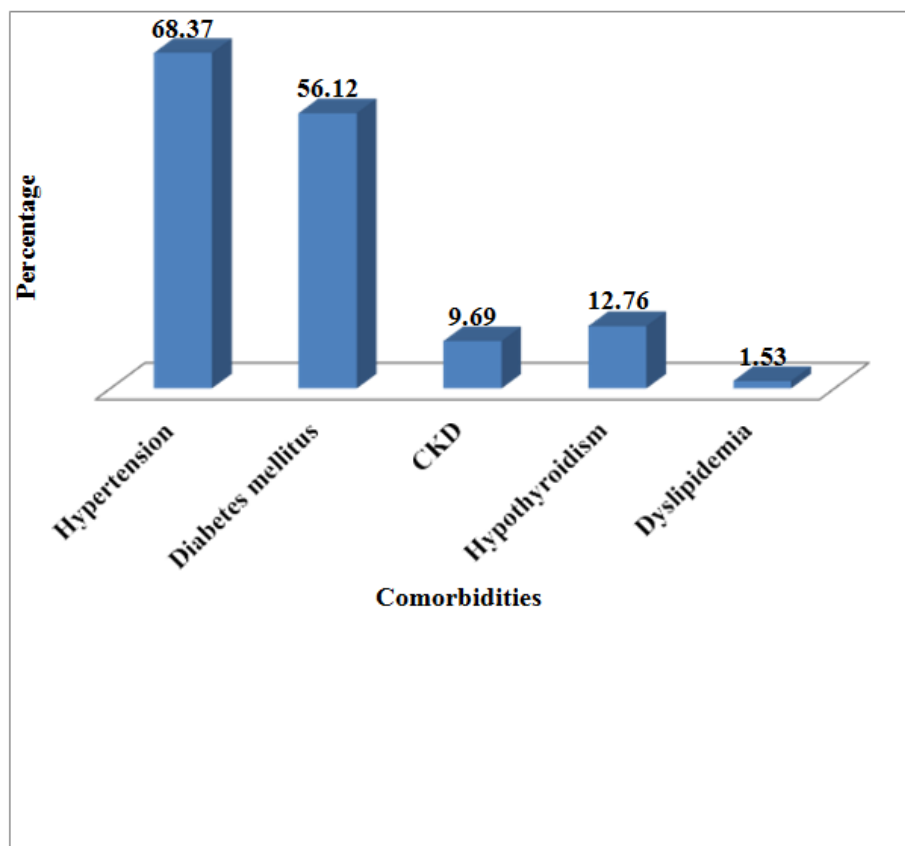
Cardiovascular disease	N	%
CAD	144	73.47
Left Ventricular Failure (LVF)	53	27.04
ACS	13	6.63
MI	55	28.06
Angina Pectoris	36	18.37
ADHFs	5	2.55
DVT	2	1.02
Cardiomyopathy	6	3.06
HF	5	2.55
Arrhythmias	11	5.61
Heart Block	4	2.04
Corpulmonale	2	1.02
RHD	3	1.53
Left varicose veins	1	0.51

*\*One patient may have more than one disease.*

Among 196 patients, 144 (73.47%) patients were diagnosed with CAD followed by 55 (28.06%) patients with MI, 53 (27.04%) patients with LVF, 36 (18.37%) patients with Angina Pectoris, 13(6.63%) patients with ACS, 11 (5.61%) patients with Arrhythmias, 6 (3.06%) patients with Cardiomyopathy, 5(2.55%) patients with

HF, 5(2.55%) patients with ADHF, 4 (2.04%) patients with Heart Block, 3(1.53%) patients with RHD, 2(1.02%) patients with Cor pulmonale, 2(1.02%) patients with DVT and 1(0.51%) patient with Left varicose veins. Data related to the distribution of cardiovascular diseases is represented in Table No. 1

### Common co-morbidities



**Fig. No. 3: Common comorbidities.**

The most frequently encountered comorbidities were Diabetes Mellitus in 110 (56.12%) patients. Further data is described in Fig.3.

### Details of drug therapy

**Table No.2: Details of drug therapy**

Drug therapy details in cardiovascular disease patients	N (%)
Total number of prescriptions analyzed (Number)	196
Total number of drugs prescribed	1952 (100)
Total number of Cardiovascular drugs prescribed	1159 (59.38)
Total number of non cardiovascular drugs prescribed	793 (40.62)
Total number of single drugs prescribed	1635 (83.76)
Total number of single cardiovascular drugs prescribed	1053 (64.40)
Total number of single non-cardiovascular drugs prescribed	582 (35.60)
Total number of fixed-dose combinations prescribed	317 (16.24)
Total number of cardiovascular FDC prescribed	106 (33.44)
Total number of noncardiovascular FDC prescribed	211 (66.56)
Cardiovascular drugs prescribed from the 2017 WHO model list of essential medicines	415 (35.81)
Cardiovascular drugs not prescribed from 2017 WHO model list of essential medicines	744 (64.19)

In 196 prescriptions analyzed, a total number of 1952 drugs were prescribed. Among these, 1159 (59.38%) were cardiovascular drugs and 793 (40.62%) were non-cardiovascular drugs. A total of 1635 (83.76%) drugs were prescribed as a single drug. Of these cardiovascular single drugs were 1053(64.40%) and non-cardiovascular single drugs were 582(35.60%).

Fixed-Dose Combinations. Of these, cardiovascular FDCs were 106(33.44%) and non-cardiovascular FDCs were 211(66.56%).

Out of 1159 cardiovascular drugs, 35.81% were from the year 2017 WHO model list of essential medicines, and 64.19% were not from the list. Data related to details of drug therapy is represented in Table No.2

A total of 317 (16.24%) drugs were prescribed as

### Assessment of prescribing indicators as per WHO.

**Table No.3: Assessment of prescribing indicators as per WHO.**

S.No.	Prescribing indicators as per WHO	%	WHO standard Values <sup>[19]</sup>
1.	The average number of drugs per prescription (number)	9.96	1.6-1.8
2.	Percentage of drugs prescribed by generic name	100	100
3.	Percentage of encounters with an antibiotic prescribed	34.18	20.0-26.8
4.	Percentage of encounters with an injections prescribed	75.00	13.4-24.1
5.	Percentage of cardiovascular drugs prescribed from WHO model list of essential medicines (2017)	35.81	100

In this present study, the average number of drugs per prescription was 9.96. The generic name of the drug was mentioned along with the brand name in the

prescriptions. Antibiotics were prescribed in 34.18% of patients and injection was prescribed in 75% of patients. Data is represented in Table No.3.

### Details of single cardiovascular drugs prescribed.

**Table No.4: Details of categories of single cardiovascular drugs prescribed.**

Categories	No. of drugs prescribed	%
<b>Antiplatelets</b>	<b>239</b>	<b>22.70</b>
Anticoagulants	113	10.73
Antianginals	199	18.90
Antihyperlipidemic	155	14.72
<b>Antihypertensives</b>	<b>273</b>	<b>25.93</b>
Inotropic	39	3.70
Antiarrhythmics	8	0.76

Vasopressin receptor antagonists	3	0.28
Others	24	2.28
Total	1053	100.00

In this present study, the most commonly prescribed categories of single cardiovascular drugs were Antihypertensives 273(25.93%) followed by Antiplatelets 239(22.70%), Antianginals 199(18.90%), Antihyperlipidemics 155(14.72%), Anticoagulants

113(10.73%), Ionotropic agents 39(3.70%), Antiarrhythmics 8(0.76%), Vasopressin receptor antagonists 3(0.28%) and others 24(2.28%). Data is represented in Table No.4.

**Table No.5: Details of single Antiplatelets Prescribed.**

Antiplatelets	No. of drugs prescribed	%
Aspirin	<b>113</b>	<b>47.28</b>
Clopidogrel	<b>71</b>	<b>29.71</b>
Ticagrelor	34	14.23
Prasugrel	20	8.37
Cilostazol	1	0.42
Total	239	100

The most commonly prescribed antiplatelets were Aspirin 113(47.28%), followed by Clopidogrel 71(29.71%), Ticagrelor 34(14.23%), Prasugrel

20(8.37%), and Cilostazol 1(0.42%). Data is represented in Table No.5.

**Table No.6: Details of single Anticoagulants prescribed.**

Anticoagulants	No. of drugs prescribed	%
Enoxaparin	56	49.56
Heparin	42	37.17
Fondaparinux sodium	7	6.19
Dabigatran	3	2.65
Dalteparin	2	1.77
Nicoumalone	3	2.65
Total	113	100

The most common anticoagulants prescribed were Enoxaparin 56 (49.56%), followed by Heparin 42(37.17%), Fondaparinux sodium 7(6.19%), Dabigatran

3(2.65%), Nicoumalone 3(2.65%) and Dalteparin 2(1.77%). Data related to this is represented in Table No.6.

**Table No.7: Details of single Antianginals prescribed.**

Antianginals	No. of drugs prescribed	%
Trimetazidine	35	17.59
Nitroglycerin	<b>77</b>	<b>38.69</b>
Ivabradine	23	11.56
Isosorbide mononitrate	4	2.01
Nicorandil	<b>46</b>	<b>23.12</b>
Ranolazine	11	5.53
Isosorbide dinitrate	3	1.51
Total	199	100

The most common antianginals prescribed were Nitroglycerin 77(38.69%), followed by Nicorandil 46(23.12%), Trimetazidine 35(17.59%), Ivabradine

23(11.56%), Ranolazine 11(5.53%), Isosorbide mononitrate 4(2.01%) and Isosorbide dinitrate 3(1.51%). Data is represented in Table No.7.

**Table No.8: Details of single Antihyperlipidemic prescribed.**

Antihyperlipidemic (statins)	No. of drugs prescribed	%
Atorvastatin	<b>131</b>	<b>84.52</b>
Rosuvastatin	24	15.48
Total	155	100

The most commonly prescribed antihyperlipidemic was Atorvastatin 131(84.52%), followed by Rosuvastatin 24(15.48%). Data is represented in Table No.8.

**Table No.9: Details of single Antihypertensives prescribed.**

Class	No. of drugs prescribed	%
ACE inhibitors	39	14.29
Angiotensin receptor Blockers	30	10.99
Calcium channel blockers	24	8.79
$\alpha$ blockers and $\alpha+\beta$ blockers	19	6.96
<b>Beta-blockers</b>	<b>88</b>	<b>32.23</b>
<b>Diuretics</b>	<b>73</b>	<b>26.74</b>
Total	273	100

Among Antihypertensives, the most commonly prescribed class was Beta-blockers 88(32.23%) followed by Diuretics 73(26.74%), ACE inhibitors 39(14.29%), Angiotensin Receptor Blockers 30(10.99%), Calcium Channel Blockers 24(8.79%) and  $\alpha$  blockers and  $\alpha+\beta$

blockers19(6.96%). Data is represented in Table No.9.

Further data relating to details of single antihypertensive classes are described in Table No.10

**Table No.10: Details of single Antihypertensive classes prescribed.**

Drug classes	Drugs	No. of drugs prescribed	%
<b>ACE inhibitors</b>	Ramipril	27	9.90
	Enalapril	10	3.66
	Perindopril	2	0.73
	Total	39	14.29
<b>ARBs</b>	Telmisartan	25	9.16
	Losartan	4	1.46
	Valsartan	1	0.37
	Total	30	10.99
<b>Calciumchannel blockers</b>	Diltiazem	10	3.66
	Amlodipine	9	3.30
	Verapamil	1	0.37
	BenedipineHCl	4	1.46
	Total	24	8.79
<b><math>\alpha</math> blockers and <math>\alpha+\beta</math> blockers</b>	Silodosin	1	0.37
	Prazosin	4	1.46
	Tamsulosin	1	0.37
	Carvedilol	13	4.76
	Total	19	6.96
<b>Beta blockers</b>	Metoprolol succinate ER	52	19.04
	Metoprolol	15	5.50
	Bisoprolol	15	5.50
	Nebivolol	5	1.83
	Atenolol	1	0.36
	<b>Total</b>	<b>88</b>	<b>32.23</b>
	<b>Diuretics</b>	Furosemide	44
Torseamide		17	6.23
Spirolactone		4	1.46
Eplerenone		8	2.93
<b>Total</b>		<b>73</b>	<b>26.74</b>



**Table No.11: Details of Inotropic agents prescribed:**

Inotropic agents	No. of drugs prescribed	%
Digoxin	17	43.59
Dobutamine	16	41.03
Noradrenaline	6	15.38
Total	39	100

Among Inotropic drugs, Digoxin 17(43.59%) was more commonly prescribed followed by Dobutamine 16(41.03%) and Noradrenaline 6(15.38%). Data is represented in Table No.11.

**Details of Antiarrhythmic agents prescribed**

In this present study, among antiarrhythmic drugs only

Amiodarone was prescribed in eight prescriptions.

**Details of vasopressin receptor antagonist drugs prescribed**

Among Vasopressin receptor antagonists, only Tolvaptan was prescribed in three prescriptions.

**Details of Cardiovascular FDCs prescribed****Table No.12: Details of categories of cardiovascular FDCs prescribed.**

Category	No. of drugs prescribed	%
<b>Antihypertensives</b>	<b>54</b>	<b>50.94</b>
Antihyperlipidemic + Antiplatelet	23	21.70
Antihyperlipidemic	1	0.94
<b>Antiplatelets</b>	<b>28</b>	<b>26.42</b>
Total	106	100

Out of 106 combinational Cardiovascular drugs prescribed, 54(50.94%) were antihypertensives, 28(26.42%) were Antiplatelets, 23(21.70%) were Antihyperlipidemic+Antiplatelet and 1(0.94%) was Antihyperlipidemic. Data on categories of combinational

cardiovascular drugs are depicted in Table No.12. Further detailed data on categories of cardiovascular FDCs is represented in Table No.13, Table. No.14, and Table. No.15.

**Table No.13: Details of Antihypertensive FDCs prescribed.**

Antihypertensives	No. of drugs prescribed	%
Telmisartan + Hydrochlorothiazide	8	14.81
Sacubitril + Valsartan	11	20.37
Telmisartan + Metoprolol	4	7.41
Furosemide + Spironolactone	7	12.96
Eplerenone + Torsemide	4	7.41
Torsemide + Spironolactone	4	7.41
Others	16	29.63
Total	54	100

**Table No.14: Details of Antihyperlipidemic + Antiplatelet FDCs prescribed.**

Antihyperlipidemic + Antiplatelets	No. of drugs prescribed	%
<b>Atorvastatin + Aspirin</b>	<b>12</b>	<b>52.17</b>
Atorvastatin + Clopidogrel	5	21.74
Rosuvastatin + Clopidogrel	2	8.70
Atorvastatin + Clopidogrel + Aspirin	2	8.70
Rosuvastatin + Clopidogrel + Aspirin	2	8.70
Total	23	100

**Table No.15: Details of Antiplatelet FDCs prescribed.**

Antiplatelets	No. of drugs prescribed	%
<b>Prasugrel + Aspirin</b>	<b>3</b>	<b>10.71</b>
Clopidogrel + Aspirin	25	89.29
Total	28	100.00



### Drug-Drug Interactions

In this present study, out of 196 prescriptions, major interactions were found in 35(17.33%) prescriptions and

moderate interactions were found in 167(82.67%) prescriptions. Data is represented in Fig.4.

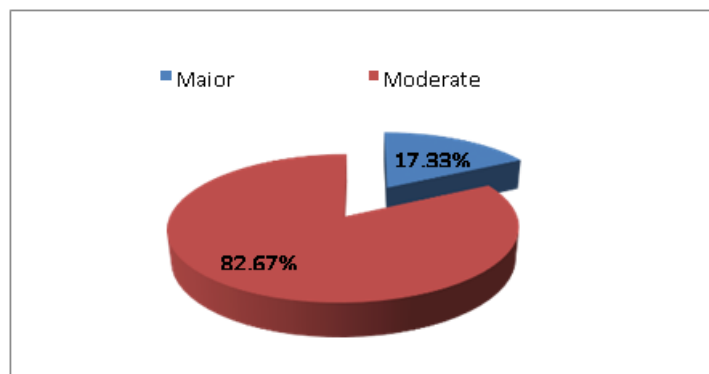


Fig. No. 4: Details of DDIs in prescriptions.

### Details of Categorization of major and moderate DDIs

In this present study, a total of 318 categories of interactions were noticed. Of which 38(11.95%)

categories of drug-drug interactions were major and 280(88.05%) categories of drug interactions were moderate. Data is depicted in Table No.16.

Table No.16: Details of Categorization of major and moderate DDIs.

Severity of DDI	Categories of drug interactions	%
Major interactions	38	11.95
<b>Moderate interactions</b>	<b>280</b>	<b>88.05</b>
Total	318	100

### The severity of DDIs

A total of 706 drug interactions were noticed. Of these 51(7.22%) drug interactions were major and

655(92.78%) drug interactions were moderate. Data is represented in Table No.17.

Table No.17: Details of the severity of DDIs.

Severity of DDI	No drug interactions	%
Major	51	7.22
Moderate	655	92.78
Total	706	100

## DISCUSSION

A prospective observational study was carried out on 196 patients to assess the prescribing pattern of drugs in patients with cardiovascular diseases.

### Gender wise distribution

In this present study, cardiovascular diseases were higher in males (65.82%) than in females (34.18). It was following the results of the study conducted by **Bhim Ram et al.**, in which the frequency of cardiovascular diseases was higher in male patients (68%) than in female patients (32%).<sup>[20]</sup>

In male patients, cardiovascular diseases are mainly triggered by many risk factors such as high blood pressure, high cholesterol, smoking or alcohol drinking habits, obesity, or diabetes, which can be controlled through the consumption of a healthy diet, regular exercise, and avoiding tobacco and alcohol.<sup>[21]</sup>

### Age-wise distribution

In this present study, the most commonly observed age group was 51-60 years (33.67%), followed by the age group of 61-70 years (25%). The results of this present study were similar to the study results of **Blessy et al.**, in which cardiovascular disease was more prevalent in the age group of 51-60 years.<sup>[21]</sup>

The reason for this might be the increased risk of cardiovascular disease with the increasing age.

### Distribution of cardiovascular diseases

In this present study, the most commonly diagnosed cardiovascular diseases were coronary artery disease (73.47%) followed by myocardial infarction (28.06%). The results were found similar to the studies conducted by **Blessy et al** and **Kerker et al.**

**Blessy et al**, reported that the most common cardiovascular diseases observed were coronary artery disease (60%) followed by myocardial infarction

(21%).<sup>[21]</sup>

**Kerker *et al.*** reported that ischemic heart disease (41%) was the most commonly observed cardiovascular disease among enrolled patients.<sup>[13]</sup>

#### Common co-morbidities

In this present study, hypertension (68.37%) and diabetes mellitus (56.12%) were the most commonly observed co-morbidities and these are the major risk factors for cardiovascular diseases.

The present study results were similar to the studies conducted by **Blessy *et al.***, and **Vakade *et al.***

**Blessy *et al.*** reported that hypertension (28.8%) and diabetes mellitus (23.8%) were the most common co-morbid conditions found in the majority of cardiovascular disease patients.<sup>[21]</sup>

**Vakade *et al.*** reported that hypertension (49.24%) and diabetes mellitus (19.51%) were the most common co-morbidities among patients with CVDs.<sup>[8]</sup>

#### An average number of drugs prescribed per prescription

In this present study, the average number of drugs per prescription was found to be 9.96. It was much higher when compared to standard values of WHO as well as the studies conducted by **Kerker *et al.*** and **Boggula *et al.***

However, as per WHO prescribing indicators, the standard value of the average number of drugs per prescription was 1.6-1.89.<sup>[19]</sup>

**Kerker *et al.***, and **Boggula *et al.***, observed that the average number of drugs per prescription was 5.08 and 6.4 respectively.<sup>[13][22]</sup>

Ideally, it is preferred to keep an average number of drugs lower, as polypharmacy leads to an increased risk of drug-drug interactions, and prescribing errors and it increases the cost of therapy.<sup>[14]</sup> However cardiovascular diseases many times, require emergency and/or aggressive therapies, which could be the reason for polypharmacy.

#### Percentage of drugs prescribed by generic names

In the present study, along with the brand name, the generic name of the drug was mentioned in the prescription. The result of this study was following the standard values of WHO prescribing indicators i.e. 100%.<sup>[19]</sup> Another study conducted by **Pendhari *et al.*** reported that 46% of drugs were prescribed by generic names.<sup>[23]</sup>

It is a well-known fact that it is preferable to prescribe drugs by generic names as it avoids duplication of drug products and these are available at a low cost, which can

translate into cost-effective drug therapy.<sup>[14]</sup> The Medical Council of India has given strict instructions to doctors to prescribe drugs by generic names.<sup>[24]</sup> But, very few private practitioners usually do this. So strict measures should be adopted so that the doctors are compelled to prescribe generic medicines.

#### Percentage of encounters with an injection prescribed

In this present study, the frequency of use of injectables was found to be 75%. The present study results were in contrast to the standard values of WHO i.e. 13.4 -24.1% and the study conducted by **Aswani *et al.***, i.e. 34.99%.<sup>[19][12]</sup>

The use of injections when oral formulations are more appropriate is irrational use of medicine because the cost of injections is always higher than that of oral therapy. Moreover, it increases the risk of bloodborne diseases such as hepatitis and HIV/AIDS being transmitted through the use of non-sterile injections.<sup>[25]</sup>

#### Percentage of drugs prescribed from an Essential drug list

In the present study, the percentage of cardiovascular drugs prescribed as per the WHO model list of essential medicine published in 2017 was 35.81%. However, the results of this present study were contrary to the standard values of WHO.<sup>[19]</sup> It was also contrary to the results of **Kerker *et al.*** and **Slathia *et al.***, where the percentage of cardiovascular drugs prescribed from EDL was 92.79% and 82.8% respectively.<sup>[13][14]</sup>

Prescribing drugs from the essential drug list is a good practice as proper selection of essential drugs, is useful for dealing with the majority of health problems cuts down the number of unnecessary products to be manufactured, promoted, and marketed. Thus, the selection of essential drugs promotes rational use of drugs and is recommended by National and International guidelines.<sup>[13]</sup>

#### Percentage of encounters with antibiotics prescribed

In this present study, Antibiotics were prescribed to 34.18% of patients. However, it was contrary to the standard values of WHO i.e. 20.0-26.8%, and the results reported by **Slathia *et al.***, i.e. 0.73%.<sup>[19][14]</sup>

The percentage of antibiotics prescribed was higher than the standard values of WHO prescribing indicators. Thus, it can lead to the development of adverse reactions and antibiotic resistance. **El Mahalli** also mentioned the development of adverse reactions and on a population level, there is a risk of the emergence of antibiotic resistance.<sup>[26]</sup>

#### Percentage of single and fixed-dose combination drugs prescribed

In this present study, single drugs and FDCs were prescribed in a percentage of 83.76% and 16.24% respectively. It was almost similar to the results of the

study conducted by **Slathia *et al.***, which reported that the prescribing frequency of single drugs was 79.88% and of fixed-dose combinations was 20.12%.<sup>[14]</sup>

The study conducted by **Kerker *et al.*** reported that the majority of drugs were prescribed as single drugs i.e., 98.7% and only 1.2% were prescribed as fixed-dose combinations.<sup>[13]</sup>

If FDCs are not properly prescribed, they can cause unwanted side effects, financial burden, and drug resistance.<sup>[26]</sup> Recently Indian government has banned over 328 FDC drugs over safety worries after the Drugs Technical Advisory Board (DTAB) recommended that "there is no therapeutic justification" for the ingredients contained in the banned FDC drugs and that these medicines "may involve risk to human beings". The chances of adverse drug effects and drug interactions can also increase if the drugs are prescribed in FDC.

Thus, minimal use of fixed-dose combinations decreases the overall cost of treatment and prevents adverse events.<sup>[27]</sup>

#### Different categories of single cardiovascular drugs prescribed

In this present study, the most commonly prescribed categories of cardiovascular drugs were antihypertensives (25.93%), followed by antiplatelets (22.70%). These observations are similar to the study conducted by **Boggula *et al.***, in which antihypertensives (38.4%) were commonly prescribed, followed by antiplatelets (34.2%).<sup>[22]</sup>

The high prescribing frequency of the antihypertensives and antiplatelets indicates the high prevalence of hypertension and coronary artery disease.

#### ➤ Antiplatelet therapy

In the present study, it was observed that aspirin (47.28%) was the most commonly prescribed antiplatelet drug followed by clopidogrel (29.71%). The result of the present study was similar to the study conducted by **Blessy *et al.***, in which the most commonly prescribed antiplatelets were aspirin (46.03%) followed by clopidogrel (41.40%).<sup>[21]</sup>

#### ➤ Anticoagulant therapy

In this present study, the most common anticoagulants prescribed were enoxaparin (49.56%) and heparin (37.17%). It was following the results reported by **Dawalji *et al.*** in which enoxaparin (47.27%) was prescribed more frequently, followed by heparin (40%).<sup>[6]</sup>

#### ➤ Antianginal drug therapy

In this present study among antianginals, nitroglycerine (38.69%) was a commonly prescribed drug which was following the results of the study conducted by **Abdul Muhit *et al.***, in which nitroglycerine (78.61%) was more

commonly prescribed by antianginal drugs.<sup>[28]</sup>

#### ➤ Antihyperlipidemic drug therapy

In the present study among antihyperlipidemic drugs, atorvastatin (84.52%) was given to most of the patients whereas the second choice was rosuvastatin (15.48%) which was similar to the results of the study by **Mukesh *et al.***, in which atorvastatin (66.96%) was most commonly prescribed followed by rosuvastatin (22.32%).<sup>[29]</sup>

The previous and present study shows that atorvastatin remains the most commonly prescribed drug among antihyperlipidemic to reduce cholesterol levels.

#### ➤ Antihypertensive drug therapy

In the present study beta-blockers (32.23%) and diuretics (26.74%) were the most commonly preferred classes of antihypertensives. The present study was following the results of the study conducted by **Abdul Muhit *et al.***, in which beta-blockers (51.16%) and diuretics (37.21%) were the most commonly prescribed antihypertensives.<sup>[30]</sup>

#### ➤ Inotropic drug therapy

In the present study among inotropic drugs, digoxin (43.59%) and dobutamine (41.03%) were most commonly prescribed. A similar study by **Blessy *et al.*** in 2017 reported that dobutamine (15%) and digoxin (10%) were the most commonly prescribed inotropic drugs.<sup>[21]</sup>

#### Commonly prescribed cardiovascular fixed-dose combinations

In this present study, the most commonly prescribed cardiovascular FDCs were antihypertensives (50.94%) followed by antiplatelets (26.42%).

In this present study, it was found that.

Sacubitril+Valsartan (20.37%) was commonly prescribed antihypertensive FDC followed by Telmisartan + Hydrochlorothiazide (14.81%).

Among antiplatelet FDCs, Aspirin+Clopidogrel (89.29%) combination was most commonly preferred.

Atorvastatin+Aspirin (52.17%) was the most commonly prescribed antihyperlipidemic+antiplatelet combination.

The present study can be compared to the following studies.

**Slathia *et al.*** observed that antihypertensives-Telmisartan+Hydrochlorothiazide (23.19%) was the commonly prescribed FDC followed by antiplatelets+antihyperlipidemic FDC-Aspirin+Atorvastatin (20.29%).<sup>[14]</sup>

**Patil *et al.*** reported that the most frequently prescribed fixed-dose combinations were Aspirin+Clopidogrel (76%) followed by Aspirin+Clopidogrel+Atorvastatin (5%).<sup>[10]</sup>

### Drug-drug interactions in the prescription

In this present study, the commonly encountered drug interactions were moderate (92.78%) followed by major (7.22%). It was almost similar to the study by **Boggula *et al.***, in which moderate drug interactions were 81.09% and major drug interactions were 9.14%.<sup>[22]</sup>

Patients with cardiovascular diseases are particularly vulnerable to DDIs due to their advanced age, polypharmacy, and the influence of heart disease on drug metabolism. The DDIs potential for a particular cardiovascular drug varies with the individual, the disease being treated, and the extent of exposure to other drugs.<sup>[22]</sup>

### CONCLUSION

The results of this present study revealed that prescribing pattern was not optimal in accordance to the standard values of prescribing indicators, recommended by WHO. Antihypertensives and antiplatelets were the most common cardiovascular drugs prescribed. It is preferable to prescribe drugs by generic name as it avoids duplication of drug and reduces economic burden on patients.<sup>[14]</sup> However, in the present study, prescribers were prescribing drugs with brand names and there was no drug prescribed by the generic name.

Out of all the drug-drug interactions observed, moderate interactions were comparatively more than major interactions. As pharmacists are experts in the area of medication therapy management, they can play a vital role in checking the treatment prescribed and detecting interactions, and in turn reduce medication-related problems and optimize drug therapy for patients.<sup>[30]</sup> Thus pharmacist can work jointly with the prescriber and assist them to identify and correct the shortcomings if any, modify treatment strategies and provide appropriate drug therapy to the patient. With this study, it can be concluded that there is a need for pharmacists to collaborate with the prescriber to improve prescribing patterns and help promote rational drug use and eliminate seemingly irrational prescribing practices in the future.

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