Innovative Research in Applied, Biological, and Chemical Sciences

ISSN: 3005-8449

INNOVATIVE RESEARCH JOURNALS

Research Article

IRABCS, vol. 4, issue 1, 1-7, 2026

Received: May 7, 2026
Revised: May 30, 2026
Accepted: June 2, 2026
https://doi.org/10.62497/irabcs.216

Evaluation of Drug Utilization Patterns and Drug-Related Problems in Myocardial Infarction Management at a Tertiary Care Hospital: A Cross-Sectional Observational Study

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How to cite: Rabbia Jadoon, Safa Gul, Jawad Khan,Umair Ali, Amjid Akbar, Muhammad Ijaz Khan. Evaluation of Drug Utilization Patterns and Drug-Related Problems in Myocardial Infarction Management at a Tertiary Care Hospital: A Cross-Sectional Observational Study. IRABCS. 2026;4(1):1-7. DOI: https://doi.org/10.62497/irabcs.216. Available from: https://irjpl.org/irabcs/article/view/216

Abstract

Background: Myocardial infarction (MI) remains a major cause of morbidity and mortality worldwide, particularly in resource-limited settings. Appropriate pharmacotherapy is essential for optimizing patient outcomes; however, drug-related problems, potential drug–drug interactions, and cost-related prescribing issues may affect the quality and safety of MI management. Evaluating drug utilization patterns in hospitalized MI patients may help identify opportunities for improving prescribing practices.

Objective: To evaluate drug utilization patterns and identify drug-related problems, potential drug–drug interactions, untreated conditions, and cost-related prescribing issues among hospitalized patients with myocardial infarction.

Methods: A prospective descriptive observational case series was conducted in the cardiac ward and coronary care unit of Ayub Teaching Hospital, Abbottabad, Pakistan, from December 2019 to March 2020. Fifteen hospitalized patients diagnosed with myocardial infarction were included during the study period as part of an exploratory pilot assessment. Data were collected prospectively using a structured Subjective, Objective, Assessment, and Plan (SOAP)-based proforma. Drug-related problems and potential drug–drug interactions were identified using standard clinical references and categorized descriptively. Data were analyzed using Microsoft Excel and presented as frequencies and percentages.

Results: Among the 15 patients included, 53.3% were male and 46.7% were female, with most patients (66.7%) aged 56–65 years. ST-elevation myocardial infarction was more common (73.3%) than non-ST-elevation myocardial infarction (26.7%). Potential drug–drug interactions were identified in all evaluated prescriptions, most commonly involving antiplatelet and anticoagulant combinations. Commonly observed drug-related problems included cost-related prescribing issues (86.7%), inappropriate dosing frequency (60.0%), inappropriate dosing (53.3%), and untreated clinical conditions (46.7%).

Conclusion: This study identified a considerable burden of drug-related problems and potential drug–drug interactions among hospitalized patients with myocardial infarction. The findings highlight the importance of regular prescription review, adherence to evidence-based prescribing practices, and multidisciplinary medication monitoring to support rational pharmacotherapy and patient safety.

Keywords: Myocardial infarction, Drug utilization, Rational prescribing, Drug–drug interactions, Pharmacotherapy, Adverse drug reactions, Clinical pharmacy, Healthcare cost, Patient safety

Introduction

Cardiovascular diseases remain the leading cause of morbidity and mortality worldwide, with myocardial infarction (MI) representing one of the most critical and life-threatening manifestations [1-2]. Despite substantial advances in diagnostic techniques and therapeutic strategies, the global burden of MI continues to rise, particularly in low- and middle-income countries where healthcare systems often face

resource constraints [3]. The effective management of MI requires timely intervention, evidence-based pharmacotherapy, and longterm secondary prevention strategies to reduce complications, recurrence, and mortality [4].

Rational use of medicines is a cornerstone of optimal clinical care and is particularly crucial in the management of acute and chronic cardiovascular conditions. Rational pharmacotherapy ensures that patients receive medications appropriate to their clinical needs, in doses that meet individual requirements, for an adequate duration, and at the lowest possible cost [5]. However, in real-world clinical settings, irrational prescribing practices including polypharmacy, inappropriate drug selection, dosing errors, and lack of adherence to clinical guidelines remain prevalent. These practices not only compromise therapeutic outcomes but also increase the risk of adverse drug reactions, drug–drug interactions, and unnecessary financial burden on patients [6].

Patients with myocardial infarction are especially vulnerable to drug-related problems due to the complexity of treatment regimens and the frequent presence of comorbid conditions. The use of multiple medications, including those with narrow therapeutic indices, necessitates careful monitoring to prevent toxicity and ensure therapeutic effectiveness [7]. Additionally, patient-related factors such as medication non-compliance, lack of awareness, and economic limitations further complicate treatment outcomes. Monitoring adverse drug reactions and identifying potential drug-related problems are therefore essential components of comprehensive patient care [8].

Although several studies have evaluated pharmacological management in cardiovascular diseases, there remains a gap in context-specific data regarding the rationality of drug use, patient compliance, and economic burden in MI management, particularly in developing healthcare settings. Furthermore, limited emphasis has been placed on integrating patient education and pharmacovigilance practices into routine clinical care. Addressing these gaps is critical for improving therapeutic outcomes and optimizing healthcare resource utilization [9]. Therefore, the present study aims to evaluate the rational use of medications in myocardial infarction, identify drug-related problems, assess patient compliance, and analyze the economic aspects of therapy. Additionally, the study seeks to emphasize the importance of patient education and continuous monitoring of adverse drug reactions to enhance the overall quality of care in MI management.

Methods and Materials

Study Design and Setting

A prospective descriptive observational case series was conducted in the Cardiology Ward and Coronary Care Unit (CCU) of Ayub Teaching Hospital, Abbottabad, Pakistan, between December 2025 and March 2026. The study was designed as an exploratory pilot assessment to evaluate drug utilization patterns and drug-related problems among hospitalized patients with myocardial infarction.

Participants

A total of 15 hospitalized patients diagnosed with myocardial infarction were included during the study period according to predefined eligibility criteria. Patients were prospectively followed during their hospital stay for assessment of prescribed medications, potential drug–drug interactions, and therapy-related problems.

Variables

The study evaluated demographic characteristics, clinical profile, medication utilization patterns, untreated clinical conditions, potential drug–drug interactions, and drug-related problems. Drug-related problems were categorized using a modified Cipolle, Strand, and Morley classification framework, including inappropriate drug selection, unnecessary drug therapy, inappropriate dose, inappropriate dosing frequency, therapeutic duplication, drug use without clear indication, and cost-related prescribing issues. Drug-related variables including medication name, dose, route, frequency, and duration were recorded. Cost-related prescribing issues were defined as prescription of comparatively expensive brands despite the availability of lower-cost therapeutically equivalent alternatives in the hospital formulary or local market. Untreated conditions were defined as clinically documented symptoms or conditions for which no pharmacological or supportive therapy was prescribed despite apparent clinical indication.

Sample Size

This study was conducted as an exploratory pilot assessment during the defined study period. Due to the limited duration of data collection, restricted patient admissions, and resource limitations associated with prospective SOAP-based monitoring, all eligible patients admitted during the study period who met the inclusion criteria were included consecutively.

Sampling Technique

A non-probability convenience sampling technique was used. Consecutive eligible patients admitted during the study period were included according to predefined eligibility criteria and investigator availability. The sampling approach was considered appropriate for this exploratory pilot study involving prospective clinical monitoring in the cardiac ward and CCU.

Inclusion Criteria

Patients diagnosed with myocardial infarction and admitted to the Cardiology Ward or Coronary Care Unit (CCU) of Ayub Teaching Hospital during the study period were included irrespective of age and gender. Only patients with complete clinical documentation, including medication history and relevant laboratory investigations, were eligible for inclusion.

Exclusion Criteria

Patients with incomplete case histories and those who were transferred to other healthcare facilities before the initiation of pharmacotherapy were excluded from the study.

Data Collection Procedure

Data were collected prospectively during hospitalization using a structured SOAP-based proforma. Subjective data included presenting complaints, medical history, medication history, and reported symptoms. Objective data included physical examination findings, laboratory investigations, ECG findings, and other relevant diagnostic parameters.

Potential drug–drug interactions were assessed using the Medscape Drug Interaction Checker and categorized according to the severity information provided by the database. Only interactions considered clinically relevant and requiring monitoring, dose adjustment, or therapeutic modification were included in the analysis. Drug utilization frequency was calculated based on the total number of prescribed medications across all included patients. Each prescribed drug was counted once according to its therapeutic class. Drug-related problems were identified and categorized using a modified Cipolle, Strand, and Morley classification system. Drug-related problems were assessed by the primary investigator. A clinical pharmacist independently reviewed a subset of cases to ensure consistency in classification and interpretation.

Statistical Analysis

Data were entered and analyzed using SPSS version 26. Descriptive statistics were used to summarize study variables. Continuous variables were expressed as mean ± standard deviation, and categorical variables were presented as frequencies and percentages. No inferential statistical tests were applied due to the small sample size and exploratory nature of the study.

Results

A total of 15 patients with myocardial infarction were analyzed. Among these, 8 (53.33%) were male patients and 7 (46.66%) were female patients. The age-wise distribution showed that 3 (20.00%) patients were in the 45–55 years group, 10 (66.66%) in the 56–65 years group, and 2 (13.32%) were above 65 years, indicating that myocardial infarction was most prevalent in the 56–65 years age category. Most prescriptions showed clinically relevant drug–drug interactions, with the highest proportion (26.7%) having two interactions, followed by 20.0% with six or more interactions. Overall, only a small proportion (6.7%) had a single interaction, while completely interaction-free prescriptions were not observed, indicating a consistently high drug–drug interaction burden in myocardial infarction therapy (Table 1).

Table 1: Demographic profile, clinical characteristics, medication utilization, and prevalence of drug-related problems in myocardial infarction patients

Domain	Variable	Category	Frequency (n)	Percentage (%)
Demographics	Gender	Male	8	53.3
		Female	7	46.7
	Age (years)	45–55	3	20.0
		56–65	10	66.7
		66–75	1	6.7
		76–85	1	6.7
Clinical profile	MI type	STEMI	11	73.3
		NSTEMI	4	26.7
	Hypertension	Present	10	66.7
	Diabetes mellitus	Present	3	20.0
	Combined comorbidities	Present	2	13.3
	Untreated conditions	Yes	7	46.7
Drug utilization	Antiplatelets	—	26	—
	Anticoagulants	—	13	—
	Antihypertensives	—	22	—
	Vasodilators	—	11	—
	Statins	—	8	—
	Antiemetics	—	7	—
	Beta-blockers	—	6	—
	Antibiotics	—	2	—
Therapy-related problems	Cost ineffectiveness	Yes	13	86.7
	Wrong dose	Yes	8	53.3
	Wrong frequency	Yes	9	60.0
	Overprescribing	Yes	9	60.0
	Drug without indication	Yes	4	26.7
	Therapeutic duplication	Yes	5	33.3
	Polypharmacy	Yes	2	13.3

Drug–drug interaction	No. of interactions	0	0	0.0
		1	1	6.7
		2	4	26.7
		3	2	13.3
		4	2	13.3
		5	2	13.3
		≥6	3	20.0

Drug utilization analysis (Table 2) showed that antiplatelets were the most frequently prescribed therapeutic class (26 prescriptions), followed by antihypertensives (22 prescriptions) and anticoagulants (13 prescriptions). These findings reflect the predominant use of antithrombotic and cardiovascular medications in the management of myocardial infarction.Vasodilators and statins were also commonly prescribed, while antibiotics and cardiac glycosides were used least frequently, reflecting targeted rather than broad-spectrum drug utilization. Regarding treatment outcomes, 8 (53.33%) patients received complete treatment of all presenting conditions, while 7 (46.66%) had at least one untreated condition, indicating a notable proportion of unmet clinical needs during hospitalization. Cost ineffectiveness was the most common therapy-related problem (86.7%), followed by wrong frequency and overprescribing (each 60.0%) and wrong dose (53.30%). Therapeutic duplication and drug without indication were also frequently observed, while polypharmacy was less common (13.30%), indicating widespread prescribing inefficiencies in myocardial infarction management.

Drug–drug interaction analysis showed that the most clinically significant interactions involved antiplatelet and anticoagulant combinations, particularly aspirin–clopidogrel and aspirin– enoxaparin, both associated with increased bleeding risk. Other important interactions included clopidogrel–enoxaparin, omeprazole–clopidogrel, and antihypertensive combinations such as ramipril with diuretics or aspirin, highlighting frequent risks of hypotension, reduced drug efficacy, and bleeding complications.Therapeutic duplication was mainly observed with repeated antiplatelet prescribing (aspirin and clopidogrel combinations), while overprescribing commonly involved triple antithrombotic therapy and multiple antihypertensive or antiemetic agents. Cost-related analysis showed frequent use of higher-priced brands despite availability of cheaper alternatives, particularly for enoxaparin, GTN, and metoclopramide.

Drug-related evaluation further identified frequent use of medications without clear indications, especially antihypertensives such as ramipril and diuretics, along with several untreated clinical conditions including constipation, cough, urinary tract infection, and chest pain. Dose and frequency errors were also observed in key drugs such as ceftriaxone, atorvastatin, and enoxaparin, indicating deviations from standard treatment guidelines.

Table 2: Spectrum of drug-related problems, implicated drug combinations, clinical recommendations, and frequency distribution in myocardial infarction management

Category	Drug / Condition	Description	Recommendation	Case Numbers
Drug–Drug Interaction	Aspirin+Clopidogrel	Increased risk of bleeding	Use with caution / monitor	11
	Aspirin+Enoxaparin	Increased bleeding, headache, dizziness	Avoid / dose adjustment	10
	Clopidogrel+Enoxaparin	High risk of fatal hemorrhage	Avoid / close monitoring	10
	Omeprazole+Clopidogrel	Reduced effect of clopidogrel	Replace omeprazole	4
	Furosemide+Bisoprolol	Hypotension and bradycardia	Monitor / avoid	2
	Aspirin+Clopidogrel duplication	Same antiplatelet class duplication	Avoid duplication	5
Overprescribing	Triple antiplatelet therapy (Aspirin+Clopidogrel+Enoxaparin)	Unnecessary combination	Rationalize therapy	8
Cost Ineffectiveness	Enoxaparin (high-cost brand)	Expensive formulation used	Use cost-effective alternative	13
Drug Without Indication	Ramipril	No clinical indication documented	Stop drug	3
	Furosemide	Not indicated in some cases	Stop drug	1
Indication Without Drug	Constipation	Untreated symptom	Add laxatives	4
	UTI	Infection not	Start antibiotics	1

		treated		
Wrong Dose	Atorvastatin	Given 40 mg instead of 10 mg	Correct dose	1
Wrong Frequency	Omeprazole	Given BD instead of OD	Adjust to OD	1

Discussion

This study provides preliminary insights into drug utilization patterns and drug-related problems among hospitalized patients with myocardial infarction in a tertiary-care setting. The findings demonstrate that antiplatelets, antihypertensives, and anticoagulants were the most frequently prescribed medication classes, reflecting the pharmacotherapeutic approaches commonly reported in the management of myocardial infarction. In addition, potential drug–drug interactions, untreated clinical conditions, and various drug-related problems were identified during hospitalization [10].

The observed medication utilization pattern is generally consistent with previous studies conducted in cardiovascular patients, where antiplatelet agents, anticoagulants, statins, and antihypertensive medications constituted the major components of therapy [11]. Chikatipalli et al. similarly reported frequent use of antiplatelet and cardiovascular medications among hospitalized cardiac patients. Such findings likely reflect the central role of these therapeutic classes in contemporary myocardial infarction management. However, direct comparisons should be interpreted cautiously because of differences in study design, patient populations, and healthcare settings [12].

Potential drug–drug interactions were commonly identified in the present study, particularly among antiplatelet and anticoagulant combinations. Similar findings have been reported in hospitalized cardiac populations, where the complexity of multidrug regimens increases the likelihood of interaction alerts [13]. Importantly, many of the identified interactions involved drug combinations routinely used in myocardial infarction management and therefore represent potential interactions requiring clinical monitoring rather than absolute contraindications [14]. Consequently, the frequency of identified interactions should not be interpreted as evidence of inappropriate prescribing but rather as an indication of the need for careful therapeutic monitoring and individualized risk assessment [15].

Cost-related prescribing issues were among the most frequently identified drug-related problems. Previous studies from resource-constrained healthcare settings have also highlighted the potential impact of medication costs on treatment accessibility and patient adherence [16]. The presence of higher-cost brands despite the availability of therapeutically equivalent alternatives may represent an opportunity for optimizing prescribing practices and reducing the economic burden of treatment. Nevertheless, the present study did not formally evaluate pharmacoeconomic outcomes, and therefore conclusions regarding cost-effectiveness should be interpreted cautiously [17].

Another notable finding was the presence of untreated clinical conditions in a proportion of patients. Similar observations have been reported in hospital-based studies, where attention to acute cardiac management may occasionally limit recognition or treatment of concurrent symptoms and comorbid conditions [18]. These findings underscore the importance of comprehensive patient assessment and regular medication review to ensure that all clinically relevant conditions are appropriately addressed during hospitalization [19].

The findings of this study should be interpreted within the context of several limitations. First, the study included a small sample of patients from a single tertiary-care center and was conducted as an exploratory pilot assessment, limiting the precision and generalizability of the findings. Second, the descriptive observational design precludes assessment of causal relationships between prescribing patterns and identified drug-related problems. Third, drug-related problems were identified through structured clinical review and interaction database screening, which may overestimate the frequency of potential drug–drug interactions compared with clinically manifested adverse outcomes. Finally, no formal inter-rater reliability assessment was performed, which may introduce a degree of subjective assessment bias.

Despite these limitations, the study provides preliminary evidence regarding medication utilization patterns and drug-related problems among hospitalized myocardial infarction patients in a Pakistani tertiary-care setting. The findings highlight the potential value of structured medication review, routine monitoring of potential drug–drug interactions, and ongoing evaluation of prescribing practices to support safe and effective pharmacotherapy.

Future studies involving larger multicenter populations are warranted to validate these findings and improve generalizability. Research incorporating standardized assessments of clinical outcomes, pharmacoeconomic measures, and pharmacist-led interventions may provide stronger evidence regarding strategies to optimize medication use and reduce drug-related problems in myocardial infarction management [20].

Conclusion

In conclusion, this study identified a considerable burden of drug-related problems and potential drug–drug interactions among hospitalized patients with myocardial infarction. Cost-related prescribing issues,

dosing and frequency discrepancies, untreated clinical conditions, and clinically relevant interaction alerts were frequently observed. Although antiplatelets, anticoagulants, and antihypertensive agents formed the cornerstone of therapy, their concurrent use often required careful monitoring because of potential interaction risks. These findings suggest opportunities for improving prescribing practices and medication review processes in hospitalized patients with myocardial infarction. Regular prescription review, adherence to evidence-based treatment recommendations, and multidisciplinary medication monitoring may help optimize pharmacotherapy and enhance patient safety.

Author Contributions

All authors contributed equally to the conception and design of the study, data collection, analysis and interpretation of data, drafting and critical revision of the manuscript, and approved the final version for publication. All authors meet the authorship criteria of the ICMJE and agree to be accountable for all aspects of the work.

Acknowledgements

The authors are thankful to the Department of Cardiology and the administration of Ayub Teaching Hospital, Abbottabad, Pakistan, for their support and cooperation during the conduct of this study. The authors also acknowledge all healthcare professionals involved in the management of myocardial infarction patients and the assistance provided in data collection.

Funding

The authors received no specific funding for this work.

Declarations

Ethics approval: This study was conducted in accordance with the ethical standards of the institutional research committee and the Declaration of Helsinki. Ethical approval for the study was obtained from the Institutional Review Board (IRB) of Ayub Teaching Hospital, Abbottabad, Pakistan.

Competing interests: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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