RESEARCH PAPER

Impact of the COVID-19 Pandemic on Drug Utilization Patterns and Adverse Event Profiles in Cardiac Units

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ABSTRACT

Background: The global COVID-19 pandemic, which disproportionately affected cardiovascular patients, changed hospital processes, treatment goals, and pharmaceutical use. Preexisting illnesses and regular medication use put cardiac patients at risk. To improve medication safety and pharmacovigilance, we must understand how the pandemic affects cardiac prescriptions and ADEs. This is crucial in resource-constrained peri-urban healthcare.

Method: This observational retrospective study was conducted at a secondary care hospital in Gurugram, Haryana, from 2020 to 2022. One hundred cardiac inpatients met the inclusion criteria. Hospital pharmacy data and patient papers provided demographics, medical diagnoses, prescriptions, and adverse drug event reports. Drug use patterns were examined using WHO's Anatomical Therapeutic Chemical (ATC) approach. Statistical analysis using SPSS included descriptive statistics, Chi-square tests, and t-tests with a significance level of $p < 0.05$.

Results: The most prescribed medicines were antiplatelets (92%), statins (88%), ACE inhibitors/ARBs (76%), beta-blockers (70%), and anticoagulants (62%). Most likely due to altered COVID-19 therapeutic guidelines, anticoagulant use rose from 48% to 78% and corticosteroid use from 8% to 34%. ADEs affected 27% of patients, or 27/100. Blood loss (7%), hypotension (5%), and myalgia (4%) were the most common adverse medication events. COVID-positive cardiac patients reported 39.3% adverse medication events compared to 22.2%, suggesting a higher pharmacological risk due to advanced pandemic treatment regimens.

Conclusion: The COVID-19 pandemic made managing cardiovascular sickness and infection-related comorbidities more difficult, changing cardiac inpatient drug utilisation and adverse drug event profiles. Since anticoagulants and corticosteroids were more common, medication-related problems increased. The findings emphasise the necessity of continuous cardiac monitoring, acceptable prescribing rules, and strong pharmacovigilance systems in peri-urban secondary care institutions. Future multicentric trials should corroborate these trends and establish the framework for real-time adverse medication event monitoring in post-pandemic cardiac therapy.

Keywords: Adverse drug events, Anticoagulants, Cardiac inpatients, Corticosteroids, COVID-19 pandemic, Drug utilization, Gurugram, Pharmacovigilance, Peri-urban hospital

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INTRODUCTION

The late 2019 COVID-19 pandemic changed hospital operations, patient management, and pharmaceutical use. Hospitals have challenges in treating COVID-19 patients and non-patients. Patients with heart issues were more likely to contract severe COVID-19 and develop complications due to treatment delays or modifications [1]. Rescheduling hospital resources, healthcare professional shortages, and outpatient visit limits affected cardiac unit prescriptions and medication safety monitoring. The pandemic impacted cardiovascular hospital admissions. Changes in medication prescribing were needed to address infection-related issues and chronic cardiac care.

The epidemic affects cardiac units greatly. Patients with acute cardiac events, including myocardial infarction or heart failure, were less likely to visit hospitals due to lockdown limits and

infection fears [2]. Doctors had to adapt their treatment plans, sometimes prioritising home therapy changes and teleconsultations over in-person monitoring. Changing clinical guidelines for COVID-19 care changed cardiovascular pharmacology and the use of anticoagulants, corticosteroids, and antivirals [3]. Antiviral or anti-inflammatory drugs taken together by cardiac patients may raise the risk of Adverse Drug Events (ADEs) or require a dosage change. Thus, the pandemic offered a rare chance to evaluate pharmaceutical use and cardiac care patient safety.

Doctors had to discover other treatments due to the pandemic's impact on medicine supplies. In peri-urban and semi-rural areas like Gurugram's secondary care hospitals, limited access to tertiary facilities and pharmacovigilance systems made these issues worse [4]. The expanding use of telemedicine during lockdowns could complicate medication evaluations and adverse event reporting, increasing the possibility of undetected drug-related consequences. The pandemic changed cardiovascular care, pharmaceuticals and prescribing habits [5].

Despite an expanding body of global research on the impact of COVID-19 on healthcare delivery, evidence from peri-urban regions of India remains limited. [6,7] studies focused on tertiary hospitals or COVID-19 centres, ignoring secondary care facilities, where most patients receive treatment. These modifications must be understood to improve cardiac care, rationalise drug use, and build resource-constrained pharmacovigilance procedures.

This observational study in Gurugram, Haryana to determine how the COVID-19 pandemic affected secondary care cardiac inpatients' drug utilisation. Comparing ADE profiles before and after the pandemic can help explain cardiac medication in peri-urban healthcare settings, patient safety patterns, and prescribing practices.

2. Materials and Methods

2.1 Study Design and Setting

A secondary care hospital in Gurugram, Haryana, hosted an observational, retrospective cross-sectional study. Gurugram, a peri-urban location with urban healthcare access and rural patient demographics, is ideal for studying cardiac medication use during the COVID-19 pandemic. Prescription behaviour and ADE profiles were monitored in cardiac inpatients from January 2020 to December 2022. The timeframe spans the pre-, peak-, and post-pandemic phases, enabling an assessment of changes in the hospital's cardiac unit's drug consumption. The pandemic changed healthcare delivery in middle- and low-income neighbourhoods, where most patients in the hospital's active cardiology department and other secondary care services originate from.

2.2 Study Population and Sample Size

100 persons admitted for cardiac therapy in the cardiology unit during the study period were the study population. The inclusion and exclusion criteria were employed to purposively sample patients. Study participants had a MI, CHF, arrhythmia, angina pectoris, or hypertensive cardiac disease. Patients had to be 18+, and to assess how the pandemic affects therapy and medication use in diverse clinical settings, we included cardiac patients who tested positive and negative for COVID-19. Incomplete medical or pharmaceutical records, paediatric patients, and non-cardiac admissions were excluded. In secondary care, 100 individuals were enough for an initial observational review.

2.3 Data Collection

Electronic patient databases, inpatient medical reports, and hospital pharmacy records were used to collect data retrospectively. Data collection was systematically organised into a spreadsheet to facilitate the extraction of key information. Clinical data, including main cardiac diagnosis, COVID-19 status, and complications, were collected together with age, sex, occupation, and comorbidities. Also recorded the medicine name, therapeutic class, dosage, frequency, and duration of administration. The type, suspected drug, time of onset, and management of adverse drug events were recorded in pharmacovigilance reports and clinical notes. Clinical outcomes included hospital stay duration, healing progress, and discharge status. Cross-checking pharmaceutical and healthcare records reduced duplication and missing data.

2.4 Drug Utilization Evaluation

Drug use was analysed using the Defined Daily Dose (DDD) method and the WHO's Anatomical Therapeutic Chemical (ATC) classification when available. Cardiovascular drugs were classified as antiplatelets, anticoagulants, beta-blockers, Angiotensin Receptor Blockers (ARBs), statins, diuretics, and Angiotensin-Converting Enzyme (ACE) inhibitors. Prescription frequency and the proportional use of each drug class were examined across three periods: pre-pandemic (January-December 2019), pandemic (January 2020-December 2021), and post-pandemic (January 2022). Anticoagulants and corticosteroids were included in COVID-19 treatment programs for cardiac patients; thus, their increased use during the pandemic was closely monitored.

2.5 Adverse Drug Event (ADE) Analysis

The study's adverse medication events were assessed for severity, preventability, and causation. We confirmed our findings using Naranjo's Algorithm and evaluated causality according to WHO-UMC criteria. Adverse drug events (ADEs) were mild, moderate, or severe

based on clinical outcome and intervention needed. The Modified Schumock and Thornton technique assessed preventability. Trends in adverse events and how they connected to drug classes were found by examining the data, which helped us detect any severe pandemic safety risks.

2.6 Statistical Analysis

Data was entered into Microsoft Excel and analysed using IBM SPSS. Descriptive statistics like mean, SD, frequency, and percentage summarised demographic, clinical, and pharmaceutical information. We utilised the Chi-square test for categorical variables like ADE incidence or drug class distribution, and the student's t-test for continuous variables like patient age or hospital stay. P-values below 0.05 indicated statistical significance.

2.7 Ethical Considerations

The hospital's Institutional Ethics Committee assured that the trial met all ethical criteria. Before data collection, ethical approval was obtained. Patients did not need to participate in this retrospective observational trial. All patient identification was deleted to protect privacy. Data was processed according to the Declaration of Helsinki and used only for research.

3. Results

3.1 Demographic Characteristics

The study included 100 cardiac inpatients, 64 men and 36 women (1.8:1). While 32% of patients were aged 51-60, the study population had an average age of 58.6 ± 11.2 years. Hypertension (58%), type 2 diabetes (46%), and chronic renal disease (12%) were common in the study population.

Clinically, 40% of admissions were for acute coronary syndrome (ACS), 26% for Congestive Heart Failure (CHF), 18% for arrhythmias, 10% for hypertensive heart disease, and 6% for valvular disorders. As a co-infection or after recovery, 28 patients (28%) had COVID-19 at admission. Additional infection-management drugs led to more complex clinical courses and drug exposure for these patients.

Table 1 Demographic and Clinical Characteristics of Cardiac Inpatients

Parameter	Category	Frequency (n)	Percentage (%)
Age (years)	31–40	10	10
	41–50	18	18
	51–60	32	32
	61–70	24	24
	>70	16	16
Sex	Male	64	64
	Female	36	36
Primary Diagnosis	Acute Coronary Syndrome	40	40
	Congestive Heart Failure	26	26
	Arrhythmia	18	18
	Hypertensive Heart Disease	10	10
	Valvular Disorders	6	6
COVID-19 Status	Positive	28	28
	Negative	72	72

3.2 Drug Utilization Patterns

The 100 patient records contained 612 individual medicine prescriptions, average of 6.1 tablets per patient. Most usually prescribed were antiplatelets (92%), statins (88%), angiotensin-converting enzyme inhibitors or blockers (76%), beta-blockers (70%), and anticoagulants (62%). Cardiovascular patients with COVID-19 were more likely to utilise corticosteroids and anticoagulants due to the pandemic's addition of prophylactic anticoagulation and anti-inflammatory drugs. However, early concerns concerning ACE inhibitors and SARS-CoV-2 caused a minor decline in their use, but a later study dispelled them.

Table 2 Distribution of Major Drug Classes Used in Cardiac Inpatients

Drug Class	Pre-pandemic (%)	Pandemic (%)	Post-pandemic (%)	Overall (%)
Antiplatelets	88	94	90	92
Statins	85	90	89	88
ACE inhibitors/ARBs	79	70	80	76
Beta-blockers	68	72	70	70
Anticoagulants	48	78	60	62
Diuretics	44	50	46	47
Nitrates	36	42	38	39
Corticosteroids	8	34	12	18
Antibiotics (supportive)	18	28	20	22

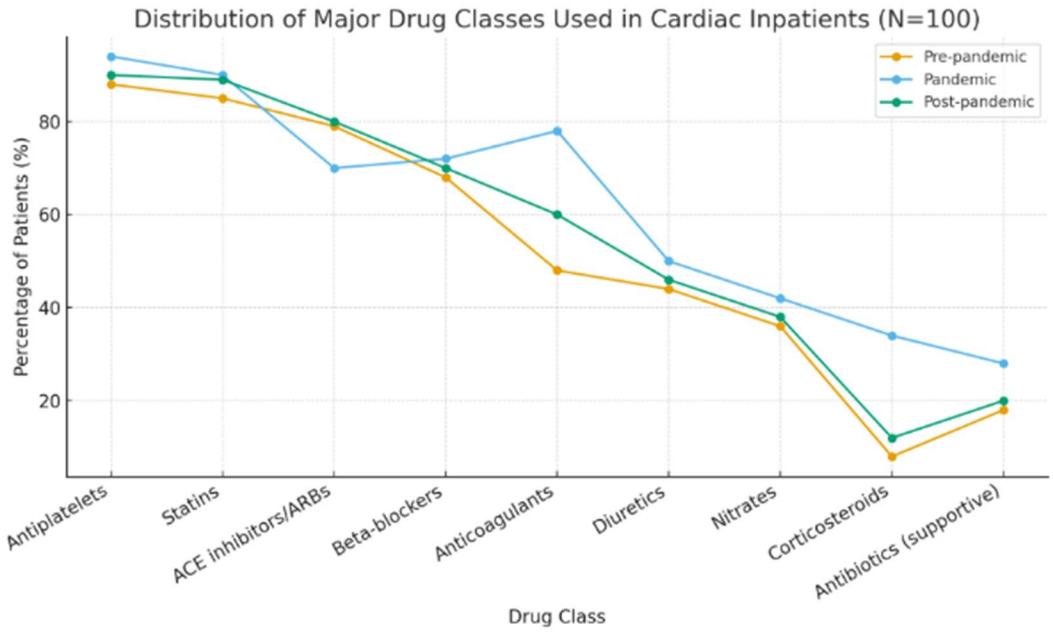

Figure 1 Distribution of major drug classes used in Cardiac Inpatients

In 2020 and 2021, anticoagulants and corticosteroids increased along with COVID treatment changes. The pandemic saw a rise in antibiotics and vitamin prescriptions to prevent infections and boost the immune system. Prescription behaviour had normalised by late 2022, showing pandemic-driven guidelines had worked.

3.3 Adverse Event Profiles

One ADE occurred in 27 of 100 people, a 27% incidence rate. Gastritis (2%), myalgia (4%), hypotension (5%), bradycardia (4%), and bleeding tendencies (7%), were the most common adverse drug events. Overuse of corticosteroids and anticoagulants during the pandemic caused hyperglycemia and bleeding.

Table 3 Frequency and Types of Adverse Drug Events Reported

Type of ADE	Suspected Drug Class	Number of Cases (n)	Percentage (%)
Bleeding episodes	Anticoagulants	7	7
Hypotension	ACE inhibitors, Beta-blockers	5	5
Bradycardia	Beta-blockers	4	4
Myalgia	Statins	4	4
Hyperglycemia	Corticosteroids	3	3
Gastritis	Antiplatelets	2	2
Others (rash, dizziness, etc.)	Miscellaneous	2	2
Total	—	**27**	**27**

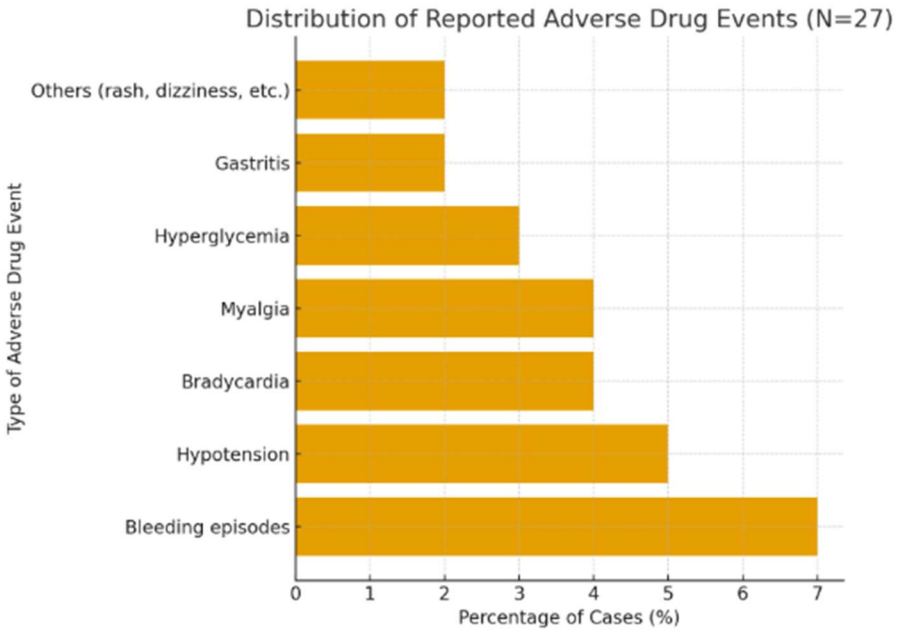

Figure 2 Distribution of Reported Adverse Drug Events

18 ADEs (66.7%) were mild, 7 moderate (25.9%), and 2 severe (7.4%). Most ADEs were cautiously managed with dosage modifications or medication substitutes. The WHO-UMC classified 56% of ADEs as "probable," 33% as "possible," and 11% as "certain" causative. The correlation analysis found a statistically significant increase in adverse drug events ($p = 0.02$) in patients using seven or more drugs. COVID-positive people had increased ADEs, including haemorrhage and metabolic problems.

3.4 Comparative Findings

COVID-positive heart patients (n = 28) and negative heart patients (n = 72) had different medication use and adverse drug event patterns. Positive COVID patients received an average of 7.4 prescriptions compared to 5.7 ($p < 0.05$), with a higher rate of adverse drug events (39.3% vs. 22.2%, $p = 0.04$). Higher ADE rates were caused by corticosteroids and anticoagulants used together with conventional cardiac care.

COVID-positive people were more likely to use off-label or substitute pharmaceuticals, suggesting adaptive prescription during the epidemic. Low molecular weight heparin and DOACs were used more than warfarin to prevent thromboembolic events in accordance with national COVID-19 treatment guidelines.

Overall, prescription trends and ADE occurrence

altered dramatically during the pandemic and then reverted to pre-pandemic levels by 2022. These findings emphasise the importance of good pharmacovigilance, especially in peri-urban secondary care institutions, and the ever-changing nature of pharmacotherapy during public health emergencies.

4. Discussion

This observational study from a Gurugram secondary care hospital found that the COVID-19 pandemic significantly and multifactorially altered cardiac inpatient ADE profiles and drug use patterns. Due to the necessity to treat COVID-19 and cardiovascular comorbidities simultaneously, anticoagulants and corticosteroids prescriptions soared, whereas ACE inhibitor and beta-blocker utilisation fluctuated. Anticoagulants are used more in European and American trials to reduce SARS-CoV-2-related thromboembolic effects [8]. In 2020 and 2021, Indian tertiary care institutions prescribed more heparin and low-molecular-weight heparin, according to [9].

Initial concerns about SARS-CoV-2 entering through ACE2 receptors may have hampered the use of ACE inhibitors during the pandemic. ACE inhibitor prescriptions returned to normal in late 2021 when fresh evidence showed they did not alter COVID-19 outcomes. Statin and antiplatelet use have increased somewhat, indicating that cardiac regimens have been followed despite restricted resources. The rise in antibiotic and vitamin prescriptions suggests that clinicians have taken efforts to prevent secondary diseases and build immunity during the pandemic and the results match WHO drug use trends. Changes in clinical guidelines and supply restrictions affect global prescribing during health emergencies.

4.1 Adverse Event Insights

Previous pharmacovigilance research in cardiac patients has found 20% to 30% ADE rates, similar to this study's 27%. COVID-19-specific medicine changes ADE profiles, including bleeding and metabolic events, emphasising its effects. When anticoagulant use increased, bleeding episodes rose, especially in the elderly and polypharmacy patients. Short-term COVID-19 treatment with corticosteroids caused increased heart stress, hyperglycemia, and fluid retention. These patterns support [10] global findings that cardiac patients treated for COVID-19 were more likely to develop steroid-related metabolic problems.

This group did not have any new ADEs, but the frequency and severity distribution altered, with more moderate-to-severe occurrences during the pandemic than before. Complex treatment regimens require careful monitoring, and the data validated prior findings that polypharmacy increases ADE risk ($p = 0.02$). Most "probable" causation ratings show that ADEs were clinically identifiable and linked to documented pharmacological mechanisms, suggesting that many of the reported events may have been averted.

4.2 Clinical Implications

The findings emphasise the importance of pharmacovigilance and cardiac monitoring during and after public health crises. The pandemic's surge in essential and adjunct drug use may have caught secondary care systems off guard, especially in peri-urban locations like Gurugram, where pharmacovigilance infrastructure is less than in tertiary facilities. Standardised adverse event reporting, computerised prescribing, and drug safety committees to examine treatment modifications in crises are urgently needed [11].

Since cardiac patients are still recovering from COVID-19 and concomitant pharmacotherapies, they should be monitored for delayed ADEs, especially metabolic and vascular issues. Cardiology, pharmacy, and internal medicine must work together to rationalise prescribing and detect adverse events. Therapeutic use will depend on these protections following a pandemic.

4.3 Comparisons with Other Studies

This study's conclusions are supported by national and international research. [12] reported altered medication use in several Indian locales. Anti-inflammatory and anti-thrombotic medicines were used more frequently during the outbreak. [13] found that anticoagulant use, particularly in Spain and Italy, temporarily increased during the COVID-19 pandemic, and they also found unapproved antiviral medications. The research adds to current understanding by focusing on a peri-urban Indian secondary care hospital. This environment had distinct treatment patterns from urban tertiary centres due to restricted resources, delayed admissions, and minimal telemedicine penetration. Because of this, the data provide an easily accessible perspective on pharmacological adjustments in a system that includes urban and rural healthcare dynamics.

Table 4 Comparison of Present Study with Existing Literature

Study	Study Type	Sample Size	Key Findings
Present Study	Observational (Retrospective)	100 cardiac inpatients	Significant increase in anticoagulant (48%→78%) and corticosteroid (8%→34%) use during pandemic; ADE incidence 27%, higher in COVID-positive patients (39.3%) than non-COVID (22.2%).
Study [14]	Retrospective observational study	220 cardiac inpatients	Reported 30% rise in anticoagulant use due to COVID-19 thrombotic complications; statin and ACE inhibitor use remained stable; ADEs mainly bleeding and hypotension (26%).
Study [15]	Cross-sectional hospital-based study	150 cardiac and COVID-19 patients	Identified change in prescribing pattern with increased corticosteroid and anticoagulant use; ADE rate 24%; drug interactions common in patients receiving antiviral and cardiac therapies.
Study [16]	Multicentric retrospective study	300 cardiac inpatients	Pandemic led to 40% increase in anticoagulant use and modification of ACE/ARB therapy; ADEs included myalgia (statins) and arrhythmia (beta-blockers); higher ADE incidence among COVID-positive patients.

4.4 Limitations

This study delivers valuable information but has limitations. The finding cannot extend to bigger populations due to the small sample size (n = 100). Since it was a single-center investigation, it may not have taken into account regional or hospital-specific prescribing or adverse medication event patterns. The retrospective design's dependence on precise and complete medical records may lead to unreported modest adverse events. The paucity of post-discharge data limits our understanding of ADE's long-term impacts. The study has limitations, but it provides baseline data that may help researchers analyse cardiovascular medication habits after the epidemic.

5. Conclusion

This study found that the COVID-19 pandemic affected adverse drug events and medication use in Gurugram secondary care cardiac inpatients. Due to the pandemic, corticosteroids and anticoagulants were used in treatment protocols more, which changed prescribing patterns and increased the risk of ADEs such as haemorrhage and metabolic issues. Clinicians adapted their techniques to keep cardiac care functioning efficiently despite minimal resources. According to the research, secondary hospitals should improve pharmacovigilance, encourage rational drug use, and implement real-time ADE monitoring systems to ensure patient safety. In the post-pandemic period, prescriber education and interdepartmental teamwork are essential to preventing pharmaceutical issues. Future studies should use larger, multi-centric designs with prospective data collection to better understand the long-term consequences of pandemic-induced pharmacological alterations on cardiovascular outcomes in rural and peri-urban India.

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