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Original Article

Drug Utilization and Prescribing Pattern in Patients With Myocardial Infarction in A Tertiary Care Teaching Hospital, Raichur, North Karnataka

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ABSTRACT

Background: Myocardial infarction **(**MI) has been the common cardiovascular emergency seen in the emergency department, becoming the leading cause of death due to cardiovascular disease in India. Several drugs are being prescribed in patients with myocardial infarction with varied success. **Aims and Objectives:** The aim of this study is to analyze and evaluate the prescription pattern and prescribing trends of drugs used in patients with MI according to the WHO core prescribing indicators **Materials and Methods:** This is a retrospective observational study that was carried out at a tertiary care teaching hospital i.e. Raichur Institute of médical sciences Raichur, India. The case record files of all the in patients of médicine department with a diagnosis of MI between January 2024 to May 2024 were retrieved from medical record section & data like name, age, sex, diagnosis, ongoing treatment detailed information on drugs were collected and analysed & rationality of prescriptions was evaluated by using the WHO core drug prescribing indicators **Results :** A total 91 patients satisfied the inclusion criteria and were chosen as study participants. Majority of patients were males (57%) and maximum patients were in the age group of 41-60 yr (48%). Average number of drugs per encounter was 9 in our study. Percentage of drugs prescribed by generic name was 48% & drugs prescribed from essential drug list was 91%. Percentage of encounters with antibiotics prescribed was 70% & injection prescribed was 100 %. Most commonly prescribed drugs in our study were Aspirin (96%), Clopidogrel (92%), Ranitidine (80%), Atorvastatin (78%), Enoxaparin (70%), Ceftriaxone (57%), Paracetamol (46%), Isosorbide Dinitrate (38%), Ramipril (35%), Ondansetron (34%), streptokinase (33%). **Conclusion:** Drugs prescribed by generic name was 48% which was less & drugs prescribed from NEDL was 91% which was good in our study.

Keywords*: Myocardial Infarction, prescribing pattern, Drug utilisation, WHO Prescribing indicators.*

INTRODUCTION

The development of drug utilization as a research area made it possible to study drug prescribing and drug usage in a scientific and formal manner. Studies of drug utilization available with regards to cardiovascular system have shown varying pattern of drug utilization in different institution.[1]. The World Health organization (WHO) defined drug utilization as "marketing, distribution, prescription and use of drugs in a society, with special emphasis on the resulting medical, social and economic consequences.[2]. Irrational prescribing has a negative impact on health and economy of both individuals and society, leading to wastage of resources and widespread health hazards. [3,4]. Coronary artery Disease (CAD), is the predominant cardiovascular disease with a substantial contribution towards cardiovascular morbidity, mortality includes cardiomyopathies, Myocardial Infarction (MI), angina pectoris, CHF, and myocarditis.[5]. Myocardial Infarction (MI), the most common frequent type of CAD, develops when a coronary artery is completely blocked or almost blocked, leading to a substantial reduction in blood flow and the infarction of a portion of the heart muscle that is carried by that artery.[6] Acute MI come in two different forms: ST-segment Elevation MI(STEMI) and Non-ST-segment Elevation

MI(NSTEMI). Around 17.5 million people die from these cardiovascular illnesses each year. MI has been the common cardiovascular emergency seen in the emergency department, becoming the leading cause of death due to CVD in India.[7] As a result of prompt reperfusion methods and other medical treatments that follow established guiding principles, there has been a significant shift in the course of treatment over time, from passive healing of the infarction to early release within 2-3 days.[8]. Among the available medications, a few are used to terminate the attack of MI while few are indicated for long term management. Various category of drugs used for MI includes Angiotensin-Converting Enzyme inhibitors (ACEi), Angiotensin-II Receptor Blockers (ARBs), statins, anti-anginal agents, anticoagulants, antiplatelet medications, adrenergic beta blockers, calcium channel blockers, diuretics, etc. are listed. Recent evidence suggests that lifestyle modification and pharmacotherapy are cornerstones for secondary prevention of cardiovascular disease.[9]

Hence it is necessary to analyse the drugs used in MI as per WHO core prescribing indicators to avoid irrational prescribing of drugs. The aim of this study is to analyze and evaluate the prescription pattern and prescribing trends of drugs used in patients with MI according to the WHO core prescribing indicators.

METHODOLOGY

Study Design and Setting

The present study is a retrospective observational study conducted at the Raichur Institute of Medical Sciences (RIMS), a tertiary care teaching hospital located in Raichur, North Karnataka. The study period spans five months, from January 2024 to May 2024. Ethical clearance and permission to access patient medical records were obtained from the Medical Superintendent of RIMS hospital prior to study commencement.

Study Population

The study population includes all inpatients admitted to the medicine department of RIMS with a clinical diagnosis of myocardial infarction (MI) during the study period.

- **Inclusion Criteria:** Patients of either gender, aged above 18 years, admitted to the ICU with a confirmed diagnosis of MI based on clinical evidence.
- **Exclusion Criteria:** Patients with incomplete medical records regarding clinical features or provisional diagnosis, and those with other cardiac events apart from MI were excluded.
- **Sample Size:** All eligible patients admitted during the study period were included; thus, the sample size was based on the total number of available cases meeting inclusion criteria within the five-month duration.
- **Sampling Technique:** Consecutive sampling of all eligible patient case records was employed, ensuring comprehensive inclusion of all MI patients admitted during the study period.

Data Collection

Data were extracted retrospectively from patient case record files obtained from the medical records section of the hospital. A pre-designed data collection form was used to record relevant information, including:

- Demographic details (age, gender)
- Diagnosis and clinical characteristics
- Detailed drug utilization data: drug name, dosage form, route, frequency, and duration of treatment

The rationality of prescriptions was evaluated using the World Health Organization (WHO) core drug prescribing indicators. The generic names of drugs were confirmed using the Indian Drug Review, and the Indian National List of Essential Medicines (2022) was used to assess drugs prescribed from the essential drug list.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using appropriate statistical software, including SPSS and GraphPad Prism version 5.0.

- **Descriptive Statistics:** Continuous variables were expressed as mean ± standard deviation (SD), and categorical data were presented as percentages.
- **Inferential Statistics:** Suitable inferential statistical tests were planned to analyze associations or differences where applicable, depending on data distribution and study objectives.

Ethical Considerations

The study was conducted after obtaining ethical clearance from the institutional ethical committee. Permission was granted by the Medical Superintendent of RIMS hospital to access patient records for research purposes. No direct patient interventions or investigations were performed as part of this retrospective study, ensuring patient confidentiality and adherence to ethical standards.

Results

The present study involved a total of 91 patients diagnosed with myocardial infarction (MI) admitted to the tertiary care teaching hospital in Raichur, North Karnataka. The demographic analysis revealed that the majority of patients were male (57%) and predominantly within the age group of 41-60 years (48%), consistent with trends reported in similar studies. . (table 1) ,(table 2)

Regarding morbidity patterns, 58% of patients had MI alone, while 42% presented with MI accompanied by comorbidities such as diabetes and hypertension. The average number of drugs prescribed per encounter was 9, with most patients receiving between 8 to 10 drugs, indicating a high degree of polypharmacy. . . (table 3) ,(table 4)

The prescribing pattern showed that aspirin (96%), clopidogrel (92%), ranitidine (80%), atorvastatin (78%), and enoxaparin (70%) were the most frequently prescribed medications, aligning with standard treatment protocols for MI. Antibiotics were prescribed in 70% of encounters, with most prescriptions containing one antibiotic, while injection use was universal (100%). The percentage of drugs prescribed by generic name was 48%, and 91% of drugs were from the essential drug list. . (table 5) . (table 6)

While inferential statistical tests were planned, the results primarily focus on descriptive statistics due to the observational nature of the study. No specific hypothesis testing outcomes are reported in the data provided. However, the descriptive findings confirm the prescribing trends and drug utilization patterns expected in MI management, supporting the study's objective to evaluate rational drug use according to WHO core prescribing indicators.

The findings are significant in demonstrating that the present study's prescribing patterns largely conform to established guidelines for MI treatment, with high use of antiplatelets, statins, and anticoagulants. The high percentage of drugs prescribed from the essential drug list (91%) reflects adherence to standardized treatment protocols, which is beneficial for cost-effective and rational drug use. However, the relatively low percentage of drugs prescribed by generic name (48%) indicates room for improvement in promoting generic prescribing, which can further enhance affordability and accessibility.

The universal use of injections and high antibiotic prescription rate (70%) highlight clinical practices that may warrant further scrutiny to ensure appropriate use and avoid potential overuse or misuse, especially of antibiotics.

An unexpected observation is the high average number of drugs per encounter (9), which may suggest polypharmacy beyond what is typically recommended, potentially increasing the risk of drug interactions and adverse effects. Additionally, the 70% rate of antibiotic prescriptions in MI patients could be considered high, given that MI is primarily a cardiovascular condition and antibiotics are not routinely indicated unless there is a concurrent infection. This finding may indicate a tendency toward prophylactic or empirical antibiotic use, which requires further evaluation.

No inferential statistical anomalies or contradictory results were identified within the data. The study's results are consistent with its objectives and comparable literature, reinforcing the validity of the observed prescribing patterns.

RESULTS -MI

Table 1: Age Distribution

Age Group(years)	No.	Percentage (%)
20-40	13	14
41-60	44	48
61-80	34	37
TOTAL	91	100

Age distribution of myocardial infarction patients showing the highest proportion (48%) in the 41-60 years age group. This reflects the predominance of middle-aged patients in the study population.

Table 2: Gender Distribution

Gender	No	Percentage (%)
Male	52	57
Female	39	43

Gender distribution indicating a male predominance (57%) among the myocardial infarction patients included in the study, consistent with known epidemiological trends.

Table 3: Morbidity Pattern

Sl no	Diagnosis	No.	Percentage (%)

1.	**Myocardial infarction**	53	58
2.	**Myocardial infarction with comorbidities like diabetes, hypertension**	38	42

Morbidity pattern highlighting that 58% of patients had myocardial infarction alone, while 42% had MI with comorbidities such as diabetes and hypertension, underscoring the burden of associated conditions

Table 4: Total number of drugs per encounter

No. of drugs	No. of encounters	Percentage (%)
6	2	2
7	5	5
8	17	19
9	28	31
10	26	29
11	09	10
12	03	3
13	01	1

Distribution of total number of drugs prescribed per encounter, with the majority of patients receiving between 8 to 10 drugs, indicating a high level of polypharmacy in the study cohort.

Table 5: Most frequently prescribed drugs with percentage

Sl no	Name of drug	No. of encounters	Percent
1.	**Aspirin**	87	96
2.	**Clopidogrel**	84	92
3.	**Ranitidine**	73	80
4.	**Atorvastatin**	71	78
5.	**Enoxaparin**	64	70
6.	**Ceftriaxone**	52	57
7.	**Paracetamol**	42	46
8.	**Isosorbide Dinitrate**	35	38
9.	**Ramipril**	32	35
10.	**Ondansetron**	31	34
11.	**Streptokinase**	30	33
12.	**Furosemide**	29	32
13.	**Normal Saline**	28	31
14.	**Ringer lactate**	15	16
15.	**Metoprolol**	11	12
16.	**Dobutamine**	11	12
17.	**Amlodipine**	10	11
18.	**Deriphylline**	8	9
19.	**Oxygen**	5	5
20.	**Metformin**	3	3
21.	**Ciprofloxacin**	2	2
22.	**Doxycycline**	1	1

Most frequently prescribed drugs with aspirin (96%) and clopidogrel (92%) being the most common, reflecting adherence to standard MI treatment protocols

Table 6: No. of Antibiotics in a prescription

No of antibiotics prescribed	No of encounters
0	27
1	60
2	03
3	01

Number of antibiotics prescribed per encounter, showing that 70% of patients received at least one antibiotic, with a small proportion receiving up to three, indicating extensive antibiotic use in this setting.

WHO PRESCRIBING INDICATORS

Total no of encounters=**91**
Total no of drugs prescribed=**843**
Number of drugs prescribed by generic name= **401**
Number of the drugs prescribed from essential drug list=**764**
Number of patients to whom an antibiotic is prescribed=**64**
Number of patients to whom an injection is prescribed= **91**

WHO Prescribing indicators	**Result**
Average no of drugs per encounter =total no of drugs prescribed///total no of encounters i.e. **843/91**	9
Percentage of drugs prescribed by generic name =no of drugs prescribed by generic name/// total no of drugs prescribed *100 i.e 401/843*100	48 %
Percentage of encounters with an antibiotic prescribed =no of patients to whom an antibiotic is prescribed /// total no of encounters*100 ie 64/91*100	70%
Percentage of encounters with an injection prescribed = no of patients to whom an injection is prescribed // total no of encounters*100 i.e. 91/91*100	100%
Percentage of drugs prescribed from essential drugs list =no of the drugs prescribed from essential drug list///total no of drugs prescribed *100 i.e. 764/843*100	91%

DISCUSSION

The present study, which included 91 patients with myocardial infarction (MI), revealed that nearly half of the patients (48%) were aged between 41 and 60 years, followed by 37% aged 61-80 years, and 14% aged 20-40 years. Males constituted 57% of the patient population, indicating a male predominance. The morbidity pattern indicated that 58% had MI alone, while 42% had MI with associated comorbidities such as diabetes and hypertension. Furthermore, polypharmacy was evident as the average number of drugs prescribed per encounter was nine, with most patients receiving between 8 to 10 drugs.

These demographic distributions and characteristics align with findings from several large-scale studies. For instance, the American Heart Association Get With The Guidelines Coronary Artery Disease program, analyzing data from 138,122 acute MI patients, observed a substantial proportion of patients aged 45 to 65 years, indicating a similar middle-aged predominance as the present study (48% aged 41-60) [11]. Additionally, that study noted an increasing prevalence of female sex among patients over time; however, males still constituted a majority, which corroborates the current finding of 57% male predominance. The presence of comorbidities like diabetes and hypertension was also consistent with their observations, where patients with non–ST-segment–elevation myocardial infarction had higher prevalence of these conditions.

Similarly, the EMPACT-MI trial, encompassing 6,610 acute MI patients, documented a median age of 64 years with 75.1% males, demonstrating a higher male proportion compared to the present study [12]. Their report also indicated a significant burden of comorbidities, with 69.1% having hypertension and 31.7% diabetes, aligning with the morbidity patterns seen in your cohort where 42% had MI with comorbidities. Such findings emphasize the shared risk factor profiles across different populations despite minor variations in demographic percentages.

Contrastingly, other studies have reported different demographic patterns. For example, in the VALIANT trial, a notable sex difference was observed where women were generally older and had more comorbidities than men, and although men were the majority, the proportion of females was higher than that in your study [13]. The presence of comorbidities in that study was linked to adverse outcomes, supporting the importance of considering comorbid conditions as observed in your study population. Additionally, an observational Swedish registry study noted that patients with peripheral artery disease and MI tended to be older with more comorbidities than those without, suggesting variability in patient characteristics depending on underlying vascular disease status [14].

Regarding drug utilization and polypharmacy, the mean prescription of nine drugs per encounter in your study highlights the complexity of managing MI patients, who often require multiple medications for optimal care. Although direct comparative quantitative data on drug counts are limited in the provided context, the emphasis on comprehensive pharmacotherapy is consistent with the clinical trials and registries which note the use of multiple cardiovascular medications post-MI [12]. For example, standard care in EMPACT-MI involved a range of cardiovascular drugs addressing ischemia, hypertension, and diabetes.

In summary, the demographics and clinical characteristics identified in your study—namely the predominant middle-aged group (41-60 years), male majority (57%), and notable comorbidity burden (42%)—are largely congruent with findings from extensive international studies such as the American Heart Association registry and the EMPACT-MI trial [11,12]. Minor differences in age and sex distributions may relate to regional population variability and sample size. The significant polypharmacy observed echoes the complex treatment regimens described in comparable studies. These similarities reinforce the generalizability of your findings while the noted differences highlight the importance of considering local epidemiological and healthcare factors in understanding MI patient profiles.

The present study revealed that aspirin (96%), clopidogrel (92%), ranitidine (80%), atorvastatin (78%), and enoxaparin (70%) were the most frequently prescribed drugs among myocardial infarction (MI) patients, with antibiotics prescribed in 70% of encounters, predominantly as a single antibiotic per prescription but with some patients receiving up to three antibiotics. Injections were prescribed in 100% of encounters. Using WHO prescribing indicators, 48% of drugs were prescribed by generic name, while 91% were from the essential drug list (EDL), indicating adherence to standardized treatment protocols alongside room for improvement in generic prescribing. The high average number of drugs per encounter and extensive antibiotic use suggest potential overuse, calling for further evaluation to prevent irrational prescribing and safeguard against adverse effects and antibiotic resistance.

When compared to similar settings, the antibiotic prescribing rate of 70% in your study contrasts with lower rates reported in several other teaching hospitals. For example, a cross-sectional study at Hawassa University Teaching and Referral Hospital in Ethiopia documented antibiotics prescribed in 58.1% of encounters, with 38.1% involving injections and a lower average drug count per encounter (1.9 drugs) [15]. Similarly, Mekelle General Hospital in Ethiopia reported antibiotics prescribed in 58.6% of prescriptions and injections in 42.2%, with generic prescribing at 90.4% and about 86.3% drug prescriptions from EDL, reflecting better generic utilization than seen in your present study [16]. These findings collectively suggest that while antibiotic use is common in MI management across these settings, your study indicates a higher rate of antibiotic (70%) and injection (100%) prescribing, possibly driven by local prescribing habits or patient profiles requiring intensive care. The higher polypharmacy observed (average nine drugs per encounter) in your study exceeds the levels typically reported in outpatient or general hospital settings, consistent with the complex pharmacotherapy often needed in MI but potentially indicative of overprescribing issues warranting audits.

Regarding generic prescribing, your present study's 48% is modest when juxtaposed with the 70% observed in public health facilities across two North Indian states [17] and the 90.4% generic prescribing in the Ethiopian Mekelle hospital [16]. Both studies demonstrate relatively strong adherence to generic drugs, highlighting an opportunity for improvement in your setting to promote cost-effective and standardized care. The 91% prescription from the EDL in your study aligns well with the 84% to 96% range reported in these comparative studies [15,17], suggesting good compliance with national essential medicine policies.

In contrast, a study from a tertiary care hospital in Central Nepal reported considerably lower generic prescribing at 2.9% and EDL adherence at 21.3%, along with lower antibiotic (37.9%) and injection (0.7%) use [18]. These dissimilarities emphasize geographic and systemic disparities in prescribing practices, where your present study's findings indicate better alignment with WHO recommendations than those reported in that Nepalese setting, particularly in rational drug list adherence, but sharing concerns regarding excessive antibiotic use and polypharmacy.

The universal use of injections in your study contrasts sharply with the 38.1% injections prescribed at Hawassa University [15] and 42.2% at Mekelle General Hospital [16], highlighting higher parenteral drug utilization in your population, likely reflecting acuity of MI management but also underscoring potential overuse with attendant risks such as injection-related complications.

Regarding antiplatelet and anticoagulant drugs, your high prescribing rates of aspirin and clopidogrel are consistent with standard MI management protocols and supported by studies demonstrating their central roles in secondary prevention [19] and the widespread use of enoxaparin as a low-molecular-weight heparin [20,21].

In summary, the present study's prescribing pattern reflects adherence to essential medicine use and contemporary MI management guidelines, with high antibiotic and injection use and polypharmacy signaling areas requiring rational drug use interventions. Compared with similar studies in Ethiopia and North India, your study shows higher rates of antibiotics, injections, and polypharmacy with lower generic prescribing, while contrasting sharply with the lower adherence and prescribing indices reported from Central Nepal. These observations suggest the need for targeted prescriber education, antibiotic stewardship, and audit mechanisms in your tertiary care setting to optimize pharmacotherapy and mitigate risks associated with overprescribing.

The present study has several limitations. Being a retrospective observational study, it relies solely on the accuracy and completeness of existing medical records, which may have led to missing or incomplete data affecting the comprehensiveness of the analysis. The sample size was limited to patients admitted within a specific five-month period at a single tertiary care teaching hospital, which may restrict the generalizability of the findings to other settings or populations. Additionally, the study did not assess clinical outcomes or patient adherence to prescribed medications, limiting the ability to correlate prescribing patterns with treatment efficacy or safety. The exclusion of patients with incomplete records or other cardiac events may have introduced selection bias. Finally, the study focused on drug utilization patterns without evaluating prescriber rationale or patient-specific factors influencing prescriptions, which could provide deeper insights into prescribing behaviors.

The present study recommends conducting prospective studies with larger, more diverse patient populations to enhance the generalizability of findings. Incorporating clinical outcomes and patient adherence assessments will enable a better understanding of the relationship between prescribing patterns and treatment effectiveness. Future research should also explore prescriber decision-making processes and patient-specific factors to provide comprehensive insights into rational drug use. Implementing regular audits and educational interventions on antibiotic stewardship and generic prescribing may help optimize drug utilization and reduce polypharmacy, ultimately improving patient safety and healthcare quality in similar tertiary care settings.

CONCLUSION

The present study analyzed drug utilization and prescribing patterns in patients with myocardial infarction admitted to a tertiary care teaching hospital in Raichur, North Karnataka. Key findings revealed a predominance of middle-aged male patients, with a significant proportion presenting comorbidities such as diabetes and hypertension. The study identified high rates of polypharmacy, with an average of nine drugs prescribed per encounter, and frequent use of essential medications like aspirin, clopidogrel, atorvastatin, and enoxaparin. Antibiotic and injection use were notably high, while generic prescribing was moderate, indicating areas for improvement. These results align with established treatment protocols but highlight potential overprescribing concerns. Overall, the present study underscores the importance of rational drug use and adherence to WHO prescribing indicators in managing myocardial infarction. It provides valuable insights for optimizing pharmacotherapy, enhancing patient safety, and guiding future interventions in similar healthcare settings.

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