



A RETROSPECTIVE ANALYSIS OF MEDICATION ERRORS IN TERTIARY HEALTHCARE: PATTERNS, CAUSES, AND INTERVENTIONS

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ABSTRACT:

Background: This study focuses on the critical issue of medication errors within a tertiary healthcare environment, acknowledging their significant impact on patient safety and healthcare quality. Medication errors are a major concern due to their potential to cause adverse patient outcomes.

Aim: The primary aim is to assess the prevalence, types, and causes of medication errors in a tertiary healthcare setting, with a view to identifying strategies to mitigate these errors.

Objective: The study aims to categorize medication errors using the NCCMERP risk index, taking into account their nature and severity. It seeks to identify the most prevalent types of errors, with an emphasis on all kinds of errors. The objective is also to comprehend the root causes of these errors in order to develop effective strategies for intervention.

Methodology: Conducted over a six-month period, this retrospective analysis reviewed 5430 patient charts from various medical wards, employing the NCCMERP risk index for classifying medication errors' severity.

Results: A total of 520 medication errors were identified, with prescribing errors being the most prevalent at 62.88%. The study highlights the need for focused interventions in prescribing and administering practices to reduce medication errors.

Conclusion: The study concludes that there is a pressing need for targeted interventions in prescribing practices and enhanced communication and education among healthcare providers. These measures are crucial for reducing medication errors and improving patient safety in tertiary healthcare settings.

Keywords: Medication Errors, Patient Safety, Prescribing Practices, NCCMERP Risk Index, Tertiary Healthcare

Introduction

The issue of medication errors is a pervasive challenge confronting global healthcare systems, encapsulated by the National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP) as any avoidable incident that may provoke incorrect medication use or endanger patient welfare.^{1,2} These incidents encompass a broad array of healthcare processes, including but not limited to prescription, communication of orders, product labeling, packaging, compounding, dispensing, administration, and patient education.³ The segmentation of medication errors is typically done according to the stage at which they occur within the medication management cycle: prescribing, transcribing, dispensing, administering, or monitoring.⁴ From a cognitive standpoint, errors are further dissected into categories such as knowledge-based, rule-based, action-based, and memory-based, shedding light on the psychological aspects contributing to these errors.⁵

The significance of medication errors was brought to the forefront by the Institute of Medicine (US) through its landmark publication, "To Err is Human; Building a Safer Health System," revealing that between 44,000 and 98,000 deaths in the U.S. are attributed to medical errors annually.⁶ This finding emphasizes the dire consequences of medication errors on patient well-being, the economic burden on healthcare systems, and the erosion of public confidence in healthcare services. While not all medication errors lead to harm, the potential for serious outcomes, including long-term injury, increased hospitalization duration, escalated treatment costs, loss of faith in healthcare systems, and mortality, remains a grave concern.⁷

The landscape of medication error reporting in India presents a concerning picture, with studies, including those by Prof. Jha, estimating that approximately 5.2 million medical errors occur each year.⁸ This situation is exacerbated in developing countries, as noted by the British Medical Journal, largely due to the lack of adequately trained healthcare personnel capable of effectively measuring clinical outcomes. The study utilized the NCCMERP (National Coordinating Council for Medication Error Reporting and Prevention) risk index to assess the severity of medication errors identified. This index classifies errors from Categories A (errors that were intercepted before affecting the patient) to Categories I (errors that occurred and impacted patient care significantly). Categories A and B are designated for errors that were caught before they could affect the patient, while Categories C through I denote errors that occurred and had an impact on patient care. This categorization helps in understanding the potential or actual impact of medication errors on patient safety within the healthcare setting examined in the study.⁹

The primary objective of this research is to assess the prevalence and characteristics of medication errors in a critical care setting, examining their types, occurrences, fundamental causes, and impacts on patient health. Through the identification of prevalent errors and analysis of their root causes, the study aims to offer strategic recommendations to minimize these errors, thereby improving patient safety and enhancing the quality of care in critical care environments. This investigation seeks to contribute to the broader goal of minimizing medication errors and advancing a culture of safety across healthcare settings, ultimately reducing the incidence of preventable harm to patients.

Materials And Methods

This study's methodology in the hospital setting for medication management begins with a physician's prescription issuance upon a patient's admission. This is followed by the pharmacist

or nurses submitting a request for the prescribed medications to the hospital's pharmacy department. Subsequently, the pharmacy provides the necessary medications for the patient, which are then administered by the nursing staff. On the following day, junior doctors transcribe the prescription, which is then reviewed and endorsed by the consultant doctors. The treatment's effectiveness and safety are continuously monitored by the attending physicians. It's important to note that medication errors can happen at any stage of this process, sometimes affecting multiple stages, which can impact patient care and lead to increased healthcare costs.

Study Design

The study was structured as a retrospective analysis of hospital data, carried out over a six-month period across all medical wards in a tertiary care hospital.

Study Population

Patient data from the medical wards, such as General Medicine, Gynecology, Podiatry, and Psychiatry, were analyzed in this study, which took place over the designated research period. There were no exclusions based on age, gender, or diagnosis. The selection of patient data for analysis was done using a random sampling approach.

Data Collection

Data collection for this retrospective study was conducted by two clinical pharmacists, who utilized a review of medication charts to identify potential medication errors, scrutinizing a total of 5,830 charts.

Errors in medication were categorized according to the phase in which they occurred: prescription, transcription, ordering, dispensing, and administration. These incidents were further examined for specific reasons, including incomplete or illegible prescriptions, incorrect medication, dosage, frequency, route, timing, formulation, dilution, omissions, the use of error-prone abbreviations as identified by the ISMP, and instances of therapeutic duplications.

The severity of medication errors was assessed using the NCCMERP risk index.⁹ Categories A and B were designated for errors that were intercepted before affecting the patient, whereas Categories C through I were used to denote errors that actually occurred and impacted patient care.

Results:

Out of the total 5430 charts reviewed, 520 medication errors were found, prescribing errors were predominant, comprising 62.69% of incidents, followed by administering errors at 19.61%. Dispensing errors were less common, accounting for 2.50%, while monitoring errors constituted 10.38% of the total. Procurement errors were the least frequent at 0.57%, and transcribing errors made up 4.23% of the cases. This distribution underscores the critical need for focused interventions in prescribing practices and the administration of medications to reduce the overall incidence of medication errors.

Table 1: Distribution of Medication Errors by Type and Gender

Error Type	Male (Number, %)
Prescribing Error	326 (62.69%)
Administering Error	102 (19.61%)
Dispensing Error	13 (2.50%)
Monitoring Error	54(10.38%)
Procurement Error	3 (0.57%)

Transcribing Error	22 (4.23%)
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Table 2 details the distribution of medication error categories across different medical specialties, namely General Medicine, Gynaecology, Psychiatry, and Pediatrics. Notably, Category B errors, which are significant but without patient harm, were most frequent in General Medicine (13.65%) and least in Psychiatry (44.61%). Category C errors, indicating an error that reached the patient without causing harm, were highest in General Medicine (21.53%) and lowest in Gynaecology (7.5%). Interestingly, Category A errors, which represent potential errors intercepted before reaching the patient, were only recorded in General Medicine (.0.96%), with no instances in the other specialties. Categories F through I, indicating more severe consequences, showed no occurrences across all specialties, highlighting an emphasis on error interception and mitigation before reaching critical severity levels.

Table 2: Error Category Distribution Across Specialties

Category	General Medicine	Gynaecology	Psychiatry	Pediatric
Category A	5 (0.96%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Category B	71(13.65%)	25 (4.80%)	24(4.61%)	28 (5.38%)
Category C	112(21.53%)	39 (7.5%)	58(11.15%)	42(8.07%)
Category D	39 (7.5%)	6(1.15%)	19 (3.65%)	6 (1.15%)
Category E	31 (5.96%)	4 (0.76%)	5 (0.96%)	4 (0.76%)
Category F	0 (0.0%)	2 (0.38%)	0 (0.0%)	0 (0.0%)
Category G	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Category H	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Category I	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 3 presents the distribution of medication errors by type across four medical specialties. Prescribing errors dominated, particularly in General Medicine (43.07%), indicating a critical area for intervention. Psychiatry noted a specific prevalence of wrong drug administration errors (5.76%), unique among the specialties. Both General Medicine and Psychiatry exhibited incidents of product deterioration and incorrect drug preparation, though these were not observed in Gynaecology and Pediatrics. This table underscores the variable nature of medication errors across different medical domains, pointing to the need for targeted preventive strategies.

Table 3: Distribution of Medication Errors by Type and Specialty

Error Type	General Medicine	Gynaecology	Psychiatry	Pediatric
Deterioration of Product	6 (1.15%)	7 (1.34%)	5 (0.96%)	10 (1.92%)
Drug Prepared Incorrectly	6 (1.15%)	0 (0.0%)	0 (0.0%)	12 (2.30%)
Prescribing Error	224 (43.07%)	63 (12.11%)	54 (10.38%)	48 (9.23%)
Unauthorized Wrong Dose	19 (3.65%)	3 (0.57%)	17 (3.26%)	6 (1.15%)
Wrong Drug Administered	3 (0.57%)	3 (0.57%)	30 (5.76%)	4 (0.76%)

Table 4 outlines the actions taken following medication errors across specialties, with a total of 520 cases analyzed. A significant effort was made to improve the communication process, most notably in General Medicine (25%) and Pediatrics (7.69%), contributing to over half of

the actions taken (53.84%). Education and training were also provided across the board, forming (30.57%) of the actions, with Psychiatry receiving a substantial portion (7.69%). Informing staff of initial errors was less common, indicating a potential area for improvement in error reporting and awareness. This analysis reveals a proactive approach to addressing medication errors through communication and education but suggests room for enhancing error acknowledgment and feedback mechanisms.

Table 4: Distribution of 520 Cases Across Actions and Specialties

Action/Specialty	General Medicine	Gynaecology	Psychiatry	Pediatric	Total (Number, %)
Communication process improved	130(25%)	40(7.69%)	70 (13.46%)	40(7.69%)	280(53.84%)
Education training provided	80 (15.38%)	28(5.30%)	26 (5%)	25(4.80%)	159(30.57%)
Informed staff of initial error	48 (9.23%)	8 (1.53%)	10 (1.92%)	15(2.88%)	81(15.57%)
Total Cases	258	76	106	80	520 (100%)

Table 5 categorizes medication errors by drug class across specialties, highlighting antibiotics as the most involved class in errors within General Medicine (15%) and Pediatrics (20%). Analgesics and antihypertensives also showed significant error rates, particularly in General Medicine (10% and 9%, respectively) and Pediatrics (12% for analgesics). Notably, antipsychotics were predominantly involved in Psychiatry errors (10%), aligning with the specialty's focus. This distribution suggests that medication error prevention efforts should be tailored to the most commonly involved drug classes within specific medical domains, especially where high-risk medications are concerned.

Table 5: Distribution of Medication classes involved in medication error

Drug Class	General Medicine (%)	Gynaecology (%)	Psychiatry (%)	Pediatric (%)
Analgesics	9%	1%	1%	2%
Antithrombotic	2%	1%	-	1%
Antacid	3%	1%	-	1%
Antiemetics	2%	2%	1%	1%
Antibiotic (all)	5%	3%	1%	2%
Antiarrhythmia	1%	-	2%	-
Antiepileptic	1%	-	2%	1%
Antihemorrhage	1%	1%	-	-
Antihistamine	4%	1%	2%	1%
Antihypertensive	5%	2%	1%	-
Antiglycemic	4%	-	-	-
Antiplatelet	1%	1%	-	-

Antipsychotic	-	-	2%	-
Bronchodilators	-	-	-	2%
Multivitamin	3%	1%	1%	2%
Sedative and Hypnotics	-	-	3%	1%
Lipid-lowering drugs	3%	1%	-	-
Corticosteroids	2%	1%	1%	1%
Thyroid agents	4%	1%	-	-

Discussion:

Our investigation into medication errors (MEs) within a tertiary healthcare setting underscores the urgent need for targeted interventions, particularly in prescribing and administration practices. Utilizing the NCCMERP risk index for severity classification, our study highlights the critical role of enhanced communication and ongoing education in reducing MEs. The identification of errors by drug class points towards tailored preventive strategies, emphasizing the management of high-risk medications. This study's insights into prescribing errors corroborate findings by Lewis et al. (2009), who identified these errors as major contributors to patient harm, reinforcing the necessity for improved prescribing protocols.¹⁰ The focus on communication and education as key mitigation strategies echoes Webster's (2022) recommendation for applying ME knowledge towards enhanced patient safety practices, suggesting a congruent approach to bridging the knowledge-practice gap in patient care.¹¹

The analysis of MEs involving specific drug classes, such as antibiotics and analgesics, reveals parallels with Zirpe et al. (2020), highlighting the ongoing challenge in safely managing high-risk medications across healthcare environments.¹² The severity-based categorization of errors, akin to the methodology used by Gates PJ et al. (2019), facilitates a detailed understanding of ME impacts and prioritizes interventions to mitigate potential patient harm effectively.¹³ The majority of errors were intercepted before impacting the patient, attributed to the vigilant monitoring by clinical pharmacists at every stage of the medication process.

Limitation:

This study, conducted in a single tertiary care hospital, may have limited generalizability to other healthcare settings due to its specific context and patient population. The retrospective design restricts causality inference between medication errors and patient outcomes. Additionally, reliance on hospital records for data collection could introduce bias, as not all medication errors may be accurately captured or reported. These factors collectively suggest the need for cautious interpretation of the findings, acknowledging the potential for unrecorded variables and reporting biases to influence the results.

Conclusion:

Our study offers a crucial lens into the pervasive issue of medication errors within a tertiary healthcare context, underscoring the imperative for targeted interventions. By identifying prescribing and administration errors as the most prevalent, it signals a vital area for improvement. Leveraging the NCCMERP risk index for severity assessment, our findings emphasize the necessity of enhanced communication and ongoing education in mitigating these errors. The categorization of errors by drug class further illuminates the path toward tailored

preventive measures, particularly for high-risk medications. This research not only contributes to the body of knowledge on patient safety but also calls for a concerted effort to refine medication management processes, thereby advancing healthcare quality and safeguarding patient well-being.

Declaration

Availability of Data and Materials

The datasets generated and analyzed during the current study are available from the corresponding author, Dr. Satheesh S., Associate Professor at JKKN College of Pharmacy, on reasonable request. The data are not publicly available due to them containing information that could compromise the privacy of research participants.

Competing Interests

The authors declare that they have no competing interests.

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Authors Contributions

Study concept and design: M Janashree; Acquisition of data: K Dhaneesh Kumar; Analysis and interpretation of data: Satheesh S; Drafting of the manuscript: M Janashree and K Dhaneesh Kumar; Critical revision of the manuscript: Satheesh S; Administrative, technical, or material support: S Vignesh; and study supervision: Satheesh S.

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