European Journal of Clinical Pharmacy
Print ISSN: 2385-409X **Online ISSN**: 3105-0409
Website: https://farmclin.com/

Original Research Article

Evaluation of Medication Safety and Drug-Related Problems Associated with Antithrombotic Therapy in Cardiology Patients at a Tertiary Care Hospital

Article History:

***Received**:* 11-11-2025
***Revised**:* 21-11-2025
***Accepted**:* 16-12-2025
***Published**:* 27-12-2025

Name of Author:
Mithul V. Mammen[1]*, Piyush Mittal[2], Shalabh Aharwal[3]

Affiliation: *[1]Research Scholar, Department of Pharmacy Practice, Teerthanker Mahaveer College of Pharmacy, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India – 244001*
[2]School of Pharmacy, Sharda University, Greater Noida – 201310, Uttar Pradesh, India
[3]Department of Cardiology, Teerthanker Mahaveer Medical College and Research Centre, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India – 244001

Corresponding Author:
Mithul V. Mammen

Abstract: ***Background***: Antithrombotic agents are cornerstone therapies in cardiology for the prevention and management of thromboembolic disorders; however, they are classified as high-risk medications due to their narrow therapeutic index and potential for serious adverse outcomes. Medication safety issues and drug-related problems (DRPs) associated with antithrombotic therapy remain underreported in routine clinical practice, particularly in tertiary care settings in India. ***Objective:*** To evaluate medication safety and identify the incidence, pattern, and risk factors of drug-related problems associated with antithrombotic therapy among cardiology patients in a tertiary care hospital**.** ***Methods****:* A prospective observational study was conducted over 24 months in the Department of Cardiology of a tertiary care teaching hospital. A total of 426 adult patients receiving antithrombotic therapy were enrolled. Drug-related problems were identified and categorized into adverse drug reactions (ADRs), drug–drug interactions, medication errors, and inappropriate dose or duration of therapy. ADRs were assessed using the WHO–UMC causality scale and Naranjo's algorithm. Statistical analysis included descriptive statistics, chi-square test, and logistic regression to identify predictors of DRPs**.** ***Results:*** At least one drug-related problem was identified in 258 patients (60.6%). Drug–drug interactions were the most common DRP (40.4%), followed by ADRs (32.4%) and medication errors (22.5%). Bleeding-related reactions constituted the majority of ADRs, while non-bleeding reactions such as gastrointestinal effects and musculoskeletal pain were also notable. Prescribing errors were the most frequent medication errors. Advanced age (>60 years), polypharmacy, combination antithrombotic therapy, and longer duration of treatment were significantly associated with DRPs ($p < 0.05$). ***Conclusion:*** Antithrombotic therapy is associated with a substantial burden of medication safety issues in cardiology patients. Systematic medication review, vigilant monitoring, and active involvement of clinical pharmacists are essential to reduce drug-related problems and improve patient safety outcomes in tertiary care hospitals.

Keywords: Antithrombotic therapy; Medication safety; Drug-related problems; Adverse drug reactions; Drug–drug interactions; Medication errors; Cardiology patients; Tertiary care hospital; Polypharmacy; Clinical pharmacy.

INTRODUCTION

Cardiovascular diseases (CVDs) represent a substantial global public health challenge and continue to be the leading cause of mortality worldwide. Thromboembolic conditions—including myocardial infarction, ischemic stroke, atrial fibrillation–associated embolism, and venous thromboembolism—contribute significantly to cardiovascular morbidity and mortality, particularly among hospitalized patients [1]. Antithrombotic therapy is fundamental to both the acute management and long-term prevention of these disorders, rendering anticoagulant and antiplatelet agents indispensable in contemporary cardiology

practice [2].

Antithrombotic agents encompass anticoagulants such as unfractionated heparin, low-molecular-weight heparins, vitamin K antagonists, and direct oral anticoagulants, along with antiplatelet drugs including aspirin and P2Y12 receptor inhibitors. These medications are commonly prescribed either as monotherapy or as part of combination regimens, depending on the underlying clinical indication [3]. Despite their established efficacy in reducing thrombotic events, antithrombotic drugs are categorized as high-risk medications owing to their narrow therapeutic window, requirement for meticulous monitoring, and potential to cause serious adverse outcomes [4].

Medication safety has emerged as a crucial aspect of patient care, particularly in tertiary care hospitals where polypharmacy, complex treatment regimens, and multiple comorbidities are frequently encountered. Drug-related problems (DRPs)—defined as events or circumstances involving drug therapy that actually or potentially interfere with desired health outcomes—are commonly observed in patients receiving antithrombotic therapy [5]. These issues include adverse drug reactions (ADRs), drug–drug interactions, medication errors, inappropriate dosing, and inadequate therapeutic monitoring [6].

Although bleeding complications are the most widely recognized adverse effects of antithrombotic therapy, increasing evidence indicates the occurrence of non-hemorrhagic adverse reactions and preventable medication errors [7]. Several studies have reported that a considerable proportion of hospital admissions related to antithrombotic therapy are preventable and arise from inappropriate prescribing practices, insufficient monitoring, or unrecognized drug interactions [8]. Such medication safety concerns not only elevate morbidity and healthcare costs but also adversely affect patient adherence and clinical outcomes [9].

Drug–drug interactions are particularly prevalent among cardiology patients due to the frequent concomitant use of multiple medications for comorbid conditions such as hypertension, diabetes mellitus, and chronic kidney disease [10]. Interactions involving antithrombotic agents may either enhance bleeding risk or diminish therapeutic effectiveness, thereby increasing the likelihood of adverse clinical outcomes [11]. Furthermore, medication errors related to incorrect dosing, therapeutic duplication, or inappropriate treatment duration further contribute to the burden of drug-related problems in routine clinical practice [12].

The inherent complexity of antithrombotic therapy, coupled with the high incidence of drug-related problems, underscores the necessity for systematic evaluation of medication safety in real-world hospital settings. Figure 1 presents a conceptual framework illustrating medication safety issues associated with antithrombotic therapy, highlighting the interaction between patient-related, drug-related, and healthcare system–related factors that lead to drug-related problems and adverse clinical outcomes.

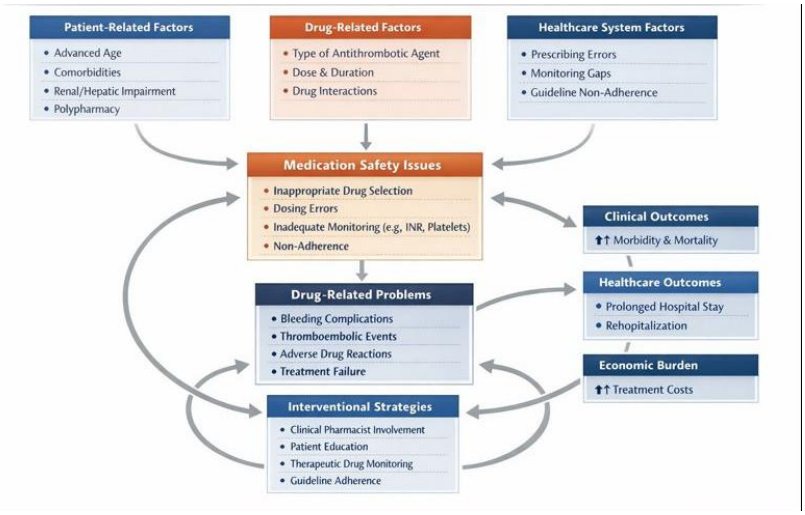

Figure 1. Conceptual framework depicting medication safety issues and drug-related problems associated with antithrombotic therapy in cardiology patients.

In developing countries such as India, published data addressing medication safety and drug-related problems associated with antithrombotic therapy remain limited. Most available studies primarily focus on bleeding complications, with inadequate emphasis on comprehensive medication safety evaluations encompassing ADRs, drug interactions, and medication errors [13]. Considering the escalating burden of cardiovascular diseases and the expanding utilization of antithrombotic agents, there

is a compelling need for hospital-based studies assessing medication safety in tertiary care cardiology settings [14].

Therefore, the present prospective observational study was undertaken to evaluate medication safety and identify drug-related problems associated with antithrombotic therapy among cardiology patients in a tertiary care hospital. The findings of this study aim to generate real-world evidence to promote safer prescribing practices, strengthen pharmacovigilance systems, and enhance the role of multidisciplinary healthcare teams in optimizing antithrombotic therapy [15].

MATERIAL AND METHODS

The present study was a prospective observational study designed to evaluate medication safety and identify drug-related problems associated with antithrombotic therapy in cardiology patients. The study was conducted in the Department of Cardiology of a tertiary care teaching hospital, including both inpatient and outpatient cardiology services. The study was conducted over 24 months. A total of 426 cardiology patients receiving antithrombotic therapy were enrolled during the study period.

Adult patients aged 18 years and above, of either gender, who were prescribed one or more antithrombotic agents—including anticoagulants and/or antiplatelet drugs—and who were admitted to or attending the cardiology department were included in the study. Only patients who provided written informed consent were eligible to participate. Patients were excluded if they had incomplete clinical or medication records, had received antithrombotic therapy for less than 24 hours, or were unwilling or unable to provide informed consent.

Antithrombotic Therapy Evaluated

The following antithrombotic agents were evaluated:

- **Anticoagulants:** Unfractionated heparin, low-molecular-weight heparins, vitamin K antagonists, and direct oral anticoagulants.
- **Antiplatelet agents:** Aspirin, clopidogrel, prasugrel, ticagrelor, and related combinations.
- Patients receiving monotherapy, dual therapy, or triple antithrombotic therapy were included.

Identification of Drug-Related Problems

Drug-related problems were identified and classified according to standard definitions and included:

- Adverse drug reactions
- Drug–drug interactions
- Medication errors (prescribing, dosing, and monitoring errors)
- Inappropriate drug selection or duration of therapy

Adverse Drug Reaction Assessment

Suspected ADRs were identified through patient interviews, medical record review, and clinical evaluation. ADRs were assessed using:

- WHO–UMC causality assessment scale
- Naranjo's Adverse Drug Reaction Probability Scale

The severity of ADRs was categorized as mild, moderate, or severe based on clinical impact and required interventions.

Assessment of Drug–Drug Interactions

Potential drug–drug interactions involving antithrombotic agents were identified using standard drug interaction references and classified according to their clinical significance as major, moderate, or minor.

Medication Error Assessment

Medication errors related to antithrombotic therapy were identified through systematic prescription review and categorized as:

- Prescribing errors
- Dosing errors
- Monitoring-related errors

Data Collection

Data were collected using a structured case record form, which included:

- Demographic details (age, gender)
- Clinical diagnosis and comorbid conditions
- Details of antithrombotic therapy (drug, dose, duration)
- Concomitant medications
- Identified drug-related problems
- ADR causality and severity assessments

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants, and patient confidentiality was strictly maintained throughout the study.

Statistical Analysis

Data were analyzed using statistical software.

- Categorical variables were expressed as frequencies and percentages.
- Continuous variables were expressed as mean ± standard deviation.

- Associations between variables were evaluated using the Chi-square test or Fisher's exact test.
- Logistic regression analysis was performed to identify independent predictors of drug-related problems.
- A *p*-value < 0.05 was considered statistically significant.

RESULTS

A total of 426 cardiology patients receiving antithrombotic therapy were included in the study. The demographic and clinical characteristics of the study population are summarized in Table 1. Nearly half of the patients were aged above 60 years (47.8%), and males constituted the majority (63.4%). Acute coronary syndrome was the most common primary cardiac diagnosis (39.4%), followed by ischemic heart disease (26.3%) and atrial fibrillation (22.5%). Hypertension (67.6%) and diabetes mellitus (51.2%) were the most frequently observed comorbidities.

The pattern of antithrombotic drug utilization is presented in **Table 2**. Dual antiplatelet therapy was the most commonly prescribed regimen (32.9%), followed by antiplatelet monotherapy (29.1%) and anticoagulant monotherapy (22.5%). Combination therapy involving both anticoagulants and antiplatelets was prescribed in 12.7% of patients, while triple antithrombotic therapy was used in a small proportion (2.8%).

The overall incidence of drug-related problems is shown in **Table 3**. At least one DRP was identified in **258 patients (60.6%)**, whereas **168 patients (39.4%)** did not experience any DRP during the study period.

The distribution of different types of DRPs is detailed in **Table 4**. Drug–drug interactions were the most frequently identified DRP (40.4%), followed by adverse drug reactions (32.4%), medication errors (22.5%), and inappropriate dose or duration of therapy (15.0%). It was observed that multiple DRPs could occur in the same patient.

Among adverse drug reactions associated with antithrombotic therapy (**Table 5**), bleeding-related reactions were predominant (53.6%), followed by gastrointestinal adverse effects (20.3%). Notably, **bone and musculoskeletal pain accounted for 15.9%** of reported ADRs. Severity assessment of ADRs (**Table 6**) revealed that most reactions were mild (47.8%) or moderate (39.1%), while severe reactions constituted 13.1% of cases. Causality assessment using the WHO–UMC scale (**Table 7**) classified the majority of ADRs as possible (50.8%) or probable (44.9%), with a smaller proportion categorized as certain (4.3%).Drug–drug interactions involving antithrombotic agents are summarized in **Table 8**. Moderate interactions were most common (55.8%), followed by major (22.1%) and minor interactions (22.1%).Medication errors identified in the study are presented in **Table 9**. Prescribing errors were the most frequent (47.9%), followed by dosing errors (31.3%) and monitoring errors (20.8%). Risk factor analysis for the occurrence of DRPs is shown in **Table 10**. Age greater than 60 years, polypharmacy (>5 drugs), use of combination antithrombotic therapy, and duration of therapy exceeding three months were all significantly associated with the presence of DRPs ($p < 0.05$

Table 1. Demographic and Clinical Characteristics of Study Population (n = 426)

Variable	Number (n)	Percentage (%)
Age group (years)		
18–40	68	16.0
41–60	154	36.2
>60	204	47.8
Gender		
Male	270	63.4
Female	156	36.6
Primary Cardiac Diagnosis		
Acute coronary syndrome	168	39.4
Ischemic heart disease	112	26.3
Atrial fibrillation	96	22.5
Other cardiac conditions	50	11.8
Comorbidities		
Hypertension	288	67.6
Diabetes mellitus	218	51.2
Chronic kidney disease	52	12.2

Table 2. Pattern of Antithrombotic Drug Utilization

Antithrombotic Regimen	Patients (n)	Percentage (%)
Antiplatelet monotherapy	124	29.1
Anticoagulant monotherapy	96	22.5
Dual antiplatelet therapy	140	32.9
Anticoagulant + antiplatelet	54	12.7
Triple antithrombotic therapy	12	2.8

Table 3. Overall Incidence of Drug-Related Problems (DRPs)

DRP Status	Number (n)	Percentage (%)
At least one DRP present	258	60.6
No DRP identified	168	39.4
Total	**426**	**100**

Table 4. Types of Drug-Related Problems Identified

Type of DRP	Number (n)	Percentage (%)
Adverse drug reactions (ADRs)	138	32.4
Drug–drug interactions	172	40.4
Medication errors	96	22.5
Inappropriate dose/duration	64	15.0

(Multiple DRPs may occur in the same patient)

Table 5. Adverse Drug Reactions Associated with Antithrombotic Therapy

Type of ADR	Number (n)	Percentage (%)
Bleeding-related reactions	74	53.6
Gastrointestinal effects	28	20.3
Bone/musculoskeletal pain	22	15.9
Others	14	10.2

Table 6. Distribution of adverse drug reactions according to severity among cardiology patients receiving antithrombotic therapy.

Severity	Number (n)	Percentage (%)
Mild	66	47.8
Moderate	54	39.1
Severe	18	13.1

Table 7. Causality assessment of adverse drug reactions associated with antithrombotic therapy using the WHO–UMC scale among cardiology patients

Causality Category	Number (n)	Percentage (%)
Certain	6	4.3
Probable	62	44.9
Possible	70	50.8

Table 8. Drug–Drug Interactions Involving Antithrombotic Drugs

Interaction Severity	Number (n)	Percentage (%)

Major	38	22.1
Moderate	96	55.8
Minor	38	22.1

Table 9. Distribution of medication errors associated with antithrombotic therapy according to error type among cardiology patient

Type of Medication Error	Number (n)	Percentage (%)
Prescribing errors	46	47.9
Dosing errors	30	31.3
Monitoring errors	20	20.8

Table 10. Risk Factors Associated with Drug-Related Problems

Risk Factor	DRP Present (n=258)	DRP Absent (n=168)	p-value
Age >60 years	156	48	0.002*
Polypharmacy (>5 drugs)	184	62	<0.001*
Combination antithrombotic therapy	128	42	0.004*
Duration of therapy >3 months	146	56	0.011*

*Statistically significant ($p < 0.05$)

DISCUSSION

The present prospective observational study evaluated medication safety and drug-related problems associated with antithrombotic therapy in cardiology patients at a tertiary care hospital. Antithrombotic drugs are widely recognized as high-risk medications due to their narrow therapeutic index, requirement for continuous monitoring, and potential to cause serious adverse outcomes. The findings of this study provide valuable real-world evidence regarding the extent and nature of medication safety issues in routine cardiology practice.

In this study, 60.6% of patients experienced at least one drug-related problem, indicating a substantial burden of medication safety concerns associated with antithrombotic therapy. Similar observations have been reported in previous studies, where drug-related problems were frequently identified among hospitalized cardiovascular patients, particularly those receiving anticoagulants and combination antithrombotic regimens [16,17]. Antithrombotic drugs have consistently been implicated as major contributors to preventable adverse drug events and hospital admissions [18].

Drug–drug interactions constituted the most frequently observed drug-related problem in the present study. This high prevalence may be attributed to polypharmacy, which is common among cardiology patients due to the coexistence of multiple chronic conditions. Holbrook et al. highlighted that antithrombotic agents, especially warfarin, are highly susceptible to clinically significant drug–drug interactions that may enhance bleeding risk or reduce therapeutic efficacy [19]. Similar findings have been reported in other hospital-based studies evaluating medication safety in cardiovascular care [20].

Adverse drug reactions were another major category of drug-related problems identified in this study. Bleeding-related reactions were the most common, which is consistent with the established safety profile of antithrombotic drugs [21]. However, the occurrence of non-bleeding adverse effects, including gastrointestinal symptoms and musculoskeletal complaints, underscores the need for comprehensive medication safety assessment beyond hemorrhagic outcomes. Previous studies have emphasized that non-hemorrhagic adverse drug reactions, although less severe, may significantly impact patient adherence and quality of life [22].

Medication errors, particularly prescribing and dosing errors, were also identified in a considerable proportion of patients. These findings are comparable to reports by Dean et al. and Gupta and Nayak, who documented prescribing errors as the most common form of medication error in hospital settings [23,24]. Inappropriate drug selection, incorrect dosing, and inadequate monitoring were the predominant contributors to these errors, highlighting gaps in prescribing practices and the need for structured medication review systems.

Risk factor analysis revealed that advanced age, polypharmacy, combination antithrombotic therapy, and longer duration of treatment were significantly associated with the occurrence of drug-related problems. Elderly patients are particularly vulnerable due to age-related changes in pharmacokinetics and pharmacodynamics, as well as increased comorbidity

burden [25]. Polypharmacy has been consistently identified as an independent predictor of adverse drug reactions and medication errors in cardiovascular patients [26].

The findings of this study emphasize the importance of systematic medication safety monitoring in cardiology departments, especially for patients receiving antithrombotic therapy. Integration of clinical pharmacists into the healthcare team has been shown to reduce medication errors, identify potential drug-related problems, and improve patient outcomes [27]. Strengthening pharmacovigilance practices and promoting interdisciplinary collaboration may play a crucial role in enhancing the safe use of antithrombotic drugs in tertiary care hospitals.

CONCLUSION

The present prospective observational study demonstrates that antithrombotic therapy is associated with a substantial burden of medication safety issues and drug-related problems in cardiology patients at a tertiary care hospital. More than half of the study population experienced at least one drug-related problem, with drug–drug interactions, adverse drug reactions, and medication errors being the most commonly identified issues.

The findings highlight that patients receiving combination antithrombotic therapy, those exposed to polypharmacy, elderly patients, and individuals undergoing long-term treatment are at a significantly higher risk of experiencing drug-related problems. Although bleeding-related adverse drug reactions were the most frequently observed, non-bleeding adverse effects and preventable medication errors also contributed meaningfully to compromised medication safety.

Overall, the study underscores the importance of systematic medication safety evaluation in cardiology practice. Regular medication review, early identification of drug-related problems, and active involvement of clinical pharmacists may play a crucial role in improving the safe and effective use of antithrombotic drugs in tertiary care hospitals.

LIMITATIONS

Despite its strengths, the present study has certain limitations. Being a single-center observational study, the findings may not be generalizable to all healthcare settings. The assessment of drug-related problems was primarily based on review of medical records and clinical documentation, which may have led to underreporting of certain events.

Additionally, the study did not include long-term follow-up to assess the persistence or recurrence of drug-related problems after discharge. Ethical and clinical constraints limited the ability to perform rechallenge for suspected adverse drug reactions, resulting in most reactions being classified as possible or probable. Finally, the potential influence of unmeasured confounding factors, such as patient adherence and lifestyle variables, could not be fully evaluatedWorld Health Organization. Cardiovascular diseases (CVDs). Geneva: World Health Organization; 2023.

REFERENCES

1. Libby P, Bonow RO, Mann DL, Tomaselli GF, Bhatt DL. Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine. 11th ed. Philadelphia: Elsevier; 2019.
2. Lip GYH, Banerjee A, Boriani G, Chiang CE, Fargo R, Freedman B, et al. Antithrombotic therapy for atrial fibrillation: CHEST guideline and expert panel report. Chest. 2018;154(5):1121–1201.
3. Institute for Safe Medication Practices. High-alert medications in acute care settings. Horsham (PA): ISMP; 2022.
4. Strand LM, Morley PC, Cipolle RJ, Ramsey R, Lamsam GD. Drug-related problems: their structure and function. DICP. 1990;24(11):1093–1097.
5. Edwards IR, Aronson JK. Adverse drug reactions: definitions, diagnosis, and management. Lancet. 2000;356(9237):1255–1259.
6. Steffel J, Verhamme P, Potpara TS, Albaladejo P, Antz M, Desteghe L, et al. The 2021 ESC guidelines on cardiovascular disease prevention and antithrombotic therapy. Eur Heart J. 2021;42(40):373–498.
7. Pirmohamed M, James S, Meakin S, Green C, Scott AK, Walley TJ, et al. Adverse drug reactions as cause of admission to hospital: prospective analysis. BMJ. 2004;329(7456):15–19.
8. Aronson JK. Medication errors: what they are, how they happen, and how to avoid them. QJM. 2009;102(8):513–521.
9. Mangoni AA, Jackson SHD. Age-related changes in pharmacokinetics and pharmacodynamics. Br J Clin Pharmacol. 2004;57(1):6–14.
10. Holbrook AM, Pereira JA, Labiris R, McDonald H, Douketis JD, Crowther M, et al. Systematic overview of warfarin and its drug and food interactions. Arch Intern Med. 2005;165(10):1095–1106.
11. Dean B, Barber N, Schachter M. What is a prescribing error? Qual Health Care. 2000;9(4):232–237.
12. Hazell L, Shakir SAW. Under-reporting of adverse drug reactions: a systematic review. Drug Saf. 2006;29(5):385–396.

13. Patel TK, Patel PB. Incidence of adverse drug reactions in Indian hospitals: a systematic review. Indian J Pharmacol. 2018;50(1):10–15.
14. Gupta SK, Nayak RP. Medication errors in India: a systematic review. Indian J Pharmacol. 2014;46(6):565–570.
15. Patel TK, Patel PB. Incidence of adverse drug reactions in Indian hospitals: a systematic review. Indian J Pharmacol. 2018;50(1):10–15.
16. Strand LM, Morley PC, Cipolle RJ, Ramsey R, Lamsam GD. Drug-related problems: their structure and function. DICP. 1990;24(11):1093–1097.
17. Pirmohamed M, James S, Meakin S, Green C, Scott AK, Walley TJ, et al. Adverse drug reactions as cause of admission to hospital: prospective analysis of 18,820 patients. BMJ. 2004;329(7456):15–19.
18. Holbrook AM, Pereira JA, Labiris R, McDonald H, Douketis JD, Crowther M, et al. Systematic overview of warfarin and its drug and food interactions. Arch Intern Med. 2005;165(10):1095–1106.
19. Mangoni AA, Jackson SHD. Age-related changes in pharmacokinetics and pharmacodynamics: basic principles and practical applications. Br J Clin Pharmacol. 2004;57(1):6–14.
20. Steffel J, Verhamme P, Potpara TS, Albaladejo P, Antz M, Desteghe L, et al. The 2021 ESC Guidelines on cardiovascular disease prevention and antithrombotic therapy. Eur Heart J. 2021;42(40):373–498.
21. Choi YJ, Kang DY, Choi NK, Lee J, Park BJ. Impact of adverse drug reactions on health-related quality of life in hospitalized patients. Drug Saf. 2019;42(1):35–44.
22. Dean B, Barber N, Schachter M. What is a prescribing error? Qual Health Care. 2000;9(4):232–237.
23. Gupta SK, Nayak RP. Medication errors in India: a systematic review. Indian J Pharmacol. 2014;46(6):565–570.
24. Aronson JK. Medication errors: what they are, how they happen, and how to avoid them. QJM. 2009;102(8):513–521.
25. Maher RL, Hanlon J, Hajjar ER. Clinical consequences of polypharmacy in elderly. Expert Opin Drug Saf. 2014;13(1):57–65.
26. Kaboli PJ, Hoth AB, McClimon BJ, Schnipper JL. Clinical pharmacists and inpatient medical care: a systematic review. Arch Intern Med. 2006;166(9):955–964.

