An Observational Analysis of Medication Error in Tertiary Care Hospital

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ABSTRACT

Background and Aim:
Medication errors (MEs) pose a critical challenge to patient safety in healthcare systems globally. This prospective observational study was conducted to assess the frequency, types, and contributing factors of MEs and drug-drug interactions (DDIs) in a tertiary care hospital setting.

Methods:
Conducted over a three-month period at Indus International Hospital, this study analyzed 200 prescriptions containing 1,339 drugs. MEs were observed during prescribing, transcribing, dispensing, and administration phases. The Drug Interaction Checker (drugs.com) was used to evaluate the severity of DDIs.

Results:
A total of 1,707 MEs were identified from 46,865 opportunities, resulting in an incidence rate of 3.64%. Prescription errors (50.6%) and administration errors (39.4%) were most prevalent, with illegible handwriting (31.3%) and dose omissions (20.9%) being the leading causes. Among 23 documented DDIs, moderate interactions (52.2%) were most common, with cardiovascular and CNS drugs being the most involved.

Conclusion:
This study highlights a significant prevalence of preventable medication errors and clinically relevant DDIs. Strengthening prescription protocols, incorporating computerized systems, and implementing formal error-reporting mechanisms are essential to enhance medication safety and reduce patient harm.

Keywords: Medication error, patient safety, drug-drug interaction, healthcare quality, prescription audit

INTRODUCTION

Medication errors (MEs) represent a significant threat to patient safety in healthcare settings worldwide. The National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP) defines medication errors as "Any preventable event that may cause or lead to inappropriate medication use or patient harm, while the medication is in the control of the health care professional, patient, or consumer." These errors can occur at any stage of the medication use process—prescribing, transcribing, dispensing, or administration—and can lead to adverse patient outcomes, increased healthcare costs, and diminished patient confidence in medical care.[1]

Studies from various regions in India have revealed concerning rates of medication errors, ranging from 15.34% to 25.7% among hospitalized patients. A particularly worrisome aspect is the under-reporting of these incidents. However, some medication errors can result in severe consequences, contributing to

significant patient morbidity, potential mortality, and substantial economic burden for both patients and healthcare systems.[2,3,4]

Drug-drug interactions (DDIs) represent another critical aspect of medication safety, occurring when multiple medications interact and potentially alter drug potency or effectiveness. These interactions contribute to 6-30% of adverse drug events and can increase the likelihood of medication errors. [5]

This study aims to examine the nature and frequency of medication errors occurring in a tertiary care hospital setting, identify demographic patterns associated with these errors, assess potential drug-drug interactions, and ultimately develop effective strategies to enhance medication management and improve patient safety.

MATERIALS AND METHODS

1.Research Design and Setting

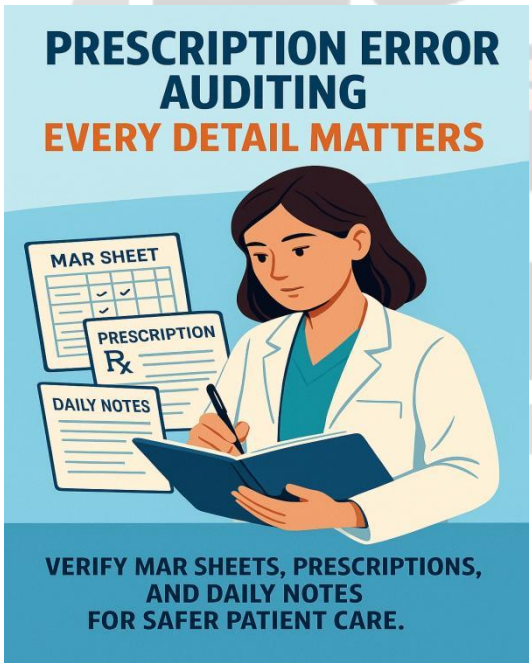
- Prospective, observational study conducted in the Medicine unit of Indus International Hospital, Derabassi
- Study duration: January 2025 to March 2025
- Institutional Ethics Committee approval was obtained prior to study initiation

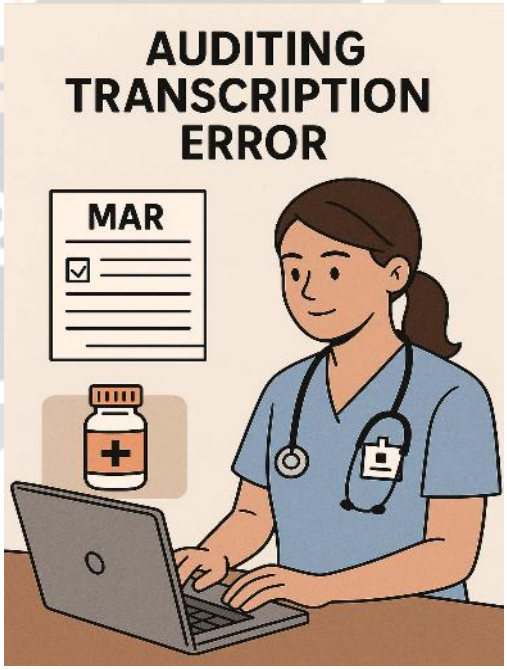
2.Participant Selection

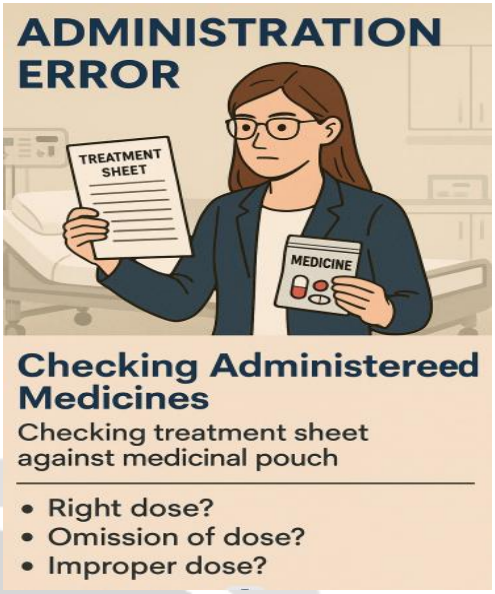
- Included: All patients admitted to the specified General and Private wards.
- Excluded: Death cases, Medico legal cases, HIV pateints.

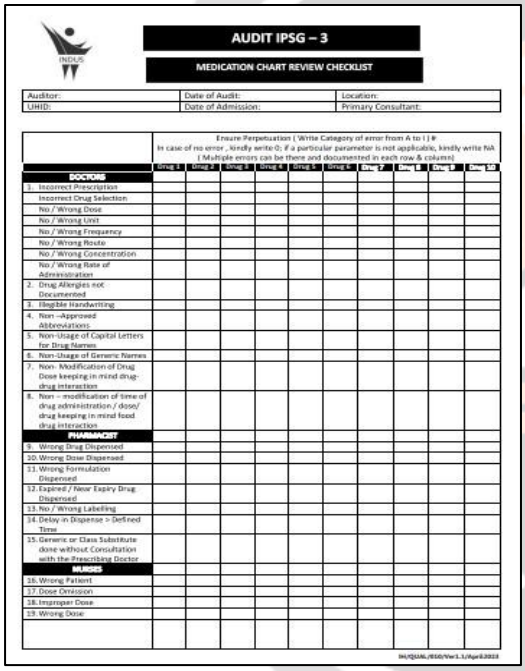
3. Data Collection Methods

Data was collected using direct observational techniques, supported by standardized tools such as the IPSG Audit 3 template from NABH 5th edition.The attached figures illustrate real-time audit documentation, medication charts, and nurse-administered drug records used during the study. These visuals provide insight into practical workflow and highlight areas prone to medication errors.









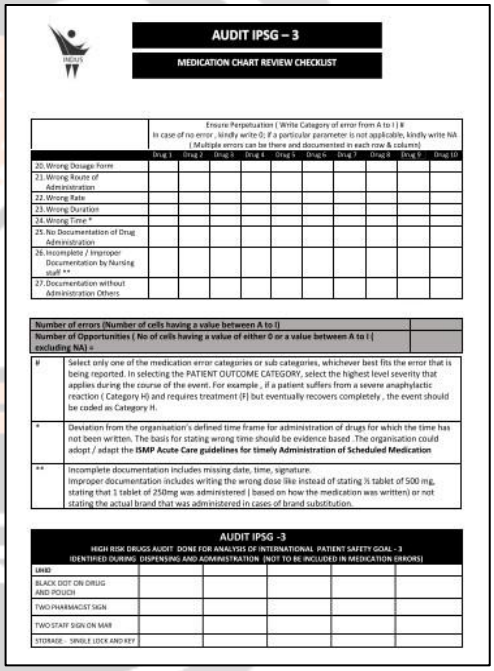


FIGURE-1 IPSG AUDIT -3 TEMPLATE IPSG

Audit 3 tool for Medication error by NABH 5th edition was used for data collection.

4.Medication Error Assessment

- The investigator accompanied nursing staff during medication rounds to observe practices
- Medication errors were classified into three main categories:

1. Prescription errors (errors occurring during the prescribing process)
2. Dispensing errors (errors occurring during medication dispensing)
3. Administration errors (errors occurring during medication administration to patients)

5.Drug-Drug Interaction (DDI) Evaluation

- Potential drug-drug interactions were assessed using the drugs.com Drug Interaction Checker software

- DDIs were categorized into three severity levels:
  Minor (non-significant) interactions
  Major (significant) interactions requiring monitoring
  Serious interactions necessitating medical intervention

The study design aimed to comprehensively capture and analyze medication management practices and potential errors across all phases of the medication use process in the hospital setting.

RESULT

The study analyzed 200 prescriptions out of 200 audited forms, 63 were found to contain errors, resulting in an overall error rate of 31.5%. This highlights a significant occurrence of documentation issues that may contribute to medication errors and underscores the need for improved accuracy in form completion. Data from 200 prescription containing 1,339 drugs, identifying 1,707 medication errors from 46,865 total medication error opportunities, yielding an incidence rate of 3.64%.

Table-1

PARAMETER	VALUE
TOTAL PRESCRIPTION	200
TOTAL DRUGS AUDITED	1339
TOTAL MEDICATION ERROR OPPORTUNITY (1339*35)	46865
TOTAL MEDICATION ERROR REPORTED	1707
INCIDENCE RATE	3.64%

Table 2. Types of medication errors

Opportunities	Numbers
Illegible Handwriting	534
Non approved abbreviations	42
Non usage of capital letters for drug name	159
Non ussage of generic Name	131
Total Doctors error	**865**
wrong strength indented (transciption)	23
Total Doctors &Nurses error	**23**
Wrong drug dispensed	14
wrong dose dispensed	14
No/ Wrong Labeling	70
Delay in dispense > Defined Time	47
Total Pharmacist error	**145**
Dose Omission	357
Improper dose	191
Wrong Duration	9
Wrong Time	5

No Documentation of Drug Administration	47
Documentation without Administration Others	65
Total Nurses error	**674**
TOTAL MEDICATION ERRORS	**1707**

This comprehensive table-2 categorizes medication errors by responsible healthcare professional and specific error type. It shows that physician errors (865) constitute the largest proportion, followed by nursing errors (674). Among physician errors, illegible handwriting (534) was the most prevalent issue. For nurses, dose omission (357) and improper dosing (191) were the most common errors.

Table 3: Type and Frequency of Medication Error Observed

Table-3 The analysis of medication errors revealed that *illegible handwriting* was the most prevalent error, accounting for **31.3%** of cases. This was followed by *dose omission*, observed in **20.9%** of incidents, and *improper dose* administration at **11.2%**. Errors related to *non-usage of capital letters for drug names* and *non-usage of generic names* were noted in **9.3%** and **7.6%** of cases, respectively.

Table-3

TYPES OF ERROR	% PREVALENCE OF OPPORTUNITIES
Illegible Handwriting	31.3
Dose Omission	20.9
Improper dose	11.2
Non usage of capital letters for drug name	9.3
Non usage of generic Name	7.6
No/ Wrong Labeling	4.1
Documentation without Administration Others	3.8
Delay in dispense > Defined Time	2.7
No Documentation of Drug Administration	2.7
Non approved abbreviations	2.5
wrong strength indented (transciption)	1.4
Wrong drug dispensed	0.8
wrong dose dispensed	0.8
Wrong Duration	0.5
Wrong Time	0.3

These findings highlight the critical need for standardized prescribing practices, improved documentation, and enhanced checks within the medication administration process to minimize preventable errors.

Figure-2 Graphical representation of % Prevalence of Opportunities.

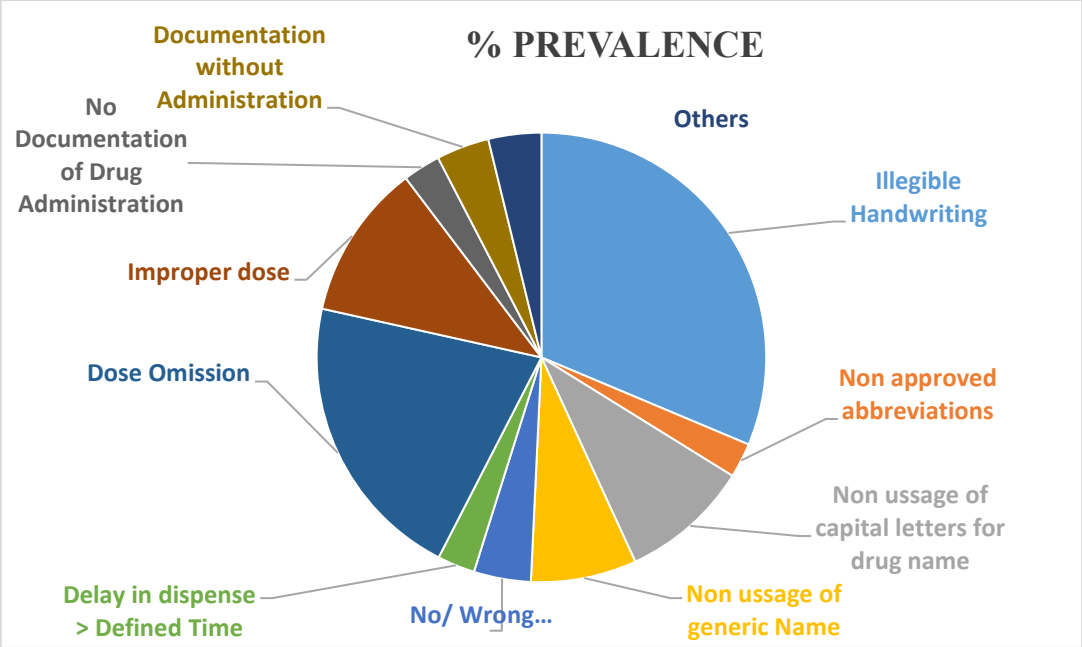
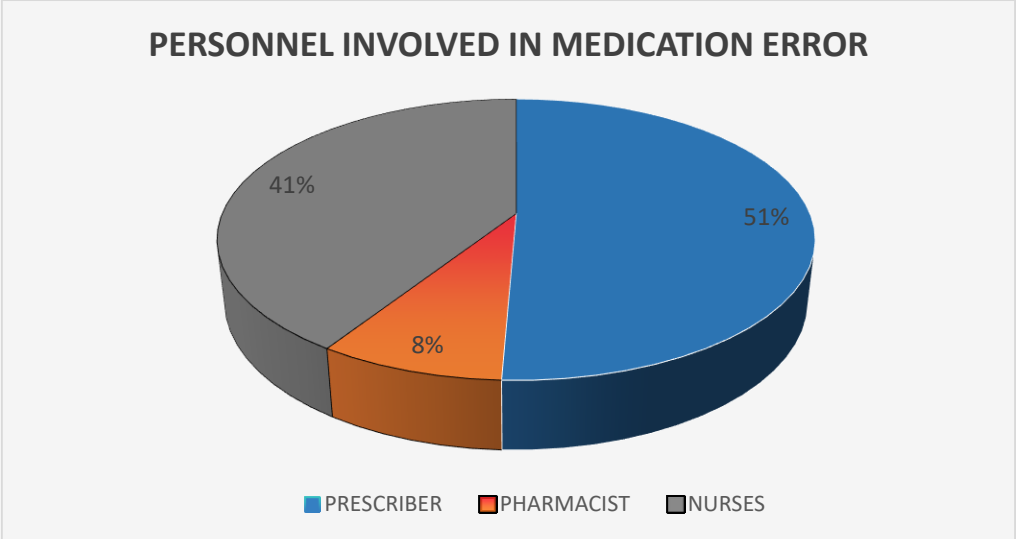


Table-4 STAGES OF ME BEFORE MEDICATION PROCESS

Process Stage	Number of Incidents	Percentage (%)
Prescribing	865	50.6%
Transcribing	23	1.3%
Dispensing	145	8.4%
Administration	674	39.4%
Total	**1707**	**100%**

Table-4 quantifies errors across the medication process stages, showing that prescribing (50.6%) and administration (39.4%) are the most error-prone stages, while transcribing (1.3%) had the lowest error rate.

Figure-3 Graphical representation of personnel involved in ME



Drug-Drug Interaction
Table-5 Drugs responsible for DDI

Drug 1	Drug2	Effect	Severity	No. of DDI
Aceclofenac	Naproxen	Risk of gastro bleeding	Moderate	3
Aspirin	Spironolactone	Hyperkalamia	Mild	2
Aspirin	Cilnidipine	Both affect platelet function and inc bleeding risk	Major	2
Atorvastatin	Carbimazole	Affect liver function	Major	1
Atorvastatin	Metoprolol	Risk of myopathy	Moderate	6
Atorvastatin	Metformin	Risk of lactic acidosis	Mild	6
Ceftriaxone	Tacrolimus	Risk of nephrotoxicity	Moderate	3
Chymoral forte	Cefuroxime axetil	Chymoral affect the efficacy of ceftum	Mild	6
Cilinidipine	Torsemide	Risk of hypotension	Moderate	5
Clopidogrel	Heparin	Increased anticoagulant effect	Mild	7
Glimpepride	Metformin	Inc hypoglycemia	Moderate	5
Glimpepride	Amlodipine	Inc hypoglycemia	Moderate	4
Levipil, Librium	Baclofen	Risk of excessive sedation	Moderate	2
Nitroglycerine	Metoprolol	Hypotension bradycardia	Moderate	4
Nortrytilline	Escitalopram	Serotonin syndrome(hallucination,seizure)	Major	1
oxen	Propanamide	Risk of hyponateremia	Mild	2
rifampin	Telmisartan	Dec telma level in blood	Mild	3
rifampin	Doxophyllin	Inc the risk of toxicity	Moderate	3
Silodosin	Mirabegron	Mirabeg dec excretion of silodosin	Mild	3
Sulfasalazine	Leflunomide	Risk of anemia	Major	1
Sevelamer carbonate	Omeprazole	Phoscut reduce the abs of omeprazole	Moderate	2
Telmisartan	Pregabalin	Angioedema	Moderate	1
Torsemide	Mirabeg	Inc hypotension	Moderate	4

The analysis of 200 prescriptions revealed 23 distinct drug-drug interactions (DDIs) with varying severity. Moderate interactions were most prevalent at 52.2% (12 interactions), followed by mild interactions at 30.4% (7 interactions), and major interactions at 17.4% (4 interactions). This suggests that while most interactions were of medium concern, nearly one-fifth represented potentially serious risks requiring careful monitoring.
The therapeutic classification of the 35 unique drugs involved shows cardiovascular medications were dominant at 28.6% (10 drugs), followed by CNS/psychiatric medications at 14.3% (5 drugs), and analgesics/anti-inflammatory and antibiotics each at 8.6% (3 drugs each). The significant representation of Central nervous system drugs also highlights their interaction potential with multiple medication classes.

Clinical Implications
The findings indicate a need for systematic improvements in medication management:
Prescribing process improvements: Addressing illegible handwriting and proper documentation through computerized systems
Administration protocol enhancements: Reducing dose omissions and improper dosing through better training and verification procedures
Drug interaction awareness: Increasing vigilance regarding potential drug-drug interactions, particularly with cardiovascular medications and ondansetron
Error reporting system: Establishing a formal medication error reporting system to monitor and reduce error incidence

DISCUSSION

The present study analyzed 200 prescriptions with 1,339 drugs, revealing 1,707 medication errors (MEs) from 46,865 medication error opportunities, with an overall incidence rate of 3.64%. While the error in prescriptions is 31.5% (63 out of 200) this rate appears equivalent to those reported in other Indian studies (15.34-25.7%)[6,7], our methodology of calculating errors against total opportunities likely accounts for this difference, providing a more comprehensive measure of error frequency.

Prescribing errors constituted the majority (50.6%) of all errors, with illegible handwriting being the predominant issue (31.3%). This aligns with findings by Patel et al. (2018), who reported that 67.1% of medication errors occurred during the prescribing phase[8]. The high prevalence of illegible handwriting represents a significant patient safety concern, as it can lead to misinterpretation and subsequent administration of incorrect medications or dosages. This finding strongly supports the implementation of computerized physician order entry systems, which have been shown to reduce prescribing errors by 55-80%[9].

Administration errors were the second most frequent category (39.4%), with dose omission (20.9%) and improper dosing (11.2%) being particularly problematic. Kumar and Choubey (2021) similarly found that dose omission accounted for 23.8% of administration errors in their study[10]. These findings highlight the need for improved medication administration protocols, including double-checking procedures and barcode medication administration systems, which have demonstrated effectiveness in reducing administration errors by up to 41%[11].

Our analysis of drug-drug interactions (DDIs) revealed moderate interactions as the most prevalent (52.2%), followed by mild (30.4%) and major interactions (17.4%). Cardiovascular medications were involved in the highest percentage of interactions (28.6%), followed by CNS medications (14.3%). This pattern aligns with research by Shah et al. (2020), who found that cardiovascular drugs were implicated in 32.7% of DDIs in their study[12]. The significant representation of potentially serious interactions underscores the need for clinical decision support systems that can automatically flag potential DDIs at the point of prescribing.

The transcription phase showed the lowest error rate (1.3%), potentially attributable to the limited role of transcription in our hospital's medication use process. This contrasts with research by Patel et al. (2019), who reported transcription errors at 8.2%[13], highlighting how institutional processes can influence error patterns.

Dispensing errors (8.4%) were dominated by labeling issues (4.1%), consistent with findings by Sharma et al. (2022), who reported inadequate labeling in 3.8% of dispensing errors[14]. This emphasizes the need for standardized labeling practices and verification procedures in pharmacy operations.

These findings collectively indicate several improvement opportunities, including implementation of electronic prescribing systems, standardized administration protocols, automated dispensing cabinets, and comprehensive staff education programs. Additionally, establishing a robust medication error reporting system would facilitate ongoing monitoring and continuous quality improvement, as recommended by the National Coordinating Council for Medication Error Reporting and Prevention[15]. My study had few limitations such as I was not available to record ME on public holidays and Sunday.Furthermore I could not assess the actual impact of DDIs. Future research should examine the impact of specific interventions on reducing medication errors and explore interdisciplinary approaches to enhancing medication safety.

CONCLUSION

Our study shows the occurrence of MEs at each phase of medication use cycle. Along with potential DDIs. Probably computerizing the medication process system in hospital settings along with pharmacological education of prescribers, medical officers and nurses could help to reduce the ME. In addition drug use policy should be implemented and maintained to reduce ME.
Establishing a formal medication error reporting system would facilitate continuous monitoring and quality improvement. While our study had limitations in scope and duration, but it provides valuable insights for developing targeted interventions to enhance medication safety, ultimately improving patient outcomes.

Authors' Contributions
Dikshit Kumari developed and wrote the protocol, and was responsible for the data analysis, and interpretation of results. Dikshit Kumari was responsible for data gathering and auditing the medication error. DSL,DK and PA was responsible also for assessment of medication errors. PKG had valuable suggestions for guideline preparations and prepared the manuscript and reviewed the data analysis and interpretation of results. All authors have read and approved the content of the manuscript.

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