RESEARCH PAPER

Evaluating the Point prevalence of drug-drug interaction in cardiac patient at tertiary care hospital

Shailesh H. Kendre[1], Sayali P. Jadhav[2], Sakshi K. Ghundre[3], Yashraj M. Arbane[4], Prashant R. Mishra[5], Sanket R. Harimkar [6]*

[1]Department of Doctor of Pharmacy, PES's Modern College of Pharmacy, Nigdi, Pune-411044, Maharashtra, India.
Email ID: Shaileshkendre200@gmail.com; https:/orcid.org/ 0009-0003-4454-9353
[2]Department of Doctor of Pharmacy, PES's Modern College of Pharmacy, Nigdi, Pune-411044, Maharashtra, India.
Email ID: Sayalijadhav1819@gmailcom; https:/orcid.org/ 0009-0006-5675-3046
[3]Department of Doctor of Pharmacy, PES's Modern College of Pharmacy, Nigdi, Pune-411044, Maharashtra, India
Email ID: Sakshighundre1206@gmail.com; https:/orcid.org/ 0009-0007-7180-9279.
[4]Department of Doctor of Pharmacy, PES's Modern College of Pharmacy, Nigdi, Pune-411044, Maharashtra, India.
Email ID: Yashrajarbane5347@gmail.com; https:/orcid.org/ 0009-0002-9653-9653-130x

[5] MBBS D.N.B Post doctoral Fellowship (Interventional Cardiology, FSCAI) consultant of Department of Cardiology, Deenanath Mangeshkar Hospital and Research center, Erandwane, Pune -411004, Maharashtra, India
Email ID: Prashantmishra@gmail.com; https:/orcid.org/ 0000-0002-1624-4558

[6] Assistant Professor, Department of Doctor of Pharmacy, PES's Modern College of Pharmacy, Nigdi, Pune-411044, Maharashtra, India.
Email ID: drsanketharimkar@gmail.com; https:/orcid.org/ 0009-0006-2041-1466

***Corresponding author:** Sanket R. Harimkar
* Assistant Professor, Department of Doctor of Pharmacy, PES's Modern college of Pharmacy, Nigdi Pune, Savitribhai Phule Pune University,
Pune 411044, Maharashtra, India. **E-mail address:** drsanketharimkar@gmail.com

ABSTRACT:
Cardiovascular disease with comorbidities demands complex drug regimens, increasing the risk of drug-drug interactions (DDIs). DDIs can compromise therapeutic outcomes through altered metabolism or synergistic effects, especially in polypharmacy settings. Indian cardiac inpatients face rising DDI risks amid limited awareness and variable prescribing practices. This study evaluates the prevalence, severity, and potential clinical Impact of DDIs in a tertiary-care cardiology unit A prospective observational cross-sectional study was conducted over six months at Deenanath Mangeshkar Hospital, Pune. 375 cardiovascular inpatients aged >18 years were enrolled using convenient sampling at discharge. Discharge prescriptions were screened for drug-drug interactions (DDIs) using the Micromedex database. Primary outcome was DDI prevalence; secondary outcomes included severity, mechanism, and clinical consequences. Data were collected via structured Case Report Forms and analyzed using descriptive statistics in Excel. Stratification by age, sex, and medication count explored subgroup patterns; missing data were excluded. Bias was minimized through standardized tools and independent verification, though sampling may limit generalizability Among 375 hospitalized cardiac patients, 61.6% experienced at least one drug-drug interaction (DDI), with a total of 621 drug-drug interaction identified. Moderate (51.8%) and severe (47.5%) interactions dominated, mostly pharmacokinetic in nature (56.0%), primarily due to altered metabolism. Frequent drug pairs included thromboxane inhibitors with p2y12 blockers and factor xa inhibitors. Micromedex data suggested potential risks like hypoglycemia (31.1%) and bleeding (17.4%).

KEYWORDS: drug-drug interactions, point prevalence, cardiac patients, tertiary care hospital, polypharmacy
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INTRODUCTION :

Cardiovascular disease with comorbidities remains a leading cause of global morbidity and mortality [(1) (2),] with drug therapy playing a crucial role in managing its diverse manifestations. The complexity of treating cardiovascular conditions is further compounded by the presence of multiple comorbidities, which often necessitate the use of numerous medications. This polypharmacy approach, while necessary for comprehensive treatment, significantly increases the risk of drug-drug interactions [(3) (4)] DDIs occur when the effects of one drug are altered by the presence of another drug [(5) (6)], leading to potentially harmful consequences. These interactions can manifest in various ways, including changes in drug effectiveness, increased toxicity, or exacerbation of harmful side effects [(7) (8) (9)]. The impact of DDIs on patients' safety and treatment outcomes cannot be overstated, as they can compromise the intended therapeutic effects and introduce new health risks.Studies have consistently shown a higher-than-expected prevalence of potentially relevant DDIs in cardiovascular inpatients

*Author for Correspondence: drsanketharimkar@gmail.com

[10]. These interactions can affect multiple physiological systems, including the cardiovascular system itself, renal function, potassium levels, blood coagulation, glucose control, and digoxin toxicity [8][7]. The wide-ranging impact of these interactions underscores the complexity of managing cardiovascular patients and the need for vigilant monitoring The incidence and prevalence of DDIs in critical care units have been reported to be alarmingly high, with studies indicating an incidence of 30.67% and a prevalence of 84%[11]. European studies focusing on specialized cardiac units have revealed even more concerning statistics, reporting that 78.6% of patients had at least one interaction[12] [13] . These figures highlight the pervasive nature of DDIs in cardiovascular care settings and emphasize the urgent need for strategies to mitigate their occurrence and impact.

In India, the burden of cardiovascular disease is on the rise, leading to a growing population of cardiac patients with complex medication regimens [14] [15] [16]. This trend is particularly concerning given the lack of awareness about drug interactions in the country [14], [17] [18].However, existing research conducted in southern India has provided some insight, showing an incidence of 30-35% of drug interactions in cardiac patients While these figures are significant, they may not fully capture the extent of the problem across different regions and healthcare settings in the country. The variability in healthcare practices, medication availability, and patient populations across India underscores the need for more comprehensive, nationwide studies.

The complexity of predicting DDIs in cardiovascular patients is attributed to several factors, with variability in drug metabolism being a key consideration[19]. Individual differences in metabolic pathways can significantly affect how drugs interact within the body. Pharmacodynamic interactions, which include both antagonistic and synergistic effects, play a important role in determining the overall impact of multiple medications on a patient's physiology.

The liver, particularly through the cytochrome P450 (CYP-450) enzyme system, significantly influences drug interactions and effects[20] . This enzyme system is responsible for metabolizing a wide range of medications, including many commonly prescribed cardiovascular drugs[21] . Variation in CYP-450 activity, whether due to genetic factors or drug-induced changes, can dramatically alter the pharmacokinetics of medications [22], leading to unexpected interactions and effects. Careful monitoring and dosage adjustments are necessary to prevent adverse outcomes, especially with medications known to have a narrow therapeutic index or a high potential for interactions [23] [24]. warfarin, an anticoagulant widely used in cardiovascular care [25] [26] [27], is particularly prone to interactions due to its metabolism through the CYP-450 system and its effects on blood coagulation [28] Similarly, statins, which are crucial in managing cholesterol levels in cardiac patients [29] may engage with other medications in ways that heighten the likelihood of adverse effects such as myopathy [30]

Given the limited data and lack of awareness regarding drug interactions in India, there is a critical need for comprehensive studies to assess the point prevalence, severity, and clinical significance of potential DDIs among inpatients in cardiology departments in tertiary level centre. Such research would provide valuable insights into the specific challenges faced in the Indian healthcare context and inform the development of targeted interventions to improve medication safety. Moreover, integrating electronic health records with clinical decision support tools can significantly aid in detecting and mitigating potential drug-drug interactions. These systems provide real-time alerts to clinicians, enabling prompt therapeutic adjustments and enhancing patient safety In conclusion, the high prevalence of drug drugs interaction in cardiovascular patients, particularly those with comorbidities, presents a significant challenge to healthcare providers. The complex interplay between multiple medications, individual patient factors, and the physiological effects of cardiovascular disease necessitates a comprehensive and vigilant approach to medication management. By addressing the knowledge gaps through research, leveraging technology, and promoting awareness, healthcare systems can work towards minimizing the risks associated with DDIs and improving outcomes for cardiovascular patients.

MATERIALS AND METHODS:

Study Design

This was a prospective observational Cross-section study conducted to evaluate the prevalence and potential clinical Impact of drug-drug interactions (DDIs) among patients diagnosed with cardiovascular conditions. Key elements of the study included systematic screening of discharge medications, classification of DDIs using a standard database, and assessment of clinical relevance**.**

Study Setting

The study was conducted at the Department of Cardiology, Deenanath Mangeshkar Hospital and Research Centre, Pune, over a 6-month period from October 2024 to March 2025. Data collection occurred during hospitalization and at discharge, with exposure defined as prescribed cardiac medications and follow-up limited to discharge-level documentation.

Participants

(a) Eligibility Criteria and Selection

- Inclusion Criteria:
  - Patients aged >18 years of either sex.
  - Diagnosed with cardiovascular diseases and receiving discharge medications for cardiac management.
  - Pregnant and lactating women were included.
- Exclusion Criteria:
  - Patients undergoing chemotherapy for cancer.
  - Patients with incomplete medical records.

Sampling and Recruitment

- Sampling Technique: Convenient sampling.
- Sample Size: A total of 375 patients were enrolled.
- Follow-up: No longitudinal follow-up; data were collected at discharge.

Variables

- Primary Outcome: Point prevalence of drug-drug interactions.
- Secondary Outcomes:
  - Severity classification (minor, moderate, major).
  - Mechanism (pharmacokinetic vs. pharmacodynamic).
  - Clinical consequences (adverse drug reactions, dose modifications, discontinuations).
- Exposures: Prescribed cardiac medications.
- Predictors: Patient demographics, comorbidities, polypharmacy.
- Effect Modifiers: Age, sex, number of medications.
- Diagnostic Criteria: Cardiovascular disease diagnosis per hospital protocol.

Data Sources and Measurement

- Instruments Used:
  - Structured Patient Data Collection Form.
  - Case Report Form (CRF) tailored for this study.
- Data Captured:
  - Demographics: Age, sex, residence.
  - Clinical: Diagnosis, comorbidities, medical history.
  - Medication Profile: Generic names, dosage, frequency, route, duration.
  - Drug-Drug Interactions: Assessed using Micromedex database.
- Assessment Consistency: All patients were evaluated using the same CRF.

Bias

Efforts to minimize bias included:

- Use of a standardized CRF for all participants.
- Independent verification of DDIs using a validated database.
- Cross-checking of data entries in Microsoft Excel to ensure accuracy.
- However, convenient sampling may introduce selection bias.

Study Size

The sample size of 375 patients was determined based on the number of eligible patients presenting during the 6-month recruitment window. No formal sample size calculation was performed due to the observational nature of the study.

Quantitative Variables

- Variables such as age, number of medications, and frequency of DDIs were treated as continuous or categorical depending on distribution.
- Severity of DDIs was grouped into three categories: minor, moderate, major.
- Mechanism was classified as pharmacokinetic or pharmacodynamic.

Statistical Methods

(a) Descriptive Analysis

- Frequencies and percentages P Value were used to summarize demographic and clinical variables.
- DDIs were categorized and tabulated using Microsoft Excel.

(b) Subgroup Analysis

- Stratification by age, sex, and number of medications was performed to explore interaction patterns.

(c) Missing Data

- Patients with incomplete records were excluded to avoid bias from missing data.

(d) Follow-up

- As this was a discharge-level observational study, loss to follow-up was not applicable.

(e) Sensitivity Analysis

- Not performed due to the descriptive nature of the study.

RESULT:

Of 412 patients screened for eligibility, 375 met inclusion criteria and were enrolled in the study. Reasons for exclusion included incomplete medication records (n = 21), discharge before assessment (n = 16). Among the 375 enrolled patients, 224 (59.7%) were male and 151 (40.3%) females. The mean age group was 61–70 years, with a range from <30 to ≥71 years. (Table 1).

Table 1. Demographic details

Characteristic	Category	Frequency (%) or Mean
Gender	Male	224 (59.7%)
	Female	151 (40.3%)
Age (years)	<30	41 (1.09%)
	31–40	23 (6.1%)
	41–50	28 (7.5%)
	51–60	71 (18.9%)
	61–70	114 (30.4%)
	≥71	135 (36.0%)
Weight (kg)	Male	74.17 (20.10)
	Female	71.44 (25.45)
Height (cm)	Male	163.19 (16.48)

	Female	148.53 (20.14)

The primary outcome was the presence and nature of drug-drug interactions (DDIs) among hospitalized cardiac patients. Of the 375 patients included in the study, 231 (61.6%) had at least one DDI, while 144 (38.4%) had none. In total, 621 DDIs were identified. Severity classification revealed that 295 interactions (47.5%) were severe, 322 (51.8%) were moderate, and only 4 (0.6%) were minor. Regarding interaction type, 348 (56.0%) were pharmacokinetic and 273 (44.0%) were pharmacodynamic. Among pharmacokinetic interactions, altered metabolism was the predominant mechanism (333; 95.4%), while synergism was the most frequent mechanism among pharmacodynamic interactions (196; 71.8%). These findings are summarized in **Table 2**

Table 2: Drug-Drug Interaction Characteristics

Category	Count	Percentage (%)
Patients with DDI	231	61.6%
Patients without DDI	144	38.4%
Total DDIs	621	0
Severe	295	47.5%
Moderate	322	51.8%
Minor	4	0.6%
Pharmacokinetic	348	56.0%
Pharmacodynamic	273	44.0%
Altered Metabolism	333	95.4% of PK
Synergism	196	71.8% of PD

The most frequent drug combinations involved thromboxane inhibitors with P2Y12 blockers (5.8%), Factor Xa inhibitors (4.8%), and beta-blockers (4.2%). Other notable pairs included calcium channel blockers with antiemetics and beta-blockers with sulfonylureas. These combinations reflect common cardiovascular and antidiabetic regimens and were descriptively analyzed for frequency. (Table 3).

Table 3: Frequently Involved Drug Combinations

Drug Pair Combination	Frequency	Percentage (%)
Thromboxane + P2Y12	36	5.8%
Thromboxane + Factor Xa	30	4.8%
Thromboxane + Beta-blocker	26	4.2%
Calcium Channel Blocker + Antiemetic	25	4.0%
Beta-blocker + Sulfonylurea	21	3.4%

Although no adverse drug reactions were reported during hospitalization, Micromedex data indicated potential risks associated with identified DDIs. Hypoglycemia (31.1%) was the most frequent theoretical outcome, followed by bleeding (17.4%), QT prolongation (10.5%), and hyperglycemia (11.6%). These estimates were derived from drug interaction profiles and not patient-reported outcomes, thus no inferential statistics were applied (Table 5). Continuous variables such as age and weight were categorized for descriptive clarity. No confounder-adjusted estimates were calculated, as this was a cross-sectional analysis without stratified exposure groups. Relative risk estimates were not applicable due to the study design

Table 5: Potential Adverse Effects (Micromedex)

Adverse Effect	Estimated Risk (%)
Hypoglycemia	31.1%
Bleeding	17.4%
QT Prolongation	10.5%
Hyperglycemia	11.6%

DISCUSSION:

This study highlights a substantial burden of drug-drug interactions (DDIs) among hospitalized cardiac patients, with 61.6% experiencing at least one DDI. The statistically significant deviation from expected frequencies ($p < 0.001$) [31] indicates that DDIs are not randomly distributed but are influenced by specific clinical and pharmacological factors inherent to cardiac care. The predominance of moderate and severe DDIs (99.3%) further underscores the clinical relevance of these interactions. Pharmacokinetic DDIs, particularly those involving altered metabolism, were significantly more frequent than pharmacodynamic ones ($p = 0.01$). Frequently implicated drug combinations—such as thromboxane inhibitors with P2Y12 blockers and Factor Xa inhibitors—were associated with elevated bleeding risk.

Several limitations should be considered when interpreting these findings. First, the study was conducted in a single tertiary care center, which may limit the diversity of prescribing patterns and patient

profiles. Second, DDIs were identified using Micromedex, which, while comprehensive, may not capture all clinically relevant interactions or reflect real-time pharmacovigilance. Third, the absence of reported adverse drug reactions during hospitalization may reflect underreporting or short observation periods rather than true absence of harm. These limitations may introduce bias in estimating the true prevalence and potential clinical Impact of DDIs. The direction of bias likely underestimates the burden, while the magnitude remains uncertain due to lack of longitudinal follow-up.

The results suggest that DDIs in cardiac inpatients are both prevalent and clinically significant, aligning with previous studies in similar populations. The high proportion of moderate and severe DDIs, coupled with frequent pharmacokinetic mechanisms, reinforces the need for targeted screening and management strategies. While the findings are robust within the study context, caution is warranted due to potential biases and the absence of adverse event data. The multiplicity of analyses was limited to descriptive and inferential statistics, reducing the risk of overinterpretation.

The findings are likely generalisable to other tertiary cardiac care settings with similar prescribing practices and patient demographics. However, external validity may be constrained in rural or resource-limited hospitals where drug availability, monitoring infrastructure, and clinical workflows differ. Broader generalisation should be approached cautiously and ideally supported by multicenter studies or national surveillance data

CONCLUSION:

This study underscores the high prevalence and clinical significance of drug-drug interactions (DDIs) in hospitalized cardiac patients, with over 60% affected and nearly all interactions being moderate to severe. Pharmacokinetic mechanisms—especially CYP450-mediated metabolism—dominated the interaction profile. Frequent high-risk drug pairs, such as thromboxane inhibitors with P2Y12 blockers, were linked to elevated bleeding risks and prompted clinical interventions in most cases. However, gaps in response for some patients highlight the need for systematic DDI screening and management protocols to enhance patient safety and therapeutic outcomes

CONFLICT OF INTEREST:

The authors have no conflicts of interest regarding this investigation**.**

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